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WHY ARE FRESH PRODUCE PRICES SO UNSTABLE IN LUSAKA? INSIGHTS FOR POLICY AND INVESTMENT PRIORITIES

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Main Points

1. Daily quantities of tomato, rape and onion entering Soweto market in Lusaka fluctuate dramatically
2. The market does a remarkable job of moderating the impact on prices of these unstable quantities, through stabilizing mechanisms such as short-term storage of tomato and rape by traders and consumers, longer-term storage of onion by traders, direct sourcing of rape from farm areas by retail traders, and exportation of tomato and onion outside Lusaka.
3. Yet even with these stabilizing mechanisms, wholesale prices are highly variable, with negative effects on farmers and consumers.
4. Reducing variability requires investments in four areas: (a) improved control of production environments by farmers through irrigation, better access to inputs and greater agronomic knowledge, (b) improved vertical flow of information from farmers to traders to brokers to retailers, (c) a regulatory framework for broker activity to improve trust and information flow between brokers and sellers, and (d) improved market infrastructure.

INTRODUCTION: Rapid urbanization and renewed per capita income growth are creating new opportunities for African farmers of fresh produce. Yet these same factors are putting great stress on the already overburdened traditional marketing systems that dominate fresh produce marketing across most of Sub-Saharan Africa (SSA).

The poor performance of many of these systems is widely known. Yet little comparative knowledge has been generated to quantify the range of observed performance across countries. Such knowledge is a necessary first step in designing policies and programs that improve farmer and consumer welfare. We begin filling this knowledge gap in this Policy Synthesis by examining the price behavior of tomato, rape, and onion in the marketing system serving Lusaka. These crops are perhaps the three main "staple vegetables" in East and southern Africa, eaten on a daily basis by most people; in Lusaka, they account for more than half of all vegetable consumption. Policy Syntheses 39 and 40, and Research Report 46 provide additional analysis for the interested reader.

