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IMPACTS OF THE KBDS AND KHDP PROJECTS IN THE TREE FRUIT VALUE CHAIN OF KENYA

microREPORT #129

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ACRONYMS AND ABBREVIATIONS

AFE	Action for Enterprise
AGOA	African Growth and Opportunity Act
BDS	Business development services
EAGA	East Africa Growers' Association
EPZ	export processing zone
EU	European Union
EUREPGAP	Euro-Retailers Produce Good Agricultural Practices
GOK	Government of Kenya
HCDA	Horticultural Crop Development Authority
HDC	Horticulture Development Centre (Fintrac)
HIV/AIDS	Human immunodeficiency virus/autoimmune deficiency syndrome
IR	Intermediate result
KACE	Kenya Agricultural Commodities Exchange
KADI	Kamurugu Agricultural Development Initiatives
KARI	Kenya Agricultural Research Institute
KBDS	Kenya Business Development Services
KHDP	Kenya Horticulture Development Project
KHE	Kenya Horticulture Exporters
Ksh	Kenya shilling
KWETU	Swahili for "our home" (local non-governmental organization)
MOA	Ministry of Agriculture
MOU	Memorandum of understanding
MSEs	Micro and small-scale enterprises
NGO	Non-governmental organization
RI	Research International Kenya
SITE	Strengthening Informal Sector Training and Enterprise
SMS	Short message service
SO	Strategic objective
USAID	United States Agency for International Development

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EXECUTIVE SUMMARY

As part of its strategy to increase rural incomes, USAID/Kenya has supported two projects to develop tree fruit value chains—the Kenya Business Development Services (KBDS) project implemented by the Emerging Markets Group and the Kenya Horticulture Development Project (KHDP) implemented by Fintrac. This report presents the findings from a study of the impacts of these projects on smallholder farmers who grow avocados and passion fruit in Central and Rift Valley provinces in Kenya. The study included a panel survey of 1,640 farmers including those who have participated in these projects and a comparison group of non-participating farmers. The survey was complemented by qualitative research comprising in-depth interviews and focus group discussions with over 100 individuals involved in the tree fruit value chains: farmers, producer group leaders, input suppliers, extension service providers, brokers, exporters and the KBDS project and KHDP directors and staff.

The two projects were designed to increase rural household incomes by:

- increasing the productivity of smallholders growing targeted fruits,
- increasing agricultural trade in local and export markets,
- improving access to business support services, and
- improving the capacity of smallholder organizations to provide business services to their members.

The impact assessment is based on a causal model of how these projects are expected to improve smallholder cultivation of tree fruits and increase rural household incomes in Kenya. The assessment documents *project activities* expected to lead to a set of *initial outcomes* including increased commercialization of tree fruit cultivation and marketing. These outcomes, in turn, are expected to contribute to increased smallholder participation in the tree fruit value chains, improved competitiveness of the tree fruit subsector in Kenya and sustainable upgrading of the smallholdings. *Subsequent outcomes* should lead to *final impacts* on competitiveness, productivity, income and wellbeing at the value chain, enterprise and household levels. To four key hypotheses about project impact that derived from the causal model, a combination of quantitative and qualitative methodologies was used. The principal findings with respect to each of these hypotheses are summarized below.

Both KBDS and KHDP undertook a wide range of interventions between the baseline and endline surveys to broaden and deepen smallholders' commercial relationships in the tree fruit value chains. KHDP interventions aimed to expand the production and productivity of passion fruit through research on new varieties, demonstration plots, training, extension services and market information. KBDS interventions aimed to improve Kenya's ability to compete in the EU avocado market by not only pioneering new varieties but also changing the governance structure of the value chain in order to improve the quality of the product grown and to forge new and closer relationships between buyers and suppliers. Both projects' interventions often started as subsidized demonstrations or pilot activities that introduced new or untested services or new linkages and relationships within the value chains. In many instances, new buyers or service providers were unknown to the farmers and did not receive their full trust. Although some activities were more successful than others, the flexibility of the projects allowed for shifts in the intervention approach in response to new threats or opportunities. This assessment therefore focuses not on the impact of one, but on a mix of interventions targeting the two tree fruit value chains.

MAIN FINDINGS OF THE STUDY

HYPOTHESIS ONE:

PROGRAM ACTIVITIES IN THE VALUE CHAIN CONTRIBUTE TO GREATER INTEGRATION OF SMALLHOLDERS AND LEAD FIRMS.

The projects succeeded in bringing smallholders and lead firms closer together by supporting a number of new actors and new relationships to overcome constraints within the avocado and passion fruit value chains. The projects' aim was to facilitate the development of high-quality commercial services that are used by farmers to upgrade their products to meet the demand of buyers. While some of these actors and relationships have worked out better than others, they have influenced the functioning of both value chains.

AVOCADO

To improve the competitiveness of the avocado value chain, the KBDS project has engaged new actors and facilitated closer relationships between lead firms (exporters) and avocado smallholders. The project was able to foster market linkages between avocado smallholders and exporters by mobilizing farmer groups—or horizontal linkages—that reduced the transaction costs for exporters to do business with large numbers of smallholders. Additionally, KBDS established “market-linkage firms” both to mobilize groups and facilitate the provision grafting, pruning and spraying services, in some cases, as an embedded service and, in other cases, on a fee-for-service basis. New stand-alone service providers—who provide fee-for-service grafting and pruning—also entered the avocado value chain created an association that promotes quality control. To afford these services, avocado farmers access credit for spraying through farmer groups, and the loans are repaid through payments by exporters.

The KBDS project has also encouraged the development of commercial oil processing firms. This has served as an incentive for smallholders to invest in commercial tree fruit production as it ensures a market for the portion of their crops that may be flawed due to weather or disease.

PASSION FRUIT

There was less experimentation on the part of KBDS and KHDP with new actors and relationships in the passion fruit value chain than in the avocado value chain. Moreover, horizontal cooperation among passion fruit farmers emphasized linkages to buyers more than linkages to supporting markets. Supporting markets for passion fruit are still underdeveloped, and limited extension services are provided primarily through non-commercial (usually government or quasi-government) providers.

Brokers between exporters and smallholders remain dominant in the passion fruit value chain, in contrast to the avocado value chain. KHDP and KBDS projects have helped some passion fruit farmers bypass brokers and sell to the export market through contracts, and they linked others to a juice processing factory outside Nairobi. In the Central program area, farmer groups and market linkage firms play an intermediation role between farmers and exporters, and are beginning to document farmer sales to ensure traceability. At the same time, trust issues have emerged in these new relationships; KBDS and KHDP are working to build trust among actors in the value chain.

HYPOTHESIS TWO:

GREATER INTEGRATION OF SMALLHOLDERS AND LEAD FIRMS CONTRIBUTES TO IMPROVED ENTERPRISE PERFORMANCE AND HOUSEHOLD WELLBEING.

