Staff Paper

FARM-LEVEL PERSPECTIVES ON THE IMPACT OF DOMESTIC SUPERMARKETS ON KENYA'S FRESH FRUITS AND VEGETABLES SUPPLY SYSTEM

David Neven
Thomas Reardon
Michael Odera
Honglin Wang

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Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48824

Farm-Level Perspectives on the Impact of Domestic Supermarkets on Kenya's Fresh Fruits and Vegetables Supply System.

David Neven
(nevendav@msu.edu)

Thomas Reardon
(reardon@msu.edu)

Michael Odera
(mikemako67@yahoo.com)

and

Honglin Wang
(wanghon7@msu.edu)

Abstract: The rise of supermarkets in Kenya has given rise to a new group of medium-sized farms managed by well-educated farmers. Focusing on kale, the essay shows that nearly all supermarket-channel farmers have the capacity to supply larger volumes year round and have transportation vehicles, an irrigation system, a packing shed, a cellular phone, and so on, pointing to the existence of a threshold capital vector which farmers must have in order to access supermarkets. Especially farm size and irrigation were found to be significant determinants of participation in the supermarket channel. Kale suppliers to supermarkets use more capital intensive production technologies, leading to average labor and land productivities which are 60-70% higher than in the traditional channel. Eighty percent of labor consists of hired workers, indicating that these farmers could be important in alleviating poverty for rural households with little or no land. While most traditional-channel kale farmers sell to brokers and get a price that lets them break-even at best, supermarket-channel farmers have a 40% gross profit margin. These margins and lower market risks in the supermarket channel have resulted in a strong growth dynamic of supermarket-channel farmers which have doubled the size of their operations over the last five years.

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David Neven, Thomas Reardon and Honglin Wang
Michigan State University

Michael M. Odera
Kenya Agriculture Research Institute

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KEY TO ABBREVIATIONS

CBS	Central Bureau of Statistics
COD	Cash On Delivery
COMESA	Common Market for Eastern and Southern Africa
DFID	Department For International Development (UK)
EAC	East African Community
FAO	Food and Agriculture Organization
FC	Factor Cost
FDI	Foreign Direct Investment
FFV	Fresh Fruits and Vegetables
GDP	Gross Domestic Product
GoK	Government of Kenya
HACCP	Hazard Analysis Critical Control Points
HCDA	Horticultural Crop Development Authority
HPHC	Horticultural Product Handling Centre
KACE	Kenya Agricultural Commodity Exchange
MD	Managing Director
MLE	Maximum Likelihood Estimation
MoARD	Ministry of Agriculture and Rural Development
MPV	Marginal Product Value
NGO	Non Governmental Organization
OLS	Ordinary Least Squares
SKU	Stock Keeping Unit
SMS	Short Messaging Services
SMT	Strategic Management Theory
TAV	Traditional African Vegetables
TCT	Transaction Cost Theory
USAID	United States Agency for International Development

FARM-LEVEL PERSPECTIVES ON THE IMPACT OF DOMESTIC SUPERMARKETS ON KENYA'S FRESH FRUITS AND VEGETABLES SUPPLY SYSTEM

1. Introduction

The rise of supermarkets in developing countries has received considerable attention in the development economics literature over the last few years (Reardon and Berdegue 2002, Weatherspoon and Reardon 2003, Hu et al. 2004). The research presented in those articles mostly focused on the retailer-level, revealing that supermarkets are (i) growing fast, (ii) becoming important, even dominant agents in the food supply chain and (iii) implementing very different procurement systems than those observed in the traditional food marketing system. In Kenya for example, Neven and Reardon 2004 showed that supermarkets are growing at an annual rate of 18%, had a 20% share of the urban food market in 2003 and are rapidly developing the various pillars of the new procurement system (i.e., centralization, regionalization, preferred suppliers, specialized wholesalers, private standards and grades). While indicating a likely differential impact of this more demanding procurement system on farmer participation in the supermarket channel, the analyses in this first wave of research on supermarkets in developing countries was for the greater part limited in its scope to data from retailers and wholesalers. Based on farmer surveys in the fresh fruits and vegetables (FFV) sub-sector, this essay aims to fill this gap in the literature by analyzing the rise of supermarkets in Kenya from the farmer perspective.

The strategic objective of this essay is to assess the effect of the development of the supermarket sector in Kenya on FFV producers' behavior and net incomes. Controlling for product we have the following three research questions:

(1) What are the determinants of the farmers' channel choice (supermarket channel vs. the traditional channel)?

(2) What are the effects of participation in the supermarket channel on the farmer's production technology?

(3) What are the effects of participation in the supermarket channel on the farmer's net income?

The research presented here focuses on kale[1] growers, although some limited analyses for tomatoes and bananas is included to get a broader perspective. These products were chosen (i) because of their importance in terms of volume in Kenya's produce sub-sector and (ii) because they represent different risk-return trade-offs. Kale is a labor-intensive crop (requiring intensive weeding) with a reliable yield (relative to agro-ecological conditions), but a generally low market

[1] Kale, a leafy green vegetable (member of the cabbage family) is the most widely grown and consumed vegetable in Kenya. Its low price and high nutritional value make it especially important in the diet of the poor who consume it with the local (maize-flour-based) staple ugali (hence its local name sukuma wiki, Swahili for 'push the week'). In 2002, overall kale production in Kenya reached 317,000MT with an estimated rural market value of Ksh2 billion, i.e., 30% of the total volume and 17% of the total value of vegetable production respectively (MoARD 2002).

price, making it well-suited for risk-averse smallholder farmers who have a high labor-to-capital ratio. Tomatoes are more capital intensive (requiring irrigation for water control, more chemicals to control diseases, more expensive good quality seeds, and so on) and their yield is more variable, but prices are generally higher, thus attracting farmers with more capital, who can afford to take greater yield risks in return for higher potential returns. In banana production, access to planting materials (e.g., tissue culture) is a critical issue as demand for these materials outstrips supply (MoARD 2000), so that less mobile and less informed smallholder farmers have less access to it.

The essay is structured as follows. The next section briefly lays out the conceptual approach to the research questions. Section 3 indicates how supermarket-channel farmers and traditional-channel farmers were defined in this study and describes the data that were collected. Section 4 compares the characteristics, the production practices and the marketing practices of farmers directly supplying supermarkets and farmers supplying the traditional system of brokers and wholesalers. Section 5 uses the case of the kale supply chain to assess the determinants of channel participation (supermarket channel vs. traditional channel) and analyzes the production technology and net income effects of this participation. Section 6 concludes and provides recommendations for development policy and programs.

2. Conceptual Approach

The rise of supermarkets in Kenya is here modeled as a shock to a domestic FFV supply system that has shown few dynamics over the last few decades, apart from a steady growth in volumes and in the number of rural producers in response to urbanization (Dijkstra 1999a). On the one hand, supermarkets may pay higher prices to farmers and/or may offer them more demand reliability both in terms of price and volume. On the other hand, meeting the supermarket's higher standards for food safety and quality and other delivery conditions may imply the presence of (or additional investments in) certain production and marketing capital as well as an increased need for working capital to deal for example with higher input use and buyer credit. In other words, the rise of supermarkets in Kenya is hypothesized to contribute to an industrialization of the food system as observed in other countries (Reardon and Barrett 2000). Here we shall take an essentially micro-economic approach, focusing on how this shock impacts the behavior of FFV producers as individual agents.

First, we model the farmer's decision on whether or not to sell to supermarkets as a standard static adoption decision, where the adoption of X (in this case the supermarket channel) is determined by the incentives for and capacities of farmers (Feder et al. 1985). The different requirements of supermarkets are hypothesized to determine a K* vector of threshold capital requirements, embodying a technology, which suppliers must have before the supermarket channel enters their opportunity set. Different technologies as embodied in different capital vectors (e.g., a labor intensive K_1* and capital intensive K_2*) may exist, with both giving farmers the capacity to meet the supermarkets' requirements. Furthermore, K* may only be weakly enforced by supermarkets and will likely be a moving target for farmers (supermarket requirements become more stringent over time). K* may include physical capital (e.g., land, vehicles), human capital (e.g., business experience), financial capital (e.g., cash reserves) and organizational capital (e.g., group membership). Farmers with a capital vector K>K* are expected to enter the supermarket channel if the incentives are there. Farmers with K<K* are excluded from the supermarket channel. The latter may be undesirable from a social welfare

point of view, if the supermarket channel represents higher net incomes for farmers and if the smallholder farmers who make up the bulk of Kenya's population are being excluded from it. Our conceptual model then takes on the following general reduced form (i.e., the input demand function as derived from the farmer's profit function; Sadoulet and De Janvry, 1995):

$$\text{channel choice} = f(p, r, \sigma, k, z),$$

where p, r, σ, k and z represent output prices, input prices, risk factors, quasi-fixed capital and shifters respectively. Output prices, input prices and risk factors (including transaction costs) are in part implicit to the channel choice (which determines governance structure) and are further determined by farm characteristics such as its location and size. Therefore input and output prices and risk factors will not be directly entered in the implementation model (section 5.1). Given the limited geographic spread of the sample populations (see next section) and thus too limited variation across the sample for this variable, location as a key shifter will also be excluded. This implies that our channel choice model will mainly be determined by quasi-fixed capital. The latter both represents resources internal to the farm and at the same time co-determines access to external resources. For example, size of the land owned by the farmers is a direct resource as well as an indicator of access to credit (Carter and Wiebe 1990).

Second, we assess the differential effect of channel choice on production technology by comparing the production functions for farmers supplying supermarkets and farmers supplying traditional marketing channel agents. The distribution of the farmers over these two groups is not random but rather the outcome of a self-selection process and this non-randomness may bias the estimated coefficients in the production function. In order to control for this selectivity bias, we use Heckit's two-stage method (Heckman 1979). In the first stage, a probit model is used to estimate the selection model, i.e., channel choice regressed on a set of exogenous determinants using the whole sample. From this estimation, the inverse Mill's ratio (λ) is calculated based on the residuals of the selection equation. This ratio represents a summarizing measure which reflects the effects of all the unmeasured characteristics which are related to channel choice (Smits 2003). In the second stage of the Heckman procedure, we estimate the production function (the substantial model which is the real focus here) for both sub-populations while adding the lambda variable as an explanatory variable to control for self-selection bias.

Third, we assess the net income effect of channel choice using gross margin analysis. We then place this net income effect in the broader context of value chain theory (Kaplinsky and Morris 2001). According to value chain theory, the following dynamic models the growth process of a firm: (1) the performance of firm A depends on the performance of A's network partners and vice versa (systemic efficiency); (2) the participation of A in a supply chain takes on a particular governance structure (system access) depending on A's performance, the policies of the government and the channel captain of A's supply chain and the location and network relationships of A; (3) the benefits accruing to A depend on the governance structure for A, the performance of A and A's market power (distributional effects); (4) the amount of benefits accruing then determine the degree of upgrading, which in turn affects the performance of A (coming full circle: system dynamics). We will assess this model by comparing (income and risk related) benefits accruing to farmers, governance structures and upgrading/growth in the supermarket channel vs. the traditional channel.

3. Definitions and Data

Farmer Surveys

The central objective of this essay is to better understand the nature and behavior of the FFV farmers who are supplying supermarkets in Kenya. There are basically three types of FFV suppliers to supermarkets (Neven and Reardon 2004): importers (14% of supplies), brokers or other middlemen relying mostly on smallholder producers (43% of supplies) and farmers supplying direct to the supermarket (43% of supplies). Of the latter, 23% come from small farms (<10 acres), 42% come from medium-sized farms (10-40 acres) and 35% come from large farms/plantations (>40 acres). Farmers as direct suppliers of FFV can further be classified into listed and unlisted suppliers, i.e., based on whether or not they are part of the list of regular FFV suppliers to the supermarkets. In 2003, 125 out of an estimated 400 direct FFV suppliers to the leading two chains were listed, with the non-listed suppliers mainly consisting of smallholder farmers and brokers ad hoc addressing shortages not yet resolved by listed suppliers (according to our interviews with the supermarkets). In this context, the target population is here defined as 'the farmers listed as direct FFV suppliers to Uchumi and Nakumatt supermarkets'. This population was selected for the following four reasons. First, within the next five years, 85-90% of the locally sourced FFV sold in supermarkets are expected to be supplied directly by farmers (or farmer groups), as opposed to through traditional brokers (in 2003, 50% was directly supplied by farmers; Neven and Reardon 2004) Second, as supermarkets develop their FFV procurement system these direct supplies will come from listed suppliers only. Third, farmers supplying supermarkets indirectly through traditional brokers feel no impact from supermarkets because the brokers' buying behavior is not different, as these are, again according to our interviews with the supermarkets, the same brokers supplying wholesale markets in Nairobi (i.e., they are not specialized brokers working with the same group of farmers over time). Fourth, 90% of FFV sold through supermarkets are sold through the two leading chains, Uchumi and Nakumatt (Neven and Reardon 2004). We shall further refer to this population of 'farmers listed as direct FFV suppliers to Uchumi and Nakumatt' as 'supermarket-channel farmers'.

In order to assess to what extent these supermarket-channel farmers are different from farmers supplying through the traditional FFV system, a similar data set was also collected on farmers who supply directly to traditional marketing agents (brokers, wholesalers, open air markets), but not to supermarkets. Since this is a large and heterogeneous population, we focused on farmers in selected key production regions for selected produce items bound for the Nairobi market. The selected products are kale, tomato and banana, which are in terms of volume the two most important vegetables and the most important fruit in the domestic market. The production areas for these products were selected based on their relative importance as indicated in interviews with operators at Nairobi's key FFV wholesale markets (Wakulima, Gikomba, Kawangare, Kangemi). We shall further refer to this population as 'traditional-channel farmers'.

