Session 4

Experiences and lessons learned with alternative fertilizer promotion efforts

- What are the various objectives to be achieved; what trade-offs do they present?
- Description of alternative policies and programmatic options – general models, not specific country cases except as illustrations of the general models we are considering
- Return to the actors at the various stages of the fertilizer supply chain (importers, wholesalers, retailers, use mark flow diagram) in fertilizer promotion and identify the key constraints affecting the functioning and performance of commercial fertilizer distribution operations;
- Describe specific public sector functions including production support (e.g., research, extension, irrigation to complement inputs and raise the effective demand for inputs) and market supporting measures (e.g., road, rail, port facilities, market information to reduce input and output marketing costs);
- Describe strategies to improve food market performance (e.g., promotion of local processing and regional trade) to reduce downside price risk associated with output supply expansion.
- Describe concept of crowding out and other possible unintended effects of fertilizer subsidy programs in a two-channel input marketing system;
- Possible SWOT analysis of the alternative models: strengths, weaknesses, opportunities, threats (this section would address the problems, issues of sustainability, crowding out/contribution of programs to total fertilizer use, contribution to output, targeting, opportunity cost of resources used, etc).
- Present progress on implementation of the June 2006 Abuja Declaration;

Experience with different types of fertilizer subsidies in Sub-Saharan Africa

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Presented at the
Fertilizer Policy Training Session of the
COMESA African Agricultural Markets Programme (AAMP)
Livingstone, Zambia
19 June 2009

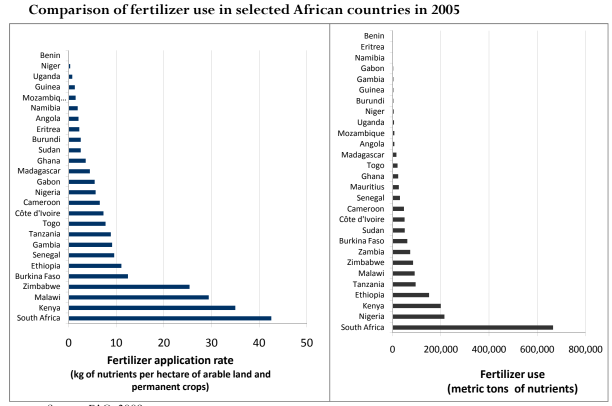
Outline

- Patterns of fertilizer use in Sub-Saharan Africa
- Theory of fertilizer subsidies
- Experiences with fertilizer subsidies
  - 1970s-1995 : Universal fertilizer subsidies
  - 1985-2005 : Fertilizer market liberalization
  - 2005- : Targeted fertilizer subsidies
- Summary

Fertilizer application rates

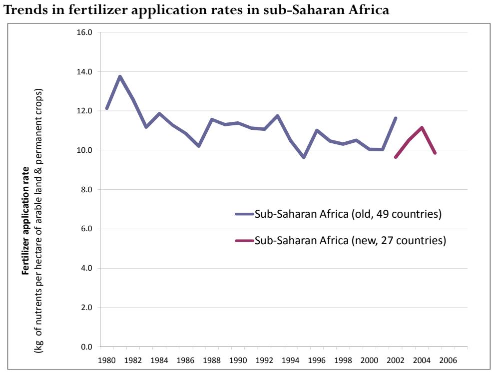
- Overall, 10-12 kg of nutrients per hectare
- Large variation by crop
  - Highest rates on sugarcane, tobacco, cotton, coffee, tea, and vegetables
  - Intermediate rates on maize
  - Close to zero for cassava, yams, sorghum, & millet
- Large variation by country
  - Highest rates in Mauritius, South Africa, & Kenya
  - Lowest rates in high-rainfall and semi-arid countries

Comparison of fertilizer use in selected African countries in 2005



Source: FAO, 2009. .

Trends in fertilizer application rates in sub-Saharan Africa



Source: FAO, 2009.

Three economic rationales for fertilizer subsidies

1. Efficiency
- Fertilizer use by farmers may be sub-optimal because of
  - Lack of information
  - Lack of liquidity
  - Risk aversion
- Subsidy could raise fertilizer use to optimal level

2. Equity
- Subsidies help farmers, who are poorer than avg
- But untargeted subsidies help largest farmers the most

3. Externalities
- Not a widely used justification for subsidies

Fertilizer policy over 1970-1995:
Subsidies and state control

- General pattern
  - One or more state-owned entity had legal monopoly on importation and distribution of fertilizer.
  - Fertilizer was sold at a subsidized pan-territorial price, 20-60% of full cost
  - Over-valued exchange rate added an implicit subsidy to imported fertilizer
- Variation across countries
  - West African countries used cotton parastatals
  - Distribution by cooperative, Min of Ag, & SOEs
  - Some countries had more market-based distribution
    - E.g. Kenya, Zimbabwe,

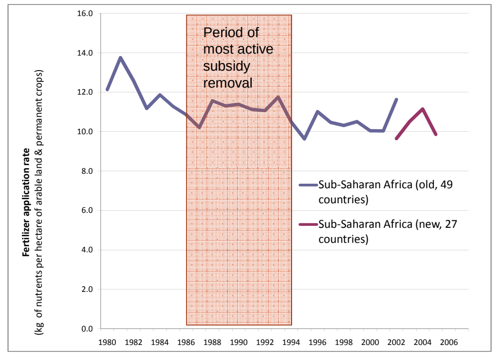
Fertilizer policy over 1970-1995:
Subsidies and state control

Problems
- Late delivery of fertilizer
  - Bureaucratic delays & lack of incentives
- Rationing
  - Budget constraints combined with increased demand usually led to rationing
- Displacement of private sector
- High fiscal cost
  - High costs due to overstaffing & lack of cost control
  - Cost more than 3% of government budget in Nigeria, Senegal, Malawi, and Tanzania
  - Affordable during commodity boom of 1970s but not in 1980s

Fertilizer policy over 1985-2005:
Subsidy removal and liberalization

- Economic crises
  - Large fiscal deficits & debt → inflation
  - Inflation & fixed exchange rate → forex shortages
  - Countries forced to accept IMF/WB structural adjustment programs in exchange for emergency financial assistance
- Structural adjustment programs
  - Market liberalization, privatization, fiscal deficit reduction
  - In fertilizer, universal subsidies phased out
    - Late 1980s, Benin, Ghana, Madagascar, Senegal & Togo
    - Early 1990s, Tanzania, Zambia, Cameroon, Malawi, & Nigeria
  - Market exchange rates eliminated implicit subsidies
  - End of state monopoly on imports & distribution
- But not all fertilizer markets fully liberalized (Nigeria, Malawi, Zambia, Ethiopia, etc.)

Effect of fertilizer subsidy removal: Africa-wide



Source: FAO, 2009.

Effect of fertilizer subsidy removal: specific countries

- Compare five-year average before and after subsidy elimination in nine countries
- Result
  - Fertilizer use declined 25-40% in five countries: Nigeria, Ghana, Cameroon, Senegal, & Tanzania
  - Fertilizer use increased 14-500% in three countries: Benin, Togo, Mali, & Madagascar
- Explanation
  - Subsidy only one factor in determining price
  - Price only one factor in determining fertilizer use
  - Devaluation increased fertilizer use in cotton-exporting countries

Fertilizer policy over 1985-2005:
Subsidy removal and liberalization

Fertilizer market development efforts

- After 1995, attention turned from fertilizer subsidies to fertilizer market development
- Elements
  - Training private agro-input dealers
  - Development of professional association and code of conduct
  - Regulatory framework to increase competition & confidence
  - Promotion of new products (smaller packets)
  - Credit programs for dealers to facilitate trade
- Technical assistance
  - IFDC and CNFA with USAID support

Renewed interest in fertilizer subsidies since 2005

Factors behind renewed interest

- Jeff Sachs and Millennium Development Villages
  - Demonstrating intensive development assistance including fertilizer subsidy
- Experience of Malawi
  - 2005 Agricultural Input Subsidy Programme (AISP) credited with making Malawi self-sufficient (exporter) of maize
- 2006 Abuja Fertilizer Summit
  - Promote idea of green revolution in Africa and advantages of vouchers as strategy to avoid pitfalls of old subsidies
- Food crisis of 2007-08
  - High price of food and fertilizer focused attention on food production and access to inputs

Input vouchers

Definition

- Certificate which entitles farmer to buy inputs at subsidized price. The input vendor can redeem voucher for cash from government.

Potential advantages

- Compatible with private-sector distribution of inputs so it will promote development of private distribution network rather than undercut it
- Facilitates targeting of input subsidy
- May reduce costs compared to government input distribution
- *Seen as way to stimulate fertilizer use without pitfalls of subsidies of 1970s and and 1980s*

Input vouchers - Malawi

Evolution of fertilizer policy

- Mid-1990s – Universal fertilizer subsidies phased out
- 1998-99 – Starter Pack (SP)
  - Free small packs of fertilizer and seed to all farmers
  - 10-40% of fertilizer subsidized
- 2000-04 – Targeted Input Programme (TIP)
  - Attempts to targets subsidized inputs to poor
  - Vouchers used but redeemable at ADMARC & SFFRRM
  - 10-20% of fertilizer subsidized
- 2005-now – Agricultural Input Subsidy Programme (AISP)
  - Farmers can buy 100 kg fertilizer at 20% of cost
  - Voucher based but role of private retailers declines
  - Half of fertilizer subsidized

Input vouchers - Malawi

Strengths of AISP

- Large-scale
- Combined with good weather, created maize self-sufficiency and exports to Zimbabwe
- Detailed monitoring and evaluation

Weaknesses of AISP

- Private retailers largely excluded from program, so AISP undermines private retailers, private share from 80% to 55%
- High cost – US$ 91 million or 5% of national budget
- Late or unpredictable delivery of fertilizer
- Confusion about eligibility of retailers and farmers

Input vouchers – Other African countries

Tanzania

- In 2008, adopted voucher-based subsidy program
- All sales through private retailers, easy redemption
- Market development activities
- Large (1.5 m beneficiaries), US$ 100-150 million

Ghana

- In 2008, launched voucher-based subsidy program (US$15m)
- Vouchers redeemable by fertilizer importers, so independent dealers excluded from program
- Started too late to benefit south

Kenya

- More limited voucher program started in 2006
- Targeted to poor and vulnerable

Conclusions

Universal subsidies of 1970s and 1980s

- Conventional wisdom: costly and inefficient but they stimulated fertilizer use and crop production
- However, evidence that they stimulated fertilizer use is mixed

Input vouchers – do they avoid problems of universal subsidies?

- Can vouchers can promote private distribution network?
  - Yes but only if well designed
  - Malawi no, Ghana somewhat, Tanzania probably
- Can vouchers be targeted to poor?
  - In Malawi, targeting poor households has been difficult
- Are voucher systems vulnerable to delays in delivery?
  - Less likely but it has happened (Ghana 2008, Malawi 2003)
- Are vouchers a good investment?
  - Need more evidence, Malawi BC ratio was 0.76 – 1.36

Conclusions

Input vouchers – lessons

- Vouchers must be widely redeemable
- Funding must be provided early
- Features of design must be transparent and communicated
- Voucher program should be complemented with fertilizer market development activities
- Voucher program is no substitute for agricultural research, roads, conducive investment environment, and consistent agricultural policy
- Tanzania NAIVS is most promising model but questions remain
  - What is benefit-cost ratio?
  - Is it fiscally sustainable?

Type of fertilizer support	Impact on poor farmers	Impact on crop prod-uction	Impact on con-sumers	Impact on taxpayer	Impact on input distri-bution network
Universal subsidy and SOE distribution					
Starter pack (give small quantities for free)					
Input voucher with SOE marketing, no targeting					
Input voucher with private marketing, no targeting					
Input voucher with private marketing, targeting high potential areas					
Input voucher with private marketing, targeting poor farmers					

Type of fertilizer support	Strengths	Weaknesses
Universal subsidy and SOE distribution		
Starter pack (give small quantities for free)		
Input voucher with SOE marketing, no targeting		
Input voucher with private marketing, no targeting		
Input voucher with private marketing, targeting high potential areas		
Input voucher with private marketing, targeting poor farmers		

Exercises with a fertilizer-crop model

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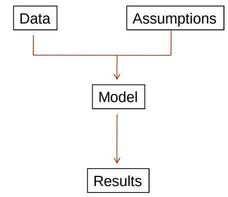
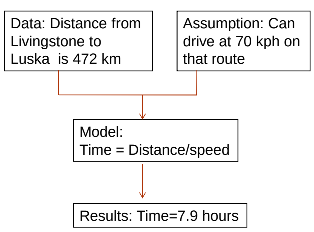
What is a model?

A set of equations represents some aspect of reality and converts data and assumptions into useful results

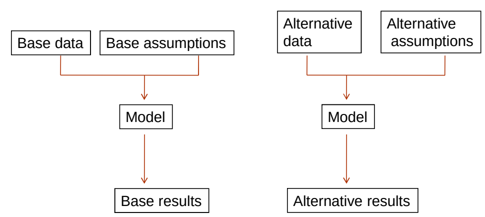


Example of a simple model



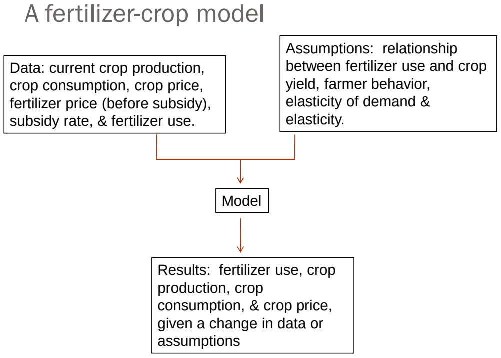
Comparative statics:

Run model twice with some difference, compare results

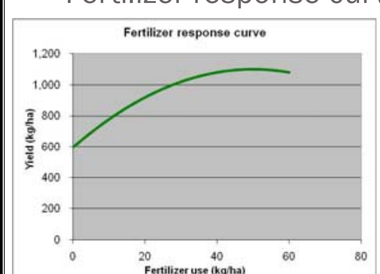


Example: If we could increase our speed from 60 to 70 kph, it would take us 15% less time or 6.7 hours.

A fertilizer-crop model

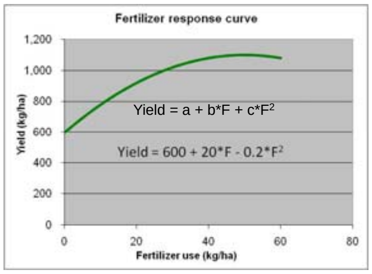


Fertilizer response curve



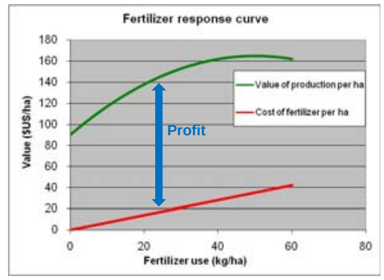
- Yield is positive even with no fertilizer
- Yield rises with more fertilizer, but the rate of increase declines
- Too much fertilizer will reduce yield

Fertilizer response curve



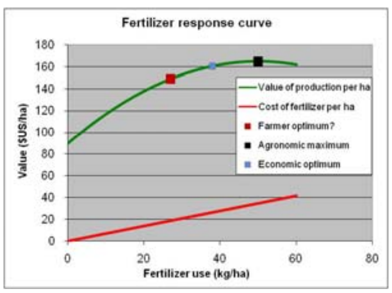
- a is the yield with no fertilizer (a>0)
- b determines the steepness of the curve at the beginning (b>0)
- c determines how quickly it turns down (c<0)

Fertilizer response curve (in value terms)



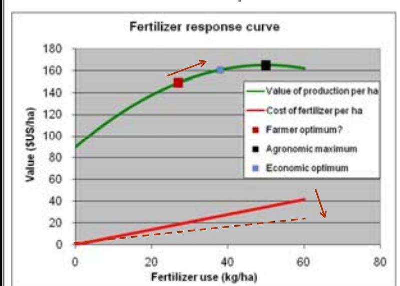
- If we multiply yield by crop price, we get the curve of the value of production per hectare
- It has the same shape
- We can add cost of fertilizer per hectare (red line)
- Profit from using fertilizer is vertical distance

Fertilizer response curve (in value terms)



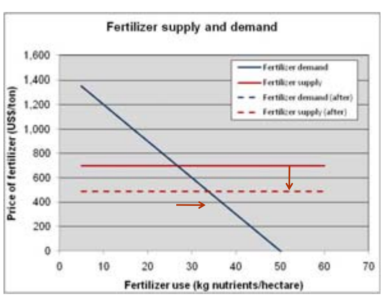
- Black box maximizes yield
- Blue box maximizes profit
- Red box is where a risk-averse farmer might choose to produce

Fertilizer response curve (in value terms)



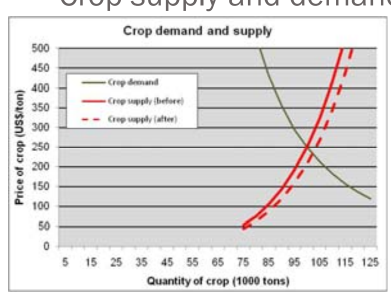
- Fertilizer subsidy lowers the angle of the red line
- This increases optimum amount of fertilizer and increases yield

Fertilizer supply and demand



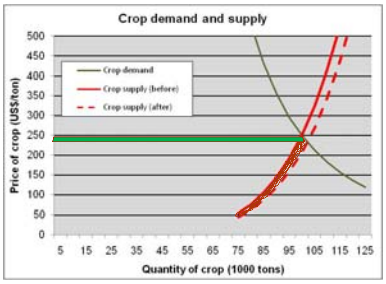
- Fertilizer subsidy lowers the retail price (red lines)
- This increases fertilizer use from 25 to 33 kg/ha

Crop supply and demand



- Fertilizer subsidy increases crop supply (shift to right)
- This increases lowers price if non-tradable

Crop supply and demand



- Benefit to **consumers** is reduction in price multiplied by quantity consumed
- Benefit to **farmers**: is area between supply curves (red) below equilibrium price

Exercises

Notes on the exercises:

1. Only the green cells should be changed.
2. Generally, we want to change the "after" cell so we can compare "before" and "after" results
3. Don't forget to return changed numbers to their original value before doing next exercise.
4. The model does not take into account rationing, late delivery, targeting, leakage, rent seeking, or differences across farmers and regions, etc. Nor has it been calibrated with real-world data. As such, it should be considered a training tool, nothing more.

Exercises

1. What is the effect of a new seed variety that is more responsive to fertilizer? Change the "b" coefficient (cell E14) from 25 to 30.
2. What is the effect of a new seed variety that gives a higher yield without fertilizer, but gives same response to fertilizer? Change the "a" coefficient to 900, but leave "b" and "c" as is.
3. What is the effect of an increase in the crop price on fertilizer use? Change the crop price from US$250 to US$ 300.
4. What would be the effect of a program that made farmers less risk averse, reducing the VCR from 2 to 1.5?
5. What is the effect of a 40% subsidy on fertilizer utilization? Do farmers use more or less than the economic optimum? What about 50%? And 60%? Which gives the largest net impact on the country?

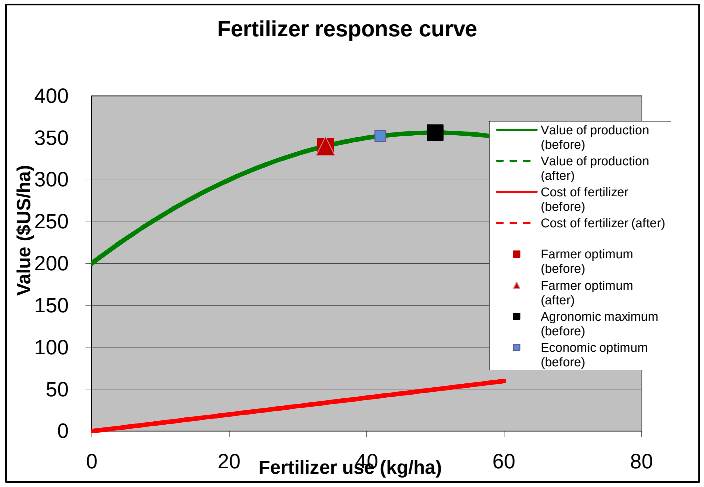
Exercises

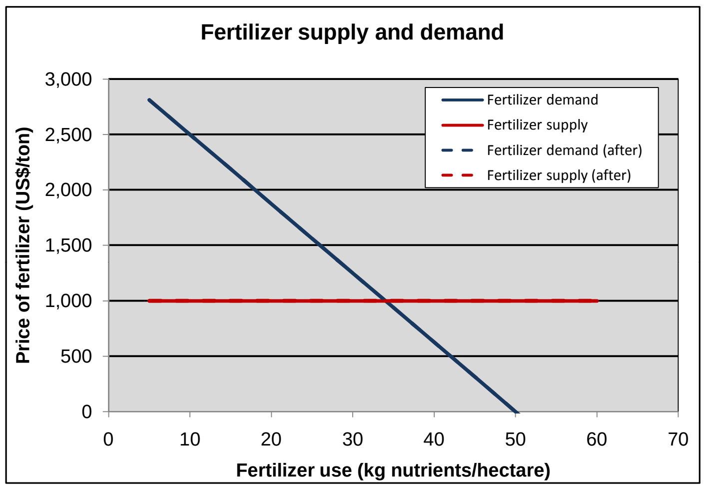
6. Suppose farmers were not risk averse and were economically rational. What is the net impact of a fertilizer subsidy? Hint: set VCR=1 in before and after columns.
7. What is the effect of a 50% fertilizer subsidy if the administrative costs are 40% of the direct subsidy costs? How about 50% or 60%?
8. What is the distribution of gains from a fertilizer subsidy between farmers and consumers? Why is this? What would be the distribution if the demand for the crop were highly elastic (e.g. elasticity of demand=-20)? What kind of crops have a highly elastic demand?

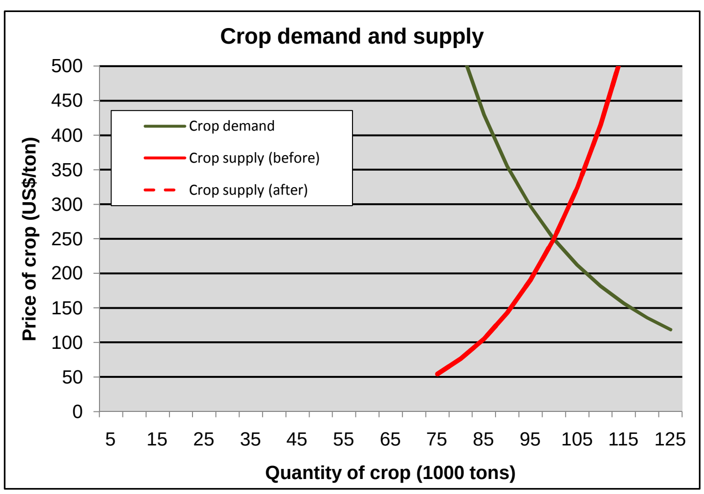
FERTILIZER-CROP MODEL

Assumptions	Before	After	Change
Price of crop (US$/ton)	250	250	0%
Price of fertilizer			
Before subsidy (US$/ton)	1,000	1,000	0%
After subsidy (US$/ton)	1,000	1,000	0%
Fertilizer subsidy			
Subsidy rate (%)	0%	0%	inf
Admin cost (% of direct cost)	0%	0%	inf
V/C ratio	2	2	0%
Fertilizer response curve			
a (constant)	800	800	0%
b (linear)	25	25	0%
c (squared)	-0.25	-0.25	0%
Crop production (th tons)	100		
Crop supply elasticity	0.30		
Crop demand elasticity	-0.30		

Results	Before	After	Change
Fertilizer use (kg/ha)	34	34	0%
Cost of subsidy	0	0	inf
Marginal output-input ratio	8	8	0%
Yield (kg/ha)	1,361	1,361	0%
Crop production (1000 tons)	100	100	0%
Crop price (US$/ton)	250	250	0%
Impact of change (1000 US$)			
Consumer gain			0
Producer gain			0
Consumer + producer gain			0
Direct cost of subsidy			0
Admin cost of subsidy			0
Net impact on country			0







Data for base scenario ("Before")

Fertilizer response curve (value of crop output for different fertilizer quantities)

Fertilizer (kg/ha)	Crop prod (kg/ha)	Value of crop (US$)	Cost of fert (US$)	Profit (US$)	Marginal VCR	Optimum Agronomic VCR=0	Economic VCR=1	Farmer
0	800	200.00	0.00	200.00				
1	825	206.19	1.00	205.19	6.19	-1	-1	-1
2	849	212.25	2.00	210.25	6.06	-1	-1	-1
3	873	218.19	3.00	215.19	5.94	-1	-1	-1
4	896	224.00	4.00	220.00	5.81	-1	-1	-1
5	919	229.69	5.00	224.69	5.69	-1	-1	-1
6	941	235.25	6.00	229.25	5.56	-1	-1	-1
7	963	240.69	7.00	233.69	5.44	-1	-1	-1
8	984	246.00	8.00	238.00	5.31	-1	-1	-1
9	1,005	251.19	9.00	242.19	5.19	-1	-1	-1
10	1,025	256.25	10.00	246.25	5.06	-1	-1	-1
11	1,045	261.19	11.00	250.19	4.94	-1	-1	-1
12	1,064	266.00	12.00	254.00	4.81	-1	-1	-1
13	1,083	270.69	13.00	257.69	4.69	-1	-1	-1
14	1,101	275.25	14.00	261.25	4.56	-1	-1	-1
15	1,119	279.69	15.00	264.69	4.44	-1	-1	-1
16	1,136	284.00	16.00	268.00	4.31	-1	-1	-1
17	1,153	288.19	17.00	271.19	4.19	-1	-1	-1
18	1,169	292.25	18.00	274.25	4.06	-1	-1	-1
19	1,185	296.19	19.00	277.19	3.94	-1	-1	-1
20	1,200	300.00	20.00	280.00	3.81	-1	-1	-1
21	1,215	303.69	21.00	282.69	3.69	-1	-1	-1
22	1,229	307.25	22.00	285.25	3.56	-1	-1	-1
23	1,243	310.69	23.00	287.69	3.44	-1	-1	-1
24	1,256	314.00	24.00	290.00	3.31	-1	-1	-1
25	1,269	317.19	25.00	292.19	3.19	-1	-1	-1
26	1,281	320.25	26.00	294.25	3.06	-1	-1	-1
27	1,293	323.19	27.00	296.19	2.94	-1	-1	-1
28	1,304	326.00	28.00	298.00	2.81	-1	-1	-1
29	1,315	328.69	29.00	299.69	2.69	-1	-1	-1
30	1,325	331.25	30.00	301.25	2.56	-1	-1	-1
31	1,335	333.69	31.00	302.69	2.44	-1	-1	-1
32	1,344	336.00	32.00	304.00	2.31	-1	-1	-1
33	1,353	338.19	33.00	305.19	2.19	-1	-1	-1
34	1,361	340.25	34.00	306.25	2.06	-1	-1	340.25
35	1,369	342.19	35.00	307.19	1.94	-1	-1	-1
36	1,376	344.00	36.00	308.00	1.81	-1	-1	-1
37	1,383	345.69	37.00	308.69	1.69	-1	-1	-1
38	1,389	347.25	38.00	309.25	1.56	-1	-1	-1
39	1,395	348.69	39.00	309.69	1.44	-1	-1	-1
40	1,400	350.00	40.00	310.00	1.31	-1	-1	-1
41	1,405	351.19	41.00	310.19	1.19	-1	-1	-1
42	1,409	352.25	42.00	310.25	1.06	-1	352.25	-1
43	1,413	353.19	43.00	310.19	0.94	-1	-1	-1
44	1,416	354.00	44.00	310.00	0.81	-1	-1	-1
45	1,419	354.69	45.00	309.69	0.69	-1	-1	-1
46	1,421	355.25	46.00	309.25	0.56	-1	-1	-1
47	1,423	355.69	47.00	308.69	0.44	-1	-1	-1
48	1,424	356.00	48.00	308.00	0.31	-1	-1	-1
49	1,425	356.19	49.00	307.19	0.19	-1	-1	-1
50	1,425	356.25	50.00	306.25	0.06	356.25	-1	-1
51	1,425	356.19	51.00	305.19	(0.06)	-1	-1	-1
52	1,424	356.00	52.00	304.00	(0.19)	-1	-1	-1
53	1,423	355.69	53.00	302.69	(0.31)	-1	-1	-1
54	1,421	355.25	54.00	301.25	(0.44)	-1	-1	-1
55	1,419	354.69	55.00	299.69	(0.56)	-1	-1	-1
56	1,416	354.00	56.00	298.00	(0.69)	-1	-1	-1
57	1,413	353.19	57.00	296.19	(0.81)	-1	-1	-1
58	1,409	352.25	58.00	294.25	(0.94)	-1	-1	-1
59	1,405	351.19	59.00	292.19	(1.06)	-1	-1	-1
60	1,400	350.00	60.00	290.00	(1.19)	-1	-1	-1

Supply and demand for fertilizer

Fertilizer demand (quant)	Fertilizer demand (price)	Fertilizer supply (price)
5	2,813	1000
10	2,500	1000
15	2,188	1000
20	1,875	1000
25	1,563	1000
30	1,250	1000
35	938	1000
40	625	1000
45	313	1000
50	-	1000
55	(313)	1000
60	(625)	1000

Fertilizer demand curve (linear)

F = a + b*P_fert

a (constant)	50.00
b (P coefficient)	-0.02

Fertilizer supply curve (horizontal)

P= 1000

Farmer optimum fert use	34
Value of output (US$/ha)	340.25
Yield (kg/ha)	1361
Elast fert wrt fert price	-0.47
Elast fert wrt crop price	0.47
Elast yield wrt fert	0.20
Elast yield wrt crop p	0.09

"@D_fert/@P_crop = [P_fert*Vcratio/(2*FRC_c)]*(-1)*(P_crop)^(-2)

"P_fert*VCratio = P_crop*(FRC_b+2*FRC

"(P_fert/P_crop)*VCratio - FRC_b = 2*FR(

"((P_fert/P_crop)*VCratio - FRC_b)/(2*FRC_c) = D_fert

"@D_fert/@P_crop = [P_fert*Vcratio/(2*FRC_c)]*(-1)*(P_crop)^(-2)

Supply and demand for crop

Crop quantity	Crop demand (price)	Crop supply (price)
5		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
65		
70		
75	652	54
80	526	76
85	430	105
90	355	143
95	297	190
100	250	250
105	212	324
110	182	415
115	157	525
120	136	659
125	119	818

Crop demand curve (double log)

log(D) = a+b*log(P)

a (constant)	6.26
b (elast of demand wrt P)	-0.30

Crop supply curve (double log)

log(S) = a+b*log(P)+log(Yield)

a (constant)	-3.65
b (elast of area wrt crop p)	0.19
Elast of yield wrt crop p	0.09
Crop supply elasticity	0.30
Equilibrium price (US$/ton)	250
Equilibrium quantity (th tons)	100

log(S) = as + bs*log(P) + log(Y)= log(D) = ad + bd*log(P)

log(P) = (ad-as)/(bs-bd)

P = exp((ad-as)/(bs-bd))

Data for alternative scenario ("After")

Fertilizer response curve (value of crop output for different fertilizer quantities)

Fertilizer (kg/ha)	Value of crop (US$)	Cost of fert (US$)	Profit (US$)	Marginal VCR	Optimum Agronomic VCR=0	Optimum Economic VCR=1	Farmer
0	200.00	0.00	200.00				
1	206.19	1.00	205.19	6.19	-1	-1	-1
2	212.25	2.00	210.25	6.06	-1	-1	-1
3	218.19	3.00	215.19	5.94	-1	-1	-1
4	224.00	4.00	220.00	5.81	-1	-1	-1
5	229.69	5.00	224.69	5.69	-1	-1	-1
6	235.25	6.00	229.25	5.56	-1	-1	-1
7	240.69	7.00	233.69	5.44	-1	-1	-1
8	246.00	8.00	238.00	5.31	-1	-1	-1
9	251.19	9.00	242.19	5.19	-1	-1	-1
10	256.25	10.00	246.25	5.06	-1	-1	-1
11	261.19	11.00	250.19	4.94	-1	-1	-1
12	266.00	12.00	254.00	4.81	-1	-1	-1
13	270.69	13.00	257.69	4.69	-1	-1	-1
14	275.25	14.00	261.25	4.56	-1	-1	-1
15	279.69	15.00	264.69	4.44	-1	-1	-1
16	284.00	16.00	268.00	4.31	-1	-1	-1
17	288.19	17.00	271.19	4.19	-1	-1	-1
18	292.25	18.00	274.25	4.06	-1	-1	-1
19	296.19	19.00	277.19	3.94	-1	-1	-1
20	300.00	20.00	280.00	3.81	-1	-1	-1
21	303.69	21.00	282.69	3.69	-1	-1	-1
22	307.25	22.00	285.25	3.56	-1	-1	-1
23	310.69	23.00	287.69	3.44	-1	-1	-1
24	314.00	24.00	290.00	3.31	-1	-1	-1
25	317.19	25.00	292.19	3.19	-1	-1	-1
26	320.25	26.00	294.25	3.06	-1	-1	-1
27	323.19	27.00	296.19	2.94	-1	-1	-1
28	326.00	28.00	298.00	2.81	-1	-1	-1
29	328.69	29.00	299.69	2.69	-1	-1	-1
30	331.25	30.00	301.25	2.56	-1	-1	-1
31	333.69	31.00	302.69	2.44	-1	-1	-1
32	336.00	32.00	304.00	2.31	-1	-1	-1
33	338.19	33.00	305.19	2.19	-1	-1	-1
34	340.25	34.00	306.25	2.06	-1	-1	340.25
35	342.19	35.00	307.19	1.94	-1	-1	-1
36	344.00	36.00	308.00	1.81	-1	-1	-1
37	345.69	37.00	308.69	1.69	-1	-1	-1
38	347.25	38.00	309.25	1.56	-1	-1	-1
39	348.69	39.00	309.69	1.44	-1	-1	-1
40	350.00	40.00	310.00	1.31	-1	-1	-1
41	351.19	41.00	310.19	1.19	-1	-1	-1
42	352.25	42.00	310.25	1.06	-1	352.25	-1
43	353.19	43.00	310.19	0.94	-1	-1	-1
44	354.00	44.00	310.00	0.81	-1	-1	-1
45	354.69	45.00	309.69	0.69	-1	-1	-1
46	355.25	46.00	309.25	0.56	-1	-1	-1
47	355.69	47.00	308.69	0.44	-1	-1	-1
48	356.00	48.00	308.00	0.31	-1	-1	-1
49	356.19	49.00	307.19	0.19	-1	-1	-1
50	356.25	50.00	306.25	0.06	356.25	-1	-1
51	356.19	51.00	305.19	(0.06)	-1	-1	-1
52	356.00	52.00	304.00	(0.19)	-1	-1	-1
53	355.69	53.00	302.69	(0.31)	-1	-1	-1
54	355.25	54.00	301.25	(0.44)	-1	-1	-1
55	354.69	55.00	299.69	(0.56)	-1	-1	-1
56	354.00	56.00	298.00	(0.69)	-1	-1	-1
57	353.19	57.00	296.19	(0.81)	-1	-1	-1
58	352.25	58.00	294.25	(0.94)	-1	-1	-1
59	351.19	59.00	292.19	(1.06)	-1	-1	-1
60	350.00	60.00	290.00	(1.19)	-1	-1	-1

Supply and demand for fertilizer

Fertilizer demand (quant)	Fertilizer demand (price)	Fertilizer supply (price)
5	2,813	1000
10	2,500	1000
15	2,188	1000
20	1,875	1000
25	1,563	1000
30	1,250	1000
35	938	1000
40	625	1000
45	313	1000
50	-	1000
55	(313)	1000
60	(625)	1000

Fertilizer demand curve (linear)
F = a + b*P_fert
a (constant) 50.00
b (P coefficient) -0.02

Fertilizer supply curve (horizontal)
P= 1000

Farmer optimum fert use 34
Value of output (US$/ha) 340.25
Yield (kg/ha) 1361

Elast fert wrt fert price -0.47
Elast fert wrt crop price 0.47
Elast yield wrt fert 0.20
Elast yield wrt crop p 0.09

Supply and demand for crop / Producer surplus

Crop quantity	Crop demand (price)	Crop supply (price)	Vertical gap between S2 - S1	Vertical gap between D - S2	Lesser of two	Only positive numbers	Vert gap times horiz gap
5							
10							
15							
20							
25							
30							
35							
40							
45							
50							
55							
60							
65							
70							
75	652	54	0	598	0	0	0.0
80	526	76	0	450	0	0	0.0
85	430	105	0	324	0	0	0.0
90	355	143	0	212	0	0	0.0
95	297	190	0	106	0	0	0.0
100	250	250	0	0	0	0	0.0
105	212	324	0	-111	-111	0	0.0
110	182	415	0	-233	-233	0	0.0
115	157	525	0	-368	-368	0	0.0
120	136	659	0	-522	-522	0	0.0
125	119	818	0	-699	-699	0	0.0

Producer surplus = 0.0

Crop demand curve (double log)
log(D) = a+b*log(P)
a (constant) 6.26
b (elast of demand wrt P) -0.30

Crop supply curve (double log)
log(S) = a+b*log(P)+log(Yield)
a (constant) -3.65
b (elast of area wrt crop p) 0.19
Elast of yield wrt crop p 0.20
Crop supply elasticity 0.43

Equilibrium price (US$/ton) 250
Equilibrium quantity (th tons) 100
Same (check) 100

log(S) = as + bs*log(P) + log(Y)= log(D) = ad + bd*log(P)
log(P) = (ad-as)/(bs-bd)
P = exp((ad-as)/(bs-bd))

Egerton University

Tegemeo Institute of Agricultural Policy and Development

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Trends and Patterns in Fertilizer Use by Smallholder Farmers in Kenya, 1997-2007

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Abstract:

This study uses nationwide household panel survey data from 1996/97 to 2006/07 to examine trends in fertilizer use on maize by smallholder maize growers. The paper also compares these findings with fertilizer use rates according to other recent surveys in Kenya to assess comparability. We also examine the correlation between household fertilizer use and indicators of welfare such as wealth and landholding size. In addition, we use econometric techniques applied to household survey data to identify the main household and community characteristics associated with fertilizer purchases. Lastly, the study considers alternative policy strategies for maintaining smallholders' access to fertilizer in the current context of substantially higher world fertilizer prices.

Trends and Patterns in Fertilizer Use by Smallholder Farmers in Kenya, 1997-2007

1.0 Introduction: Implications of High Food and Fertilizer Prices

Increasing farm productivity is important in reducing poverty in rural agrarian societies. The structural transformation paradigm espoused by Johnston and Mellor (1961) and Mellor (1976) underscores the role of agricultural productivity growth in rural poverty reduction, demographic change, and economic development. This structural and demographic transformation was seen in many Asian countries during their Green Revolutions. There is general agreement among researchers and policy makers that increased levels of fertilizer use, improved soil fertility and farmer management practices, and improved seed technologies are also required in Africa to generate these gains in farm productivity growth (Morris et al., 2007).

The current spike in world food, fuel and fertilizer prices has led a number of developing countries to re-assess their agricultural and food security policies. The cost of white maize in international markets, as of August 2008, is in the range of US$240 per ton,[1] whereas its historical mean over the 2000-2006 period was roughly US$100 per ton. This means that the cost of landing maize in interior markets in eastern and southern Africa, factoring in substantially higher transport costs in 2008, is now in the range of US$400-450 per ton. As a result of considerably higher import prices, the costs and risks of national and regional food production shortfalls are more severe now than they used to be.

Increased fertilizer use is one of the important means by which households and nations can reduce the likelihood of having to rely on international markets for grain. However, world fertilizer prices have risen even more so than food prices. After accounting for inland transport costs, the wholesale price of DAP fertilizer in Nakuru, Kenya has risen from 1,750 Ksh per 50kg bag in 2007 (US$538 per ton) to nearly 4,000 Ksh per 50kg bag (US$1,283 per ton) in 2008. These world price conditions, combined with the civil disruptions experienced in early 2008, are likely to break the steady upward trend in fertilizer use that Kenya has experienced over the past 15 years (Figure 1).

Governments in the region are searching for options to reduce their reliance on international food markets at a time when food prices are very high but when the soaring price of fertilizer has reduced farmers' effective demand for it. Many smallholder farmers may also lack the ability to afford fertilizer without seasonal finance. If fertilizer needs are not met and sufficient imports cannot be mobilized, widespread hunger may result, with negative social and political consequences at the national (and international) level, particularly if hunger turns into famine. It therefore may not be surprising that the Government of Kenya has announced in early September 2008 a plan to set aside Ksh 11 billion (US$183 million) for fertilizer imports, which farmers will access at discounted prices. However, the impact that a fertilizer subsidy program can make to mitigate hunger and poverty depend crucially on how the subsidy program is designed and implemented, and whether the other necessary conditions are put in place to enable farmers to benefit appreciably from increased use of fertilizer.

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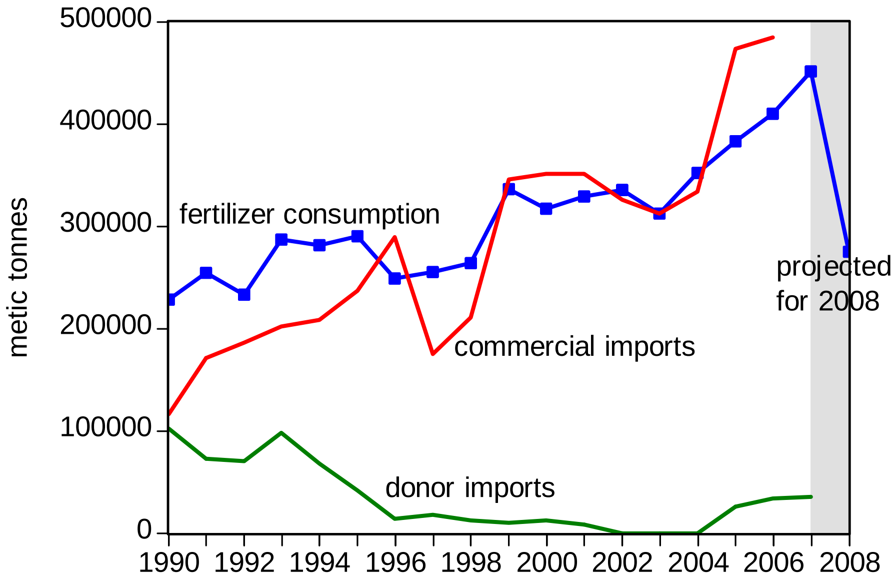
[1] Yellow maize #2 US Gulf was $243/mt as of August 30, 2008. White maize, SAFEX Randfontain South Africa was $241/mt as of August 30, 2008; white maize, fob Argentina, was $213/mt, August 15, 2008.

Figure 1. Trends in fertilizer consumption, commercial imports, and donor imports, 1990-2007, with projections for 2008.



Source: Ministry of Agriculture, 1990-2007; 2008 projections from interviews of fertilizer importers.

This study provides an empirical foundation to guide future fertilizer promotion policies and programs in Kenya. By obtaining a clear understanding of the farmer characteristics and geographic factors associated with commercial fertilizer purchase for use on maize, the major food security crop in the country, policy makers may be able to more accurately refine their programs to pinpoint where direct assistance may be necessary. The study tracks trends in fertilizer use among 1,260 small-scale farm households surveyed by Egerton University's Tegemeo Institute in 1997, 2000, 2004, and 2007.[2] The paper also compares fertilizer use rates in this data set with those of other recent surveys in Kenya to assess comparability. We also examine the correlation between household fertilizer use and indicators of welfare such as wealth and landholding size. In addition, we use fixed effects regression models to identify household and community factors associated with fertilizer use. Lastly, the study considers alternative policy strategies for maintaining smallholders' access to fertilizer in the current context of substantially higher world fertilizer prices.

