Egerton University

Tegemeo Institute Of Agricultural Policy And Development

FERTILIZER TRADE UNDER MARKET LIBERALIZATION: PRELIMINARY EVIDENCE FROM KENYA

by

Steven Were Omamo and Lawrence O. Mose

Tegemeo Working paper 1

KENYA AGRICULTURAL MARKETING AND POLICY ANALYSIS PROJECT

KENYA AGRICULTURAL RESEARCH INSTITUTE

MICHIGAN STATE UNIVERSITY

Support for this study was provided from the Rockefeller Foundation, Nairobi Office, and under the Kenya Agricultural Marketing and Policy Analysis Project (KAMPAP), supported by the United States Agency for International Development/Kenya.

Omamo is research officer with the International Livestock Research Institute, and Mose is a research fellow with the Kenya Agricultural Research Institute.

1. INTRODUCTION

Soil nutrient depletion is widespread in Kenya (de Jager et al. 1998; KARI 1998). Inorganic fertilizers hold considerable potential for nutrient replenishment but typically are applied at rates well below recommended levels or not at all (Tegemeo 1998). Fundamental to wider adoption and more intensive use of fertilizers is a well-functioning fertilizer distribution system (Goletti and Alfano 1995). Indeed, low adoption and application rates for fertilizer in Kenya appear to be due in part to the lingering effects of the disarray in the country's fertilizer sector up until 1990 (Argwings-Kodhek 1997). Prior to this, the Kenya Grain Growers Cooperative Union (KGGCU)—a parastatal agricultural commodity and input trading organization now known as the Kenya Farmers Association (KFA)—had a virtual monopoly over international procurement and domestic distribution of fertilizer. Under this system of control, access to fertilizer was poor, particularly in smallholder farming regions. The dominant position of the KFA caused several private importers and distributors to cease to operate, to fall under receivership, or to close branches countrywide (Argwings-Kodhek et al. 1991). In 1990, faced with a deepening crisis in this key agricultural sub-sector, the Kenya government liberalized international and domestic trade in fertilizer by abolishing import quotas and licenses and decontrolling prices.

Following liberalization, numerous private traders—ranging from specialized large-scale importer-distributors sited in major urban areas to diversified small-scale retailers in relatively isolated rural trading centres—have entered the fertilizer trade, displacing the KFA in most parts of the country (Argwings-Kodhek 1997; Omamo 1996). But despite this evidence of a vigorous response to market liberalization by the private sector, little is known about the factors that influence traders' willingness and abilities to supply fertilizer. Moreover, it is far from clear if and how an increased private sector presence in fertilizer distribution in Kenya overrides or eliminates enduring demand-side constraints on expanded use of inorganic fertilizers by farmers.

This paper reports results of a countrywide survey of fertilizer traders undertaken in late September 1997 with the aim of identifying broad supply-side and demand-side factors influencing trade in inorganic fertilizers in Kenya. The next two sections describe the sampling and econometric procedures followed. Regression results are then reported. Implications of the results for policy and research round-out the analysis.

2. SURVEY

Using a structured questionnaire, 59 wholesale and retail fertilizer traders were interviewed in 5 provinces, 17 districts, and 37 market centres around the country over the course of three weeks in September 1997 (Table 1). Given the limited time and financial resources available for the survey, an emphasis was placed on breadth, rather than depth, of coverage. All major agroecological zones (AEZs) were covered, with low-potential AEZs (L-LM) and higher potential zones (UM-UH) approximately equally represented. To further ensure a wide spatial reach, the sample was split roughly equally between eastern and western Kenya. Save for Nyanza, where only 2 districts were included, the spread of interviews was fairly even across administrative provinces in which cropping is prominent. Data collected included

quantities of major fertilizers sold and prices charged, dates of entry into fertilizer trading, principal suppliers and customers, perceptions about market conditions, access to key services such as credit, and market prices for major agricultural commodities.