Two farmer surveys were conducted. The first farmer survey took place in the period September-November, 2003 and focused on the capacities of the farmers and the marketing methods they used. A total of 115 farmers were interviewed, comprising two sub-samples. The first sub-sample consists of 49 supermarket-channel farmers randomly selected from the supplier lists provided by Uchumi and Mugoya, the (then) specialized FFV wholesaler of Nakumatt (these 49 farmers equal 40% of the listed FFV suppliers). One of the requirements for being a listed supermarket-channel farmer is that the farmer can easily be reached by phone. Thanks to

the emergence and rapid diffusion of cellular phones in Kenya, many farmers, not just the rich ones, have (access to) a phone (e.g., 30% of the traditional-channel farmers in our research could be reached by cellular phone). This allowed us to contact the supermarket-channel farmers by phone to set up a time and place to meet for the interview. If a farmer could not be reached or refused to participate, he or she was replaced by the next farmer on the list (which consists almost exclusively of individual farmers). The interviews usually took place on the farm, but on occasion at a supermarket after delivery or at an in-town office (as we shall discuss in more detail in section 4.3, quite a few of the key supermarket-channel farms started out as "hobby-farms" of those with well-paying formal jobs in Nairobi who turned commercial in response to the rise of supermarkets). Most of these farmers produced a wide variety of FFV items (most of them marketed to the supermarkets) but each farmer was interviewed in detail only for her or his highest volume produce item[2]. In terms of location, around 80% of the supermarket-channel farms were located in favorable FFV zones within a 100km radius around Nairobi (mostly in the highlands north and north-west of the capital), the same zones where most of the traditional-channel farmers are located. The other 20% were located either farther from Nairobi or in the less fertile rural areas south-east of Nairobi (which have the advantage of lower prices and greater expansion possibilities due to the far lower population density). The average distance from the farm to Nairobi is 72km (i.e., closer than the traditional channel farmers in this study). For this sample we found that 25% of them are small farms (<10 acres), 43% are medium-sized farms (between 10 and 40 acres), 18% are large farms (between 40 and 200 acres) and 14% are plantations (>200 acre). This closely matches the distribution of the FFV supplies over different sizes as given by the supermarkets.

The second sub-sample consists of 66 traditional-channel farmers (22 kale growers, 22 tomato growers, 22 banana growers), all of them located in zones which are well-suited for these crops and which are key production zones for the Nairobi-bound supplies of these produce items[3]. In terms of distance, these farms are located farther away from Nairobi than the supermarket-channel farmers (less than 70% are within a 100km radius around Nairobi, while the average distance to Nairobi is 122km). With no crop specific population frameworks available, farmers were selected (within a division) based on a judgment sample with the assistance of local traders and/or the division's horticultural development officer. The latter were asked to select a sample that was in terms of farm size representative for the division. The average farm size for the traditional-channel farms in our sample is 5.2 acres, which is similar to the average farm size indicated in other reports as varying from 3 to 7 acres depending on the specific location (e.g., Dijkstra 1992, Ministry of Agriculture 2003, 2004). Of the traditional-channel farmers sampled in this survey, 85% were smallholders and 15% were medium-sized.

The second farmer survey (August 2004) focused on technology choices and net income effects. For this survey we focused on kale only. Kale was selected because it is a produce item for which there is a sufficiently large group of suppliers to supermarkets and for which supermarkets have developed their supply system the most with nearly all of the kale being supplied directly to the supermarket by listed farmers (and thus providing an interesting case-

[2] These items are: kale (12 growers), tomato (5 growers), banana (5 growers), spinach (12 growers), papaya (3 growers), lettuce (2 growers), cabbage (2 growers), pineapple (2 growers), and broccoli, mangoes, capsicum, black nightshade (mnavu), French beans and potatoes (1 grower each). In the comparative part of our analysis we focused on the 5 tomato, 12 kale and 5 banana growers in this sample.

[3]The selected districts were Kirinyaga (22 farmers) for tomatoes, Kiambu (12 farmers), Thika (6 farmers) and Nyandarua (4 farmers) for kale and Meru (14 farmers) and Muranga (8 farmers) for bananas.

study of the farm-level impact of supermarkets). A total of 51 farmers were interviewed in this survey, again comprising of two sub-samples. In the first sub-sample, we selected 14 out of 30 listed farmers supplying kale to Uchumi and/or Nakumatt (this sample thus represents roughly half of the kale suppliers to these chains). Of these farms, about 60% were located in the same key production area from where we selected the traditional-channel sample (i.e., Kiambu district, well-suited for growing kale in terms of agro-ecological conditions and, because of its proximity to Nairobi, well-suited for marketing the highly perishable kale). The other 40% were located in the less fertile (peri-urban) zones south-east of Nairobi, where as mentioned above, land is more available and thus less expensive. The average (total) farm size in this sub-sample is 31 acres and the average distance to Nairobi is 36km (i.e., ten times the size of the traditional-channel farmers described in the next paragraph and located slightly closer to the capital).

To have a comparable sample (second sub-sample), we then interviewed 37 traditional-channel farmers located in two divisions which were identified as key kale production areas for the Nairobi market (Lari and Limuru divisions in Kiambu district). Kale growers in these two divisions represent a production volume that is 50% of the estimated consumption in Nairobi. The average distance to the market is, as in the first farmer survey, greater for traditional-channel farmers than for supermarket-channel farmers (49km vs. 36km). As in the 2003 survey, farmers were selected based on a judgment sample with the assistance of divisional horticultural development officers. The average farm size of the traditional-channel farmers in this sample is 3 acres, which is in line with the officially reported average farm size of 3 acres (Ministry of Agriculture 2004).

Semi-Structured Interviews

In addition to the two farmer surveys, additional semi-structured interviews were conducted to get a better understanding of various aspects of the domestic FFV system in Kenya. These included interviews with: (1) selected input suppliers to obtain cost data on certain inputs; (2) key experts on the different technology options; and (3) the successive intermediaries downstream from farmer to retailer in the traditional FFV market channel.

4. The Nature of Supermarket-Channel Farmers

4.1 Supermarket-Channel Farmers Compared to Traditional-Channel Farmers

In this section we will compare supermarket-channel farmers and traditional-channel farmers with respect to a set of key characteristics for the three selected products: tomato, kale and banana. The data indicate that there are substantial differences between supermarket-channel and traditional-channel farmers in terms of landholdings, labor use, gender, human capital, physical capital, diversification, organization capital and marketing practices. In this section we shall discuss only the findings where the significance of the difference is at the 10% level or higher.

Land Related Differences

Supermarket-channel farms are on average much larger, in overall farm size, than traditional farms (Table 1). This holds across the three products, but is especially stark for the kale farmers where the ratio between the two sizes is 12 to 1. One reason for this may be that kale is a less

risky crop than tomatoes (requiring fewer inputs, less capital) and therefore involves more smallholder farmers in the traditional channel thus reducing the average overall farm size in this group. Not only is the overall farm size, but also the land devoted to the specific crop (tomato, kale or banana) is greater for the supermarket-channel farmers. The main reason is that given their higher land availability supermarket-channel farmers will optimize by bringing an area under cultivation that is in line with the size of the orders they get from the supermarkets, taking into account that for a year-round delivery (as preferred by the supermarkets) several plots of the produce item in various successive stages of the harvest cycle are required. By contrast, the traditional-channel farmers use part of the farm size for food-crop production (beans, maize), for dairy, for their home-stead, and so on, leaving only small plots (relative to the supermarket-channel farmers) for FFV production, even if these plots represent a large portion of the farm size (e.g., for kale on average nearly 25% of the overall farm-size, compared to only 7% for supermarket-channel farmers).

Other patterns, related to technology and land-use, which hold across the three selected products are that supermarket-channel farmers have less of their land under cultivation (e.g., in the case of kale 71% versus 87% for traditional-channel farmers), but have a larger percentage of it under irrigation. Both patterns are related to the need to supply supermarkets on a regular basis throughout the year. Fallow periods, as a part of crop rotation cycles, are facilitated when farms are large and enough land is available to take the place of the land under fallow. Another reason for the higher percentage of the land not farmed is that supermarket-channel farmers have bought land for future expansion as they are growing fast (see section 5.5). Irrigation is a condition sine qua non for regular year-round supply and the most critical requirement demanded by supermarkets (Neven and Reardon 2004). Again, the difference is most pronounced for the kale farmers (75% of the farm size is irrigated for supermarket-channel farmers versus only 18% for traditional-channel farmers). As before, this results from the large number of small farms which have specialized in kale and which do not have the capital to invest in irrigation systems.

With regard to landownership, clear distinctions emerge across the products. Amongst kale growers, supermarket-channel farmers basically own all of their land while only two thirds of the farm land of the traditional-channel farmers is owned by them. This is mainly because of land provided for free by parents to their children in the selected divisions for kale (relatively densely populated areas with limited opportunities to buy or rent land). Supermarket-channel farmers who supply tomatoes on the other hand opt mostly for leased land relative to their traditional competitors. One reason is that the tomato growing regions selected in this study have a relatively dense network of rivers so that there is no need to install boreholes and neither are other permanent structures (e.g., greenhouses) used for tomato growing. The presence of such fixed capital assets would create an incentive to buy rather then lease land in order to secure them. For banana growers there is no significant difference in landownership (as a percentage of the farm size) between supermarket-channel farmers and traditional-channel farmers. The observation that many coffee growers shifted to banana growing after sustained periods of depressed coffee prices (MoARD 2002) and the more long-term nature of the cultivation of bananas are two likely determinants of relatively high degrees of land-ownership for both groups of farmers (nature of crop provides incentive to secure investment through land-ownership). Specialization in horticulture (as a percentage of the farmed land) appears to be slightly higher for supermarket-channel farmers, except for kale. We further found a negative correlation between land ownership and specialization in horticulture (significant at the 1% level), indicating that leased land is used more intensively for FFV. This may be the result of leased land being

leased for a particular purpose (e.g., to grow only tomatoes) and for a particular time period, potentially short enough not to care too much about depleting the soil because of intensive cultivation of one particular crop (another, more fertile piece of land may be leased for the next cycle). It can further be expected that a resource (like leased land) with a specific use limitation (duration of the lease) and explicit cost (rent payment) provides more of an incentive to get the highest possible return from it.

Table 1: Land Related Differences (supermarket- vs. traditional-channel farmers)

Crop	Tomato		Kale		Banana	
Farm characteristic	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=12)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**
farm size (acres)	6.1 *	23.0 *	3.8 *	45.6 *	5.8	34.0
land owned (% of farm size)	60 *	20 *	66 ***	99 ***	87	80
land irrigated (% of farm size)	93 **	100 **	18 ***	75 ***	41	66
land farmed (% of farm size)	89	80	87 *	71 *	93	88
land used for horticulture (% of land farmed)	90 ***	100 ***	83	65	52	66
Land used for crop (acres)	2.5	4.5	0.9 *	3.4 *	1.5 *	9.3 *

Notes: *=significant at the 10% level, ** = significant at the 5% level, *** significant at the 1% level.
Source: authors' farmer survey 2003.

Labor, Gender and Human Capital Differences

As expected given the difference in farm size, supermarket-channel farmers have more permanent employees and more casual workers than traditional-channel farmers (Table 2). The average labor-to-land ratio (number of permanent farm workers per acre of farmed land for the whole farm, not just the specific crop) is lower for supermarket-channel farmers than for traditional-channel farmers, mainly due to a heavy reliance on abundantly available family labor amongst the latter. For example in the case of kale, 79% of the permanent farm workers on traditional-channel farms are family members, while for supermarket-channel farms 79% of the permanent farm workers are hired employees. This pattern also holds at the aggregated level (i.e., sum of all farm workers over sum of all farm sizes for each product-farmer type combination), although the difference become less stark because the larger traditional-channel farmers are less labor intensive. The aggregated numbers imply that the size of the farm is taken into account and we found that labor-to-land ratio and size (measured as land farmed for all products) are negatively correlated for traditional-channel farms (significant at the 1% level). For example, kale farms (in the traditional channel) below five acres have a labor-to-land ratio of 1.9, while farms above five acres have a labor-to-land ratio of 0.9. The high number of hired permanent and casual workers on farms in the supermarket channel implies that supermarket-channel farmers are (in absolute numbers) important providers of job opportunities for rural households with little or no land. For permanent employees, this also holds in relative (labor per acre) terms. In the case of kale growers for example, the average farm-level number of permanent hired workers per acre of farmed land (across all products, not just kale) is 0.9 for the supermarket-channel farmers and only 0.5 for the traditional-channel farmers. However, the opposite holds for casual workers: for kale growers, for example, the average number of casual workers per acre of farmed land is 2.1 for the supermarket-channel farmers and 1.3 for the traditional-channel farmers. However, the comparison is less straight forward as the actual labor

time for which casual workers are hired is difficult to estimate (it was not estimated in this study which merely asked farmers to indicate the number of casuals hired during peak times).