2.0 Data

Data for this study is from 3 sources: i) Tegemeo rural household survey data from 1997, 2000, 2004, and 2007; ii) interviews with key stakeholders in the fertilizer distribution system; and iii) statistics compiled by the Ministry of Agriculture on fertilizer prices at Mombasa and upcountry (Nakuru).

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[2] In other Tegemeo papers, the balanced panel consists of 1,275 households, but 15 households did not have complete information on all variables used in this study, hence the 1,260 sample size.

The panel household survey was designed and implemented under the Tegemeo Agricultural Monitoring and Policy Analysis Project (TAMPA), implemented by Egerton University/Tegemeo Institute, with support from Michigan State University. The sampling frame for the panel was prepared in consultation with the Kenya National Bureau of Statistics (KNBS) in 1997; although KNBS's agricultural sample frame was not made available. Twenty-four (24) districts were purposively chosen to represent the broad range of agro-ecological zones (AEZs) and agricultural production systems in Kenya. Next, all non-urban divisions in the selected districts were assigned to one or more AEZs based on agronomic information from secondary data. Third, proportional to population across AEZs, divisions were selected from each AEZ. Fourth, within each division, villages and households in that order were randomly selected. A total of 1,578 households were selected in the 24 districts within eight agriculturally-oriented provinces of the country. The sample excluded large farms with over 50 acres and two pastoral areas. The initial survey was implemented in 1997, which covered both the 1996/97 and 1995/96 cropping seasons. Subsequent follow up surveys were conducted in 2000, 2004, and 2007.

This analysis is based on 1,260 households which formed a balanced panel for each of the five cropping years, 1995/96, 1996/1997, 1999/2000, 2003/04 and 2006/07 (hereafter referred to as 1996, 1997, 2000, 2004 and 2007, respectively). The attrition rate for the panel was 19% over the 10-year period. Some of the main reasons for this attrition are related to death of household heads and spouses leading to dissolution of households, and relocation of households from the study areas. Households in Turkana and Garissa districts were not interviewed in the 2004 and 2007 surveys. The 22 districts in the survey were assigned to agro-regional zones as defined in Table 1.

Of the eight agro-ecological zones shown in Table 1, areas which have both a main season and short-rains season are found in Eastern Lowlands, Central Highlands, Western Highlands, and Western Lowlands. For these two-season areas, we focus on the main crop season only. Most of the districts covering the High-Potential Maize Zone, Western Transitional, Marginal Rain Shadow, and Coastal Lowlands have only one cropping season.

Table 1: Sampled districts in agro-ecological zones

Agro-ecological zone	Districts	Categorization	Number of households
Coastal Lowlands	Kilifi, Kwale	Low-potential	70
Eastern Lowlands	Machakos, Mwingi, Makueni, Kitui, Taita-Taveta	Low-potential	143
Western Lowlands	Kisumu, Siaya	Low-potential	149
Western Transitional	Bungoma (lower elevation), Kakamega (lower elevation)	Low/medium-potential	148
Western Highlands	Vihiga, Kisii	High-potential	128
Central Highlands	Nyeri, Muranga, Meru	High-potential	240
High-Potential Maize Zone	Kakamega (upper elevation), Bungoma (upper elevation) Trans Nzoia, Uasin Gishu, Bomet, Nakuru, Narok	High-potential	345
Marginal Rain Shadow	Laikipia	Low-potential	37
Overall sample			**1260**

A major advantage of panel data is that it overcomes problems of sample comparability over time. In many countries, various farm surveys can be drawn upon to measure trends in livelihoods and agricultural performance over time. However, the comparability of these surveys is often compromised by differences in sampled households, locations, month/season of interview, recall period, and the way in which data is collected. The findings reported in this study are based on a balanced panel of 1,260 households consistently interviewed in 1997, 2000, 2004, and 2007, which provides a unique opportunity to track changes in agricultural performance for a consistently defined nationwide sample of small-scale farmers.

Data on fertilizer use was collected at both the household and field levels, with field data covering field size in acres, crops cultivated and harvested from each field, amount of fertilizers applied on each field, amount of seed planted for each crop, and type of maize seed planted. For the regression analysis below dummies are used to represent type of seed planted for each observation. Data is also available on household demographics on age, years of education, gender, employment and on infrastructure like distance to extension service and to fertilizer sellers.

Table 2 shows some basic descriptive statistics for the household sample pooled across all four survey years (n=1,260 households * 4 years, giving 5,040 observations). The land under maize is very similar for fertilizer users and non users at 5.17 and 4.56 acres, respectively. The proportion of cropped land under maize fields is also very similar for fertilizer users and non-users, at 41% and 42%. Household size as measured in adult equivalents is almost identical. While 28% of inorganic fertilizer users also used manure on their maize fields, 38% of the households not using inorganic fertilizer did.

However, there are some notable differences in the attributes of fertilizer users and non-users. First, the mean value of household productive assets is considerably higher among fertilizer users (Kenya Shillings[3] 51,000) compared to non-users (Kenya Shillings 30,000). The fertilizer-using households were generally located in areas receiving higher and more stable rainfall. Main season rainfall was 697 mm on average among inorganic fertilizer users compared to 588 mm for non users. The water stress variable, defined as the fraction of 20-day periods receiving less than 40 mm of rainfall, was higher among fertilizer non users than users.

Also, fertilizer using households are in closer proximity to fertilizer retailers than non-users. The fertilizer using households were 3.15 km away on average from the nearest fertilizer retailer compared to 8.64 km for the non-using households. Fertilizer users were also only 0.84 km from the nearest motorable road, compared to 1.28 km for non users. Moreover, fertilizer users are found to be closer to agricultural extension services. Lastly, we find that maize yields in the main season for households using fertilizer averaged 1,332 kgs per acre over the four years compared to 665 kgs per acre among households not using inorganic fertilizer. More details, broken by percentiles (25^{th}, 50th, and 75^{th}), on these variables are presented in Table 2 below. A test of differences in means between users and non-users conditional on unequal variances was rejected for most of these variables.

[3] The average exchange rate over four survey years is Kenya Shillings 67=1US$).

Table 2: Descriptive Characteristics of Households Using Fertilizer on Maize vs. not using, 1997, 2000, 2004, 2007 pooled.

	Households using fertilizer on maize (n=2660 households over 4 surveys)				Households not using fertilizer on maize (n=1480 households over 4 surveys)				Test of equality
	Value of variable at (percentile):				Value of variable at (percentile):				
	Mean (a)	25th	50th (median)	75th	Mean (b)	25th	50th	75th	(a)=(b)
Diversification Index[1]: Using Crop Revenue	0.37	0.23	0.37	0.51	0.48	0.36	0.49	0.63	Rejected**
% of cropped area under maize (both mono + intercrop)	0.41	0.21	0.34	0.57	0.42	0.26	0.38	0.50	
Household total area under crops (acres)	5.17	2.13	3.56	5.92	4.56	2.00	3.23	5.50	Rejected**
Fertilizer application rate on maize fields (kgs/acre)	64.31	25.00	50.00	100.00	0.00	0.00	0.00	0.00	Rejected**
Manure/Compost Use Dummy	0.28	0.00	0.00	1.00	0.37	0.00	0.00	1.00	Rejected**
Household Adult Equivalents	5.00	3.26	4.68	6.45	4.97	3.10	4.65	6.39	
Household Head Education (years in school)	7.13	3.00	7.00	11.00	5.27	0.00	6.00	8.00	Rejected**
Dependency Ratio[2]	0.55	0.00	0.31	0.83	0.65	0.00	0.43	1.00	Rejected**
Main Season Rainfall (mm)	696.78	503.70	756.00	914.30	588.10	330.60	681.00	831.00	Rejected**
Fraction of 20-day periods with <40mm of rainfall	0.21	0.00	0.19	0.33	0.25	0.00	0.15	0.44	Rejected**
Maize Yield (kgs/acre)	1322.31	626.61	1062.95	1620.00	665.70	257.50	503.77	855.00	Rejected**
Household Agricultural Assets Value	51225	2000	8000	31400	30436	1300	5500	24500	Rejected**
Distance from Fertilizer Seller	3.11	1.00	2.00	3.50	8.45	2.00	4.00	10.00	Rejected**
Distance to Motorable Road	0.84	0.10	0.30	1.00	1.28	0.20	0.50	2.00	Rejected**
Distance to Tarmac Road	6.57	2.00	6.00	10.00	10.01	2.00	6.00	14.00	Rejected**
Distance from Extension Advice	4.62	2.00	3.00	6.00	6.13	2.00	4.00	8.45	Rejected**

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007. From the 1,260 households consistently interviewed all the four surveys, there are 5,040 household observations. Of these, 4140 households planted maize and had complete information on all variables. Of these, 5,040 observations, 2,660 used fertilizer and 1,480 households did not use fertilizer (i.e. approximately 36% did not use fertilizer over all four survey years).

Notes:

[1]Diversification index for the fields was generated from individual crop revenues using the Herfindahl index, a measure of concentration.

[2]This was calculated as the ratio of the sum of adult equivalents of households members below 15 years (x) to that of total household equivalents (N) minus (x) i.e. x/(N-x). Note: the test for equality of means was based on a prior test for equality of variances between the groups; the latter was rejected for all groups at 5% significance; therefore the tests for equal means are based on un-equal variances; **indicates significance of 5% while * is for 10%.

3.0 Methods

The study reports bi-variate tables and graphs to provide the reader with a basic description of key trends and patterns of fertilizer use. However, as we will see, bi-variate results may give misleading information about the factors associated with fertilizer use because they do not hold other factors fixed. To provide a more accurate assessment of the household and community factors associated with household purchase of inorganic fertilizer, we estimate Probit and two-step Tobit models. The latter models identify the factors that affect the decisions by farmers to participate in fertilizer markets and conditional on participation, their level of purchases.

There are different two-step econometric approaches for modeling household decisions to participate in the market and the level of participation (in this case how much fertilizer to buy). Much of the literature is based on the famous Heckman two-step procedure using maximum likelihood procedures to estimate both the underlying and selection equations simultaneously or sequentially depending on the assumptions about the distribution of the disturbances and the data generating process. Issues of sample selection in a two-stage procedure are accounted for by generating the inverse Mills ratio (IMR) which is then used in the second equation as an additional variable. Tests on the IMR can verify whether a two stage procedure is appropriate or not. However, the appropriateness of Heckman procedures depends on the underlying assumption that zero fertilizer use represents an unobserved or "censored" effect and hence is not a valid observation. By contrast, Cragg's double hurdle models treat zero dependent-variable values as valid observations and hence are more directly applicable for our case of modeling household decisions to purchase fertilizer (to be included in the final version of this paper).

Because two-step regression procedures may be prone to biased estimates, a systems approach using maximum likelihood methods is the more desired approach. Though likelihood functions for cross-sectional data do exist, there is no comparable alternative for panel data. Therefore, this study will use pooled cross-sectional and panel approaches where appropriate taking into account sample selection. We fit a pooled Tobit and Panel Random Effects Model that assumes that unobserved individual heterogeneity is exogenous with respect to explanatory factors.

4.0 Trends in Fertilizer Use

4.1 Trends in the Proportion of Smallholder Households Using Fertilizer, by Agro-Ecological Zone

The proportion of sampled smallholder farmers using fertilizer on maize in the main season has grown from 55% in 1996 to 70% in 2007 (Table 3). These rates vary considerably throughout the country, ranging from less than 10% of households surveyed in the drier lowland areas to over 95% of small farmers in Central Province and the maize surplus areas of Western Kenya. The highest proportion of smallholders using fertilizer is in Central, High Potential Maize Zone, and Western Highlands zones, where over 80% of all maize growing smallholders apply fertilizer on maize.

However, the percentage of households using fertilizer is much lower in the drier areas such as eastern lowlands (43% in 2007), western lowlands (13% in 2007) and marginal rain shadow (16% in 2007), though this proportion has increased in all zones between 1997 and 2007.

Table 3: Percent of Farm Households Using Fertilizer on Maize

Agro-regional zone	1996	1997	2000	2004	2007
	% of households using fertilizer on maize				
Coastal Lowlands	0	0	3	4	14
Eastern Lowlands	21	27	25	47	43
Western Lowlands	2	1	5	5	13
Western Transitional	39	41	70	71	81
High Potential Maize Zone	85	84	90	87	91
Western Highlands	81	75	91	91	95
Central Highlands	88	90	90	91	93
Marginal Rain Shadow	6	6	12	11	16
Total Sample	**56**	**58**	**64**	**66**	**70**

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

Table 4: Fertilizer dose rates (kgs applied on maize fields receiving fertilizer, main season.

Agro-regional zone	1997	2000	2004	2007
	Dose rate (kgs/acre) on fertilized maize fields			
Coastal Lowlands	11	5	3	7
Eastern Lowlands	10	18	15	16
Western Lowlands	24	14	10	12
Western Transitional	54	48	62	71
High Potential Maize Zone	65	67	74	75
Western Highlands	31	36	46	47
Central Highlands	68	64	64	58
Marginal Rain Shadow	12	15	43	43
National sample	**56**	**55**	**60**	**59**

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

This study defines fertilizer dose rates as the amount of fertilizer applied to fields receiving fertilizer. Unfertilized maize fields are not counted in this computation. By contrast, fertilizer application rates are defined as the amount of fertilizer applied to all maize fields in the sample, whether they received fertilizer or not. By definition, dose rates are higher than application rates.

Mean dose rates in the six districts sampled in the High-Potential Maize zone in 2007 were 75kg per acre (187kg per hectare), comparable to or higher than post-Green Revolution dose rates on rain-fed grain crops in the relatively productive areas of South and East Asia. In the drier lowlands by contrast, dose rates are low, but it is unclear whether economically optimal dose rates in such areas are much higher than observed here (further analysis is needed on this question). Overall, Kenya's agricultural extension system recommends that farmers should apply 100kgs of fertilizer per acre of maize, but this recommendation may be based on high-potential rainfall and soil conditions and may therefore not be appropriate for the drier regions in the country nor may it be appropriate given post-liberalization maize/fertilizer price ratios.

Overall, fertilizer dose rates on maize fields have not increased appreciably. Mean dose rate was 56kg per acre in 1997, rising to only 59kg in 2007 (Table 4). Dose rates appear to be even declining somewhat in the lowlands zones, while it is increasing in the moderate-potential and high-potential areas.

The findings reported in Tables 3 and 4 from the nationwide Tegemeo survey data are largely consistent with those of other available studies. For example, a 2007 Rockefeller Foundation-funded study undertaken in four districts of Western Kenya (Siaya, Bungoma, Vihiga, which are included in the Tegemeo sample, and Butere-Mumias[4]) reports either a similar or higher proportion of small-scale farmers using inorganic fertilizer on maize than according to this study (Rockefeller Foundation, 2007). The mean district-level fertilizer application rates on fields receiving fertilizer are slightly higher in the Rockefeller study than in the Tegemeo survey for comparable districts. The study indicates that "The districts were stratified into High Potential Maize, Western Transitional, Western Highland and Western Lowland agro-ecological zones, based on the Tegemeo Institute's Rural Household classification" (pg. 6). We reproduce Tables 5-2 and 5-3 on page 37 of the Rockefeller study, which reports household fertilizer use on maize, here referred to as Tables 5 and 6.

Table 5 (Table 5-2 in Rockefeller Study): Fertilizer use and application rate in selected crops by beneficiary group, Western Kenya, 2005

	Market access category of household:					
	Cereal bank members	Non-cereal bank members	Spillover households (in proximity to cereal bank operation)	CNFA	Non-CNFA	Overall
Fertilizer use %	84.9	77.1	76.2	91.9	70.3	78.3
Rate (kg/acre), users only	83.2	66.2	82.2	76.0	66.3	68.3

Source: Rockefeller Foundation baseline survey, 2005
Note: CNFA refers to an input dealer training programme undertaken in parts of Western Kenya.

[4] Not in Tegemeo Sample

Table 6 (Table 5-3 in Rockefeller Study): Fertilizer use and application rates by District, Western Kenya, 2005 according to Rockefeller study compared to the 2004 Tegemeo survey.

	District				
	Bungoma	Butere-Mumias	Vihiga	Siaya	Overall
Fertilizer use %	86.8	64.6	82.4	49.7	78.3
Rate (kg/acre), users only	104.2	59.6	38.1	37.0	68.3
According to Tegemeo 2004 survey:					
Fertilizer use %	61.7	Not included in Tegemeo same	78.8	24.1	66.2
Rate (kg/acre), users only	88.9		32.9	34.8	41.1

Source: Rockefeller Foundation baseline survey, 2005

Another recent study by Marenya and Barrett (2008) of fertilizer use patterns in Vihiga and South Nandi district in 2005 found that 88% of the 260 farmers used fertilizer in the 2004 main crop season, compared to 78% in the Tegemeo sample in Vihiga District (South Nandi district was not included in the Tegemeo sample). In their study of Nakuru District, Obare et al (2003) found over 90% of farmers using fertilizer on maize. Nakuru District is also included in the Tegemeo sample, and we find that the proportion of households using fertilizer on maize in Nakuru varied between 83% and 91%, averaging 87% over the four years. Based on available corroborating evidence, we conclude that the findings reported in Tables 3 and 4 are comparable, and if anything may underestimate the extent of fertilizer use as compared to other studies.

4.2 Trends in Fertilizer Application Rates for Mono-cropped and Intercropped Maize Fields

Tables 7 and 8 present fertilizer application rates and doses per acre for different kinds of maize fields: pure stand maize fields, maize fields inter-cropped with less than 4 other crops, and maize fields intercropped with 4 or more other crops. Some interesting insights emerge. First, note that of the total maize area in the sample (2,260 acres), roughly two-thirds of this area was in maize fields intercropped with less than 4 other crops in 1997 (usually maize-bean), but over time, an increasingly higher proportion of maize area has been under the third category, maize fields intercropped with 4 or more other crops (Table 7). By 2006/07, 1,049 acres in the total nationwide sample were devoted to maize intercropped with 4 or more other crops (usually beans and/or other legumes, potatoes, and/or a horticultural crop), while 790 acres were to maize intercropped with less than 4 other crops, followed by only 473 acres under mono-crop maize. In both of the intercropped maize categories, the proportion of maize area under fertilization has risen dramatically (from 65% to 85% of the area with less than 4 other crops, and from 21% to 55% of the area with 4 or more other crops). By contrast, the percentage of area under maize pure stand receiving fertilizer has risen only slightly, from 74% in 1997 to 80% in 2007.

Table 7. Proportion of smallholder maize area fertilized, 1996/97 - 2006/07.

	% of maize area receiving fertilizer (total acres in sample)			
Category of maize field	**1996/97**	**1999/00**	**2003/04**	**2006/07**
Maize pure stand fields	74% (518)	73% (429)	76% (332)	80% (473)
Maize fields intercropped with < 4 other crops	63% (1 432)	71% (1 012)	70% (1 057)	85% (790)
Maize fields intercropped with > 4 other crops	21% (310)	53% (1 118)	49% (894)	55% (1 049)
All maize fields in sample	60% (2 260)	63% (2 560)	63% (2 283)	70% (2 312)

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

Table 8 presents trends over time in the intensity of fertilizer application on different categories of maize fields. The intensity of fertilizer application has increased dramatically on the intercropped fields. For example, on the maize fields intercropped with less than 4 other crops, mean dose rates rose from 60.9 kg/acre in 1997 to 74.2 kg/acre in 2007. When counting all fields, both fertilized and unfertilized fields in this category of maize field, mean application rates rose from 36.1 kg/acre in 1997 to 59.4 kg/acre in 2007 (Table 8, second row), a 65% increase. The dose rates on fertilized mono-cropped maize field were roughly constant over the 10-year period at just over 70kg per acre, but when accounting for the increased proportion of pure stand fields receiving fertilizer over time, the overall increase in application rates on maize pure stand fields has risen steadily over the decade, from 37.9 to 53.7kg per acre (Table 8, first row).

Table 8. Fertilizer use rates per acre of maize cultivated by smallholder farmers, and dose rates on fertilized maize fields, 1996/97, 1999/00, 2003/04, and 2006/07.

	Mean fertilizer use rates on maize fields, fertilized and unfertilized, kgs/acre (Mean dose rates on fertilized maize fields, kgs/acre)			
Category of maize field	**1996/07**	**1999/00**	**2003/04**	**2006/07**
Maize pure stand fields	37.9 (72.6)	36.4 (64.2)	49.3 (71.0)	53.7 (74.1)
Maize fields intercropped with < 4 other crops	36.1 (60.9)	37.5 (61.9)	46.7 (66.4)	59.4 (74.2)
Maize fields intercropped with > 4 other crops	13.5 (42.1)	30.7 (60.7)	32.2 (58.0)	33.3 (56.1)
All maize fields in sample	33.6 (61.3)	34.2 (61.6)	41.1 (64.1)	44.7 (63.5)

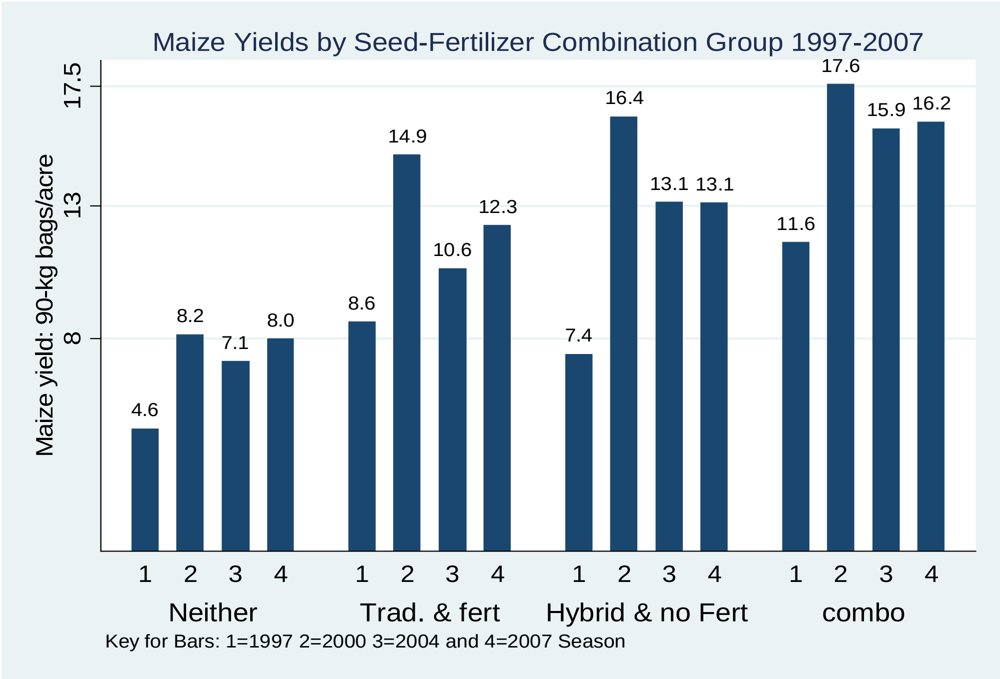
Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

4.3 Maize Yields by Seed Use Type and Fertilizer Combination

To analyze the relationship between yields and seed-fertilizer combination, the sample was divided into four groups: (i) fields using use both hybrid seed maize and inorganic fertilizer; (ii) fields using hybrid seed but no fertilizer; (iii) fields using OPVs or traditional seed varieties with fertilizer, and (iv) fields using traditional seed and no fertilizer.

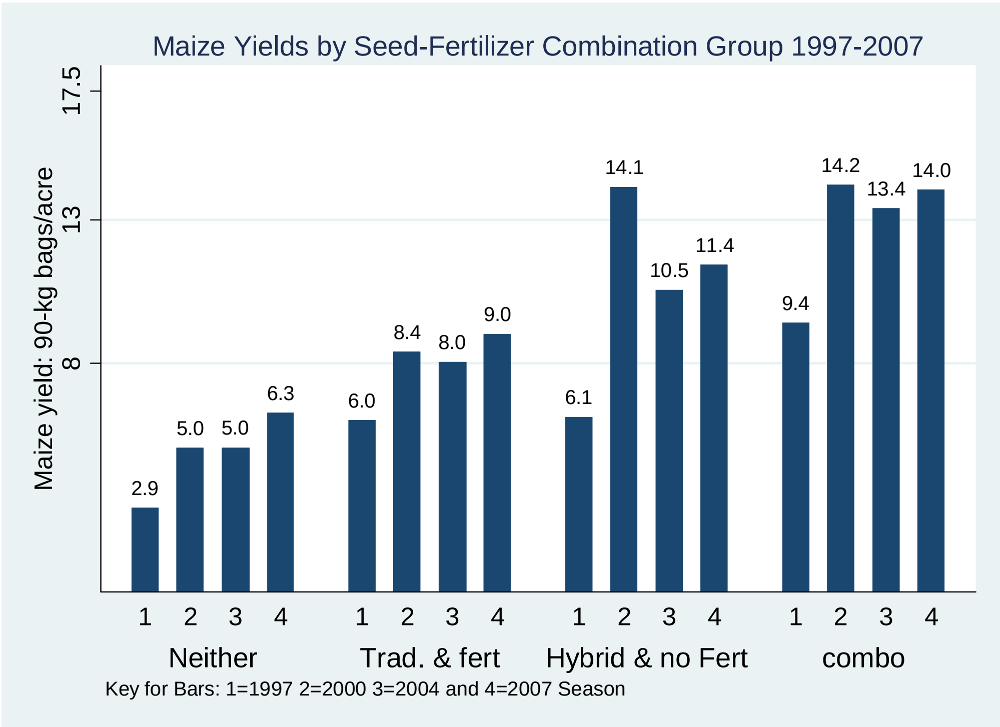
Given that the majority of maize fields in the sample are intercropped with other crops, it may be invalid to measure yields (a partial measure of land productivity) by counting the output of only one crop, especially if many other crops are harvested on the same area. For this reason, we present yields in two ways. We first count all crops harvested on the maize area, converting other crops to kgs of maize based on relative price ratios (Figure 2a). This provides a more complete picture of output per unit of land on area devoted to maize. In the second method, we ignore the production of other crops and count only the kgs of maize harvested on maize fields (Figure 2b).

Figure 2(a): Maize yields (converting other crops on intercropped maize fields to maize equivalents), by seed and fertilizer technology category.



Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007. *Note: Yields used here are the maize-equivalent for mixed-crop fields where all each crop's production is converted to maize using the relative prices with maize as the numeraire.*

Figure 2(b): Maize Yields (not converting production of other crops into maize equivalents), by seed and fertilizer technology category



Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

Several interesting observations come out of Figures 2a and 2b, which depict the yield outcomes for these different groups. First, maize yields generally appear to be increasing across the years from 1997 to 2007 for each of these four categories of maize fields. But the year 2000 stands out as recording the highest yields for each of these classes of technology use. Moreover, and most importantly, maize yields are consistently lowest among Category IV farms (those using neither hybrid seed nor fertilizer) and are highest among Category I farmers using both hybrid seed and fertilizer.

The findings in Figure 2a and 2b are surprisingly similar in the story they tell. The "*combo*" group (users of both hybrid seed and fertilizer) has higher yields relative to all the other combinations, while the "neither" group does poorest. The stark difference between the "*neither*" group and the 3 other groups for every year shows the effect of hybrid and fertilizer use on maize yields. The group that uses no fertilizer and plants traditional seed (neither) has an average yield of approximately 7 bags per acre of 90 kilograms each (when counting the other crops converted to maize equivalents) and only 5 bags per acre when counting only maize production. The groups that either use fertilizer with traditional seed or hybrid seed without applying fertilizer had an average yield of about 10 to 12 bags/acre (in maize equivalents, or 8 to 10 bags/acre when ignoring the other crops harvested). The group using both fertilizer and hybrid seed maize has the highest average yield of 15 bags/acre (13 when ignoring the other crops harvested). The yields for this latter group are twice as large as the group that uses neither hybrid nor fertilizer. Clearly, the adoption of a combination of appropriate technologies appears to be associated with smallholder productivity and therefore incomes which will raise food security status. However, as shown earlier, fertilizer use in Kenya is highest in the moderate- to high-potential areas, where maize yields are likely to be higher than in the semi-arid regions even without fertilizer. A multivariate analysis of the contribution of fertilizer to maize yield, holding geographic and other factors constant, is contained in Kibaara et al (2008).

4.4 Relationship between household farm size and fertilizer use rates

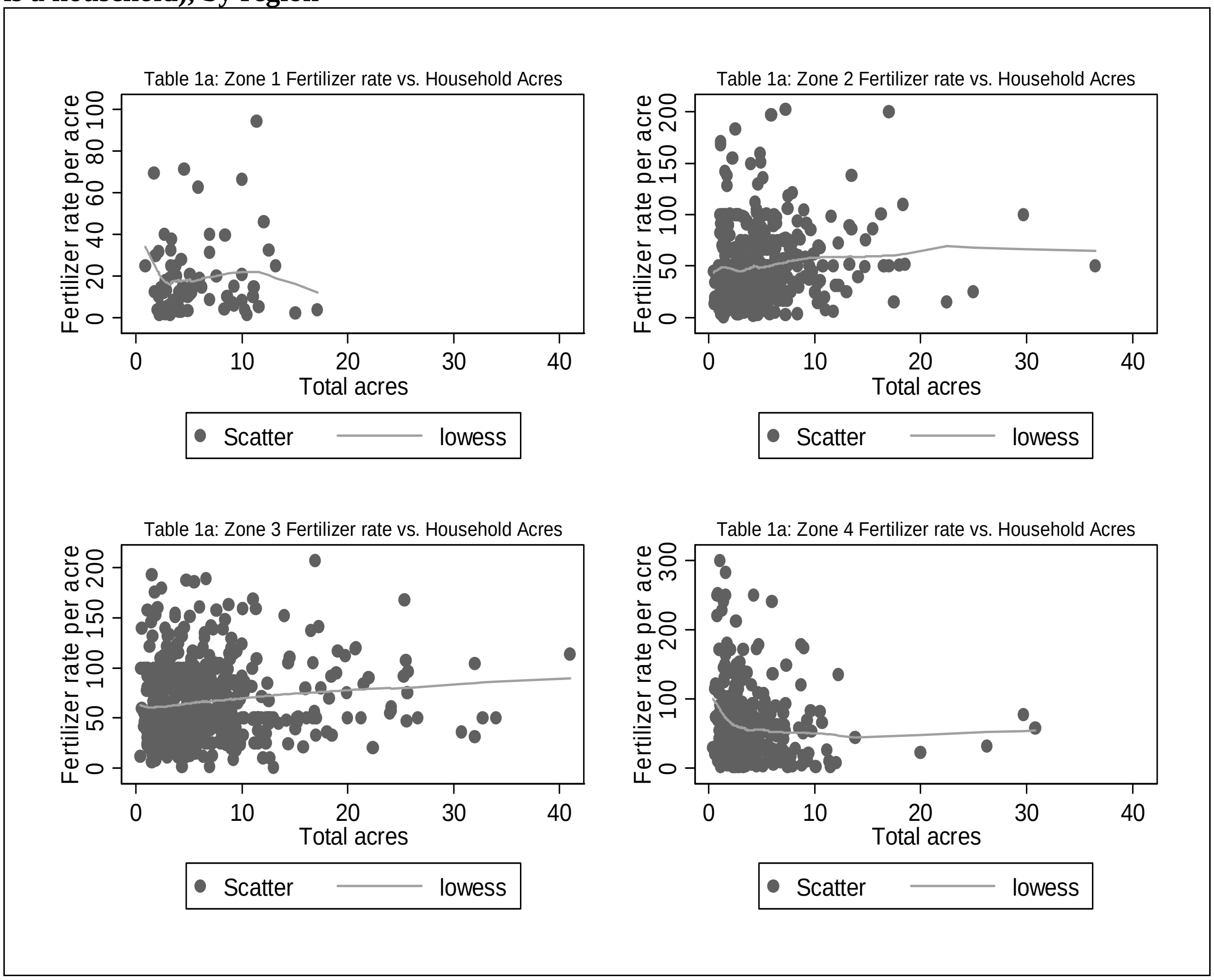
A common worry is that the poor cannot afford to purchase fertilizer and that even if fertilizer use rates are increasing in Kenya, this may not have much of an impact on poverty if the poor cannot afford to purchase this key input. To assess this, we examine the relationship between farm size and fertilizer use. Landholding size is one of the most important indicators of wealth in Kenya. Across the 1997, 2000, and 2004 surveys, the majority of all households had 75% to 100% of the value of their total assets in land (Burke et al., 2006).[5]

Figure 3 shows scatterplots of fertilizer use by farm size by region. Each dot represents a household in the sample. A bi-variate regression line was estimated for each figure, using Locally Weighted Smoothed Scatterplot regressions, or "lowess" (Cleveland, 1979). However, Figure 3 shows that for any given zone and among landholding size under 20 acres, which accounts for nearly all of the sampled households, there is tremendous variation in the amount of fertilizer per acre used on maize. In Zone 1, for example, there appears to be a slight inverse relationship between farm size and intensity of fertilizer use, and mean dose rates in this semi-arid zone are in the range of 20-40 kg/acre throughout the farm size distribution. There is a slight positive relationship between farm size and fertilizer use intensity in the more productive Zones 2 and 3, but still the defining feature of Figure 3 is

[5] When this study was undertaken, the 2007 survey had not been initiated.

great variation in fertilizer use regardless of farm size, in every zone. Many small farms use fertilizer very intensively, and many other farms of similar size do not. Household characteristics associated with fertilizer use are discussed below. Differences in fertilizer use appear to be greatest across the zones, with the most productive Zone 3 achieving substantially higher mean use than in Zone 1, the semi-arid lowlands regions.

Figure 3. Scatter plot of household acres cultivated vs. fertilizer use per acre (each dot is a household), by region



Notes:
Zone 1: Eastern and Western Lowlands (Kitui, Mwingi, Machakos, Makueni, Siaya, Kisumu);
Zone 2: Western Transitional and Western Highlands (Bungoma, lower elevation divisions in Kakamega, Kisii, and Vihiga)
Zone 3: High-potential maize zone (Trans-Nzoia, Uasin Gishu, Bomet, Nakuru, upper elevation divisions in Kakamega)
Zone 4: Central Highlands (Muranga, Nyeri, Meru, Laikipia).
Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

4.5 Relationship between household assets and fertilizer use

We now examine the relationship between fertilizer use and the total value of remaining household assets other than land. This includes livestock, small animals such as chickens, goats, and sheep, draft equipment such as ploughs and harrows, irrigation equipment, ox-carts, bicycles, cars, etc. Table 9 breaks fertilizer use and area under all crops across asset levels. After ranking all households in the sample according to their asset values, we then divided the sample into four asset quartiles. The lowest asset quartile has a mean value of agricultural assets of approximately 3,000 Kenya Shillings, the second quartile at around 12,000 Ksh, the third at 25,000 Ksh, and the highest group at 170,000 Ksh worth of assets. The asset values of the lowest group are a quarter of the second higher group, which in turn are half of that of the next group, which are one-sixth that of the top group – clearly there are great disparities in wealth in Kenya's smallholder farming areas.

Here, we start to find some systematic positive association between household assets and fertilizer use rates (Table 9). Fertilizer use rates increase across asset quartiles for each maize field category. Counting all fields cultivated, households in the top asset quartile used 42 kgs/acre on crops compared to 31kg/acre for the poorest asset quartile (a difference of 35%). Area under cultivation also increases even more dramatically across the asset quartiles. However, within each group, fertilizer rates decline as the number of mixed crops surpass three per field.

Table 9: Field Fertilizer Use on Maize and Area Under all Crops by Asset Levels

	Asset Quartiles			
	1 (lowest)	2	3	4 (Highest)
Maize pure stand fields				
Assets (Kenya Shillings)	3,303	12,262	27,259	235,820
Fertilizer Dose Rate (kgs/acre)*	65	60	66	79
Fertilizer Application Rate (kgs/acre)**	32	42	40	51
Total Household Area Cropped (acres)	4.01	5.13	5.79	11.03
Maize mixed fields <4 crops				
Assets (Kenya Shillings)	3,518	14,967	29,231	163,242
Fertilizer Dose Rate (kgs/acre)*	60	61	66	68
Fertilizer Application Rate (kgs/acre)**	33	41	46	46
Total Household Area Cropped (acres)	3.79	4.10	5.29	6.00
Maize mixed fields >=4 crops				
Assets (Kenya Shillings)	1,693	5,560	14,962	107,501
Fertilizer Dose Rate (kgs/acre)*	53	58	63	59
Fertilizer Application Rate (kgs/acre)**	24	30	33	32
Total Household Area Cropped (acres)	4.10	4.93	6.33	4.75
All maize fields in sample				
Assets (Kenya Shillings)	2,982	12,106	25,633	166,919
Fertilizer Dose Rate (kgs/acre)*	59	60	66	68
Fertilizer Application Rate (kgs/acre)**	31	38	42	42
Total Household Area Cropped (acres)	3.91	4.47	5.60	6.45

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.
Note: *for fields receiving fertilizer. **for all fields, including those not receiving any fertilizer.

4.6 Trend in Distance to Fertilizer Seller by Agro-Ecological Zones

One of the causes of increased fertilizer use in Kenya since the de-regulation of fertilizer trade in the early 1990s has been the improvement in market access to fertilizer which might be measured by the distance from the farm gate to the purchase point.

After the elimination of retail price controls, import licensing quotas, foreign exchange controls, and the phase-out of external fertilizer donation programs that disrupted commercial operations, Kenya has witnessed rapid investment in private fertilizer distribution networks, with over 10 importers, 500 wholesalers and 7,000 retailers now operating in the country (Ariga, Jayne, and Nyoro, 2006).

As a direct result of an increasingly dense network of fertilizer retailers operating in rural areas, the mean distance of small farmers to the nearest fertilizer retailer has declined from 7.4 km to 3.2 km between 1997 and 2007 (Table 10). This has greatly expanded small farmers' access to fertilizer, reduced their transactions costs, and thereby raised the profitability of using fertilizer, other factors held constant. Therefore, the reduction in distance travelled to access fertilizer is likely to be an important factor behind increased fertilizer use by smallholders as seen in the longitudinal survey data.

Table 10: Distance in Kilometers to the nearest fertilizer Seller

Zones		1997	2000	2004	2007	All Years
Zone 1						
	Fertilizer Users	5.29	4.23	3.38	2.54	3.66
	Fertilizer Non-Users	13.73	8.94	6.28	3.56	8.68
	Both	12.67	8.37	5.64	3.32	7.81
Zone 2						
	Fertilizer Users	4.45	2.63	2.00	2.91	2.9
	Fertilizer Non-Users	6.01	5.52	3.06	3.42	5.3
	Both	5.22	3.28	2.19	2.98	3.57
Zone 3						
	Fertilizer Users	4.58	4.00	3.06	3.56	3.89
	Fertilizer Non-Users	6.89	2.91	3.40	4.11	5.02
	Both	4.99	3.88	3.11	3.62	4.05
Zone 4						
	Fertilizer Users	2.45	1.39	1.31	1.25	1.78
	Fertilizer Non-Users	4.97	2.88	2.27	1.96	3.10
	Both	2.72	1.57	1.42	1.31	1.92
Zone 5						
	Fertilizer Users	27.50	9.10	13.00	2.70	9.77
	Fertilizer Non-Users	23.93	19.62	11.14	5.67	16.57
	Both	24.03	19.23	11.21	5.29	16.21
Total						
	Fertilizer Users	4.03	3.08	2.40	2.88	3.15
	Fertilizer Non-Users	11.98	9.39	6.07	3.92	8.64
	Both	7.38	5.65	3.70	3.22	5.26

Source: Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

Long distances to purchase point may imply higher transport and transaction costs in acquiring inputs which can inhibit use. The longest distances are generally in the drier Zone 5 (Kwale/Kilifi/Laikipia) and Zone 1 (see Note to Figure 3 for details of which areas fall in these zones). Central Highlands (Zone 4) has the lowest distances, a legacy of the cooperative movement organized around cash crops like coffee, tea, and horticulture.

Another noteworthy finding is that distances to motorable and tarmac roads have also declined dramatically over the 1997-2007 period (Kibaara et al., 2008). There is a significant decline in distances to a motorable road from an average of 1 km in 1997 to 2004 to 0.5 km in 2007. The reduction in distances to motorable road could be associated with investments in maintenance of feeder roads (graders, bridges, culvert, murram) in the rural areas following the introduction of the Constituency Development Fund (CDF). This is a decentralised fund introduced in 2003 where all the 210 constituencies are allocated 2.5% of the total government revenue. Analysis show that in 2005, road related projects at the constituency level accounted for 11% of the total constituency budget (authors' calculation from www.cdf.go.ke).

4.7 Trends in Fertilizer Trade Margins

Figures 4 and 5 plot trends in the c.i.f. price of DAP fertilizer ex Mombasa and the wholesale price of DAP in wholesale Nakuru markets in western Kenya. Both price series are collected annually by the Ministry of Agriculture. DAP is the main planting basal fertilizer applied on maize in Kenya. The Mombasa prices are a reflection of world DAP prices plus port charges and duties, which were reduced in 2003. The difference between the Nakuru and Mombasa prices thus reflect domestic fertilizer marketing costs. Figure 4 shows the trends in nominal Ksh, while Figure 5 deflates these nominal prices by the consumer price index.

Figure 4 shows that between 1994 and 2002, DAP prices in Nakuru were basically flat even in nominal terms even though Mombasa prices roughly doubled over the same period. From 2002 to 2007, DAP prices rose by 25% in nominal terms in Nakuru and by about 30% at Mombasa. Between 2007 and 2008, both Nakuru and Mombasa prices have shot up dramatically due to soaring world prices.

However, by deflating prices by the CPI, we see how fertilizer prices have moved relative to the general price index of consumer goods and services in Kenya (Figure 5). While world prices, c.i.f. Mombasa have stayed roughly constant over the 1990 to 2007 period, real DAP prices at Nakuru have declined substantially, from roughly 3800 Ksh/50kg to 2000 Ksh/50kg in constant 2007 shillings. While both import prices and upcountry prices have shot up in 2008, in relation to the general price index, DAP prices in 2008 are in real terms about equal to where they stood in the mid-1990s, about the time that the substantial decline in marketing costs began. Prices of Urea show a similar pattern. Clearly there have been some positive developments in Kenya's fertilizer marketing system that have accounted for this cost reduction.

