CHAPTER 5

PROFILES OF FARMERS SUPPLYING TO SUPERMARKETS AND TRADITIONAL MARKETS IN BOTSWANA AND ZAMBIA

5.1 Introduction

The description of products found on supermarket shelves and the procurement practices in Botswana, Namibia and Zambia in Chapter 4 showed that FFV was sourced mainly from South Africa and in smaller volumes from both large and small to medium scale-farmers in Botswana and Zambia. The objective of this chapter is to describe the characteristics of farmers that supplied FFV to supermarkets and those that supply to the traditional markets in Botswana and Zambia and to determine if there are any differences among them. In Namibia, a survey of farmers supplying to supermarkets and the traditional markets was not possible because there were very few if any small-scale farmers who produce FFV for commercial purposes let alone supplying to supermarkets. Therefore, the analysis was carried out for Botswana and Zambia where farmers supplying FFV to supermarkets and traditional market channels were available. Some of this information will be used in the next chapter to determine the factors that influence participation in the supermarket channel and the impact of this participation on farmers' incomes.

Small-scale farmers that supplied to supermarkets and the traditional market channel (in Zambia and Botswana) were sampled as already detailed in section 1.8.2. Farmers were interviewed using a structured questionnaire (Appendix 6). The characteristics of small-scale farmers supplying to supermarkets and the traditional channel are described in the following paragraphs to answer research question 4 of the study and test hypothesis 1.

5.2 Profiles of farmers that supply FFV to the two market channels in Zambia

The profiles (characteristics) of farmers selling FFV to supermarkets and those selling to the traditional market were obtained by interviewing sampled farmers. Examining household characteristics of farmers supplying to these markets may help to explain why

some farmers use the FFV supply chain of supermarkets while others do not. The farmers who were sampled and interviewed produce a range of vegetables including tomatoes, cucumbers, kale/spinach, traditional vegetables, onions, carrots, green maize and cabbages.

5.2.1 Entry of sampled farmers in FFV production in Zambia

Approximately 90% of interviewed farmers supplying vegetables to supermarkets and 85% of those supplying to the traditional market channels in Lusaka and Chipata in Zambia started production in the early 1990s to 2004 (Table 5.1). This could be attributed to policy changes by the government of Zambia that focuses on promoting agriculture as an alternative source of economic growth, employment and foreign exchange earnings (Haantuba, 2003).

Table 5.1: Entry of small-scale farmers into production of FFV in Zambia

Type of market	**Year**			
	1970-1989		**1990 – 2004**	
	Frequency	Percent of farmers	Frequency	Percent of farmers
Those supplying to supermarkets	2	10	18	90
Those supplying to traditional markets	9	15.5	49	84.5

It is evident that many more farmers have entered the production of fresh fruit and vegetables since the 1990s and production of FFV has gathered momentum since then to date. These farmers also started selling to supermarkets in the late 1990s to date (Table 5.2).

These changes could be explained by direct government intervention in promoting high-value crop production as a way of diversifying the economy away from mining. To create jobs and improve the livelihood of the people the government has facilitated the production of high-value crops such as FFV for local consumption and export. Increasing demand for FFV by the middle to upper-income groups and probably the availability of

markets (for example supermarkets and export markets) for these products could also have contributed to increased involvement of farmers in the production of these crops.

Table 5.2: Year when small-scale farmers started selling to supermarkets in Zambia

Year		Frequency	Percent	Cumulative percent
	1997	2	10.0	10.0
	2000	5	25.0	35.0
	2001	1	5.0	40.0
	2002	4	20.0	60.0
	2003	6	30.0	90.0
	2004	2	10.0	100.0
	Total	20	100.0	

5.2.2 Resource endowment of sample farmers in Zambia

In this section the resource endowments of farmers participating in the supermarket and traditional channel of FFV supply is discussed.

5.2.2.1 Land ownership and endowment

Farmers sampled and interviewed in Lusaka acquired land through buying and through land allocation by government 30% and 70% of the respondents respectively. Farmers accessed land for producing FFV through ownership or renting. There are two main types of land ownership namely freehold and traditional (Table 5.3).

Table 5.3: Types of land ownership among sampled farmers in Zambia

Type of land ownership	Those who supply to supermarkets		Those who supply to traditional market channel	
	Frequency	%	Frequency	%
Freehold	12	60	9	15.5
Traditional ownership	7	35	49	84.5
Rented	1	5	0	0
Total	20	100	49	100

Among the farmers supplying through the traditional market channel, some acquired land through inheritance (12.2%) and the remaining (87.8%) were allocated land by chiefs or

the state. The land ownership type was traditional meaning the possessor has the right to use the land but may not sell it nor uses it as collateral to negotiate a loan.

Farm sizes are generally small even though farm sizes differ. It is significant that farmers supplying supermarkets have farms that are, as a mean, double the size of the farms of farmers supplying to the traditional markets: 6.1 ha as opposed to 3.1 ha (Table 5.4).

Table 5.4: Farm sizes of FFV producers in Zambia

Farmer type	Land size [15] (hectares)				
	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Supplying to supermarket	20	1	22	6.09	4.624
Supplying to traditional market channel	58	0.8	22.2	3.1	3.1843
Significance test of means t value P value					 1.99 0.0027***

*** 1% significance level

Total land size under FFV has been undergoing gradual change since farmers started supplying to the supermarkets and traditional market channels in Zambia as shown in Table 5.5.

[15]The concept of small farm varies widely across different regions of the world since they are defined primarily in relation to the average land holding size in that region. In sub-Saharan Africa, small-scale or smallholder farms can be classified as having a size of <2ha to 5ha on average or a farmer having 10-20 head of cattle (Narayan & Gulati, 2002). But for different countries in the region classification of small farms also varies widely, for example in Kenya a small-scale farm has a size from 0.52 -10ha (Republic of Kenya, 1989), whereas in Zambia it varies from 1- 9ha (Copstake, 1997) and in Botswana it varies from 1ha-10ha (Republic of Botswana, 2004a). Therefore, for the purpose of this study all farm holdings involved in the production of FFV with a total farm size from 0.5 ha to 10 ha are considered to be small-scale farms.

Table 5.5: Comparison of total land size, land under FFV 5 years before and after supplying FFV to various channel in Zambia

Variable	Supermarket farms	Traditional market farms
Total land size	6.1	3.1
Land under FFV 5 years ago	0.6	0.2
Land under FFV today	0.9	0.3

5.2.2.2 Ownership of vehicles

In Zambia, 45% of the farmers interviewed supplying supermarkets owned vehicles whereas 55% relied on hired vehicles (Table 5.6). Among farmers that supplied to the traditional market channels, 1.7% owned a vehicle for transporting produce to the market while the remaining 98.3% did not. Most of these farmers relied on bicycles, ox carts or hiring of vehicles to transport their produce to the market.

Table 5.6 Ownership of vehicles among sampled farmers in Zambia

Type of farmer	Ownership of vehicle	Frequency	Percent	Cumulative percent
Farmers who supply to supermarkets	Own 1 or more	9	45	45
	Own none	11	55	100
	Total number	20	100	
Farmers who supply to traditional markets	Own 1 or more	1	1.7	1.7
	Own none	57	98.3	100
	Total number	58	100	

5.2.2.3 Ownership of tractors and other land-preparation implements

Ownership of tractors among the farmers supplying to supermarkets was negligible (only 15%). Instead of tractors farmers used hand hoes (65%) and in some cases ox-drawn ploughs or hiring of tractors for land preparation. None of the farmers supplying the

traditional market channel owned tractors. The majority of these farmers used hand implements (hoes) and in some cases ox ploughs for preparing land for the production of vegetables.