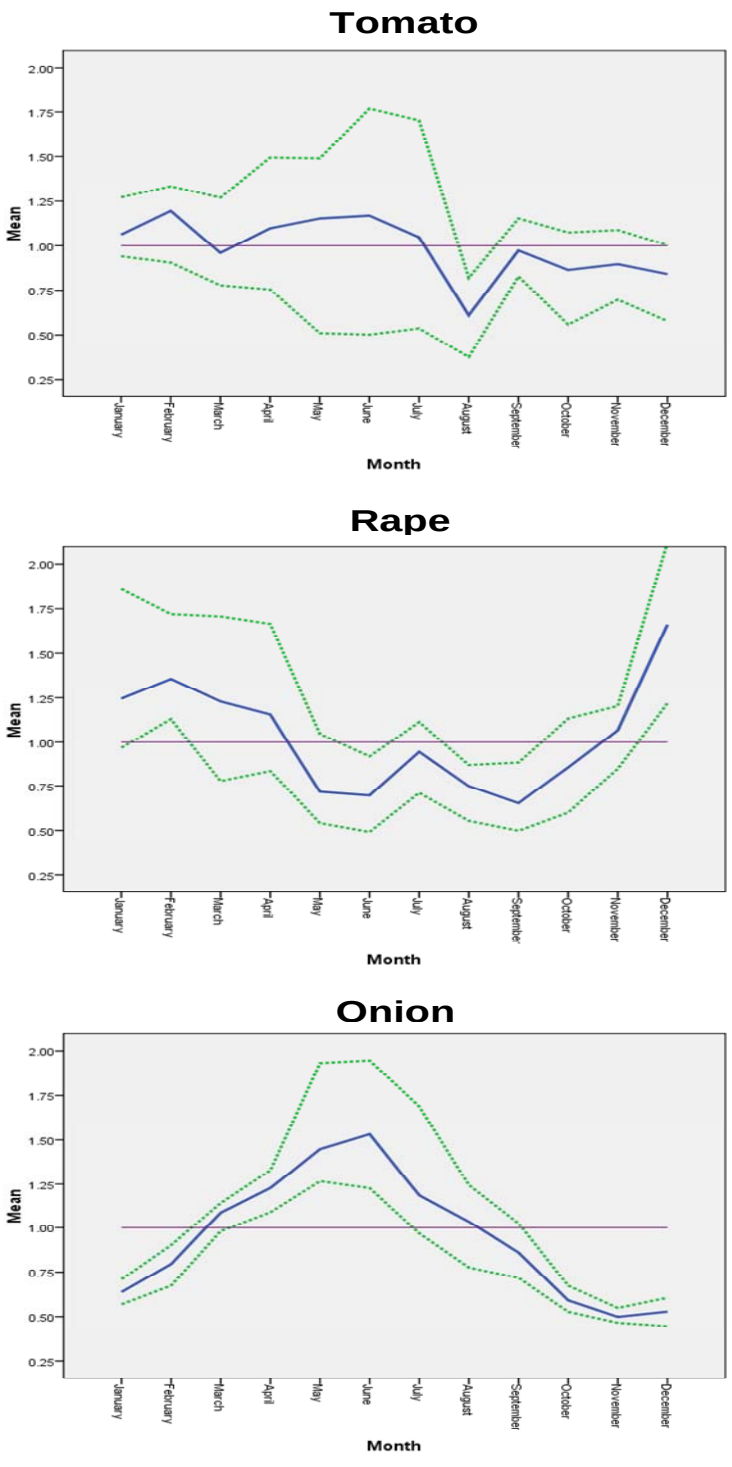
DATA Primary data for this study come from three sources. The Food Security Research Project (ACF/FSRP, carried out in collaboration with the Agricultural Consultative Forum) has collaborated with the Zambia National Farmers' Union (ZNFU) since January 2007 to collect detailed information on prices and quantities of tomato, rape, and onion in Lusaka's dominant wholesale market (Soweto). On Monday, Wednesday, and Friday of each week, market reporters collect information on all trucks entering the market with the three products. These data allow computation of total volumes and values flowing through Soweto. Market reporters also interview traders on the destination of product leaving Soweto.

PRICE SEASONALITY: Seasonal indices are a common way to portray the movement of prices over a "typical" year. They show the average percent by which prices in each of the 12 months differ from average prices over the surrounding 12 month period. We additionally assess the stability of this seasonal price pattern by plotting three lines: the seasonal index, and the index plus and minus a 25% "confidence

interval". The resulting bound is a 50% confidence interval on the index; 25% of daily price observations fall below the lower line and 25% above the upper line[1].

Based on weather patterns and interviews with brokers in Soweto, tomato is expected to show seasonal supply peaks (low price periods), immediately after the wet season from April to October, with very little supply and high prices in the rainy season from November to March. For rape we expect one long season of high supply and low prices during the dry months of May to November. Onion is expected to be similar to tomato, with low supplies and high prices from April to July.

Figure 1. Seasonal Price Indices for Tomato, Rape, and Onion in Lusaka



Actual price seasonality follows these expectations most closely for rape, followed by onion, with tomato diverging widely from expectations (Figure 1). The 50% confidence intervals on the tomato seasonal index are also the widest, especially during the anticipated high price season of May through July. In fact, during only one month (August) did daily tomato prices have a better than 75% probability of lying above (below) the mean price over the period of analysis when the mean index lied above (below) it[2]. Rape prices reached this threshold during five months (February and December above the mean; June, August and September below it) while onion prices did so during seven months (April-June above the mean; October-February below it). This instability in tomato's seasonal price pattern is linked to known problems with groundwater availability in key producing areas, and potentially also to difficulty in managing disease outbreaks. Rape's seasonal pattern is more stable because most of it is produced in low-lying areas near river banks during the dry season, minimizing the risk of water shortages and (by producing less during the rainy season) avoiding disease problems.