Table 2: Labor, Human Capital and Gender Differences (superm. vs. trad. channel)

Crop	Tomato		Kale		Banana	
Farm characteristic	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=12)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**
permanent employees(#/farm)	4	19	3 **	33 **	3	8
casual labor (#/farm)	10 **	17 **	4 *	19 *	4 ***	11 ***
family labor (% of permanent empl.)	47 ***	3 ***	79 ***	21 ***	74 ***	11 ***
labor-to-land ratio (farm level)	1.4	0.9	1.6	1.1	1.1	0.5
labor-to-land ratio (aggregate)	0.9	0.9	1.1	0.9	0.6	0.4
schooling farm head (yrs)	9 **	13 **	7 ***	13 ***	7 ***	15 ***
age farm head (yrs)	35	38	40	47	53	46
years in farming farm head	10.6	9.4	12.9	13.4	21.2 **	9.6 **
female labor (% of empl., farm level)	24	41	54 **	39 **	47	20
female labor (% of empl,, aggregate)	22	59	51	34	36	10
female headed farms (%)	5	20	32	17	27	20

Notes: *=significant at the 10% level, ** = significant at the 5% level, *** significant at the 1% level.
Source: authors' farmer survey 2003.

The age of farmers does not appear to be different between the two groups of farmers, and except for banana growers (some of whom have been in farming since the 1930s and 1940s), the same can be said about the years of farming experience the farmers have. There is however a very clear pattern regarding the education of the farmers: traditional-channel farmers on average have a primary education, while supermarket-channel farmers on average have a secondary education. This can be explained mostly by the observation that many of the supermarket-channel farmers had (or still have) formal jobs in the private or public sector and started out as hobby-farmers (see section 4.2 for more detail). Hence higher education gave access to formal, well-paying jobs, from there to savings invested in farms and from there to supermarket channel participation.

The survey also allows us to make some observations regarding farm-level gender-related aspects of the impact of the rise of supermarkets in the domestic FFV supply channel. First, for kale and banana there appear to be fewer farms headed by women amongst the supermarket-channel farmers while the opposite appears to hold for tomato, although no statistical differences could be found. Second, the average percentage of full-time employees who are women is significantly lower for kale supermarket-channel farmers than for kale farmers in the traditional channel. Within the limitations of the data set, this pattern does not hold across all produce items as tomato supermarket-channel farmers appear to hire more women than their traditional competitors do.

Physical Capital Differences

Table 3 paints a stark picture regarding the diffusion of physical capital in the two farmer groups. When we look at the kale farmers, we see that all of the supermarket-channel farmers have a phone and their own (motorized) means of transportation, and that a large percentage have an advanced irrigation system (i.e., drip or sprinkler), a packing shed and electricity at the farm

(either through a generator or from the grid). By contrast, significantly less of the traditional-channel farmers use these technologies, with (cellular) phones having reached the highest degree of diffusion amongst traditional-channel farmers (3 out of 10 traditional-channel farmers have (access to) a cellular phone). Other technologies such as greenhouses, shadow netting and cold rooms were encountered, but only at very few farms, all of which are supermarket-channel farmers. The latter is related more to the nature of these farms than that this has resulted from the requirements of the supermarkets. For example, some of the supermarket-channel farmers (about 10%) also supply (different produce items) for the export market and have set up cold chain technologies for this. This implies that these farmers have an advantage if and when domestic supermarkets would start requiring cold chain technology from their produce suppliers.

While the small numbers of supermarket-channel farmers for tomato and banana does not allow meaningful chi-square tests, it appears this wide divide in technology use between supermarket-channel farmers and traditional-channel farmers also holds for these two produce items. The relatively high percentages of traditional-channel farmers using irrigation for tomatoes and bananas results from tomatoes needing at least furrow irrigation and one of the selected banana growing areas having a government installed irrigation infrastructure (main line).

The high rate of technology diffusion amongst the supermarket-channel farmers (close to 100%) indicates that there probably is a threshold level capital vector (K*) which farmers must have in order to access the supermarket channel. Supermarkets indicated to us that they select their FFV suppliers on the basis of their ability to become reliable suppliers over the long term. This means that these farms must demonstrate their ability to produce year-round (presence of irrigation system and year round source of clean water) and to deliver with short lead times (presence of phone, transportation, packing shed). The presence of these technologies is at present a very strong but not yet strict requirement (not all these technologies have a diffusion rate of 100% for all produce items), mainly because the FFV procurement system of the supermarkets is still in an early, formative stage. A strict implementation of these physical capital requirements is likely for the near future.

Table 3: Physical Capital Differences (Supermarket vs. Traditional-channel farmers)

Crop	Tomato		Kale		Banana	
Farm characteristic	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=12)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**
farms with phone (%)	29	100	31 ***	100 ***	24	100
farms with irrigation system (%)	100	100	27 ***	92 ***	55	100
farms with drip/overhead irrig. (%)	5	40	18 ***	92 ***	32	40
farms with transp. vehicles (%)	14	80	9 ***	100 ***	5	80
farms with a packing shed (%)	0	80	0 ***	75 ***	0	40
farms with electricity (%)	0	20	5 ***	83 ***	5	20

Notes: *** significant at the 1% level.
Source: authors' farmer survey 2003.

Table 4 compares supermarket-channel farmers and traditional-channel farmers over a broad set of farm characteristics. In terms of diversification, two observations can be made. First, we found no statistically significant difference in the percentage of overall income coming from farming. Across the three products and two channels, farming is, on average, the main source of income. Second, farmers growing tomatoes and kale for supermarkets grow more than twice as many different horticultural crops and are therefore far less dependent on the production and market risks of any particular crop. This is in part the result of the greater availability of land for supermarket-channel farmers.

Table 4: Differences in Diversification, Organizational Capital and Marketing Practices (Supermarket vs. Traditional-channel farmers)

Crop	Tomato		Kale		Banana	
Farm characteristic	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=12)**	**Trad. Farm. (N=22)**	**Super. Farm. (N=5)**
% of hh income from farming	87	82	81	60	87	60
# of different horticultural products grown (at a given time)	2 *	5 *	3 ***	7 ***	3	2
farms collaborating with other farms (%)	46	0	32	33	29	80
farms member of coop/assoc. (%)	18	0	73 ***	8 ***	77	0
farms with livestock (%)	41	0	68	92	96	60
output marketed of crop (%)	84 ***	99 ***	72 ***	96 ***	74 ***	100 ***
farms keeping farm records (%)	64	80	33 ***	92 ***	18	100
farms transporting to buyer (%)	23	100	9 ***	100 ***	14	100
farms getting phone-orders (%)	0	80	5 ***	100 ***	0	100

Notes: *=significant at the 10% level, ** = significant at the 5% level, *** significant at the 1% level.
Transportation to buyer is for transportation beyond the main road. Most kale farmers will take produce to brokers near main road on a donkey cart.
Source: authors' farmer survey 2003.

In terms of organizational capital, table 4 shows some interesting variation. While the degree of collaboration amongst kale farmers is not related to the channel they operate in, the nature of this collaboration is related. Kale farmers in the traditional channel collaborate mostly on the marketing side, bulking their produce to facilitate transporting it themselves to the wholesale market where they get a better price (this type of collaboration is more prevalent as the farms are located closer to Nairobi). Kale farmers in the supermarket channel, who know each other in part because of the farmer meetings organized several times per year by the supermarkets, mostly collaborate on production issues (sharing of best practices). For tomatoes, it is the traditional-channel farmers who collaborate more because it allows them to overcome their small size and jointly transport their produce to the wholesalers in Nairobi. This is related to the nature of the tomatoes which require proper synchronizing of production and marketing (once at the right ripening stage for the intended market, tomatoes need to be harvested relatively quickly). This means that tomato farmers in the traditional channel (who for the greater part have no transportation) are more at the mercy of (collecting) brokers, a dependency they try to avoid by taking the marketing of their tomatoes in their own hands through collective action. Tomato growers in the supermarket channel on the other hand have their own transportation (as well as a

larger volume) and therefore have less incentive to collaborate with other farmers. For bananas on the other hand it is the supermarket-channel farmers who collaborate more. This is because these farmers (1) want to collaborate on the production side, trying new banana varieties and new propagation techniques such as tissue culture bananas; and (2) these farmers are trying to develop new marketing supply chains for bananas, with some farmers taking the lead and organizing other growers. While point (1) above results from the fact that supermarket-channel farmers are better educated and thus have better access to new technologies (not from any specific initiative of the supermarkets), point (2) is to some extent stimulated by the growth of supermarkets. For example, one of the supermarket banana suppliers (who uses tissue culture bananas) found that the Kampala banana was more popular amongst consumers than the Cavendish banana he was growing, but realized that the Cavendish's longer shelf life would still make it the winner in supermarkets. Having been a supplier to Uchumi since 2001, he has worked out a concept for a supplier organization (with collection points for multiple farmers, cold storage, and ripening rooms in Nairobi) that could provide the supermarkets with the banana supply they need (year-round supply of good quality bananas with a long shelf-life). The main (basically only) obstacle to the realization of his concept is a lack of capital.

Table 4 indicates that there is greater participation in cooperatives or associations amongst traditional channel farmers than amongst supermarket-channel farmers. An important reason for this is that the former are linked in cooperatives or associations related to non-FFV products. For example, an important diversification strategy of traditional-channel farmers is to go into dairy and many of those with dairy cows are a member of a dairy cooperative (this is especially the case for the kale growers in Kiambu district)[4]. While about half of the supermarket-channel farmers also have livestock (especially kale farmers), very few (less than 5%) of them are members of a dairy cooperative. Other traditional-channel farmers are part of formal self-help groups (especially women), mostly with the objective to pool financial resources and create a revolving fund from which members can draw to make investments or deal with emergencies. Some of the traditional tomato and banana farmers in Kirinyaga and Muranga districts also grow coffee and are members of coffee coops. Only two FFV cooperatives were encountered within the study's sample, both for traditional-channel farmers in Muranga district. The first is the Mukago Bio-Banana Group which is focused on organic growing methods for bananas intended for the domestic market and has 60 members who are organized around a farmer field school. The other is the Koome Self Help Group which has 156 members and is focused on the marketing of horticultural crops. Farmers did indicate that coop membership gives them greater access to low-interest loans which they could use in their FFV farming and which could facilitate market access. However, the data presented here clearly indicate that coop membership is not a determinant of access to the supermarket channel at this point in time. The main reason for group formation amongst FFV farmers is to overcome a small scale which stands in the way of efficient marketing. Supermarket-channel farmers, because of their size, have less need to group themselves for marketing purposes.

Finally, table 4 points to some differences in the marketing practices of the two farmer groups. First, supermarket-channel farmers market a higher percentage of their crop than do traditional-channel farmers. This is in part related to the latter's smaller size, which implies that home-consumption plays a more significant role. However, FFV are mainly intended for selling

[4] Livestock/dairy provides a perfect complement to FFV production as it transforms the nearly worthless FFV wastage into meat, milk and manure. For smallholder producers dairy is also important because it creates a more continuous income to offset the more erratic income from FFV.

to the market as for all three produce items and for both types of farmers more than 70% of the production is marketed (it is nearly 100% for the supermarket-channel farmers). Second, the way in which the produce is marketed differs between the two supply channels in important ways. Supermarket-channel farmers receive their orders by phone, transport the ordered produce to the supermarket and keep records of their deliveries in order to be able to follow up with payments. By contrast, traditional-channel farmers just harvest when they think the market price is good (or when they can no longer postpone harvesting), sell the produce either from the farm or take it by bicycle or donkey cart to a collection market near the main road and keep no records of their transactions. These differences hold across the three produce items as could be expected given that they are directly determined by channel choice (by the supermarkets).

Differences in Marketing Capacity

Looking across the four tables in this section, it becomes apparent that supermarket-channel farmers differ greatly from traditional-channel farmers in their marketing practices because they differ greatly with respect to their marketing capacity. The latter has four components. First, there is a physical capital component. Nearly all supermarket-channel farmers have a pick-up truck, a packing shed and a cell-phone. Renting transportation provides less control and farmers may supply markets too late (loose a buyer or face lower prices). Second, there is a human capital component. Supermarket-channel farmers have a larger labor force (needed to allow for short order-cycles) and better business management skills. The latter follows from their higher level of education and more extensive business experience (e.g., having had their own non-farm business or experience with supplying FFV to exporters, institutions, wholesalers). Third, there is a risk component. Supermarket-channel farmers' risk management strategies are more market-focused: more diversified income, more market options, more produce items. Compare this to small-scale farmers whose risk management tools focus on the production side and include keeping quasi-fixed capital low, minimizing cash outflows and integrating horticulture with livestock/dairy. Fourth, there is a working capital component. Accessing the supermarket channel greatly increase working capital needs, as payment periods shift from zero days (the cash-on-delivery used in the traditional channel) to periods of up to 30 days[5]. Again, these differences over a broad set of capacity variables indicate the existence of a threshold capital vector at the entrance of the supermarket supply channel.

Given the limited marketing options available to smallholder farmers, it is not surprising that our survey reveals that 60% of the traditional-channel farmers say they have never thought about supplying supermarkets. The 40% who did think about it either had no idea on how to initiate the contact or saw another obstruction that closed off the channel for them (e.g., no transportation).

4.2 The Relative Impact of Export Channel Farmers in the Supermarket Channel

[5] The up and downs of supermarkets can increase the working capital challenge. Cash flow difficulties at Uchumi in 2004 led to partial payments to FFV suppliers. One farmer for example indicated that the supermarket held two months worth of his turnover in its accounts payable to him. Only farmers with sufficient financial working capital can survive such cash-flow pressure and remain in the supermarket channel.