ENTERPRISE PERFORMANCE

Tree fruit smallholdings are measured in numbers of trees owned, production and productivity levels, cultivation methods, attention to quality and manner of fruit sales. Holdings in Kenya range from very small scale and casually operated to relatively large and commercial. Between the baseline and endline surveys, production and productivity increased for avocado farmers in the participant group located in the Central program area served by KBDS. For the control group, production and productivity were lower and remained relatively constant between the baseline and endline. Women, who managed just over ten percent of the farms in the survey, improved their relative productivity and increased production faster than men.

In the Central program area, production and productivity soared for passion fruit farmers (both participant and control groups) whose vines matured during the period. In the Rift program area, where KHDP concentrated, production and productivity also increased for both groups—but less for participant farmers (who started at higher levels) than for controls. Production and productivity levels were initially higher in the Rift than in the Central program area, but were overtaken by the time of the endline (both participants and controls).

For all avocado farmers, the sales price and cash value of sales increased between the baseline and endline, with higher cash value of sales for farmers in the participant group as compared to the control group, both at baseline and endline. At the same time, the sales price for passion fruit fell between the baseline and the endline, while the average cash value of sales increased almost ten-fold for passion fruit farmers in the Central program area (both participants and controls). In KDHP's Rift program area, the value of sales declined for farmers in the participant group but almost doubled for farmers in the control group.

Passion fruit growers sold their fruit to a variety of buyers, with the number and proportion of buyers selling to the export market were higher in the Rift as compared to the Central program areas. In both areas, the number of buyers selling to export markets was greater for participants than for controls and did not change between the baseline and endline.

Participant group farmers had access to more sources of information than those in the control groups at both the baseline and endline, though the control group farmers narrowed the gap by the endline. Irrigation use declined for passion fruit farmers but increased slightly for avocado farmers, while fertilizer use was high among passion fruit farmers at both the baseline and endline and lower among avocado farmers, declining slightly for the participant group between the baseline and endline.

HOUSEHOLD WELLBEING

Tree fruit income has continued to be an important source of household income for sampled households, though it was more important for participants than controls. With the exception of the avocado control group, average asset scores increased between the baseline and endline for participants and controls in all program areas. The largest increase in assets was for the poorest households (both participants and controls).

HYPOTHESIS THREE:

GREATER INTEGRATION OF SMALLHOLDERS AND LEAD FIRMS CONTRIBUTES TO SUSTAINABILITY THROUGH INCREASED INVESTMENT AND UPGRADING IN SMALLHOLDER ENTERPRISES.

Both KBDS and KHDP succeeded in promoting upgrading in the avocado and passion fruit value chains. Farmers invested in planting new trees or vines at the start of the project. They introduced new varieties of fruit that have higher demand in export markets, planted more disease-resistant passion fruit seedlings and protected their crops through use of fertilizer and sprays; productive assets increased between the baseline and endline for both participant and control groups.

HYPOTHESIS FOUR:

GREATER INTEGRATION BETWEEN SMALLHOLDERS AND LEAD FIRMS CONTRIBUTES TO THE IMPROVED FUNCTIONING, COMPETITIVENESS, AND GROWTH OF THE VALUE CHAIN.

Ultimately, the goal of both projects was for farmers form commercial relationships in the value chain that improve the competitiveness of the chain and its ability to respond to market opportunities. The projects helped to create incentives for the entry of new actors and formation of new market relationships as well as upgrading in these two value chains. Some but not all of these relationships are commercial at this time. The potential for commercialization depends in part on the ability of a relationship to deliver sustained benefits to the farmers. This in turn depends on maintaining Kenya's overall competitiveness in the markets in which its tree fruit are sold.

DISCUSSION OF FINDINGS

KBDS and KHDP activities have clearly influenced value chain dynamics (upgrading, inter-firm cooperation and governance patterns). Evidence shows that new actors and relationships have brought smallholders closer to lead firms. Findings on Hypothesis Two show continued demand for avocados and passion fruit, and growth in production and sales for farmers. However, there was not substantial difference between participants and controls in the amount of change. Despite efforts made to select control groups that were isolated from the two projects, some of the benefits enjoyed by control group farmers may in fact be the result of spillovers from project interventions.

Analysis of the value chains shows that trust among actors is an important factor influencing the response of smallholders—and that of the value chain as a whole—to end market opportunities. Trust is a key factor in the interplay of governance patterns, inter-firm cooperation and the development of business services that promote upgrading and market linkages. Trust also influences intra-household dynamics and decision-making around tree fruit production, sales and upgrading.

In general, the lack of trust among actors has limited the ability of the value chain to respond fully to market opportunities. Lack of trust has affected interfirm cooperation and has hampered the emergence of a more directed governance pattern in both value chains—which would enable the supply of products that meet a broader range of standards required in export markets. This, in turn, has affected incentives for upgrading.

Overall, the survey of farmers shows that production and productivity have risen for both avocado and passion fruit farmers in the study. Moreover, more tree fruit farmers in both value chains are selling to export buyers. The projects have succeeded in promoting upgrading in the avocado and passion fruit value chains. Farmers invested in planting new trees or vines at the start of the project. Productive assets increased between the baseline and endline for both participant and control groups.

The integration of smallholders into a broader network of commercial relationships in the value chains and improvements in enterprise performance were accompanied by the increased importance of tree fruits as a source of household income. Within the sample, tree fruit income continued to be more important for participants than for controls. Average asset scores increased between the baseline and endline for participants and controls in all program areas, except for the avocado control group. The largest increase in assets was for the poorest households (both participants and controls).

Fewer female- than male-headed households were represented in the sample, but they generally had similar characteristics and experienced similar changes between the baseline and endline study periods.

IMPLICATIONS FOR FUTURE PROGRAMMING

1. START WITH AN ASSESSMENT OF END-MARKET DEMAND

A broad assessment of global, regional and domestic markets should be the starting point in efforts to improve the competitiveness of value chains that benefit the poor. In assessing the potential of a value chain to benefit producers, and poor households in general, it is critical to consider end-market demand, how to create incentives within the value chain for meeting this demand, and how it will benefit the poor.

Understanding Kenya's competitive position vis-à-vis other countries is important before developing programs that link Kenyan producers to global value chains. Who are the competitors? How is Kenya viewed among them? For example, Kenya is ranked 72 of 180 countries in the World Bank's "Doing Business 2008." It is ranked 99 of 131 countries in the Global Competitiveness Index 2007-2008. The World Economic Forum ranked Kenya as relatively strong in its business and financial market sophisticated but very weak in infrastructure and technological readiness. How do buyers in end markets view Kenya? What is Kenya's competitive advantage?

In the case of tree fruits, Kenya's competitiveness in the EU market is questionable at this time. Future growth of the industry may have to rely primarily on domestic and regional markets.

2. IDENTIFY SYSTEMIC WEAKNESSES THAT AFFECT THE FUNCTIONING OF THE VALUE CHAIN

Another role of donor-funded projects at the start of a value chain initiative is to identify systemic weaknesses in the chain that affect its ability to respond to markets. In the case of the avocado value chain, the lack of an effective intermediation function between farmer groups and exporters was a weakness that was not sufficiently identified at the beginning of the project. By default, KBDS initially provided this function, but it eventually commercialized the role and turned it over to a market linkage firm. The transition was challenging, and things might have been smoother if this function had been commercialized from the start.