Figure 4. Price of DAP (Di-Ammonium Phosphate) in Mombasa and Nakuru (nominal Shillings per 50kg bag)

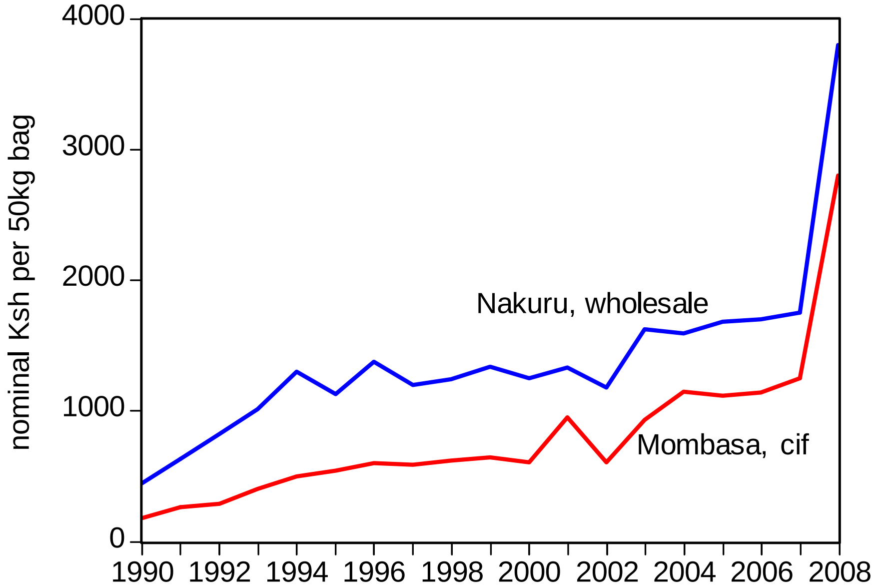
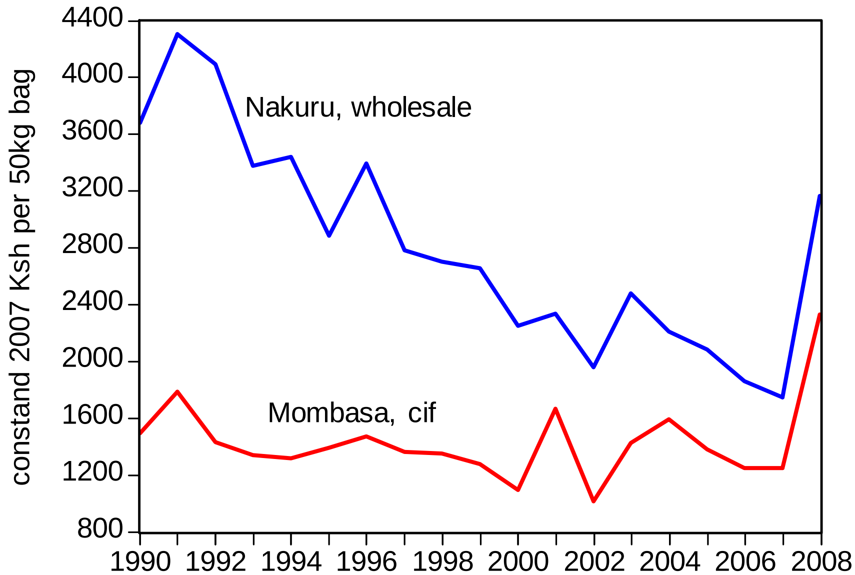


Figure 5. Price of DAP (Di-Ammonium Phosphate) in Mombasa and Nakuru (constant 2007 Shillings per 50kg bag)

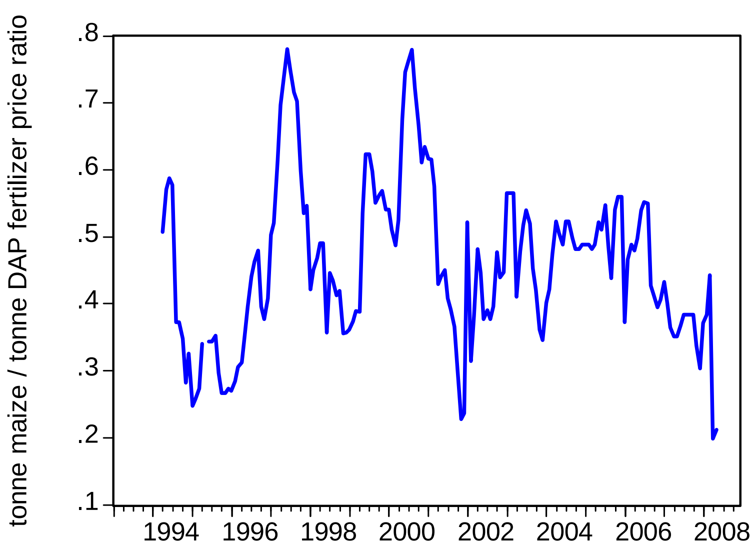


Note: Nakuru is a maize-producing area in the Rift Valley of Kenya, 400 miles (645 km) by road west of the port of Mombasa.
Source: Ministry of Agriculture. FMB weekly fertilizer reports for CIF Mombasa.

Recent interviews of key informants in Kenya's fertilizer sector undertaken for this study identify four factors responsible for the declining fertilizer marketing costs observed in Kenya: (i) exploiting the potential for cheaper backhaul transportation, taking greater advantage of trucks transporting cargo from Rwanda and Congo to the port of Mombasa; (ii) private importers are increasingly using international connections to source credit at lower interest and financing costs than are available in the domestic economy; (iii) mergers between local and international firms in which knowledge and economies of scope enable cost savings in local distribution; and (iv) increased competition among local importers and wholesalers given the expansion of firms engaged in fertilizer marketing since the early 1990s. In fact, it is likely that the fourth factor – increased competition – has stimulated firms to exploit the other cost-reducing innovations identified in order to maintain their market position. Intense competition has caused some shake-out in the fertilizer import stage, as firms that did not innovate quickly enough soon found themselves uncompetitive and lacking sufficient volume to continue in the business (2008 interviews of fertilizer industry representatives).

Notwithstanding these efficiency gains in Kenya's fertilizer marketing system, the world realities in 2008 have caused domestic fertilizer prices to be extremely costly relative to the price of maize. Figure 6 plots monthly wholesale maize to wholesale fertilizer price ratios per tonne at Nakuru. The higher the ratio, the more profitable and the greater the incentive to apply fertilizer on maize. While this ratio has historically ranged between 0.4 and 0.6, at the time of planting in 2008, it has plunged to below 0.25. The price of maize in Kenya has not risen nearly as dramatically as fertilizer. This, along with the civil disruptions earlier in 2008, is likely to disrupt the steady upward trend in total fertilizer use by smallholder farmers since the early 1990s. Initial projections are that only 275,000 tons of fertilizer were purchased this year by Kenyan farmers, compared with 451,000 tons in 2006/07. The conclusions section of the report considers alternative approaches to sustain fertilizer use and food security in Kenya.

Figure 6: Maize / Fertilizer Price Ratios, Nakuru, Kenya, 1994-2008.



Notes: Price ratio defined as wholesale market price per metric tonne, Nakuru, divided by DAP, c.i.f. Nakuru per metric tonne, in nominal shillings.
Sources: Ministry of Agriculture Market Information Bureau, Nairobi.

Over 90% of up-country fertilizer distribution is done by road, with rail covering less than 10%; the direct cost of rail is cheaper by a third compared to road but rail costs are associated with delays and unreliable deliveries, thus forcing fertilizer wholesalers to use more expensive road transportation. Road transport is becoming increasingly expensive as road conditions deteriorate, competition for transport services have increased due to WFP food distribution, and increasing fuel costs which have doubled between 2006 and 2008. Fertilizer importers also indicate that waiting times at weighbridges along the road adds to fertilizer marketing costs. Recently the Prime Minister has ordered that the number of weigh-bridges and road blocks be reduced along the highways and the port of Mombasa to be open 24 hours in order to reduce costs and accelerate clearing cargo from the port (Daily Nation, August 2008). A serious rehabilitation of the Kenya railways could reduce fertilizer marketing costs further and thereby help offset the effects of higher world fertilizer prices over time.

According to a recent Ministry of Agriculture report (Sikobe and Ulare, 2008), increased fertilizer prices are mostly due to changed international market conditions, port handling costs, and transport and not collusion among importers (as far as a recent MoA report reveals and interviews carried out with importers for this study). The MoA estimates importer margins at about 7-8% and at the retail level at 3-4% due to increased competition.

5.0 Econometric model findings

5.1 Factors Affecting Household Fertilizer Use Decisions in the Low Potential Agro-Ecological Zones

The results from probit, OLS, and Fixed Effects (FE) regressions on the decision to buy fertilizer or not to buy and the decision on fertilizer intensity per acre are shown in Table 11(a) for zones consisting of low potential areas. Since the proportion of households using fertilizer is relatively low in these predominantly semi-arid areas, we first estimate probit models of the decision to purchase fertilizer, and then estimate OLS and fixed effects models on the sub-sample of fertilizer users. We construct four landholding size quartile categorical variables,[6] four household asset quartile variables,[7] dummies for four agro-ecological zones, five dummies of categories for education of household heads based on years at school, four dummies for maize seed type, five dummies for land tenure system types, and distance to fertilizer seller as the major explanatory variables of interest. For each of these categories we dropped one dummy to avoid perfect co-linearity. The advantage of using a dummy variable approach is that the relationship between a particular variable and fertilizer use may be non-linear. Even using a quadratic term may not accurately capture complex non-linear relationships, and with highly skewed distributions for variables like assets and landholding size, extreme values have a relatively large impact on estimated coefficients. The use of multiple dummy variables circumvents this problem.

The results from probit and OLS on pooled data and Fixed Effects (FE) models are shown in Table 11a. In these zones (Zone 2=Coastal Lowlands, Zone 3=Eastern Lowlands, Zone 4=Western Lowlands, and Zone 5=Western Transitional) only 44% of the sample used fertilizer. Statistics on key variables of interest including number using fertilizer, asset

[6] We used this measure as a proxy for landholding size (which is missing for year 2000 panel survey)
[7] Assets are defined as the aggregated value of livestock and other animals, ploughs, tractors, animal housing units, ox carts, bicycles, other farm transport equipment, pumps, irrigation equipment, wells, and vehicles.

values, acres, and proportion of sample under different categories of variables for this regression sample are provided in Table 11b.

It is noteworthy that some of the factors may have different signs or effects on the two decisions (participation and fertilizer intensity). Though the price of maize has a significant but extremely small negative effect on the probability of participating in the fertilizer market in the relatively low potential zones, the sign and magnitude are different for the decision on fertilizer intensities. This implies that for these zones, though higher prices for maize have practically no effect on households' decision to purchase fertilizer, a higher maize price does affect the amount of fertilizer purchased. A 10 percent increase in maize price is found to lead to a 11 percent increase in the intensity of fertilizer use for those purchasing the input, which amounts to roughly 6 kgs per acre on average.

The level of education category has a large and significant effect on the decision to purchase fertilizer. Households containing a member with more than 12 years of education have a 40 percentage point greater likelihood of purchasing fertilizer compared to households with heads having between 1 to 4 years of education. Approximately 39% of those using fertilizer have more than nine years of education compared to only 20 % of those not using fertilizer with similar education levels (Table 11b).

Just like for education, farm size (acres) has a positive effect on participation (the probability increases by 14 percentage points moving from lowest farm size group to the middle two farm size quartiles. The probability of fertilizer purchase is not statistically different between the smallest 25 percent of farms and the largest 25 percent of farms in the lowland areas. Farm size also appears to have no effect on the level of intensity of fertilizer use in the low potential zones.

Though there is a positive relationship between household asset levels and intensity of fertilizer use, this is not significant. A simple t-test for differences between the means of asset values and acres cropped for fertilizer users and non-users is rejected, implying that in these low potential zones, fertilizer use is not related to differences in household wealth across the sample. The proportional distribution of asset values and acres cropped across quartiles for those using or not using fertilizer is fairly similar as shown in Table 11b.

Zonal dummies offer some insights into market participation trends across agro-ecological zones. We have dropped zone 2 (coastal lowlands) as a base for comparing the other zones in Table 11(a). There is no significant differences in the probability of participation compared to Zone 4 (western lowlands covering Siaya and Kisumu districts) though intensities are higher. However, the probability of participation when compared to Zones 3 (Western Lowlands) and zone 5 (Western Transitional) are higher by .38 and .60 respectively. Moving from zone 2 to zone 4 raises intensity by 18 kgs per acre; a log-linear specification (not included here) shows a more than 150% increase in intensity in zones 3, 4, and 5 compared to zone 2. Interacting distance to fertilizer seller with zonal dummies (not shown in Table) shows a negative relationship for all zones except for zone 3 where it is insignificant, showing that distance to fertilizer sell point is inversely related to the decision to buy in most zones except in the High-Potential Maize Zone, where the rainfall and soils are favorable enough to generate strong effective demand for fertilizer even when households have to travel relatively far to purchase it.

Table 11a: Probit Regression on Pooled Data plus OLS and Fixed effects on Fertilizer Users for Low Potential Zones (Zones 2, 3, 4, 5)*

Model / dependent variable	Probit: 1=purchased fertilizer for use on maize	OLS: Fertilizer use intensity (kgs /acre)	Fixed Effects: Fertilizer use Intensity (kgs /acre)
CPI-Indexed lagged prices of Maize (90-kg bag MoA data)	-0.000**	0.033***	-0.004
	(0.000)	(0.010)	(0.017)
CPI-Indexed Price of DAP Fertilizer (50-kg bags Tegemeo Survey Data)	-0.000	-0.009	-0.017**
	(0.000)	(0.005)	(0.007)
Acre: 2nd Quartile	0.140*	-12.490	7.617
	(0.070)	(8.162)	(11.980)
Acre: 3rd Quartile	0.147*	-3.004	1.542
	(0.067)	(8.013)	(11.035)
Acre: 4th Quartile	0.091	-4.782	-6.542
	(0.065)	(7.474)	(11.691)
Asset: 1st Quartile	0.060	-3.637	14.190*
	(0.046)	(5.794)	(6.835)
Asset: 2nd Quartile	0.033	-7.178	-0.895
	(0.044)	(4.477)	(6.185)
Asset: 3rd Quartile	-0.040	-0.876	-7.188
	(0.043)	(4.282)	(6.221)
Dummy Zone=3 Eastern Lowlands	0.385***	-1.383	
	(0.074)	(12.428)	
Dummy Zone=4 Western Lowlands	0.025	18.193*	
	(0.096)	(8.698)	
Dummy Zone=5 Western Transition	0.600***	18.052	
	(0.067)	(20.222)	
Education Head: None	0.001	14.269**	20.238
	(0.053)	(5.471)	(10.546)
Education Head: 5 to 8 Years	0.049	8.682	23.188*
	(0.046)	(4.958)	(9.293)
Education Head: 9 to 12 Years	0.234***	1.024	20.067
	(0.049)	(8.335)	(15.300)
Education Head: Over 12 years	0.403***	-10.507	37.478*
	(0.055)	(12.232)	(19.006)
Seed Type: Hybrid	-0.006	15.319**	9.595
	(0.057)	(4.800)	(9.741)
Seed Type: Retained Hybrid	-0.288***	12.016	-23.269
	(0.058)	(10.407)	(19.234)
Seed Type: Local Seed	-0.235***	5.166	-27.360

Model / dependent variable	Probit: 1=purchased fertilizer for use on maize	OLS: Fertilizer use intensity (kgs /acre)	Fixed Effects: Fertilizer use Intensity (kgs /acre)
	(0.051)	(8.182)	(16.108)
Distance to Fertilizer Seller: 1st Nearest Quartile	0.135**	-28.645***	12.084
	(0.051)	(6.263)	(10.025)
Distance to Fertilizer Seller: 2nd Nearest Quartile	0.112*	-27.113***	7.006
	(0.047)	(5.561)	(10.025)
Distance to Fertilizer Seller: 3rd Nearest Quartile	0.131**	-25.589***	2.047
	(0.045)	(6.164)	(8.727)
Tenure; Own with Title	-0.245***	25.499*	3.533
	(0.061)	(10.322)	(9.548)
Tenure; Own without Title	-0.185**	25.022**	4.755
	(0.064)	(8.609)	(7.639)
Tenure; Owned by Parents of User	-0.214**	18.951	-8.016
	(0.069)	(10.450)	(10.153)
Tenure: Communal Ownership	-0.218	63.334***	-10.021
	(0.118)	(10.941)	(40.539)
Inverse Mills Ratio		40.782*	
		(17.470)	
constant		-49.143*	173.422
		(23.373)	(104.222)
Number of observations	1,366	599	599
Adjusted R2	0.314	0.305	-0.547
note: *** p<.001, ** p<.01, * p<.05			

Note: Zone 2=Coastal Lowlands, Zone 3=Eastern Lowlands, Zone 4=Western Lowlands, and Zone 5=Western Transitional

Households planting hybrid or open pollinated varieties (OPV, the omitted dummy) seed maize, have a 25 percentage point higher probability of purchasing fertilizer than those planting retained hybrids or local seed maize. The OLS results indicate a 15 kg per acre increase in fertilizer use intensity for fields planted with hybrid seed compared to OPVs. i.e. hybrid seed maize growers use 15 kgs more per acre compared to OPV growers. From Table 11b, 64% of farmers using fertilizer plant hybrid seed maize while 58% of fertilizer non-users plant local seed maize in these zones. Clearly there is a correlation between hybrid seed and fertilizer use. We can conclude the decision to buy improved seed (hybrid and OPV) positively raises the probability of buying fertilizer too; farmers appear to be aware of some synergy between these technologies.

Table 11b: Descriptive statistics for fertilizer users and non-users in the low-potential zones sample, pooled statistics for 1997, 2000, 2004, and 2007.

Statistic	**Users (n=599)**	**Non-users (n=767)**
Education Head: None	13%	21%
Education Head: 1 to 4 Years	18%	21%
Education Head: 5 to 8 Years	30%	38%
Education Head: 9 to 12 Years	30%	16%
Education Head: Over 12 years	9%	4%
Seed Type: Hybrid	64%	25%
Seed Type: Retained Hybrid	10%	16%
Seed Type: OPV	1%	1%
Seed Type: Local Seed	25%	58%
Acre: 1st Quartile	6%	9%
Acre: 2nd Quartile	22%	22%
Acre: 3rd Quartile	30%	26%
Acre: 4th Quartile	42%	43%
Distance to Fertilizer Seller: 1st Nearest Quartile	24%	11%
Distance to Fertilizer Seller: 2nd Nearest Quartile	26%	26%
Distance to Fertilizer Seller: 3rd Nearest Quartile	31%	29%
Distance to Fertilizer Seller: 4th Nearest Quartile	19%	34%
Asset: 1st Quartile	18%	23%
Asset: 2nd Quartile	23%	20%
Asset: 3rd Quartile	21%	24%
Asset: 4th Quartile	38%	33%
Tenure; Own with Title	38%	43%
Tenure; Own without Title	44%	45%
Tenure; Owned by Parents of User	9%	8%
Tenure: Communal Ownership	0%	1%
Tenure: Rented for fee	9%	3%
Distance to fertilizer Seller (kilometers)		
Mean	3.4	6.9
25^{th} percentile	1.5	2.0
50^{th} percentile (median)	2.5	3.5
75^{th} percentile	4.0	7.0

Note: the descriptive statistics for this sub-sample of households in low-potential zones is the sub-sample used in the estimation of models in Table 11a.

The Tegemeo data shows that there has been a major reduction between 1997 and 2007 in the mean distance from households to the nearest fertilizer seller. This is consistent with IFDC's finding that there has been major new investment in fertilizer stockists in rural Kenya during this period. The model results in Table 11a indicate that the household decision to participate in the fertilizer market and the level of intensity are both related to the distance to the nearest fertilizer stockist. For the low potential areas, moving from the furthest 4th quartile (omitted dummy from regression) to the group in closest proximity to fertilizer stockists raises the probability of participation by more than 13 percentage points. Households in the first three distance quartiles (from zero to four kms) have roughly the same probability of purchasing fertilizer, so the impact of distance on access appears to take hold at distances greater than four kms. The fixed effects model results show no significant differences in fertilizer use intensities across distances to seller. This implies that though the decision to participate in the fertilizer market is dependent on distance to fertilizer seller, how much to apply per acre does not. The OLS pooled results, however, indicate the unexpected finding that households further away from fertilizer stockists tend to purchase greater quantities, other factors constant. Therefore, while proximity to the nearest stockist tends to positively influence farmers' decisions to purchase fertilizer, the amounts purchased appear to be inversely related to proximity. Overall however, and as seen in Table 11b, the fertilizer users in the low-potential areas are on average clearly closer to fertilizer stockists than the non-users.

The land tenure relationships offer an interesting view of how the type of tenure affects the probability of participation and level of fertilizer intensity. Nine percent of fertilizer users rent land for a fee while three percent of those not using fertilizer rent land for a fee (Table 11b). In the low potential areas, the probability of purchasing fertilizer is higher for renters than those who own land with or without title (by 24 and 18 percentage points, respectively) as well as for those who use their parents' land (by 21 percentage points). One possible explanation is that renting puts pressure on the renter to maximize returns in order to recoup their costs including the risk of losing use of the land to the landlord or some other third party. But once they decide to buy fertilizer, renters are probably faced by other limiting factors that force them to apply less fertilizer per acre compared to similar renters in high potential zones (Section 5.2). However, the levels of intensity in fertilizer use are not different across these land tenure types from the FE regression. However, the OLS regression indicates higher intensities when moving from renter types to the other types of tenure. It is also important to note that land title in Kenya is not an iron-clad safe instrument of property ownership. It is widely believed that it is possible to have more than one person having title to the same piece of land. When coupled with a weak legal/judicial land dispute adjudication system, multiple land titles create uncertainty which hinders long-term investments in land.

5.2 Factors Affecting Household Fertilizer Use Decisions In High Potential Areas

We now look at the three relatively high-potential zones where over 90% of the households use inorganic fertilizer on maize. These three zones (Zone 6=High Potential Maize Zone; Zone 7=Western Highlands, and Zone 8=Central Highlands) account for over two-thirds of the total sample in the nationwide Tegemeo Institute surveys. Consequently, for these zones we did not include a probit analysis of the decision to participate in the fertilizer market because there is not a censored problem or pile-up of zero values. The results from pooled OLS and Fixed Effects (FE) models on the quantity of fertilizer used per acre of maize crop are shown in Table12a. Statistics on key variables of interest including number using fertilizer, asset values, acres, and proportion of sample under different categories of variables for this regression sample are provided in Table 12b.

Table 12a presents OLS and FE results for two different specifications to examine the robustness of results to alternative ways of accounting for maize and fertilizer prices. The first specification includes maize prices from the six-month period prior to planting (a simple naïve expectations specification) and DAP fertilizer prices as separate variables (columns A and B). The other specification uses these same variables as a maize-DAP fertilizer price ratio (columns C and D).

From models A and B in Table 12a, the price of maize taken alone has no discernible effect on fertilizer intensity. However, the ratio of maize to DAP fertilizer price has a positive and significant impact on fertilizer intensity. Increasing this ratio by one raises fertilizer intensity by 15 and 20 kgs per acre for OLS and FE results (C and D) respectively. A test for differences in this ratio between users and non-users of fertilizer is rejected indicating that both groups face similar maize-fertilizer price conditions on average. The elasticity estimate for the change can be interpreted as a 3 percent change in fertilizer intensity per acre given a 10 percent change in the price ratio i.e. about 2 kgs per acre using the average intensity for the group. This is significantly less than what we estimated for the low potential areas in Section 5.1 for a change in maize prices.

As shown in Table 12a, fertilizer intensity is negatively related to the size of the farm, decreasing with farm size for all FE models while decreasing up to some level and then tapering off for OLS models (A and C). Moving from the group with the lowest total acres under all crops to the third group implies a decrease in fertilizer intensity of 13 kilograms per acre of maize for both OLS and FE models. Moving from the third largest group to the largest farm cultivation group increases the intensity of fertilizer on maize by 2 kgs per acre (approximately 14-12=2 kgs) using FE model (B and D), while the OLS models indicate an increase of 13 kgs per acre. This indicates a non-linear relationship between fertilizer intensity and farm size with highest intensity at low farm sizes, followed by a decline and then increase again after some farm size threshold. Overall, the results indicate that the smallest farms use the most fertilizer per acre of maize.

The level of education category has a significant effect on fertilizer use rates in the high potential zones. Using OLS results, those in the highest education level category (more than 12 years in school) on average apply 13 more kgs per acre than all the other household education categories. The FE regression shows no significant differences in fertilizer use rates with education. Approximately 33% of those using fertilizer have more than nine years of education compared to only 21 % of those not using fertilizer with similar education levels (Table 11b).

Perhaps surprisingly, none of the four models show any significant relationship between household assets/wealth and the quantity of fertilizer applied per acre of maize. The mean asset value for fertilizer non-users is nearly two-fifths that of fertilizer users.

Fertilizer use rates vary across these relatively high-potential zones. We have dropped zone 7 (Western Highlands) as a base for comparing the other zones in Table 12a. According to the OLS results, farms in the High-Potential Maize Zone use an average of 15-18 kgs more fertilizer per acre of maize than farms in the Western Highlands. Farms in Central Highlands also tend to use fertilizer on maize more intensively than in the Western Highlands, by 8-12 kgs per acre. Interacting distance to fertilizer seller with zonal dummies (not shown in Table) shows a negative relationship for all zones except for zone 3 where it is insignificant, showing that distance to the nearest fertilizer stockist is inversely related to the decision to buy (as expected) in most zones except in the HPMZ, where the rainfall and soils are favorable enough to generate strong effective demand for fertilizer even when households have to travel relatively far to purchase it.

Table 12(a): OLS and Fixed Effects on Fertilizer Intensity for High Potential Zones (Zones 6, 7, 8)*

Model type	(A) Pooled OLS	(B) Fixed Effects	(C) Pooled OLS	(d) Fixed Effects
dependent variable	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)
CPI-indexed lagged maize price (90-kg bag)	-0.01	0.01	-	-
	(0.01)	(0.01)	-	-
CPI-Indexed Price of DAP Fertilizer (50-kg bags: Tegemeo Survey Data)	-0.01***	-0.005*	-	-
	(0.00)	(0.00)	-	-
Price Ratio (Maize/DAP)			15.44*	19.55*
			(7.00)	(7.89)
Dummy Zone=6 High-Potential Maize Zone	15.27***		18.41***	
	(2.55)		(2.40)	
Dummy Zone=8 Central Highlands	12.88***		8.60**	
	(3.63)		(3.29)	
Farm size: 2nd Quartile	-11.36***	-9.49*	-11.18***	-9.41*
	(3.12)	(4.23)	(3.14)	(4.24)
Farm size: 3rd Quartile	-13.05***	-13.92***	-12.71***	-13.77***
	(3.04)	(4.10)	(3.05)	(4.11)
Farm size: 4th Quartile	-4.88	-11.80**	-4.56	-11.69*
	(3.16)	(4.57)	(3.17)	(4.57)
Household assets: 1st Quartile	0.22	-0.08	0.16	-0.27
	(2.98)	(3.34)	(3.00)	(3.33)
Household assets: 2nd Quartile	-3.79	-2.38	-3.88	-2.44
	(2.51)	(3.16)	(2.52)	(3.16)
Household assets: 3rd Quartile	2.02	0.79	1.61	0.74
	(2.82)	(3.31)	(2.83)	(3.32)
Education Head: None	-2.57	-0.44	-2.49	-0.35
	(3.38)	(4.33)	(3.38)	(4.32)
Education Head: 5 to 8 Years	-1.20	1.38	-0.81	1.50
	(3.05)	(3.71)	(3.05)	(3.71)
Education Head: 9 to 12 Years	4.91	-0.76	5.18	-0.70
	(3.04)	(4.79)	(3.04)	(4.77)
Education Head: Over 12 years	12.84**	-0.457	12.51**	-0.388
	(4.29)	(6.25)	(4.32)	(6.23)
Seed Type: Hybrid	-1.40	12.05	-3.74	12.16
	(15.17)	(14.79)	(15.01)	(14.79)
Seed Type: Retained Hybrid	-19.40	-3.75	-20.50	-3.56

Model type	(A) Pooled OLS	(B) Fixed Effects	(C) Pooled OLS	(d) Fixed Effects
dependent variable	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)	fertilizer rate (kgs/acre)
	(15.82)	(16.34)	(15.68)	(16.34)
Seed Type: Local Seed	-29.13	-8.45	-30.14*	-8.35
	(15.29)	(14.87)	(15.15)	(14.87)
Distance to Fertilizer Seller: 1st Nearest Quartile	-8.54**	-1.80	-8.83**	-1.45
	(3.05)	(3.29)	(3.06)	(3.28)
Distance to Fertilizer Seller: 2nd Nearest Quartile	-5.03	2.77	-5.41	2.94
	(3.04)	(3.11)	(3.03)	(3.09)
Distance to Fertilizer Seller: 3rd Nearest Quartile	-3.57	-0.15	-4.09	-0.12
	(3.10)	(3.17)	(3.11)	(3.16)
Tenure; Own with Title	-8.28**	-1.88	-8.49**	-1.90
	(3.11)	(3.50)	(3.14)	(3.50)
Tenure; Own without Title	-13.74***	-3.05	-14.18***	-2.94
	(3.24)	(3.40)	(3.25)	(3.41)
Tenure; Owned by Parents of User	-12.28*	-5.20	-14.37**	-5.18
	(5.47)	(5.62)	(5.52)	(5.62)
Tenure: Communal Ownership	-7.73	-3.76	-9.03	-3.75
	(16.62)	(11.20)	(16.81)	(11.15)
Soil: % of Clay=35	36.03***		38.18***	
	(5.86)		(5.86)	
Soil: % of Clay=50	-3.69		-2.85	
	(3.94)		(3.91)	
Soil: % of Clay=58	15.89***		16.47***	
	(3.59)		(3.58)	
Soil: % of Clay=70	32.94***		34.45***	
	(3.236)		(3.206)	
Constant	82.29***	68.19***	40.37*	51.92**
	(18.81)	(18.37)	(16.85)	(16.16)
Number of observations	2,698	2,698	2,698	2,698
Adjusted R^2	0.134	0.020	0.129	0.021
note: *** p<.001, ** p<.01, * p<.05				

Note: The Zones covered here include 6 (HPMZ), 7(Western Highlands), and 8 (Central Highlands).
Standard errors are in parentheses: * Significant at 5%; ** significant at 1%

Households planting Open Pollinated Variety (OPV, the omitted dummy) seed maize have higher intensity (30 kgs per acre) compared to those planting local seed. However comparing with other seed types (hybrid and retained seed) for all model results indicates no significant differences in intensity between these seed types and OPVs. From Table 12b, 87% of the households using fertilizer plant hybrid seed maize compared to 53% of fertilizer non-users in these high potential zones.

Table 12(b): Statistics from Regression Sample of Table 12(a): Proportions of Observations in each Category of Fertilizer Users and Non-Users for High Potential Zones (see notes below the Table for interpretation)

Statistic	Users: n=2473	Non-Users: n=225
Education Head: None	17%	21%
Education Head: 1 to 4 Years	18%	22%
Education Head: 5 to 8 Years	32%	36%
Education Head: 9 to 12 Years	24%	12%
Education Head: Over 12 years	9%	9%
Seed Type: Hybrid	87%	53%
Seed Type: Retained Hybrid	3%	5%
Seed Type: OPV	1%	1%
Seed Type: Local Seed	9%	41%
	%	
Acre:Ist Quartile	22%	32%
Acre: 2nd Quartile	26%	24%
Acre: 3rd Quartile	25%	24%
Acre: 4th Quartile	27%	2%
Distance to Fertilizer Seller: 1st Nearest Quartile	38%	33%
Distance to Fertilizer Seller: 2nd Nearest Quartile	29%	28%
Distance to Fertilizer Seller: 3rd Nearest Quartile	18%	19%
Distance to Fertilizer Seller: 4th Nearest Quartile	15%	2%
Asset: 1st Quartile	17%	21%
Asset: 2nd Quartile	21%	16%
Asset: 3rd Quartile	21%	2%
Asset: 4th Quartile	41%	43%
Tenure; Own with Title	53%	51%
Tenure; Own without Title	27%	32%
Tenure; Owned by Parents of User	7%	8%
Tenure: Communal Ownership	0%	3%
Tenure: Rented for fee	13%	6%
Distance to Nearest Fertilizer Seller (Kilometers)		
Mean	2.8	3.2
P25	1.0	1.0
P50	2.0	2.0
P75	3.0	4.0
Farm Size(Acres Cropped)		
Mean	5.4	3.9
P25	2.1	1.7

Statistic	Users: n=2473	Non-Users: n=225
P50	3.5	2.9
P75	5.9	4.6
Value of Household Assets (Kenya Shillings)		
Mean	49962	19705
P25	900	150
P50	5240	3000
P75	24000	17000

Note: the descriptive statistics for this sub-sample of households in high-potential zones is the sub-sample used in the estimation of models in Table 12a, accounting for roughly 69% of the households nationwide Tegemeo sample.

Just like in Section 5.1 the effect of distance to nearest fertilizer seller is analyzed here as well. The results from the FE regression show no significant differences in fertilizer intensity between groups based on how far they are from the seller. Though OLS results follow similar trends, one result indicates a decrease in intensification from the furthest group moving to the closest group, which is counter-intuitive. The FE results are appropriate in this case considering that these high potential regions are covered with one of the densest road network system in the country compared to low potential zones discussed in Section 5.1. As shown in Table 12b, over 75% of the households reside less than 5.9 kms from the nearest fertilizer stockist among users (and less than 4.6 kms from the nearest stockist among non-users). Given these relatively short distances and the dense network of rural stockists in these areas, distance to fertilizer seller appears to not be a big factor affecting fertilizer use in these high-potential zones. Fertilizer appears to be profitable and worth the effort to acquire even for the relatively remote households, given that over 90% of the households in these zones are purchasing fertilizer already.

The land tenure relationships provide some insights into how tenure type affects the level of fertilizer intensity. Thirteen percent of fertilizer users rent land for a fee while six percent of those not using fertilizer rent land for a fee (Table 12(b)). The levels of intensity in fertilizer use are not different across these land tenure types from the FE regression. However, the OLS regression indicates lower intensities when moving from renter types to the other types of tenure, which is the opposite result compared to the low potential zones in Section 5.1 above. One possible explanation is that renting puts pressure on the renter to maximize returns in order to recoup their costs including the risk of losing use of the land to the landlord or some other third party.

6.0 Summary and Policy Implications

This study has so far addressed three major issues. First, using nationwide household panel data from four surveys between 1997 and 2007, we examine trends in fertilizer use on maize by smallholder maize growers. Since the survey is a balanced nationwide panel of 1,260 households, the results provide a fairly reliable indicator of the changes in fertilizer use patterns over time, although the survey is not strictly nationally representative. There are seven main findings from examination of this first objective:

1. The percentage of sampled smallholders using fertilizer on maize has increased from 56% in 1996 to 70% in 2007.

2. Fertilizer application rates (which include all maize fields regardless of whether they received fertilizer or not) rose from 34kgs/acre in 1997 to 45kgs/acre in 2007, a 32% increase.

3. Fertilizer dose rates on maize (which include all maize fields receiving fertilizer) have increased only slightly, from 61kg/acre in 1997 to 63kg/acre in 2007.

4. There are great variations regionally in fertilizer use on maize. Over 90% of smallholders use fertilizer on maize in three of the broad zones surveyed: the High Potential Maize Zone; Western Highlands, and Central Highlands. Fertilizer use is low and barely rising in most of the semi-arid regions (Coastal Lowlands, Western Lowlands, and the Marginal Rain Shadow). However, fertilizer use has risen impressively in the medium-potential Eastern Lowlands and Western Transitional Zones, where the percentage of households using fertilizer on maize has risen from 21% and 39%, respectively, in 1997 to 43% and 81% in 2007.

5. While the total area under maize has remained largely constant over the decade, maize yields have increased quite impressively over the 1997-2007 period, which is correlated with the rise in fertilizer use. Paying attention to the different types of maize production technologies and maize cultivation techniques is important to carefully control for confounding factors when examining trends in maize yields in Kenya. After stratifying between hybrid seed vs. non-hybrid users, and between maize intercrop vs. monocrop fields, we find that maize yields of all types of field has risen over time, which reflects the influence of many factors in addition to fertilizer use.

6. There has been a relative shift over time in the proportion of maize area under monocrop to intercrop, and increasing numbers of crops grown with maize on intercropped fields. Fertilizer use has increased especially rapidly on the intercropped fields, and less so on monocropped fields.

7. Fertilizer marketing costs have declined substantially in constant shillings between the mid 1990s and 2007. Interviews of key informants in Kenya's fertilizer sector identified four factors responsible for the declining fertilizer marketing costs observed in Kenya: (i) exploiting the potential for cheaper backhaul transportation, taking greater advantage of trucks transporting cargo from Rwanda and Congo to the port of Mombasa; (ii) private importers are increasingly using international connections to source credit at lower interest and financing costs than are available in the domestic economy; (iii) mergers between local and international firms in which knowledge and economies of scope enable cost savings in local distribution; and (iv) increased competition among local importers and wholesalers given the expansion in the number of firms engaged in fertilizer marketing since the early 1990s. It is likely that the fourth factor – increased competition – has to some extent stimulated firms to exploit the other cost-reducing innovations identified in order to maintain their market position.

The second objective of the study was to compare the aforementioned findings about the proportion of smallholder households purchasing fertilizer with estimates based on other analyses during the same general time period. Based on three other studies that could be found covering a sub-set of the same districts as in the Tegemeo survey (Rockefeller Foundation, 2007, Obare et al., 2003, Marenya and Barrett, 2008), we find that the Tegemeo survey estimates are comparable and in some case lower than estimates of fertilizer purchase and dose rates of other studies. The rise in smallholder use of fertilizer as seen in the Tegemeo survey data is also consistent with official Ministry of Agriculture figures (shown in Figure 1) indicating that total fertilizer consumption in Kenya has risen 65% between 1997 and 2007.

Third, we examine the association between household fertilizer use and indicators of welfare such as wealth and landholding size. The study estimates alternative probit, OLS, and Fixed Effects models applied to household survey data to identify the main household and community characteristics associated with fertilizer purchases. The model results provide three general insights:

1. The dominant factor influencing smallholder households' decisions to use fertilizer on maize is location. Use rates are much higher in areas where main season rainfall is relatively high and stable than they are in the drier areas. Fertilizer use appears to be highly risky in many of the semi-arid regions, and its role in contributing to poverty alleviation and food security is likely to be limited by these environmental factors unless accompanied by other actions to improve soil organic matter and moisture (Marenya and Barrett, 2008).

2. Within a given agro-ecological zone, the decision of households to purchase fertilizer is slightly related to farm size, and unrelated to household wealth. In relatively productive areas, the proportion of poor and relatively wealthy households applying fertilizer on maize is similar. In risky environments, a relatively small proportion of poor and wealthy households apply fertilizer on maize. Among households that do apply fertilizer, the quantities applied are positively and significantly related to farm size.

3. Distance to the nearest fertilizer retailer has an important influence on households' decision to purchase fertilizer in the relatively low-potential areas. But once the decision to buy has been made, distance has very little influence on the quantity of fertilizer purchased. Since the liberalization of the fertilizer market in the early 1990s, there has been massive new entry and investment in fertilizer wholesaling and retailing, with the IFDC estimating over 500 wholesalers and 7,000 retailers operating in the country. This has led to a more dense network of rural stockists and a major reduction in the distance between farms and fertilizer stockists, which has contributed to the impressive growth in fertilizer use by Kenyan smallholders from the early 1990s to 2007. However, in the high-potential zones, fertilizer use appears to be largest unrelated to distance, although it bears repeating that almost all households in the high-potential zones are relatively close to fertilizer stockists, with more than 90% of the households being within 8.8kms of a stockist in 2007.

However, in 2008, the positive trends in fertilizer use by Kenyan farmers have been partially reversed by both civil disruption and the unprecedented surge in world fertilizer prices. Early 2008 witnessed the destruction of quite a bit of physical infrastructure in western Kenya (e.g., petrol stations and grain storage) as well as the closing of many input supply stores. Moreover, the incentives to use fertilizer in Kenya have been adversely affected by world events as maize/fertilizer price ratios have plunged to their lowest level in at least 18 years. While farmers may not stop using fertilizer completely, they are at least likely to apply less of it until maize-fertilizer price ratios rebound.

This brings us to our fourth and last objective, which is to consider alternative policy strategies for maintaining smallholders' access to fertilizer in the current context of substantially higher world fertilizer prices. There are two clear options which pose little cost and should be actively pursued. First, focus on identifying way to reduce the costs of supplying fertilizer to farmers, and second, focus on raising the efficiency of fertilizer use. Both of these general strategies will help to offset the impact of higher world fertilizer prices. Specific examples for consideration include:

1. *Consider changes in government roles that could reduce fertilizer distribution costs.* For example, because of frequent delays in offloading of commodities at the port of Mombasa, it is difficult to arrange for transport for upcountry fertilizer distribution with coincide with when the shipment is fully offloaded at the port. Because of this coordination problem, fertilizer importers have invested in storage facilities near the port, where fertilizer can be temporarily stored to wait until trucks arrive for loading and upcountry distribution. These investments make sense if the delays and inefficiency at the Port of Mombasa is taken as given. However, if procedures for streamlining the efficiency of off-loading at the port could be achieved (e.g., through privatization of stevedoring services and issuing performance contracts, or devolving wider management of port operations to professional firms), then it would be possible for fertilizer importing firms to avoid both demurrage charges and redundant storage charges near the port by achieving greater certainty about the time of full offloading. These reductions in fertilizer marketing costs under a competitive marketing environment would then be passed along in the form of lower farm-gate prices.[8]

2. *Reducing transactions costs associated with VAT and port operations:* Currently fertilizer, as well as most other farm inputs, is zero-rated with respect to import duties. This means that no duty is charged on fertilizers, although at least up till 2007, VAT on related services was still levied. VAT is charged, for example, on transport and services like bagging at the port of Mombasa. Although VAT is supposed to be refunded, the process is lengthy and is a source of continuing frustration for market participants. In addition, the port handling charges coupled with Kenya Bureau of Standards (KEBS) charges and other taxes account for 17% of CIF (Gitonga). Port fees, levies and accessorial charges need to rationalized and aggregated. In addition, the numerous documentation procedures need to be reduced and some of these services possibly be provided through the electronic means. Interviews with key informants in the fertilizer industry have identified numerous other potential sources of cost savings, many of which require action on the part of government to improve efficiency.

3. *Investing in the eroded rail, road, and port infrastructure* would reduce distribution costs. The farm-gate price of fertilizer in Western Kenya is roughly twice as high as the landed cost at Mombasa, and transport costs are the major component of this cost difference. High farm-gate prices of fertilizer restrict demand for its use and depress agricultural productivity. Hence efforts to improve the efficiency of port costs and upland shipping would bring major economy-wide benefits.

4. *Tailoring fertilizer packages to local demand conditions* would increase demand from smaller farmers who require and are able to purchase only small packets. Repackaging of

[8] Some efficiency improvements in Mombasa port operations have recently been implemented, and more comprehensive reforms are currently under consideration.

fertilizers from 50 kg into 25 kg, 10 kg, 2 kg and 1 kg packets is increasingly taking place, but this is sometimes associated with fertilizer adulteration and counterfeit products. While adulteration and sales of counterfeit products continues to be a problem, these are often isolated events, rather than a well organized activity (GDS, 2005, p. 71).[9] Part of the wide fluctuations in the nitrogen and phosphorous concentration in fertilizers can be accounted for by the absence of effective measurement and calibration facilities. In this context, Kenya Plant Health Inspectorate Service should become more effective in monitoring and controlling adulteration and counterfeit products, as well as intensifying farmer and stockist awareness program to help protect farmers from sub-standard products.

5. *Raise fertilizer response rates through agronomic training of farmers.* The profitability of fertilizer use could be enhanced by improving the aggregate crop yield response rates to fertilizer application. This requires making complementary investments in training for farmers on agronomic practices, soil fertility, and water management and efficient use of fertilizer, and investing in crop science to generate more fertilizer-responsive seeds.[10] Survey data commonly indicate that the contribution of fertilizer to food grain yields varies tremendously across farms even within the same villages. Simply bringing fertilizer response rates among the bottom half of the distribution up to the mean would contribute substantially to household and national food security (Nyoro, et al., 2004).