Exporters and export-channel farmers are only of limited importance as suppliers of FFV to supermarkets, with only 10-15% of supermarket-channel farmers being involved in export markets as well. Exporters are critical in some produce lines (mostly the higher value, lower volume items such as French beans or avocado), and absent in other produce lines (most domestic market fruits and vegetables, e.g. banana, tomato, kale). Mainly this is because there is little overlap in product types. For example, for kale, tomato and banana (which combined represent in volume terms 50% of the domestic FFV production), exports are insignificant (less than 100MT in 2002; MoARD 2002). These produce items find ready markets in Kenya and FFV exporters have instead focused on (directed their capital toward) higher value produce items such as French beans, snow peas, Asian vegetables (okra, eggplant) and avocadoes (these exports also include fresh-cut, shelf-ready (and at times even labeled) vegetable packs for supermarket chains in the EU). For fruits, the only two items which are of importance to both the export and the domestic market are mango and passion fruit, but even then only 4% of production is being exported.

The importance of exporters thus critically depends on the type of produce. The three main instances where the export and the domestic supermarket channels do overlap are: (1) semi-processed fresh vegetable packs of typical export produce items such as French beans or snowpeas (90% comes from exporters); (2) Asian vegetables, such as okra and eggplant, mainly directed to the large Asian community (50% comes from exporters); (3) fruits which are of some importance for exports, i.e., pineapple[6], avocado, mango and passion fruit (20-100% coming from exporters, e.g., 100% for pineapple, 20% for mango).

Farmers who are linked to both the export channel and the domestic market channel (like the 10% of the supermarket-channel farmers mentioned here), in many cases do so for different produce items (or even non-produce items: two of the supermarket-channel farmers in our sample exported flowers). For example, a farm may produce French beans as an outgrower for one of Kenya's major FFV exporters and at the same time produce tomatoes as a listed supplier to supermarkets in the domestic market. Typically these farmers are: (1) first involved in the export channel for a particular crop (say French beans); (2) using the experience and earnings from exports to expand their capital vector (land expansion, additional vehicles, construction of a packing shed, familiarity with good agricultural practices, and so on); and (3) then using their increased capital assets to also enter the supermarket channel as producers of domestic market crop (say spinach). The other instance where the export channel and the supermarket channel overlap is when the leading exporters divert some of their production (second grade unless there is oversupply) from the export market to the domestic market (see for example the case of Sunripe, section 4.4). And even here, there is a tendency to move away from the exporter: Fresh 'n Juici, Nakumatt's specialized FFV supplier, is doing most of the fresh-cut processing in-house (in part because supermarkets want affordable, first grade produce for their customers). However, the volumes involved are of relatively minor importance to both the exporter (almost all is exported) and the domestic supermarket (almost all FFV sales are for domestic market crops; although this is likely to increase in importance as supermarkets increase their market share in the FFV market).

[6] Fresh pineapples are not very important in Kenya's FFV exports, but Kenya's largest pineapple producer (DelMonte) is a major exporter of canned pineapple, while at the same time it sells fresh pineapples and pineapple juice in the domestic market (including supermarkets).

For farmers, the difference in accessibility between the supermarket channel and the export market channel depends in great part on their size. Whereas (some) smallholder producers can access the export channel through various outgrower schemes[7], this is far less feasible in the supermarket channel since few such outgrower schemes exist and hence fewer smallholder producers are involved (apart from through traditional brokers, but supermarkets are moving away from brokers; Neven and Reardon 2004).

4.3 Supermarket-Channel Farmers Categorized

When we look at the supermarket-channel farmers as a group, it becomes apparent that to a large extent they represent a newly emerging class of farmers in Kenya. In the previous two sections we made the case that supermarket-channel farmers are distinct from both the typical traditional-channel farmers and the export-channel farmers. So where then does this emerging class of farmers come from? Based on our random sample of 49 farmers from the leading supermarkets' FFV supplier lists, we can distinguish four types of supermarket-channel farmers: (1) *specialized farms*, whose main focus is the production of FFV for domestic supermarkets; (2) *intensifying farms*, whose main focus is not FFV for the domestic market, but who use part of their resources to also supply FFV to supermarkets; (3) *specialty product farms*, whose main focus is value-added FFV (e.g., vegetable packs) which they supply to supermarket amongst others; and (4) *market diversifying farms*, whose main focus is FFV for the domestic market, but who do not have the domestic supermarkets as their main focus.

Type 1: Specialized Farms

The first type consists of recently established farms (in the last 10 years) that linked up with supermarkets in the last 5 years, started shifting to supplying mainly or even only domestic supermarkets and experienced fast growth since. An estimated 43% of the farmers fall in this category, all of them mainly growing vegetables. In many cases, the farmer is a well-educated individual who has or had a primary job in Nairobi (e.g., private or public sector employees, small business owners) and invested his or her savings in land (landownership also has an important socio-cultural meaning in Kenyan society). This land was at first either not used, used for non-intensive farming (e.g., maize) or used for intensive farming (horticulture), but remained mostly a hobby for its owner. Some of the more entrepreneurial farmers in this group took samples of their produce to the supermarket's produce procurement manager in order to get a trial order and farmers successful in getting the quantity, quality and delivery right for the initial supplies succeeded in linking up with the supermarkets in a more long term relationship (i.e., the usual way farmers got linked up with supermarkets once the latter started to really expand the FFV category). Once they gained entry, these farmers quickly realized the potential (increasing supply orders from supermarkets coming in), but found that continued access would require them to make additional investments in production and marketing technology and run their farms under more professional management. In many cases, it implied an exit from other professional engagements (albeit not necessarily for both spouses in a household). In other cases, farms were set up from the start for full-time, commercial farming.

[7] Albeit increasingly less so due to the increasingly stringent food safety standards in the export channel (see for example Dolan and Humprey 2000).

A typical example of a farmer of this type is L Farm[8]. L farm was started in 1999 by a former employee of the Central Bank of Kenya who over time had build up a three-branch supermarket chain in the greater Nairobi metro area. L-farm initially supplied its own supermarkets. Since its start in 1999, the farm has specialized in leafy green vegetables (because of their high turnover) and almost exclusively supplied supermarkets (because they offered the best prices and presented the lowest transaction costs as they buy in large volumes). As the supermarket sector was growing and becoming more competitive, the farmer felt his competitive advantage was in farming and so he sold his supermarkets for premium prices to the leading supermarket chains and invested the proceeds in the expansion and upgrading of his farm. The farm is located 35km south of Nairobi in the dry, very sparsely populated areas of Kiserian district on three pieces of land bought from the pastoral Masai tribe. It is relatively inexpensive land with almost boundless expansion options, only limited by the presence of aquifer layers. The latter must be accessed by boreholes of which L Farm has installed two. Given the limited availability of water, 64% of the farmed area is under an efficient drip irrigation system which allows the farm to grow and supply FFV year-round. Supplies of leafy vegetables (e.g., kale) to the Nairobi market show strong seasonal patterns (as most of the production takes place under rainfed conditions) with shortages (especially of good quality produce) occurring during several months each year. L farm's ability to produce good quality leafy vegetables in those low-supply months thus addresses the supermarket's key requirement of year-round supply ability of farmers.

L Farm started from an initial size of 30 acres in 1999. In 2001 it began supplying the leading supermarket chains, Uchumi and Nakumatt, growing along with them as they expanded their produce sections. By 2004, L Farm had grown to 110 acres (of which 55 are farmed, the rest set aside for future expansion), had four transportation vehicles and three hand-tractors and employed 50 workers. Not withstanding this high growth rate, the farmer indicated that he could have increased his production much faster if affordable credit would have been available to invest in additional boreholes. The absence of such credit is the farmer's most critical problem and one he has been trying to discuss with supermarkets, requesting them (1) to provide farmers like him (who have all the right capacities: market knowledge, size, irrigation system, close to Nairobi, and so on) with formal supply agreements that can be used to demonstrate credit worthiness of farmers and (2) to even broker with commercial banks or other lending institutions to provide affordable credit to their (listed) FFV suppliers. In conclusion, the case of L Farm demonstrates the emergence of a list of preferred FFV suppliers in the supermarket's strategy to assure supply consistency. This is similar to what has been observed elsewhere (see for example Berdegue et all. (2004) for the case of Central America).

Type 2: Intensifying Farms

The second type of supermarket-channel farmer consists of larger farms with extensive business experience whose main economic activity is not FFV production for the domestic market, but who use part of their land for the latter in order not to leave it laying idle. These main activities (which are to these farms more profitable than the supply of FFV to supermarkets) are varied and include flowers or vegetables grown for export, tea, livestock and dairy processing, amongst others. In most cases, FFV were first supplied to traditional-channel agents, such as wholesalers,

[8] Farm names are withheld throughout this essay in order to comply with the MSU/UCRIHS stipulations.

and only later to domestic supermarkets (when these became bigger sellers of FFV). We can classify 22% of the supermarket-channel farmers in this category.

A good example here is SR Farm. SR Farm is an exporter of flowers to the EU. The 250-acre farm has 258 employees and was a coffee plantation until 2000. With coffee prices depressed, the farm shifted to alternative, more lucrative horticultural products with 60 acres under horticulture by 2003 (the remaining 190 acres are still under coffee but are not harvested (because of the low prices) nor uprooted because of government restrictions and for strategic reasons, i.e., a future increase in coffee prices). Of these 60 acres, 12.5 acres were allocated to the production of roses for export which are now the main focus of the farm (they are the most profitable part, high turnover per acre). Another part of those 60 acres is devoted to vegetables for the export market (e.g., 8 acres of French beans). However, most of the 60 acres under horticulture is used for the production of FFV intended for the domestic market For the latter they produce a wide variety of items, including 3 acres of bananas, 4 acres of cabbages and 14 acres of kale. Of the kale about 60% was marketed to the supermarkets and 40% to traditional local markets. Their expansive, advanced irrigation system (covering 100 acres) allows them to produce FFV during the off-season. The farm is capital intensive using 5 tractors, two trucks, charcoal and electric coolers, modern packing sheds and greenhouses (1/2 ha).

For supermarkets, the main attraction points of SR Farm are its large supply capacity, its ability to supply constantly throughout the year and its business skills, which make it easy to order from them (e.g., place orders by phone, pay through bank transfers, and so on). While there is a loosely followed continuous supply agreement between SR Farm and Uchumi, the farm would like to move to a stricter implemented supply contract. Without the latter SR Farm is unlikely to make additional investments in its FFV production for the domestic market (such as making the organizational investments needed to optimize its harvest cycles to the needs of the supermarkets).

Type 3: Specialty Product Farms

The third type of supermarket-channel farmer, of minor importance at this point in time (4% of suppliers), consists of specialty produce suppliers who have catered to more sophisticated markets domestically or abroad. Here we find for example the producers of pre-packaged, pre-cut vegetables for export.

An interesting example is provided by GD Farm. Started in 2000 as a supplier to the airline and tourism industry, GD Farm is a 10 acre farm specialized in organic mixed salad packs, although it produces various other organic FFV as well (e.g., strawberries). Because all products are organic, produce items can be marketed for twice the price of their conventional counterparts. The farm has 30 employees, is fully irrigated, has five acres under shadow netting, has a washing and packing shed and complies with HACCP standards as this is demanded by the airlines. In order to get its highly perishable salad bags in good condition to customers, they use the cold chain system of a leading meat processor, with whom they forged a partnership. Its salad bags are bar-coded and labeled under their own brand name. In 2003, the airline and tourism industry on the one hand and the domestic supermarkets on the other hand, each took about half of its supplies. Its past growth has been financed by loans, retained earnings and credit by suppliers (e.g., of irrigation equipment). The farm is developing various new products to extend its range and plans to increase the acreage under production as well as make additional investments in irrigation. The main attraction for supermarkets of having GD Farm as a FFV

supplier is that (1) it helps them complete both their line of value-added vegetable packs and their line of organic FFV items, which is important in attracting the higher income consumer segment; (2) it has the capacity (experience from other sectors, packing shed, clean water, and so on) to wash, package, correctly weigh and label the product (important aspects for these higher value-added produce items intended for the more discerning high-income consumer segment); and (3) it has the capacity to supply these produce items year-round (irrigation system).

Type 4: Market Diversifying Farms

The fourth type of supermarket-channel farmers consists of a varied group of farmers whose main product focus is FFV for the domestic market, but for whom supermarkets are not the main focus. These farmers have merely diversified their market by supplying part of their output to supermarkets without showing much change in their farm practices or turnover because of it. Of the supermarket-channel farmers, 31% fall into this category. Here we find most of the fruit suppliers, which include (i) farms who have recently shifted from coffee (low prices) to bananas or from export crops (market exclusion, e.g. due to inability to meet quality requirements in export markets) to vegetables for the domestic market, (ii) medium-sized to large fruit growers and (iii) big plantation farms such as Delmonte (13,000 acres of pineapples). For the larger producers in this category, supermarkets are expected to have little or no impact for the next five to ten years, as they represent only a minor part of the turnover of these producers. However, small and medium sized farms in this category are expected over time to either fully engage in the supermarket channel (thus becoming farmers of the first type) or to exit this channel because the participation costs or the opportunity costs are too high.

F Farm is an example of the smaller farmers in this category of supermarket-channel suppliers who finds himself at such a cross-road. Established in 1997, F Farm is a 15 acre farm near Naivasha (85km west of Nairobi) which employs 4 full-time workers and 10 casuals when needed. The farmer used to be in poultry, but exited this market when prices were too low. He then shifted to FFV, growing a very wide variety of FFV (13 different crops at the time of the interview, from celery over broccoli to papaya). Some of these items are sold to the leading supermarket chains (since 2000) in addition to traditional buyers. For example, 80% of his spinach sales go to the supermarket while 20% goes to the main wholesale markets in Nairobi. Whatever cannot be marketed for either lack of quality or lack of demand goes to waste.

