

# Fertilizer Promotion in Zambia: Learning from Regional Experience & Strategies to Raise Smallholder Productivity

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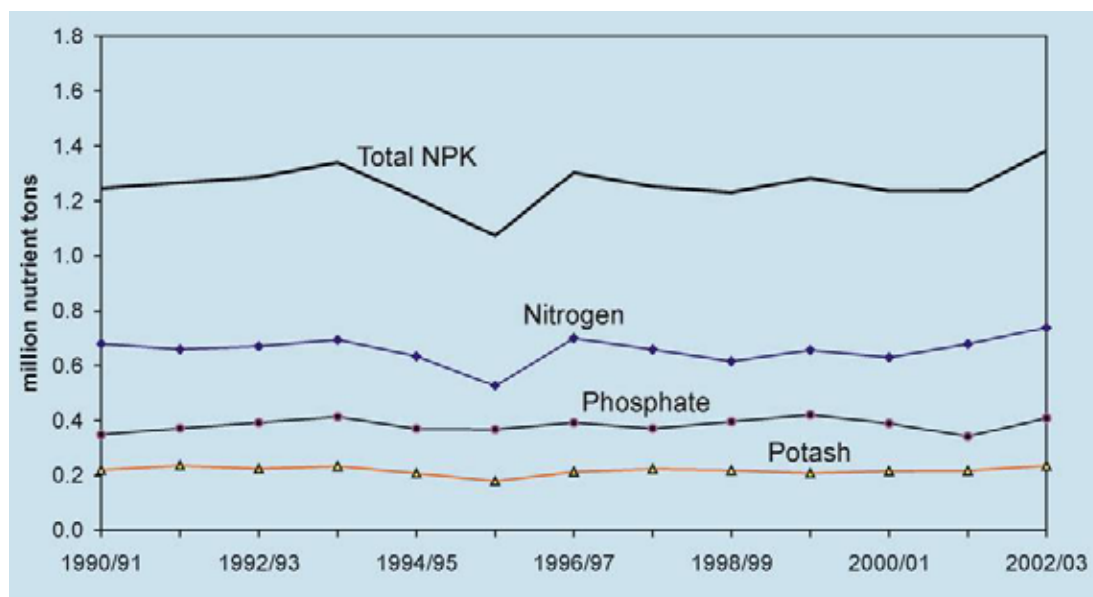
## Current thinking on “strategy”

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- Strong consensus about need for greater investment in public goods (infrastructure, crop science) and certain policy reforms
- Major debate with regard to what constitutes the right “enabling environment”
  - Input subsidies
  - food price support/stabilization
  - the role of regional trade

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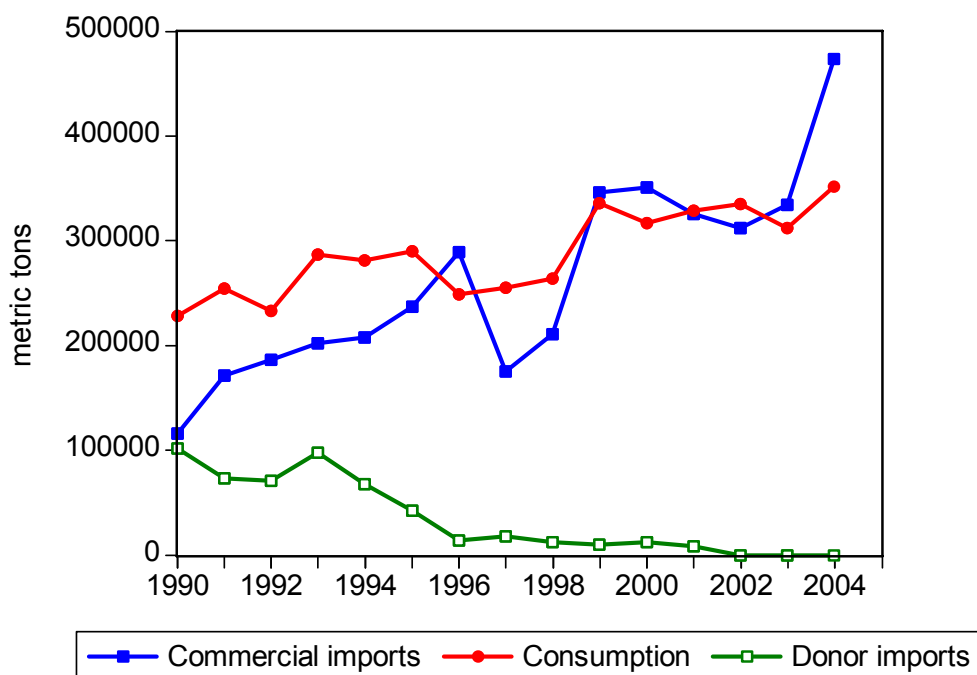
## Sub-Saharan Africa: Nitrogen, Phosphate, Potash, and Total NPK Consumption, 1990/91 - 2002/03