5.2.2.4 Ownership of irrigation systems

It was evident from the survey of farmers in Zambia that all farmers that supplied FFV to the supermarkets own irrigation systems. Given the harsh climate and the need to supply FFV consistently this is something that was to be expected. Most of the farmers purchased the irrigation systems from their own savings or from loans obtained from government schemes such as FAP in Botswana and ZATAC in Zambia. None of the farmers received any assistance from the supermarkets they supplied to. About 45% of these farmers owned sprinkler irrigation systems, 20% owned drip irrigation, 20% used treadle pumps and 15% used hosepipes and/or furrow irrigation (Table 5.7). Those farmers who do not own irrigation systems and rely on rainfed production are not in a position to supply to supermarkets because of erratic production. These farmers therefore, tend to produce only field crops such as maize and sweet potatoes. Those who produce vegetables using rain-fed conditions could rely on traditional markets such as Soweto or any other spot market. The majority of the farmers producing vegetables for the traditional markets also used simple irrigation methods such as buckets or furrow irrigation (89.2%) and treadle pumps (10.25%). These farmers farmed a quarter to one hectare of land under irrigation.

Table 5.7: Types of irrigation systems owned by farmers in Zambia

Type of farmer	Type of irrigation system	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets	Sprinkler	9	45.0	45.0
	Drip	4	20.0	65.0
	Treadle pump	4	20.0	85.0
	Bucket/ furrow	3	15.0	100
	None	0	0	100
	Total	20	100	
Farmers supplying traditional markets	Sprinkler	3	5.2	5.2
	Drip	0	0	0
	Treadle pump	5	8.6	13.8
	Bucket/ furrow	44	75.9	89.7
	None	6	10.3	100.0
	Total	58	100.0	

5.2.2.5 Ownership of sorting/packaging shades

Ownership of sorting/packaging shades[16] was low (20.7%) among farmers' who supply vegetables to supermarkets in Zambia and almost non-existent (1.7%) among farmers supplying to the traditional channels (Table 5.8). Ownership of sorting /packaging shades indicates that such farmers are engaged in basic processing at farm level before delivering to the market.

The type of on-farm processing of fresh produce by farmers who supply to various supermarkets included washing, sorting and packaging, which were practiced by 40% of these farmers. Among those supplying to traditional markets none were involved in this type of processing on farm that is adding value to the produce, before delivery.

[16] The sorting/packing shades are either temporary or permanent buildings in which farmers' sort, grade and package fresh produce. In the sorting/packaging shade there are equipment such as tables, knives, machines for sealing plastic bags, troughs for washing etc, which are used to sort, wash, grade and pack products such as tomatoes, or wash, cut and pack products such as kale or spinach. This is an attempt to add value to the product before marketing them. The farmer owns these sorting/packing shades privately.

Table 5.8: Ownership of sorting/packaging shades in Zambia

Type of farmer	Owned sorting/packaging shades	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets	Yes	8	27.6	27.6
	No	21	72.4	100.0
	Total	29	100.0	
Farmers supplying traditional markets	Yes	1	1.7	1.7
	No	57	98.3	100.0
	Total	58	100.0	

5.2.2.6 Ownership of greenhouses

About 10% of the farmers interviewed supplying to supermarkets owned greenhouses while none of the farmers supplying to traditional market channels had greenhouses. Farmers depended on natural conditions to produce fresh vegetables for the market with minimal modification of the crop environment.

5.2.3 Household characteristics

A descriptive analysis of the household demographics and structure of the sampled Zambian farmers is described below. This analysis may help us to understand whether the number of persons in a household may influence participation in FFV production and marketing.

5.2.3.1 Household size

The households interviewed who are producing vegetables and supplying the supermarkets consist on average of six persons (in adult equivalents) whereas households supplying traditional markets consist on average of seven persons (Table 5.9).

Table 5.9: Household size among sampled farmers in Zambia

Type of farmer	Household size				
	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Farmers supplying supermarkets	20	2	14	6.36	2.629
Farmers supplying traditional markets	58	3	15	7.17	2.992

5.2.3.2 Gender of household head

There were both male and female-headed households involved in producing fresh vegetables for the supermarkets and the traditional market channels. Among households supplying to supermarkets, 85% are male-headed. Among the households supplying to traditional market channels, 81% of the households are male-headed (Table 5.10).

Table 5.10: Gender of household heads in Zambia

Type of farmer	Type of household head	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets	Male-headed	17	85.0	85.0
	Female-headed	3	15.0	100.0
	Total number	20	100.0	
Farmers supplying traditional markets	Male-headed	47	81.0	81.0
	Female-headed	9	19.0	100.0
	Total number	58	100.0	

5.2.3.3 Education levels of household heads

Household heads supplying to supermarkets have a higher level of education compared to those supplying vegetables to the traditional channels. Nearly all household heads supplying to the supermarket channel attained secondary level of education (85%) and tertiary level of education (15%). The majority of farmers supplying to the traditional channel only have low levels of formal education, 60.3% of these household heads only completed primary level education, 29.4% secondary education, and 8.6% have no formal schooling (Table 5.11).

Table 5.11: Education levels of household heads in Zambia

Type of farmer	Level of education	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets N=20	None	0	0	0
	Primary	1	5	5.0
	Secondary	17	85.0	90.0
	Tertiary	2	10.0	100.0
	Total number	20	100.0	
Farmers supplying traditional markets N=58	None	5	8.6	8.6
	Primary	35	60.3	68.9
	Secondary	17	29.4	100.0
	Tertiary	1	1.7	100.0
	Total number	58	100	

5.2.3.4 Income sources of farmers

There is high incidence of dependence on farming as the only source of income among farmers supplying the traditional market channel (77.6%) compared to those supplying the supermarket channel (65%). About 35% did not depend on farming as their only source of income. These farmers hold other jobs or are engaged in other off-farm activities that earn them income. These farmers tend to delegate the management of the farming activities to their wives or hired managers. The other sources of income for these farmers include teaching, some are civil servants and some are engaged in private sector activities (business such as running shops and brick making) as shown in Table 5.12.

Table 5.12: Types of off-farm sources of income for farmers in Zambia

Type of farmer	Type of off-farm source of income	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets N=20	Teachers	0	0	0
	Civil servants	3	15.0	15.0
	Private sector	2	10.0	25.0
	Pensioners	3	15.0	40.0
	Depend on farming only	12	60.0	100.0
	Total number	20	100.0	
Farmers supplying traditional markets N=58	Teachers	1	1.7	1.7
	Civil servants	1	1.7	3.4
	Private sector	8	13.8	17.2
	Pensioners	3	5.2	22.4
	Depend on farming only	45	77.6	100.0
	Total number	58	100.0	

This implies that farmers supplying the supermarkets are wealthier, and may have access to other sources of funds and information for production compared to those supplying the traditional markets.

5.2.3.5 Input use and costs

Farmers supplying to supermarkets used more inputs, which translated into higher mean input costs compared to non-supermarket farmers (Table 5.13).