Onion's relatively stable seasonal pattern derives primarily from the ability of traders to draw from a wider geographic range to supply Lusaka. Note,

[1] See Research Report 46 for details on how the index and confidence intervals were calculated.

[2] These months are identified by the top line lying below the mean when the index is below it, or the bottom line lying above the mean when the index is above it.

however, that onion shows the greatest (though stable across years) total seasonal variation among the three crops, with seasonal highs of 1.5 times the mean price, and lows of 0.5; equivalent figures were 1.2 and 0.62 for tomato, and 1.65 and 0.7 for rape.

Figure 2 shows the observed price patterns of the three crops during the entire study period. While the expected low price periods for tomato were April and May and then from August to October, analysis shows that the period of low prices during 2007 actually extended over the entire period from April to October, though there were small peaks and troughs within this period. The seasonal pattern in 2008 diverged sharply from expectations around April/May due to problems accessing irrigation water in Lusaka West, one of the major supply areas. Price patterns for rape and onion largely followed expectations.

PRICE VARIABILITY: Perishable commodities depend on some combination of cold storage, strong information flows between buyers and sellers, and effective control of production environments (through irrigation and pest management) to regulate flow of product to the market and avoid dramatic price swings. South Africa has all three: very large producer-shippers that dominate that market have cold transport and access to the inputs and knowledge they need to avoid most dramatic fluctuations in output, and brokers operating in the country's wholesale markets communicate constantly with producers and buyers to match supply to demand. In Zambia, traditional fresh produce supply chains handle over 90% of all marketed fresh produce. Production in these chains is dominated by small- and medium-scale farmers, many of whom have poor access to inputs and extension advice and face very high variability in yields. Most sales go into an atomistic retail sector that makes it difficult for brokers to anticipate demand, even if farmers were able to respond to attempts at active coordination by the brokers. Finally, these chains have no cold storage, meaning that wholesale prices for products like tomato and (especially) rape must adjust daily to clear the market. Under these conditions, price variability can be extreme, with negative implications for farmers and consumers.[3]