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Intensity of fertilizer use (1996-2002)	% growth in fertilizer use intensity (kg/ha cultivated) (mean 1996-2002 / mean 1990-95)	
	< +30%	> +30%
< 25 kg/ha	DRC (0.5, -47%)	Uganda (0.6, +237%)
	Angola (0.7, -69%)	Rwanda (1.8, +89%)
	Niger (0.9, +5%)	Mozambique (3.2, +142%)
	Guinea (2.0, -4%)	Ghana (3.6, +68%)
	Burundi (2.3, -6%)	Chad (4.3, +93%)
	Madagascar (2.9, -8%)	Cameroon (5.9, +77%)
	Mauritania (4.0, -64%)	Togo (7.0, +30%)
	Tanzania (4.8, -47%)	Cote d'Ivoire (11.8, +53%)
	Gambia (5.2, +15%)	Botswana (11.8, +294%)
	Nigeria (5.6, -73%)	Senegal (13.2, +67%)
	Burkina Faso (5.9, -28%)	Ethiopia (14.4, +71%)
	Zambia (8.4, -34%)	Benin (17.6, +76%)
	Mali (9.0, +7%)	Lesotho (23.2, +35%)
	> 25 kg/ha	Swaziland (30.5, -40%)
	Malawi (30.8, +9%)	
	Zimbabwe (48.3, +9%)	

## Fertilizer Trends, Kenya, 1990-2004



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## % of Small-Scale Farmers Using Fertilizer

	1995/96	1996/97	1999/00	2003/04
Coastal Lowlands	2%	3%	5%	6%
Eastern Lowlands	19%	30%	37%	46%
Western Lowlands	2%	3%	4%	8%
Western Transitional	29%	32%	59%	61%
High Potential Maize Zone	67%	69%	86%	90%
Western Highlands	52%	57%	73%	74%
Central Highlands	63%	78%	90%	93%
Marginal Rain Shadow	12%	20%	22%	27%
Nationwide Sample	43%	51%	64%	69%

## Reasons for the Upsurge in Fertilizer Use in Kenya

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1. GoK has maintained a stable fertilizer policy stance since 1990
  - Eliminated import licensing quotas
  - Foreign exchange controls
  - Retail price controls
  - No large subsidy programs

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## Reasons for the Upsurge in Fertilizer Use in Kenya

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2. Private sector investment in fertilizer distribution has expanded rapidly
  - 10-11 importers
  - 500 wholesalers
  - 8,000 retailers

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# Reasons for the Upsurge in Fertilizer Use in Kenya

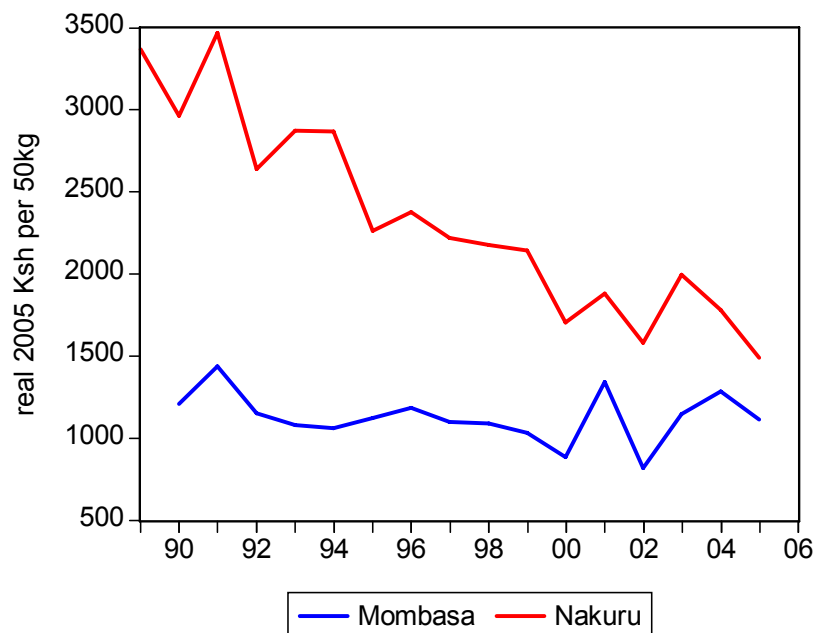
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3. Small farmers' are now much closer to fertilizer retailers
- 1997: 8.4kms
  - 2004: 4.3kms