For the supermarket, F Farm is a qualified supplier because it has an irrigation system, its own transportation, a phone, and so on, indicating it can meet the requirements for year-round supplies and short order-cycles (in the case of more perishable leafy vegetables). The farmer likes selling to the supermarkets because they are easy to supply to (less time-consuming), because the volumes are larger and because the payment systems allows him to organize the farm's accounts (e.g., worker payments). The problem is that the orders he gets are too erratic (supermarkets telling him "call tomorrow or the day after"), which makes it difficult to organize the harvesting. The farmer also feels that receiving agents at supermarkets are not knowledgeable about produce and that supermarkets take too long to pay him (up to a month). If this changes and he gets more stable orders, he would further invest in the farm (especially irrigation) and would likely become a dedicated supermarket-channel farmer. If things remain as they are, the farmer will likely exit the supermarket channel, already indicating that should prices for poultry get better, he would move back into that direction.

4.4 Cases of Smallholder Farmer Groups Supplying Supermarkets

Based on the estimated FFV turnover and distribution over the different types of suppliers (Neven and Reardon 2004), we estimate that around 1,000 smallholder farmers were part of the supplier base of the supermarkets in 2003. These farmers supply (1) indirectly through brokers/wholesalers (roughly 900 farmers) and (2) as (irregular) direct suppliers to individual stores, mostly for highly perishable vegetables like leafy greens to up-country branches (roughly 100 farmers). With supermarkets shifting away from brokers to direct supplies by farmers and moving to procurement centralization (Neven and Reardon 2004), the importance of smallholder producers in the supermarket channel is expected to dwindle to about 20% of FFV supplies (their absolute number will be determined by the FFV turnover in supermarkets as this is growing rapidly from a small base).

Given this bleak scenario for smallholder producer participation in the supermarket channel on the one hand and the rising importance of supermarkets and the potential benefits of becoming a regular (listed) supplier to them (see section 5) on the other hand, we briefly present five cases that demonstrate different strategies that may allow for a greater participation by smallholder farmers in the supermarket channel. These cases represent all the formats we could identify (based on interviews with industry experts, including the supermarkets' FFV procurement managers) of smallholder involvement other than through traditional-channel brokers or through direct supplies. The types of suppliers presented in these cases were not included in the distribution of the FFV suppliers presented earlier because they represent (in this early stage of supermarket development) too small a fraction of the supermarket's FFV supplies (<1%). Across the five cases, three key success factors emerge: (1) a focus on products with a clear market potential; (2) the catalyzing involvement of private or public organizations as marketing facilitators with a commercial basis (i.e., intended to be sustainable without subsidies); and (3) group formation amongst farmers. The case-information is mostly based on in-depth interviews with key stakeholders, but also on secondary information sources.

Case 1: Family Concern – An NGO Organizing Smallholder Farmers

Family Concern, a Kenyan NGO whose mission it is to combine development and business objectives in building marketing linkages for small scale growers, is the lead organization in a project that aims to facilitate the supply of traditional African vegetables (TAV)[9] from smallholder producers to domestic supermarkets in Kenya. The International Plant and Genetic Resources Institute (IPGRI) and the Kenya Agricultural Research Institute (KARI) where involved as technical partners on the production side, FARM Africa (a UK based NGO) was involved to provide expertise and financial support and Uchumi was involved on the marketing side.

Based on consumer market studies, Family Concern had identified that (1) there existed a high and growing demand for TAV, and (2) that this demand was not matched by supplies. Uchumi had come to the same conclusion as it could not keep these vegetables on the shelves and was trying (but not fast enough succeeding) in getting its listed FFV suppliers to produce more. In 2003, Uchumi estimated that potential demand for TAV was three times the actual sales of 100MT per month. When in 2003, Family Concern approached Uchumi with the proposal to

[9] These are leafy vegetables such as black nightshade, spiderplant, cowpeas and amaranth.

organize smallholder farmers for the production and marketing of TAV, the supermarket was very interested to get involved. Family Concern and its partners then went to work, enlisting 50 smallholder producers in the rural and peri-urban areas around Nairobi (with on average .25 acres available for TAV) and organizing them in a sort of outgrower scheme to organically grow TAV under well-defined good agricultural practices (e.g., with regard to use of clean water). Farmers receive seed and technical assistance, are inspected with regard to their farm practices and are, since 2004, marketing their produce through Family Concern, who is responsible for transporting the bunches of TAV to Uchumi based on the latter's order schedule. In order to differentiate its product in the market place, Family Concern supports its product with in-store advertising and plans to introduce its own label (African Delicacies).

The project benefits farmers as well as the supermarket. Farmers get assistance in growing a cash-flow friendly product (ready for harvest after only 4-5 weeks, pest and diseases resistant) for a reliable market, while Uchumi resolves (at least partially) one of its key FFV supply shortages, expands its lines of organic and branded FFV items and improves its image as it advertises its assistance to smallholder farmers to consumers in its stores.

Case 2: HPHC – A Government-Owned Company Organizing Smallholder Farmers

Established in 2003, the Horticultural Produce Handling Company (HPHC) is a government-owned company set up to own and commercialize an elaborate modern cold chain infrastructure (financed by the Japan International Cooperation Agency JICA) which is intended to improve the marketing system for horticultural produce from smallholder producers. While initially managed by the parastatal Horticultural Crop Development Authority (HCDA), government involvement is expected to be greatly reduced over the period 2004-2005 (both in terms of ownership and management). An initial focus on the EU export market has been replaced by a dominantly domestic and East Africa regional focus because of difficulties in accessing export markets. HPHC's facilities include seven satellite depots with pre-cooling units, a central warehouse in Nairobi (near Jomo Kenyatta International Airport) with cold storage facilities and insulated trucks of various capacities to maintain the cold chain from collection point to supermarket.

Under the stringent quality and safety requirements normally associated with the export market, farmers produce and supply as groups of 15-40 outgrowers to a collection center which has a charcoal cooler, a toilet and clean water. Selected farms have sizes varying from 0.125 to 2 acres and are located within a 5km radius of a collection center (which is financed by the farmers themselves). Pre-cooled and insulated HPHC trucks (2MT capacity) then pick the produce from these collection points and take it to the nearest satellite depot. Larger trucks (8MT) take the produce from the satellite depots to the Horticultural Centre in Nairobi and from there to various buyers. Farmers get planting, harvesting and spraying schedules and technical assistance from HPHC as well as buy their seeds from them. For this organization of the farmers and the cold chain distribution, HPHC charged (in 2003) a low commission of 17% of the sales price leading to higher prices for farmers (the 17% is far below the 65% of the wholesale price going to brokers and wholesalers in the traditional channel). One of these buyers has been Uchumi who bought Asian vegetables from HPHC in 2003 (albeit for small volumes and on an irregular basis).

HPHC has not started off as an instant success. Lack of marketing experience and trading network partners have largely kept it out of export markets and in 2003 the company was

operating at only 5% of its capacity. However, its recent shift in market focus to the domestic and regional market may fit well the strategic objectives and needs of a supermarket like Uchumi. HPHC can offer the volumes and the food quality and safety assurances that are key pillars in the FFV procurement system currently being developed by the leading supermarkets in Kenya. It is therefore not surprising that in 2003 HPHC and Uchumi were exploring potential collaboration. If HPHC succeeds in getting its marketing strategies right (e.g., by getting supermarkets like Uchumi and others in the region such as South Africa's Shoprite on its customer list) then its potential impact is large (HPHC's management indicated to us that they aim to get a 5% share of the domestic FFV market by 2006).

Case 3: Iga Muka – A Farmer Group Assisted by a Private Sector Marketing Facilitator

Started in 1989, Iga Muka is a self-help group of about 30 smallholder farmers growing a wide variety of FFV on their farms located on the slopes of Mt Kenya (some 200km from Nairobi, i.e., further away than most FFV suppliers for the Nairobi market). The farmers group succeeded in linking up with Uchumi via the Kenya Agricultural Commodity Exchange (KACE). Operational since 2000, KACE is a private sector firm that facilitates linkages between sellers and buyers of agricultural commodities, in part by setting up market information points which have small trading floors where buyers and sellers (like Iga Muka and Uchumi) can interact. KACE gets its revenues from selling market price information on commodities (e.g., through SMS messages on farmer's cellular phones) and taking commissions on brokered sales as well as from donor support (e.g., from USAID and DFID). Although it plans to overcome it, KACE was still dependent on donor support in 2003.

In 2002, Iga Muka contacted KACE on the possibility of finding a market for its strawberries, which are the group's biggest income earner. Through an initial contact at a KACE auction in Nairobi, Iga Muka placed a first order with Uchumi which then turned into a longer term supply arrangement. The strawberries are harvested and collected three times a week. In a small packing shed, the strawberries are graded according to size, stage or ripening and appearance and packaged in plastic punnets of 1/2kg. The product is not labeled, other than with a barcode to comply with supermarket requirements, as the costs of labeling are considered too high at this point. Iga Muka has a full-time grader on its payroll at the collection point and has a marketing agent (representative) in Nairobi. This agent collects the orders from Uchumi (and other buyers). As the group does not have its own transportation, it uses public transportation (mini-buses) to transport about 60 to 100kg of strawberries three times a week to Nairobi (200km of partially very rough roads). Small volumes of about 60-80kg of strawberries per week, out of a maximum of 300kg, are intended for Uchumi, the rest is either marketed through KACE to non-supermarket buyers (e.g., institutions, greengrocers, and so on) or goes to waste.

While the group has succeeded in remaining in the supermarket channel, it is not really equipped to supply supermarkets and has not been increasing its business because profits are too low and access to credit is restricted. For example the group would like to invest in small-scale processing equipment which would help solve the demand volatility problem as well as make the grading more efficient (first grade to supermarkets, lower grades for jam). However, it has not been able to build the capital from retained earnings while commercial loans are considered too risky. The absence of growth as well as increasingly delayed payments by Uchumi (which was working through some financial problems in 2003-2004) have lowered morale and undermined the internal stability of the group which would have exited the supermarket channel already if it

were not for its relatively transparent accounting system and for its good organization (i.e., a constitution that spells out a code of conduct for its members in addition to penalties for going against the group's bylaws).

Case 4: Sunripe – An Exporter with Smallholder Outgrowers Supplying Supermarkets

Sunripe, a family business founded in 1969 and in 2004 one of Kenya's largest FFV exporters, growing at an average annual rate of 20% over the last 15 years (Shah 2004), produces 40 different high-value lines of fruits and vegetables from its own farms as well as from 1,000 contracted smallholder producers. A (small) part of its output is sold to Uchumi.

Sunripe is a change leader in Kenya's export industry. In 1999 for example, it was one of the first exporters in Kenya to start developing fresh-cut and washed & ready-to-eat vegetable prepacks for the export market. Because (1) there are lower grades of produce which fail to meet export standards and (2) there is sometimes oversupply if the quantity contracted from farmers exceeds fluctuating demand from buyers in the export market, exporter like Sunripe have excess produce for which they need alternative markets. Around the same time (since 1997 and onward) supermarkets like Uchumi were rapidly developing their FFV sections, continuously adding new items (especially in the hypermarkets). Given this strategic fit between supply and demand, Sunripe started supplying Uchumi with a number of different organically grown pre-packed vegetables (e.g., pre-cut French beans, mixed stir-fry vegetables, and so on), providing an alternative market for Sunripe and making a major contribution to both its line of organic products and its line of pre-packed vegetable products for Uchumi. Another area where the two companies are considering collaboration is with respect to the setting-up of quality and food safety control systems for Uchumi's FFV suppliers. Sunripe, which became EurepGAP certified in October 2003, would be an excellent source of expertise in this area, especially with respect to the implementation of traceability systems (for food safety) amongst smallholder producers.

Sunripe's 1,000 smallholder outgrowers, thus demonstrate yet another way in which smallholder producers of FFV can be connected through non-traditional channels to domestic supermarkets in Kenya. However, recent research indicates that the implementation of increasingly stringent food safety standards imposed by EU supermarkets on their FFV suppliers will likely lead to a declining role for smallholder farmers in Kenya's FFV export sector (Dolan and Humphrey 2000).

Case 5: B Farm – A Lead Farmer Organizing Smallholder Farmers

Another format under which smallholder growers could remain or become linked to supermarkets is that of a lead farmers who organizes and buys from a group of other farmers. While this type of supplier is not yet important in the supplier base of the supermarkets, it appears to be increasing in importance as several of these groups have emerged in 2003-2004. B Farm, a 16 acre family farm located 25km from Nairobi, provides a good example here. This farm was started in 1992 and began supplying kale to Uchumi in 2002. As the supermarket orders grew in size and regularity, the farmer decided to source kale from other farmers rather than to expand his own farm. By 2004, he sourced from 40 other farmers (mostly smallholders) who are as a group organized so that the supermarket can be supplied with bunches of kale on a daily basis. For the participating farmers, the key differences between selling to brokers or selling to B farm is that (i) they now face a much more secure demand for kale and (ii) they get a

better price (as B Farm pays a premium to secure supplies). These are crucial differences for smallholder farmers as risk reduction and higher profitability are important steps toward a growth dynamic. B farm is also a retailer of farm inputs which further facilitates access to inputs for the participating smallholder farmers and may be a precursor on the path to interlinked supply contracts.