3. CREATE INCENTIVES FOR THE DEVELOPMENT OF BROADER AND DEEPER NETWORKS OF COMMERCIAL RELATIONSHIPS SUPPORTIVE OF SMALLHOLDERS

The commercialization of previously non-commercial but essential functions and the 'layering' of commercial relationships can result in benefits and incentives for behavior changes that improve the functioning of a value chain. The network of commercial relationships that developed in the avocado value chain has resulted in benefits to smallholders in terms of higher prices. Higher volumes of better-quality Hass avocados has enabled Kenyan exporters to respond to market opportunities in Europe during months when the supply from other countries is low. The improved network of commercial relationships supporting smallholders and the flow of benefits to them have provided an incentive for farmers to upgrade processes and products related to avocado production.

4. RECOGNIZE THAT IN ANY ONE VALUE CHAIN THERE ARE MULTIPLE WAYS TO PERFORM A FUNCTION AND MULTIPLE ACTORS WHO CAN PERFORM IT

There may not be one better or worse model for performing functions or providing services in a value chain. Projects designed to promote the development of value chains should recognize that there is more than one way to perform a function, and involving multiple actors can improve the overall functioning and competitiveness of the value chain.

5. FARMER GROUPS CAN CREATE EFFICIENCIES BY BRINGING FARMERS INTO A BROADER AND DEEPER NETWORK OF COMMERCIAL RELATIONSHIPS IN THE VALUE CHAIN

Farmer groups, in and of themselves, will not integrate smallholders into value chains. Rather, it is the ability of these groups to bring farmers into a network of commercial relationships in the value chain that is important. Farmer groups can play a role in organizing collection points, scheduling deliveries, keeping records, processing payments, negotiating supply contracts and organizing horticulture services. These functions create horizontal efficiencies in linking producers to buyers and supporting markets. The groups add value when collective action and cooperation lead to specific benefits such as decreased transaction costs, better access to information, and links to services needed for upgrading.

6. ACCEPT THE REALITY OF COMPETITIVE PRESSURES THAT FOSTER SYSTEMIC CHANGE IN THE VALUE CHAIN

Competitive pressure should be part of any market facilitation strategy. Competitive pressure was evident in the passion fruit Central program area, with the entry of several export buyers and several independent market linkage firms. It also was evident in the avocado value chain with the entry of four processing firms in the Central program area during the course of the study.

7. THINK BEYOND TRAINING

Training can play an important role in improving the knowledge and skills of value chain actors. However, meeting market requirements goes beyond filling knowledge gaps through training. Meeting market requirements depends on how the system functions in terms of the types and conduct of relationships and whether there are incentives for innovations that will make the chain more competitive. This, in turn, depends on a flow of benefits that supports effective relationships and innovation. Value chains will be better equipped to respond to end-market demand if 1) training goes beyond knowledge transfer to the promotion of behavior change in the value chain—in terms of relationships (interfirm cooperation) and innovation; and 2) the system generates a flow of benefits to actors in the value chain, as benefits are the main incentive to change.

8. VALUE CHAIN FINANCE SHOULD FOLLOW, NOT LEAD, THE FORMATION OF WIN-WIN RELATIONSHIPS AND BE LINKED TO THE GROWTH PROCESS

Focusing on finance first can be a problem for smallholders and other value chain actors if such a focus does not increase income beyond the cost of finance. Financing should be sought for upgrading activities that will result in significant increases in income. For example, meeting certification requirements (e.g., GLOBALGAP standards) does not necessarily result in higher prices or farmer income, and the costs of upgrading can be significant. When the benefits of upgrading to meet these standards do not flow to farmers (it is not a win-win relationship), borrowing to cover these costs does not make sense.

9. CONSIDER THE SUSTAINABILITY OF VALUE CHAIN FUNCTIONS FROM THE BEGINNING

This is a driving principle of private-sector development programs, but it does not always play out in the design of projects. ‘Jump-starting’ certain value chain functions or targeting certain groups within value chains often involves subsidies. A vision of the longer-term systemic implications of targeting and subsidies should be considered prior to

implementation. For example, the ‘hand holding’ function played by the KBDS project with avocado farmers at the beginning of the project may have made it more difficult for commercial market linkage firms to enter the value chain.

10. FLEXIBLE APPROACHES TO EXPERIMENTATION CAN PROMOTE INNOVATION AND LEARNING

Flexibility in programs provides an opportunity for innovation and learning. The private sector is dynamic and not always predictable, particularly in global markets. Interventions to improve the competitiveness of value chains and benefit the poor are relatively new. Innovation can be risky and the outcomes uncertain. Flexible approaches that support experimentation and learning—regardless of their success or failure—hold promise for finding new ways to stimulate the system toward increased competitiveness. In supporting value chain projects, it is useful to think not only of profits and losses but of other, less tangible benefits in the short, medium and long terms.

11. CONSIDER A RANGE OF METHODOLOGIES TO STUDY IMPACTS

A final note concerns the challenge of evaluating the impact of value chain development programs. In the case of Kenyan tree fruits, it was not possible to take a simple approach, given the complexity of both the avocado and passion fruit value chains, the dynamic conditions surrounding them and the nature of the interventions. Mixed methods were needed. The team learned the value of starting with an assessment of the structure and dynamics of the value chain in order to understand where the interventions fit in, how they are working and what results they were having. The team also learned the need for evaluators to be realistic about the difficulties of isolating the impact of interventions in the private sector. Finding a control group willing to stand back while others benefit is not easy.

It is also important to be realistic about the timeframe of impacts. If the aim is to achieve short-term impacts, then programs should support interventions that can be expected to have results in a short time frame. In the case of Kenya tree fruits, KBDS and KHDP were able to encourage the entry of new actors (by buying down their risk) and facilitate new relationships—some better than others. However, as time-bound projects, they were not well positioned to make dramatic changes in Kenya’s competitiveness. Nor could they rush the process of building trust, which has historical and socio-cultural dimensions that have a profound influence on the functioning of the value chains.

I. INTRODUCTION

As part of its strategy to increase rural incomes, USAID/Kenya has supported two projects focused on the development the tree fruit value chain—the Kenya Business Development Services (KBDS) project implemented by the Emerging Markets Group and the Kenya Horticulture Development Project (KHDP) implemented by Fintrac. This report presents the findings from a study that involved a panel survey of 1,640 smallholder farmers who grow tree fruit in Central and Rift Valley Provinces in Kenya. The sample includes farmers who have participated in these projects along with a comparison group of non-participating farmers. The survey was complemented by qualitative research comprising in-depth interviews and focus group discussions with over 100 individuals involved in the tree fruit value chains: farmers, producer group leaders, input suppliers, extension workers, brokers, exporters and the KBDS and KHDP project directors and staff.