6. Finally, *producer organizations, despite their poor track record, will increasingly be crucial for rural income growth.* Assuming that the management and politicization of producer organizations/cooperatives could be minimized, they might afford an important pathway for smallholders to use much higher levels of input use and achieve better production and marketing practices than the current separate and uncoordinated stages in the supply value chains. The role of independent producer groups would be to reduce the transaction costs and risks of private marketing firms dealing with farmers and developing a production base through the transfer of credit, inputs, and know-how. Programs such as the Farm Inputs Promotion and KMDP/CGA farmer training programs are the examples of successful work with groups to combine farm extension knowledge, supply chain development, and supply of fertilizer by small dealers.

While all of these measures can contribute to increased fertilizer use, none is likely to prove effective in isolation. Policy makers should, therefore, select strategic combinations of supply- and demand-side measures to allow supply and demand to grow in parallel – strengthening the basis for viable private sector-led commercial fertilizer markets.

The final question is about the role of fertilizer subsidies. The greatest scope for subsidies to promote fertilizer use is in the areas where fertilizer use is relatively low. According to the Tegemeo survey finding, this is in semi-arid areas (Coastal Lowlands, Eastern Lowlands, and Western Lowlands). The distribution of subsidized fertilizer in these areas is likely to contribute positively to fertilizer use, but its contribution to yields and smallholder incomes are likely to be limited, because of the environmental riskiness and low response rates in

[9] According to GDS, nearly 3-5 percent of repackaged fertilizers are sold using counterfeit labels and packages. Specifically, fake brand name labels are used to sell inferior quality fertilizers.
[10] Research indicates that the highest crop yield response is obtained when improved seed, fertilizer and good agronomic practices are combined (Heinrich, 2004; Marenya and Barrett, 2008). In some areas, improved management practices may have greater impact on yields than fertilizer alone (Haggblade and Tembo, 2003).

many of these areas. A major question, therefore, is whether poverty reduction and food security objectives can be best achieved through fertilizer subsidies or other types of public programs and investments.

In the high potential areas, the large majority of farmers are already purchasing fertilizer and use rates are quite high as of 2007, although use rates are likely to have fallen since then. Fertilizer subsidies are seductive in that they promise increased fertilizer use and food production, but these outcomes are by no means assured. Providing subsidized fertilizer in areas where commercial purchases are high will almost certainly result in a partial crowding out of commercial sales, as shown by findings in Zambia and Malawi where fertilizer use rates are considerably lower than in Kenya (see Xu, 2008; Dorward et al., 2008). Where purchase of commercial fertilizer is high, then a ton of subsidized fertilizer distributed by government is unlikely to result in an additional ton of fertilizer on farmers' fields since the farmers previously purchasing fertilizer are no longer likely to buy it if they can acquire the same amount more cheaply from a government program.

As a tool for increasing overall agricultural productivity, especially for small, poor farmers, fertilizer subsidies have a questionable record. Long experience with input subsidy programs in Africa is not encouraging on several points: (a) there is very little evidence from Africa that fertilizer subsidies have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments, (b) there are no examples of subsidy programs where the benefits were not disproportionately captured by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor,[11] and (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have "kick-started" productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end.[12]

Notwithstanding these caveats, fertilizer subsidies are one of the few tools in the arsenal of policy responses that can be implemented in a fairly short time frame and which have widespread support in rural areas. For these reasons, fertilizer subsidies are likely to be the first line of response by many governments in the region despite having a mixed track record in Africa (Morris et al., 2007). Minde et al., (2008) provide a number of implementation guidelines about how to improve the effectiveness to fertilizer subsidies, once the decision to implement them has been made. Some of them are mentioned here:

1. ***Use input vouchers that can be redeemed at local retail stores rather than direct distribution*** in order to maintain or improve the capacity of the private sector input delivery system.

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[11] The logical response is to call for better targeting of future input subsidy programs. However, Dorward et al. (2008, section 7.2.3) includes an illuminating discussion of the practical difficulties involved in targeting subsidized fertilizers to poor households, including lack of information on who the poor households are, and unwillingness of some communities to exclude any households from receiving subsidized fertilizer. The daunting variety of difficulties described here makes it hard to be optimistic about the prospects for significantly improved targeting. In a recent interview of the President of Malawi in August 2008 admitted that the Malawi fertilizer subsidy program was failing the poor. "Sadly it is the rich who are benefiting a great deal. They are selling to the poor at exorbitant prices" (The Guardian, August 12, 2008). An IFDC report (2008) indicates that "In many Nigerian states, 75% or more of the subsidized fertilizer goes to large farms or political patrons, leaving very little for smallholder farmers who need it most."
[12] Countries such as Malawi and Zambia have had almost continuous fertilizer subsidy programs each year for the past several decades even during the so-called liberalization process (e.g., see Dorward et al., 2008; Jayne et al., 2002).

2. ***Involve a wide range of fertilizer importers, wholesalers, and retailers in the input voucher scheme,*** even if it entails additional logistical costs. Providing tenders to only 2-3 firms to import fertilizer can entrench their position in the market, cause other firms to cease making investments in the system or drop out altogether, leading to a more concentrated input marketing system and restricted competition when the input subsidy program comes to an end. A system that allows farmers to redeem coupons at the full range of existing independent agro-dealer retail stores will promote additional investment in remote rural areas where it is most needed. By contrast, failure to involve the small rural retailers may lead many of them to stop carrying fertilizer, as was the case in Malawi after the 2005/06 season, leading to erosion rather than development of a private retailing system.

3. ***Before deciding to target the input vouchers***, carefully consider the objectives of the targeting and the practical feasibility and costs of implementing a targeted program, including personnel costs, time requirements and potential delays, leakage, and displacement of commercial sales by subsidized inputs.

4. ***If effective targeting does not seem feasible or achievable at an acceptable cost, then a small universal voucher program would be worth considering.*** For example, a program designed to provide all farmers with inputs for 0.2 ha would primarily benefit small farmers while at the same time limiting the displacement of commercial purchases by larger higher-income farmers, some degree of which might occur anyway under a program that fails to successfully target small farmers.[13]

5. ***Address infrastructure and input supply constraints as well as improving procurement efficiency*** (joint procurement arrangements and regional procurement hubs). This will help achieve the goal of enhancing farm-level fertilizer supplies at a lower price. Facilitating the movement of fertilizers across borders (removing customs duties and export taxes) will also contribute to overall improvements in supply efficiency.

6. ***Facilitate private sector partnerships with farmers***, such as through contract farming where conditions are suitable, would go a long way toward reducing the financial burden on government.

In the current high price environment, the availability of seasonal loans for input purchase takes in heightened importance for maintaining farmers' effective commercial demand for fertilizer. Many Kenyan farmers have been able to finance fertilizer through the credit offered in the integrated input-output chains for crops such as tea, sugar, and coffee. These integrated marketing arrangements have also provided the means for farmers to obtain fertilizer for their food crops, since the companies can recoup their loans for other crops as well when the farmers sell their cash crop back to the company. But in areas where fertilizer use on a particular crop is profitable, such as maize in Western Kenya and horticulture throughout the country, most farmers have achieved reasonable levels of fertilizer use without credit. Support for the development of viable credit programs may also help smallholders maintain their access to fertilizer use despite current high prices, for households in which liquidity constraints are the main problem.

[13] The option of a small universal subsidy program is discussed in Imperial College et al. (2007). See also Chinsinga (2005) for a discussion of the earlier experience in Malawi with universal and targeted input subsidy programs.

To build durable input and output markets, governments should establish a supportive policy environment that attracts local and foreign direct investment. The experience of Kenya shows how a stable policy environment can foster an impressive private sector response that supports smallholder agricultural productivity and poverty alleviation. These goals remain elusive in countries lacking a sustained commitment to the development of viable commercial input delivery systems. Output price stability has also facilitated the impressive growth in fertilizer use in Kenya. The operations of the National Cereals and Produce Board since the early 1990s, and the elimination of regional trade barriers since the inception of the East African Commission Custom Union in January 2005, have both promoted maize price stability (Jayne, Myers, Nyoro, 2008; Chapoto and Jayne, 2007). Complementary programs to support small farmer productivity, such as the Farm Input Promotions (FIPS) program, the CNFA agro-dealer training and credit program, and the organization of farmers into groups to facilitate their access to extension and credit services under the Kenya Market Development Programme, have also been important factors in raising fertilizer use in Kenya.

Because mean household incomes are higher in Kenya compared with many other African countries, the impressive market-led growth in smallholder fertilizer use in Kenya may not be easily transferable to areas where effective demand is highly constrained. And the Kenya success story is fragile. Sustaining its momentum will depend on commitment to supportive public investment and policy choices. Governance problems and civil disruption are jeopardizing the sustainability of the commercially driven input distribution system and rural development more generally. Continued access to input credit for small farmers in many parts of the country will require government commitment to limit the potential for politicization and interference in the management of the interlinked crop marketing systems for sugarcane, tea, and coffee, which have provided a means for farmers to acquire additional fertilizer on credit for use on food crops. Also, new investment is needed in Kenya's eroded rail, road, and port infrastructure to maintain Kenya's competitiveness. Lastly, effective systems to improve smallholders' crop husbandry and management practices are needed to provide incentives for continued expansion of fertilizer use and productivity growth in areas where fertilizer is only marginally profitable at present.

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Towards 'smart' subsidies in agriculture? Lessons from recent experience in Malawi

Andrew Dorward, Ephraim Chirwa, Duncan Boughton, Eric Crawford, Thom Jayne, Rachel Slater, Valerie Kelly and Maxton Tsoka

The recent spike in international food and fertilizer prices has underlined the vulnerability of poor urban and rural households in many developing countries, especially in Africa. The combination of factors that resulted in this spike has renewed policymakers' focus on the need to increase staple food crop productivity. While the pros and cons of input subsidies have been hotly debated over the past decade, input subsidies are being introduced (or re-introduced) in several countries as a means to shore up food security in the short-term while also implementing longer-term investments to raise productivity. With fertilizer prices likely to remain high in the short to medium term, such subsidies will inevitably imply a high budgetary burden. The challenge is to design so-called "smart" input subsidy programmes that have a significant impact on the availability of food in the short run while stimulating growth and rural development and increasing (or at least not suppressing) effective demand for and commercial distribution of inputs in the long run. Beginning in 2005/6, after almost a decade of experience with smaller-scale subsidy programmes, Malawi introduced a large-scale input subsidy programme using vouchers. The purpose of this brief is to review Malawi's experience in order to identify the challenges facing "smart" subsidy programmes if they are to be sustainable and cost effective in delivering on their goals.

Policy conclusions

- The Malawi Government Agricultural Inputs Subsidy Programme as implemented in 2006/7 was very costly, but is capable of generating benefit:cost ratios between 0.76 and 1.36 (a ratio of 1 represents a "break even" point), not allowing for "second-round" growth effects.
- Major determinants of programme impact include clear understanding of programme objectives (increased wages, reduced food prices, growth and diversification) and trade-offs, extent and effectiveness of subsidy targeting, timeliness in implementation, programme scale and cost, extent of public/private sector partnership, and policy makers' access to and use of reliable and timely information.
- Programme impact is also vulnerable to factors either partially or completely outside government control, including variations in international fertiliser and maize prices and weather.

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Policy conclusions cont'd...

- The voucher or coupon system can be an effective way of rationing and targeting subsidy access to maximise incremental production and economic and social gains, with opportunities for innovative public/private partnerships to develop input supply and demand systems – but there are many practical and political challenges in programme design and implementation to increase efficiency, control costs and limit patronage and fraud.
- Other countries looking at Malawi's experience must identify interactions between the potential benefits of input subsidies, socio-agro-ecological conditions, critical programme features needed for achievement of benefits, and the costs and risks of failure.
- Input subsidies are not a quick fix for dealing with high food and fertiliser prices: their design and sustainable implementation must promote smallholders' incremental access to and productive use of inputs, build sustainable demand and private sector supply, and be integrated with other policies for increasing agricultural productivity, rural development and management of incremental production to provide rural people with reliable improvements in food access and real incomes.

Introduction

Agricultural input subsidies were common in poor rural economies in the 1960s and 70s, and a major element in Asia's green revolution. However, conventional wisdom among policy analysts in the 1980s and 90s was that subsidies had been ineffective and inefficient policy instruments in Africa, contributing to government over-spending and fiscal and macro-economic problems. Recent years have seen a resurgence of interest in these subsidies in Africa, together with the emergence of 'smart subsidies', innovative delivery systems intended to reduce common problems facing subsidy programmes and to extend their benefits.

The evolving implementation of a large-scale seed and fertiliser subsidy in Malawi has attracted considerable international attention. This policy brief presents the major findings of an in-depth evaluation of the 2006/7 subsidy programme.

Background

The implementation and impacts of the 2006/7 Agricultural Input Subsidy Programme (AISP) in Malawi have to be understood in the context of widespread rural poverty and food insecurity, vulnerable agriculture-based livelihoods, low and variable agricultural productivity, severe liquidity constraints to fertiliser use, and a long-standing history of smallholder agricultural input subsidies in Malawi.

Poverty in Malawi is pervasive and predominantly rural with a national poverty head count of 52% in 2004/5 and 94% of poor people living in rural areas (NSO, 2005). Poverty and limited land availability means that the great majority of the poor are food-deficit small-scale farmers: their food security and real incomes are heavily dependent on low-input production of maize (the dominant staple in most parts of the country) on small land holdings with declining soil fertility, as well as on casual labouring and other income earning opportunities for significant parts of the year when they have to buy food. At these times their real incomes and ability to purchase food are highly sensitive to maize prices, which change dramatically between and within seasons. During the last 10 years such farmers have faced both chronic and acute food insecurity problems with national food shortages due to poor production seasons and reliance on late and expensive government and donor-funded food staple imports.

Farmers are well aware of the potential for hybrid seed and fertilisers to increase their maize production, but purchases of both are limited by supply constraints (poor and/or costly parastatal and private distribution systems to rural areas) and major profitability and affordability constraints on demand. High fertiliser prices, high maize price variation and a range of agronomic and crop management constraints on maize yields lead to limited profitability of fertiliser use on maize. Value:cost ratios (VCRs) of 2 or more are generally recognised as the minimum for profitable investment in fertilisers, but figure 1 shows that VCRs over the last ten years have been highly variable, particularly when maize is valued at pre-harvest prices (the value of maize to deficit, buying households) and almost always below 2 when maize is valued at post-harvest prices (the value of maize households with a surplus to sell). Deficit households for whom fertiliser use on maize is most profitable also face severe "affordability" problems – they are very short of cash with which to buy fertilisers, credit is perceived as risky and difficult or costly to obtain, and there are limited opportunities to buy fertilisers in bags smaller than 50kg: in 2003/4 the cost of one 50kg bag of fertiliser was around 10% of median per capita annual rural expenditure.

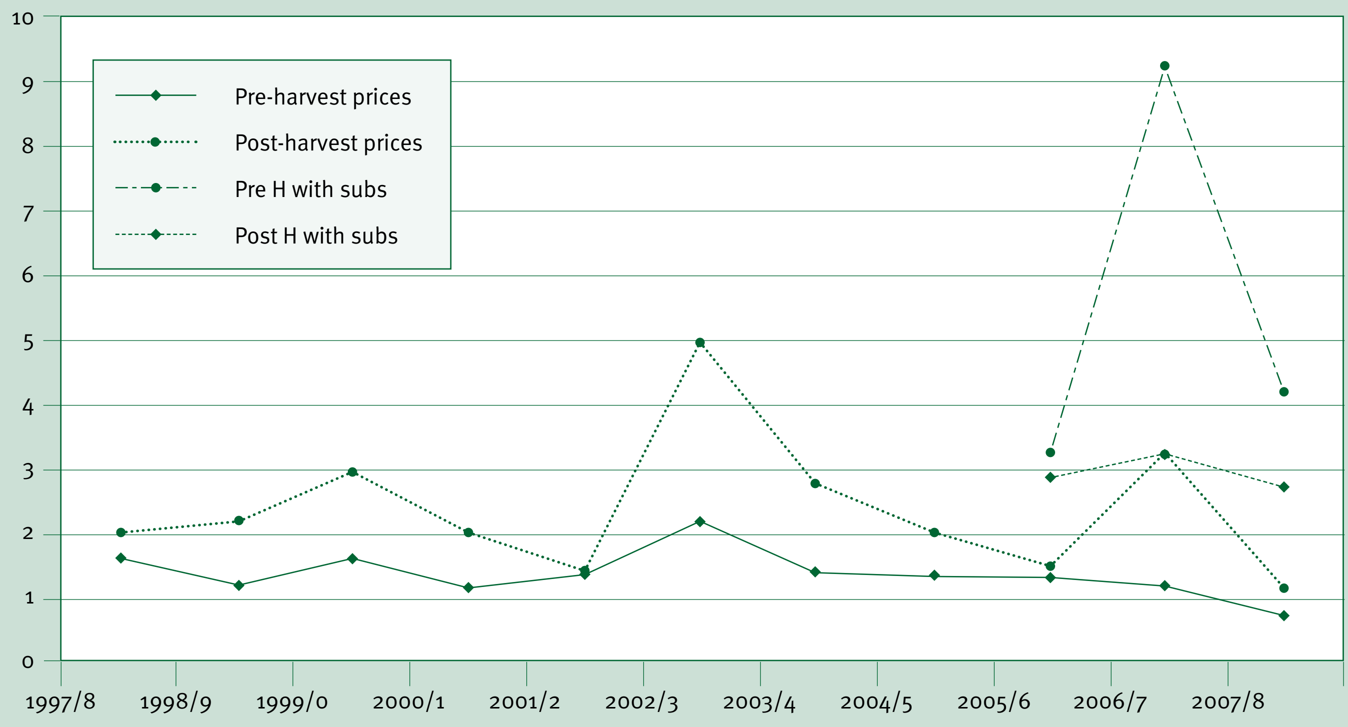
It is not surprising that in this context agricultural input subsidies have a long history and major political and economic significance in Malawi. General price subsidies on smallholder maize seed and fertilisers, were, with subsidised credit, a major component of Malawi's agricultural development policy during the 1970s and 80s.The withdrawal of these subsidies has been followed by their fitful reintroduction in response to maize shortages, changing political pressures, rising domestic fertiliser prices, and low maize productivity. Restrictions on private sector trading in maize and fertilisers were also removed in the 1990s, but parastatal and humanitarian interventions in these markets have continued. Beginning in 1998, first universal "starter packs" and then "targeted inputs" of free packs of fertiliser and matching maize seed for 0.1ha of land were distributed. Maize production and prices fluctuated wildly, however, and combined with high fertiliser prices led to the low and variable VCRs presented in Figure 1 and discussed earlier.

The 2005/6 subsidy programmes: implementation and results

The major candidates in the 2004 presidential elections all made manifesto commitments to fertiliser subsidies. Poor rainfall, and late distribution and limited scope of the targeted inputs programme for the 2004/5 season, resulted in low national maize production in 2005. With slow official importation and emergency response measures, this low production translated into very serious food shortages and high maize prices in 2005/6. The government then introduced a large-scale input subsidy in the 2005/06 season with the stated objectives of promoting access to and use of fertilizers in both maize and tobacco production in order to increase agricultural productivity and food security. Distribution of fertilisers was to be handled entirely by parastatals, due in large part to distrust between government and the private sector associated with the limited 2004/5 input subsidy programme.

The subsidy was implemented through the distribution of coupons for four fertilizer types which recipients could redeem at parastatal outlets at approximately one-third of the normal cash price. In addition, 6,000 tons of OPV maize seed were also offered for sale at a similar discount, but without coupons. There was considerable local variation in the criteria for the selection of beneficiaries, the proportion of people receiving coupons, and the number of coupons received per recipient household. A total of 131,000 tonnes of subsidized fertilizer were sold, all by two parastatals, with private sector involvement limited to importation of part of the total. Direct costs of the programme (excluding overhead costs) were reported to be MK7.2 billion against a budget of MK5.1 billion. This was financed from the government budget, supported by direct budgetary support. Reported 2005/6 private sector fertilizer sales were considerably lower than sales in the previous year and several of the main private sector fertiliser distribution chains reported significant financial losses as a result of lower commercial sales and their exclusion from the programme. These problems were particularly serious for a large part of the small-scale independent agro-dealer network. Incremental fertilizer use on maize as a result of the subsidy was estimated to be a little over 100,000 tonnes. This increase, coupled with good rains, led to a bumper harvest.

Figure 1: Maize and Nitrogen Value Cost Ratios, 1997-2007



Source: SOAS et al (2008)

The 2006/7 subsidy programme: implementation and impacts

The programme was implemented again in the following (2006/7) season, but this time with some donor financial support, greater involvement of the private sector in subsidised input sales, and greater choice of varieties of subsidized maize seed for farmers. Two million seed and 3 million fertiliser coupons were budgeted for the 2006/7 programme and allocated to districts and sub-districts, with a subsequent distribution of more than 1 million unbudgeted 'supplementary' fertiliser coupons. There were reports of substantial diversion of coupons in some areas, but few large-scale confirmed cases. Farmers paid roughly 28% of the full fertiliser cost, with government paying the remainder.

A total of 175,000 tonnes of subsidised maize and tobacco fertilisers were sold (against the redemption of 3.5 million coupons), with just under 50,000 tonnes sold by six private companies. 4,500 tonnes of maize hybrid and OPV maize seed were sold (57% by private retailers, including small agrodealers). Late disbursement of inputs in the southern region (due to late fertilizer procurement, late issue of coupons, and late opening of markets), together with stock-outs in some markets, led to many farmers spending long periods queuing for their inputs, delaying planting and/or fertilizer applications.

Direct programme cost to government and donors was just under US$91 million, with 87% funded by the Malawi Government. Fertiliser sales were 17% over budget (due to the issue of supplementary coupons) and total Government expenditure was 25% over budget (which was already 40% of the Ministry of Agriculture budget and over 5% of the national budget). Following estimates of a very large national maize harvest in 2007, Government agreed to exports of 400,000 tons of maize to Zimbabwe during 2007/8, although traders were subsequently only able to source and export around 300,000 tons.

Formal evaluation of the 2006/7 programme identified the following benefits:

- **Increased maize output**: the Ministry of Agriculture and Food Security (MoAFS) estimated total maize production of 2.7 and 3.4 million tonnes in 2005/6 and 2006/7 respectively, both record harvests and markedly higher than the 1.2 million tonne estimate for 2004/5. But whereas maize prices were very low following the 2005/6 harvest, as would be expected following a record harvest, the much higher prices following the 2006/7 harvest suggest that maize production was over-estimated. Furthermore, the good rains in both years mean that not all of the increases in production can be attributed to the subsidy programme.
- **Improved household food security**: Rural households' own subjective rankings of their economic well-being were 8% higher in May/June 2007 (before food prices started rising later in the season) than in 2004.
- **Increased private sector participation** in seed and fertiliser retail sales under the 2006/7 programme relative to 2005/6 (although small independent agro-dealers were still excluded from subsidised fertiliser sales) allowed for a partial financial recovery and increased optimism.

Cost-benefit analysis of the 2006/7 programme showed that impacts are highly sensitive to management and to external conditions, but that with good management the program could yield favourable economic returns (although it was not possible to compare the programme's rate of return with alternative longer term public investments). Estimated benefit:cost ratios ranged from 0.76 to 1.36 with impacts, costs and effective use of scarce government resources in such programmes depending upon:

- **Displacement of unsubsidised sales** - the extent to which subsidized fertilizer displace purchases which farmers would make anyway without the subsidy;
- **Incremental maize production**, which is determined by displacement, timeliness and method of use, variety / fertiliser interactions, and rainfall;
- **Coupon targeting**, which affects direct benefits to poorer households, fertilizer displacement, incremental maize output, and maize prices and wage rate impacts; and
- **National and regional maize prices** and the extent to which additional output lowers maize prices and makes grain more affordable to low-income households.

Financial analysis of government costs and returns found that net returns are very sensitive to displacement rates, and the programme cannot be justified solely by its contribution to reducing government financing of food imports in years of poor production: other approaches to securing grain supplies and price stabilisation may be more efficient and effective than a subsidy programme. Implementation of the programme does not appear to have had adverse effects on macroeconomic stability or on budgetary allocations to other sectors, but its staffing demands on the Ministry of Agriculture and Food Security and on local government have affected the delivery of other services.

Impact evaluation also needs to take into account the benefits not included in the above analysis: stimulus or constraints to private sector input supply, especially for currently under-served areas, and the benefits of transfers and lower maize prices in stimulating "second round" farm and non-farm growth. Impacts of the programme on the welfare and resilience of poor households (often referred to as social protection impacts) include a higher degree of food self-sufficiency among deficit producers, higher volumes of marketed maize resulting in downward pressure on maize prices to the benefit of food purchasers, and higher wages and farm and non-farm employment. Such benefits are critically important in the context of high rates of poverty, vulnerability, food insecurity and dependence upon low-productivity maize production among rural people in Malawi. Such potential benefits from the 2006/7 programme were unfortunately undermined by the high 2007/8 maize prices, following exports prompted by over estimates of maize production and stocks.

Conclusions and Policy Lessons

Experience from the 2005/6 and 2006/7 programmes suggests that there is considerable potential for Malawi to improve on the outcomes from the program. There are also, however, substantial dangers that without explicit action to improve effectiveness and control its costs the programme could become an unsustainable drain on resources. These dangers are likely to be exacerbated by recent dramatic increases in international fertiliser prices (Dorward and Poulton, 2008). The following key issues need attention.

Programme objectives, policy coordination and complementary investments: A comprehensive and consistent framework of objectives is needed to resolve potentially conflicting objectives and to allow appropriate targets and budgets to be set for long and short-term plans. Greater emphasis is needed on setting the programme within wider agricultural and national development strategies. Particular issues arise with maize market and price policies, social protection policies and programmes, and complementary investments in rural roads and in agricultural research and extension. If maize market interventions lead to high domestic prices (as occurred with maize exports in 2007/8) then this seriously undermines positive subsidy programme impacts on food security, social protection and rural economic growth. Paradoxically even interventions intended to reduce prices often have unintended consequences that result in higher prices. Similarly, poor roads and lack of agricultural research and extension limit the effectiveness of the programme in raising farm productivity. Adequate investments must be made in these areas and the scale of the AISP limited and its implementation made more cost-effective so that it does not starve other investments of resources. Improved coordination between the input subsidy and other safety net programmes could facilitate more efficient local coupon allocation, distribution and redemption mechanisms.

Targeting and displacement of commercial fertilizer purchases: National and household-level estimates suggest that in 2006/7 between 30 and 40% of subsidized fertiliser purchases displaced commercial purchases rather than adding to total purchases. Such displacement undermines private sector viability and transfers scarce government funds to less poor farmers with reduced developmental benefits from the programme. A positive correlation between displacement and household wealth and land holding in 2006/7 suggests that displacement can be reduced by targeting subsidies more effectively to poorer famers, and by more timely and transparent programme implementation to help farmers better plan their commercial purchases. An alternative to administratively complex and sensitive targeting within villages could be to provide a smaller subsidy to all rural households across the country or to all rural households in selected geographical areas whose agro-economic conditions offer the greatest economic returns to input subsidies (although the latter might pose particular political difficulties).

Scale and cost control: Year on year increases in both the scale of the programme and the prices of inputs have led to burgeoning costs and fiscal outlays (these continued in 2007/8). The programme is a major item in the national budget and has also gone over budget in all three years of its implementation as a result of both price and (except in 2005/6) physical input distribution overruns. Increases in programme scale are likely to lead to increasing displacement and hence declining returns to increasing costs, particularly in the context of recent dramatic increases in international fertiliser prices (2008/9 urea prices are more than 2.5 times the 2006/7 price). Programme scale and cost need to be limited, together with more effective targeting and efficient implementation, to ensure efficient resource use and to release resources for alternative and complementary investments.

Agricultural sector and programme information needs: There are fundamental information gaps that prevent effective planning and management of the AISP and of agricultural and rural programmes. Discrepancies between MoAFS and NSO estimates of farm families and rural households are very problematic. Reliable, rigorous information on smallholder production of major crops and of national stocks, flows and consumption of staples is also critically important for agricultural and food security and market monitoring and policy.

Engagement of the private sector and timely, transparent implementation: Although the private sector's 2006/7 market share increased over 2005/06, it has the capacity to supply much greater quantities. Allowing the private sector to supply more in future would enhance its viability as well as enable the government to reduce programme costs. In the past, investments in the agro-dealer network have supported increased competition and improved farmer access to low-cost inputs, particularly in under-served areas. Increased participation of agro-dealers in 2006/7 and 2007/8 needs to be continued. Uncertainties about subsidy programme modalities from year to year also depress the incentives for suppliers and farmers to invest in unsubsidised fertilizer procurement, and often delay subsidy implementation and reduce its effectiveness. Greater consistency, transparency and timeliness in planning and implementation is needed from government, as well as commitment from all stakeholders to a 'transition strategy' for greater private sector involvement in input markets in under-served locations.

Flexibility and learning: Programme consistency is important for developing administrative capacity in programme administration and for nurturing investment confidence among farmers and private input suppliers, However the programme also needs to evolve, responding to changing conditions, identifying and implementing ways of improving efficiency and effectiveness, and keeping one step ahead of the many opportunists looking to defraud the system. The Government has shown an admirable willingness to work with partners to develop and try new ways of working to improve the programme. Nevertheless managing transition, flexibility, and learning while maintaining consistency, stability and long-term commitment is a major challenge.

Lessons for other countries

Decisions to implement similar subsidy programmes in other countries need to clearly identify programme benefits and objectives (with potential positive or negative interactions between them), and to establish (a) the potential for achieving these objectives (given the extent and nature of household vulnerability, food and input markets, and potential agronomic benefits of increased input use), and (b) critical features of subsidy programme design needed for effective and efficient achievement of objectives. Potential benefits then need to be weighed against the opportunity cost of resources allocated to the programme, particularly investments in long-term food staple productivity growth, and the risks of failure (involving, for example, difficulties in controlling costs, dangers of fraud and/or subsidy capture, displacement, high fertiliser costs, and bad weather). These issues must then be given significant attention in programme design and implementation (see SOAS et al, 2008, for a full discussion). High international fertiliser prices and likely increased weather uncertainty as a result of global climate change pose particular challenges and dangers – but may also, paradoxically, increase the potential gains from effective subsidy implementation. They also increase the importance and urgency of investment in promotion of wider measures for increasing soil health and fertility.

It is important that input subsidies should not be seen as a quick fix for dealing with high food prices: important and over-riding principles in their design and implementation should be that they lead to incremental access to and productive use of inputs by smallholder farmers, that they should build sustainable smallholder input demand and private sector input supply, and that there be careful consideration of the management of incremental production to provide rural people with reliable improvements in food access and real incomes.

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Promoting Fertilizer Use in Africa:

Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya

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Promoting Fertilizer Use in Africa: Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya

Isaac Minde, T.S. Jayne, Eric Crawford, Joshua Ariga, and Jones Govereh

Background and objectives of the report

It is generally agreed that increasing agricultural productivity is critical to stimulating the rate of economic growth in Africa. There are many important and often complementary determinants of agricultural productivity. In this paper, we focus on fertilizer, without intending to imply that it is the only or most significant productivity determinants. Other key factors are seed technology, adequate water availability, labor, agronomic and other farmer management practices, and choice of crops to grow.

Promoting the use of fertilizer and improved seed involves addressing the supply and demand constraints that keep usage rates low, especially among smallholder farmers. Such inputs must be available, affordable, and profitable—for suppliers and farmers alike—without creating untenable financial risks. Agricultural research, input market development, and direct promotion of input use through provision of credit and subsidized distribution are used to improve access to improved inputs and the incentive to use them.

Recently, the role of input subsidies in stimulating growth and addressing food security and poverty alleviation objectives has re-emerged as an important agricultural policy debate. Sharp increases in world food and fertilizer prices in 2007 and 2008 have created a sense of urgency in meeting productivity and social welfare goals, and have put fertilizer promotion programs and fertilizer subsidies high on the list of options for government and donor responses to the crisis.

The purpose of this paper is to synthesize experiences with recent fertilizer promotion approaches in Malawi, Zambia, and Kenya, involving both subsidized distribution and development of private sector input markets. The aim is to contribute empirically based insights about when to invest in fertilizer promotion programs, including those with a significant subsidy element, and about how best to design and implement them. As background before synthesizing experiences across the three countries, the report draws briefly from the extensive recent debate about the case for and against fertilizer subsidies and how to make them more effective.[1] We focus on four salient questions:

- What are the guiding principles of a "smart" fertilizer subsidy program, and what determines its costs and benefits?
- What has been the experience of Malawi and Zambia with fertilizer subsidy programs—their achievements and limitations—and what lessons can be drawn for the design of future subsidy programs that would contribute most effectively to national food security and smallholder productivity?
- What can be learned from Kenya's experience of rapid smallholder adoption of fertilizer without subsidies?
- How do the sharply higher world food and fertilizer prices affect the justification for fertilizer subsidies in the region?

[1] For example, see Crawford, Jayne, and Kelly (2006); World Bank (2007a), especially pp. 150-53 on developing efficient input markets, including Box 6.7, "Is there a rationale for fertilizer subsidies?"; World Bank (2007b); Morris et al. (2007); Minde and Ndlovu (2007a and b); and Salzburg (2008).

“Smart” fertilizer subsidies

What are “smart” fertilizer subsidy programs?

Input subsidy programs may have various objectives, including to increase agricultural productivity, improve food security, or provide income support for poor farmers. National and household food security objectives may be especially urgent in times of crisis, such as the current environment of rapid and major increases in fertilizer and food grain prices. Regardless of their objectives, the design and implementation of input subsidies should be “smart” in the sense that (a) their benefits in terms of agricultural productivity and food security exceed what could be achieved by investing the resources in other areas;[2] and (b) they encourage farmers’ purchases of fertilizer on commercial terms, or at least do not impede it, which could result if government input subsidy programs crowd out commercial transactions or undermine investment in fertilizer distribution by suppliers and agro-dealers.

Minde and Ndlovu (2007b) describe “smart” subsidies as those involving (**S**)pecific targeting to farmers who would not otherwise use purchased inputs (or to areas where added fertilizer can contribute most to yield improvement), (**M**)easurable impacts, (**A**)chievable goals, a (**R**)esults orientation, and a (**T**)imely duration of implementation, i.e., being time-bound or having a feasible exit strategy. Morris et al. (2007, 103-105) identify ten guiding principles for subsidies to be “market smart”:

- Promote the factor or product as part of a wider strategy that includes complementary inputs and strengthening of markets
- Favor market-based solutions that do not undermine incentives for private investment
- Promote competition and cost reductions by reducing barriers to entry
- Recognize that effective demand from farmers is critical for long-run sustainability
- Insist on economic efficiency as the basis for fertilizer promotion efforts
- Empower farmers to make the decisions about soil fertility management
- Devise an exit strategy to limit the time period of public interventions
- Pursue regional integration in order to benefit from the economies of market size
- Emphasize sustainability as a goal when designing interventions, and,
- Promote pro-poor growth, in recognition of the importance of equity considerations.

While the concept of “smart” fertilizer subsidies is very appealing, they can be difficult to design. Also, unanticipated implementation problems can cause even well-designed programs to fall short of being “smart” in practice. To illustrate these points, and to identify lessons for future programs, we review below the experience with input subsidy programs in Malawi and Zambia.

What factors determine the costs and benefits of fertilizer subsidies?

The main cost factors are:

1. *The cost of acquiring the fertilizer.* World fertilizer prices have more than doubled over the past year and ocean freight and transport costs have also increased, reducing the potential returns to fertilizer subsidy programs. The subsidies needed to bring farm-gate

[2] A corollary of (a) is that the public funds devoted to input subsidies should not be so great as to leave insufficient resources for public investments such as agricultural research and development, farmer training and extension, and physical infrastructure, which have been shown by Fan, Gulati, and Thorat (2007) to have relatively high direct payoffs for smallholder farmers and as well as increasing the payoffs to input subsidies (Jayne and Myers, 2007).

fertilizer prices down to levels considered affordable to low-income farmers will require greater outlays from national budgets than in prior years.

2. *The full economic cost of implementing the fertilizer subsidy program*. These costs include not only the economic costs of distributing and applying the fertilizer but also the opportunity costs of the resources used in the program, e.g., the flow of benefits that otherwise could have been achieved with the resources used for the subsidy program.[3]

The main benefit factors are:

3. *The price of output.* World food grain prices have increased dramatically in the recent past. To the extent that these increases are transmitted to domestic prices, they will boost the potential returns to fertilizer subsidy programs. In an extreme case where needed grain could not be obtained from regional or world markets, the benefits of additional domestic food production generated from a subsidy program would include saved lives and malnutrition averted.

4. *Agronomic response rates.* The payoffs to fertilizer subsidy programs could be enhanced by improving the aggregate crop yield response rates to fertilizer application. This requires making complementary investments in training for farmers on agronomic practices, soil fertility and water management and efficient use of fertilizer, and investing in crop science to generate more fertilizer-responsive seeds.[4] Survey data commonly indicate that the contribution of fertilizer to food grain yields varies tremendously across farms even within the same villages. Simply bringing fertilizer response rates among the bottom half of the distribution up to the mean would contribute substantially to household and national food security (Nyoro et al., 2004).

5. *The degree to which subsidized fertilizer adds to total fertilizer use, rather than crowding out or displacing commercial fertilizer sales.* This concept may be best understood in a "with/without" framework. Assume, for example, that in the absence of a subsidy program a given farm would purchase 2 bags of fertilizer. If this farmer is allocated 4 bags of subsidized fertilizer, then she may no longer purchase the 2 bags from the trader. In this case, the additional fertilizer use as a result of the program would be only 2 bags instead of 4, i.e., 50% not 100% of the amount supplied. The two bags that she would have purchased from the trader now remain in the trader's inventory. This displacement of commercial sales will be low or zero if subsidized fertilizer is sold to households who otherwise would not have access to fertilizer or could not afford to buy it. Findings from Malawi and Zambia indicate that an additional kg of fertilizer distributed under the subsidy program adds only 0.5 to 0.8 kg to the amount of fertilizer used by farmers (implying a displacement rate of 20-50%), and that crowding out is lower when the subsidy is targeted to relatively poor households than when targeted to non-poor farmers (Dorward et al., 2008; Ricker-Gilbert and Jayne, 2008; Weber, 2008).

   The displacement of commercial fertilizer sales remains important even under a targeted input voucher program involving the private sector. It is possible that commercial fertilizer imports and sales to farmers may fall to near zero at the same time that private stockists are given fertilizer by the government to provide to farmers under the subsidy program. Stockists' financial situation can be "made whole" through such a program, but the overall contribution of the subsidy program to increased fertilizer use would still

[3] This would include, for example, benefits lost by redirecting Ministry of Agriculture extension staff to manage the distribution of subsidized fertilizer rather than to work with farmers to improve crop cultivation practices.

[4] Research indicates that the highest crop yield response is obtained when improved seed, fertilizer and good agronomic practices are combined (Heinrich, 2004). In some areas, improved management practices may have greater impact on yields than fertilizer alone (Haggblade and Tembo, 2003).

remain a major issue. The point highlighted here concerns the extent to which a fertilizer subsidy program displaces commercial sales (and therefore the extent to which it adds to total fertilizer use), not whether the fertilizer subsidy program allows private traders to be compensated for the loss of commercial sales by becoming agents of the subsidy program.

6. *Timely arrival and utilization of the fertilizer by farmers.* Crop yields may fall if fertilizer is applied significantly later than the optimal time in the crop growth cycle. Yet late arrival of fertilizer is a common feature of fertilizer promotion programs. For example, a recent study of fertilizer transport subsidies in Tanzania (MOAFC, 2007) reported that fertilizer arrived late in almost all regions visited. Late arrival and application of fertilizer were noted in the 2006/07 input subsidy program in Malawi (described below and reported in Dorward et al., 2008), and described for Zambia in Xu (2008, p. 68).

The benefits and costs of fertilizer promotion activities are influenced, potentially greatly, by these factors listed above. Difficulties in controlling for these factors pose methodological challenges for impact evaluations of fertilizer promotion programs. However, many unobservable household and village characteristics can be controlled for using household panel survey data to derive important lessons from past experience with fertilizer subsidy programs. The remainder of this report summarizes insights from these and other studies.[5]

Experience with fertilizer subsidies in Malawi

Malawian smallholder agriculture is characterized by large numbers of very poor farmers heavily dependent on low-input maize production on small land holdings that are very short of nitrogen. Maize production by these farmers is not normally sufficient to meet annual consumption needs, and they depend upon casual laboring and other income-earning opportunities to finance the purchase of the balance of their needs. Although Malawi is one of the poorest countries in the world, the nationally representative Integrated Household Survey 2 (IHS-2) conducted by the National Statistical Office (Dorward et al., 2008) indicates that 45% and 36% of smallholder farmers still purchased an average of 65 kg of fertilizer per household in 2002/3 and 2003/4. In those seasons, the Targeted Inputs Program distributed small packages of free fertilizer (a total of 35,000 metric tons (mt) and 22,000 mt, respectively compared to 179,000 mt distributed in the 2006/07 program[6]). Households purchasing commercial fertilizer tended to be relatively better off. Poorer households were less likely to purchase commercial fertilizer, though to date there remains little analysis to show whether unaffordability, lack of access, lack of profitability, or some combination, is the main constraint.

Food insecurity problems facing Malawian farmers have remained severe in recent years with national food shortages due to poor production seasons and late and expensive government-funded imports leading to large increases in the local market price of maize (Tschirley and Jayne, 2008). In this context, the government started implementing the Agricultural Input Support Programme (AISP) in the 2005/06 season with the stated objectives of improving smallholder productivity and food and cash crop production and reducing vulnerability to food insecurity and hunger. Other objectives were to promote food self sufficiency, development of private sector input markets (emphasized by donor agencies), and wider growth and development.

[5] For more detailed household-level analysis, the reader is referred to Ariga et al. (2008); Dorward et al. (2008); Xu et al. (forthcoming); and Ricker-Gilbert and Jayne (2008).
[6] Approximately 175,000 mt distributed through the AISP and 4,000 mt through the Assets for Inputs program.

Malawi has recently received popular acclaim for its success in turning the country into a food surplus maize exporter (New York Times, 2007).[7] In 2005/06, the government re-introduced a large-scale fertilizer subsidy program (see Dorward et al., 2008 for a detailed assessment). Erratic rainfall in 2005/06 and the exclusion of the private input distribution system in this first year of implementation impeded the impact of the program in this first year.

In the second year of the program (2006/7), there was an explicit attempt to involve the private sector in the fertilizer voucher program. Roughly 2 million seed and 3 million fertilizer coupons for distribution to targeted households were initially allocated to districts and areas within districts in proportion to maize and (for "tobacco fertilizers") tobacco areas.[8] Government issued tenders to private firms to import and distribute the subsidized fertilizer. Import tenders were issued to selected firms that supplied government (ADMARC and SFFRFM) warehouses and/or private sector distributors authorized to sell subsidized fertilizer. Contracts allowing private sector firms to redeem coupons at the retail level were awarded initially to four firms, and later expanded to six firms. The criteria for participation in the coupon redemption process were evidence of a well-established retail network and access to supplies. These criteria excluded participation by independent agro-dealers operating small shops as well as a number of major importers who did not have their own distribution networks. Coupons, each good for one 50-kg bag of fertilizer, were supposed to be allocated to targeted households (able farmers who would otherwise be unable to purchase inputs) by Village Development Committees at the rate of one NPK (23:21:0) and one urea coupon per household, and one D compound and one CAN coupon per recipient tobacco farmer. Seed coupons were also distributed, one per household, sufficient to cover the cost of 2 kg of hybrid seed or 3 kg of open-pollinated variety (OPV) seed. The program was not designed to reach the poorest farm households, since it was felt that the 100 kg of fertilizer distributed per household was too much to be used effectively on the small land holdings typical of such households. In practice, allocation procedures varied widely between different areas, with some local authorities deciding to give only one coupon per household to a larger number of households. There were reports of substantial diversion of coupons in some areas, but few large-scale confirmed cases. Farmers were required to redeem fertilizer vouchers and pay MK950 (U.S. $6.50) per 50-kg bag, representing roughly 28% of the full cost, with government paying for the remaining 72% of the cost. A total of just under 175,000 metric tons (mt) of fertilizer and 4,500 mt of improved maize seed were distributed at a cost to government and donors of about US$91 million (Dorward et al., 2008).