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# 4. Large decline in fertilizer (DAP) marketing margins

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# Objectives:

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1. To consider the range of potential impacts of fertilizer promotion programs
2. To specifically assess impacts of Fertilizer Support Program (FSP) on maize production
3. To identify implementation modalities and complementary investments that would raise FSP effectiveness

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# Various impacts of fertilizer subsidy programs:

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1. Contribution of fertilizer to crop production: crop-fertilizer response rate
2. Displacement effect:  $\Delta$  total fert use /  $\Delta$  program fert
3. Labor market effects: increased food yields raises demand for agricultural wage labor
4. Food price effect: Increased food surplus reduces food prices  $\rightarrow$  benefits food purchasing households
5. Dynamic effects: Lower food prices in year  $t$  may depress area cultivated and demand for fertilizer in year  $t+1$
6. Substitution in production: fertilizer subsidy programs may raise area cultivated of some crops at expense of others

**In short: Complex effects that are difficult to measure**

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- We focus on Points 1 and 2, but discuss potential effects of Points 3 - 6.

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## Aims / objectives of FSP

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- Rebuild the eroded asset base of farmers through direct income transfer
- Increase private sector participation in input supply, thereby reducing state involvement
- Ensure timely and adequate supply of inputs
- Improve access of SH farmers to inputs
- Ensure competitiveness and transparency in input marketing

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## Objectives (2)

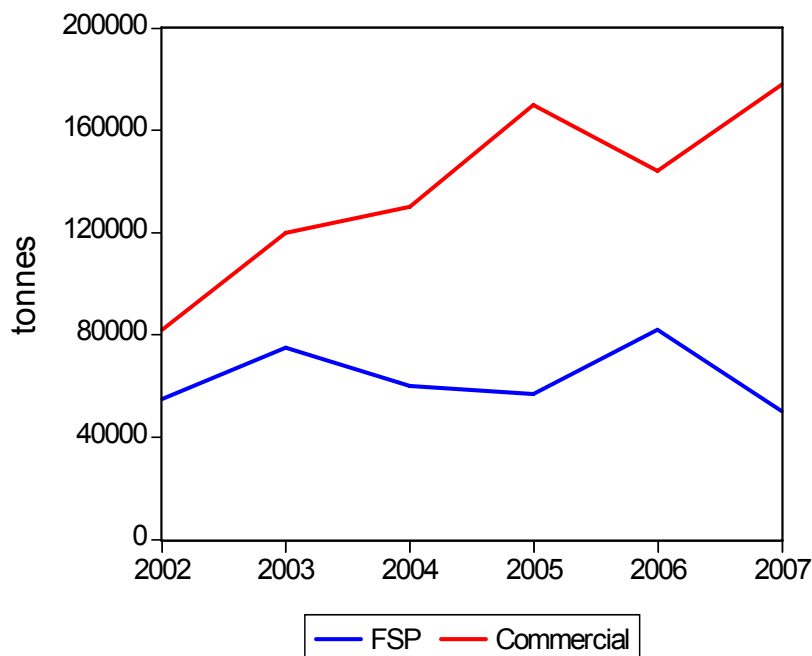
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- Introduce a risk-sharing mechanism where farmers cover part of costs of improving productivity
- Expand markets for private sector input suppliers
- Facilitate farmer organization and knowledge dissemination for agricultural development