Section I of the report describes the main features of the environment in which the projects have been implemented. Section II outlines the project activities studied. Section III presents the causal model for the two projects and Section IV the research design. Section V reports our findings on changes in the value chains for avocados and passion fruit during the study period and the project impacts at the value chain, enterprise and household levels. Section VI discusses these findings, and Section VII draws implications for future programming.

A. MAIN FEATURES OF THE PROGRAM ENVIRONMENT

I. GENERAL

Kenya has many natural advantages and is the largest and most diversified economy in East Africa, but it has long experienced low investment rates and slow economic growth. Growth accelerated in 2005-2007,¹ but disruptions following the presidential election of December 2007 have cast uncertainty over Kenya's future.

Real Gross Domestic Product rose 5.7 percent in 2005 and 6.1 percent in 2006. Export revenues also increased in 2005-2007 but fell as a percentage of GDP. Tea and horticultural products remained the principal commodity exports, while tourism and worker remittances brought in increasing amounts of foreign exchange. Although the growth of imports, spurred by government deficits and capital inflows, outpaced that of exports, foreign exchange reserves increased and the Kenyan shilling appreciated against the US dollar (while declining against the euro). Inflation ran at 14.5 percent in 2006 but fell to 9 percent in 2007, aided by favorable harvests.

Kenya remains a low-income country, with Gross National Income per capita of approximately \$500. Most Kenyans are farmers who achieve low levels of productivity and live at or near the poverty level. Agriculture occupies about 75 percent of the labor force but generates only 26 percent of GDP. Nearly 80 percent of the population resides in rural areas. An HIV/AIDS adult prevalence rate of 6.1 percent (2005) has depressed life expectancy at birth to 49 years, while the infant mortality rate remains relatively high at 79 per thousand live births. Kenyan women still have an average of five children during their reproductive lives. The labor force is growing at 2.6 percent a year. Transportation infrastructure remains inadequate and electricity shortages are common.

About one-half of all Kenyans can be regarded as poor.² According to the Welfare Monitoring Survey of 2000, 52.9 percent of the rural population and 49.2 percent of the urban population lived below defined poverty lines.³ Rural

¹ The information in this section comes from internet postings by the World Bank and Economist Intelligence Unit.

² See Jane Kabubo-Mariara and Godfrey K. Ndeng'e. "Measuring and Monitoring Poverty: The Case of Kenya." Paper presented at the Poverty Analysis and Data Initiative (PADI) Workshop on Measuring and Monitoring Poverty, Mombasa, May 7-8, 2004.

³ Cited in Paul Gamba and Elliot Mghenyi. 2004. "Rural Poverty Dynamics, Agricultural Productivity and Access to Resources." Tegemeo Institute of Agricultural Policy and Development, Egerton University, Nairobi, p. 4.

poverty is linked to inequalities in access to land and education. Female-headed households are poorer than male-headed households, partly because of disparities in access to these resources. The poor also lack access to agricultural credit. Recent economic growth, good as it has been by historical standards, has been too slow to reduce the prevalence and severity of poverty. Kenyan farmers cultivate an average of 1.8 hectares in the rainy season; most lack the irrigation facilities that would be needed to farm year-round.⁴ Just over one-half of farmers have a deed to their land, while another one-third owns the land but has no formal title. Fewer than one-half of farms are located within five kilometers of a paved road. The average farm household had 6.8 members in 2000 and was headed by a 53-year old. Male household heads (86 percent of the total) averaged six years of schooling, female household heads four years.

Significant social change is occurring. School enrollment rates are high at the primary level and rising at the secondary level while improvements have been registered in child immunization, access to safe drinking water and adult literacy. Rapid increases (from near-zero levels) have been recorded in internet and especially cell phone use.

2. THE HORTICULTURAL SUBSECTOR

Kenyan horticulture includes a wide range of fruits and vegetables as well as an export-oriented flower subsector. The country's tropical and temperate climate zones favor cultivation of a wide range of horticultural crops. In the coastal lowlands, farmers grow mangos, citrus fruits, cashews, bananas, hot peppers, brinjals and melons. Crops grown in the middle altitudes include bananas, mangos, avocado, pineapple, grapes, passion fruit, pawpaw, citrus, flowers, onions, garlic, tomatoes, kale, cucumbers, peppers, okra and French beans. At higher elevations, avocado, pears, apples, plums, carrots, cabbage, peas, potatoes and flowers are grown. Horticultural production in Kenya benefits from a climate that allows year-round cultivation, fertile soils and a competitive labor force.

The 2000 Rural Household Survey carried out by Egerton College, Tegemeo Institute, and Michigan State University found that 98 percent of farmers in Kenya grew some fruits and vegetables and 35 percent of fruit and vegetable production was marketed. Overall, fruits and vegetables contributed 18 percent of average household income. Over 90 percent of households in all income groups grow fruits and vegetables, but richer households market a larger share of their output and account for a large proportion of total sales. According to a study by the Institute of Development Studies at the University of Sussex, households that are involved in the production or processing of horticultural crops earned higher incomes than households that are not, other things equal.⁵

Avocados and passion fruit—the foci of this study—are two of the three most important fruits in Kenya's fresh fruit export market (the other is mangos). Official data on production and exports are regarded as suspect but suggest that production of passion fruit and fruit crops in general has stagnated recently while avocado production has experienced some growth (Table 1). In 2006 there was a dip in both production and export of fruits, caused by irregular weather patterns. Sun interspersed with heavy unexpected rains had devastating affects on tree fruit production.

⁴ Data cited in this paragraph come from the Rural Household Survey carried out by Egerton College, Tegemeo Institute, and Michigan State University in 2000, as reported in Nicholas Minot and Margaret Ngiigi, "Are Horticultural Exports a Replicable Success Story? Evidence from Kenya and Cote d'Ivoire." Paper presented at the InWEnt, IFPRI, NEPAD, CTA conference, "Successes in African Agriculture," Pretoria, December 1-3, 2003.

⁵ McCulloch, Neil and Masako Ota, n.d. "Export Horticulture and Poverty in Kenya." Institute of Development Studies, University of Sussex.

Table 1. Production of Avocados, Passion Fruit, and All Fruit, 2002-2006 (000 Tons)

	Avocado	Passion Fruit	All Fruit
2002	62	29	2,173
2003	71	29	1,951
2004	80	32	1,967
2005	100	33	1,905
2006	91	33	1,628

Source: Ministry of Agriculture. *Economic Review of Agriculture 2007*.

Separate and somewhat inconsistent export statistics are maintained by the Horticultural Crops Development Authority (HCDA) and Kenya Customs. Both sets of data (Tables 2-4) suggest that exports of all fresh fruits have declined, although informants state that passion fruit exports to Uganda, which may be left out of the official data, have in fact boomed. What is certain is that exports of fresh fruit are small relative to exports of vegetables and cut flowers.