In this second year of the program, the combination of favorable weather and the distribution of improved maize seed and fertilizer through the subsidy program produced what was considered to be a record maize harvest in 2007. The government issued an official maize production estimate of 3.4 million tons. Domestic consumption requirements were believed to be in the range of 2.0 million tons, indicating a surplus of well over a million tons.

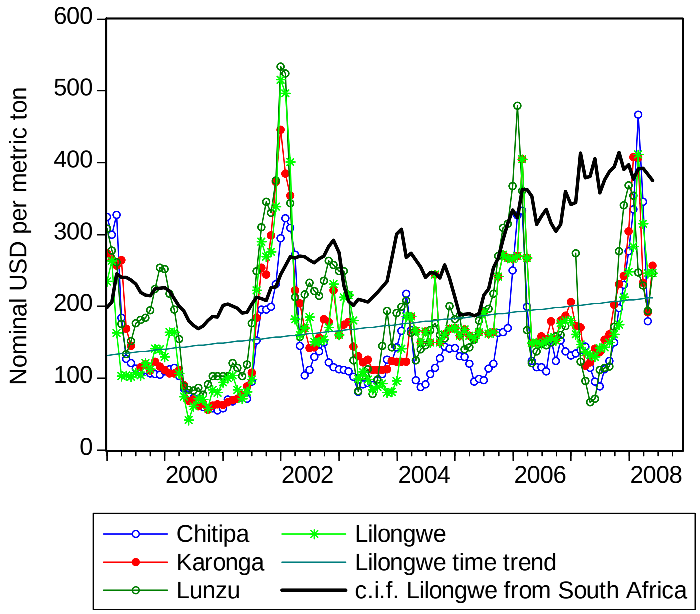
In response to the reported surplus, the government issued tenders to private traders to supply 450,000 tons for export to other countries in the region. However, the private sector reported difficulties in sourcing this quantity of maize, and by late 2007 Malawi had only exported 283,000 tons. The government then suspended further exports due to a rapid escalation in

[7] President Bingu Wa Mutharika was recently awarded a United Nations (UN) Global Creative Leadership Award and also received the first Food, Agriculture and Natural Resources Policy Network (FANRPAN) food security policy leadership award for reviving the country's fertilizer subsidy program. He also was honored at the 2008 African Green Revolution Conference in August 2008 for the country's success in promoting food security.

[8] These 3 million fertilizer coupons were distributed over a total number of 2.48 million smallholder farm households according to the 2000 Census adjusted for population growth rates between 2000 and 2006. The Ministry of Agriculture, however, estimates the number of farm households at 3.2 million.

domestic market prices. Within several months after the harvest, maize prices reached near record highs, exceeded only in the major crisis year of 2001/2 and the drought year of 2005/06 (Figure 1). By late 2007/early 2008, maize prices in Malawian markets were $100 to $150 per ton higher than in other regional markets. The 2007/08 season was also characterized by reports of localized maize shortages, rationing of maize by the marketing board ADMARC, and net maize imports of over 50,000 tons from neighboring countries, primarily Mozambique and Tanzania (Reuters, 2008; FEWSNet, 2008). These outcomes are difficult to reconcile with the official estimates of a record maize harvest of 3.4 million tons in 2007, which is now widely believed to be an overestimate.

Figure 1. Retail prices of maize in Malawian markets, January 1999 to May 2008, in nominal USD per metric ton.



Sources: SAFEX, Malawi Food Security Updates, FEWSNet. Kwacha/USD exchange rates from National Statistical Office bulletins.

Dorward et al. (2008, 72-77) conducted an economic benefit-cost analysis of the AISP, taking into account a range of assumptions about grain-fertilizer response rates in the 2006/07 production year (a year of abundant rainfall), displacement of commercial sales of fertilizer, contribution of improved maize seed to aggregate output, and maize price. The estimated benefit-cost ratios ranged from 0.76 to 1.36, and tended to be greater than 1.0 when the key variables were set at intermediate or more favorable levels. These results do not include the potential long-run growth impacts from higher 2006/07 incomes.

The AISP did not seem to have had adverse impacts on government budget allocations to nonagricultural sectors such as infrastructure, education and health. However, the sizeable government budgetary cost of the AISP (roughly $80 million) did seem to have adversely affected delivery of other services by the Ministry of Agriculture and Food Security, as evidenced by declining budget shares for research and extension (Dorward et al., 2008, 93).

The AISP evaluation identified a number of areas in which changes in program design or implementation would improve impacts:[9] (a) establish more comprehensive and consistent program objectives, e.g., to reconcile social protection versus productivity goals; (b) target subsidized inputs to the poorest 50% of small farmers, to reduce displacement of commercial sales and hence improve the aggregate impact of the program on maize production; (c) improve the monitoring of program impacts through strengthening the capacity of the national statistical agency to collect and analyze farm household survey data; (d) more effectively involve rural private retailers in the distribution of subsidized inputs (the small independent agro-dealers were largely excluded from the 2005/06 and 2006/07 programs and many of them had stopped selling fertilizer after the introduction of AISP, although the remaining dealers were incorporated into the 2007/08 program to a greater extent); (e) clearer and more timely procedures for AISP planning and implementation; and (f) better coordination of the AISP with other social safety net programs and policies, and with complementary agricultural development investments, such as research, extension, and roads. A number of these issues have been addressed through changes in the design of the 2007/08 program.

Experience with fertilizer subsidies in Zambia

Insights from Zambia are based on various analyses carried out by the Food Security Research Project and collaborating partners, using information from nationally representative surveys of smallholder farms conducted annually by the government's Central Statistical Office.

Five Phases of Fertilizer Subsidies

In the early 1990s, as part of economy-wide structural adjustment programs, the Zambian government initiated a process of fertilizer market reform that has evolved in five distinct phases. In the first phase, from 1991-93, the government appointed several state-affiliated banks and credit unions to distribute fertilizer on credit. Repayment rates were less than 5% during this period (Govereh et al., 2002). In the second phase, from 1994-96, the government appointed a few large private firms as Credit Managers (most importantly, Cavmont Merchant Bank Ltd. and SGS Ltd.) to import and deliver fertilizer on loan to "credit coordinators," who were private retailers tasked with forwarding the fertilizer on credit to farmers. Cavmont and SGS did not take ownership of the fertilizer; rather they received management fees for their role of distributing fertilizer to designated credit coordinators on behalf of government. The designation of both credit managers and credit coordinators was made by government. The volume of fertilizer supplied through this system was determined by availability of donated fertilizer from donors and local production. In 1994/95 and 1995/96, credit coordinators repaid Cavmont and SGS between 20-30% of the total loan value during this period, with evaluations concluding that many credit coordinators sold the fertilizer illegally instead of forwarding it to designated farmers on loan (Republic of Zambia, 1996; Pletcher, 2000). Pletcher (2000) argues that because this government distribution system provided selected private agents with the potential for major financial gains and a protected market, they became co-opted into the government system and did not lobby for a more transparent open market system. Cavmont and SGS exited the market only when government insisted that they sign performance contracts requiring them to absorb some of the repayment losses being incurred by the system.

The government responded by designating the state-run Food Reserve Agency to carry out the tasks of importing and distributing fertilizer to the agents. During this third phase, which lasted from 1996 until 1999, the FRA appointed private sector "agents" to distribute fertilizer

[9] For more details, see Dorward et al. (2008, iv-vi).

to farmers and cooperatives on behalf of FRA. Ostensibly, the criteria for designating agents were related to past repayment history and collateral, but in practice the system was again vulnerable to political interference. Evaluations of the program again concluded that a large proportion of the in-kind credit, designed to help farmers afford fertilizer, was diverted before reaching them (Govereh et al., 2002).

The fourth phase started in the 1999/00 crop season. Under pressure from donors to curtail the state's distribution of fertilizer on credit, the government contracted several large private firms to import and distribute roughly 45,000 tons of fertilizer (approximately three-quarters of all fertilizer delivered to the smallholder sector) to designated cooperatives on credit. The private firms operated on a commission basis on behalf of FRA. In 2000, there were four main fertilizer importers and wholesalers in Zambia: Omnia, Sasol, Norsk Hydro, and Farmer's Friend, with 85% of the volume concentrated in the hands of the two firms that the government chose to distribute fertilizer to selected cooperatives under its credit program. As with the private agents and credit coordinators before them, the selection of cooperatives to receive the fertilizer on credit lacked transparency and allegedly involved interference from state officials.[10] Evaluations indicated once again that a large proportion of fertilizer acquired on loan from FRA (through Omnia and Farmer's Friend) was sold by implementing agents before it got to farmers (Govereh et al., 2002). Overall repayment rates rose to 43%. During the decade of the 1990s, encompassing these first four phases of relatively limited fertilizer subsidy programs in Zambia, national fertilizer use and maize production actually declined.

The fifth and current phase of Zambia's experience with fertilizer subsidies since liberalization in 1990 is marked by the Fertilizer Support Programme (FSP), which started in the 2002/03 season. The remainder of this section focuses on Zambia's experience in promoting fertilizer use under the FSP. The volume of subsidies delivered under the FSP has been somewhat larger than during the first 4 phases, averaging 66,345 mt of fertilizer per year compared to 42,505 mt per year in the previous 8 years. Two factors have relieved the government's budget constraints and made it easier for them to reinstate and self-finance their fertilizer promotion programs: the transition of the World Bank and other donors from conditionality agreements to direct budget support, and debt forgiveness under the HIPC program. Both of these recent developments have provided additional discretionary funds to scale-up the former fertilizer programs.

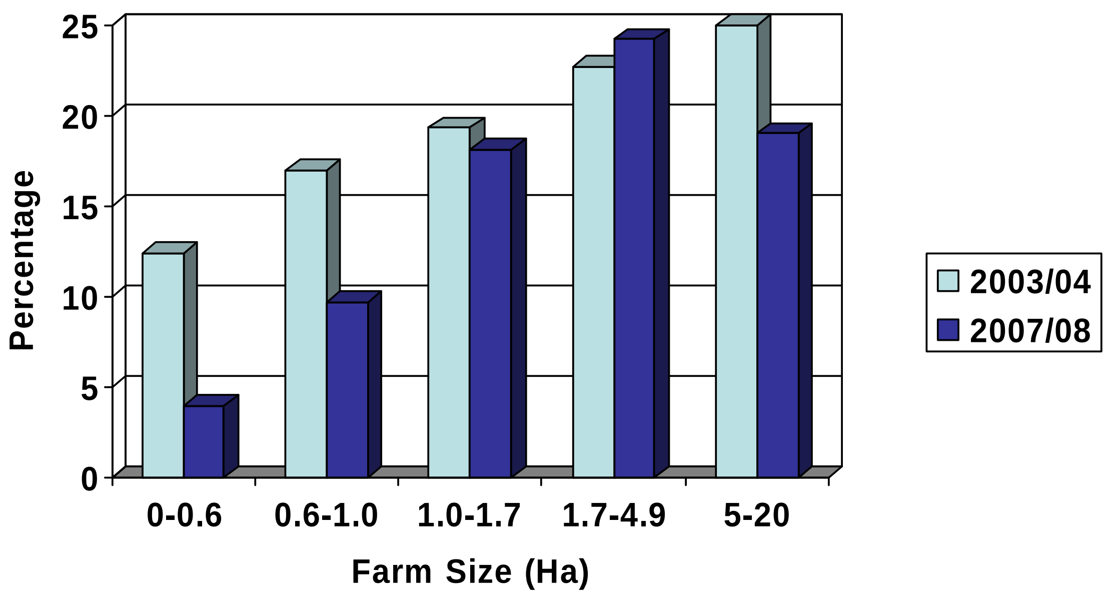
Starting in 2002/03 under the FSP, the government has awarded tenders annually to private companies to import and deliver fertilizer to registered cooperatives and other delivery points, where it is subsequently allocated by the coops and agricultural extension workers to farmers. The intent of the program has changed over time, first being conceived as a way to support smallholders in remote areas where markets were believed not to function. Later, the program's objectives evolved toward increasing maize production and marketed supplies. The FSP Program Manual establishes criteria for targeting farmers, one of them being possession of or access to at least 1-5 hectares of land and the capacity to produce maize on that area. Given that roughly 40 percent of the farms nationwide have less than one hectare of land, this criterion effectively excludes the poorest farmers from receiving subsidized fertilizer under the FSP (Weber, 2008).

[10]Politicians' financial interest in the FRA fertilizer distribution surfaced publicly in a front page article in the country's main newspaper, the Zambia Times ("Members of Parliament 'Shrink' Over FRA Debts Debate," November 11, 2000).

Impacts of Subsidies

In Zambia, for farmers in the small-scale category (0-20 ha of land), those with larger farms received more subsidized FSP fertilizer than those with smaller farms (Figure 2). Also, as found in Malawi (Dorward et al., 2008, p. 61), households that received subsidized fertilizer in Zambia tended on average to be larger in terms of land holdings and wealthier than households who did not receive subsidized fertilizer (Table 1). The government's stated rationale for targeting the more capitalized farmers was that they would use fertilizer more efficiently than smaller farms and contribute more to national maize supplies.

Figure 2. Percentage of small farmers who use fertilizer and who acquired subsidized fertilizer from the Zambian Fertilizer Support Programme, by farm size group, 2002/03 and 2007/08.



Source: Zambia Crop Forecast Surveys, 2002/03 and 2007/08.

Table 1. Characteristics of households obtaining fertilizer from government subsidy programs vs. non-recipients, Zambia, 2003.

	Households receiving fertilizer from government program	Households not receiving fertilizer from government
Share of total national sample (%)	13.9	86.1
Total household income ('000 kwacha per capita)	804	266
Value of farm assets ('000 kwacha per capita)	425	173
Landholding size (hectares per capita)	0.23	0.15
Distance from farm to district towns (km)	29.8	35.2

Source: Govereh et al. (2006) based on farm survey data from the Second Supplemental Survey, Government of Zambia, Central Statistical Office, 2004.

However, providing subsidized inputs to relatively well-off farmers may be inconsistent with national policy objectives related to productivity as well as to poverty alleviation. For example, the study by MACO/CSO/FSRP (2008), based on CSO survey data for 2007/08, indicates that mean maize yield increases per ton of fertilizer applied are lowest for the largest farm size category (3.32 metric tons/hectare for farms between 5-20 hectares). The highest yield increase per ton of fertilizer was 5.33 mt/ha for farmers in the 1.7-5.0 hectare category, while farms under one hectare averaged 4.55 mt/ha. Based on this information alone (but see the footnote to Table 2 below), one might conclude that targeting fertilizer to farms in the range of 1.7 – 5.0 hectares would provide the greatest amount of additional maize per unit of subsidized fertilizer.

Table 2. Fertilizer use and maize yields by farm size category, 2007/08 Crop Forecast Survey Data, Zambia.

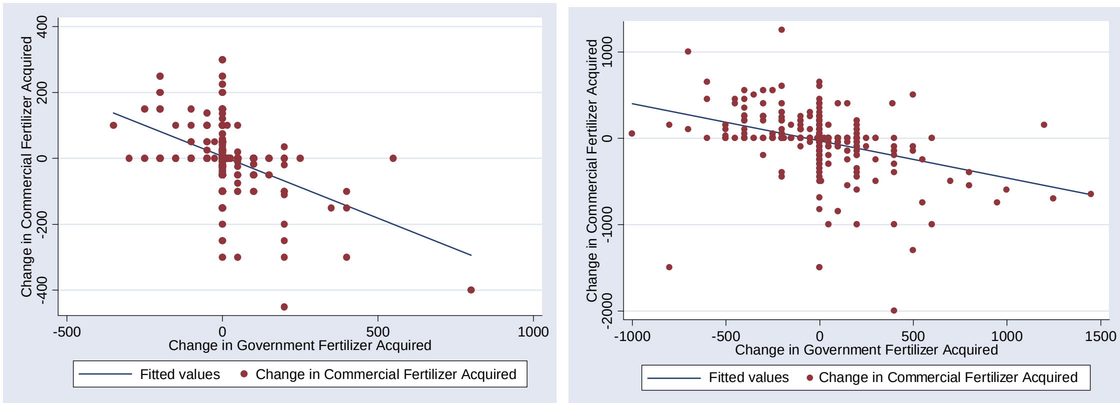
	Farm size category (hectares)				
	0 - 0.60	0.61 - 1.01	1.02 – 1.75	1.76 – 4.98	5.00 – 19.94
Maize yield, unfertilized fields (mt/ha)	1.86	1.52	1.62	1.49	2.00
Maize yield, fertilized fields (mt/ha)	3.18	2.66	2.63	2.61	2.63
Difference in yield (fertilized vs. unfertilized fields) (mt/ha) a/	1.32	1.14	1.01	1.12	0.63
Fertilizer used on maize field (mt/ha)	0.29	0.25	0.24	0.21	0.19
Additional maize output per ton of fertilizer applied a/	4.55	4.56	4.21	5.33	3.32

Source: Central Statistical Office Crop Forecast Surveys, 2007/08 season, Zambia.
a/ These estimates do not control for variables other than fertilizer, such as labor inputs or land quality, that may affect the difference in yield on fertilized vs. unfertilized fields. These average response rates are based on maize area harvested, not planted. In 2007/08, over 25% of the maize fields planted nationwide were not harvested, mainly due to floods and lodging.

Survey evidence also indicates that the crowding out of commercial fertilizer purchases by subsidized fertilizer is somewhat higher for large farms compared to small farms (Figure 3). Each dot in the graphs of Figure 3 represents a farm household surveyed by the CSO in both 1999/00 and 2002/03. The slope of the line measures the change in a household's commercial purchases of fertilizer per additional unit of fertilizer acquired from the government. In the case of the poorest tercile of farm households surveyed, the slope of the line is -0.34 while for the wealthiest tercile it was found to be -0.44. This means that each additional ton of subsidized fertilizer distributed to poor households contributes +0.66 tons of additional fertilizer use on their fields, while the incremental fertilizer use is only +0.56 tons among farms in the wealthiest tercile. Incremental fertilizer use observed for small farms is higher because they are generally poorer and less able to purchase fertilizer commercially. More than 80% of small farmers make no commercial purchases of fertilizer. For them, there is nothing to displace; all of the subsidized fertilizer they receive adds to their total fertilizer use. Similar findings were obtained for Malawi using nationwide survey data from 3 production seasons; mean incremental fertilizer use per unit of subsidized fertilizer acquired among the asset poor was +0.72 vs. +0.15 for the non-poor (Ricker-Gilbert and Jayne, 2008). This means that a fertilizer subsidy program will contribute more to national fertilizer use when a voucher is targeted to an asset-poor household than to a relatively non-poor household.

Figure 3. Changes in household acquisition of government-subsidized fertilizer compared to changes in purchases of commercial fertilizer, 2002/03 vs. 1999/00 production years, Zambia.

Poorest tercile of households ranked by assets | Wealthiest tercile of households ranked by assets



Slope of line (-0.34) | Slope of line (-0.44)

Note: These slope coefficients are accurate. The diagram for the wealthiest tercile (right side of Figure 3) has a much bigger Y-axis scale that has been collapsed to the same height as in the diagram for the poorest tercile. This makes the slope for the wealthiest tercile appear to be shallower than it actually is.

After taking account of differences in maize yields per ton of fertilizer used, and the effect of displacement rates on incremental fertilizer use, the incremental maize output per ton of fertilizer used is the product of two terms: (i) the maize-fertilizer response rate for farmer recipient i; and (ii) the extent to which an additional bag of fertilizer targeted to recipient i contributes to overall fertilizer use after accounting for potential crowding out.[11] This can be computed numerically as:

(1) $\Delta Qmz_i = (\Delta Qmz_i / \Delta total\ fertilizer\ use_i) * (\Delta Total\ fertilizer\ use_i / \Delta 1bag\ subsidized\ fertilizer_i)$

Both of the right-hand side terms in (1) are likely to differ for farmer groups ranked by landholding size and/or wealth. On-going research from both Zambia and Malawi suggests that the first term is greatest among relatively small and poorer farms, because the second term (incremental fertilizer use from an increase in subsidized fertilizer distribution) is appreciably higher for the poor (Ricker-Gilbert and Jayne, 2008; Xu et al., 2008). These findings suggest that targeting relatively poor farm households seems to increase rather than decrease the contribution of fertilizer subsidies to national maize production.

In addition to the objective of increasing national maize supplies, governments in the region are also concerned with ensuring household food security, achieving basic minimum nutritional standards, and improving equity. These objectives are also supported by targeting resources to the poorest rural households, since they run the greatest risk of being priced out of the market if they do not produce enough food for themselves. Well-targeted fertilizer subsidies therefore have the potential to help the rural poor feed themselves, rely less on markets for food, avert malnutrition, and promote equity in incomes in addition to increasing national grain production.

Another issue is how much subsidized fertilizer is actually received by intended beneficiaries. Evidence from Zambia indicates that only 29% of the fertilizer intended for distribution under the Fertilizer Support Programme in 2007/08 was received directly by the intended

[11] This specification assumes no interaction between fertilizer and other inputs as well as no differences in the use of other inputs between groups of farmers who received fertilizer and those who did not.

farmer beneficiaries. Official Ministry of Agriculture figures indicate that 50,000 tons of fertilizer were intended to be distributed under the Fertilizer Support Programme to 125,000 smallholder farmers in the 2007/08 season. Yet results from the nationally representative 2007/2008 CSO/MACO Crop Forecast Survey are much lower: only 14,706 tons of FSP-subsidized fertilizer received by an estimated 56,271 farmers reporting FSP to be the principal source of fertilizer they used. This finding is consistent with widespread anecdotal reports, newspaper reports of statements by GRZ officials, and a Chipata District Farmer Association study (CDFA, 2008), indicating that a substantial amount of FSP fertilizer was sold illegally to traders who subsequently sold it at market prices to farmers. As an indication of the potential magnitude of this diversion of FSP fertilizer, the 2008 Crop Forecast Survey indicates that 259,717 smallholders (about 25% of the national total) received 59,366 tons of fertilizer from commercial sources (MACO/ACF/FSRP, 2008). These survey findings, when juxtaposed with official FSP distribution figures, suggest that a substantial portion of this "commercial" fertilizer purchased by farmers in 2007/08 was recycled FSP fertilizer.[12] If this is the case, then the primary beneficiaries of the subsidy were likely to have been those in charge of allocating the fertilizer. These observations illustrate the potential for wide differences between fertilizer subsidy programs in theory and in practice, and indicate that implementation procedures and the ability to control them are critical determinants of their actual impact.

To the extent that the FSP fertilizer is nevertheless used on farmers' fields, it still contributes to national maize production. This is an extremely important benefit especially at a time such as 2008 when the cost of maize importation is very high. Over the six years since the introduction of the FSP program in 2002/03, fertilizer use by smallholder farmers has increased by 12.5% (Figure 4). Smallholder maize yields have also risen from 2.19 tons per hectare in 2002/03 to 2.51 tons/hectare in 2007/08 (MACO/CSO/FSRP, 2008), although abundant and relatively well-distributed rainfall in the 2005/06, 2006/07 and 2007/08 seasons may also be an important factor in these trends.

In summary, keeping food prices at tolerable levels through expanding local supply has important economic, social and political benefits. However, the experience of Zambia indicates that improvements in the pass-through of subsidized fertilizer to smallholder farmers and changes in targeting criteria and effectiveness would greatly increase the benefits of the FSP relative to its costs.

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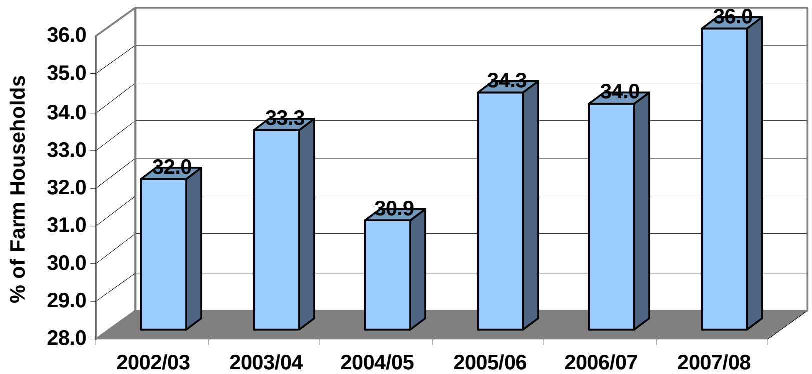
[12] However, since the national survey does not include urban districts, we were not able to estimate the amount of FSP fertilizer received by urban farmers, even though FSP distribution plans indicate that they did distribute a portion of their supplies to urban cooperatives.

Figure 4. Percentage of smallholder farm households using fertilizer, 2000/01 to 2007/08, Zambia.



Source: Central Statistical Office, Crop Forecast Surveys, Zambia.

The case of Kenya: fertilizer adoption without subsidies

Findings from Kenya are drawn from an Egerton Unversity/Tegemeo Institute report on trends and patterns in fertilizer use since the initiation of input market liberalization in 1990 (Ariga, Jayne, Nyoro, 2007; Ariga, Jayne, Nyoro, 2008). This study tracks trends in fertilizer use for a nationwide sample of 1,260 small-scale farm households in 22 districts surveyed by Egerton University's Tegemeo Institute in 1997, 2000, 2004 and 2007.[13]

Kenya liberalized its fertilizer market and phased out all fertilizer subsidy programs in the early 1990s. Total fertilizer consumption has risen from a mean of roughly 180,000 tons per year during the 1980s, to 250,000 tons per year during the early 1990s, to 325,000 tons in the 2000-2003 period, to over 400,000 tons in the 2004/05 and 2005/06 seasons. In the most recent year for which data is available, 2007, Kenyan farmers consumed 451,219 metric tons of fertilizer. Anecdotal reports indicate that at most 300,000 tons of fertilizer has been consumed so far in 2008 due to both civil disruption and the escalating cost of fertilizer in world markets.

The nationwide study of 1,260 smallholder households surveyed four times between 1995/96 and 2006/07 by Egerton University's Tegemeo Institute shows that fertilizer use per cropped hectare has risen by 39% over this 11-year period. The evidence suggests that growth in fertilizer consumption is occurring on smallholder farms; it is not driven by large-scale or estate-sector agriculture. The proportion of small farmers using fertilizer has increased steadily from 56% in 1995/96 to 70% in 2006/07 (Table 3). These rates vary considerably throughout the country, ranging from less than 10% of households surveyed in the drier lowland areas to over 90% of small farmers in Central Province and the maize surplus areas of Western Kenya. Interestingly, mean fertilizer use per hectare is virtually constant across farm size (hectares cropped), suggesting that even small and poor farmers are gaining access to fertilizer, and additional maize output per ton of fertilizer applied is higher for farms with under 2 ha cultivated than for those in the 2-40 ha range (Table 4; see footnote a/). When stratifying the nationwide sample according to wealth, the proportion of the poorest 25% of the farm households using fertilizer in high-potential areas increased from 67% in 1995/96 to 90% in 2006/07. Among the poorest 25% of farm households in semi-arid areas, the

[13] The Tegemeo survey is not strictly nationally representative but was designed to be proportionately representative within the main agricultural zones in Kenya. See Ariga et al. (2008) for details.

proportion using fertilizer increased from 3% to 17%. Fertilizer use remains limited in the drier regions because of low profitability.

These finding underscore the inferences made by Duflo, Kremer and Robinson (2007) in their randomized evaluation of fertilizer usage in Busia District of Western Kenya, and by Marenya and Barrett (2008), both of which indicate that the fertilizer use recommendations of the Government's extension service are unprofitable for most farmers in many areas of the country.

Table 3: Percent of Farm Households Using Fertilizer on Maize

Agro-regional zone	1996	1997	2000	2004	2007
	% of households using fertilizer on maize				
Coastal Lowlands	0	0	3	4	14
Eastern Lowlands	21	27	25	47	43
Western Lowlands	2	1	5	5	13
Western Transitional	39	41	70	71	81
High Potential Maize Zone	85	84	90	87	91
Western Highlands	81	75	91	91	95
Central Highlands	88	90	90	91	93
Marginal Rain Shadow	6	6	12	11	16
Total Sample	**56**	**58**	**64**	**66**	**70**

Source: Ariga et al. (2008), based on Tegemeo Institute/Egerton University household surveys, 1997, 2000, 2004, and 2007.

7.

Table 4. Fertilizer use and maize yields by farm size (hectares cropped) category, Kenya.

	(hectares cropped, average of four seasons)				
	0.16-0.81	0.85-1.30	1.30-1.78	1.78-2.51	2.55-39.11
Maize yield, unfertilized fields (mt/ha)	0.66	0.73	0.67	0.79	0.71
Maize yield, fertilized fields (mt/ha)	1.18	1.10	1.12	1.07	1.15
Difference in yield (fertilized vs. unfertilized fields) (mt/ha) a/	0.52	0.37	0.44	0.28	0.44
Fertilizer used on maize field (mt/ha)	0.12	0.12	0.12	0.14	0.15
Additional maize output per ton of fertilizer applied a/	4.23	3.15	3.60	2.00	2.97

Source: Tegemeo Institute / MSU Household Panel Surveys for the 1996/97, 1999/00, 2003/04, and 2006/07 cropping seasons.
a/ These estimates do not control for variables other than fertilizer, such as labor inputs or land quality, that may affect the difference in yield on fertilized vs. unfertilized fields.

Fertilizer consumption in Kenya grew both for food crops (mainly maize and domestic horticulture) and for export crops such as tea, sugarcane, and coffee. Fertilizer use per hectare of maize cultivated has increased dramatically in all but the semi-arid parts of the country. About 87% of small-scale farmers in the high-potential maize zones of Western Kenya now use fertilizer on maize, with dose rates of roughly 163 kg per hectare, higher than mean levels obtained in South and East Asia.

Three main factors account for the expanded use of fertilizer by small farmers in Kenya. First, the Government of Kenya has pursued a relatively stable fertilizer marketing policy since 1990. After the elimination of retail price controls, import licensing quotas, foreign exchange controls, and the phase-out of external fertilizer donation programs that disrupted commercial operations, Kenya has witnessed rapid investment in private fertilizer distribution networks, with over 10 importers, 500 wholesalers and 7,000 retailers now operating in the country.

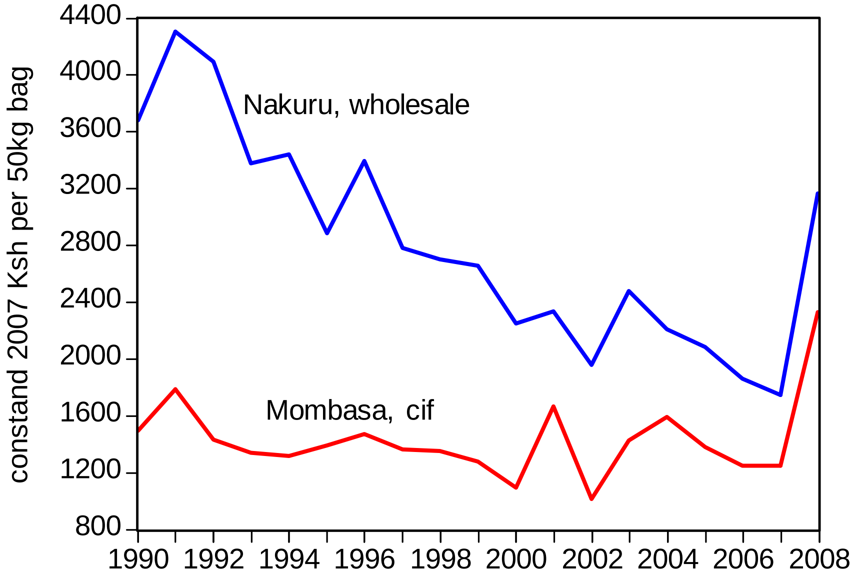
Secondly, because of the increasingly dense network of fertilizer retailers operating in rural areas, the mean distance of small farmers to the nearest fertilizer retailer declined progressively from 8.4 km to 3.9 km between 1997 and 2007. This has greatly expanded small farmers' access to fertilizer, reduced transport and transaction costs, and increased the profitability of using fertilizer.

The third factor is intense competition in importing and wholesaling, creating pressure to cut costs and innovate in logistics. As a result, over the past 10 years fertilizer transport and marketing costs from Mombasa to Western Kenya have declined by nearly 45%, from $245 to $140 per ton, allowing farm-gate fertilizer prices to remain roughly constant despite rising world prices (Figure 5).

Interviews of key informants in Kenya's fertilizer sector identified four factors responsible for the declining fertilizer marketing costs observed in Kenya: (i) exploiting the potential for cheaper backhaul transportation, taking greater advantage of trucks transporting cargo from Rwanda and Congo to the port of Mombasa; (ii) private importers are increasingly using international connections to source credit at lower interest and financing costs than are available in the domestic economy; (iii) mergers between local and international firms in which knowledge and economies of scale enable cost savings in local distribution; and (iv) increased competition among local importers and wholesalers given the expansion in the number of firms engaged in fertilizer marketing since the early 1990s.

Regarding credit, many Kenyan farmers have been able to finance fertilizer through the credit offered in the integrated input-output chains for crops such as tea, sugar, and coffee. These integrated marketing arrangements have also provided the means for farmers to obtain fertilizer for their food crops, since the companies can recoup their loans for other crops as well when the farmers sell their cash crop back to the company. But in areas where fertilizer use on a particular crop is profitable, such as maize in Western Kenya and horticulture throughout the country, most farmers have achieved reasonable levels of fertilizer use without credit.

Figure 5. Price of DAP (Di-Ammonium Phosphate) in Mombasa and Nakuru (constant 2007 Shillings per 50kg bag)



Note: Nakuru is a maize-producing area in the Rift Valley of Kenya, 400 miles (645 km) by road west of the port of Mombasa. Source: Ministry of Agriculture. FMB weekly fertilizer reports for CIF Mombasa.

The experience of Kenya shows how a stable policy environment can foster an impressive private sector response that supports smallholder agricultural productivity and poverty alleviation. These goals remain elusive in countries lacking a sustained commitment to the development of viable commercial input delivery systems. Output price stability has also facilitated the impressive growth in fertilizer use in Kenya. The operations of the National Cereals and Produce Board since the early 1990s, and the elimination of regional trade barriers since the inception of the East African Commission Custom Union in January 2005, have both promoted maize price stability (Jayne, Myers, Nyoro, 2008; Chapoto and Jayne, 2007). Complementary programs to support small farmer productivity, such as the Farm Input Promotions (FIPS) program, the CNFA agro-dealer training and credit program, and the organization of farmers into groups to facilitate their access to extension and credit services under the Kenya Market Development Programme, have also been important factors in raising fertilizer use in Kenya.

Because mean household incomes are higher in Kenya compared with many other African countries, the impressive market-led growth in smallholder fertilizer use in Kenya may not be easily transferable to areas where effective demand is highly constrained. And the Kenya success story is fragile. Sustaining its momentum will depend on commitment to supportive public investment and policy choices. Governance problems and civil disruption would jeopardize the sustainability of the commercially driven input distribution system and rural development more generally. Continued access to input credit for small farmers in many parts of the country will require government commitment to limit the potential for politicization and interference in the management of the interlinked crop marketing systems for sugarcane, tea, and coffee, which have provided a means for farmers to acquire additional fertilizer on credit for use on food crops. Also, new investment is needed in Kenya's eroded rail, road, and port infrastructure to maintain Kenya's competitiveness. Lastly, effective systems to improve smallholders' crop husbandry and management practices are needed to provide incentives for continued expansion of fertilizer use and productivity growth in areas where fertilizer is only marginally profitable at present.

Implications of sharply higher maize, fertilizer, and fuel prices

Since the beginning of 2007, world prices of maize and fertilizer have increased dramatically. According to data from the World Bank (2008a), increases in quarterly average prices from January–March 2007 to July-September 2008 are $74 for maize (from $171 to $245), $810/ton for DAP (from $344 to $1,154), $447 for urea (from $298 to $745), and $59 for crude oil ($57 to $116.[14]

A recent IMF study has examined the macroeconomic impact of higher food and fuel prices (IMF, 2008). Results indicate sizeable negative balance of payments impacts, primarily from the fuel price increases (since fuel imports by low- and middle-income countries are at least twice as large as food imports). Price increases have also contributed to inflation and poverty (especially for the urban poor), but here food prices have a bigger impact than fuel prices.

At the farm and national level, the presumption is that these price changes will have negative effects on the profitability and affordability of fertilizer use: they may lead to lower fertilizer application rates and hence yields; they may make fertilizer unaffordable for many farmers who previously bought fertilizer commercially and produced a marketed surplus; they may lead some farmers to switch land out of maize and into other crops; and they may further discourage fertilizer non-users from adopting fertilizer. The fear is that without support for maintaining fertilizer use levels, domestic maize output will decline, perhaps requiring governments to meet domestic consumption needs through very expensive imports. If sufficient maize imports cannot be mobilized, widespread hunger may result, with negative social and political consequences at the national (and international) level, particularly if hunger turns into famine.

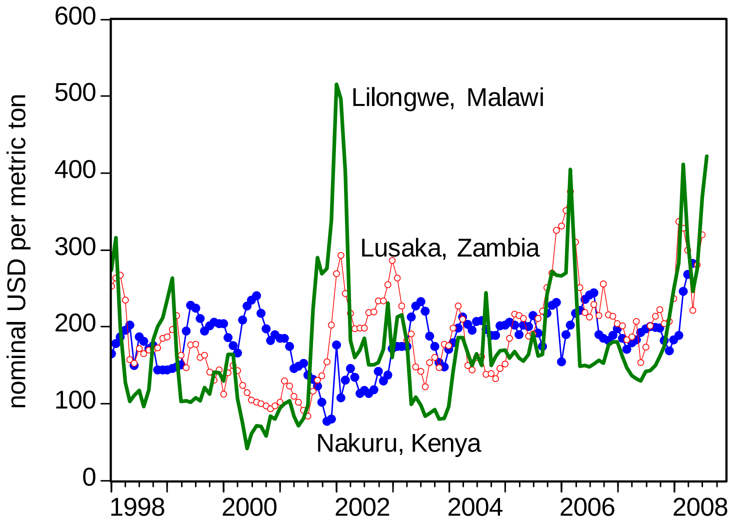
How have these recent world price increases affected prices in Eastern and Southern Africa, and what are their implications for incentives to use fertilizer?[15] For producers, rising maize and fertilizer prices have positive and negative effects on profitability, respectively. The net effect on profitability depends on location and other specific circumstances, and is unclear a priori. For export-oriented crops, fuel price increases raise the costs of imported inputs and transport to the border, thereby reducing profitability. For import substitutes, the net effect on profitability depends on the location of production relative to the market to which output is delivered. Rising maize and fuel costs will increase the import parity prices at major internal markets. For production zones close to these markets, the rise in import parity price may offset the increased cost of transport from the production zone to those markets. This may not be true for more distant production zones.

Figure 6 presents trends in maize prices in regional markets in Eastern and Southern Africa, in nominal USD per ton. The 2001/02 and 2005/06 years were drought years exacerbated by poor coordination between the private and public sectors in mobilizing needed imports in some countries (Tschirley and Jayne, 2008). The high food prices in 2007/08, by contrast, are not due to major production shortfalls, although maize production in South Africa was relatively low in both 2005/06 and 2006/07. The continued turmoil in Zimbabwe may also be contributing to rising prices.

[14] These world prices have fallen significantly as of October 2008, to $183 for maize, $970 for DAP, $406 for urea, and $73 for crude oil (World Bank, 2008a), but local prices within the Eastern and Southern Africa region remain high. World Bank price forecasts in nominal terms for 2009 are higher for maize ($210) and lower for DAP and urea ($500 and $350, respectively) (World Bank, 2008b).

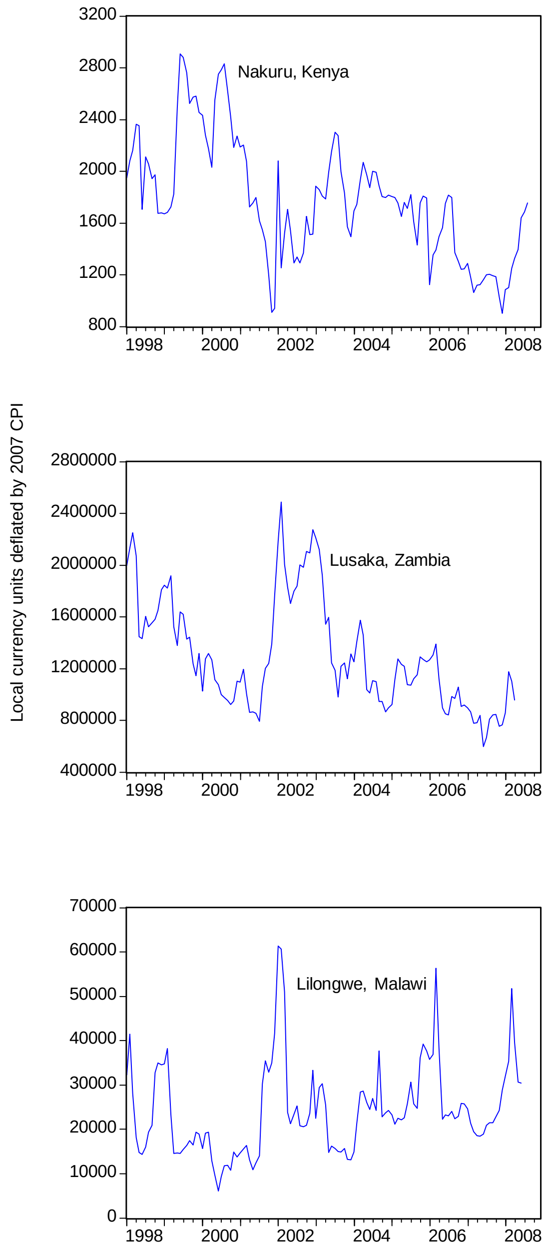
[15] Implications for consumers and government budgets are also important, but are not the focus here.

Figure 6. Retail prices of maize in Southern African markets, January 1999 to May 2008, in nominal USD per metric ton.



The trend in prices changes somewhat when examining regional maize price trends in inflation-adjusted local currency units (Figure 7). Maize prices are rising in some countries in the region (Malawi), and falling in others (Zambia and Kenya). Real prices in Zambia and Kenya are falling mainly because of currency appreciation against the US dollar in recent years. Rising food prices denominated in USD are offset to a large extent when converted into local currency units and further offset when adjusted by the ratio of US GDP price index to local inflation rates. Note, however, that declining real maize prices do not necessarily imply improved affordability for consumers, since the decline is occurring in part because other commodity prices are rising more rapidly, which affects consumers' real incomes and purchasing power. If incomes have not risen as fast as food prices, consumers' purchasing power has declined. To examine this it would be necessary to track food price trends against wage rates and nonfarm business income for both urban and rural households, yet even annual data on wage rates in the countries examined has proven difficult to obtain.