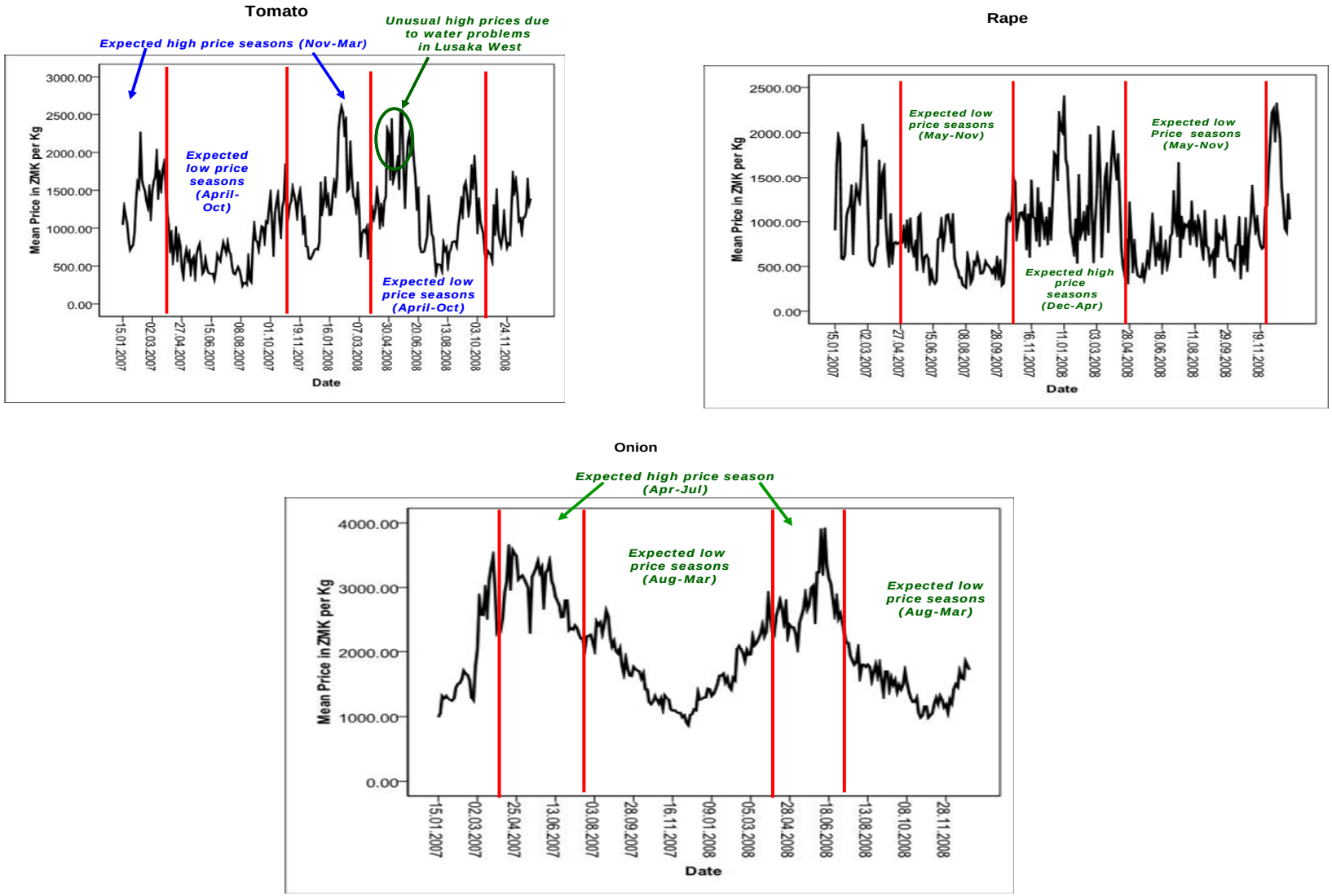
We first quantify variability in daily prices and quantities at wholesale. The coefficient of variation in Table 1 is affected by day-to-day fluctuations and by longer seasonal variation; the other two measures eliminate seasonal variation by focusing on day-to-day variability. Five points stand out. First, daily quantities arriving in the market fluctuate dramatically for each crop: mean day-to-day changes[4] (absolute value) in quantities arriving on the market are 29% for tomato, 32% for rape, and 56% for onion. For all three crops, these changes exceed 20% in absolute value more than half the time. Second, this variability in quantities drives great variability in prices for rape and tomato, which see mean day-to-day absolute price changes of 30% and 20%, respectively. Third, in all cases, prices vary less day-to-day than do quantities. This differential is dramatic for onion (which has the highest variability in quantities) but is explained by the storability of this crop, which allows market supply to differ from quantities arriving at the market (volumes put into storage are not offered for sale). For rape and tomato, neither of which can be stored to any significant degree, the pattern suggests a perhaps surprising willingness of consumers to alter their consumption in response to price changes. Finally, tomato prices vary substantially less day-to-day than do rape prices, despite comparable variability in quantities.

We explore the mechanisms behind these last two points below. We now examine price behavior more formally by estimating price flexibilities for each crop. Price flexibilities are a common measure of price behavior, showing the % change in prices for 1% change in quantities arriving on the market. Note that high price flexibilities are associated with *less* flexible and *less* stable systems: systems that are less able to slow down or speed up the flow of product from farmer to consumer in response to changing circumstances and in which, for

[3] See Mwiinga 2009 for a detailed assessment of production and price risk for tomato in Zambia.

[4] Note that all these calculations are based on Monday-Wednesday-Friday data collection, meaning that two thirds of the computed "day-to-day" changes occur over two days, and one third over three days.

Figure 2. Seasonality of Wholesale Prices in Soweto Market



Source: FSRP Vegetable Market Volumes and Prices Monitoring Data, January 2007 to January 2009.