Table 2. Horticultural Exports by Value (Billion Kenya Shillings)

Year	Cut Flowers	Vegetables	Fruit
1995	3.6	2.2	0.6
1996	4.3	2.6	0.8
1997	4.9	3.1	0.8
1998	1.8	4.0	0.8
1999	7.2	5.7	1.2
2000	7.2	5.3	1.1
2001	10.6	8.0	1.6
2002	14.8	10.5	1.5
2003	16.5	10.6	1.8
2004	18.7	12.1	1.8
2005	22.9	13.9	2.1
2006	23.6	17.8	1.7

Source: Horticultural Crops Development Authority (HCDA), 1995-2006 www.hcda.or.ke.

Table 3. Horticultural Exports by FOB Value (Kenya Customs Data, 2001-2006) (Billion Kenya Shillings)

Year	Cut Flowers	Fresh Veg.	Fresh Fruit	Nuts	Processed Veg.	Processed Fruit
2001	9.6	3.2	1.0	1.0	1.0	3.6
2002	11.4	8.8	0.9	0.9	1.2	4.3
2003	16.0	10.7	2.0	0.6	2.1	4.5
2004	21.3	13.3	1.3	2.0	2.1	4.9
2005	21.4	14.3	1.3	0.8	2.4	4.6
2006	24.8	15.5	1.5	0.8	1.8	5.0

Source: Kenya Customs, as cited in Kenya Horticultural Development Project Marketing News – January-February 2007.

Table 4. Exports of Avocados and Passion Fruit (Million Kg) HCDA, 1995-2006

Year	Avocado	Passion Fruit
1995	9.9	0.9
1996	10.4	1.0
1997	13.3	0.8
1998	6.4	0.6
1999	9.2	0.9

Year	Avocado	Passion Fruit
2000	10.7	0.8
2001	15.4	0.8
2002	12.9	1.0
2003	19.0	1.5
2004	16.9	1.5
2005	15.2	1.5
2006	13.0	0.9

Source: www.hcda.or.ke

Kenyan horticultural products are exported primarily to Europe and the Middle East,⁶ where they compete with products from other African countries, Southern Europe and the Middle East. Consignments of fresh cut flowers, fruits and vegetables are air freighted daily to various destinations from Kenya’s two international airports. Some bulky produce is shipped from the port of Mombassa. The European Union is the principal importer of Kenya’s fresh produce. Flowers go mainly to the Netherlands for sale by auction. By 1999, Kenya had become the leading supplier of flowers to the EU, followed by Israel, Costa Rica, Colombia, the United States, Ecuador and Zimbabwe. Britain, France, the Netherlands and Germany are the main importers of vegetables. Kenya is also one of the most successful exporters of fresh vegetables to EU countries; in 2002 it ranked second among EU non-members in the value of fresh vegetables imported. Beans and peas were the main items supplied. The leading destinations for fresh fruit exports are France, Dubai, the Netherlands and the UK. The Middle East is a significant market for mangos.

Supermarkets are an increasing source of demand for horticultural products in Europe, especially fresh produce. Another important factor influencing demand is increasing consumer concern about food safety as well as social and environmental aspects of the food supply chain. As a result, the regulatory environment has become more stringent, raising the bar for new entrants and posing new challenges for existing suppliers.

Supermarkets are emerging in Kenya, with more than 200 supermarkets and hypermarket stores now open.⁷ The Uchumi and Nakumatt chains have dominated the market with about a 70 percent share.⁸ However, supermarkets are limited to urban areas and serve primarily the upper and middle classes. In the country as a whole, traditional markets will continue to be the dominant form of retailing for some time to come. Smallholders have opportunities to supply supermarkets and hotels, although increasing quality standards are being applied.

3. END-MARKET OPPORTUNITIES FOR KENYAN AVOCADOS AND PASSION FRUIT

AVOCADOS

The domestic market is the largest source of demand for Kenyan avocados. They are sold locally through market vendors, small retail outlets, supermarkets and hotels. Prior to 2004–2005 the local market involved primarily wholesale and retail fresh fruit sales. Since then, three avocado oil processors have opened in Kenya and provide a growing market opportunity for Grade 2 avocados—which are not suitable for export or sale in the domestic fresh fruit market. The processors produce a crude oil that is sold for further refining and processing in Europe, South Africa or the United States. As an ingredient, avocado oil is primarily used in the cosmetics and edible oil industries.

⁶ Regional exports, especially to neighboring Uganda and Tanzania, are minimal. Kenya is a net importer of horticultural products from these countries.

⁷ See James K. Nyoro, Joshua Ariga, and Isaac K. Ngugi. 2007. “Kenya” in Bill Vorley, Andrew Fearn, and Derek Ray (eds). 2007. *Regoverning Markets. A Place for Small-Scale Producers in Modern Agrifood Chains?* Burlington, VT: Gower Publishing Company, pp. 163-171.

⁸ Uchumi declared bankruptcy and closed down in May 2007, only to reopen some stores with government investment. They are currently said to be seeking a “strategic partner.”

In the export market, Kenyan avocados are sold primarily in Europe and the Middle East. In the European market, Kenya competes primarily with South Africa, Mexico, Israel and the United States.⁹ Its competitive niche in Europe is its ability to supply avocados during the Northern Hemisphere winter, when imports from South Africa and other suppliers are not widely available. In addition, avocados are primarily shipped sea freight to Europe which contributes to Kenya's cost competitiveness. Approximately one third of avocado production is exported.

Future growth of export opportunities for Kenyan avocados is uncertain because of difficulties meeting required quality standards and competition from other producing countries; however, the demand from exporters for high-grade avocados supplied by smallholders continues at this point.

PASSION FRUIT

Major markets for Kenyan fresh passion fruit are domestic and regional. In the domestic market, there is high demand for passion fruit for fresh juice and concentrate for use in fruit canning factories. In the regional market, Uganda has significant passion fruit processing capacity and strong demand for purple passion fruit for fresh juice. Brokers from Uganda are active seasonal buyers in Kenya, especially in areas in Western and Rift provinces close to the border.

The volume of Kenyan passion fruit exported to Europe is smaller but has increased over the past few years. While passion fruit exporters are optimistic about market growth for Kenyan fruit, they say that traceability systems must be present and pesticide residue levels controlled. Fruit supplied by brokers cannot provide this level of assurance, so exporters are motivated to seek supplies more directly through contracts with smallholder groups. However, the volume of smallholder fruit supplied through contracts still meets only a small percentage of exporter requirements, so brokers remain the main supplier.

Most Kenyan passion fruit is exported to Europe via air freight. However, one exporter recently started shipping by sea freight, which has potential for increasing the volume and price competitiveness of Kenyan exports.

Figures 1 and 2 show the major actors in the avocado and passion fruit value chains and their relationships in supplying fruit to these end markets.