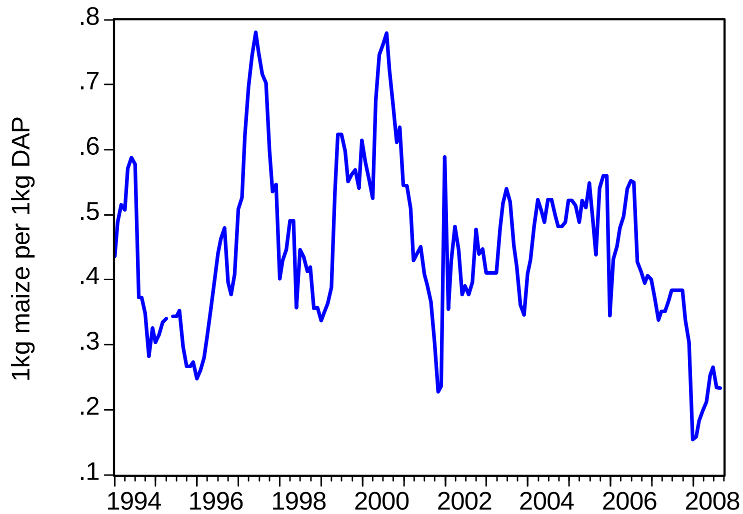
Figure 7. Maize prices in various markets of Eastern and Southern Africa, in local currency units per ton.



Sources: Ministry of Agriculture market information systems in Malawi, Zambia, and Kenya, National Statistical Offices for CPI data.

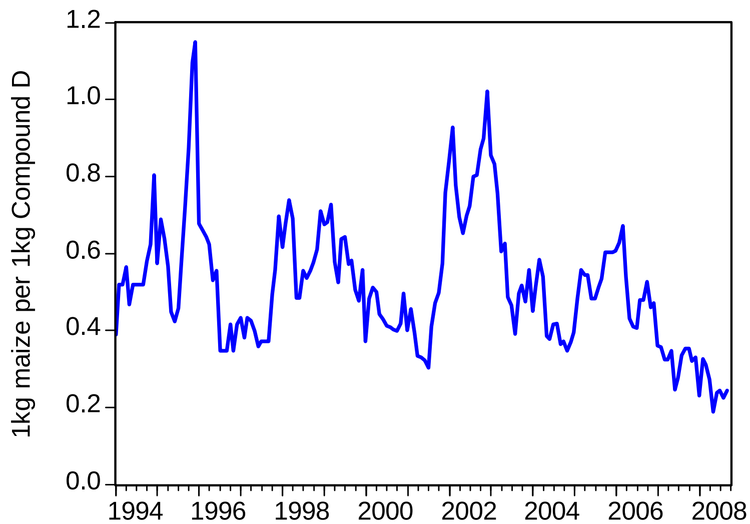
Trends in the local maize-fertilizer price ratio are a third important indicator to examine in evaluating how recent grain and fertilizer price rises will affect the incentives to use fertilizer. There has been a dramatic rise in fertilizer prices since 2007, and this rise in fertilizer prices has been proportionately higher than the rise in food prices. Figures 8, 9 and 10 present trends in maize-fertilizer price ratios over the 1994-2008 period for Kenya, Zambia and Malawi. Maize-fertilizer price ratios in 2008 are at all-time lows in Kenya and Zambia. In Malawi, the relatively high price of maize in 2008 has partially offset the impact of rising fertilizer prices, and the anticipated expansion of the fertilizer subsidy program for 2008/09 is also likely to stabilize fertilizer use in Malawi.

Figure 8. Maize / Fertilizer Price Ratios, Kenya, 1994-2008.



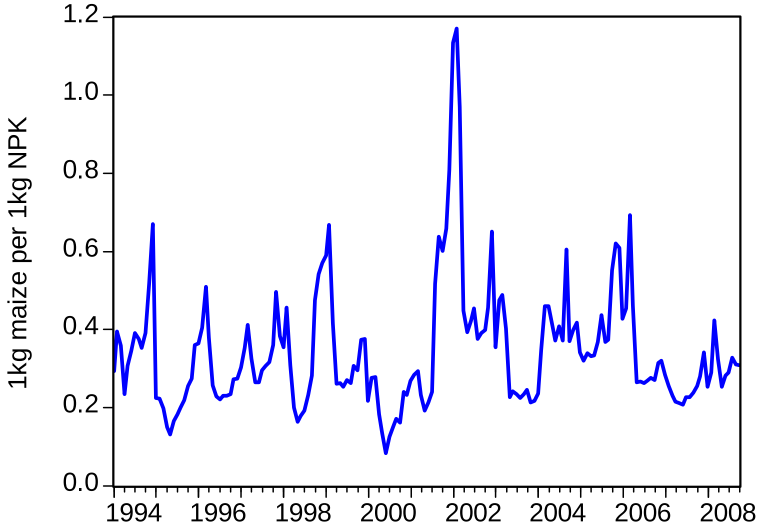
Notes: Price ratio defined as wholesale market price per metric ton, Nakuru, divided by DAP, c.i.f. Nakuru per metric ton, in nominal shillings.
Sources: Ministry of Agriculture Market Information Bureau, Nairobi.

Figure 9. Maize / Fertilizer Price Ratios, Zambia, 1995-2008.



Notes: Price ratio defined as retail market price per metric ton, Lusaka, divided by Compound D, c.i.f. average of provincial centers per metric ton.
Sources: Omnia data files and Ministry of Agriculture and Cooperatives files for Compound D; CSO retail price data for maize prices.

Figure 10. Maize / Fertilizer Price Ratios, Malawi, 1990-2008.



Notes: Price ratio defined as retail maize market price per kg, Lilongwe, divided by NPK (23:21:0 4s) c.i.f. Lilongwe per kg, in nominal kwacha.
Sources: FEWSNet reports for maize prices; Ministry of Agriculture for fertilizer prices, Lilongwe.

Relatively low maize-fertilizer price ratios in most of the rest of the region are likely to produce several unwelcome outcomes: (a) less fertilizer used on maize and other crops in the coming cropping season; (b) lower maize yields and production, other factors constant; (c) continued upward pressure on maize prices, even in countries that so far have not experienced major price increases; and (d) a possible shift in area out of crops that require heavy fertilization for profitability and into crops that are profitable even at low or no fertilizer use (e.g., a partial shift into roots and tubers at the expense of maize in the mixed cassava/maize zones, and a shift out of fertilizer-intensive cash crops such as tobacco and tea).

The impact of lower fertilizer use on maize production and marketed supplies will be most discernable in countries that make relatively intensive use of fertilizer such as Kenya and least discernable in countries where fertilizer use is negligible, such as Mozambique.[16] However, high fertilizer prices will limit expansion of production through technology adoption. For that reason, the Mozambican government is considering a fertilizer subsidy program similar to Malawi's starter pack program. Countries gearing up for large-scale fertilizer subsidy programs in 2008, such as Malawi, may also not be greatly affected in the short run. However, the impact of Malawi's subsidy program and the current ADMARC and NFRA operations associated with maize price stabilization are anticipated to impose massive fiscal costs on the treasury with potentially serious macroeconomic consequences that could indirectly affect livelihoods and food insecurity in 2009 and beyond.

As important as fertilizer use is in increasing food production over time, many other factors are crucial as well. Over the medium and longer run, smallholder productivity and food security outcomes in the region will also depend on investments in seed research and other forms of crop science; extension programs to improve farmer knowledge and management practices; initiatives to organize farmers into viable groups for accessing seasonal loans to finance crop input purchase, obtain support services (e.g., crop husbandry knowledge, conservation farming techniques and other viable agronomic practices, soil testing for fine-tuning efficient fertilizer use recommendations), and achieve scale economies in crop

[16] In 2007, 70 percent of smallholder farmers in Kenya used fertilizer while only 4 percent of farmers in Mozambique did.

marketing; and investments in physical infrastructure, e.g., roads, electrification, port development, etc. For empirical estimates of how infrastructure investments affect agricultural productivity, see Antle, (1983) and Binswanger, H., S. Khandker, M. Rosenzweig (1993).

It is also important to stress that incentives to use fertilizer depend not only on the maize-fertilizer price ratio but also on fertilizer application rates and the maize yield response to fertilizer. Without pretending to any definitive results that would support specific policy recommendations, several rough calculations can be used to illustrate this point, given the maize and fertilizer price increases cited at the beginning of this section.[17]

First, consider a farmer who currently applies fertilizer. Using a simple partial budget that assumes a fertilizer application rate of 100 kg/ha each for DAP and urea, a yield of 2 tons/ha, a maize price increase of $75/ton, and an average fertilizer price increase of $630/ton,[18] the change in value of output is 2 x $75 = $150 and the change in cost is 200/1000 x $630 = $126, for a net gain of $24. With these assumptions, the net gain is negative only if more than 115 kg/ha each of DAP and urea are used, or if the fertilizer dose remains at 100 kg/ha each of DAP and urea and the yield falls to about 1.7 tons/ha. This illustrates the importance of the maize yield response to fertilizer, other things equal.

Second, consider a farmer who does not currently apply fertilizer. Heisey (cited in Byerlee and Eicher, 1997) indicates that in Malawi 55 kg of nutrient per ha applied to local (unimproved) maize gives a 750 kg/ha increase in yield over unfertilized local maize. Valuing maize and fertilizer at the July-September 2008 quarterly average prices cited by the World Bank (2008a), the gain in value of maize is roughly $184 minus the cost of fertilizer applied of $163,[19] for a net gain of $21 per ha. As in the first illustration, this result depends heavily on the maize-fertilizer response rate. Also, note that while the net gain in this simple example is positive, it is substantially lower than the net gain ($74) that would be obtained at the prices prevailing in the January-March quarter of 2007. Moreover, the net gain of $21 per ha implies a value-cost ratio (VCR) of $184/163 = 1.13, which is well below the value of 2.0 commonly used as a threshold for acceptability to farmers.

Third, the benefit-cost analysis reported in Dorward et al. (2008) for the 2006/07 Malawi input subsidy program provides another way of estimating the impact of recent maize and fertilizer price increases. Increasing the maize price from $147.5/ton to $245/ton, raising the average cost of fertilizer by $630/ton, and holding constant other assumptions from Dorward et al., the benefit-cost ratios for the Malawi program decline only slightly, ranging from 0.72 to 1.18, instead of from 0.76 to 1.25 (the range reported in Dorward et al. for the base maize price of $147.5).[20] Other noteworthy impacts of the fertilizer price increase in this example are that the cost of procuring the aggregate amount of subsidized fertilizer distributed (approximately 175,000 tons) would rise by $630/ton, increasing the budgetary outlay by $110.25 million. Also, if farmers were expected to make the same 28% co-payment, they

[17] These examples do not include the effect of fuel price increases on within-country prices of maize and fertilizer. Also, using the October 2008 prices given in World Bank (2008a) would result in net losses rather than net gains in the first two illustrations discussed in the text. On the other hand, at the forecast nominal 2009 prices (higher for maize, lower for fertilizer) cited in footnote 14 (World Bank, 2008b), the net gains in these two illustrations would be much higher.

[18] Average of $810 increase for DAP and $447 increase for urea, rounded up to $630.

[19] Using an average of DAP and urea prices ($1,154 + $745)/2 = $950 and a nitrogen nutrient content of fertilizer of 32% (average of 18% and 46%).

[20] This result is explained by (a) the positive effect of the maize price increase tending to offset the negative effect of fertilizer price increase, and (b) the fact that fertilizer costs make up only part of the total cost in the BCR denominator (54-56% of total costs given 2006/07 prices, and 70-74% given the World Bank's 2008 prices).

would need to pay 2,094 MK per bag rather than 950 MK per bag.[21] This illustrates the farm- and national-level financial costs associated with large fertilizer price increases.

Lastly, even if fertilizer use on maize remains profitable, it may become less profitable than other crops for some farmers, inducing them to switch out of maize. For example, anecdotal reports from Zambia indicate that because of the major run-up in soybean prices, many commercial farmers are expecting to find it more profitable to apply fertilizer on that crop in the upcoming growing season. Maize producers may also apply less fertilizer than in previous years if supplies are rationed or otherwise constrained.

While maize-fertilizer price ratios may not be abnormally low relative to long-run mean levels, this is not cause for complacency. Major gains can be achieved from efforts to reduce costs in the fertilizer distribution system to push down the cost to farmers. There is also a need for innovative farmer extension programs to assist farmers to use fertilizer more efficiently so that each kg used produces more output. Also, at least some smallholder farmers who have been buying fertilizer at commercial prices may cut back on the amount of fertilizer used per hectare rather than eliminating fertilizer use entirely. If this is true, the potential effect of high prices may not be a great as some predict. A lot depends on whether timely fertilizer stocks are available for sale. Also if a smallholder has access to cash to buy fertilizer, and has a very small area on which to plant maize, the cheapest way to get maize to eat may still be to pay even higher prices for fertilizer to avoid having to buy even more expensive maize from the market. Hence, potentially the most important consideration is to ensure that adequate fertilizer supplies are imported into each country in the region in a timely and efficient way, as well as ensuring their distribution to the sites where they are needed.

Conclusions and implications for policy

The existence of acute poverty and hunger, exacerbated by soaring food and fertilizer prices, cries out for an immediate response. "Smart" fertilizer subsidy programs in Africa are attractive to many because they offer the potential to increase the food grain harvest and thus reduce hunger in the short run. Income gains transferred to farmers through the subsidy are expected to result in greater savings and investment in productive assets, contributing to longer-run growth. In addition, income transfers to farmers address the social and political objectives of poverty alleviation and improved equity.

However, achieving these benefits depends greatly on how the programs are implemented. The contribution of fertilizer subsidy programs to reducing poverty and hunger would be higher if they could be designed and implemented so as to (a) target households with little ability to afford fertilizer; (b) target areas where applying fertilizer can actually increase total output; and (c) promote rather than undercutting the development of a commercial fertilizer distribution system.

[21] In fact, the co-payment was not increased in the 2007/08 Malawi program.

Several caveats should be considered before implementing fertilizer subsidies:

1. Fertilizer subsidies may not be the best option for addressing the current crisis of high food and fertilizer prices. Significant increases in demand for fertilizer are likely to drive up prices further (Salzburg, 2008). Also, the supply response to increased fertilizer use is not assured, given weather and other maize production risks prevalent in most of eastern and southern Africa. Thus, implementing large-scale fertilizer subsidy programs will not guarantee an adequate harvest. Lastly, subsidies targeted to particular crops such as maize may reduce output of other food crops such as cassava (Zulu et al., 2001), reducing the net food supply response.

2. Fertilizer subsidies may not be the best option for addressing the current crisis of high food and fertilizer prices. Significant increases in demand for fertilizer are likely to drive up prices further (Salzburg, 2008). Also, the supply response to increased fertilizer use is not assured, given weather and other maize production risks prevalent in most of eastern and southern Africa. Thus, implementing large-scale fertilizer subsidy programs will not guarantee an adequate harvest. Lastly, subsidies targeted to particular crops such as maize may reduce output of other food crops such as cassava (Zulu et al., 2001), reducing the net food supply response.

3. As a tool for increasing overall agricultural productivity, especially for small, poor farmers, fertilizer subsidies have a questionable record. Long experience with input subsidy programs in Africa is not encouraging on several points:[22] (a) there is very little evidence from Africa that fertilizer subsidies have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments, (b) there are no examples of subsidy programs where the benefits were not disproportionately captured by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor,[23] and (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have "kick-started" productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end.[24]

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[22] Morris et al. (2007, 103) summarize by saying: "the weight of empirical evidence now show(s) that fertilizer subsidies are likely to be inefficient, costly, and fiscally unsustainable."

[23] The logical response is to call for better targeting of future input subsidy programs. However, Dorward et al. (2008, section 7.2.3) includes an illuminating discussion of the practical difficulties involved in targeting subsidized fertilizers to poor households, including lack of information on who the poor households are, and unwillingness of some communities to exclude any households from receiving subsidized fertilizer. The daunting variety of difficulties described here makes it hard to be optimistic about the prospects for significantly improved targeting.

[24] For example, Malawi and Zambia have had almost continuous fertilizer subsidy programs each year for the past several decades even during the so-called liberalization process (e.g., see Dorward et al., 2008; Jayne et al., 2002).

4. As a tool for increasing overall agricultural productivity, especially for small, poor farmers, fertilizer subsidies have a questionable record. Long experience with input subsidy programs in Africa is not encouraging on several points:[25] (a) there is very little evidence from Africa that fertilizer subsidies have been a sustainable or cost-effective way to achieve agricultural productivity gains compared to other investments, (b) there are no examples of subsidy programs where the benefits were not disproportionately captured by larger and relatively better-off farmers, even when efforts were made to target subsidies to the poor,[26] and (c) there is little evidence that subsidies or other intensive fertilizer promotion programs have "kick-started" productivity growth among poor farmers in Africa enough to sustain high levels of input use once the programs end.[27]

5. In the high potential areas of Kenya, Zambia, and Malawi, many if not most households use fertilizer regularly. In less stable production zones, low or no fertilizer use by many smallholders is explained not just by credit constraints that limit acquisition, but also by the risk of crop failure, with resulting financial losses and consumption shortfalls. The lack of insurance causes inefficiency in production choices (Dercon and Christiaensen, 2007). Recent trials of weather-indexed insurance are a promising potential solution for the risk problem (World Bank, 2007a, p. 149).

6. Hence, a balance is needed between interventions to address short-term supply shortages and avoid widespread hunger vs. investments and policies to drive growth and lift poor households out of the poverty trap in which they are caught. Currently, the governments of Malawi and Zambia devote at least 60% of their agricultural budgets to input and crop marketing subsidies, leaving relatively little for the long-term investments required for sustainable reductions in poverty and hunger.

If the decision is made to implement input subsidies, the experiences of Zambia and Malawi provide several practical guidelines for how to maximize their effectiveness in meeting important national objectives other than economic growth, such as improved national food security, alleviation of poverty and hunger:

1. ***Use input vouchers that can be redeemed at local retail stores rather than direct distribution*** in order to maintain or improve the capacity of the private sector input delivery system.

[25] Morris et al. (2007, 103) summarize by saying: "the weight of empirical evidence now show(s) that fertilizer subsidies are likely to be inefficient, costly, and fiscally unsustainable."

[26] The logical response is to call for better targeting of future input subsidy programs. However, Dorward et al. (2008, section 7.2.3) includes an illuminating discussion of the practical difficulties involved in targeting subsidized fertilizers to poor households, including lack of information on who the poor households are, and unwillingness of some communities to exclude any households from receiving subsidized fertilizer. The daunting variety of difficulties described here makes it hard to be optimistic about the prospects for significantly improved targeting.

[27] For example, Malawi and Zambia have had almost continuous fertilizer subsidy programs each year for the past several decades even during the so-called liberalization process (e.g., see Dorward et al., 2008; Jayne et al., 2002).

2. ***Involve a wide range of fertilizer importers, wholesalers, and retailers in the input voucher scheme,*** even if it entails additional logistical costs. Providing tenders to only 2-3 firms to import fertilizer can entrench their position in the market, cause other firms to cease making investments in the system or drop out altogether, leading to a more concentrated input marketing system and restricted competition when the input subsidy program comes to an end. A system that allows farmers to redeem coupons at the full range of existing independent agro-dealer retail stores will promote additional investment in remote rural areas where it is most needed. By contrast, failure to involve the small rural retailers may lead many of them to stop carrying fertilizer, as was the case in Malawi after the 2005/06 season, leading to erosion rather than development of a private retailing system.

3. ***Before deciding to target the input vouchers***, carefully consider the objectives of the targeting and the practical feasibility and costs of implementing a targeted program, including personnel costs, time requirements and potential delays, leakage, and displacement of commercial sales by subsidized inputs.

    a. If the objective is to increase total output, then the inputs need to reach farmers who can use them efficiently and on a large enough area to generate significant gains in total output. Evidence indicates that a high proportion of non-poor farmers are able to acquire fertilizer through markets so spending scarce government resources to provide them with discounted fertilizer will largely substitute subsidized fertilizer for commercial fertilizer, adding relatively little to overall fertilizer use or crop output. In some cases, small farmers may also use fertilizer more efficiently than larger farmers.

    b. If the objective is to alleviate poverty, or to overcome liquidity constraints for poor farmers who would otherwise be unable to purchase fertilizer, then it must be possible to identify poor farmers, and socially acceptable to channel vouchers to them, at a reasonable cost including leakage. Assisting low-income households to acquire fertilizer especially in a high food price environment may make the difference between their ability to eat and going hungry. Providing crop production support to relatively asset-poor households also contributes importantly to equity and social protection objectives,

    c. If effective targeting does not seem feasible or achievable at an acceptable cost, then a small universal voucher program would be worth considering. For example, a program designed to provide all farmers with inputs for 0.2 ha would primarily benefit small farmers while at the same time limiting the displacement of commercial purchases by larger higher-income farmers, some degree of which might occur anyway under a program that fails to target small farmers successfully.[28]

4. ***Address infrastructure and input supply constraints as well as improving procurement efficiency*** (joint procurement arrangements and regional procurement hubs). This will help achieve the goal of enhancing farm-level fertilizer supplies at a lower price. Facilitating the movement of fertilizers across borders (removing customs duties and export taxes) will also contribute to overall improvements in supply efficiency.

[28] The option of a small universal subsidy program is discussed in Imperial College et al. (2007). See also Chinsinga (2005) for a discussion of the earlier experience in Malawi with universal and targeted input subsidy programs.

5. ***Facilitate private sector partnerships with farmers***, such as through contract farming where conditions are suitable, would go a long way toward reducing the financial burden on government.

6. ***Strengthen farmers' effective demand for fertilizer*** by making fertilizer use profitable and by building durable input markets and output markets that can absorb the increased output without gluts that depress producer prices. This involves two major commitments from government:

   a. To increase farmers' demand for fertilizer, governments should invest in rural infrastructure, efficient port facilities and standards of commerce to reduce the costs of distribution; fund agricultural research to produce seeds that respond to fertilizer; determine and disseminate fertilizer use recommendations that are appropriate for different areas (as opposed to one blanket recommendation for an entire country); and nurture the development of rural financial systems, market information systems, institutions for contract enforcement, and telecommunications to attract new investments by commodity marketing firms. These "public goods" investments, often considered outside the scope of fertilizer marketing policy, nevertheless strongly affect the demand for fertilizer and hence whether sustainable markets for fertilizer can arise.

   b. To build durable input and output markets, governments should establish a supportive policy environment that attracts local and foreign direct investment. The case of Kenya shows how a stable policy environment has induced an impressive private sector response that has helped to make fertilizer accessible to most small farmers. Importantly, this has involved reforms to the financial market (elimination of foreign exchange controls) as well as to fertilizer and crop markets. In other countries, the implementation of large subsidy programs has inhibited the type of private investment response seen in Kenya, due to the risk of huge losses that subsidy programs inflict on commercial input dealers.

7. ***Increase fertilizer use efficiency*** by promoting farmers' use of improved crop management practices such as crop rotation with legumes, changes in density and spacing patterns of seeds and placement of fertilizer and seeds at planting (FIPS Africa, 2008), improved soil organic matter, early planting, timely weeding, applying fertilizer in response to rainfall (Snapp, Blackie, and Donovan, 2003; Blackie et al. 2006), water harvesting, and other conservation farming methods (Haggblade and Tembo, 2003).

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UGANDA STRATEGY SUPPORT PROGRAM (USSP) Brief No. 4

Use of Inorganic Fertilizers in Uganda

Juliet Namazzi

Improving agricultural productivity is vital for poor rural households in Uganda to meet their food security needs and to promote sustained increases in income. Inorganic fertilizer can be a powerful productivity enhancing input. While Uganda has one of the highest soil nutrient depletion rates in the world, it has one of the lowest rates of annual inorganic fertilizer application – only 1.8 kg per hectare. The World Bank calculated that the value of replacing these depleted soil nutrients could be 20 percent of average rural Ugandan household income. Promoting fertilizer use is therefore crucial to sustainably increase agricultural productivity in Uganda. This brief explores the economics of fertilizer use by smallholder farmers in Uganda, the determinants of fertilizer use, and options for government action.

Uganda's fertilizer marketing chain, as shown in Figure 1, is highly concentrated, creating conditions of oligarchy and imperfect competition. The size of the market is estimated to be between 16,000-20,000 tons of fertilizer products annually. However, about half of Uganda's annual fertilizer imports are imported directly by commercial crop growers. The commercial fertilizer supply system upon which smallholder farmers are dependent consists of five to seven importers, about 15 to 20 wholesalers, and 250 to 300 small-scale rural retail stockists. Importing firms face high costs in transporting the bulky commodity. While the costs of importing fertilizer to Uganda have fallen significantly in recent years due to increased supplies in Kenya, they still remain high compared to prices in the rest of the world. Moreover, the variability in fertilizer prices globally is transferred directly to the Ugandan market – Ugandan farmers who use fertilizer are bearing the full weight of the sharp increases in global prices in 2007 and 2008.

Maize is the staple food crop grown by Uganda smallholders for which inorganic fertilizer application is likely to be the most profitable An increasingly important crop in Uganda, maize is grown both as a food crop and as an export commodity. However, yields are low, averaging 1.0 tons per hectare. Poor soil fertility, particularly nitrogen deficiency, is a severe constraint to smallholder maize productivity. Studies of maize grown at three fertility regimes revealed significant response to nitrogen application. Medium rates of fertilizer application (60 kg N, 45 kg P_2O_5, 30 kg K_2O per hectare) yielded a 270 percent increase in yield over no fertilizer application, while doubling the amount of fertilizer from this medium level of application increased yields by only 16 percent. As such, relatively modest investments by smallholders in inorganic fertilizer could dramatically increase their maize productivity.

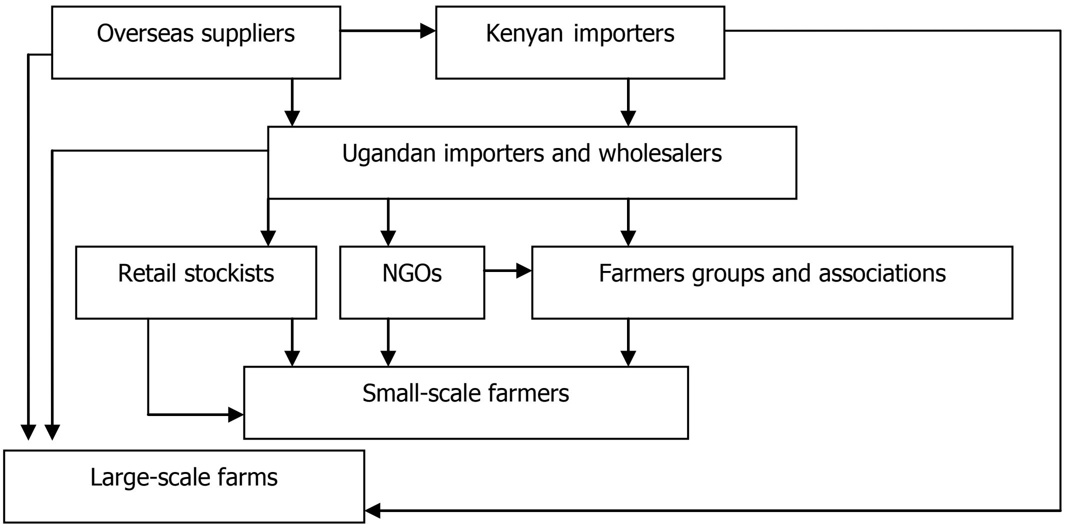
Determinants of inorganic fertilizer use

Agronomically, maize yield responses to the application of inorganic fertilizer in most locations in Uganda are significant, but most smallholder farmers do not use fertilizers. There are three primary determinants of inorganic fertilizer use amongst smallholder farmers in Uganda – demand-specific, supply-specific, and cross-cutting – that together account for this pattern.

Demand-specific Factors

There are two demand-specific factors. High fertilizer prices and low output prices is the first. Farm-level fertilizer prices in Uganda are among the highest in the world. In spite of the significant yield response to fertilizer application on maize, the high fertilizer prices are not offset by sufficiently high producer prices for maize, resulting in fertilizer use being only marginally profitable. Recognizing this, farmers will only have quite limited demand for fertilizers. Poor agricultural advisory services is the second demand-specific determinant. In general, inadequate technical information is provided to smallholders on how they might make profitable use of inorganic fertilizer. Without the information they require to make efficient

Figure 1: The fertilizer marketing chain in Uganda



Source: Omamo, 2003

use of the fertilizer they purchase, farmers are unable to make a profit on their investment in fertilizer, so quickly turn away from the use of the technology

Supply-specific determinants

Supply-specific determinants include risky policy environments and institutional risk. Unpredictable government or donor intervention in the fertilizer market interferes with the establishment of a practice of regular fertilizer use by smallholders. Historically, the government of Uganda has not been as interventionist in fertilizer markets as its neighbors, but it has done little to effectively promote a strong agricultural inputs sector. Institutional risk is another supply specific determinant. Uganda's quality control, packaging, safety and enforcement are inadequate and frequent procedural changes create uncertainty and risk to fertilizer suppliers. Other supply-specific determinants include the high costs of market entry and the lack of commercial storage facilities.

Cross-cutting determinants

Cross-cutting determinants include the availability of the infrastructure and institutions that are vital for fertilizer availability and market access. Poor road networks in Uganda limit the supply of fertilizer and increase fertilizer costs. Weak market information systems are also cross-cutting. Uganda lacks a marketing system capable of supporting the development of effective input markets. Poor financial services also limit fertilizer use and supply. Farmers lack credit to finance purchases of fertilizer and to market their production. Suppliers lack access to credit, limiting the amount of fertilizer available to farmers. High interest rates and stringent collateral requirements also limit the use and supply of fertilizer.

Government Role in Fertilizer Input Markets

Investment in "Public Goods"

The determinants listed above reveal a need for action. While the results of government interventions to foster sustainable soil fertility management practices, including the use of inorganic fertilizer, in the past have failed to impress, no other actor can meet the needs of farmers, suppliers, importers and producers. The following section articulates policies that balance the need for limited government intervention and a flourishing private sector in strengthening the supply and use of inorganic fertilizers in Uganda.

Improve infrastructure. Poor roads and transport networks contribute significantly (according to one survey, 50-60 percent) to the high cost of fertilizer, while also making transporting goods to market a challenge. Public investment requires an efficient, reliable infrastructure for the movement of bulk goods like fertilizer. More public funds should be directed towards the Ministry of Works and the Uganda National Road Authority for effective transport infrastructure development programs. This will lower the transaction costs incurred in fertilizer procurement, reducing the price of fertilizer.

Improve access to finance. According to the World Bank, credit limitations are a binding constraint to increased agricultural production in Uganda and will continue to impact production in the future. Improved access to credit has been shown elsewhere to be an important component of efforts to increase fertilizer use to raise agricultural productivity. In Uganda, the Prosperity for All program is developing rural financial services through savings and cooperatives, but many major constraints in access to rural finance remain and must be addressed more effectively by the government.

Enhance incentives for on-farm investment. When farmers can invest, they have a tendency to invest in off-farm ventures rather than in fertilizers or other productivity-enhancing inputs. To increase investment in fertilizer, the government should identify and implement mechanisms to lower the input-to-output price ratio through increasing crop output prices, reducing fertilizer prices, or both, thereby increasing the profitability of fertilizer use.

Introduce appropriate regulations. Indirect but effective regulation that creates incentives and encourages investment by the private sector should be encouraged. Effective agricultural input quality control regulation is critically important to preventing product adulteration.

Strengthen research and extension. Public sector support for agricultural research systems, improved seed, and the dissemination of appropriate input recommendations is important in raising farmers' willingness to pay for fertilizers. The Ugandan Plan for Modernization of Agriculture needs to increase the availability of agricultural extension services through the expansion of NAADS.

Strengthen coordination linkages. Farmers cannot benefit fully from market participation until they develop the human capital required for creating and managing cooperatives. Strategic relationships between all fertilizer market chain actors, including farmer groups, must be established.

Market smart subsidies. While subsidies have often failed to stimulate fertilizer use in the past, a market-based approach to fertilizer subsidies is necessary in the short term. Market-smart policies are public subsidies and related interventions that promote increased use of fertilizers in a way that stimulates input market development without impeding private investment. Market-smart subsidies can sometimes be useful in the short run to address some of the problems that contribute to low fertilizer use, but do not present a long term solution to the problem of missing fertilizer markets. Sustainable growth in fertilizer use is only likely if public resources can support measures that address the many underlying structural problems that affect the supply and use of inorganic fertilizer in Uganda.

This brief is intended to promote discussion; it has not been formally peer reviewed but has been reviewed by at least one internal and/or external reviewer.

The Uganda Strategy Support Program of the International Food Policy Research Institute (IFPRI) works closely with the government of Uganda, represented by the Plan for the Modernisation of Agriculture (PMA) Secretariat, and other development partners to provide information relevant for the design and for implementation of Uganda's agricultural and rural development strategies. For more information, see www.ifpri.org/themes/ussp /ussp.htm or www.pma.go.ug.

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ACF/FSP Study Team - Policy Advisory Note

Proposed Reforms for the Zambian Fertilizer Support Programme (FSP)

(27 February 2009)

Objectives and Assessment Procedures: Given government and stakeholder concerns about achieving greater effectiveness from GRZ budget allocations to the fertilizer support programme, a representative study team of major agricultural industry players and stakeholders was established by the Ministry of Agriculture and Cooperative (MACO) following a Cabinet directive to review the FSP implementation thus far, and to proceed with a view to coming up with recommendations for improved FSP future implementation, effectiveness and efficiency. Results of this review exercise are summarized in this advisory note.

The study team collected and reviewed numerous assessments of Zambia's experience with FSP, and as well as studies of similar programmes in neighboring countries. The study team organized and conducted careful case review visits to three countries (Kenya, Tanzania and Malawi) and likewise sought-out input from key Zambian stakeholder assessments and relevant on-going agricultural input and productivity enhancement projects.

A draft study tour and review report was developed by the study team, and was subjected to review and debate by stakeholder in two specific review sessions (See Annex 1 for lists of participants in these review sessions.) The full Study Tour Report with detailed recommendations is attached in Annex 2, and contains schedules of all interviews conducted in each country (Study Tour Report Annexes 1 to 3).

Situational Analysis: The assessment identified key findings and stakeholder supported concerns about FSP past and current performance. These include the following:

- Little overall progress in improving productivity on maize, the principal crop targeted in FSP;
- Poor targeting of farmers/beneficiaries to achieve programme food security objectives;
- Fundamental disconnects between improved farmer, extension agent and agro-dealer training, and the distribution of productivity enhancing inputs like fertilizer and improved seed;
- Delays in input distribution beyond recommended application dates which significantly reduces the effectiveness of both seed and fertilizer use;
- Poor fertilizer use efficiency among many targeted farmers due to poor and/or missing crop/agronomic management practices and use of complementary inputs as well as recommended conservation farming practices;
- Inconsistency in FSP policy implementation, especially in reversal of plans to reduce the subsidy level, and to stimulate learning by public sector extension agents as well as private sector agro-dealers;
- Negative FSP impact on achieving a broader private sector participation in input distribution;
- Long-term concerns about the FSP sustainability; and
- Poor monitoring of program effects making it difficult to measure programme achievements against objectives.

Stakeholder Feedback on Proposed Reforms: Three stakeholder meetings (see Annex 1) contributed to and endorsed the Proposed FSP Reforms. The following were among the key stakeholder feedback on the proposed reforms:

- Change FSP name to Farmer Input Training Support Programme.

- Programme should have a foundation of strengthened links to training in order to benefit farmers through upgraded extension services as well as agro-dealer training in yield enhancing technologies such as conservation farming technologies and appropriate input application practices.
- Programme should employ a flexible (electronic) Input Voucher System and its implementation should be immediately (2009/2010 agricultural cropping season).
- Over the longer-run diversify the input pack to include other seed and the pack size should start at ½ hectare and a farmer can access up to two packs. In the first year of implementation keep the programme as simple as possible by reducing the pack size, restricting to inputs such as fertilizer and seed.
- Selection/targeting of farmers should be done at the community level using the farmer register and MACO camp officers.
- A given beneficiary shall access The Farm Input Training Support Programme for 2 consecutive seasons only, and the subsidy is to start at 50% for first season and reduce to 25% in the second season. New entrants benefiting in subsequent years will follow the same subsidy structure of 50 % in the first year and 25 % in the second year.
- Graduation is assisted by improved farmer knowledge and better payoff to the farmers own investment in improved input use. Linkages are also to be encouraged to Micro Financial Institutions and banks with rural coverage such as ZANACO and Finance Bank. Camp Officer and agro-dealer training of farmers will continue after graduation.
- Improved M/E to determine effects of the support programme and to make mid-course adjustment to better achieve objectives, which has lacked in FSP implementation

Recommendations: In order to improve the FSP's effectiveness and efficiency, the programme should be changed towards a **Farmer Input Training Support Programme** and be implemented through a **Voucher Scheme** (smart subsidy) starting in the 2009/2010 agricultural season. It is further recommended that the Ministry draw upon the expertise represented by the study team to help with the guiding of the implementation of the programme.

Implementation Actions: In order to implement the above recommendation, the following Actions need to be undertaken:

Actions	Dates
Implementation Actions for the 2009/2010 Agricultural Season	
1. Government to announce the new system and make known the quantities of inputs under the subsidy programme	By March, 2009
2. Camp farmer registers must be completed and submitted to district, province and national level	By 30th April, 2009.
3. Review of the FSP implementation manual	By 31st March 2009.
4. Printing of all programme documentation should be completed	By 1st June 2009.
5. Farmers' selection should be completed	By 1st June 2009
6. Stakeholder sensitization for farmers, suppliers, extension workers, politicians, associations, NGO's	By 31st August 2009
7. Agro dealers should receive vouchers	By 1st November 2009 and redeem them by 30th November 2009.
8. A register of Agro Dealers based at the district completed through the DACO's office	By end of June 2009.
Implementation Actions for the 2010/2011Agricultural Season	
9. Training of Agro dealers	Ongoing
10. Increase farmers contribution in the second year to 75%	By 2010
11. Diversification of composition of seed.	By 2010

Actions	Dates
12. Enhance number of importers, wholesalers and local manufactures	By 2010
13. Stockiest infrastructure development	By 2010
14. Infrastructure development	By 2010
15. Financial support to Agro Dealers	By 2010
Long Term Actions	
16. In an event that input prices in a given year rise to alarming levels, Government should consider shifting to a general subsidy program which subsidizes the importers and producers of fertilizer.	
17. Government withdrawal from input supply and distribution.	

Resource Requirements: In the 2009 National budget, Government allocated significant resources to the FSP. These resources will be used primarily to reimburse agro-dealers whom have redeemed the vouchers from farmer beneficiaries. Government and cooperating partners must partner to assist the FSP implementation office in MACO to undertake a series of start-up planning, organization and training activities. Among others, this will include rapid start efforts to complete a computerized farmer register, rapid development of the voucher programme design/implementation details, and development/printing of farmer and agro-dealer sensitization/training materials.

Expected Impacts: The expected impacts of implementing the recommendations in this Advisory Note will be, among others, improved (more productive and profitable) smallholder farmers' use as well as access to improved farm inputs; reduced household-level food insecurity and reduced rural poverty levels; increased national effective demand for fertilizers and related inputs; and increased private sector participation in input and output markets. These recommendations will also increase the potential for foreign exchange earnings from more competitive agricultural exports

Recommended Minister's Action: Adoption of the recommendations as raised in this Advisory Note.

Other Options Considered: Continuation of the FSP status quo is unlikely to trigger the expected agricultural sector performance increases and will continue inhibiting the availability of affordable and improved use of farm inputs at the farm level. Government will continue incurring large investments on subsidies with limited payoffs, and at the expense of other important developmental works to promote growth in the agricultural sector. Farming inputs distribution and availability will continue to be concentrated along the line of rail.

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Annex 1. List of Participants in Stakeholder Review

Annex 1 A. Participants in ACF Organized Stakeholder Review of Study Team Recommendations. Seeking Input from Prior Assessments and Ongoing Projects

ATTENDANCE LIST FOR THE ACF MEETING ON OBTAINING EXPERIENCES WITH THE FERTLILIZER SUPPORT PROGRAM AND SIMILAR ACTIVITIES, HELD ON TUESDAY 3RD FEBRUARY, 2009 AT THE ACF OFFICES AT 09:30 HOURS

NAME	INSTITUTION
VINCENT MKUYAMBA	OMNIA FERTILIZER
ERNEST CHIKOTE	PANNAR SEED
ROB MUNRO	PROFIT
MAVUTO CHISI	PROFIT
MARK WOOD	PROFIT
JAMES MWEEMBA	PROFIT
MASAMBA BRIAN	MPONGWE AGENT
ODD EIRIK ARNESEN	NORWEGIAN EMBASSY
PAUL KAPOTWE	PAM
LYTTON ZULU	CROPSERVE
MICHAEL WEBER	ACF/FSRP
MLOTHA DAMASEKE	USAID
JOHN KASANGA	IMCS LIMITED
DENNIS CHIWELE	RURALNET ASSOCIATES LIMITED
STEVE POWER	CARE
REUBEN CHONGO	CARE
CAROLINE CHISOOWA	MACO
HARGREAVES SIKWIBELE	MACO
MARK MBUNJI	SEED CO
HARRY NGOMA	CARE
HAMUSIMBI COILLARD	ZNFU
GREEN MBOZI	MACO
DAVID P ZULU	MoFNP
ISABEL L TEMBO	PAM
HYDE HAANTUBA	ACF
MASIYE NAWIKO	ACF

ANNEX 1 B. Seeking Input from Stakeholders on the Draft Study Team Report

ATTENDANCE LIST FOR THE ACF MEETING ON 'THE PROPOSED REFORMS FOR THE ZAMBIAN FERTILIZER SUPPORT PROGRAM.' HELD ON TUESDAY 19TH FEBRUARY, 2009 AT THE ACF OFFICES AT 09:00 HOURS

NAME	INSTITUTION
BOTHA FANSON	ZNFU EASTERN PROVINCE
JUSTIN MWANSA	MACO
ROYGER. S PHIRI	NAPSSPZ
DR SIMAINGA S	MACO
NGAMBI C	MACO -MONGU
DAVID M MUNDIA	MACO
M MUKELABAI	MACO -NAIS
COLLINS NKAJIKO	CFU
DR KABWE PUTA	MACO -SOLWEZI
CHARLES SONDASHI	MACO –NORTH WESTERN
DR O KABIVDA	MACO – CHIPATA
LYDIA SM NDULU	MACO – COPPERBELT
L LIYEMBANI	MACO – NORTHERN
H NGOMA	CARE
E JERE	ZWFU
CECILIA V MAKOTA	ZAM WOMEN IN AGRICULTURE
BARTH MNSENGE	ZNFU
SIMON MALAMBO	ZNFU
CHIKWANDA HENRY	ZNFU
ODD E ARNESEN	NORWEGIAN EMBASSY
MOOSHO IWAKANDO	NORWEGIAN EMBASSY
VLADINIR RISTANOVIC	MTI SEED
W RUTHURFORD SMITH	PANNAR SEED
FRIDAY A SILAVWE	ZNFU
ROSE MUBITA	ZNFU
XAVIER ROVILLARD	MACO EU
ODINEGA CHISALA	MACO
PHILIP S KALIMBA	MACO
GEORGE L SAMIHAMBA	MACO
DR A NANSUNGW	MACO
SYLVESTA P MAPULANGA	ZAMSF
JOHN A SANDWE	ZAMSF
BEN ZULU	ZAMSEED
CHANCE KABAGHE	FSRP
PATRICK CHIBBAMULILO	JICA
GREENSON B IKOWA	ZNFU
FRANCESCA DIMAURO	EUROPEAN UNION
MOSES C KAPUKA	MACO
JIM BEJEMU	F.A.O
MLOPHA DAMASEKE	USAID
MIKE SIAME	KAMANO SEED
WILMA VILJANMAA	EMBASSY OF FINLAND

MUNAKOMBWE J.W.H	ZNFU
PAUL CHISULO	MACO
EDDY DELAUNAY BELLER	E.C DELEGATION
BALLARD ZULU	USAID
EVA OULSSUN	SIDA EMBASSY
RICHARD N SOKO	NCZ
AGNESS K NGOLWE	SWEDISH EMBASSY
CHARLES T MAGUGWI	FISHERIES
GEOFFREY PHIRI	ZANIS
THOMAS MUKUBWE	MACO
HON A MWAMBA	NAZ
MARY NGOMA	ZAMBIA COOPERATION FEDERATION
TIRAS J BANDA	ZCF
DORA M PHIRI	MACO- HQ
AGATHA BECKETA	ZAMBIAN FERTILIZER
ANTHONY CHAPOTO	FSRP
ZIMBA KINGSLY	MACO
JACOB M SHAWN	MACO- MUNGUI
JOHN M KASANGA	IMCS
KAMRAN OSMAN	FAIRFIELD COMMODITIES / SASOL
ROB MURO	PROFIT
FELIX EDWARDS	WFP
AUGUSTINE MUTELEKSHA	ACF
RORIA M KATYAMBA	MACO-ABM
MP MANGANI	MACO – DVLD
D MALWELE	NATIONAL ASSEMBLY
H R KANEMA	LDT
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ANNEX 1 C. Participants in ACF/FSRP Ibis Garden Orientation Meeting with the Agriculture and Lands Committee of Parliament

SHARING EVIDENCE BASES RESEARCH RESULTS WITH THE PARLIAMENTARY COMMITTEE FOR AGRICULTURE AND LANDS HELD AT IBIS GARDENS FROM 20 TO 21 FEBRUARY 2009.