5. The Impact of Supermarkets in the Kale Supply Channel

5.1 Kale Supply Channels in Kenya

Kale Production Characteristics

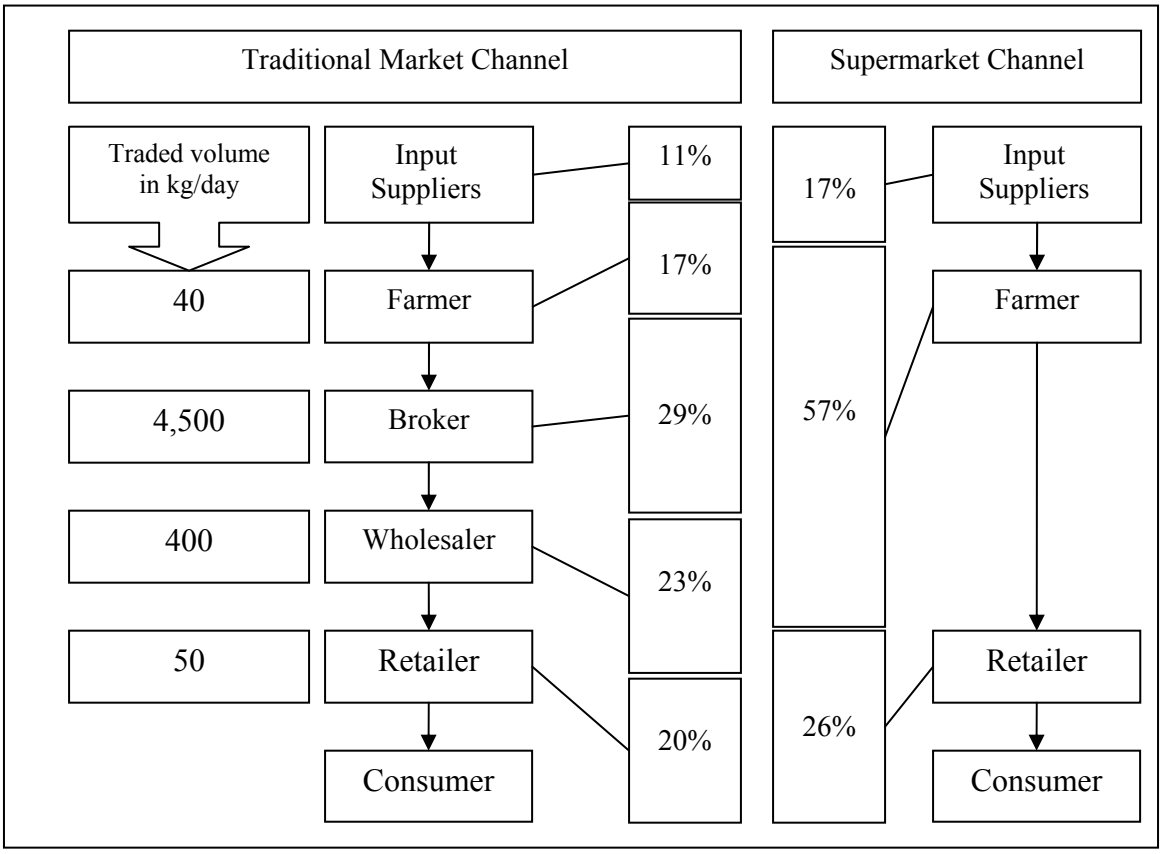
There are two key characteristics of kale production in Kenya that are important for the present analysis. First, most of the kale production in Kenya takes place under rain-fed conditions, leading to strong supply and price seasonality (annual production cycles are tuned to a short rains and a long rains season). This implies that for supermarkets, who want year-round supplies, kale must be ordered from farmers who have irrigation and a year-round source of water. Second, there are no specific, formal quality or food safety standards in the domestic market (in the traditional channel nor in the supermarket channel) but quality, mostly determined by freshness, leaf size and color and the degree of damage due to pests or other decay, does play a role in price determination. For the supermarkets who want to differentiate themselves on quality, only the best quality of FFV will be accepted. This implies that farmers supplying supermarkets must be able to control quality (e.g., through pest management, by being located close to Nairobi so the highly perishable kale arrives fresh, and so on).

Kale Supply Chains

The entry of supermarkets in the kale supply chain leads to supply channel integration. Kale farmers in Kenya have potentially four market options, depending on their capacities: (1) they sell to brokers from their farm; (2) they sell to brokers near the main road; (3) they sell to wholesalers in main urban areas; and (4) they sell directly to retailers or institutions. Which option is chosen is mostly determined by the transportation capacity of the farmer and his or her willingness to take risks (the more downstream the farmer takes the produce, the higher the price, but also the higher the transportation costs and the higher the price risks). Given that most traditional-channel farmers are risk-averse smallholder producers without (motorized) transportation, most farmers in this channel sell to brokers at the farm or near the main road (rural collection market). For example, in our farmer sample we found that of the Lari farmers (at 60km from Nairobi), 52% sell kale from the farm, 38% take it to the main road and 10% take it to wholesale markets in Nairobi. Supermarket-channel farms on the other hand are larger and have their own transportation and are capable of taking their produce direct to the supermarkets. Figure 1 compares the traditional market channel with the supermarket channel for kale, indicating the distribution of the marketing margin over the supply chain's successive economic agents, as well as an indication of the size (in terms of sales volume) of these economic agents for the traditional channel. Figure 1 indicates that the shift from the standard traditional supply chain to the supermarket supply chain for kale implies a vertical integration, with the farmer integrating the broker and part of the wholesale function and capturing a far greater part of the marketing margin. This extends earlier research on the applicability of market channel theory in

Kenya to the supermarket channel. Dijkstra (2001) showed how channel theory (i.e., vertical channel disintegration (i.e., the number of successive distinct business entities in the supply chain) is negatively correlated with the size of producers and retailers) could explain long supply channels for FFV in Kenya. Here we find the mirror image: supermarkets (as large retailers) and supermarket-channel farmers (as larger producers) lead to short (direct) supply channels.

Figure 1: Marketing Margins in Kale Supply Chains



Note: margin to input suppliers in traditional chain assumes farmers buy seeds and manure, rather than use their own.
Source: authors' farmer survey, interviews with 15 channel participants, including brokers, wholesalers and retailers and price-measurements throughout the chain.

Traditional Kale Supply Chains

Traditional kale supply chains provide marketing solutions to smallholder farmers, but are characterized by a small percentage of the marketing margin captured by the farmer, high transaction costs (produce changes ownerships many times) and brokers with high market power (they trade the largest volumes and are most knowledgeable about prices at the farm and in the wholesale markets). In the standard traditional supply chain for kale, a farmer stuffs the harvested kale leafs in bags of 75kg and takes them by donkey cart to an open air collection market near the main road to Nairobi[10]. At this rural market, independently operating brokers

[10] Alternatively, the farmer may sell directly off-farm to a broker who was directed to the farm by agents hired by the broker. Agents are local people who are very knowledgeable about which farmers have a ready harvest. Or the

arrive with a pick-up or a larger lorry. They negotiate the prices with farmers and, once a price is agreed upon, they pay loaders to load the lorry to maximum capacity. The broker then takes the kale bags to one of the wholesale markets in Nairobi, pays a fee to enter the market, and starts negotiating prices again, this time with several wholesalers[11]. Once a price is agreed upon off-loaders are paid by the buyer to unload the bags of kale. It takes about 10 wholesalers to buy a whole lorry-load of kale and so it can take brokers the better part of a day to sell it all. Wholesalers then take leafs from the bags and bunch them in bunches of approximately 650gr. In the next step, small, traditional retailers such as market stalls, kiosks or street hawkers come to the wholesale market where prices (this time per bunch) are once more negotiated. Retailers then pay cart pullers to bring the bought produce to their retail outlet. These retailers then break up the bunches into smaller bunches of maybe 200gr and offer them for sale to the end-consumer, who again will negotiate the price.

While quite challenging for the resource-poor, risk-averse smallholder producers (who form the bulk of the producers in the traditional channel), there are variations to the above supply chain structure which allow farmers to capture more of the marketing margin and reach an intermediate step to selling to supermarkets. Farmers may form small groups whose combined harvest is sufficiently large to make it economical to rent a truck and take the produce directly to the wholesale market or even to retailers (some of the ad hoc supplies of kale to supermarkets come from smallholder farmers this way). Farmers may also bunch the kale leafs themselves in order to capture the value-added. When bunches are made closer to the farm, they are usually transported in extra large bags (approximately 200kg).

The Supermarket Kale Supply Chain

At the other extreme is the supermarket supply chain for kale, which is relative to the traditional supply channel shorter, more efficient from a transaction cost point of view, allows the farmer to capture a large portion of the marketing margin (farmer and supermarket each capture a part of the wholesaler's margin) and controlled by the supermarket in stead of by the broker (who disappears). The supermarket calls the farmer in the afternoon with the order for the next day, indicating also if the price has changed since the last order and if so by how much. Early in the morning of the next day, the farmer puts his entire workforce (if needed supplemented with casual labor) on the kale harvest, and in about 2 hours the farm workers have picked and bunched enough leafs to fill the order and have loaded them directly on a truck (no bags), covered with canvas. The farm's driver then takes the kale to the supermarket's reception bay, has the delivery-book filled out and returns to the farm less then an hour after delivery. Supermarket employees place the kale bunches in the FFV section. The farmer is paid bi-weekly (in principle) for the cumulative supply over that time period. Given the wide variety of produce items grown by supermarket-channel farmers, they usually supply more than one item per delivery to the supermarkets.

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farmer may pay another farmer to take her or his bags to the road-side market.

[11] Alternatively, a small group of wholesalers may join forces and hire a transporter to go to the rural market to buy a number of bags of kale or they place a joint order with an established broker.

5.2 Determinants of Farmer Participation in the Supermarket Channel

In this section we want to assess how farm characteristics determine the participation of the farm in the supermarket channel for kale (Y). Since negative dependent variables are not possible and assuming non-linear effects of the explanatory variables, we modeled this channel adoption decision as a probit model. The model takes on the following form:

$$\text{Prob } (Y=1|X) = G(\beta_0 + X\beta),$$

where G is the standard normal cumulative distribution function. In their most general form, adoption functions contain the following five categories of explanatory variables: prices of inputs and outputs, risk factors, quasi-fixed capital and shift factors. Prices of inputs and outputs were not directly included as they are implicit in the channel choice and further determined by the size and location of the farm. The risk factor and quasi-fixed capital explanatory variables we want to include here capture risk-sensitivity (land ownership), land capital (size of the farm), access to financial capital (size of land and ownership, education), human capital (age, education, gender) and physical capital (presence of an irrigation system). Each of these explanatory variables is hypothesized to ceteris paribus increase the probability of adoption of the supermarket channel. With regard to gender it is hypothesized that men are more likely to enter the supermarket channel because they (1) are assumed to have better access to the required production factors and (2) tend to get more involved when the transactions become more formal, sizeable and rewarding (Dolan 2001). Two variables normally presented in adoption models, household size (quasi-fixed capital) and location (shift factor), were omitted here. Most of the supermarket-channel farmers rely for the greater part on (often large numbers of) hired employees, making size of the household (indicating the availability of family labor) not a very meaningful variable. Location was left out the model because the traditional-channel farmers were selected from only two nearby divisions so that for this sub-sample there was too little variation over the location variable. One further departure from the standard adoption model is that for the size of the farm, land ownership and the presence (or absence) of an irrigation system we used the 1999 situation. The 1999 data reflect the position of the farms at the time when they became suppliers to supermarkets (all the supermarket-channel farmers became suppliers to supermarkets around or shortly after 1999). If we would have used the current situation (e.g., the size of the farm in 2004) then there could potentially be an endogeneity problem as farm-size could well have been influenced by supermarket channel participation. Based on the above, the implementation model has the following determinant variables (X):

(a) the percentage of the farm size that is owned in 1999 (percent owned 99);
(b) the size of the farm in acres in 1999 (size 99);
(c) the number of years of schooling of the head of the farm (education of head); (d) the age in years of the head of the farm (age of head);
(e) the gender of the head of the farm (gender of head); and
(f) a dummy variable indicating if the farm had an irrigation system (sprinkler or drip) in 1999 (irrigation 99).

Based on maximum likelihood estimation (MLE), Table 5 presents the probit estimators ($\hat{\beta}_i$) of the above model. Table 5 indicates that the results are as hypothesized, namely, the probability of

a farm participating in the supermarket channel increases as the farm (i) is larger and (ii) has a drip or overhead irrigation. The marginal effect indicates that, for the average farm (in terms of the independent variables), having one more acre of land (i.e., a relatively large 10% increase relative to the average size of 10 acres) increased the probability that the farm will participate in the supermarket channel with nearly 12% while having a drip or overhead irrigation system increases this probability with a dramatic 46%. The latter indicates that having irrigation is a critical capital requirement for farms who want to become FFV suppliers to supermarkets. Education, age, gender and land-ownership did not have ceteris paribus a statistically significant impact on the probability of a farm participating in the supermarket channel in our sample.