Table 5.13: Input costs of farmers in Zambia

	Input costs (Kwacha/Ha) 1US$ = 4800 Kwacha				
Type of farmer	**Sample size (N)**	**Minimum**	**Maximum**	**Mean**	**Std. deviation**
Farmers supplying supermarkets	20	152000	5 000 000	1200363.20	1155021.989
Farmers supplying traditional markets	58	46000	4 440 000	423092.62	706989.7

5.2.3.6 Household wealth ranking

This was based on enumerator assessment of the farmer's wealth status. Farmers' ownership of a permanent house (iron-roofed and built of stone or bricks), a vehicle or tractor and other assets of production such as large land size, higher income and other sources of income apart from farming, were used to classify households into either low, medium or high-wealth households. This is a qualitative measure of household wealth or income. According to the assessments made by interviewers, 70% of farmers supplying supermarkets in Zambia belong to medium-wealth households and the remaining 30% belong to high-wealth households. Household wealth ranking of farmers who supply to the traditional market showed that 48.3% belonged to the low-wealth household group, 48.3% to medium and the remaining 3.4% to the high-wealth household group (Table 5.14).

Table 5.14: Wealth ranking of interviewed farmers in Zambia

Type of farmer	Household wealth ranking	Frequency	Percent	Cumulative percent
Farmers supplying supermarkets	Low	0	0	0
	Medium	14	70.0	70.0
	High	6	30.0	100.0
	Total number	20	100.0	
Farmers supplying traditional markets	Low	28	48.3	48.3
	Medium	28	48.3	96.6
	High	2	3.4	100
	Total number	58	100.0	

5.2.3.7 Proximity to urban centres and FFV markets in Zambia

Most of the small-scale to medium-scale farmers producing vegetables and supplying the various market channels (supermarket or traditional) are located near urban centres. Farmers supplying the supermarket in Lusaka were on average located approximately 15.25km away from the urban centre whereas those supplying the traditional markets are located on average 20.85km from the markets that they supply (Table 5.15).

Table 5.15: Mean distance (km) from farm to market or urban centre

Farmer type	Distance from farm to major town (km)				
	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Supplying supermarkets	20	5	35	15.25	6.414
Supplying traditional market channel	58	5	25	20.85	5.218

The assumption made is that those who live near urban centres have easier access to the market compared to those who are located far away and hence those near the market face lower transaction costs especially transport costs and can easily access information regarding market conditions such as prevailing prices and what products are required in the market.

5.2.4 Farmers' ability to meet supermarket conditions

The ability of farmers to supply supermarkets may be influenced by transaction costs. According to the New Institutional Economics, high transaction costs, tough contract conditions and high quality requirements imposed by supermarkets on suppliers may also influence who and who does not participate in the supermarket channel. These factors are examined below to shed light on how trading conditions affect farmers' access to supermarkets.

5.2.4.1 Supply arrangements (Contracts)

All the interviewed farmers in Zambia that supplied FFV to supermarkets had done this on contract basis (mainly verbal). Written contracts only apply in the case of processed products. The preference for verbal contracts largely lies in the increased flexibility provided to the supermarket buyers or their agents. It allows them to vary purchase prices according to trends in market prices. By having these verbal contracts, the buyer avoids paying a very high price when the market price of the product is low. The verbal contract also provides more flexibility for small-scale producers since they are often in a situation where they would not be able to meet the volumes specified in written contracts. Thus for both parties a verbal agreement allows the flexibility which reduces the risk considerably. However, the problem with a verbal agreement is that the buyer does not always honour these agreements as a result of opportunistic behaviour. It quite often happens that if there is excess supply to the supermarket resulting in them not being able to purchase the produce, it forces the farmers to make alternative marketing arrangements at short notice like selling at Soweto market, where the produce may fetch much lower prices.

5.2.4.2 Credit period

In Lusaka, 90% of farmers supplying to the supermarkets are payed within a week, whereas the remaining 10% receive their payments immediately, that is cash on delivery (Table 5.16). When and how the farmers receive their payments depends on the agreement made between the farmer and the supermarket during negotiations at the start of the contract.

Table 5.16: Number of days before receiving payment from supermarkets

	Frequency	Percent	Cumulative percent
Immediately (cash on delivery)	2	10.0	10.0
1 Week	18	90.0	100.0
Total	20	100.0	

5.2.4.3 Membership of a farmers' group

Membership of a farmers' group can assist farmers to access supermarkets in that pooling their products can help mitigate the problem of the small size of their separate enterprises and the related low volumes that might make supplying supermarkets near to impossible. Of the farmers supplying supermarkets 65% belong to a farmers' organisation (Table 5.17).

Table 5.17: Farmers who supply supermarkets and belong to a farmers' group in Zambia

Response	Frequency	Percent	Cumulative%
Yes	13	65.0	65.0
No	7	35.0	100.0
Total	20	100.0	

5.2.5 Mean comparisons of farmers supplying to supermarkets and traditional market channels

Several of the continuous variables (farm size, age of household head, number of persons forming part of the household, labour, input costs and distance from farm to nearest urban centre) were tested to establish if there are any significant differences between these two groups of farmers. A one-way analysis of variance was performed to test for equality of means between these two groups of farmers. The mean comparison analysis compares the two to determine whether there are any statistical differences.

Group 1: farmers who supply to the supermarket channel

Group 2: farmers who supply to the traditional channel

Let μ_1 and μ_2 be the means of the two populations with variance δ^2. A random sample was drawn from each population.

Let $\overline{X_1}$, $\overline{X_2}$, S_1^2 , S_2^2, n_1 and n_2 denote the sample means, variances and sizes.

Ho: $\mu_1 - \mu_2 = 0$ or Ho: $\mu_1 = \mu_2$ versus H1: $\mu_1 \neq \mu_2$

Assumptions:

The variance (δ^2) is the same in the two populations

$\overline{X_1}$ and $\overline{X_2}$ are normally and independently distributed

Test for significant differences between the means of the two independent and unequal samples from the two populations is based on the t-distribution. This test is fully described in Snedecor and Cochran, 1989: 89-94 and in Steel & Torrie, 1986:96-97). These computations are normally provided in most statistical packages such as SAS.

The test criterion is

$$t = \frac{\overline{X_1} - \overline{X_2}}{s_{\overline{X_1} - \overline{X_2}}} \qquad (1)$$

$$\text{Where } s^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)} \qquad (2)$$

The two samples in this study were not equal, $n_1 \neq n_2$,

Hence, $S_{\overline{X_1} - X_2}$ is calculated by

$$S_{\overline{X1} - \overline{X2}} = \sqrt{S^2\left(\frac{1}{n_1}\right)\left(\frac{1}{n_2}\right)} = \sqrt{S^2\left(\frac{n_1 + n_2}{n_1 n_2}\right)} \qquad (3)$$

Using equations 1 and 3 a t-value is computed and used to test for differences in means between the farmers supplying supermarkets and those supplying the traditional channel.

The result of this analysis is given in Table 5.17. Farmers who supply supermarkets own on average significantly more land (double the size) compared to those who supply the

traditional market channel. The difference in farm size means that between the two farmer groups it is significant at 5% significance level. There was no significant difference in mean age of the household head and mean number of persons residing in the households in the two groups (Table 5.18).

Farmers who supply supermarkets used more labour (number of household members who work full-time on the farm plus hired labour) than those who supply traditional markets. The difference in labour use is significant at 1% significance level. Farmers supplying supermarkets use twice as much labour as those who supply the traditional markets. Farmers who supply to the supermarkets in Zambia use more inputs, which translate into higher input costs compared to those who supply to the traditional market. This variable is significant at 1% significance level. Farmers supplying the supermarkets incur twice as much input costs compared to farmers supplying the traditional markets. This could be explained by the need to meet quantities and quality standards set by supermarkets necessitating the use of more inputs such as labour, chemicals and fertilisers in order to produce more high quality vegetables.