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ANNEX 2. Report of Study Tour
(Including annexes of study tour agenda, people/organizations visited, resource materials consulted by country, including Zambia, and examples of voucher experiences and agro-dealer training activities in Zambia)

Report on Proposed Reforms for the Zambian Fertilizer Support Programme

February 2009

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Executive Summary

This report presents: 1) a situational analysis/review of the Fertilizer Support Programme (FSP) past performance; 2) findings of the Zambia fertilizer reform study tour team on past performances and experiences of regional agricultural inputs subsidy programmes in Kenya, Tanzania and Malawi; and 3) the study team's proposed reforms of Zambia's agricultural inputs procurement and distribution systems. Specifically, the report outlines proposals responding to various stakeholders' concerns about the Fertilizer Support Programme's:

- Poor targeting of farmers/beneficiaries
- Delays in inputs distribution;
- Limited programme impact on agricultural production and impact on food security;
- Policy inconsistencies on some key programme implementation features, especially with regards to the programme's plans to reduce subsidy levels, increase number of beneficiaries and the need to stimulate agro-dealer development;
- Poor monitoring of programme effects, a situation which has made it difficult to clearly point out programme achievements against its objectives; and
- Long-term concerns about the FSP sustainability.

To come up with the above outlined results, a representative study team of major agricultural industry players and stakeholders was established by the Ministry of Agriculture and Cooperative (MACO) following a Cabinet directive to review the FSP implementation thus far, and with a view to coming up with recommendations for improved FSP future implementation, effectiveness and efficiency. Results of this review exercise are summarized below.

FSP PAST PERFORMANCE: During the first seven years of FSP implementation, the programme has undoubtedly improved small scale farmers' access to agricultural inputs (i.e. fertilizers and improved maize seeds). Since inception, FSP has managed to distribute a total of 422,000 Mt of fertilizer (valued at ZMK1,361.1 billion), covering a total of 1,505,000 hectares of small scale maize. Annually, the programme supplied an average of 60,000 metric tonnes of fertilizer covering about 150,000 small scale farmers, (each with a 1 hectare input pack for maize) countrywide.

The above positive results notwithstanding, there has been a number of concerns about FSP past performance, especially with regards to FSP's beneficiary targeting; impact on household and national food security (value for money); effect on private sector investment and participation in agricultural inputs supply markets; and the programme's long-term sustainability, given the ever increasing competition for national resources by various sectors.

Due to weak organizational structures and leadership at districts and local levels, there has been an increase in cases of inaccurate targeting and selection of FSP beneficiaries. In some cases smallholder farmers who do not deserve subsidized inputs have ended up benefiting from FSP. As a result, the programme has also found it very difficult to establish the actual number of beneficiaries under this programme.

It has also not been easy to measure or establish the exact FSP impact on household and national food security mainly due to weak FSP beneficiaries' performance monitoring mechanisms. FSP effect to agricultural productivity and impact on food security has been compromised by poor fertilizer use efficiency by FSP beneficiaries. For instance, the 2004 CSO/MACO crop forecast data estimated an average maize yield of 2 metric tonnes per hectare (about 1 metric tonne less the expected FSP maize yield per hectare) among small scale farmers who used FSP fertilizers. The main reasons for low maize yields have been poor agronomic practices like delayed planting, poor and untimely fertilizer application, weed infestation among others.

A limited number of fertilizer companies have been able to participate in the procurement and distribution of FSP fertilizers since FSP inception. The situation is however completely different with regards to seeds, where a larger number of seed companies have been able to participate under the FSP. If left unchecked, such a development could lead to a lesser competitive fertilizer procurement distribution market in the country.

FSP implementation has also been characterized by a number of policy inconsistencies, especially with regards to level of subsidy and farmer graduation. Initially the level of government subsidy per FSP input pack was expected to gradually decrease while FSP beneficiary contribution was expected to steadily increase from 50% towards 100%. For some reason, this has not happened as initially planned. As a result it has been difficult to make beneficiaries to graduate out of FSP.

REGIONAL EXPERIENCES ON GOVERNMENT SUPPORTED INPUTS PROGRAMMES: All three countries which were visited by the study team have run subsidized agricultural inputs programmes, as a way of helping to improve access to improved inputs among resource constrained small scale farmers and to improve their household and national food security. Each of these countries' input subsidy programmes are implemented differently and posses a number of unique features.

When compared to the Tanzanian and Malawian agricultural inputs subsidy programmes, the Kenyan inputs subsidy programme (NAAIP) is unique with regards to its "one off subsidy" approach for each of the beneficiaries. NAAIP beneficiaries receive subsidized inputs only once and are weaned of thereafter. After a year of receiving subsidized inputs, farmers are linked to Equity Bank for seasonal input loans. The rationale behind this is that Government does not want to create perpetual dependency among beneficiaries. Farmer's names are also electronically registered and this makes beneficiary tracing easy.

The Tanzanian inputs voucher programme seems more superior in that vouchers are reimbursed at a local Bank; in this case Micro Finance Bank of Tanzania. The programme has also a much diversified input pack mix, thereby enabling farmers to access other agricultural inputs like agrochemicals, seedlings for plantation crops and other seeds for crops like rice and sunflower.

Malawi on the other hand, has a flexible voucher which is given to farmers who have not benefited from the full input pack (the fertilizer and seed vouchers). The Malawian input voucher is specific to the target group's average of cultivated land size. The Malawian input subsidy programme constitutes about 80% of the overall input requirements for the country. The programme is the main driver of the agricultural sector.

PROPOSED REFORMS OF THE ZAMBIAN FSP: In order to improve FSP effectiveness and efficiency, especially with regards to timeliness and cost-effectiveness of inputs procurement and distribution, FSP impact on food security and farm incomes, and a better value for money, the study team proposes a change in the mode of inputs procurement and distribution, from the current system to a **Voucher Based Inputs Supply System.** A Voucher Based Inputs Supply System will:

- ☞ Enable FSP empower beneficiary farmers with requisite purchasing power (in form of a discount voucher) to purchase inputs of their choice at their nearest input outlets, resulting into timely distribution of inputs;
- ☞ Help minimize administrative burden and costs, thereby reducing direct government involvement in inputs procurement/importation and in-country distribution;
- ☞ Stimulate market competitiveness and in turn encourage the development of a private sector led agro-dealer (stockists) inputs supply networks in agricultural areas; and
- ☞ Encourage private sector participation in agricultural inputs importation, manufacturing and in-country distribution, amongst other attendant benefits of a well functioning voucher based inputs distribution system;

Other specific proposed reforms to the current FSP are as follows:

- ☞ Establishment of agro-dealers' supply networks in rural areas (to be done in collaboration with on-going private sector initiatives)
- ☞ Flexible FSP input pack and size (min 0.5ha and max 1 hectare input packs with options of including seeds of other preferred crops and/or agrochemicals);
- ☞ Establishment of up-to-date computerized farmer register/database and camp based beneficiary selection criteria;
- ☞ Establishment of functional linkages to financial institutions for inputs and stock credit facilities for farmers, agro-dealers and fertilizer importing and manufacturing companies; and
- ☞ Improved inputs utilization and beneficiaries' performance monitoring mechanisms.

1. Introduction

Following concerns raised by stakeholders on the performance of the FSP with regards to poor targeting, delays in input distribution, limited private sector participation, poor fertilizer utilization by small scale farmers, inconsistency of policy implementation especially in reversal of plans to reduce the subsidy level and to stimulate agro-dealer development, and the long term sustainability of the Program, a representative team of major industry players was put in place to review and recommend proposals to reform the Zambian Fertilizer Support Programme.

This report presents a situational analysis on past and current performance of Zambia's Fertilizer Support Programme (FSP); findings of the Zambia fertilizer reform study tour on past and current performances and experiences of regional agricultural inputs subsidy programmes in Kenya, Tanzania and Malawi; and it outlines the study team's proposals meant to help improve the effectiveness and efficiency of FSP.

1.1 Situation Analysis/Problem Statement

Like many other developing countries in Africa, Zambia is characterized by:

- Poor access to improved inputs (for instance prior to FSP, only 20 and 30% of small scale farmers accessed fertilizer and improved seeds respectively);
- High food insecurity and poverty levels, with about 67% and 73% food insecure and poverty stricken households respectively (PRSP, 2001);
- Low farm incomes;
- Low national effective demand for fertilizer;
- High cost of farm inputs (fertilizers and seeds) at Farm-gate levels;
- Limited private sector participation in input and output markets.

In order to improve smallholder farmers' access to affordable improved inputs; reduce food insecurity and poverty levels; increase national effective demand for fertilizers; and to encourage private sector participation in input and output markets, the Government of the Republic of Zambia has put in place policies meant to liberalize agricultural markets. It is on this basis, that Government is running "a managed" transition towards full market liberalization. With supportive agricultural policy in place, emphasis is now on gradual disengagement, from agricultural services provision in order to give room to the private sector. While some positive developments such as increased out-grower schemes and contract farming, crop diversification and changes in land management strategies have been recorded, the private sector has, however remained constrained in providing input and output marketing services.

In response to the above, Government designed the Fertilizer Support Programme (FSP). FSP is meant to improve: 1) household and national food security and incomes; 2) access to agricultural inputs for smallholder farm households; and 3) build the capacity of the private sector in inputs marketing. The FSP is also meant to help cushion smallholder farmers from the adverse effects of unfavourable weather conditions that destroyed the asset base of smallholder farmers in Zambia.

FSP has been in operation for seven (7) years and has since managed to distribute a total of 422,000 Mt of fertilizer, valued at ZMK1, 361.1 billion, to cover about 1,505,000 hectares of small scale maize. The table below summarizes the FSP performance since 2002/2003 agricultural season to-date.

Table 1: FSP Performance since Inception

Season	Budgeted (ZMK billion)	Fertilizer Amount (MT)	Number of Farmers	Expected Production in (MT)
2002/03	100	48000	120,000	360,000
2003/04	114.5	60,000	150,000	450,000
2004/05	112.6	50,000	125,000	375,000
2005/06	140.0	50,000	125,000	375,000
2006/07	252.0	84,000	210,000	630,000
2007/08	150.0	50,000	125,000	375,000
2008/09	492.0	80,000	200,000	600,000
TOTAL	**1,361.1**	**422,000**	**1,505,000**	**3,135,000**

Source: MACO/FSP Annual Reports

The above FSP performance figures notwithstanding, there have been a number of stakeholders' concerns about FSP effectiveness and efficiency. Recent comparative analysis demonstrates Zambia's poor record in reaching targeted farmers through subsidized input programmes over the past decades. In addition private input importing and distribution networks are not growing fast enough and are fundamentally discouraged by existing programs. Specifically, stakeholders have raised the concerns about FSP past and current performance. These include the following:

1. Poor targeting of farmers/beneficiaries;
2. Delays in input distribution;
3. Poor fertilizer use efficiency among targeted farmers;
4. Inconsistency in policy implementation, especially in reversal of plans to reduce the subsidy level, and to stimulate agro-dealer development;
5. FSP impact on private sector participation;
6. Long-term concerns about the FSP sustainability; and
7. Poor monitoring of program effects making it difficult to measure programme achievements against objectives.

Poor Beneficiary Targeting and Selection

The selection of beneficiary cooperatives and farmer organizations and farmers under FSP has been by the District Agriculture Committees (DACs). However, most of the DACs have been either non-existent or poorly managed during the most part of FSP implementation period. This has led to increased cases of inaccurate targeting and selection of beneficiaries. In some cases smallholder farmers who do not deserve subsidized inputs have benefited from FSP. The programme has found it very difficult to establish the actual number of beneficiaries under this programme.

Delays in input distribution

Delays in the release of funds by the Ministry of Finance and National Planning and the prolonged tendering process have led to delayed payments to input suppliers and service providers under the FSP. Further, the annual contracts for the supply of inputs under the FSP do not provide incentives for investment and availability of inputs all year round. The suppliers of fertilizer are unable to make long term plans to supply fertilizer in rural areas because of uncertainty.

Poor Fertilizer Use Efficiency

Another critical stakeholders' concern about FSP has been the seemingly limited programme impact on agricultural productivity and its consequential effects on household and national food security. The 2004 CSO/MACO crop forecast data estimates an average maize yield of 2 metric tonnes per hectare among FSP beneficiaries. Such a yield level means a reduction by about 1 metric tonne (33%) of maize per FSP sponsored hectare. Implicitly, failure by FSP beneficiaries to achieve the expected FSP minimum of 3 metric tonnes per hectare means poor fertilizer use efficiency among FSP beneficiaries. This in turn limits FSP impact on agricultural production and food security. There is therefore need for deliberate measures to help improve productivity among FSP beneficiaries. It has also been difficult to establish how much of FSP subsidized inputs have been used on maize production or other crops.

Policy Inconsistencies in FSP Implementation

FSP implementation has also been characterized by a number of policy inconsistencies, especially with regards to level of subsidy and farmer graduation. Initially the level of government subsidy per FSP input pack was expected to gradually decrease from 50% in the first year to 25% in second year and zero subsidy in the third for each beneficiary. Conversely, each FSP beneficiary was expected to contribute 50% of total costs of inputs in the first year and increase to 75% in the second year, and finally meet the full inputs cost in the third year. For some reason, this has not happened as initially planned. Subsidy levels have instead steadily increased from 50% to 60% in 2007, then to about 85% in 2008/2009 agricultural season. The increasing subsidy levels present challenges in the graduation of programme beneficiaries.

FSP Impact on Private Sector

Notwithstanding the initial FSP aims of wanting to ensure competitiveness and transparency in the procurement and distribution of agricultural inputs, there are concerns that FSP is slowly creating a monopoly in the inputs industry (especially with regards to fertilizer procurement and distribution). Only a limited number of fertilizer companies have been able to participate in the procurement and distribution of FSP fertilizers. The situation is completely different with regards to seeds, where a larger number of seed companies have been able to successfully participate under the FSP. If left unchecked, such a development could lead to a lesser transparent and uncompetitive inputs distribution market.

Long-term Concerns about FSP Sustainability

Another very critical factor about FSP has been the stakeholders' concerns about the efficiency of the programme. In the absence of a comprehensive analysis of economic efficiency and programme effectiveness, stakeholders are wondering if at all Zambia is getting the best value for money from FSP interventions, especially that more money is being allocated to FSP every year. In view of such concerns, there is need for improved programme monitoring and comprehensive analysis of economic efficiency and programme effectiveness.

Poor monitoring of program effects

FSP was not designed with adequate monitoring and evaluation instruments to ensure that the programme implementation runs according to plan. Hence there has been ineffective monitoring and evaluation during its implementation.

Given the various concerns raised by stakeholders, a team was constituted to review the implementation of the Fertilizer Support Programme. The team undertook a study tour to Kenya, Tanzania and Malawi to in order to learn experiences of government supported input distribution programmes in existence in the region.

1.2 Purpose and Objectives of Study Tour

The principal objectives of the study tour that was undertaken from 14th t0 24th February 2009, were to better understand various approaches by national Governments in Kenya, Tanzania and Malawi to (i) effectively build capacity among the resource constraint smallholder farmers for strengthening their ability to acquire input delivery services under full market conditions and (ii) assist private sector players in developing a service delivery network that reaches out to previously under-serviced rural farming communities.

2. Key Features of Regional Agricultural Inputs Subsidy Programmes

A number of key features for each of the subsidy programmes in the 3 countries were identified and summarized for purposes of sharing past programme performance experiences. For easy comparison, key features are presented in accordance with the following categories:

1. Procurement and Distribution Process;
2. Subsidy Programme scope;
3. Inputs Pack Size;
4. Beneficiary selection criteria; and
5. Other features unique to each of national subsidy programme.

2.1. Kenya's Agricultural Input Supply System

The subsections below summarize the key features of Kenya's Agricultural inputs distribution policy and initiatives.

2.1.1 Procurement and Distribution

The Kenyan government liberalized the importation and distribution of fertilizers in 1991. Prior to this, government used to control fertilizer importation into the country. Currently, Kenya's bulk of fertilizer, including estate fertilizer (tea, coffee, sugarcane and flowers), is imported by the private sector. Since liberalization of the fertilizer trade, there has been a significant increase in Kenya's fertilizer demand from about 150,000mt in 1986 to 270,000mt in 1996. The country now uses up to 450,000mt of fertilizer and about 40,000mt of improved seed. The Kenyan government has been consistent with its liberalized policy on fertilizer importation and distribution for the past ten years. This has facilitated the growth of a strong private sector participation in the distribution of agricultural inputs in the country. There are about 5 big strong private companies involved in fertilizer marketing with about 500 wholesalers and 8,000 small holder stockist networks countrywide. As a result, the distances from farm gate to the nearest depot have been drastically minimized to an average of about 4 kilometres.

2.1.2 Process Subsidy Programme Scope

Following the 2006 Abuja conference and in an attempt to improve access to quality inputs by small scale farmers, the Kenyan government initiated a National Accelerated Agriculture Input Access Project (NAAIP). Inputs under this programme are distributed using a voucher system through private sector led agro-dealer networks which have been developed throughout the country. The adoption of the use of the voucher system was meant to ensure that efforts made by the private sector are not disturbed. The development of the agro-dealer network has been supported by substantial investments in road infrastructure networks by the government. NAAIP seeks to address the problem of food security and poverty among resource poor farmers (with land size of 2.5 acres or less); by providing start-up inputs grant and establish linkages with input dealers, produce markets and financial services. The project is planned to run from 2006 to 2010 and targets about 2.5 million small scale farmers by the end of its life span. Annually, the project targets 45,000 beneficiaries. In 2007, government allocated about US$3.3 million and US$4 million (2.3% of the US$17 million Ministry of Agriculture budget) in 2008 budget. This subsidy programme is about 13% of the overall total budget allocation to the agricultural sector.

2.1.3 Input Pack Size

Under this project a farmer is given a 50kg bag of basal (Di Ammonium Phosphate (DAP)), 50kg bag of top dressing (Urea) and a 10kg bag of maize seed. This input pack translated to US$87 per farmer in 2006 and increased to US$100 per farmer in 2007. The inputs under the projects are at an agreed price, which is about 10% less than the prevailing market prices. Selected farmers receive input vouchers (valid for 60 days) from government, which they redeem at their nearest accredited stockists/agro-dealers. The agro-dealers thereafter take vouchers to the Ministry of Agriculture for re-imbursement. The use of vouchers has enabled farmers to access inputs within their localities and in a timely manner. The voucher system also gives farmers room to choose their preferred inputs.

In tandem with the voucher programme, government negotiated a US$40 million credit facility with Equity Bank to provide loans to farmers and stockists (e.g. Equity Bank lends at 10% and 15% to farmers and stockists respectively). **Citizens Network for Foreign Affairs** (CNFA), an international NGO (originally American), supported by the Alliance for a Green Revolution in Africa (AGRA), guarantees the credit to farmers at 3% value of credit amount. These loans enable stockists to procure input supplies in advance; and farmers to easily access input loans after they are weaned out of the subsidy programme. The government has forced the programme to be expanded against the original plan of starting in few places. This has put pressure on CNFA on the capacity building training programme for the agro-dealers.

2.1.4 Beneficiary Selection

NAAIP uses a village based beneficiary selection criteria, where community based selection committees and Village Assemblies scrutinize and approve lists of selected beneficiaries for each year. Upon approval, lists of beneficiaries are submitted to the Ministry of Agriculture for final approval and voucher issuance. The beneficiary list is computerized and this makes it easy for the Ministry of Agriculture to monitor and trace the beneficiaries using the electronic database. For one to qualify as a NAAIP beneficiary, such a farmer should meet the following conditions:

- Own at least an acre of farm land;
- Be vulnerable,(either be a widow, orphan, child headed household, HIV/AIDS affected/infected);
- Be willing to join a group;
- Show willingness to contribute towards mobilization of resources for input ; and
- Willingness to be trained.

2.1.5 Features Unique to NAAIP

When compared to the Tanzanian and Malawian agricultural inputs subsidy programmes, NAAIP has the following Key features unique to its operations: i.e. one off subsidy for each of the beneficiaries. NAAIP beneficiaries receive subsidized inputs only once and are weaned off thereafter. After a year of receiving subsidized inputs, farmers are thereafter linked to Equity Bank for seasonal input loans. The rationale behind this is that the Government does not want to create perpetual dependency among beneficiaries. Farmer's names are electronically registered and this makes tracing easy.

2.2 Tanzania's Input Supply System

The Tanzanian inputs supply system was also studied and its key features are summarized as follows:

2.2.1 Subsidy Programme Scope

The Tanzanian government used to subsidize fertilizer through a reimbursement programme at the national level in the past years. Even with this type of subsidy, government used to contract the private sector to import specified quantities of fertilizer into the country. Under this bulk procurement and reimbursement system, the government negotiated with the private sector, the national/standard price at which fertilizer would be sold to farmers. Government reimbursed the price differential to the private sector. Under this type of subsidy, the Tanzanian government noted that the reimbursement programme did not benefit the farmers at the grassroots and therefore decided to change the programme.

As a result of the concerns noted in the reimbursement programme, the government introduced a voucher system to distribute agricultural inputs in the country in 2008/2009. The objective of voucher input programme is to promote proper utilization of fertilizer to enable farmers increase maize crop productivity. The programme targets 700,000 small scale farmers. For the 2008/2009 agricultural season, the programme has been allocated US$51.5 million targeting 155,000 tonnes of fertilizer, 6,000 tonnes of improved seeds (i.e. maize, rice and sunflower), 2,000 litres of agro chemicals, 8,000,000 and 9,000,000 improved tea and coffee seedlings to cater for 700,000 farmers.

2.2.2 Procurement and Distribution Process

The voucher programme is being implemented in regions and some districts with potential for maize production. Even under the voucher system, importation of most fertilizer and other agricultural inputs is mainly done through the private sector. A government owned Tanzania Fertilizer Company limited, which was originally established to manufacture fertilizer, is also involved in fertilizer importing and trading and has been competing alongside with other private sector companies with very little support from the government. The factory was established in 1972 and closed in 1992. The company changed its mandate from manufacturing to trading and also participated in the importation and distribution of subsidized inputs under the voucher programme.

Inputs under the subsidy programme are distributed through an agro-dealer network developed across the country. Farmers are expected to take the vouchers to an agro-dealer and make a top up payment and secure inputs. The network of the agro-dealers has grown and the government has up scaled the programme. CNFA provides regular business and management training to the agro dealers. CNFA also provides guarantee funds being managed by the national Microfinance Bank. Like in Kenya CFNA in Tanzania is also being supported by the Alliance for a Green Revolution in Africa (AGRA). After training, these dealers are accredited and eligible to participate in the voucher programme. With accreditation, an agro-dealer can access credit facility from the National Microfinance Bank (NMB). NMB is the contracted bank that redeems the agriculture input vouchers. The Bank also hosts the Guarantee Fund to agro dealers. The Agriculture Council of Tanzania provides overall planning, monitoring and evaluation of the Tanzania Agricultural Inputs Partnership.

2.2.3 Input Pack Size

Beneficiaries under the input voucher programme receive a one (1) acre input pack for maize consisting: 1 x 50kg of basal fertilizer (DAP); 1x50kg of Urea and a 10kg of maize seed. To allow for diversification of crop commodities, beneficiaries are also given cashew, tea and/or coffee seedlings, agrochemicals; and seed for rice and sunflower. There is no specified time under which beneficiaries are expected to be weaned off the programme.

2.2.4 Beneficiary Selection

In Tanzania the selection of farmers is done by the Village Inputs Committee of the Village Assembly which is a local authority establishment. For a farmer to be selected, he/she must meet the following criteria:

- Must be a permanent resident of a said village
- Must have own field which is cultivatable but produces less due to low or non-utilization of modern agricultural inputs
- Must be able to follow the recommended agricultural practices
- Be able to pay the difference of the voucher value (subsidy) and the market prices of the recommended inputs for crop productivity and production

2.2.5 Features Unique to Tanzanian Model

The Tanzanian inputs voucher programme seems more superior to the Kenyan input subsidy model in that vouchers are reimbursed at a local Bank; in this case Micro Finance Bank of Tanzania. The programme has also a much diversified input pack mix, thereby enabling farmers to access other agricultural inputs like agrochemicals, seedlings for plantation crops and other seeds for crops like rice and sunflower.

2.3 Malawi's Input Supply System

The Malawian agricultural input subsidy programme was also studied in detail with its key features summarized below.

2.3.1 Subsidy Programme Scope

In Malawi the main objective of the Agricultural Input Subsidy Programme is to improve food security and improve accessibility and affordability of agricultural inputs among most vulnerable farmers in the country. The programme started in 2005 and targets 1.7 million small scale farmers annually.

The programme in Malawi covers inputs for maize, tobacco and legumes. However, maize and tobacco dominate the programme due to the importance of these crops in the Malawi economy.

2.3.2 Procurement and Distribution Process

Importation of fertilizer and other agricultural inputs is through government tenders issued to the private sector. Government contracts private sector to supply input requirements under the subsidy programme. After importation, contracted private sector firms deliver fertilizer to designated government owned warehouses for onward distribution throughout the country.

Distribution of fertilizer under the subsidy programme is done by two government owned companies. In 2006/2007 the government involved some private companies to participate in the programme. However, there were complaints that most coupons were redeemed in exchange for other goods like bicycles and groceries. In trying to resolve this problem, government has now decided to only use the two parastatal bodies to distribute fertilizer to farmers. This again has displaced the private sector participation in agricultural input marketing. However, this subsidy programme on fertilizer runs parallel with the voucher programme on seed, which is mainly distributed through the private sector. The two government companies have established depots throughout the country. The procurement of inputs is done under an international competitive bidding process and an internal procurement committee evaluates the tender documents. Successful bidders will later sign a contract with government. The importation of fertilizer is done by the private sector. The inputs will be distributed to designated warehouses under the two government owned companies in the main three regions. The two companies later distribute the inputs to designated beneficiaries. Transport services are contracted out to private transporters.

2.3.3 Input Pack Size and Mix

The Malawian subsidy programme supports a farmer with a 50 kg bag of basal (DAP), 50kg of top dressing fertilizer and 10 kg bag of maize seed. The programme also supports farmers with other inputs such as tobacco, groundnuts, soyabeans and beans.

2.3.4 Beneficiary Selection

The Ministry of Agriculture has developed a distribution matrix for each village and section within Extension Planning Areas (EPAS) based on the number of farm families. The list of beneficiaries for each village is availed at an open forum and beneficiaries are identified and pre-registered according to the laid out criteria. Only one beneficiary per household is registered based on the following criteria:

- A resource poor Malawian farmer that owns a piece of land (the household should own land and should have be cultivated during the season)
- Guardians looking after physically challenged persons (care should be taken to offer chance to those looking after the physically challenged. The community should determine the legibility of the guardian)
- Resident of the village (the community shall identify the bona fide residents of the village as beneficiaries)
- The vulnerable group (These households could be child headed, female headed or orphan headed and those with infected or affected with HIV and AIDS)

2.3.5 Features Unique to Malawian Inputs Model

Malawi has a flexible voucher which is given to farmers who have not benefited from the full input pack (the fertilizer and seed vouchers). The Malawian input voucher is specific to the target group's average of cultivated land size. The Malawian input subsidy programme constitutes about 80% of the overall input requirements for the country. The programme is the main driver of the agricultural sector.

2.4 Summary Comparison of findings from the Tri-nations input Support Study Tour

	Kenya	**Tanzania**	**Malawi**
Name of Input Support programme	**National Accelerated Access Agriculture Input Programme**	**Agriculture Input Subsidy through Voucher**	**Input Support Programme**
Objectives	Increase access to quality inputs to poor small holder farmers	Promote proper utilization of fertilizer to enable farmers increase maize crop productivity	Improve food security; Improve food accessibility and affordability of agro-inputs among vulnerable farmers in the country
Input support target group size	2,500,000	700,000	1,700,000
National Fertilizer Consumption (MT)	451,240	215,411	213,000
o/w fertilizer Input support expressed as percent	4,500 1	96,820 45	170,000 80
Input Support Composition	One 50kg of basal fertilizer (DAP)	One 50kg of basal fertilizer (DAP)	Maize One 50kg of basal fertilizer

	Kenya	Tanzania	Malawi
	One 50kg of basal fertilizer (Urea) One 10kg of maize seed	One 50kg of basal fertilizer (Urea) One 10kg of maize seed Cashew seeds Agro-Chemicals Tea and Coffee seedlings Rice and Sunflower	(DAP) One 50kg of top fertilizer (Urea) One 10kg of maize seed or Tobacco One bag of D compound and one bag CAN Tobacco and legumes seeds
Input distribution mode	Voucher redeemed at stockists; Stockists reimburse	Voucher through smart subsidy redeemed at the local bank	Vouchers (paper trial) are redeemed at the Ministry of Agriculture.
Scope of programme	451,240 MT of fertilizer 40 MT of improved seed (maize, Rice and Sunflower)	96,820 MT of Fertilizer 1,769 MT of improved seed (maize, Rice and Sunflower) 1,100 MT and 50,000 litres of Agro-chemicals, 5 million improved coffee seedlings	6000 MT of Maize Seed, 1000 MT of legumes o/w 400MT of groundnuts 300MT of Soya beans 300 MT of beans
Cost of the subsidized fertilizer	KShs 4,000 (US$ 53.33)	**(Data needed)**	MK 950 (US$ 6.33)
Cost of fertilizer on the commercial market	KShs 6,400 (US$ 85.33)	**(Data needed)**	MK 14,500 (US$ 96.66)
Subsidy as Percent of the Ministry budget	2.3 percent	**(Data needed)**	
Level of private sector participation	Importation and distribution; To-date 300 wholesalers 5,000 stockists established	Importation and distribution through agro-dealers;	Only local distribution. Government imports through a Parastatal company (ADMAC)
Parameters in targeting beneficiaries	Poor and privileged farmers Farmer groups with a common interest	Permanent resident of a said village; Has a field which cultivatable but produces lees due to low or non-utilization of modern agricultural inputs; Must be able to follow the recommended agricultural practices; Be able to pay the difference of voucher value (subsidy) and the market prices of the recommended inputs for crop productivity and production	Resource poor Guardian looking after physically challenged persons Resident of the village Vulnerable
GDP in US$	**6.96 billion**	**16.18 billion**	**2.1 billion**
Percent. contribution of Agric to GDP	**28%**	**40%**	**42%**
Percent of the subsidy of the GDP	**(Data needed)**	**(Data needed)**	13.5 percent
Graduation period from ISP	One year	One year	Perpetual

3. Proposed Reforms of the Zambian FSP

The study team process has worked over the past 3-4 months in planning the study programme, in reviewing Zambian experiences and in consulting with selected stakeholders, and in final deliberations.

To reach agreement on proposals for going forward, apart from drawing on the regional experiences, the Ministry of Agriculture and Cooperatives of Zambia has already been involved in some internal evaluations of the FSP which have been taken into consideration in this evaluation and coming up with the set of recommendations presented below (See annex 3 of this report for a list of resource materials by country that the team drew upon.). In addition to consulting the FSP self-evaluation, a number of local private companies, NGO's., agricultural development projects and other government agencies were consulted as part of the fact finding efforts of the team. Finally, several other consultancy reports which have evaluated the FSP programme in different years of operation have been consulted (see Annex 3.).

In summary, from this review, consultation and team deliberation process, ZAM-FAST offers the following proposed reforms.

3.1. Overall objective

The overall objective of the input support programme is to increase small scale farmers' productivity in order to contribute to improved household and national household food security.

3.2 Specific Objectives

Specifically, the fertilizer support programme should redouble efforts to:

- Improve access of small scale farmers to agriculture inputs
- Increase private sector participation and agro dealer network expansion in input marketing.
- Ensure timely, effective and adequate supply of agricultural inputs to small scale farmers.

3.3 Procurement

Importation and manufacturing of fertilizer will remain fully liberalized while GRZ will strengthen market/industry coordination, regulation, and competition enhancement efforts, as well as continue important trunk line, and rural road infrastructure which is fundamental to bringing down the long-run cost of using improved agricultural inputs.

The private sector will be encouraged to import/manufacture all fertilizer requirements for the country. The government will announce the amount of inputs to be purchased by farmers via an input voucher system under the Fertilizer Support programme early in each season in order enable the private sector to make their importation plans in good time to cater to the sum of FSP and private/commercial fertilizer import demands. To ensure that the intended farmers have the benefits of the input subsidy from the government programme the selected farmers will, from now onwards be given supplemental resources directly from government so that they can buy desired inputs directly from agro-dealers.

3.4 Distribution (Agro-dealer network)

All the inputs under the Fertilizer support Programme will be distributed through the existing and to be upgraded private sector agro dealer network. Many private input agro-dealers are already operating, as documented in the CSO/MACO crop forecast of 2007/2008 which found that small and medium farmers obtained significantly more fertilizer from commercial/private sources than they did from the FSP programme. Yet more effort is required to strengthen agro-dealers. This will have to be developed with efforts from government with the support from other collaborating partners. The fertilizer and seed companies will be expected to deliver inputs to agro dealers and be expected to sell them to various farmers at competitive prices.

3.5 Pack (mix and size)

The programme will support a minimum of half hectare and a maximum one hectare of maize input pack per beneficiary. As part of the up to one hectare pack, the programme will be flexible and may also support beneficiaries with any of the following crops: rice, sunflower, groundnuts, beans and soyabeans. Herbicides, plant protectant chemicals and lime may also be considered under the programme.

3.6 Beneficiary Selection

The beneficiaries will be selected at camp level based on the farmers' register. The selection criteria will include:

- A Zambian resident in the participating Camp
- Capacity to grow half hectare to five hectares
- Should be trained (or willing to be trained) in conservation agriculture and proper use of productivity enhancing inputs
- Capacity to pay farmers' contribution
- Should not be a current beneficiary of the Food Security Pack, among others
- Special efforts should be made to assist farmers who have graduated from the Food Security Pack programme.

3.7 Farmer Graduation

Small and medium-scale households participating in the program will agree to be graduated from subsidized assistance after 2 cropping seasons of participation. In addition, programme participants will agree to contribute 50 % of the cost of the inputs in year one, and 75 % of the cost in year two. These measures are important to build from the beginning an existing strategy to assure programme sustainability and to encourage farmers to become self-reliant in obtaining agricultural inputs.

A clear and practical graduation policy will also assure government hat it can assist over time a larger number of smallholders. The graduation will be assured/controlled by the use of the farmer register at the camp level, and by a certification to be given by the camp officer that after two years a given farmer has indeed graduated. In addition, any farmers in the program during the allowed two-seasons of participation will also be asked to sign a certification in the second year that he/she agrees to graduate at the end of the second season.

The certification signed by the farmer will also confirm that it is understood that it will be an offense for the farmer to re-register his/her household under another name/identity or under the name/identity of other members of this household so as to avoid graduation from the programme. Verification of graduation of the head of household and related members of the household will likewise be confirmed by the responsible camp officer.

3.8 Linkages to finance

Access to reliable operating as well as investment financing is essential to assure sustainability of farmer graduation and continued involvement of farmers as well as other input value chain participants over the medium and long-term. The proposed adjustments to the Fertilizer Support Programme will closely coordinate with the other training programmes supported by cooperating partners offering targeted financing to farmers and agro-businesses. These include the IDA funded Agricultural Development Support Programme (ADSP) and the IFAD funded Rural Finance Programme, which aims at providing credit to rural agro-industry clients. The banks involved in the liquidation of vouchers should also be engaged to support farmer and agro dealer loan schemes.

3.9 Input utilization -extension and farmer/agro-dealer training

Gradual and significant improvement of crop productivity is essential for household and national income growth. The record in Zambia and other countries is very consistent that no one improved input alone can stimulate significant and sustainable productivity improvements. Improved seeds and inorganic fertilizer are fundamental, but must be complemented with other strategic inputs, as well as important improvement in farmer knowledge about agronomic practices, including the use as much as possible of organic soil fertility enhancements and other conservation farming practices.

Enhanced input utilization will be achieved through the fundamental linkage of the programme to camp extension officers and to agro-dealers who can likewise assist farmers in obtaining practical input application instructions and dosage rate information.

To achieve the needed level of enhanced extension and training, MACO camp extension officers as well as agro-dealers will be targeted for public as well as NGO programme training assistance. In addition, MACO will upgrade living and operating conditions for camp extension officers, and will seek funding to fill vacant camp officer positions. Assistance of the new MACO/SIDA ASP project is an example of MACO based improvements to be made. CARE Zambia with assistance of AGRA, as well as the PROFIT Project are examples of important agro-dealer and agro-service provider training and related assistance that will be linked to the enhanced FSP programme.

4. Action Plan for an Enhanced Fertiliser Support Programme

4.1 Short Term (for the coming farming season 2008/2009)

The fertilizer subsidy programme will be implemented through a voucher scheme (smart subsidy) to beneficiary small scale farmers. It is also assumed that GRZ may want to consider immediately allocating more resources to the food security pack programme, as it is an effectively designed programme to assist smallholders who will not yet qualify to receive benefits from FSP. To ensure the implementation of the recommended enhancements to the programme the following should be completed:

1. Government and cooperating partners must partner to assist the FSP implementation office in MACO to undertake a series of start-up planning, organization and training activities. Among others, this will include rapid start efforts to complete a computerized farmer register, rapid voucher programme design/implementation details, development and printing of farmer and agro-dealer sensitisation/training materials.
2. An important part of the immediate planning for the FSP voucher system will require close public/private collaboration to learn from and build upon the already existing voucher programmes/experiments under way in Zambia by cooperating partners (see Annex 4 for example of three such efforts.)
3. Agricultural Camps farmers' registers must be completed and submitted to district, province and national level by 30th April, 2009.
4. Government must make known the quantities of fertilizer and seed to be procured under the subsidy programme by 1st March 2009.
5. Review of the FSP implementation manual by end of March 2009.
6. Printing of all programme documentation should be completed by 1st June 2009.
7. Farmers' selection should be completed by 1st June 2009.
8. Stakeholder sensitisation for farmers, suppliers, extension workers, politicians, associations, NGO's by end of August 2009.
9. Agro dealers should receive vouchers by 1st November 2009 and redeem them by 30th November 2009.
10. The vouchers will be printed according to pack size.

11. A pack shall consist of inputs for half hectare (2 by 50 kg bags of basal and 2 by 50 kg bags of top dressing) and a beneficiary can obtain up to a maximum of inputs of two packs. Programme design and implementation efforts will need to develop the criteria which camp officers will use to prioritise voucher allocation to different beneficiary levels.
12. The initial level of subsidy should be 50%.
13. A register of Agro Dealers based at the district should be completed through the DACO's office by end of June 2009.

4.2 Medium Term (The next farming season – 2009/2010)

- Training of Agro dealers
- Increase farmers contribution to 75%
- Diversification of composition of seed.
- Enhance number of importers, wholesalers and local manufactures
- Stockist infrastructure development
- Infrastructure development
- Financial support to Agro Dealers
- Provision of general subsidy for fertilizer importers and producers

4.3 Long Term

- In an event that input prices in a given year rise to alarming levels, Government should consider shifting to a direct program which subsidises the importers and producers of fertilizer.
- In general, Government withdrawal will be assured with a plan for an orderly exit strategy from input supply subsidies.

5. Conclusion

Distributing agricultural inputs through a voucher system will help achieve GRZ objectives and also build Public-Private Partnerships. It will more effectively enable government to assure that the inputs will reach directly to intended beneficiaries at the lowest possible overall programme cost. This approach will likewise be more effective in encouraging the development of additional growth of agro dealer's networks in rural areas.