Table 1. Selected Measures 0f Variability in Prices and Quantities for Tomato, Rape, and Onion (Soweto, 15 January 2007 to 16 November 2009)

	Tomato		Rape		Onion	
Variability measure	Price	Quantity	Price	Quantity	Price	Quantity
CV	0.51	0.31	0.48	0.41	0.41	0.47
Mean day-to-day absolute % change	20%	29%	30%	32%	7%	56%
Share of day-to-day changes > 20%	39%	51%	52%	56%	5%	64%

Source: FSRP Vegetable Market Volumes and Prices Monitoring Data, January 2007 to January 2009.

that reason, prices must bear the brunt of any adjustment. High price flexibilities mean high price instability for a given instability in quantities arriving on a market; when these quantities are themselves highly variable, the resulting price instability can impose high costs on farmers and consumers. Marketing systems as a result seek ways to reduce price flexibility.

Because our three crops are "staple vegetables" consumed on a nearly daily basis by most households, we expect their demand to be price inelastic: we don't expect consumers to greatly reduce or increase their purchases in response to price changes. In the extreme case of zero storage due to perishability, we would expect fluctuations in quantities to drive proportionally larger changes in price; price flexibilities would lie above unity. In the case where some very short-term storage (2-3 days) is possible, flexibilities in high frequency data (e.g., daily) could lie below unity, rising and eventually exceeding unity as data frequency diminishes (e.g., from daily to weekly to monthly).

Storage can in principle occur at four levels in the system: farm, wholesale, among retailers, and among consumers. Storage on farm is not relevant to our analysis, since our quantity data is for volumes arriving at the market. These data show that ending stocks of tomato and rape average only 15% and 2%, respectively (compared to 89% for onion), of daily volumes arriving at the market; rape is essentially not stored at wholesale, and tomato storage is also very low. On the other hand, we know that retailers frequently keep tomatoes for 2-3 days, and may even keep rape until the next day if they don't sell it all. UCS data indicates that 45% of Lusaka consumers own a refrigerator (Hichaambwa, et al, 2009), suggesting that some of these households may be able to store 2-3 days' supply of rape and perhaps a week to 10 days' supply of tomato.

Our channel maps (Policy Synthesis 40 and Research Report 46) show that retailers purchase a large share of their rape directly from farmers. This provides another avenue for reducing price flexibility, as retailers can arbitrage between purchases from farmers and brokers at Soweto depending on relative prices. We also know that retailers buy entire plots of rape and can harvest it over a (short) period of time, effectively storing it in the field. The channel maps also show a final potential mechanism for reducing price flexibility: shipping outside of Lusaka. If these shipments can be made on short notice, in response to large arrivals in Soweto, or delayed when little product arrives, they will reduce price flexibility; if instead they are contracted and must be shipped on an agreed schedule, they can increase price instability. Given what we know of how the marketing system functions, we expect the former situation to prevail and therefore expect that these shipments will reduce price flexibility. Note that rape is not shipped outside of Lusaka, suggesting another reason, in addition to its greater perishability, to expect high estimated price flexibilities.

We estimated two models for each crop: one with daily data and one with weekly data (Table 2; see Research Report 46 for full econometric results). Based on the discussion above, we expect price flexibilities to be well below unity for onion in both models, highest for rape in both models, and substantially lower for tomato and rape in the daily than in the weekly model.

Table 2. Summary Results on Price Flexibility Estimations

	Tomato	Rape	Onion
# of daily obs	357	353	343
# of weekly obs	139	140	137
Daily flexibility	-0.28***	-0.791***	-0.001
Wkly flexibility	-0.891***	-0.966***	-0.091***

*** significant at 1%

Results strongly confirm these expectations. Daily onion prices are unaffected by the same

day's quantity, being driven entirely by seasonal fluctuations in supply and by the previous day's price; together these explain nearly all the variation in the daily onion price. Onion's price flexibility becomes statistically significant but remains small in the weekly model. Rape has the highest flexibility, at -0.79 in the daily model and nearly unity in the weekly model. The fact that rape's price flexibility does not exceed unity even in the weekly model – well beyond the time that the product can be stored except in refrigerators – suggests that retail traders' direct purchases from farmers (and perhaps other factors we are unaware of) act to stabilize wholesale market prices of this crop. Tomato has quite a low flexibility in the daily model (-0.28), suggesting that storage of 2-3 days at retail and consumer levels is common, and probably also that shipments outside of Lusaka stabilize the market. This crop's flexibility rises markedly in the weekly model, to -0.89.