Table 1. The Sample of Traders

		No. of Traders Interviewed	Percent of Sample
Province:	Central	11	18.7
	Eastern	16	27.1
	Rift Valley	15	25.4
	Nyanza	5	8.5
	Western	12	20.3
Region:	Eastern[a/]	27	45.8
	Western[b/]	32	54.2
AEZ[c/]:	L	2	3.4
	LM 1-2	10	17.0
	LM 3-6	21	35.6
	UM 0-1	13	22.0
	UM 2-6	9	15.2
	LH	4	6.8
	TOTAL	**59**	

a/ Districts in Eastern Region = Thika, Muranga, Nyeri, Laikipia, Meru, Mwingi, Makueni, Machakos.
b/ Districts in Western Region = Nakuru, Bomet, Kisii, Siaya, Vihiga, Kakamega, Bungoma, Trans Nzoia, Uasin Gishu.
c/ AEZs: L = lowlands; LM = lower midlands; UM = upper midlands; LH = lower highlands.

3. MODEL

As is true for any commodity, traded quantities of fertilizer both determine and reflect quantities demanded and supplied. A complete analysis of factors influencing trade in fertilizers thus would estimate relationships that explicitly link quantities of fertilizer traded to various determinants of demand and supply, most notably price and income. However, the simultaneous equation estimation techniques appropriate for this purpose typically require more degrees of freedom than were afforded by the sample size on hand. A unified microeconomic basis for the analysis thus was not formulated. Instead, trader revenues from fertilizer sales—i.e., quantities sold multiplied by prices—were interpreted as reflections of farmer expenditures on fertilizer, allowing various demand-side influences to be

hypothesized. Similarly, it was postulated that revenues likely are impacted by several trader-specific characteristics. Data on some of these characteristics thus were used to define variables that might influence revenues from the supply-side. The resulting model was estimated using ordinary least squares procedures. In generalized form, the model reads as follows:

SALES = f(AEZ, REGION, MZEPRICE, YEARS, CREDIT, CONSTRAINT, TRADE).

Table 2. Descriptive Statistics for Regression Variables

Variable	Units	Mean	S.D.	Med.	Max.	Min.
SALES	Millions of Kenya Shillings	15.41	44.23	1.62	238.11	0.11
AEZ	Binary Variable	0.44	.	.	.	.
REGION	Binary Variable	0.46	.	.	.	.
MZEPRCE	Kshs/90kg bag	1,239	180	1,200	1,608	940
YEARS	Number of Years	6	5.62	4	27	1
CREDIT	Binary Variable	0.31	.	.	.	.
CONSTRAINT	Binary Variable	0.51	.	.	.	.
TRADE	Binary Variable	0.60	.	.	.	.

The first three regressors represent potential demand-side influences on fertilizer sales and the latter four address firm-specific, supply-side factors. SALES = the value in Kenya shillings of inorganic fertilizer sold by a trader in 1997; AEZ = 1 for traders operating in

low-potential agroecological zones (L-LM) and 0 for those in high potential zones (UM-UH); REGION = 1 for traders located in eastern Kenya and 0 for those in western Kenya—i.e., as defined in the sampling frame (Table 1); MZEPRICE = the price of a 90 kg bag of maize at the time of the survey in the market centre in which the sampled trader was sited; YEARS = the number of years that a trader has been selling fertilizer; CREDIT = 1 if a trader received credit to finance fertilizer trade in 1997 and 0 if not; CONSTRAINT = 1 if a trader identified stiff competition and low trading margins as the most important constraints on expanded sales and 0 if other constraints were more important[1]; TRADE = 1 if a trader perceived business conditions to have improved under market liberalization and 0 if not. Table 2 contains summary statistics for the dependent variable and regressors.

Anticipated relationships between fertilizer revenues and the independent variables were established *a priori*. The higher is agroecological potential in Kenya, the higher are extant yields and incomes, the greater the willingness and abilities of farmers to adopt fertilizer-intensive technologies, and thus the higher should be revenues from fertilizer sales (Heyer, Maitha, and Senga 1976; Mose, Nyangito, and Mugunieri 1997; PAM-KMDP 1995). The expected influence of the AEZ variable was negative.