Table 5.18: Mean comparison of sampled farmers supplying FFV to supermarkets and the traditional market channels in Zambia

Variable	Least-squares means	t Value	p Value
Farm size (ha)			
Supply to supermarkets	4.7306	2.50	0.0221**
Supply to traditional markets	2.6658		
Age of household			
Supply to supermarkets	47. 198	1.65	0.1172
Supply to traditional markets	42.0545		
Household size (number)			
Supply to supermarkets	7.78277	0.64	0.5296
Supply to traditional markets	7.3091		
Number of labourers			
Supply to supermarkets	7.58277	3.98	0.0009***
Supply to traditional markets	4.1090		
Input use (costs) in Kwacha			
Supply to supermarkets	672 780.885	3.89	0.0011***
Supply to traditional markets	291 422.727		

Supply to supermarkets, N=19; Supply to traditional markets, N=55
** 10 % significance level ** 5% significance level; *** 1% significance level*

5.3 Profiles of farmers that supply FFV to the two market channels in Botswana

The sampling for the Botswana farmers was also detailed in section 1.8.2 in the sampling and data collection procedures. The number of farmers engaged in FFV production in Botswana is still small. The sample consisted of 13 out of 20 farmers from the Gaborone District/Region representing approximately 65% of the farmers producing for commercial purposes at the time of the survey. It is important to note that

there are not many farmers in Botswana producing FFV on a commercial scale and this is therefore a constraint not only for the supermarkets investing in Botswana but also for this study.

5.3.1 Entry of sampled farmers into production of FFV in Botswana

All farmers sampled and interviewed in Botswana commenced production of FFV in the mid-1990s (Table 5.19). The emerging group of small-scale to medium-scale horticultural producers who are now beginning to produce for the market started their farming enterprises in the mid-nineties and started selling to supermarkets in the late 1990s to date (Table 5.19).

Table 5.19: Entry of small-scale farmers into production of FFV in Botswana

Year	Frequency	Percent	Cumulative percent
1993	1	7.7	7.7
1995	2	15.4	23.1
1998	1	7.7	30.8
1999	1	7.7	38.5
2000	5	38.5	76.9
2001	1	7.7	84.6
2003	1	7.7	92.3
2004	1	7.7	100.0
Total	13	100.0	

This trend may well point to the availability of markets because this period also coincided with the rapid expansion of supermarkets in Botswana. There was an upsurge of farmers starting horticultural farming in 2000. This trend could probably be explained by direct government intervention through the implementation of the Financial Assistance Policy, a free government grant to farmers to start horticultural projects, which ran from 1991-2001. This is the period when supermarkets were expanding in Botswana. Coupled with government policy requiring supermarkets to source FFV available locally (this is effected by closing borders to imports when local farmers have produced enough of a particular commodity) may have encouraged farmers to venture into FFV production.

5.3.2 Resource endowment of farmers in Botswana

The resource endowment of farmers participating in the supermarket and traditional channel of FFV in Botswana is discussed below.

5.3.2.1 Land ownership

In Gaborone District/Region, 61.5% of the farmers interviewed obtained access to land by being allocated land by the state (land boards), 30.8% by buying and 7.7% by renting land. Most (61.5%) land under horticultural production was acquired on a 15-99 years leasehold. Freehold land made up 30.8% of all land under horticulture. Some farmers participating in the study reported that accessing more land for FFV production was difficult because of lack of surface water for irrigation.

Farmers supplying to supermarkets in Gaborone District/Region owned on average 7.63 ha of land compared to 4.33 ha owned by farmers supplying to the traditional market channel. Generally, all 13 farmers producing vegetables in the region own on average 6.87 ha of land (Table 5.20).

Table 5.20: Size of land owned by farmers involved in FFV production in Botswana

Farmer type	Land sizes (hectares)				
	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Gaborone (supply to supermarket)	10	1	31	7.63	9.704
Gaborone (supply to traditional market channel)	3	1	10	4.33	4.933
All farmers	13	1	31	6.87	8.762

5.3.2.2 Vehicle ownership

Approximately 69.2% of the farmers supplying FFV to supermarkets and other market channels owned at least one vehicle, whereas the remaining 30.2% relied on hired vehicles (Table 5.21) to transport their produce to the market.

Table 5.21: Ownership of vehicles among sampled farmers in Botswana

Own transport facility	Frequency	Percent	Cumulative percent
Own 1 or more	9	69.2	69.2
Do not own	4	30.8	100
Total	13	100	

5.3.2.3 Ownership of tractors and other land-preparation implements

There was a high incidence of farmers owning tractors among the sampled farmers in Gaborone District/Region (61.5%). The higher incidence of farmers owning tractors in Botswana could have been a result of the implementation of the Financial Assistance Policy, a grant by government, to farmers to assist them to purchase farming equipment.

5.3.2.4 Ownership of irrigation systems

All the farmers interviewed own irrigation systems (Table 5.22). Production of FFV in the studied region is close to impossible without irrigation. This is because of Botswana's climatic conditions, which are mainly arid to semi-arid. The annual rainfall is in the range of 250-650mm, with an evapotranspiration rate of 1800-2200mm per annum. Among the farmers interviewed, 46.2% own and use sprinkler-irrigation systems, 30.8% own and use drip-irrigation systems and 23.1% own and use hosepipes or furrow irrigation to produce vegetables (Table 5.22).

Table 5.22: Types of irrigation systems owned by sampled farmers in Botswana

Place	Type of irrigation system	Frequency	Percent	Cumulative percent
Gaborone	Sprinkler	6	46.2	46.2
	Drip	4	30.8	76.9
	Hosepipe/furrow	3	23.1	100.0
	Total	13	100.0	

It is worth noting that those farmers who do not own irrigation systems and have no access to water for irrigation mainly grow field crops such as sorghum, maize and vegetables under rainfed conditions. Production under rainfed conditions is highly erratic and unreliable, and these farmers barely produce enough for subsistence purposes.

Therefore, these small-scale farmers are automatically excluded from the supermarkets' supply chain in Botswana.

5.3.2.5 Ownership of sorting/packing shades

Approximately 31% of surveyed farmers in Botswana own sorting/packing shades but a reasonable number are involved in basic on-farm processing. The survey results reveal that 38.5% of farmers interviewed are involved in some basic on-farm processing of FFV (Table 5.23).

Table 5.23: On-farm processing of FFV by sampled farmers in Botswana

Place	Basic On-farm* processing	Frequency	Percent	Cumulative percent
Gaborone	Yes	5	38.5	38.5
	No	8	61.5	100.0
	Total	13	100.0	

** Basic processing of farm produce such as cutting of vegetables and packing in plastic bags or packing tomatoes and cucumber in plastic bags following the specifications and requirements of the supermarkets.*

Of the farmers involved in basic processing, about 7.7% are engaged in cutting and packing leafy vegetables such as kale or spinach and 30.8% were involved in washing, sorting and packaging products such as tomatoes and cucumbers for the supermarkets. One tomato grower has his own tomato brand and through his own marketing efforts negotiated space in the supermarket and sold his own tomatoes, which competed favourably with other supermarket brands.

Approximately 23.1 % (3 out of 13) of the surveyed farmers owned greenhouses. Those producing in greenhouses were mainly engaged in growing tomatoes, cucumber, broccoli and cauliflower. These are high value crops mainly targeting the chain supermarkets.

5.3.3 Household characteristics

A descriptive analysis of the household demographics and structure for the farmers sampled in Botswana is described below. As already explained for Zambia, this analysis

may help us to understand whether the number of persons in a household influences participation in FFV production and marketing.

5.3.3.1 Household size

The interviewed households in the Gaborone District/Region consist on average of five persons.