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## Fertilizer use, FSP and commercial

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To derive benefit-cost ratio for Fertilizer Support Programme (considering only points 1 and 2):

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- Key parameters of interest:
  1. Cost of imported fertilizer + admin costs
  2. Additional total fertilizer use as a result of FSP
  3. Maize-fertilizer response rates
    - farmer management skills
    - application rate
    - are basal and top dressing used in correct proportions
    - was program fertilizer delivered on time
  4. Price of maize

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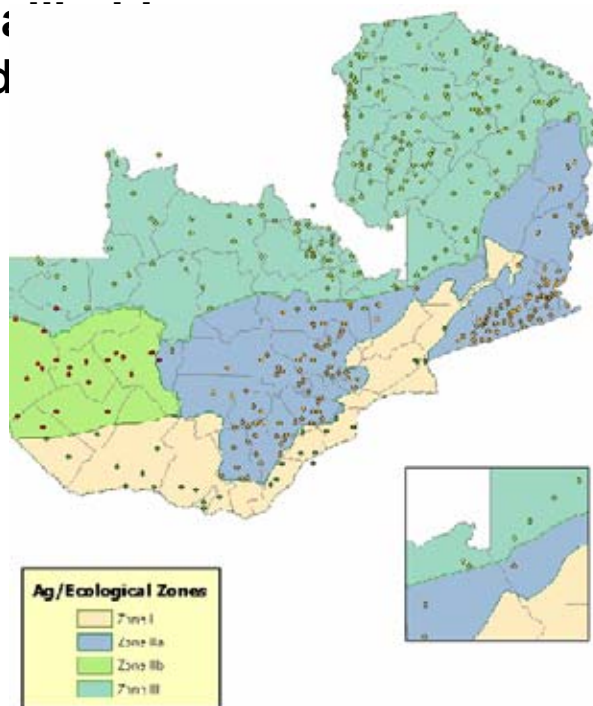
## Data:

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1. Data drawn from survey data of 2,660 smallholder farm households
2. Post-Harvest Surveys
3. 1999/00 and 2002/03 seasons
4. Using estimated response rates and displacement from model results, we then conduct simulations to examine benefit/cost ratios under range of different assumptions

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# Empirical Data on Smallholder Agriculture in Zambia – Nationwide Surveys



**Map of CSO Statistical Enumeration Areas (SEAs) Sampled in the CSO/MACO/FSRP Post Harvest and Supplemental Surveys in 2001 and 2004 by Zambia's Agro-Ecological Zones**

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Variable	1999/00	2002/03
	Mean	Mean
<i>Maize yield, kgs per hectare</i>	1781.67	1776.92
<i>Nitrogen nutrient kgs per hectare</i>	21.38	28.75
<i>% of basal to total fertilizer application</i>	47.73	49.02
<i>mm of rainfall in growing season</i>	838.45	1034.25
<i>=1 if used hybrid</i>	0.19	0.28
<i>=1 if fertilizer available on time</i>	0.69	0.72
<i>=1 if used animal draft power</i>	0.519	0.475
<i>maize area</i>	1.6	1.21
<i>family labor units</i>	3.06	4.43
<i>=1 if extension contact</i>	0.221	0.594
<i>=1 if hh used FSP fertilizer</i>	0.157	0.153
<i>age of hh head</i>	44.6	47.4
<i>education of hh head</i>	4.69	4.64
<i>=1 if female-headed hh)</i>	0.178	0.178
<i>=1 if prime-age mortality in past 3 years)</i>	0.083	0.137

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Zambia	Total Income	Assets	Landholding size
	'000 kwacha per capita		ha per capita
<b>Fertilizer source:</b>			
<i>Households not acquiring fertilizer:</i>	266	173	.15

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Source: Govereh et al, 2006

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Source: Govereh et al, 2006

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<b>Fertilizer source:</b>			
<i>Households not acquiring fertilizer:</i>	266	173	.15
<i>Cash purchases from private retailers:</i>	774	342	.20
<i>Government Fertilizer Support Program (50% subsidy)</i>	804	425	.23