Poor rural infrastructure raises farm-to-market transaction costs and lowers farm income by increasing costs of using markets to acquire and dispose of goods and services (Omamo 1998a and 1998b). The lower are farm incomes, the lower is the demand for fertilizer, and thus the lower should be trader revenues from fertilizer sales. Preliminary analysis of official data suggests that the districts grouped into the eastern regions of the country (Table 1) have more kilometres of paved roads per inhabitant than do those in western Kenya (MTC 1984). The coefficient on the REGION variable was expected to take a positive sign.

Given the prominence of maize in Kenyan agriculture (Pearson et al. 1995), returns to maize production as reflected in maize prices likely are an important influence on households' willingness to apply fertilizer. Indeed, Mose, Nyangito, and Mugunieri (1997) identified the maize: fertilizer price ratio as a significant determinant of fertilizer use on small farms in Kenya: the higher was the ratio, the higher were fertilizer application rates among sampled farmers. The anticipated sign on the MZEPRICE coefficient thus was positive.

The longer a firm persists in a particular line of business, the greater might be its ability to expand sales. However, changes in market conditions—such as those associated with market liberalization—may induce entry of traders with more resources and greater abilities than have those with longer histories in the market. Among sampled traders, the average number of years in fertilizer trading was six and the median was four; most of them had entered the market after liberalization in 1990. Assuming this entry was in response to profitable opportunities, the sign of the coefficient on the YEARS variable was expected to be negative.

The agricultural calendar imparts extreme seasonality on fertilizer sales in Kenya (Omamo, 1996). This implies an important role for credit in overriding seasonal liquidity constraints. The greater a trader's access to credit, the greater his ability to increase sales, especially by granting credit to customers. The sign of the coefficient on the CREDIT variable was expected to be positive.

Increased competition and falling margins have been identified as important features of the post-liberalization fertilizer market (Argwings-Kodhek 1997). This suggests that gains from liberalization are being passed on to farmers. Yet sales volumes are depressed in some areas

(Argwings-Kodhek 1997). The net effect on revenues is unknown. If stiff competition and low trading margins are indeed important constraints on increased sales and revenues —implying that farmers truly are benefitting under liberalization—then the coefficient on the CONSTRAINT variable should have a negative sign.

Traders' perceptions of market conditions likely influence their willingness to invest in sales-enhancing activities and facilities. The more optimistic they are, the more likely they may be to invest and thus realize associated gains. The anticipated influence of the TRADE variable on revenues was positive.

4. RESULTS

Of the 59 traders interviewed, only 43 were able to provide data on quantities and prices of fertilizer sold. But despite the smaller number of observations used in the estimation, the model performs remarkably well (Table 3). All coefficients have the expected signs and a majority are significant at conventional levels. The high R-squared statistic and significant F-statistic indicate that, together, the seven regressors explain a considerable degree of the variability in revenues from fertilizer sales around the country.[2]

Table 3. Regression Results

Independent Variable	Coefficient Estimate	t-statistic	Sig.
Constant	1200	8.579	0.001
AEZ	-0.507	-3.180	0.034
REGION	0.043	0.275	0.797
MZEPRICE	0.506	3.064	0.038
YEARS	-1.110	-8.667	0.001
CREDIT	1.000	6.023	0.004
CONSTRAINT	-0.104	-0.978	0.383
TRADE	0.111	0.941	0.400
Observations = 43			
Adjusted R^2 = 0.91			
F-Statistic = 16.42 ($p<0.008$)			

Revenues from fertilizer sales appear to be influenced importantly by both demand-side and supply-side factors. The negative and significant sign on the AEZ coefficient indicates that revenues for traders in areas with low agroecological potential are significantly below those

in high-potential areas, this despite average fertilizer prices being higher in the former. A region's underlying production potential is confirmed as an important demand-side factor influencing fertilizer sales.

The coefficient on the REGION variable has the anticipated positive sign but is not significant. This may be because as currently defined, the variable is only a crude measure of the quality of rural infrastructure. Unfortunately, the data on hand do not permit a more precise exploration of this relationship.