⁹ *Avocado Situation and Outlook For Selected Countries*; World Horticultural Trade & U.S. Export Opportunities; USDA/FAS; May 2006

Figure 1. Kenya Avocado Value Chain Map

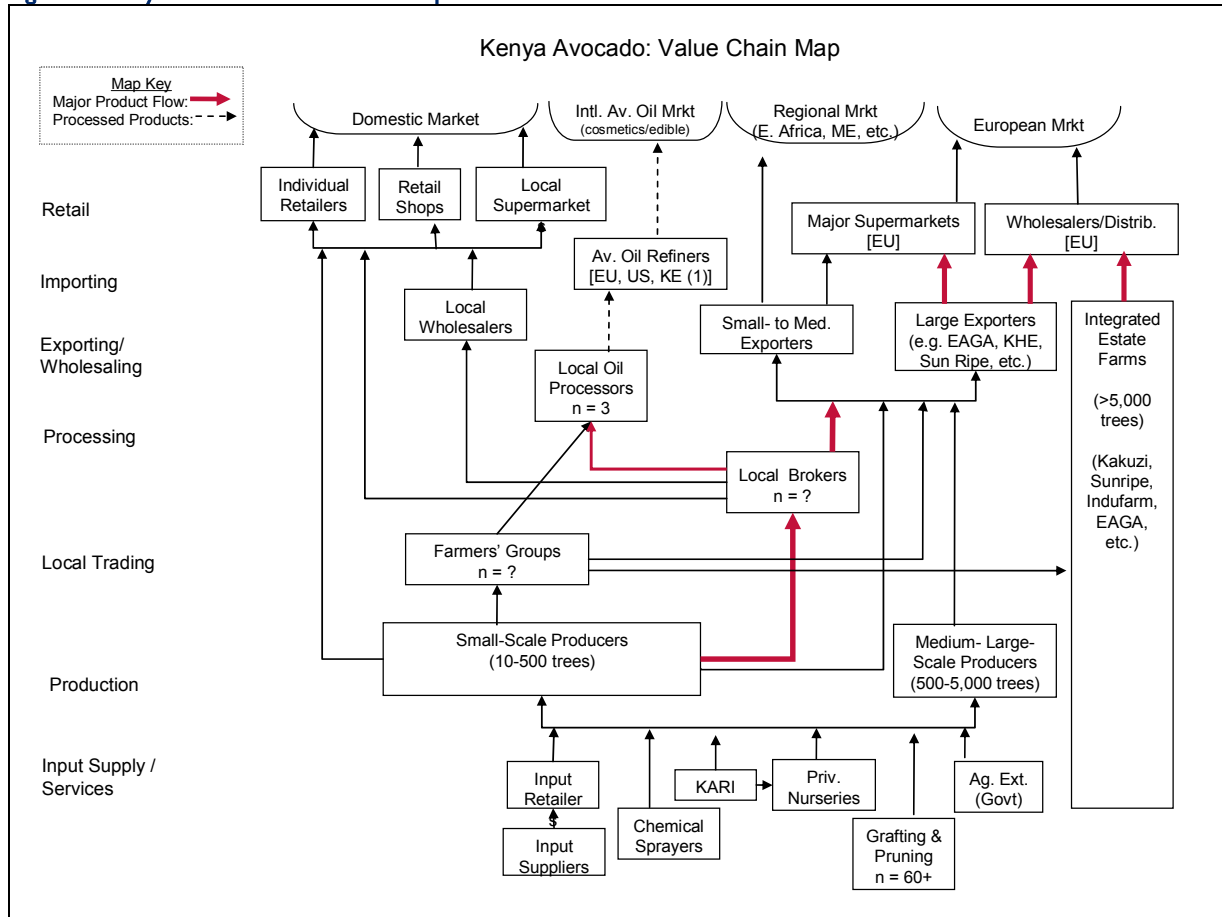
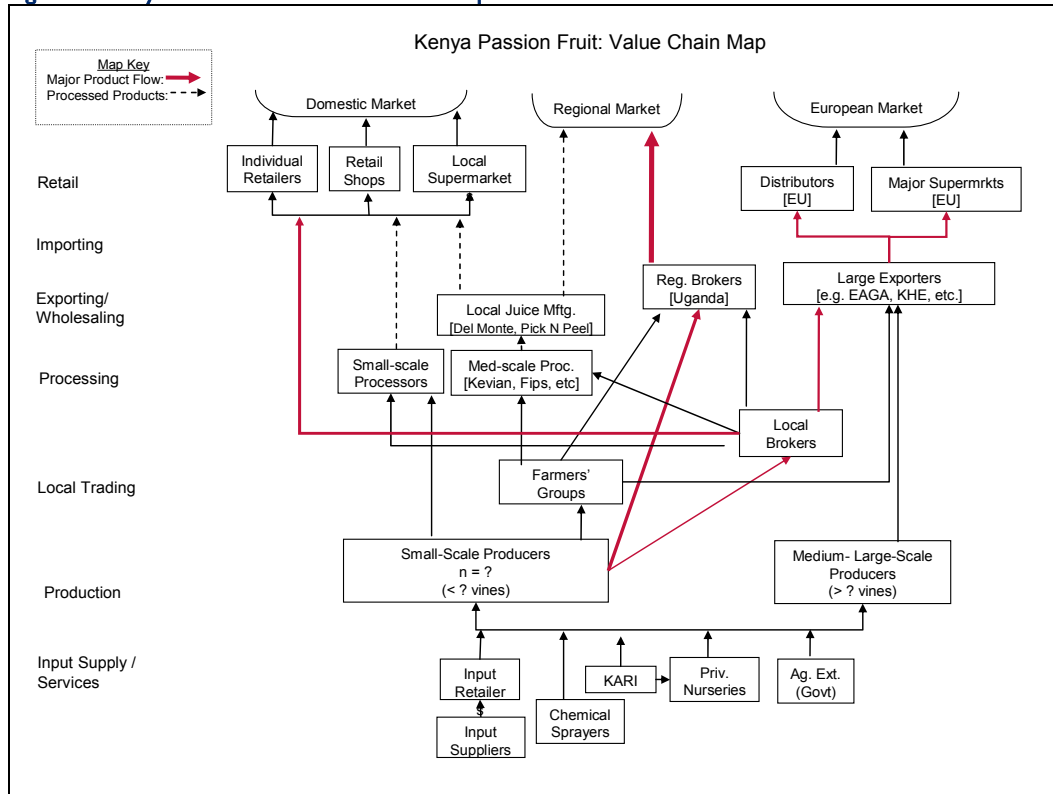


Figure 2. Kenya Passion Fruit Value Chain Map



B. USAID'S PROGRAM

The overarching goal of USAID's program in Kenya is to build a democratic and prosperous nation. That goal is being addressed through five strategic objectives (SOs):

- improving the balance of power among institutions of government
- promoting sustainable use of natural resources
- improving rural incomes by increasing agricultural and rural enterprise opportunities
- improving health conditions
- providing education support for children from marginalized populations¹⁰

USAID/Kenya's strategy for raising rural incomes includes:

- increasing productivity in three targeted agricultural subsectors: dairy, horticulture and maize;
- increasing the volume and value of traded agricultural commodities;
- increasing access to business support services (credit and savings, appropriate technology, skills and business training) for micro and small enterprises; and
- increasing the effectiveness of smallholder organizations in providing services to members and representing their business interests.