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Source: Govereh et al, 2006

## Characteristics of smallholder farmers, Zambia 2003/04

	N=	Farm size (ha)	Asset values (US\$)	Gr. Rev., maize sales (US\$)	Gr. Rev., crop sales (US\$)	Total hh income (US\$)
Top 50% of maize sales	31,328 (2%)	4.3	1,132	720	1163	2,932
Rest of maize sellers	328,561 (26%)	1.6	316	88	193	634
Households not selling maize	907,255 (72%)	0.9	231	0	97	415

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## Fertilizer use patterns, 2002/03

	% receiving FSP fertilizer	% purchasing fertilizer from retailers	-- kgs per hh (users only)	
			Received from FSP	private retailers
Top 50% of maize sales	38%	54%	1,011	815
Rest of maize sellers	21%	30%	248	225
Households not selling maize	9%	13%	173	157

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## Parameter values:

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### 1. Cost of imported fertilizer + admin costs

US\$ 450 landed at provincial depots + US\$ 75 for program admin and logistical costs to satellite depots = \$525

\$525/mt most likely under-estimates true cost of delivering FSP fertilizer to farmers

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## Parameter values:

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2. Additional fertilizer use from additional ton of fertilizer distributed under FSP
  - +0.7 to 1.0 in areas where private sector is not active -- tends to be semi-arid areas where fertilizer use is risky and/or unprofitable
  - +0.3 to 0.4 in areas where private traders are active -- tends to be productive areas where fertilizer use is profitable

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## Parameter values:

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3. Response rates (kgs maize per kg fertilizer applied):
  - If used on-time and in correct proportions basal/top dressing, estimated response rates:
    - 7.42
    - 5.58
    - 3.88

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## Parameter values:

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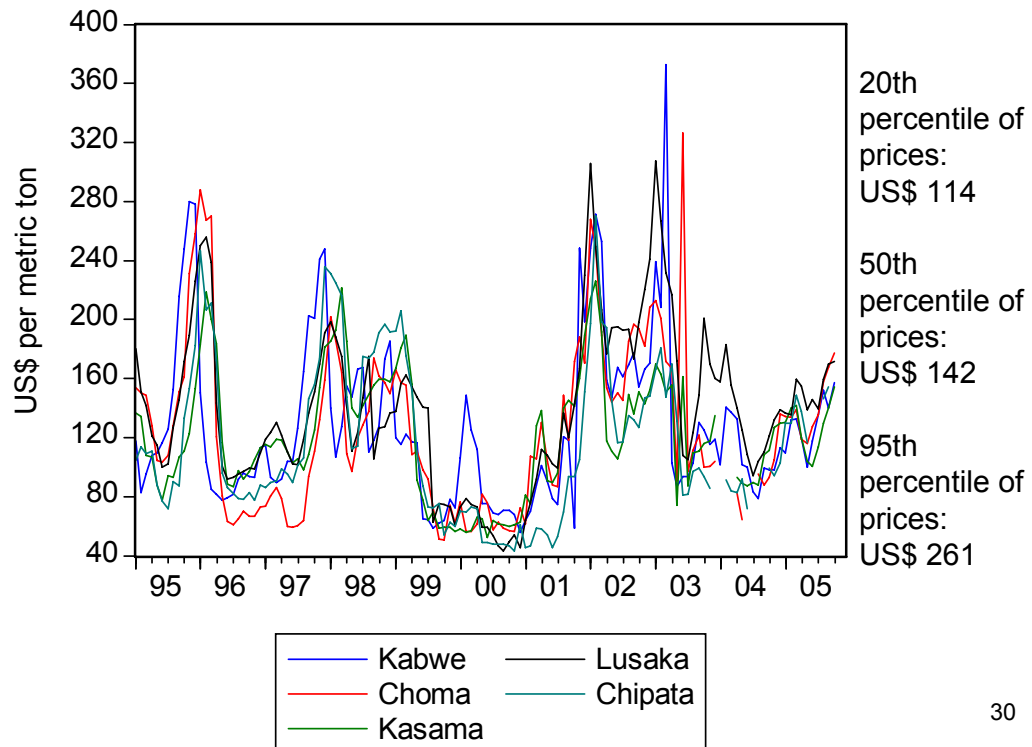
### 4. Was program fertilizer delivered on time:

- About 70% of FSP users indicated that fertilizer was available on time
- If not, deduct roughly 35% off maize-fertilizer response rates