The positive and significant relationship between maize prices and revenues from fertilizer sales confirms the dominant perception in Kenya of a positive correlation between the demand for fertilizer and returns to maize production.

The coefficient on the YEARS variable points to a strong inverse relationship between fertilizer sales revenues and the length of time traders have been in the fertilizer business. This finding lends support to claims that opportunities to enter the fertilizer market are increasing as the effects of liberalization take hold. It also indicates that recent entrants into the market are better able to exploit these new opportunities than are more established firms.

The anticipated positive relationship between access to credit and fertilizer revenues is confirmed by the significant coefficient on the CREDIT variable. This is a particularly meaningful result because only 30 percent of sampled traders received credit in 1997 (Table 2). Further, among those receiving credit, a greater than proportionate share (85 percent) fell in high-potential areas. Credit-related supply-side impediments to trade thus may reinforce demand-side constraints related to poor agroecological potential.

The results indicate that revenues from fertilizer sales are depressed by increasing competition and low trading margins, but not significantly so. The extent to which gains from liberalization are being passed on to farmers thus remains unclear.

Finally, traders' perceptions of market conditions following liberalization have the anticipated positive relationship with revenues but this link also is not significant. A more direct representation of investment decisions—unfortunately not possible with the current data—likely would improve this estimate.

5. IMPLICATIONS FOR POLICY AND RESEARCH

The results confirm that liberalization of Kenya's fertilizer market has induced a vigorous response from the private sector, pointing to important efficiency gains to the agricultural sector. But the results also suggest that liberalization is not sufficient to override several structural constraints on soil fertility replenishment in Kenyan agriculture and thus raise some concerns for equity.

The results indicate that the post-liberalization market-based fertilizer distribution system is inherently biased against low-potential agroecological zones. Demand-side factors (e.g., agroecological conditions and food prices) and supply-side factors (e.g., duration in fertilizer trading and access to credit) have mutually-reinforcing dampening effects on trade in these

areas. Continued support for research on soil fertility management problems in low-potential areas is vital. But the current analysis suggests that returns to research investments will hinge on expansions of fertilizer trade networks, whose appearance and sustainability will depend on demand-increasing technical change on farms. Prospects for improved equity thus rest on efficiency gains in low potential areas. Despite the insignificance of the REGION variable in the regression equation, public investment in improved rural infrastructure is likely to be important in this regard.

The finding that access to credit influences fertilizer revenues is significant. For as in many parts of the world, fertilizer trading in Kenya exhibits large economies of scale that require access to credit if they are to be realized (Omamo 1996). A key policy challenge is to design mechanisms through which these economies—currently captured by large-scale traders and farmers—can be passed on to smaller traders and farmers. In theory, this was one of the roles to be played by the now moribund Kenya Farmers Association (KFA). Indeed, despite continued operational difficulties borne of excessive political interference, the KFA retains the apparatus and expertise to capture economies to large-scale trade in international and domestic fertilizer markets. With political goodwill and a sharper commercial orientation, the KFA could be a vehicle through which seasonal liquidity constraints in Kenya's fertilizer industry can be overridden in an equity-enhancing fashion.

The results suggest several areas for further research, not only in Kenya, but in other countries in which fertilizer trade has been liberalized. Market liberalization is a process, not an event. Two issues are important in understanding this process for fertilizer. The first relates to factors influencing investment in, and expansion of, the fertilizer distribution network, the second to price formation. This paper gives some insight into the first question, but considerably more work is required. For instance, investment patterns likely are influenced by variations in infrastructure quality not only across regions, as in the current analysis, but also within them.
With regard to price formation, careful cost build-up studies are crucial first steps. In the case of Kenya, a key question to be answered is why fertilizer prices are on average so much higher in the country than they are elsewhere in east and central Africa (Jayne et al. 1999).

A third area for further research relates to farmer profitability as a demand-side influence on patterns of investment and trade in fertilizer markets. Within the current analytical framework, a logical extension would be to include among the regressors variables that capture farmer use of fertilizer. A more theoretically consistent—and thus more data-intensive and computationally demanding—analysis would endogenize traders' investment (location) and supply decisions with farmers purchase and application choices.