Table 5: Determinants of Farmer Adoption of the Supermarket Channel (Probit Results)

Independent variables	P(Supplies kale to supermarkets) (s.e.)	Marginal effect
Size 99	0.30 (0.157)*	+11.8%
Education head	0.19 (0.164)	-
Percent owned 99	-0.01 (0.014)	-
Irrigation 99	1.35 (0.746)*	+46%
Gender of head	0.55 (1.078)	-
Age of head	0.02 (0.031)	-
Constant	-5.76 (3.930)	-
No. of observations	57	
(Pseudo) R-square	0.7621	

Notes: * = significant at the 10% level. Marginal effect measured at the mean levels of the determinant variables.
Source: authors' farmer survey 2004

5.3 Supermarket Channel Participation and the Farmer's Production Technology

In this section we want to compare the production technologies used by supermarket-channel farmers and traditional-channel farmers. In the micro-economic theory of the firm, technology is represented by a production function which reflects the technological relation that exists between any particular combination of inputs and the resulting levels of outputs q (Sadoulet and de Janvry 1995). These inputs consist of an X vector of variable inputs (e.g., fertilizer) and a Z vector of quasi-fixed inputs (e.g., land). Various types of production functions exist. Here we select the Cobb-Douglas production function which is the most used functional form for the analysis of farm efficiency (Battese, 1992; Bravo-Ureta and Pinheiro, 1993). This production function takes on the following form:

$$q = A\, X^{\alpha}\, Z^{\beta}$$

Where α and β represent the elasticity of production for the inputs with respect to the output, i.e., the percentage change in output for a 1% change in the input keeping all other inputs fixed ($\partial q_* x / \partial x_* q$, $\partial q_* z / \partial z_* q$). By selecting land, labor and fertilizer as the inputs and taking the natural logs, we get the following two production functions which we want to estimate and compare:

Supermarket-channel farmers: $\text{lnoutput} = A_1 + \alpha_1 * \text{lnlabor} + \beta_1 * \text{lnland} + \gamma_1 * \text{lnfertil} + e_1$ (1)

Traditional-channel farmers: $\text{lnoutput} = A_2 + \alpha_2 * \text{lnlabor} + \beta_2 * \text{lnland} + \gamma_2 * \text{lnfertil} + e_2$ (2)

Whereby lnoutput is defined as the natural log of output measured as kg of kale produced by the farmer from the current acreage over 1 cycle; lnlabor is the natural log of the number of full work-days used for land preparation, planting and weeding of kale; lnland is the natural log of the number of acre-months used for kale growing (we want to take into account a harvest cycle length which over the sample varies from 2 to 12 months[12]); and lnfertil is the natural log of the number of kg of fertilizer applied to the current acreage over 1 cycle (summarized over the various types of fertilizer which in terms of value per kg do not differ widely). The last term, e, is the estimated error (disturbance) which contains the unobserved explanatory factors.

Chow Test

A method often used in econometrics to test for differences in regression functions across groups is the Chow test (Wooldridge 2000). The Chow statistic tests the null hypothesis that the intercept and all the coefficients are the same across the groups. For equations (1) and (2) above we get:

$$H_0: A1=A2,\ \alpha_1=\alpha_2,\ \beta_1=\beta_2,\ \gamma_1=\gamma_2$$

The Chow test involves estimating a restricted model (the four restrictions under H_0) and an unrestricted model (under the alternative hypothesis that H_0 does not hold). The following F statistic must be calculated:

$$F_{k+1,\ n-2k-2} = [(SSR_r - SSR_1 - SSR_2)/(SSR_1+SSR_2)] \ .\ [(n-2k-2)/(k+1)],$$

where (i) SSR are the sum of squared residuals obtained (through ordinary least squares estimation) for the restricted model (using all observations) and for two separate regressions, one for each group (using only the observations for one group at a time), (ii) k is the number of coefficients to be estimated and (iii) n is the overall number of observations. The value of the F-statistic here is 1.891 with a corresponding p-value of 0.129. This means we can reject H_0 at the 15% level. The test indicates that there is a statistically significant difference (at the 15% level) between the production functions of supermarket-channel farmers and traditional-channel farmers.

Estimation of the Production Functions Corrected for Self-Selection Bias

The distribution of the farmers over the two groups (supermarket channel, traditional channel) is not random but rather the outcome of a self-selection process. In order to control for this (potential) selectivity bias, we use Heckit's two-stage method. In the first step, this method calculates the inverse Mill's ratio (λ) for each observation (via a probit model for channel choice)

[12] Kale leafs can be harvested from the same plants at regular intervals over periods stretching up to 12 months, although the normal harvest cycle is about three months (East Africa Seed Co. 2002).

which then in the second step is added in to the substantial model (the production function) as a control variable. The models now become:

Supermarket-channel farmers:

$$\text{lnoutput} = A_{1+} \alpha_1 * \text{lnlabor} + \beta_1 * \text{lnland} + \gamma_1 * \text{lnfertil} + \delta_1 * \lambda + e_1 \quad (3)$$

Traditional-channel farmers:

$$\text{lnoutput} = A_{2+} \alpha_2 * \text{lnlabor} + \beta_2 * \text{lnland} + \gamma_2 * \text{lnfertil} + \delta_2 * \lambda + e_2 \quad (4)$$

Table 6 lists the estimated parameters for both models. The λ regressor is significant for equation 4 which means its presence corrects for a self-selection bias. We further find that both models are significant and that the signs of the coefficients are as expected, namely output increases as, ceteris paribus, more land or more fertilizer are used. Labor was found not to have a statistically significant effect in either model.

Table 6: Heckit Two-Stage Estimates of the Cobb-Douglas Production Functions

Dependent variable: lnoutput Independent variables	Supermarket farmers Coefficient (s.e.)	Traditional market farmers Coefficient (s.e.)
Constant	6.8237 (1.1484)***	6.6034 (0.8699)***
Lnland	0.8681 (0.3133)***	0.5794 (0.2453)**
Lnlabor	-0.3254 (0.2527)	0.0446 (0.2388)
Lnfertil	0.2407 (0.1070)**	0.2030 (0.1553)
Mill's lambda	0.1952 (0.2471)	0.9889 (0.5379)**
Wald Chi^2	107.3	28.25
Significance	0.0000	0.0000

Notes: ** = significant at the 5% level, *** significant at the 1% level.
Source: authors' farmer survey 2004.

Table 7 compares the marginal product values for the significant coefficients of table 6. The marginal product value is calculated by multiplying the marginal productivity of a factor x_i ($\partial q/\partial x_i = \alpha * q / x_{i)}$ with the market price of the output. Several observations can be made. First, the data indicate that the marginal product value (MPV) differs greatly between the two groups of farmers: in absolute terms the MPV is larger for the well-capitalized supermarket-channel farmers while as a relative measure (relative to gross revenue) it is larger for the traditional-channel farmers who capture only a small percentage of the marketing margin. Where one additional acre-month of land would increase revenue from the sale of kale with Ksh3,217 for traditional-channel farmers (i.e., roughly 10% of their average total revenue per acre), it would increase revenues for supermarket-channel farmers with Ksh8,073 (i.e., roughly 5% of their average total revenue per acre). Second, each of calculated marginal product values is larger than the corresponding factor cost, indicating that these factors are used below the optimal quantity for both groups of farmers. For traditional-channel farmers, this may indicate that land access is constrained by a limited access to land (high population density). For supermarket-channel farmers, who on average only use 70% of their land, the bottleneck is more likely to be found in the limited access to capital for irrigation system expansion. Third, the average land productivity and the average labor productivity are respectively 59% and 73% higher for supermarket-channel farmers than for traditional-channel farmers. This results from the more capital intensive

production methods used by supermarket-channel farmers (more variable inputs like fertilizer or chemicals and more quasi-fixed inputs per unit of labor and per unit of land). Relative to daily wages (which are Ksh150/day and Ksh120/day for supermarket-channel and traditional-channel farmers respectively) average labor productivity is four times the wage rate for supermarket-channel farmers and three times the wage rate for traditional-market farmers. This extends to the supermarket-led part of the FFV supply system, the findings of Carter and Wiebe (1990) that higher access to capital (in this case of the supermarket-channel farmers) impacts the agrarian structure and productivity in Kenya.

Table 7: Input Use and Farm Efficiency

	Supermarket farmers			Traditional farmers		
Input	**MPV**		**FC**	**MPV**		**FC**
Land (acre-months)	8,073Ksh	>	667Ksh	3,217Ksh	>	1,083Ksh
Fertilizer (kg)	56Ksh	>	28Ksh			
Productivity Measures						
Labor productivity (average output value per work day)	605Ksh			349Ksh		
Land productivity (average output value per acre-month)	10,264Ksh			6,437Ksh		

Notes: marginal product value (MPV) valued at farm-gate price of Ksh3.6/kg. Factor costs (FC) are sub-sample averages.
Source: authors' farmer survey 2004.

5.4 Net Income Effect of Supplying Supermarkets

In this section we assess whether or not there is a positive net income effect for farmers if they supply kale to supermarkets rather than to traditional buyers. Table 8 provides a gross margin analysis for the two types of farmers. The top half in this table, which looks at production, allows for a straight forward comparison between supermarket-channel and traditional-channel farmers. However, the marketing part forced us to make a choice. The supply channel for supermarkets has a particular given structure, with all farmers taking their harvest directly to the supermarket. Traditional-channel farmers can however supply to brokers, wholesalers or retailers (other than supermarkets). Furthermore, either type of farmer may sell to a wider set of buyers at different links in the supply chain. For example, a supermarket-channel farmer may sell his highest quality grade to supermarkets and the lower grades to wholesalers. Or a traditional-channel farmer may sell to a broker at the farm for one harvest, but collaborate with other farmers to take the next week's harvest to a wholesaler. However, in most cases, both types of farmers sell most, if not all, of their harvest to a single type of buyer. In table 8 we opted to compare the most extreme (but also most common) marketing choices, namely supermarket-channel farmers sell (nearly) 100% of their kale to supermarkets (applies to 60% of the farmers) and traditional-channel farmers sell (nearly) 100% of their kale to a broker at the farm (applies to 46% of the farmers).

Table 8 indicates that there are substantial differences between the two groups of farmers. On average, supermarket-channel farmers use about twice the amount of inputs (fertilizer, manure, chemicals) traditional retailers use, but pay less per unit as they buy larger volumes. Supermarket-channel farmers use less seed, but seed of a higher quality (traditional-channel farmers produce their own seed which is cheap and of lower quality). The variable production

costs incurred by supermarket-channel farmers further include the costs for tractor rental and energy to operate an irrigation system. Traditional-channel farmers use more labor per acre, mostly because there is an abundance of family labor relative to the small farm sizes. Wages for hired labor are higher in the supermarket channel than in the traditional channel. (Family labor was valued at the same rate as hired labor in table 8.) Given the higher input levels, yields per acre are higher for supermarket-channel farmers[13].

When we translate these farm practices into the production cost per kg of kale, we see that there is almost no difference between the two groups of farmers, with both types of farmers producing kale at about 3.5Ksh/kg on average. From this comparable starting point at the production level, the two paths diverge. Traditional-channel farmers incur limited marketing costs (only harvesting and bagging), but also receive a low price from brokers at the farm-gate which allows them to break even at best. Supermarket-channel farmers on the other hand also incur transportation costs, but receive a price which is more than three times the farm-gate price, resulting in a gross profit of about 40%.

Let us now return to the net income effect of supplying supermarkets. Before selling to supermarkets, most current supermarket-channel farmers already had the capacity to market their production to buyers in Nairobi. Selling to supermarkets, who buy larger volumes per delivery, lowers the farmer's transaction costs (several farmers told us that the time spend in selling was reduced from a day to an hour) and pays them a higher price (about 10-20% higher), and thus has a strong positive net income effect for these farmers. For individual traditional-channel farmers, shifting from a broker at the gate to selling to supermarkets would not have a positive net income effect as the transportation costs would be prohibitively high (given the small volumes). Table 9 indicates how the supply capacity differs between the two groups of farmers. When harvest cycle length and size of the farm area under kale are taken into account, supermarket-channel farmers can supply more than five times the volume of traditional-channel farmers. This large difference in supply capacity (and the fact that supermarket-channel farmers grow a wider variety of crops) allows for far more efficient transportation.

[13] Yields per acre vary greatly because of differences in variety, harvest cycle length, soil quality, climate and farm practices, but are estimated at 6MT per acre on average (MoARD 2002) while yields up to 15MT per acre are possible (for comparison, kale yields in the US can go up to 18MT per acre; Oregon State University 2002). The relatively high yield found here for traditional-channel farmers may be due to the specific selection of our sample (a key kale production area for the Nairobi market) or to the farmer's overestimation of the quantity harvested and/or underestimation of the area under kale.

Table 8: Gross Margin Analysis Kale Supermarket vs. Traditional-channel farmers

Data are per acre		Farmers supplying 100% to supermarkets				Kiambu farmers supplying 100% to brokers at the farm			
Line Items[1]	**Unit**	**Units**	**Unit Cost (Ksh)**	**Cost Total (Ksh)**	**% of Rev.**	**Units**	**Unit Cost (Ksh)**	**Cost Total (Ksh)**	**% of Rev.**
Seed **	Kg	0.4	1280	512	0.3	1.1	790	869	2.6
Inorganic fertilizer	Kg	314	28.0	8,792	5.7	177	28.8	5,098	15.1
Manure ***	MT	6.6	1,300	8,580	5.6	3.3	2,100	6,930	20.6
Chemicals *	L	3.3	1,090	3,597	2.3	1.6	1,135	1,816	5.4
Cost Irrigation (var.)	Month	5.4	2,200	11,880	7.7	0	na	0	0
Tractor rental	Acre	1	2,000	2,000	1.3	0	na	0	0
Total inputs				*35,361*	*23.0*			*14,713*	*43.7*
Labor by activity									
Land preparation	Mds	17	150	2,550	1.7	28	120	3,360	10.0
Planting	Mds	12	150	1,800	1.2	19	120	2,280	6.8
Weeding	Mds	55	150	8,250	5.4	85	120	10,200	30.3
Labor by Source									
Family labor ***	Mds	8	150	1200	0.8	120	120	14400	42.8
Hired labor ***	Mds	76	150	11400	7.4	12	120	1440	4.3
Total Labor Cost	Mds	84	150	12,600	8.2	132	120	15,840	47.1
Total Product. Cost	**Kg**	**12,800**	**3.7**	**47,961**	**31.2**	**9,350**	**3.3**	**30,533**	**0.8**
Harvesting	Mds	77	170	13,090	8.5	26	120	3,120	9.3
Take & Sell Market	Mds	29	300	8,700	5.7	0	Na	0	0
Rope (bag or bunch)	Pce	19,700	0.08	1,576	1.0	125	2	250	0.7
Bags	Bag	Na	Na	0	0	125	20	2,500	7.4
Transport (var.)	Km	1,700	10	17,000	11.1	0	Na	0	0
Phone Cost	Na	Na	Na	390	0.3	Na	Na	0	0
Total Market. Cost	**Kg**	**12,800**	**3.2**	**40,756**	**26.5**	**9,350**	**0.6**	**5,870**	**17.4**
Total Cost			**6.9**	**88,717**	**57.8**		**3.9**	**36,423**	**108**
Total Revenue			**12.0**	**153,600**	**100.0**		**3.6**	**33,660**	**100**
Gross Profit			**5.1**	**64,883**	**42.2**		**-0.3**	**-2,763**	**-8.2**
Gross Profit (excl. family labor)			**5.2**	**66,083**	**43.0**		**1.2**	**11,637**	**34.6**
Yield			**12.8 MT/acre**				**9.4 MT/acre**		

Notes: (1) significance for production line items: * = significant at the 10% level , ** = significant at the 5% level, *** significant at the 1% level; (2) numbers are indicative only as they are based on the farmer's estimations, not direct measurement; (3) prices used are weighed sample averages for both groups of farmers; (4) weight conversions used: 1 bag=75kg, 1 bunch=0.65kg (authors' field measurements).
Source: authors' farmer survey 2004.