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### 5. Price of maize:

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Cost of fertilizer	$\Delta F_{tot} / \Delta FSP$	$\Delta Q_m / \Delta F$	Pmz	B/C ratio
525	0.7	5.58	142	1.06
525	0.7	7.50	120	1.20
525	0.7	4.00	260	1.39
525	0.4	5.58	142	0.60
525	0.4	7.50	120	0.69
525	0.4	4.00	260	0.79

Cost of fertilizer	$\Delta F_{tot} / \Delta FSP$	$\Delta Q_m / \Delta F$	Pmz	B/C ratio
525	0.4	7.50	142	0.81
525	0.6	7.50	142	1.22
525	0.7	7.50	142	1.42

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- Average of all simulations, using alternative parameter estimates:

**B/C ratio: 1.07**

- This average B/C estimate based on average of all scenarios assuming FSP fertilizer is delivered on time and used in correct proportions
- Recall: many additional impacts of fertilizer subsidy programs which are not yet included in this B/C ratio

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## Three reasons for estimated low B/C ratio of FSP:

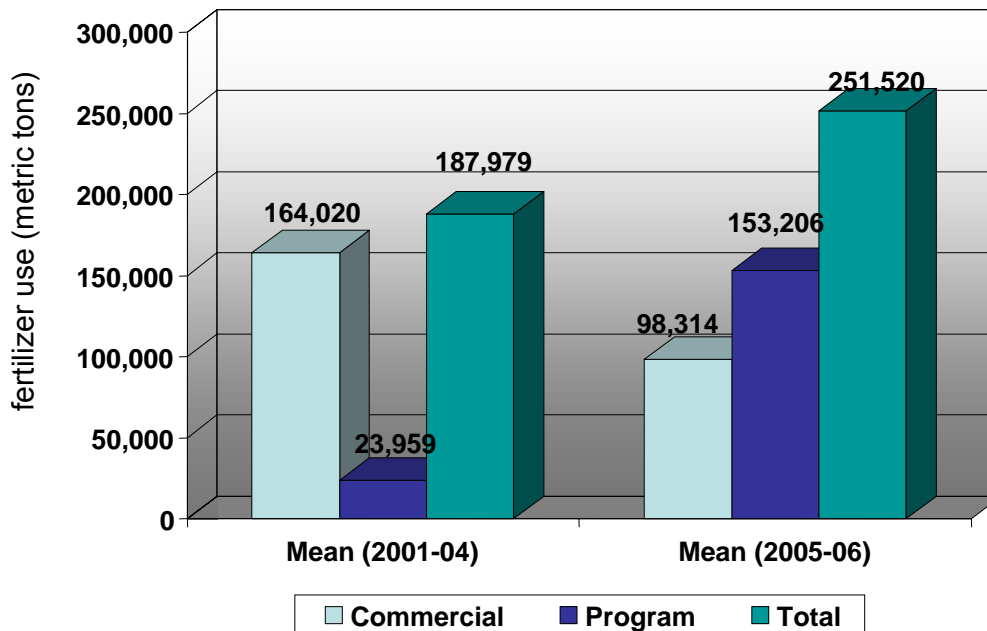
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1. Relatively low maize-fertilizer response rates (much lower than Malawi)
2. Poor targeting
3. crowding out of commercial sales → limited overall additional fertilizer use

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# Malawi

\* The additional 129,247 mt subsidized fertilizer only raised total use by 63,541 mt  
note: numbers subject to updating



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## Factors that could improve the B/C ratio of FSP:

1. Target relatively poor farming households
  - This will minimize displacement and have the most direct effect on poverty reduction
2. In areas where private traders are active, provide alternative form of benefits to farmers (e.g, lime)
3. Reduce recommended fertilizer application levels – 4x4 appears to give lower response rate than 2x2
4. Prioritize R&D to generate improved fertilizer-responsive seeds (note Malawi appears to get higher response to fertilizer than most areas of Zambia.
5. Open regional trade (especially in good harvest years) will raise and stabilize the price of maize → improve profitability of using fertilizer on maize

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## Additional Considerations:

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1. Labor market effects
2. Effect of lower maize prices on consumption and food security
3. Dynamic effects of lower maize price in year  $t$  on maize cultivation and demand for ag. labor in year  $t+1$
4. Substitution effects, crop shifts