5.3.3.2 Education levels of household heads in Botswana

The majority of the farmers interviewed producing FFV in Botswana were well-educated. About 69.2% had attained tertiary level education, 7.7% secondary level and 23.1% primary level (Table 5.24). Owing to the fact that most of these farmers are well-schooled, they are able to negotiate contracts with supermarkets on their own. Most of the farmers interviewed were able to access one or more supermarkets and supply fresh vegetables and fruit.

Table 5.24: Education levels of household heads of sampled farmers in Botswana

	Level of education	Frequency	Percent	Cumulative percent
Supplying supermarkets	Primary	2	20.0	20.0
	Secondary	1	10.0	30.0
	Tertiary	7	70.0	100.0
	Total number	10	100.0	
Supplying traditional markets	Primary	1	33.3	33.3
	Secondary	0	0	33.3
	Tertiary	2	66.7	100.0
	Total number	3	100.0	

5.3.3.3 Income sources of farmers

In Botswana, 69.2% of the farmers involved in producing vegetables for supermarkets and other channels do not depend on farming as their only source of income whereas only 30.8% depend on farming as their only source of income (Table 5.25). Some of these farmers are engaged in farming as a part-time activity as most of them are employed as

civil servants, business people or retired civil servants and teachers (Table 5.25). The farmers involved in non-farm employment tend to delegate the running of the farming enterprise to their wives or hired managers.

Table 5.25: Types of off-farm sources of income for farmers in Botswana

Type of off-farm source of income	Frequency	Percent	Cumulative percent
Civil servants	3	23.1	23.1
Private sector	6	46.2	69.2
Depend on farming only	4	30.8	100.0
Total number	13	100.0	

5.3.3.4 Input use and costs

Input costs of farmers supplying to supermarkets were higher than those of farmers supplying to traditional markets (Table 5.26). This could be because those farmers that supply to supermarkets have to supply high quality products that require the use of more inputs such as fertilisers and pesticides, and they also want to obtain high yields for continuity of supply.

Table 5.26: Input costs of sampled farmers in Botswana (pula)

Place	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Gaborone (supermarket suppliers)	10	1500	60000	8294.00	18185.775
Gaborone (all farmers)	13	1500	60000	6880.0	15977.351
Gaborone (traditional suppliers)	3	2000	2500	2166.67	288.675

5.3.3.5 Household wealth ranking in Botswana

Just as in Zambia, household wealth ranking was based on enumerator assessment of the farmer's wealth status. Farmers' ownership of a permanent house (iron-roofed and built of stone or bricks), a vehicle or tractor and other assets of production such as larger land

size, higher income and other sources of income apart from farming, were used to classify households into either low, medium or high-wealth households among the sampled farmers in Gaborone District/Region. This is a qualitative measure of household wealth or income. According to the assessments made during the interviews, 32.1% of farmers supplying to supermarkets in Gaborone belong to medium-wealth households and the remaining 76.9% belong to high-wealth households (Table 5.27).

Table 5.27: Wealth ranking of interviewed farmers in Botswana

Place	Household wealth ranking	Frequency	Percent	Cumulative percent
Gaborone (supplying to supermarkets)	Low	0	0	0
	Medium	3	30.0	30.0
	High	7	70.0	100.0
	Total number	10	100.0	
All farmers (Gaborone)	Low	0	0	0
	Medium	3	23.1	23.1
	High	10	76.9	100.0
	Total number	13	100.0	

5.3.3.6 Proximity to the urban centres and FFV markets in Botswana

The majority of the emerging farmers are located near Gaborone city, the furthest being about 80km away. On average farmers supplying fresh vegetables to supermarkets in Gaborone are located 32.5 km from the city (Table 5.28).

Table 5.28: Mean distance from farm to market or urban centre

Farmer type	Distance of farm to major town (km)				
	Sample size (N)	Minimum	Maximum	Mean	Std. deviation
Gaborone (supply to supermarket)	10	5	80	32.50	26.588
Gaborone (supply to all market channels)	13	5	80	30.77	23.87

5.3.4 Farmers' ability to meet supermarket conditions in Botswana

Just as in Zambia, the ability of farmers to supply supermarkets in Botswana may be influenced by transaction costs which are determined by tough contract conditions and high quality requirements imposed by supermarkets on suppliers. This may also influence who and who does not participate in the supermarket channel. These factors are discussed below to show how these conditions may affect farmers' access to supermarkets.

5.3.4.1 Supply arrangements (Contracts)

In Botswana, just like farmers supplying to supermarkets in Zambia, about 80% of farmers supplied on verbal contracts (Table 5.29). Farmers in Gaborone District/Region tend to access the supermarket channel easily because FFV is in high demand and this demand has not yet been met.

Table 5.29: Nature of contracts between supermarkets and farmers in Gaborone Botswana

	Frequency	Percent	Cumulative percent
Verbal contracts	8	80.0	80.0
No response	2	20.0	100.0
Total	10	100.0	

5.3.4.2 Credit period

Approximately 50% of farmers supplying to supermarkets in Botswana received cash on delivery, 20% in 30 days and 30% in 60 days (Table 5.30). When and how the farmers received their payments depended on the conditions set by the supermarket. Supplying farmers had to fit in with this arrangement. These conditions varied from supermarket to supermarket. Some farmers preferred the longer credit period, which enabled them to get a reasonable pay cheque after a month or two, which could be better used in production than would a daily payment.

Table 5.30: Number of days before receiving payment

Credit period*	Frequency	Percent	Cumulative percent
Cash on delivery	5	50.0	50.0
30 days	2	20.0	70.0
60 days	3	30.0	100
Total	10	100	

***** *Number of days before receiving payment after supplying products to supermarkets*

Farmers supplying to chain supermarkets such as Spar had to wait for up to 60 days to receive payment. Some farmers reported that this was a constraint on their production processes and can be a barrier to entry for some farmers who cannot afford to wait that long.

5.3.4.3 Membership to a farmers' group

In Gaborone, 50% of the farmers interviewed belonged to a farmers' group. These farmers belong to a professional farmer group (Horticultural Association of Botswana). Most farmers joined this organisation to socialise and receive information in horticultural production, not for organising marketing. The situation in Botswana is unlike that of Zambia where most farmers were organised in co-operatives that assist them with information on farming, providing subsidised inputs and negotiating access to the supermarket channel.

5.3.5 Mean comparison of farmers supplying to supermarkets and traditional market channels in Botswana

Just as in Zambia, comparison of means for farmers who supply to supermarkets and farmers who supply to the traditional market channel was carried out for sampled farmers in Botswana. A one-way analysis of variance was performed to test for equality of means between these two groups of farmers but there was no significant difference between the two groups in all variables analysed. This could be due to the small sample size in Botswana (10 supplying to supermarkets and three to traditional markets). The number of farmers growing FFV in Botswana is still small as horticulture in Botswana is still in its infancy and therefore the sample could not be increased any further at the time of the research.

5.4 Summary

The results of the analysis of farmer characteristics supplying to supermarkets and traditional markets show that there is an increase in the number of farmers entering into FFV production in both Zambia and Botswana since the early 1990s. The major drivers of these changes are increased government intervention by promoting high-value crops to fulfil development goals such as diversification of the economy, job creation and improvement of rural households' income and welfare in Botswana and Zambia. In the same period there has been rapid expansion of supermarkets in Botswana and Zambia which may have provided a ready market for producers in these countries.