Table 9: Supply Capacity Supermarket vs. Traditional-channel farmers

	Traditional Farmers	Supermarket Farmers	Difference
Yield 1 (MT/acre)	9.4	12.8	+37%
Harvest Cycle Length (months)	5.1	4.4	
Yield 2 (kg/acre, month)	1,843	2,909	+59%
Average Land Under Kale (acres)	0.9	3.6	
Supply Capacity (bunches/week)	415	2,600	+527%

Source: authors' farmer survey 2004.

However, if traditional-channel farmers would join together to market their output, supplying to supermarkets would have a dramatic effect on their net income, as it would allow them to capture the 40% gross profit margin now enjoyed by the supermarket-channel farmers. Various factors hinder the emergence of marketing groups amongst traditional-channel farmers. First, there is a dire lack of experience with marketing produce (in fact, most farmers dislike to be engaged in marketing activities). Second, risk-averseness deters traditional-channel farmers from selling to more downstream buyers. On the one hand, selling to wholesalers exposes farmers to high price fluctuation risks which may average out for a broker supplying daily, but which could financially cripple a group of smallholders who could maybe market once a month. On the other hand, selling to supermarkets, which could provide more stable prices, implies that farmers have access to affordable credit and are willing to risk taking out a loan to invest in the irrigation system required by supermarkets. Furthermore, selling to supermarkets, who at times take up to a month to make payments, will often also exceed the working capital capacities of cash-strapped farmers.

5.5 Supermarkets and Farmer Growth Dynamics

Confirming the financial benefit of increased net income for farmers who can access the supermarket channel as indicated in the previous section, 93% of these farmers said that supplying to supermarkets has affected their profitability favorably. However, supermarkets also provide other benefits which are even more important to farmers than a higher price. While 34% of the supermarket-channel farmers say that the higher price is a key reason for selling to supermarkets, 46% say that the ease of selling to supermarkets is the key attraction. Consider a farmer in the traditional channel. Uninformed about the price of the day (maybe reacting to the previous day's price), the farmer decides to harvest (maybe because there was no longer time to postpone it or because of an urgent need for cash) and takes her or his produce to the rural market. Many farmers and few brokers may show up at this market, leading to plummeting prices, which the farmer has to accept, even if they are below production cost, as the opportunity cost of the kale is close to zero (animal feed). Even within a given day, prices can fluctuate strongly, making the marketing process much like a gamble. Now consider a supermarket-channel farmer. Since supplies are made to order, the farmer is certain, before harvesting, that the sale will take place and at what price. Prices paid by supermarkets change step-wise, remaining constant over longer time intervals, a stability which is desired by both the supermarket and the farmer. These orders are also coming in throughout the year with some reliability (at least for the growing group of FFV suppliers who get long term supply agreements). While supermarkets and their FFV suppliers start to build up long term

relationships, 95% of the traditional-channel farmers are selling in spot markets with buyers varying all the time.

The combination of higher net incomes and greater stability in volumes and prices in the supermarket channel, have created a strong growth dynamic. Of the farmers supplying kale to supermarkets, 75% said they increased production in response to supermarket demand. Supermarket-channel farmers have kept investing in their farm, resulting in a strong growth: the average farmed acreage of supermarket-channel farmers increased by 104% over 1999-2004, compared to by only 10% for traditional-channel farmers. In search for growth, the single most important input access constraint faced by supermarket and traditional-channel farmers alike is access to credit (Table 10). It is in this context meaningful that 44% of the supermarket-channel farmers believe that their status as a supplier to supermarkets (which gives them formal proof of a steady income flow) has increased their access to credit. However, increased access to credit does not necessarily mean affordable credit. Commercial credit is expensive (15-20% interest rate), while government supported loans (10% interest rate) are, according to the farmers, too difficult to obtain because of slow and selective bureaucratic procedures. This probably explains why even for supermarket-channel farmers access to credit remains a key constraint. Nevertheless, growing as they are, the current list of supermarket-channel farmers are likely to be able to follow growing demand for FFV by supermarkets for the next five years: 71% of these farmers state that, should supermarkets ask them to, they could double their current supply of kale within one (five month) cycle (92% of them by increasing production, 8% by sourcing from other farmers).

Table 10: Farmers' Access Constraints to Key Inputs

% of farmers indicating that:	Traditional Farmers	Supermarket Farmers
access to credit is a problem	88%	85%
access to inputs is a problem	43%	16%
access to land is a problem	8%	19%
access to labor is a problem	3%	8%

Source: authors' farmer survey 2003.

6. Summary, Conclusions and Recommendations

Our research has shown that the rise of supermarkets has given rise to a new group of farmers in the domestic FFV market. The key suppliers of FFV to supermarkets are mostly recently established, medium-sized farms (10-40 acres) managed by well-educated farmers and specialized in supplying supermarkets. Around 40% of supermarket-channel farmers fell in this category in 2004 and it is expected that these farmers will become dominant in the supplier base over the next five years. In terms of their capital, supermarket-channel farmers differ starkly from traditional-channel farmers. Especially size and the presence of an irrigation system were found to be critical determinants of participation in the supermarket channel. This is so because it addresses the current FFV procurement priorities for supermarkets in Kenya: finding farmers who can supply large volumes year-round. The fact that nearly all supermarket-channel farmers have the capacity to supply large volumes, have one or more transportation vehicles, an irrigation system, a packing shed, a cellular phone, and so on, points to the presence of a threshold capital vector which farmers must have in order to enter the supermarket channel. Only 25% of the

farmers supplying supermarkets directly can be classified as smallholders (less than 10 acres) and while we gave several examples of groups of smallholders who, assisted by market facilitators, are linked into the supermarket channel, the importance of such smallholder groups as direct suppliers of FFV to supermarkets is minimal. We further found that amongst kale suppliers to supermarkets, women are less frequently the head of the farm (1/6 in stead of 1/3 of the farms as is the case for traditional-channel farmers) and make up a smaller percentage of the employed workforce (a third in stead of half).

Farms supplying kale to supermarkets have adopted capital intensive technologies. They use more quasi-fixed capital (e.g., irrigation systems) and apply (per acre) twice the amount of fertilizer, manure and chemicals used by traditional-channel farmers outside the supermarket channel. Consequently, average land and labor productivity are about 60-70% higher for supermarket farms. Although supermarket-channel farmers include few smallholder producers (relative to the traditional channel) and have a lower labor-to-land ratio, they employ many hired workers. On average there are 13 full-time workers per supermarket farm and 80% of these are hired laborers. The overall effect on labor is about a 20% reduction per acre. Furthermore, commensurate with their higher productivity, these hired farmed workers are paid a 15% higher wage on average. Our analysis further shows that, for kale, overall productivity of supermarket-channel farmers and traditional-channel farmers is similar as both have nearly the same production cost per kg of kale. Therefore, on the production side, the essential limitation of traditional producers (85% of which are smallholders) is not their production efficiency but their lack of scale and inability to produce year round (in the absence of modern irrigation systems).

An even more important difference between supermarket-channel farmers and traditional-channel farmers is their marketing capacity. Most (individual) traditional-channel farmers do not have their own (motorized) transportation and lack the scale to rent it. Therefore these farmers are forced to sell to brokers who come to the farms at prices that allow them to break even at best. On the other hand, many supermarket-channel farmers were already supplying their produce to wholesalers or retailers in Nairobi and could easily make the switch to supplying supermarkets. The 10-20% higher prices paid by supermarkets (relative to wholesalers) give supermarket-channel farmers a healthy gross profit margin of 40% (for kale).

If smallholder farmers could achieve the same transportation efficiency as supermarket-channel farmers (by marketing in groups) and could supply direct to supermarkets, they would get three times the price they currently get from brokers at the farm, capturing the same 40% gross profits currently enjoyed by the supermarket-channel farmers. Furthermore, supermarket-channel farmers indicated that the benefits of market risk reduction (more stable prices and volumes) and reduced transaction costs are even more important than the higher price. The combination of higher gross profits and a stable long term trading relationship has been a powerful determinant of a strong growth dynamic amongst supermarket-channel farmers. The latter have, on average over the last five years, doubled the size of their operations (where the traditional-channel farmers in this study only increased theirs with 10%). This strong growth further indicates that the current supermarket-channel farmers will likely keep pace with the growth of supermarkets and even increase their share of the supermarkets' FFV supplies.

Development Policy and Program Recommendations

For development policies and programs, the key insight revealed by studies on the rise of supermarkets in developing countries (like this one), is that supermarkets are changing the

structure of the food system whether directly through their actions or through the competitive response they provoke in the traditional system, and that they are doing so fast. Those (farmers) who adapt (fast) will benefit from this change. Therefore, if we want to help smallholders in this new context, whether by helping them to link up with supermarkets or by making traditional channels more competitive, a similar set of recommendations can be put forward. The following three recommendations will help the design of development programs in taking the new reality of retailer driven food systems in developing countries into account.

First, assistance programs must focus on complete supply chains, not individual agents, not parts of a chain. It is not enough to merely start from the market. There is a need to design the whole chain from the beginning. As we have shown in this paper, farmers need to meet a vector of criteria in order to gain access to supermarkets which cannot be addressed by assistance programs targeting an isolated problem in a particular industry (horizontal level), such as developing a higher yielding variety for farmers independent of other considerations regarding the structure of the supply chain. Essentially, this implies multiple partners to be involved in the development program, especially retailers. The design of the supply chains may further imply the creation of new market facilitators (e.g., outgrower schemes), which in turns raises the need to carefully look at potential agency problems in the design (are the stakeholders, more specifically the smallholder farmers, in control and benefiting?).

Second, scale increase is needed throughout the chain. At the heart of the dynamics created by supermarkets chains is an increase in scale, first at the retail level, but then throughout the chain. Scale facilitates investment as well as the use of risk reducing institutions such as contracts, standards and grades, and so on. This implies group formation at the farmer level (investment capital, harvest schedules, volume), but also (simultaneously) group formation at the wholesaler and retailer level (e.g., a new type of smaller 'farmer markets' that can be located near residential areas and which share a FFV procurement system). The size of group formation is determined by the economies of size associated with transportation vehicles and irrigation systems as well as by the volume requirements of the supermarkets (or other larger-scale buyers of FFV).

Third, one of the most critical challenges in any program designed to help smallholder farmers in accessing modern supply chains is how to assist them in dealing with the inherent higher working capital requirements. Smallholder growers are very sensitive to working capital and cash flow issues as indicated by the frequently reported break-down of contractual relationships between farmers and buyers because of the former (either in temptation or in need) selling to brokers for cash (e.g., Jaffee and Morton 1995). Therefore there is a strong need to develop and integrate creative solutions that help keep working capital (and cash-outflows) down for farmers. The following are some examples in this context: blended fertilizer, labor-driven pumps, factoring. One project in Western Kenya involving 25 farmers has developed a fertilizer which is blended specifically for a particular application in a particular area (based on a soil analysis) and is marketing the fertilizer in small affordable bags (Okwemba 2004). Initial results indicate yields that are 200% higher, which implies, inversely, that cash-strapped farmers could reduce their expenditure on fertilizer without loss of yield. Kenya's MoneyMaker pumps, recently heralded as one of 'Ten Inventions That Will Change the World' by Newsweek magazine (Stone 2003), provide a labor-intensive solution to the required irrigation system. The pumps are (relatively) low cost in purchase ($60) and in operation (using the labor of a worker pedaling the pumps' pistons). Factoring, in Kenya pioneered by the Kenya Gatsby Trust (an NGO), is a financial tool that could greatly help farmers in dealing with the payment terms of

supermarkets. Factoring entails buying out (at a fee) the buyer's payment obligation to the supplier after delivery took place. For example, a farmer supplies Ksh5,000 worth of FFV to the supermarket and receives an immediate payment of Ksh4,800 payment from the factoring agent, rather than waiting 30 days for the payment to come from the actual buyer. Factoring could be worked out more systematically in order to take away the farmer's temptation of defaulting on a contract by selling to a broker because the latter offers cash on delivery.

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