CONCLUSIONS: All in all, this analysis suggests that Lusaka's traditional marketing system has found ways to reduce the effects on prices of fluctuations in quantities arriving on the market, despite no cold chain below the consumer level and difficulty coordinating supplies between a large number of small farmers and small traders. It is notable that flexibilities for tomato and rape remain below unity even beyond the time period that retailers and most households can reasonably be expected to store these products; shipment of tomato outside of Lusaka and procurement of rape directly from farmers are the two most likely mechanisms driving this result.

Yet even with these stabilizing mechanisms, wholesale prices are highly variable, due to even greater variability in daily quantities. This variability imposes real costs on farmers and consumers. Reducing variability requires investments in at least four areas. First, farmers need to be assisted to better control their production environments, though irrigation, better access to inputs, greater agronomic knowledge about which inputs to use and how, and ideally, early warning type information on threats from crop pests. Second, the vertical flow of information in the system, from farmers to traders to brokers to retailers, need to be improved so that demand and supply can be more closely matched without the dramatic price fluctuations that market participants current experience. Continual information flows spanning farmers to retailers through brokers, is a fundamental feature of well performing fresh produce systems. Third, improved physical market infrastructure at wholesale, while not directly contributing to price stability, is a *sine qua non* for broader improvements, given the deplorable state of the Soweto wholesaling area. Note that we are not at this point suggesting investment in a cold chain, and certainly not public investment. Basic improvements in physical infrastructure, together with improved production practices and information flows, should be given higher priority at this point in Zambia's development. Finally, one likely benefit of an effective regulatory framework to govern the behavior of brokers (see Policy Synthesis 39) is improved trust on the part of farmers and other sellers, potentially leading to improved information flow and, as a result, reduced instability.

REFERENCES:

Hichaambwa, M., A. Chapoto, M. Beaver and M. Weber, (2009). Patterns of Urban Food Consumption and Expenditure in Zambia: An Overview Report Based on the CSO/MACO/FSRP Food Consumption Survey in Urban Areas of Lusaka, Kitwe, Mansa and Kasama, 2007-2008. FSRP WP No. 43.

Humphrey, John (2006). "The supermarket revolution in developing countries: tidal wave or tough competitive struggle?" Journal of Economic Geography. Vol 0, No 2007.

Minten, B. (2008). "The food retail revolution in poor countries: is it coming or is it over?" Economic Development and Cultural Change, 56, pp 767-789.

Mwiinga, M, (2009). An assessment of tomato price variability in Lusaka and its effects on smallholder farmers". Unpublished M.S. thesis. Department of Agricultural, Food, and Resource Economics, Michigan State University.

Traill, B. (2006). "The Rapid Rise of Supermarkets?" Development Policy Review. 24(2), Pp. 163 – 174.

Tschirley, D. and M. Hichaambwa, (2010). The Structure and Behaviour of Vegetable Markets Serving Lusaka. FSRP Working Paper.

Tschirley, D., M. Hichaambwa and M. Mwiinga, (2009). Comparative Assessment of the Market Structure and Price Behaviour of Three Stable Vegetables in Lusaka, Zambia. CABI Monograph

Tschirley, D., M. Ayieko, M. Hichaambwa, J. Goeb, W. Loescher (2009). "Modernizing Africa's Fresh Produce Supply Chains without Rapid Supermarket Takeover: Towards a Definition of Research and Investment Priorities". Paper prepared for the conference "Towards priority actions for market development for African farmers". ILRI, Nairobi. May 15-17, 2009.