The two projects studied are part of the effort to raise rural incomes. As we have seen, nearly all rural households have some fruit trees and derive a significant share of their cash income from them. Raising productivity and the income earned from this form of agriculture could contribute significantly to the increases in average rural household income sought by the GOK and USAID/Kenya.

¹⁰ From USAID Congressional Presentation.

II. PROGRAMS STUDIED

The two programs included in this study—the Kenya Business Development Services (KBDS) and Kenya Horticultural Development (KHDP) projects—were designed to increase rural household incomes by:

- increasing the productivity of smallholders growing targeted fruits;
- increasing agricultural trade in local and export markets;
- improving access to business support services; and
- improving the capacity of smallholder organizations to provide business services to their members.

A. KENYA BUSINESS DEVELOPMENT SERVICES (KBDS) PROGRAM

KBDS seeks to improve smallholder farmers' access to markets and to the commercial skills and resources to compete in those markets. The project works in two sub-sectors with high growth potential for small-scale farmers: tree fruit (avocados, passion fruit and mangos) and Lake Victoria fish. KBDS supports interventions to introduce, demonstrate and leave behind commercial business services that address constraints in these subsectors.

KBDS programming is flexible and introduces new interventions in response to market dynamics. It has a market intervention fund and uses competitive tenders to maximize the use of Kenyan expertise and resources and encourage deeper and broader commercial relationships in the value chain. Since 2003 it has negotiated 36 contracts with 14 actors in the tree fruit subsector to promote farmer cooperation and upgrading through group mobilization and management and market linkages. The project has entered into memoranda of understanding with both exporters and processors to develop commercial strategies for sourcing avocados, passion fruit and mangos from smallholders. This has been complemented by agreements with local private sector management firms, service providers and NGOs addressing a range of supply constraints facing tree fruit smallholders. Other service providers (pruning, spraying, finance) were developed to help smallholders supply the quality and quantity of fruit required.

To demonstrate the benefits of market linkages, KBDS has temporarily subsidized the operational costs of the field staff of market linkage firms on the ground. Otherwise, critical services such as picking, grading, spraying, harvesting, collection, transport, payment and financing have all been arranged directly between farmers and exporters on commercial terms. While the brokerage function was not new in the value chain, the market linkage firms tried to overcome past mistrust and show smallholders that they could sell more directly to exporters and show exporters that smallholders could deliver reliable volumes and quality in a timely manner. KBDS contractors initially helped organize groups to promote farmer cooperation, negotiate contracts, set up record keeping systems, manage the logistics of orders and pick ups, and facilitate communication (Bear and Andrews 2006).

B. KENYA HORTICULTURAL DEVELOPMENT PROGRAM (KHDP)

KHDP seeks to increase rural incomes through enhanced smallholder production and employment in the horticulture industry. Agricultural products targeted by KHDP include passion fruit (fresh and processed), chili products (fresh, processed and dried), vanilla and spices, smallholder flowers, tree crops for processing (cashew and mango) and local market vegetables (onions, carrots, cabbage, tomato and indigenous vegetables).

KHDP has three main program areas: EUREPGAP/SPS support, new product development and domestic market interventions. With field offices and staff agronomists in Thika, Eldoret, Nanyuki and Mombasa, KHDP provides marketing, post-harvest handling, processing and agronomic support to smallholders and associated agribusinesses.

KHDP's work in passion fruit has focused on developing Kenyan varieties of passion fruit for fresh export and improving agricultural practices of local producers. The project also has emphasized expanding local processing

capabilities for local market products and strengthening the farm-to-market value chain, including business services to smallholders.

C. PROGRAM ACTIVITIES STUDIED

The impact assessment concentrated on program activities related to three tree fruits in five geographic program areas: one focused on avocado (KBDS Central), two focused on passion fruit (KBDS Central and KHDP Rift) and two focused on mangos (KBDS Central/Eastern and KBDS Eastern) (see Figure 3).¹¹ Activities in the mango areas ceased after the baseline, so only the avocado and passion fruit interventions are covered in this report.

AVOCADO CENTRAL PROGRAM AREA

KBDS activities in the Avocado Central Program Area started in 2003 with the mobilization of avocado farmer groups. The groups were formed to facilitate farmer cooperation in accessing technical training, adopting improved inputs and techniques (spraying, grafting/pruning) and linking to lead firms buying avocados. East Africa Growers Association (EAGA) was the first export firm to link to the farmer groups through sales contracts, and initially provided embedded spraying services. After the first year, EAGA continued its sales contracts but phased out of direct provision of the spraying.¹²

During the course of the study, KBDS supported a range of activities to strengthen and deepen commercial relationships in the avocado value chain. This included activities to support the development of four market linkage firms that manage farmer groups and link avocado smallholders through sales contracts with five exporters and three avocado oil processors. At the baseline, there were no market linkage firms, and only one exporter was buying avocados directly from smallholder farmer groups. In 2007, 5,320 farmers in groups were selling avocados directly to these five exporters through contracts, and 7,771 farmers were selling avocados directly to the three processing firms. In addition, KBDS provided support to facilitate the development of 60 grafting and pruning service providers and the formation of 2 associations of grafting and pruning service providers. To further facilitate commercial linkages involving smallholders in the value chain, Equity Bank developed a loan product for farmers in the groups to access spraying services. In 2007, 4,796 farmers used the grafting and pruning services. In addition, 3,055 used spraying services.

KBDS-supported activities have played a direct and indirect role in developing all of these new vertical relationships between producers, service providers and buyers. KBDS-supported activities also have promoted horizontal linkages in the value chain by developing market linkage firms that mobilize and manage farmer groups, and by promoting the establishment of two associations of grafting and pruning service providers. The development of this kind of network of commercial relationships that involve smallholders is critical to systemic shifts in behavior.

PASSION FRUIT CENTRAL PROGRAM AREA

KBDS support for passion fruit started in 2003 and focused on Embu and Meru Districts where passion fruit production was new. Although most Kenyan passion fruit is produced either for domestic consumption or export to Uganda, KBDS participants in these two districts produced primarily for export to the UK and France.

¹¹ In the baseline report, areas were labeled using the name of the firm or organization initially contracted to carry out the program in each of these areas. Since most of these contractual arrangements have since expired, and additional contracts have been carried out with farmers in these areas, this report refers to the study areas in geographical terms while retaining references to the terminology used in the baseline report

¹² Because these initial activities were undertaken before the baseline study, resulting changes are not captured in the longitudinal data and impacts are probably underestimated.

Prior to the baseline study period, KBDS had facilitated the mobilization of passion fruit farmer groups, farmer training and market linkages through contract sales to EAGA. Some grafting and pruning took place, but spraying services—which are physically easier but technically more challenging to carry out for passion fruit compared to avocado—were not used by passion fruit farmers.

Between the baseline and end line study periods, demand for fresh passion fruit in Europe grew, and sales and market linkages between farmers and EAGA expanded. KBDS awarded a contract to another lead firm, Juice Juice Enterprises Ltd. (a fresh juice manufacturer for the Nairobi food service and retail market) to collaborate with KARI (a government agriculture research center) to set up a demonstration farm. The farm encouraged passion fruit production in Meru and Embu Districts by offering extension advice and technical support to farmers.