There is evidence that both small-scale and large-scale farmers are able to access and supply to chain supermarkets even though the number of small-scale farmers supplying to supermarkets is still small. Small-scale farmers accessing supermarkets are well-capitalised and generally produce for commercial purposes. The results show that farmers supplying supermarkets are well educated, own significantly more resources such as land, better irrigation systems, sorting/packing shades and used significantly more inputs such as fertilizers, chemicals and labour in an effort to produce high quality products compared to those supplying to traditional markets.

CHAPTER 6

THE DETERMINANTS AND IMPACT OF FARMERS' PARTICIPATION IN THE SUPERMARKETS FFV SUPPLY CHAIN IN THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

6.1 Introduction

The descriptive results in chapter 5 showed the characteristics of different households involved in the FFV supply chains in Botswana and Zambia. It was evident that the participation of farmers in the supermarket supply chain of FFV in Botswana and Zambia was influenced by various factors such as land, labour and so on as postulated in Chapter 3.

The objective of this chapter is to present empirical results of the model developed in Chapter 3 to determine the factors that influence the choice of participation in the supermarket channel and the impact of this participation on household income. The model attempts to answer research question 4, which is further broken down into two questions:

1. What determines the decision of farmers to participate in the supermarket channel?
2. What is the impact (gain) from this participation on household income?

These two research questions are tackled by empirically estimating the model presented in section 3.5.1.

6.2 Estimating the model

From the descriptive analysis of supermarkets' procurement practices in Chapter 4 and the characteristics of farmers in Chapter 5, it is clear that not all farmers are able to participate in the supermarkets' FFV supply chain in the case-study countries. The estimation model may be susceptible to self-selection in that higher income from FFV may not necessarily be directly attributed to the decision to participate in the supermarket

channel. There may be other unidentified factors (managerial skills and previous experience) that increase both the probability of participating in the supermarket channel and the observed income. Owing to the problem of self-selection, an ordinary least squares (OLS) estimate of the income equation would actually overestimate the impact or gain from participation in the supermarkets' FFV supply chain by farmers. To deal with the problem of self-selection a two-step procedure proposed by Heckman (1979) is used to correct for sample selection bias and then OLS is used to calculate the causal (average treatment) effects. These models have been discussed extensively in Tobin (1958), Heckman (1979), Lalonde (1986), Winship and Mare (1992), Angrist *et al.* (1996), Greene (2000), Imbens (2004) and Wooldridge (2006).

6.2.1 Two-step impact estimation procedure

From section 3.5.1, the model that accounts for farmers' participation or non-participation in supermarket FFV supply chain is

$Y_i = \beta X_i + \delta R_i + \varepsilon_i$; δ is the treatment effect (impact) to be estimated; R_i is a dummy variable indicating whether farmer participates in the supermarket channel or not. The sample selection rule is that Y_i is observed when $R^*_i > 0$

The model of supermarket participation (whether farmer chooses to sell to supermarket channel or not is given by

$R^*_i = w_i z_i + u_i$ defines households that participate in the supermarket channel as

$R_i = 1$ if $R_i^* > 0$, 0 otherwise

$R_i = 0$ if $R_i^* \leq 0$

Step 1

The first step of the procedure involves establishing the probability that a farmer participates in the supermarket channel by estimating a probit model (Greene, 2000; Heckman, 1979).

Y_i is observed when $R_i^* > 0$

u_i and ε_i are distributed such that u_i / ε_i jointly distributed

$u_i \mid X_i) \sim N (0, \sigma^2, \rho)$

Given that $u_i \sim N(0, \sigma^2=1)$

$\Pr (Y_i \text{ observed} \mid X_i, Z_i) = 1- F (-w_i Z_i)$ (7)

$$E(Y_i \mid Y_i \text{ observed}, X_i, Z_i) = \beta X_i + \sigma\lambda_i \quad (8)$$

Where $\lambda_i = E(u_i \mid u_i > -w_i Z_i) = f(-w_i Z_i) / 1-F(-w_i Z_i)$- indicator or inverse Mills ratio which is not observable but can be obtained by estimating a probit choice model and f(.) represents the density and F(.) the cumulative distribution function of a standard normal variable. Then λ_i can be estimated from probit model coefficients obtained by maximum likelihood estimation method.

The equation for estimating the impact of supermarkets on small-scale farmers can be written as: $Y_i = \beta X_i + \delta R_i + \sigma\lambda_i + v_i^*$

Where $E(v_i^* \mid X_i) = 0$

Step two

To obtain the average treatment effect, δ is estimated by regressing Y_i on X_i , R_i and estimated λ_i by least squares.

6.2.2 Variables in the model

In this section the variables that are included in the two-step treatment model for estimation of supermarkets' impact on small-scale farmers are discussed.

Dependent variables

In Namibia and Botswana, the number of small-scale farmers involved in FFV supplying to the market was small (in Botswana) and almost non-existent in Namibia. Therefore, the analysis was done only for Zambia where a reasonable data set was available. In Namibia and Botswana, the number of small-scale farmers involved in FFV to supply to the market was small (in Botswana) and almost non-existent in Namibia. Therefore, the analysis was done only for Zambia where a reasonable data set was available. To estimate equation 1 and 2 data collected from 78 farmers (20 small-scale farmers who supply FFV to Shoprite in Lusaka and 58 in Chipata and Lusaka who do not supply to Shoprite in Zambia) in 2005 was used. The dependent variable consists of two variables; the probability that a farmer participates in the supermarket supply chain for FFV by selling FFV to Freshmark or directly to Shoprite and the value of sales of vegetables (proxy for income) to the supermarket. This variable assumes 1 for those who participate

in the supermarket supply chain and zero for those who do not (Table 6.1). The products used in the analysis included all the fresh vegetables grown by any farmer in the area and could be sold directly to the supermarket or to the designated buying company. Fresh fruit and vegetables are high-value crops that are being promoted by these governments (Zambia, Botswana and Namibia) and can perhaps contribute to the improvement of the incomes of the households involved in these activities. Also, these products can be sold directly through supermarkets.

Table 6.1: Dependent and independent variables used in the model

Dependent variables	**Model description**
Fresh fruit and vegetable market	• Probability of selling FFV (STSMKT) • Value of products sold (VFFVSALT)
Independent variables	
Household resource endowments (assets)	• Farm size (Ha) • Ownership of tractor or vehicle (yes=1, 0 otherwise)
Household structure	• Labour = Number of household members working on the farm + hired labour (numbers) • Age of household head (years) • Gender of household head (household head is female = 1, 0 otherwise)
Information-accessing variables	• Distance from farm to market or urban centre (km) • Membership in a farmers' organisation (yes = 1, 0 otherwise)

Independent variables

The independent (explanatory variables) are divided into three constructs; household resource endowments (assets), household structure, access to information variables.

Household endowments

Variables included in household endowments are farm size, ownership of tractor/vehicle (transport facilities). Land is a necessary requirement in the production of FFV if there is to be any output marketed. The variable land (FARMSIZE) was documented in hectares (ha). Households accessed land through owning or renting it. Households with more arable land possessed higher potential to produce more FFV and stood a higher chance of participating in FFV market. Ownership of land alone without other inputs may not

necessarily increase the probability of a farmer accessing the supermarket supply chain for FFV.

Ownership of irrigation systems (OWNIRISYS) was presented as a dummy variable, which assumed the value of 1 if a household owned irrigation system, 0 otherwise. Farmers who own irrigation systems are more likely to produce and supply a variety of FFV to various markets. This variable was dropped during preliminary analysis due to the problem of multicollinearity.

Ownership of tractor or vehicle (OWNVEH) could help reduce transaction costs, especially transport costs enabling the household to easily participate in the FFV market. Ownership of transport facilities may help farmers to seek and access distant markets implying these farmers have a better opportunity of supplying to the supermarket channel. This was also a dummy variable assuming the value of 1 if household owned vehicle or tractor and 0 otherwise.