Annex 1: Zambia – Study Team Members

Timing: Jan 14-17 Kenya; Jan 18-20 Tanzania; Jan 21-23 Malawi, 2009

Zambia Ministry of Agriculture and Cooperatives

1. Mr. Green Mbozi**,** Director, Agribusiness and Marketing Department, (gmbozi@maff.gov.zm)
   Team Leader

2. Mr. Julius J. Shawa, Director, Policy and Planning Department, (jjshawa@maff.gov.zm)

3. Mr. Sitwala H. Sikwibele, Chief Agricultural Economist (hsikwibele@maff.gov.zm)

4. Ms. Caroline Chiyoowa, Principal Accountant, (lekwac@yahoo.com)

Zambia Ministry of Finance and National Planning

5. Mr. David P. Zulu, Programme Implementation Office, (dmark2000@hotmail.com)

Programme Against Malnutrition,

6. Ms Isabel L. Tembo, Senior Programme Officer, (isabel_tembo@yahoo.com)

Zambia National Farmers Union

7. Mr. Coillard Hamusimbi, Liaison and Programme Officer, (hamusimbi@znfu.org.zm)

Conservation Farming Unit

8. Mr. Collins Nkatiko, Operations Director, (cnkatiko@iconnect.zm)

Agricultural Consultative Forum

9. Dr. Hyde Haantuba , Secretariat Co-ordinator (acfs@microlink.zm)
10. Mr. Masiye Nawiko , Secretariat Programme Officer (acfs@microlink.zm)

Zambia Food Security Research Project

11. Prof Michael T. Weber , Food Security Advisor (webermi@msu.edu)

Seed Co. Ltd Zambia

12. Marx Mbunji, Zambia Business Unit Manager (MarxM@seedco.co.zm)

Annex 2a: Study Team: Kenya Study Tour Programme

Program for Zambia Fertilizer Reform Study Tour to Kenya
14-18th January, 2009

Day	Time	Place	Contact Person	Status: C = confirmed TBC = To be confirmed
Wednesday 14th	16:25 hrs	Arrival at Hotel Boulevard	Esther Muiru	C
Thursday 15th	09:00 hrs 09:30	Ministry of Agriculture	High Commission of Zambia in Kenya Dr. Mary Mathenge	C
	14:00 hrs Courtesy Visit	PS Ministry of Agriculture	PS	C
	14:30 hrs	Depart for Tegemeo Briefing	Dr. Mary Mathenge / Betty Kibarra	TBC
	16:00 -17:00 hrs	MEA LTD	Mr. Muriuki	C
Friday 16th	08:30 hrs	Team Discussion or possible private firm visit	Hotel Boulevard	TBC
	10:00 hrs	CNFA Offices	Joseph Mwangangi	C
	13:00 -14:00hrs	Rockefeller Foundation	James Nyoro	C
	14:00 – 16:00 hrs	AGRA	Joe Devries, Bashir Jama & Akin Adesina	C
Sat 17	Team meeting? Visit other private fertilizer and/or seed firms? Short visit to a Farmer (CNFA?)			
Sun 18	Travel to Tanzania			

Annex 2b: Study Team: Tanzania Study Tour Programme

18 -20th January, 2009

Day	Time	Place	Contact Person	Status C- confirmed TBC- To be confirmed
Sunday	Depart Nairobi 08:05 KQ 480	Travel to Tanzania		C
Sunday	Dar	Peacock Hotel- Bibi Titi Moh. Rd		C
Monday 08:30 hrs	Briefing from ACT on TAP Agricultural Council of Tanzania	ACT Offices	Director ACT Mrs Janet F. Bitegeko Mark Magila, Value Chain Manager ACT	C
Monday 09:45 am	Briefing from CNFA	ACT Offices	Fernandos Vallerian/Frida Nyongo, Hamis Saadan CNFA	C
Monday 11:00 hrs	Fertilizer Company Premium	Premium office	Prakash Shar, Managing Director Confirmed	C
Monday 14:00 hrs	Briefing from various offices in Ministry of Agriculture	Ministry of Agriculture	Dr Musola, Assistant Director of Agriculture Inputs	C
Monday 15:00	Visit to PS Office Ministry of Ag	Ministry of Agriculture	Confirmed	TBC
Tuesday 09:00 hrs	Yara- Chapa Meli Fertilizers - Tanzania Limited	Yara Offices	Simon Girdlestone Chapa Meli Confirmed	C
Tues 11:00 hrs	Tanzania Fertilizer Company	TFC Office	Fernandos Vallerian/Frida Nyongo CNFA,	C
Tuesday 14:00	Ag Research on yield response or rate of return to smallholder use of fertilizer?	Ministry of Agriculture	Suggestions welcome. **You will meet Director of Research and Development** Mr Min of AG	C
Tuesday 16:00	Wrap Up Session	ACT and CNFA CNFA Offices	Hamis Saadan CNFA	C
Wednesday 05:25	Depart for Malawi			

Annex 2c: Study Team: Malawi Study Tour Programme

21st – 23rd January 2009

Day	Time	Activity/Event	Coordinator
Wednesday 21st Jan. 2009	9.45 – 12.00 pm	Guests arrive at KIA via KQ 422 and travel to Lilongwe Hotel	CISANET Administrative Assistant
	12.00 – 1.20 pm	**Lunch**	Lilongwe Hotel
	Afternoon	Rest after the early morning flight and late afternoon team meeting	Lilongwe Hotel
Thursday 22nd Jan. 2009	8.30 – 10.00am	Travel to and briefing from Zambia High Commission.	Zambia High Commission
	9.40 – 10:40 am	Meeting with Civil Society members at NASFAM Board Room	CISANET Secretariat
	11.00 – 12:30 pm	Meeting at the Ministry of Agriculture for briefing on the Farm Input Subsidy Programme	Ministry of Agriculture
	12.30 – 1.30 pm	**Lunch for delegates**	
	1.30 – 2.00 pm	Travel to Lilongwe ADD for a debriefing on district management of the program at Lilongwe ADD	Ministry of Agriculture *(T. Mpezeni, LADD)*
	2.00 – 5.00 pm	Field visit in Lilongwe ADD	
Friday 23rd Jan. 2009	8.30 – 10.00 am	Meeting with members of private sector firms involved in inputs i.e. Fertilizer Association at CNFA conference room	CNFA & Fertilizer Association of Malawi
	Group 1 - 10.:15 – 12:30 pm	Travel to SFFRFM offices in Kanengo	CISANET & Ministry of Agriculture
		Meeting at SFFRFM on program logistics	
			CISANET Secretariat
	Group 2 - 10.15 – 12.00 pm	Meeting with selected donors supporting the inputs program (Irish Aid, DFID and NORAD) at Irish Embassy, ARWA House	
	12.00 – 1.20 pm	**Lunch**	
	2.00 – 2:30 pm	Travel to Ministry of Agriculture for a wrap-up session	Ministry of Agriculture
Saturday 24th	7.45 am	Delegation departs Lilongwe Hotel for KIA	CISANET

Annex 3: Study Team: Resource Materials

Zambia Agricultural Fertilizer Programme Study Tour: Gaining Insights from On-Going Reforms in Malawi, Kenya and Tanzania.

Study Tour Orientation

Description of Activities

- Fertilizer Study Tour ACF Concept Note 2008

Participant List/Contact Information

- Participant List

Program Schedule

- Jan 14-17 Kenya; Jan 18-21 Tanzania; Jan 22-24 Malawi

Cross-Country Materials

Policy Briefs

- Fertilizer Subsidies and Sustainable Agricultural Growth in Africa: Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya. MSU Policy Synthesis #83, Oct 2008.
- FANRPAN Potential For Input Voucher Systems Policy Brief Nov2007.pdf
- WDR 2008 - New Approaches to Input Subsidies
- AGRA Agro Dealer Development Programme
- AGRA Soil Health Programme Africa

Papers

- Fertilizer Subsidies and Sustainable Agricultural Growth in Africa: Current Issues and Empirical Evidence from Malawi, Zambia, and Kenya. Isaac Minde, T. S. Jayne, Joshua Ariga, Jones Govereh, and Eric Crawford. Report prepared for Re-SAKSS Southern Africa, November 24, 2008.

News Reports

- ICRAF Food Crisis Soil Fertility Statement-FINAL
- Making Fertilizer Subsidies Work Long Term Tough Dec2007
- McPherson Rabbinge Comments Subsidies Abuja, 2006
- Soil Fertility Futures Agriculture Debate
- Soil Fertility Futures Agriculture Debate Draft Summary

Tool Kits

- WB Fertilizer Toolkit: http://www.worldbank.org/afr/fertilizer_tk/

Malawi Materials

Policy Briefs

- NRP 116 Lesson From Malawi Experience
- Malawi Two views fertilizer support leisa, 2008
- FANRPAN Abstract Malawi Voucher Report, 2007

Papers

- Evaluation of the 2006/7 Agricultural Input Subsidy Programme, Malawi. Final Report. School of Oriental and African Studies (SOAS), Wadonda Consult, Michigan State University (MSU), Overseas Development Institute (ODI). March 2008.
- Social Analysis of Malawi's Maize Marketing Reforms. Final version: December 22, 2008. Report for the World Bank, Malawi by T. S. Jayne, Julius Mangisoni, and Nicholas Sitko

Presentations

- Evaluation of the 2006/7 Agricultural Input Supply Programme. Malawi Report conducted for the Ministry of Agriculture and Food Security by School of Oriental & African Studies (SOAS), Wadonda Consult ODI, Michigan State University (MSU). Lilongwe March 2008.
- Malawi’s Maize Marketing System: A Rapid Appraisal Study. By T.S. Jayne, Julius Mangisoni, Nicholas Sitko for discussion at World Bank Maize Stakeholders Seminar, Lilongwe, Malawi, December 8, 2008

News Reports

- President_Mutharika_On_Fert_subsidy_Aug_2008
- Nyasa_Times_Oppositon_On_Fert_Sept_2008
- The Window on Malawi_Food_Shortage_Oct_2008
- Malawi_AGRA_Grant_Agro_dealers_TheDailyTimes

Kenya Materials

Policy Briefs

- Can The Market Deliver? Lessons from Kenya's Rising Use of Fertilizer Following Liberalization. Joshua Ariga and T.S. Jayne. July 2006. KePB 7.

Papers

- Trends and Patterns in Fertilizer Use by Smallholder Farmers in Kenya, 1997-2007. Joshua Ariga, T.S. Jayne, Betty Kibaara, and J.K. Nyoro. Draft for Review Working Paper XX/2008. October 2008
- How High Are Rates of Return to Fertilizer? Evidence from Field Experiments in Kenya. Duflo, Esther, Michael Kremer, and Jonathan Robinson. 2008. AER 98(2):482-488. (Not downloadable here due to AER property right)

Presentations

- Trends and Patterns In Fertilizer Use in Kenya by Smallholder Farmers in Kenya 1997 -2007

News Reports

- KENYA_Agro_Dealer_Grant_News
- Mbendi_Japan_Fertilizer_Grant_Kenya_Sept_2008
- KBC_Govt_fert_subsidies_next_month_Oct14_2008
- allAfrica_Kenya_Maize_Export_Ban_Oct2008
- allAfrica_Kenya_Relief_Low_Fertiliser_Costs_0ct14_08

Tanzania Materials

Policy Briefs

- TAIP_Brief

Papers

- TAIP Strategy 22 9 07 _2_
- Tap_concept ote

News Reports

- CNFA _ Tanzania Agro-dealer Strengthening Program (TASP)
- ACT_Press_Release_President_Kikwete_GreenRevolution
- TAP_Partnership_web_page
- Agricultural Council of Tanzania - Web_Page_Home

Zambia Fertilizer Materials

Policy Briefs

- MS Zambia Newsletter October 2008 - Fertilizer support is a subsidy disaster by Michael Muleba, Executive Director, Farmers Organization Support Program (FOSUP)

Papers

- FSP_Internal_Evauation_2008
- Fertilizer Report 4-08_CFU_ZNFU
- Chipata District Farmers Report on Findings of the Findings of the 2007/08 Fertilizer Support Programme
- Fertilizer_Support_Assessment_CSPR_2005
- CFU_Low_Yields_ZF 20.10.07
- CFU_Faidherbia_Trials_ZF 20 2.08

Presentations

- Empirical Information on Smallholder Maize Production and Fertilizer Use In Zambia. Presentation at Fertilizer Support Programme Evaluation Kick-Off Workshop. Protea Safari Lodge, Zambia. June 25-26, 2008

News Reports

- Fertilizer Programme Difficulties News Clipping 2008/2009

Zambia Smallholder Materials

Presentations

- Targeting Challenges: Using Zambian Rural Household Data Sets to Inform the Process of Categorisation of Resource Poor Smallholder Farmers. By the Food Security Research Project, Kafue Gorge ACF Sponsored Workshop, Aug 20-22, 2008.

Annex 4 Study Team: Resource Materials on Details on Voucher Programmes Operating and/or Underdevelopment in Zambia

Annex 4a. -- ZNFU-CFU Experience with Vouchers

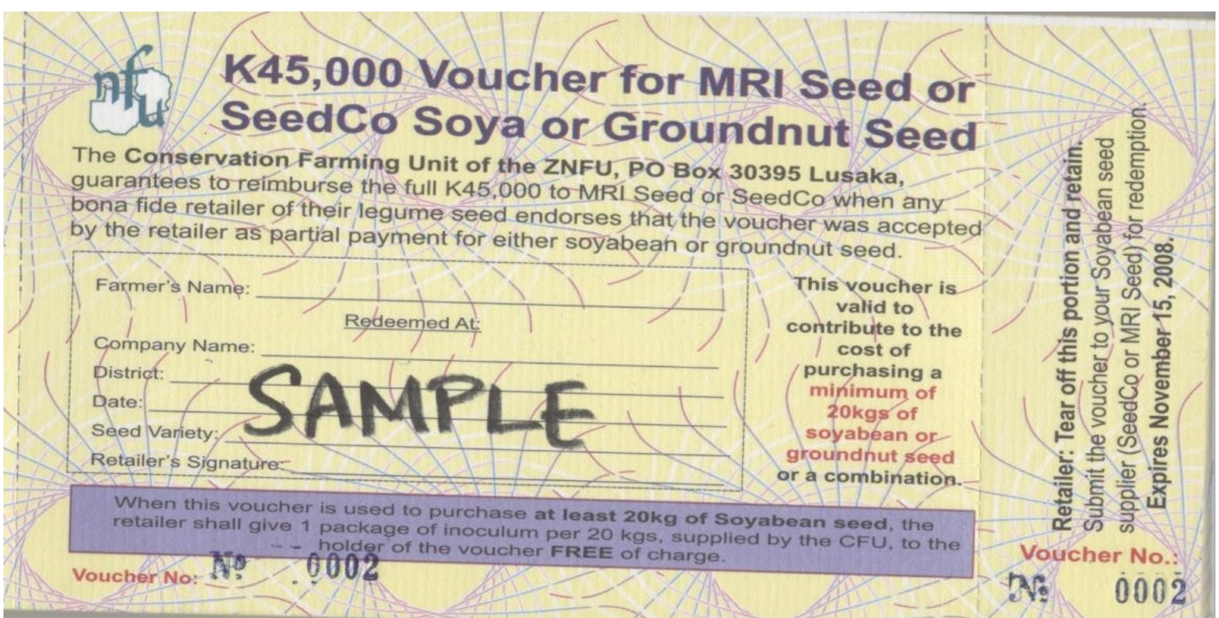
No Farmers no Future

Conservation Farming Unit

P.O. Box 30395 Lusaka Zambia. Tel (2601)265455, Fax (2601)264781
E-Mail cfu@zamnet.zm

The CFU is providing the below vouchers to farmers in order to give them a discount on **MRI Seed or SeedCo variety soya and groundnut seed**. Please accept the below vouchers, with the following conditions:

1. The voucher may be used to discount the purchase of **20kg or soya or groundnut seed**, **or 10kg of each seed.** The voucher may NOT be used to purchase only 10 kg of seed.
2. The farmer must pay the remaining balance for the seed in cash. Two or more vouchers may not be combined to purchase 20kgs of seed.
3. When the voucher is redeemed, please fill out each line.
4. When a farmer purchases 20kg of soya, he should receive 1 packet of inoculum that is being provided by the CFU for **FREE**.
5. The inoculum that is being provided by the CFU should NOT be sold to any farmer, and should only be given to farmers who present the below voucher and purchase 20 kgs of soya seed.
6. After you have collected the voucher from a farmer, please tear off and keep at your store the portion on the right, and send the main voucher back to your soya supplier (MRI or SeedCO).
7. If you have any questions, please contact your local CFU staff member or Meredith at 0978 694420.


K45,000 Voucher for MRI Seed or SeedCo Soya or Groundnut Seed

The Conservation Farming Unit of the ZNFU, PO Box 30395 Lusaka, guarantees to reimburse the full K45,000 to MRI Seed or SeedCo when any bona fide retailer of their legume seed endorses that the voucher was accepted by the retailer as partial payment for either soyabean or groundnut seed.

Farmer's Name:
Redeemed At:
Company Name:
District:
Date:
Seed Variety:
Retailer's Signature:

SAMPLE

This voucher is valid to contribute to the cost of purchasing a minimum of 20kgs of soyabean or groundnut seed or a combination.

When this voucher is used to purchase at least 20kg of Soyabean seed, the retailer shall give 1 package of inoculum per 20 kgs, supplied by the CFU, to the holder of the voucher FREE of charge.

Voucher No: № 0002

Retailer: Tear off this portion and retain. Submit the voucher to your Soyabean seed supplier (SeedCo or MRI Seed) for redemption. Expires November 15, 2008.

Voucher No.: № 0002

NOTE: The voucher expiry date has been delayed until at least November 30th, 2008. Your local CFU Staff will keep you updated.

Annex 4-b ZNFU Experience with Vouchers

Annex 4 c. PROFIT Project Experience with Vouchers

FERTILISER SUBSIDY PROGRAMME – A PILOT VOUCHER SCHEME

Current Private Sector-driven In-community Agent Fertilizer Distribution Model:

I. Fertilizer Company issues landed price list to Agents
II. Agents collect orders and cash from client farmers
III. Agent pays cash into Fertilizer Company account
IV. Fertilizer Company delivers from regional/district depot
V. Fertilizer Company pays Agent commission

Basic Overview of MTZL e-Voucher System -the Process

1) Targeting of voucher Recipients

2) Allocation of subsidy fund matching total value of vouchers issued into an secure ESCROW account accessible electronically to the MZTL Voucher System

3) Recipients take NRC to local registration point where secret pin code is issued

4) Once NRC and pin details are entered into the system, an e-voucher is issued in the name of the Recipient and the recipient is registered in the MZTL Voucher System

5) Recipient now needs NRC, e-voucher and secret pin to activate the voucher, which he/she redeems through an authorised Voucher Receiving Agent, as if it was e-cash. As he pays, the three authorisation codes (NRC, voucher and pin) are entered into an enabled cell-phone, and the MZTL System verifies the authenticity o f the discount, which is then authorised (in a similar way to a credit or debit card).

6) Once authorised and confirmed by the MZTL System, the value of the discount is automatically debited from the ESCROW subsidy account and credited to the Voucher Receiving Agent's account. The Recipient has now redeemed his voucher and is no longer on the system

Notes:

a) The MZTL e-payment system is already in operation within Zambia, approved by the Bank of Zambia, and the voucher system would run through this channel
b) Any supplier of fertilizer (or seed) could apply to become a Voucher Receiving Agent – they would just need to meet the MZTL agent criteria of registered business, bank account holding etc, and register with GRZ (or other donor) as a 'licensed' dealer in vouchers with access to the MZTL Voucher System
c) Ultimately there would probably be two types of voucher transaction:
    i. Using an In-community Agent:
        1. Fertilizer Company issues landed price list to Agents
        2. Agents collect orders from client farmers
        3. Fertilizer Company sales staff visits community, collects cash and enters voucher details into the mobile phone. Once verified by the MZTL System, the orders are confirmed
        4. Fertilizer Company delivers from regional/district depot
        5. Fertilizer Company pays Agent commission

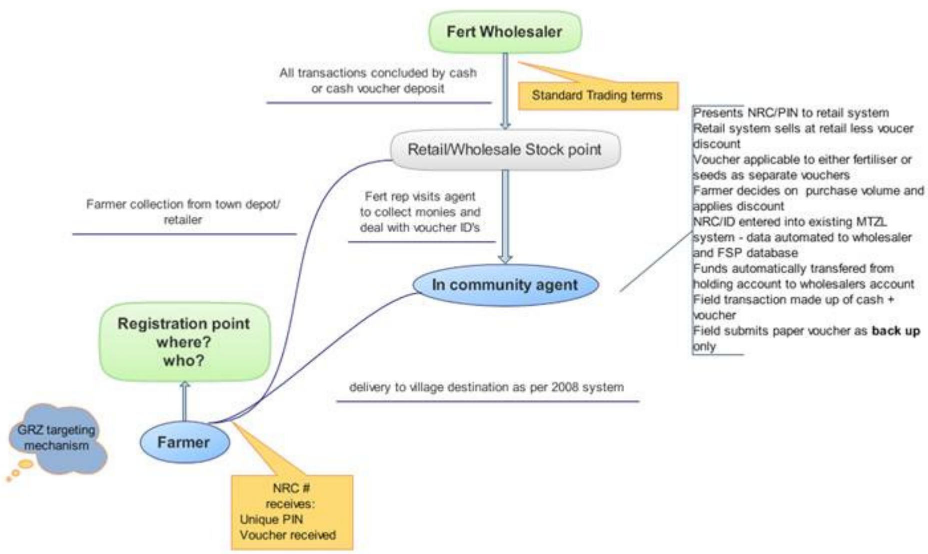
    ii. Using an existing 'bricks and mortar' retail agent/stockist
        1. Recipient purchases fertilizer for cash and uses voucher as a discount

2. Stockist (being an MTZL agent) enters discount details into phone and verifies authenticity
3. Sends ‘invoice’ on a regular basis to Fertilizer Company for redeemed vouchers which can be paid in cash or more stock

Benefits:

a) A wide number of suppliers could participate, encouraging competition
b) There would be no automatic tie to type of fertilizer or seed, encouraging diversification from maize
c) Fraud is difficult due to the triangulation of NRC, e-voucher number and pin
d) Since the Voucher is simply e-cash, there is no ‘distortion’ to commercial activity caused by the subsidy

Basic Schematic of the Proposed Voucher System



PROFIT 2009 Pilot Proposal

Target Group: 16,000 Dunavant ‘Gold Club’ members (better performing cotton farmers)
Participating Fertilizer Company: Omnia
Individual Voucher Value: K100, 000 per farmer, redeemed against any type of fertilizer from Omnia
Timeframe for Implementation: 2009, with vouchers ready for collection and redemption by June 09
Operation:
- In-community agent collects orders
- Omnia Sales Staff visits community and collects cash and vouchers, and verifies vouchers on-site through mobile phone
- Omnia delivers order to community from regional depot
- Vouchers automatically redeemed against subsidy ESCROW account via MTZL Voucher System

Funds Sought:
- approx $300,000 for subsidy
- approx $100,000 for design and implementation of MTZL Voucher System

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Research Results from the Department of Policy Analysis
MARD-Directorate of Economics*

Observations and Emerging Lessons from the 1998/99 High-Input Maize Program in Nampula Province, Mozambique

Julie Howard, Jaquelino Massingue, José Jaime Jeje, David Tschirley, Duncan Boughton and Alexandre Serrano**

BACKGROUND: Since 1997, Ministry of Agriculture and Rural Development (MARD) and Michigan State University (MSU) researchers have been collaborating to assess (1) the current financial and economic profitability of improved technology use, and (2) the costs and benefits of interventions to increase profitability by reducing input marketing costs and improving extension assistance.

A farm-level survey[1] of Rural Extension Directorate and Sasakawa-Global 2000 (DNER/SG) high-input maize program (improved seed and fertilizer) participants was undertaken in 1997 in Nampula Province (northern Mozambique), focusing on the 1996/97 production season. In the following production season (1997/98), the survey was broadened to include participants in DNER's low-input maize program (improved management only) and farmers who did not participate in either program. Yield results for these two seasons are summarized in Table 1, and profitability results are presented in Table 2.

The 1996/97 and 1997/98 results showed that significant yield increases are possible with the application of improved seed and fertilizer technology. However, given the high cost of inputs and the relatively low farmgate price of maize at harvest, the yield increases achieved by the average participant were generally insufficient to render production of improved maize more profitable (on a net income per hectare basis) than production of maize using traditional low-input methods. If farmers were able to store maize and gain from steep price rises that took place during both 1996/97 and 1997/98 marketing seasons (Table 2), then profitability increased. The steep price rises were spurred by a surge in maize exports to neighboring Malawi in 1996/97 and 1997/98. 1999 prices were flat and farmers have been unable to improve profitability through storage to the same extent. Maize exports declined substantially in the 1998/99 and 1999/2000 seasons due to increased domestic maize production in Malawi.

During the first two years of the study, maize yields were affected by the late delivery of inputs, inadequate extension assistance, and mixed signals regarding farmers' obligation to repay input credit extended by the DNER/SG program. In the 1998/99 season, in an effort to improve implementation and enhance program sustainability, DNER/SG began collaborating with the Cooperative League of the

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* The views expressed here are those of the authors and do not necessarily reflect the official position of the Ministry of Agriculture and Rural Development.

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[1] Methods used in the MARD/MSU study included physical crop cuts for yield estimation and interviews with sample farmers to collect information on labor and other inputs used in the production process. Since the objective of the study was to assess the performance and profitability of the improved maize program **under typical on-farm conditions**, our approach was inclusive – gathering yield and input data from almost all participants. This approach contrasts with the more traditional agronomic focus on assessing the **potential** performance of the technology. Agronomists may prefer to exclude poorer results from the analysis on the grounds that if crop management is flawed (e.g., because of late input delivery, delayed planting or weeding) the trials do not represent true tests of the technology. From the socioeconomist's perspective, delays in input delivery, flawed technology application and uncertain weather are typical constraints of the real farm environment in which improved technology must perform. Failing to consider these constraints and the impacts they may have on yields and profitability can result in a misleading assessment of the risks of technology adoption from the farmer's perspective, and underestimate the importance of designing policies and programs that help reduce marketing costs and ameliorate weather, management and price risks.

Table 1. Maize Yield Results from DNER/SG Maize Programs

Year	Region 7 -- Ribaue District			Region 8 -- Monapo and Meconta Districts			Region 10 -- Malema District		
	Hi-Input Maize	Lo-Input Maize	Non-participant	Hi-Input Maize	Lo-Input Maize	Non-participant	Hi-Input Maize	Lo-Input Maize	Non-participant
96/97[a] (tons/ha)	0.8			2.4			2.9		
n	(16)			(24)			(21)		
97/98[b] (tons/ha)	1.3	1.3	1.1	2.7	2.0	1.7	1.9	2.0	1.2
n	(34)	(27)	(21)	(32)	(34)	(30)	(13)	(10)	(7)
98/99[c] (tons/ha)	2.4		1.1				3.0		1.6
n	(24)		(13)				(20)		(23)

Source: Calculated from MARD/MSU survey data
Notes:
[a] 1996/97 data were collected from individual farmers participating in the DNER/SG hi-input program. Inputs used were 100 kg 12-24-12, 100 kg urea and 30 kg improved maize seed per hectare.
[b] 1997/98 data were collected from plots of individual farmers: (a) participating in the DNER/SG hi-input program using the same inputs as above (sole-cropped); (b) participating in the DNER lo-input extension group program who received advice about cultural practices but did not use fertilizer or improved seeds (sole or intercropped); and (c) plots of individual farmers who did not participate in either program (sole or intercropped).
[c] 1998/99 data were collected from 80 plots belonging to members of 5 farmer associations assisted by CLUSA. Data were collected from (a) plots where DNER/SG improved seed and fertilizer (same amounts as above) were used (primarily sole-cropped maize); and (b) plots where no improved inputs were used (primarily intercropped).

USA (CLUSA), which has been working to develop farmer associations in Nampula Province since 1996. Twenty-one CLUSA-assisted associations (involving some 300 farmers) participated in the DNER/SG improved maize program during the 1998/99 production year. With CLUSA assistance, contracts for delivery of improved seed and fertilizer were developed with private sector companies[2] and signed by individual associations. Performance contracts were also signed with the extension service. At the end of the season, CLUSA helped associations (through meta-association groups called "fora") to negotiate contracts with commodity buyers for the sale of maize produced in the program.

During 1998/99, MARD/MSU researchers followed the progress of the improved maize program in five CLUSA-assisted associations located in two different agroecological zones of Nampula Province. The objective of this study was to assess how greater involvement of farmer associations in maize intensification affects marketing costs and extension effectiveness. This preliminary report summarizes our observations on the 1998/99 production season and part of the 1999/00 marketing season, based on analysis of maize yield data and informal group interviews with participating farmer associations carried out in March and November 1999. In the final section we discuss some of the preliminary conclusions that are emerging from the broader three-year maize intensification study.

OBSERVATIONS:

Preliminary results indicate that 1998/99 high-input maize yields were substantially higher than high-input yields from previous seasons. In Region 7 (Ribaue)1998/99 maize yields were 1.1-1.6 tons/ha higher than high-input yields from 1996/97 and 1997/98. In Region 10 (Malema, a more favorable agroecological zone for maize) 1998/99 yields exceeded 1997/98 yields by 1.1 ton/ha and were similar to yields achieved in 1996/97 (2.9 tons/ha) (Table 1). Participating farmers and other observers raised the following points about factors affecting maize performance in 1998/99 and plans for the 1999/2000 season.

[2] The private sector companies involved were Agroquimicos for the supply of fertilizer and SEMOC for the supply of improved maize seed.

Table 2. Summary of Results from 1996/97 and 1997/98 Farm-Level Maize Enterprise Budgets

	Region 7 (Ribaue)			Reg. 8 (Monapo/Meconta)			Region 10 (Malema)		
<u>**MAIZE PROGRAMS 1996/97**</u> 1 USD = 11,500 mt	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.
Maize grain yield (tons/ha)	**0.8**			**2.4**			**2.9**		
3. Returns at June 1997 prices									
June farmgate price ($/kg)	0.06			**0.06**			**0.06**		
Net income ($/ha)	**-61.97**			**32.32**			**53.27**		
Net returns to family labor ($/ae day)	**-0.73**			**0.48**			**0.6**		
4. Returns at average July-December 1997 prices									
Avg. July-December price ($/kg)	**0.073**			**0.068**			**0.073**		
Net income ($/ha)	**-62.15**			**29.53**			**72.2**		
Net returns to family labor ($/ae day)	**-0.73**			**0.44**			**0.81**		
5. Returns at December 1997 prices									
December price ($/kg)	**0.12**			**0.098**			**0.12**		
Net income ($/ha)	**-32.41**			**80.74**			**188.95**		
Net returns to family labor ($/ae day)	**-0.38**			**1.21**			**2.12**		

	Region 7 (Ribaue)			Reg. 8 (Monapo/Meconta)			Region 10 (Malema)		
<u>**MAIZE PROGRAMS 1997/98**</u> 1 USD = 12,000 mt	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.	**Hi-Input Maize**	Lo-Input Maize	Non-Prog. Part.
Maize grain yield (tons/ha)	**1.3**	1.3	1.1	**2.7**	2	1.7	**1.9**	2	1.2
6. Returns at September 1998 Prices									
September price ($/kg)	**0.09**	0.09	0.09	**0.09**	0.09	0.09	**0.09**	0.09	0.09
Net income ($/ha)	**-5.68**	106.07	85.91	**100.37**	138.4	119.5	**17.88**	116.62	100.85
Net returns to family labor ($/ae day)	**-0.09**	1.14	0.79	**1.34**	0.86	0.64	**0.38**	1.08	0.87
7. Returns at November 1998 Prices									
November price($/kg)	**0.14**	0.14	0.14	**0.13**	0.13	0.13	**0.14**	0.14	0.14
Net income ($/ha)	**55.6**	167.58	136.44	**188.63**	203.62	177.37	**103.81**	207.34	158.86
Net returns to family labor ($/ae day)	**0.91**	1.8	1.25	**2.52**	1.26	0.94	**2.21**	1.92	1.37

Weather conditions were somewhat better than 1997/98, but it is unlikely that the 1998/99 yield increase can be attributed entirely to improved weather. Maize production in 1997/98 was affected by spotty droughts in some areas and flooding in others. There were two problems during the 1998/99 season, but in general, conditions were better than in 1997/98. First, a 2-week drought shortly after planting necessitated re-seeding of many plots – often at lower than the recommended density because of a shortage of improved maize seed. Following the initial drought, rains were fairly regular throughout the 1998/99 season. Second, termite attacks throughout the season affected both plant density and yield.

Farmers were able to plant high-input maize on time. Fertilizer and improved maize seed arrived in most association villages well before the planting season because of advance planning facilitated by CLUSA, DNER, SG2000 and increased cooperation between Agroquimicos, SEMOC and the associations. In previous seasons planting was delayed by 2-5 weeks because of the late arrival of inputs. Mozambique's private sector input distribution system is very weak, with only a handful of input dealers in the country.

Extension agent performance improved in 1998/99. At the beginning of the 1998/99 season, CLUSA associations signed an agreement specifying technical assistance to be provided by DNER. Technical assistance included the selection of appropriate fields for improved maize and demonstrations of planting and fertilization techniques. Most extension agents felt they were able to work more efficiently through the associations, and associations thought that extension agents were more responsive to their needs. Some associations that were unhappy with their extension agent's performance complained to DNER, which replaced the agents. While overall performance was better, problems remain, i.e., assigned extension areas are very large, lack of transportation is a significant constraint, and extension agents require additional training and backstopping.

Most association members have already repaid their input credit. Although in previous years high-input program participants have signed input credit contracts with DNER/SG, most Nampula participants were never required to repay the credit. CLUSA personnel have worked intensively to help association members understand the contracting mechanism, the obligation of SEMOC and Agroquimicos to deliver inputs on time, and the corresponding obligation of the farmers to repay the input credit regardless of the season's outcome. As of November 1999, three-quarters of associations had repaid their maize input loans in cash. The remaining associations renegotiated with SEMOC and Agroquimicos to extend the repayment date in the expectation that maize prices would rise during this period. Under the terms of the agreement, each farmer granted an extension had to store 600 kgs of maize for later sale. A delegation of input company and DNER representatives visited each association to verify the quantity of maize in storage.

Farmers in several associations wanted to repay the maize input loan with proceeds from cotton sales. These plans were frustrated because of major delays in the start of cotton marketing during the 1998/99 season. Ordinarily cotton marketing begins in July, but cotton had not yet been collected in two of three cotton-producing associations by mid-November.

The high repayment rate is especially significant given farmers' disappointment over the low profitability of improved maize production in 1998/99. Nampula farmers expanded maize area in 1998/99 in response to strong demand from Malawi in the previous two seasons. Nampula farmers can transport maize cheaply to Malawi using the railway line linking the Mozambican port of Nacala with southern Malawi. Malawi's demand for imported maize plummeted in 1998/99. Malawi's own maize harvest was good, in part because of the distribution of free maize inputs and favorable weather conditions. While in the previous two seasons the price of maize has doubled between the June-September post-harvest period and December-January, in 1998/99 maize prices price remained flat. The major commodity buyer in Nampula, V&M/ICM, paid farmers 1000 mt/kg in August-September and accumulated large stocks. With much weaker demand from Malawi, the price had declined to 800 mt/kg by November.

Although high-input maize program yields rose in 1998/99, given the low maize prices, repaying the input credit will require 56-70% of the average farmer's gross maize revenue in Ribaue and 44-55% of gross revenue in Malema. Our 1997/98 analysis revealed that even when we consider only high-input maize produced under "optimal conditions" – the highest tercile of yields from the zone where inputs were delivered on time (Monapo/Meconta) – net income per hectare from high-input maize exceeded net income from traditional maize only if farmers stored their maize until January, taking advantage of the substantial maize price rise that year. Even with the substantial yield increase realized by association farmers in 1998/99, a preliminary analysis suggests that net earnings per hectare will again be higher for traditional maize than high-input maize until maize prices rise to 1100-1200 mt/kg.

Although farmers expressed disappointment with its overall profitability, interest in the improved maize program continues to grow, especially in Malema (Region 10). Farmers in several associations, when asked why they wanted to continue growing improved maize, stated that maize was important not just as a commercial crop but also for home consumption – and that they would be willing to pay for the maize inputs with the earnings from other commercial crops. Indeed, many association farmers have paid or plan to pay for maize inputs with cotton earnings. This strategy permits them to repay the maize input loan on time while allowing them the flexibility to store maize for later sale or consumption. The latter point may be very important in some cases: past MSU research in Mozambique and elsewhere suggests that many farmers become net buyers later in the season when prices are usually high.

One possible explanation for the apparent paradox (low profitability/increasing interest in intensification) is that although improved maize may not always be a highly profitable commercial crop, use of improved maize seeds with fertilizer permits farmers to produce a targeted amount of maize using less land and labor, for both family consumption and the market. With this strategy more land and labor are available for the production of other marketed commodities. This may become increasingly important in Malema, where smallholder cash cropping systems are diversifying. Farmers have experience with cotton and tobacco and are beginning to experiment with pigeon pea and oilseed crops. The expansion in demand for maize inputs comes from new participants. Current participants in Malema will continue to grow improved maize, but do not appear to be significantly expanding maize area.

This result underscores the importance of analyzing the profitability of individual crops within the context of the farming system. It is essential to analyze the contribution crops (whose individual profitability may be limited if viewed on a purely commercial basis) make to food security and income both directly and indirectly. Farmers in Malema evidently are already viewing the contribution of intensive maize in this larger context. The use of improved inputs on maize directly contributes to family food security and may directly contribute to income through its commercialization. Even if it is not sold, however, improved maize may make an important indirect contribution to total family income by freeing up land and labor (ordinarily needed for the production of food staples) for additional production of non-maize commercial crops.

EMERGING LESSONS: Our discussions with farmers, extension and CLUSA personnel revealed the emerging role of farmer associations and fora in Nampula Province as facilitators/brokers for a range of agricultural services, including agricultural input and output marketing, credit and agricultural extension services. Farmer associations and fora are facilitating private sector expansion by reducing marketing and other transactions costs. For example, farmer groups reduce input supplier marketing costs and risks by aggregating demand for inputs, facilitating local delivery of products and guaranteeing credit repayment. During 1998/99 254 CLUSA-assisted associations received credit worth nearly USD 180,000 in agricultural inputs for cotton, tobacco, maize and sunflower provided by agribusiness, agricultural chemical and seed companies.

Private sector input companies are responding to the increased demand for agricultural technology. Demand is increasing for improved seeds of existing and new commercial commodities such as cotton, pigeon pea, oilseeds, groundnut and beans. During 1998/99 Agroquimicos and Agrivet (another private sector pesticide dealer working in the region) sponsored on-farm trials of technologies (including termiticides, cotton insecticides and herbicides) with farmer associations. Following these trials, a number of associations are planning to sign individual contracts with input companies for the supply of agricultural chemicals. There are similar cost advantages for commodity brokers working through associations and fora.

During the past three seasons associations have served as marketing agents for their communities, buying maize from individuals on behalf of private wholesalers and storing it for bulk collection. New marketing and production opportunities are continuing to emerge (e.g., in sunflower, sesame, groundnut, bean and pigeon pea production) as mutual trust develops between farmer associations and private sector companies. CLUSA's head office in Nampula provides an easy point of contact for interested private sector businesses. The head office in turn can in turn disseminate information through the region quickly through the network of fora and association leaders.

Farmer associations and fora are also serving as a focal point and facilitator for NGO activities. In Nampula Province, CARE and World Vision are using the CLUSA methodology to develop associations in villages where they work. These NGOs are increasingly focusing on helping the private sector link with rural farmers instead of providing services themselves. For example, World Vision and CARE are building private sector capacity to market small packs of oilseeds, village oil presses and spare parts for presses instead of providing these directly. Technoserve is currently working with Mozambican investors interested in establishing large-scale oil press facilities in the region to (a) estimate the potential supply and sources of oilseeds, (b) identify equipment suppliers, and (c) facilitate forward production contracts between the companies and farmer associations.

The increase in agricultural opportunities is creating a demand for more effective extension services. As a result of the performance contract drawn up between associations and DNER, farmers participating in the maize program have new, clearer expectations of extension agents serving their villages. In most cases both associations and extension agents reported that the contract helped to focus and improve extension assistance for maize. In cases where associations were dissatisfied with the extension agent, the contracting process empowered farmers to complain to the DNER supervisors and get a new agent. Farmers recognize that DNER operates under severe resource constraints in many areas. As a response, a new program has begun to provide basic agricultural technical training to farmer fora representatives through a series of courses to be offered in conjunction with DNER and donor organizations. These fora representatives will in turn train association representatives, who will assist DNER extension agents assigned to their villages and share technical information with other association members.

Further development of export markets for maize and other crops is crucial to keep this process going. Recent research has shown that the surge in formal maize exports to Malawi during the 1997/98 and 1998/99 marketing seasons increased producer prices by 15-21% in Nampula and Zambezia Provinces. Of equal importance, this trade opportunity brought large traders with greater operating capital into the maize market, most of them for the first time. The entrance of such traders improves liquidity, provides competition for smaller informal traders, and allows farmers and farm associations to bulk maize and produce with greater confidence for the market. On the other hand, the failure of some of these traders to find sufficient export markets during the 1999/2000 marketing year, and their decision to stop or slow their maize purchases, severely affected farmers planning to sell maize. Without a dependable export market, the growth in demand for improved technologies and services will be limited by the self-sufficiency needs of most smallholder farmers. The increasing cross-border trade in maize and other commodities also means that it is very important for donors and governments to consider the possible regional as well as national impacts of programs such as Malawi's distribution of free seed and fertilizers to smallholders in the 1998/99 production season.

ROLE OF SG2000 AND OTHER PROGRAMS IN RAISING AGRICULTURAL PRODUCTIVITY: Sasakawa Global 2000 (SG) in Mozambique has played a pivotal role in introducing improved maize technology to Mozambican smallholders through initial financing of the technology package and in the design and implementation of the DNER extension program for improved maize. SG was also one of the first NGOs in Mozambique to recognize the importance of motivating private sector involvement in agricultural input distribution.

As Nampula Province and other areas of Mozambique move out of the initial phase of the improved technology "campaign," however, it is important that SG and similar pilot programs also make adjustments if they are to effectively promote agricultural development.

First, it is crucial that intensification efforts be pursued in the context of expanding domestic and regional markets. Regional exports of maize have been shown to significantly increase producer prices and thus improve the profitability of the DNER/SG package. Beyond the direct effect on prices, only regional export markets will provide the level of demand needed to absorb the production increases that would come from sustained intensification efforts over a long period of time.

Longer-term programs aimed at reducing transportation costs can have a critical impact on both intensification and the regionalization of commodity trade by lowering the farmgate cost of inputs and raising the price farmers receive for their products. Transportation costs represent at least one-third of the farmgate cost of fertilizers in Mozambique. Examples of key interventions include improvements to the farm-to-market road and rail network, port infrastructure and logistic improvements to reduce regional sea freight costs, and increasing the capacity and efficiency of truck fleets.

Second, it is important to ensure that the technology packages being promoted are financially profitable from the smallholder perspective and do not expose farmers to high levels of risk. MARD/MSU study results from the last three seasons suggest that the improved maize technology package currently being promoted in Nampula Province (improved open-pollinated seed, 100 kg 12-24-12, 100 kg urea/ha) is inappropriate as a primary anchor for commercialization. Improved maize as a primary commercial crop is excessively risky because potential smallholder yields are relatively low compared to competing maize-growing areas at higher altitudes in neighboring provinces and countries in the region, and maize prices are extremely volatile worldwide. Although improved maize produced solely for commercial purposes is excessively risky for most smallholders, it can be an important component of a diversified cash cropping system in which the earnings from other cash crops (such as cotton, sunflower, pigeon pea) ensure that credit can be repaid.

Several alternative strategies are possible. **It will be important to move away from blanket fertilizer recommendations and toward recommendations geared more specifically to soil needs and economic capacities of farmers as quickly as possible.** Economic analysis of INIA/DNER fertilizer trial results in Nampula indicates that profitability would improve considerably with reduced fertilizer rates (particularly P and K). **A second strategy would be to target technology packages consisting of maize hybrids (with higher yield potential) and fertilizer to higher altitude areas of Nampula and other regions of Mozambique.** Third, NGOs such as World Vision and CARE are actively working with INIA and DNER to **identify technology packages and markets for alternative crops that have a higher payoff than the intensive maize package.**

Pilot programs such as DNER/SG and others have as a long-term objective increased agricultural production through adoption of commercially viable technology packages. **It is important to ensure that short-term program implementation strategies do not compromise the achievement of the longer-term goal.** During the first two years of the MARD/MSU study repayment of credit by farmers and stockists was not enforced by DNER/SG in Nampula Province. The consequences of creating a culture where credit repayment is not expected are readily apparent in neighboring Zambia, where years of subsidized input schemes have made it extremely difficult to establish a viable private sector marketing and credit system.

It will also be important for future pilot programs to include a cost and returns analysis as part of the training accompanying the technical package. Farmers need to have a realistic understanding of the potential gains and risks of adopting any new technology. Nampula participants in the DNER/SG high-input maize program were told they could expect yields of 5 tons per hectare and prices of 1500 mt/kg by December 1999. Our analysis suggests that even good farmers will get 2.5-3 tons with improved technology under normal circumstances, and maize prices are extremely volatile. Creating unrealistic expectations among farmers about yields and prices may discourage them from trying new technologies in the future.