NOTES

1. This was by far the most common constraint identified by traders. Others included poor access to credit, high transaction costs in trade, poor market information, short trading seasons, poor service from suppliers, and inappropriate packaging.

2. However, because of the large number of dummy independent variables in the equation, the model is unlikely to yield reliable predictions of these revenues.

REFERENCES

Argwings-Kodhek, G. 1997. *Factors Constraining Fertilizer Use in Kenya*. Egerton University Tegemeo Institute of Agricultural Policy and Development Working Paper. Nairobi: Tegemeo Institute Egerton University.

Argwings-Kodhek, G., S. W. Omamo, F. Karin, and G. Okumu. 1991. *Fertilizer Marketing in Kenya*. Policy Analysis Matrix - Kenya Marketing Development Programme Project Paper. Nairobi: Egerton University, Policy Analysis Matrix Project.

de Jager, A., I. Kariuki, F. M. Matiri, M. Odendo, and J. M. Wanyama. Forthcoming (1998). Linking Economic Performance and Nutrient Balances in Different Farming Systems in Kenya: A Synthesis Towards an Integrated Analysis of Economic and Ecological Sustainability. *Agriculture, Ecosystems, and Environment* 71.2: 81-92.

Goletti, F., and A. Alfano. 1995. *Agricultural Input Market Reforms: A Review of Selected Literature*. MSSD Discussion Paper No. 4. Washington, D.C.: International Food Policy Research Institute.

Heyer, J., J. Maitha, and W. Senga (eds.). 1976. *Agricultural Development in Kenya: An Economic Assessment.* Nairobi: Oxford University Press.

Jayne, T.S., M. Mukumbu, M. Chisvo, D. Tschirley, M. Weber, B. Zulu, R. Johansson, P. Santos, and D. Soroko. 1999. *Successes and Challenges of Food Market Reform: Experiences from Kenya, Mozambique, Zambia, and Zimbabwe.* MSU International Development Working Paper No. 72. East Lansing: Michigan State University.

KARI. 1998. *Soil Fertility Research Priorities in Kenya*. Nairobi: Soil Fertility and Plant Nutrition Research Program of the Kenya Agricultural Research Institute.

Mose, L., H. Nyangito, and L. Mugunieri. 1997. An Economic Analysis of the Determinants of Fertilizer Use Among Smallholder Maize Producers in Western Kenya. Nairobi: Kenya Agricultural Research Institute. Unpublished manuscript.

MTC. 1984. *Assessment of the Socio-economic Impacts of the Kenya Rural Access Roads Programme*. Nairobi: Ministry of Transport and Communications, Transport Planning and Control Division.

Omamo, S. W. 1996. *Fertilizer Trade Under Market Liberalization: The Case of Njoro Division, Nakuru District, Kenya*. Research report prepared for the Rockefeller Foundation, Nairobi Office.

Omamo, S. W. 1998a. Farm-to-Market Transaction Costs and Specialization in Small-Scale Agriculture: Explorations with a Nonseparable Household Model. *Journal of Development Studies* 35.2: 152-163.

Omamo, S. W. 1998b. Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya. *American Journal of Agricultural Economics* 80.1: 116-123.

PAM-KMDP. 1995. *Farm Budgets for Food Crops, Cash Crops, and Livestock in Kenya*. Nairobi: Policy Analysis Matrix Project of the Kenya Marketing Development Programme.

Pearson, S. R, E. Monke, G. Argwings-Kodhek, A. Winter-Nelson, S. Pagiola, and F. Avillez. 1995. *Agricultural Policy in Kenya: Applications of the Policy Analysis Matrix*. Ithaca: Cornell University Press.

Tegemeo. 1998. *Monitoring for Improved Agricultural Sector Policy Making*. Tegemeo Institute for Agricultural Policy and Development Working Paper. Nairobi: Egerton University Tegemeo Institute for Agricultural Policy and Development.