Household structure

This construct consisted of three variables: labour available to households, gender of household head and age of household head.

The total number of people working on the farm (LABOUR), which included the number of household members who work on the farm full-time plus hired workers, may influence the ability of the household to produce for the market. Households with a higher labour supply may be able to devote more labour to the production of FFV, which is a labour-intensive enterprise. These households may be able to produce more and easily participate in the FFV chain. This variable is expected to have a positive impact on participation and on income.

Another variable in this group was gender of household head (GHHD). Generally male-headed households tend to have more resources and access to information for production compared to female-headed households. This variable was presented as a dummy

variable assuming the value of 1 if household was female-headed, zero otherwise. This variable's impact on accessing supermarket supply chain is unknown.

The final variable in this group was the age of household head (HHAGE). This variable is taken as a proxy for experience of the farmer in production of FFV. It was measured in number of years. Older household heads may have more experience in the production of FFV and may have more social capital and networks. On the other hand, older household heads may be more averse to taking risks so that they do not easily adopt new methods of production. Due to the stringent requirements of supermarkets older household heads may find it more risky especially when it comes to rejection of low-quality produce. Many of them may opt not to supply to this market. It follows younger household heads may be more able to adopt risky production systems. Therefore, this variable is expected to have either a positive or a negative impact on participation and income accruing from participation in the FFV supply chain.

Access to information variables

The third group of explanatory variables are related to the ability of households to access information about markets and production. Variables in this group could assist households in reducing the cost of searching for information and hence facilitate the household participation in the marketing channel. This construct consist of two variables, namely distance of farm to the nearest urban centre (DIURBC) and membership of a farmers' organisation (MOFAGRP).

The variable distance of farm to the nearest urban centre (DIURBC) was measured in kilometres. Households near urban centres are near markets and sources of information about market conditions. These households are more likely to participate in FFV markets as these farmers face lower transaction costs especially transport costs. This variable is expected to have a negative impact on participation as well as on income.

Another variable that may improve the ability of farmers to access the FFV markets is their ability to produce a continuous supply of FFV throughout the year. For most small-

scale producers, to achieve this requirement may necessitate joining a co-operative or farmers' group (MOFAGRP). This variable was a dummy variable assuming the value of 1 if a farmer is a member of a farmers' group, zero otherwise. The fact that a farmer joins a farmers' group may not necessarily increase the probability of supplying to supermarkets. The impact of this variable in so far as it influences participation in the supermarket channel and its impact on household income is not known in the context of SADC countries. The expected sign of the coefficient is unknown.

6.2.3 Hypothesis

The model is intended to answer research questions 2 and 3 of the study as presented in section 1.3.3. The model presented in section 6.2.1 aims to test the hypothesis that small-scale farmers growing vegetables and supplying to supermarkets earn higher incomes compared with those supplying to the traditional market channel. The hypothesized relationships between variables, the decision to participate and incomes are shown in Table 6.2.

Table 6.2: Hypothesized relationship of participation with income

Variable description	Variable description	Participation decision	Impact on income
Household endowments (Assets)			
Farm size	FARMSIZE	+	+
Own tractor or vehicle	OWNVEH	+	+
Household structure			
Household head age	HHAGE	- / +	- / +
Gender of household head	GENHD	?	?
Labour	LABOUR	+	+
Information access			
Distance from farm to nearest urban centre or market	DIURBC	-	-
Membership of a farmers' organisation	MOFAGRP	?	?

The participation decision is modelled by the probit model. The probit model aims to identify factors that influence farmers' participation in the FFV markets. A positive sign implies that a unit change in the explanatory variable will result in an increase in the probability to participate in the FFV market. A positive sign in the linear regression model implies that a unit change in the variable leads to a positive change in value of sales (income). On the other hand, a negative sign on the coefficient of the variable implies that a unit change in the variable leads to a decline in the probability of participation in the FFV market as well as a decline in household income.

The probit model is used to generate log likelihood function that is used to generate the inverse Mills ratio, which is used in the second stage to take care of the selectivity bias problem. The treatment effects are obtained by including the supermarket dummy variable and the inverse Mills ratio with the explanatory variable in the ordinary least squares regression. Statistical software Stata version 8.0 (Stata Corporation, 1984) is used in the analysis. The statistical significance of the inverse Mills ratio and supermarket dummy is examined to find out whether selection bias exists between these two groups of farmers and whether participation in the supermarket channel significantly increases income of these households.

6.3 Decision to supply vegetables to supermarkets or the traditional market channel

The model of decisions of farmers to supply to supermarkets is determined by the probit model, which is specified as:

Pr (STSMKT) = f (FARMSIZE OWNVEH HHAGE GENHD LABOUR DIURBC MOFAGRP)

The probability of selling to the supermarket channel is influenced by the explanatory variables specified in the model. Table 6.3 presents the results of the probit estimates of the factors that influence farmers' participation in the supermarket FFV supply chain.

Table 6.3: Factors that influence farmers' participation in the supermarket FFV supply chain, probit results

Variable	Coefficient	Std. error	Z-Stat.	P value
Constant	5.343919	3.751057	1.42	0.154
Household endowments				
Farm size (ha)	0.160136	0.150677	1.06	0.288
Owns tractor or vehicle	4.328424	1.810059	2.39	0.017**
Household structure				
Household head age	-0.069235	0.527433	-1.31	0.189
Household head is female	-1.637593	1.058993	-1.55	0.122
Labour	0.490036	0.227575	2.15	0.031**
Information access				
Distance from farm to nearest urban centre	-0.269457	-0.137126	-1.97	0.049**
Membership of a farmers' organisation	-2.429095	1.237532	-1.96	0.050**
% Correctly predicted LR (model) χ^2 N= 74	90 61.22***			
N selling to supermarket = 19				

* 10 % significance level, ** 5% significance level; *** 1% significance level

As shown in Table 6.3, the model is highly significant and correctly predicts 90% of the observed outcomes. The model chi-square of 61.22 is highly significant at 1% significance level. This implies that in total the model identifies factors influencing farmers' participation in the supermarkets FFV supply chain. Four of the seven factors are significantly different from zero. Two of these (ownership of tractor / vehicle and labour) are positively related to participation in the FFV channels whereas two (distance from farm to urban centre and membership of a farmers' organization) is negatively associated with farmers' participation in the FFV markets. This implies that a unit increase in distance away from the urban centre will reduce the probability of the farmer

participating in the FFV market, meaning the closer you are the better. The remaining variables (farm size, gender of household head and age of household head) do not significantly differ from zero.

Membership by farmers of a farmers' organisation was negatively related to participation in the FFV supply chain. This result is contrary to expectation. It is documented that farmers organising into farmers' groups may mitigate the problem of low volumes by helping farmers gain large volumes of produce required by supermarkets and give them power to negotiate better prices. The farmer organisations in Zambia are co-operatives and informal farmers' groups. The co-operatives were still young in that they were still being formed and even though farmers were in a co-operative they sold products as individuals (Emongor *et al*., 2004). The co-operatives are only helping farmers to access inputs and information, not assisting farmers in marketing their produce. This implies that given the current level of farmer group formation in the case-study countries, farmers' membership in a farmers' group does not increase their probability to supply to the supermarket channel or traditional channel. According to the probit results, being a member of a farmer organisation reduces the probability of participating in the FFV market.