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## Agricultural Subsidies

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- Returns sometimes positive, but generally lower than in investments

\$1 in ag. R&D → \$4.30 in ag. Income

\$1 in ag. subsidies → \$1.70 in ag income

43 countries, Fan and Rao (2003)

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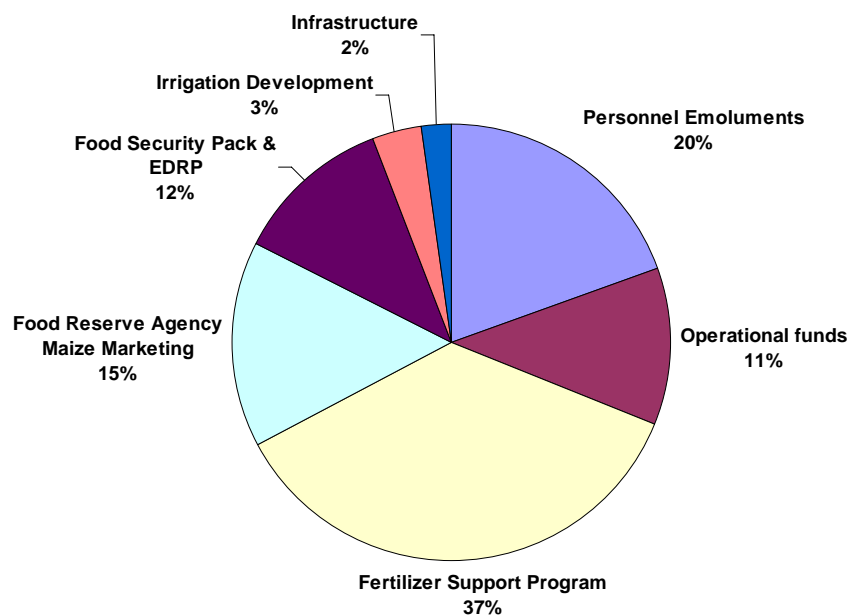
## IFPRI review of rate of return studies:

	Returns
Subsidies	Negative – 1.20
Investments	
- research & extension	1.35 to 1.70
- roads	1.20 to 1.30
- education	1.50 to 1.25
- communications	1.10 to 1.15
- irrigation	1.10 to 1.15

If we believe these findings, they have major implications

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## Budget allocation to Agricultural Sector in Zambia: ZMK465 million in 2005



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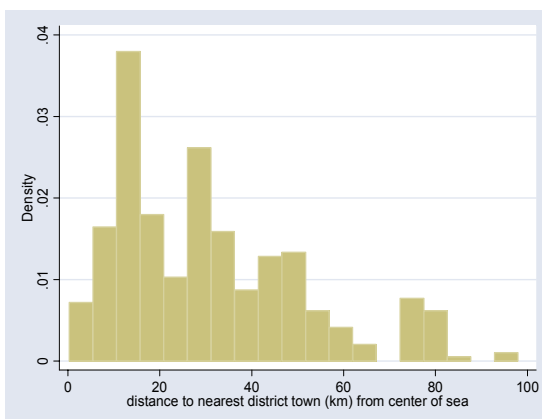


Thank you  
FSRP Web Site  
<http://www.aec.msu.edu/fs2/>

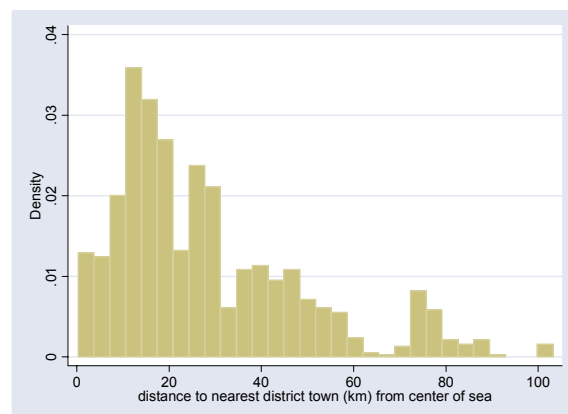
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## Households acquiring fertilizer from FSP and private traders, by distance from district town

FSP recipients



Hhs purchasing from traders



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