6.4 The impact of farmers' participation in the supermarket FFV supply chain on household income

In stage two of the Heckman procedure, an ordinary least-squares regression was estimated to account for selection bias and estimate treatment effect (impact) of farmer participation in the supermarket FFV supply chain on farmer income. The OLS model was specified as:

VFFVSAL = f (FARMSIZE OWNVEH HHAGE GENHD LABOUR DIURBC MOFAGRP STSMKT Mills)

This means that the value of sales of FFV to supermarkets is determined by the above factors in the model. In order to estimate treatment effects (impact), the OLS model

included the dummy for supermarket participation and inverse Mills ratio (Mills). Table 6.4 presents results of the regression model to show the impact of farmers' participation in the supermarket FFV supply chain on household income.

Table 6.4: Impact of farmers' participation in supermarket FFV supply chain, regression results

Variable	Coefficient	Std. error	t-Stat.	p value
Constant	0.767818	1.214656	0.63	0.530
Household endowments				
Farm size (ha)	0.0108219	0.0581635	0.19	0.853
Owns tractor or vehicle	1.226134	0.62706	1.96	0.055
Household structure				
Household head age	-0.0278303	0.126074	-2.21	0.031**
Household head is female	0.0236544	0.2885752	0.08	0.935
Labour	0.1451915	0.540874	2.68	0.009***
Information access				
Distance from farm to nearest urban centre	-0.0571444	0.025957	-2.20	0.031**
Membership of a farmers' organisation	-483265.6	402691.2	-1.20	0.235
Mills	3.391477	1.848337	1.83	0.071*
STSMKT	1.060624	0.474308.7	2.24	0.029* *
F (9, 64) 4.12 Probability value	4.12 *** 0.0003			
R^2 Adjusted R^2 N selling to supermarket Total N	0.367 0.278 19 74			

* 10 % significance level ** 5% significance level; *** 1% significance level

The model is highly significant at 1% significance level with an F-statistic of 4.12. Five variables have coefficients that differ significantly from zero. These are "household age",

"labour", "distance from farm to urban centre", "supermarket participation dummy" and "Mills". Participation in the supermarket channel has a positive impact on the farmers' income. By participating in the supermarket FFV supply chain, farmers' increase value of sales by 1.060624 million kwacha (approximately R 1 494).

Among household structure variables, a unit change in household age a negative impact on value of sales of FFV. Increasing household age by a unit would result in the value of sales of FFV declining by 0.0278303 million kwacha (R39.2). On the other hand, if a farmer increases labour by one person it will increase value of sales by 0.1451915 million kwacha (R 204).

Among the information-access variables, distance from the farm to the nearest urban centre has a negative impact on value of sales. If the distance from the farm to nearest urban centre is increased by 1 unit, this will result in a decline in value of sales of 0.057144 million kwacha (R80). Farm size and ownership of tractor or vehicle does not significantly contribute to value of sales. The inverse Mills ratio is significant at 10% significance level in this model. Membership of a farmers' organisation has no impact on income of households.

6.5 Hypothesis testing

In order to test the hypothesis that farmers who supply to supermarkets have higher incomes compared to those who supply to the traditional markets, mean equality tests were carried out on the value of sales (proxy for income) of the two groups of farmers in Botswana and Zambia. The model allows comparison to be made on value of sales by supermarket farmers compared to those who do not supply to supermarkets. The results of the mean income comparisons are shown in Table 6.5.

Farmers who supplied to supermarkets have a higher mean average value of sales (income) compared to those who supply to traditional markets in both Zambia and Botswana (Table 6.5). The difference in mean income for those who supply to

supermarkets and those who supply to traditional markets in Zambia is statistically significant at 5% significance level whereas it is not statistically significant for the Botswana sampled farmers. This then confirms the hypothesis that farmers who supply to supermarkets earn higher incomes compared to those that supply to the traditional channel.

Table 6.5: Mean comparison of value of sales (proxy for income) of farmers supplying to supermarkets and those supplying to traditional markets in Botswana and Zambia

Variable	Least-squares means	t Value	P Value
Botswana			
Value of sales (Pula)			
Supply to supermarkets	P 15807.77	1.54	0.1555
Supply to traditional markets	P 9816.67		
Zambia			
Value of sales (Million Kwacha)			
Supply to supermarkets	K million 2.0701	2.44	0.0252**
Supply to traditional markets	K million 1.1642		

Supply to supermarkets, N=19; Supply to traditional markets, N=55
* 10 % significance level ** 5% significance level; *** 1% significance level

Caveat

While questions to capture data on lagged variables were included in the questionnaire (question 7 and 19) the information collected was not sufficient to allow tests of causality. Due to insufficient responses to those questions on lagged assets, the study did not carry out causality analysis but the analysis carried out in the study used current values of assets, therefore it is not possible to conclude whether supermarkets select asset-endowed small-holder farmers or whether small-holder farmers accrued assets as a result of trading with supermarkets.

It is worth noting that currently, the number of small-scale farmers who access the supermarket channel is still small. For example in Zambia Freshmark sources about 10% of its vegetables from small-scale farmers whose number was about 22 compared to large scale farms who supply 90% of the produce. The reader should also bear in mind that these 22 farmers are drawn out of a large number of small-scale farmers who make up the bulk of farmers in Zambia

6.6 Summary

In this chapter, the factors that influence small-scale farmers' participation in the supermarket FFV supply chain were determined by estimating a probit model in step 1 of Heckman's procedure. The probit model was also used to estimate the inverse Mills ratio, which was incorporated into the second step of the procedure to estimate the income equation. The probability of selling FFV to the supermarket was influenced by factors in the model, that is farm size, ownership of tractor or vehicle, age of household head, gender of the household head, labour, distance from farm to the nearest urban centre and membership of a farmers' organisation. Three of these factors, namely ownership of tractor or vehicle, labour and distance were statistically significant. Labour and ownership of tractor or vehicle influences participation in the supermarkets' FFV supply chain positively, whereas distance from farm to urban centre influence participation negatively. The probit model was highly significant at 1% significance level with a chi-square of 61.22. The model predicted 90% of the outcomes correctly. In the second step of the procedure, the impact of farmers' participation in the supermarket FFV supply chain was estimated using ordinary least-squares regression model. In order to estimate treatment effects (impact), the OLS model included the dummy for supermarket participation and inverse Mills ratio (Mills). The results showed that the model was highly significant at 1% significance level with an F-statistic of 4.12. Four variables had coefficients significantly different from zero. These are the household age, labour, distance from farm to urban centre and supermarket participation dummy. Participation in the supermarket channel has a positive impact on the farmers' income. By participating in the supermarket FFV supply chain, farmers increased income by 1.060624 million kwacha.

This implies that supermarkets may be beneficial to small-scale farmers if they can access them. A widowed farmer in Lusaka said this about supplying to Freshmark "I have been able to earn good income and take my children to school (2 in secondary school), buy food, build a good house and dress myself and my children well. Even though I have not yet been able to purchase a vehicle but all in all my family has been well catered for, we have not lacked."

Another farmer in Luangeni village, Chipata had this to say, "We were trained to produce better quality vegetables by the project for Shoprite. Even though I no longer supply to Shoprite, the conditions in our village has drastically changed. Most people in the village now produce more vegetables and sell in the local market, earn more money than before we were trained. We can now afford to take our children to school, to hospital and some people in the village have purchased iron sheets to build better houses. Generally, the life of the villagers has been changing for the better."

This shows that there is a correlation between supermarkets and the wealth of the farmer. Due to difficulties in apportioning causation due to lack of lagged variables, this association between the ability of the farmer to supply to supermarkets and wealth creation is difficult to prove.