During this period, the share of Kenyan passion fruit exported to Europe was still small but grew due to the increased price and higher unit value of passion fruit. To supply this market, three exporters (EAGA, KHE, and Sun Ripe) were competing to buy passion fruit in Meru and Embu Districts and KBDS reported that 98 groups (with 2,450 total farmers) had signed supply contracts with the exporters.¹³ KHE offered higher farm-gate prices to smallholder suppliers than EAGA, but bought lower volumes. Sun Ripe (not a KBDS partner) also bought passion fruit in the area. The competitive pressure that this market facilitation strategy stimulated is important in fostering systemic change.

To further strengthen commercial relationships engaging smallholders in the passion fruit value chain, KBDS awarded contracts to several market linkage service providers to offer fee-based services related to crop management, maintenance of document control, forecasting production, group formation and linkage to lead firms. Although brokers remained the dominant channel for smallholder sales and onward supply to processors during the end line survey period, exporters and other buyers (both EAGA and KHE) were buying the majority of their passion fruit through KBDS market linkage schemes, not through brokers.

PASSION FRUIT RIFT PROGRAM AREA

Unlike KBDS, KHDP implements activities directly through its own agronomists and field staff. KHDP passion fruit activities in the El Doret area of Rift Province were just beginning during the baseline survey. KHDP had identified existing farmer groups and were introducing them to grafted planting material and linking them to nurseries supplying improved root stock. KHDP also linked the groups to public training and extension services from HCDA and the Ministry of Agriculture. The Kenya Agricultural Research Institute (KARI), a key implementation partner of KHDP, was targeted for capacity building as a source of grafted seedlings for nurseries and farmers. During this period, plans were underway for expanding demonstration plots and developing nurseries.

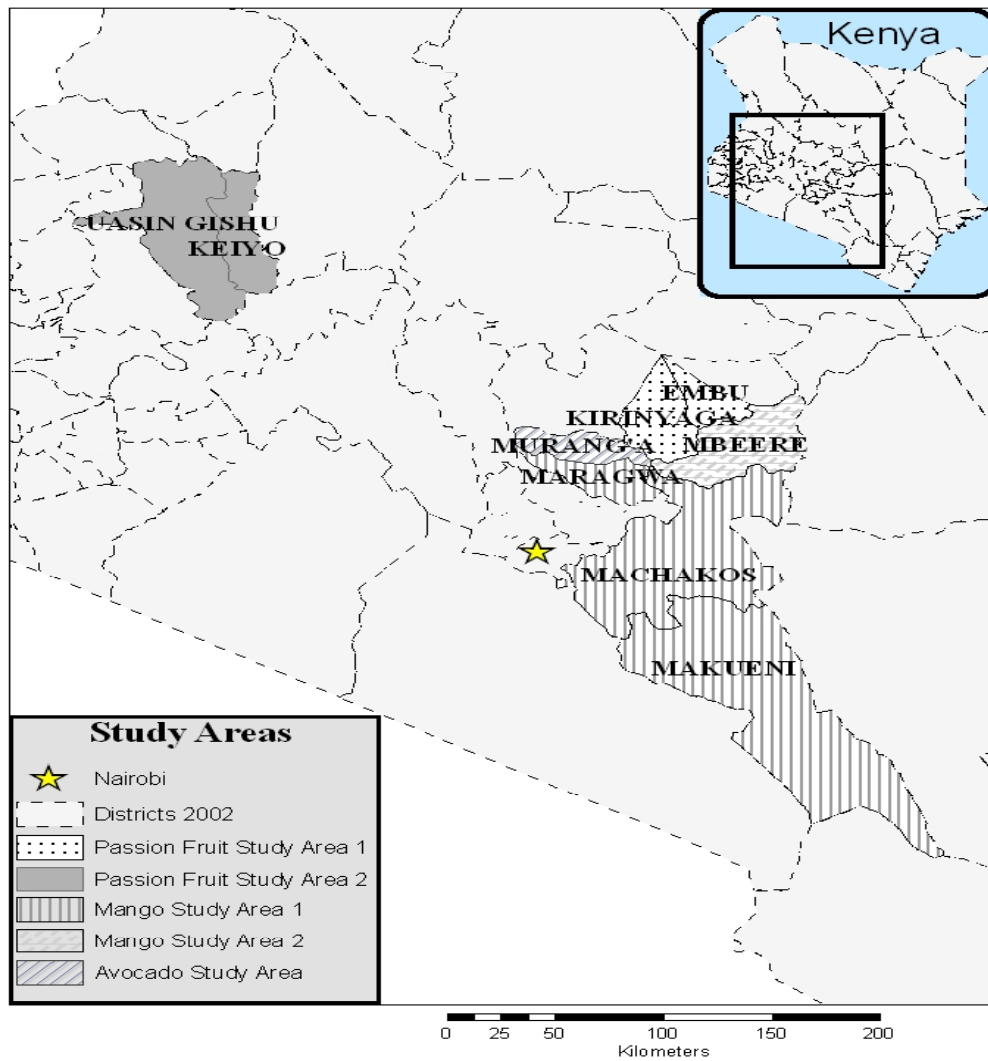
Between the baseline and end line surveys, KHDP continued to work in the El Doret area with passion fruit farmers, but experienced some setbacks. According to the program director, farmers were hesitant to purchase grafted seedlings from the nurseries due largely to their expense. The first batch of grafted seedlings that KARI provided to one of the local demonstration farms was diseased, and all the plants died. While this discouraged specific groups of farmers linked to KHDP, overall passion fruit production in the El Doret area took off.

KHDP passion fruit activities beyond Rift Province advanced, overlapping somewhat with the Central program area covered by KBDS. KHDP provided a screened greenhouse and demonstration plot on the KARI facility in Thika, Central Province. KHDP also provided on-going support to KARI to develop clean mother plants and conduct further research on improved varieties. KHDP also has continued to train and promote selected nurseries to serve as retail outlets for improved planting materials. KHDP supported a local medium-scale passion fruit processor (Kasarani Fresh) near Thika, Central Province to improve its operations and productivity. KHDP facilitated access to

¹³ Source: Jan/Feb 2007 KBDS Newsletter

appropriate processing equipment to expand capacity and improve quality of its pulp concentrate. KHDP also helped to link smallholder passion fruit farmers to Kasarani as contracted suppliers.

Figure 3. Map of Study Area



III. EXPECTED RESULTS OF PROGRAM ACTIVITIES

Figure 4 depicts a causal model of how these projects are expected to improve smallholder cultivation of tree fruits and increase rural household incomes in Kenya. In this model, the *project activities* described above are expected to lead to a set of *initial outcomes* involving increased commercialization of tree fruit cultivation and marketing. These, in turn, are expected to contribute to increased smallholder participation in the tree fruit value chains, improved competitiveness of the Kenyan subsector, and sustainable upgrading of the smallholdings. These *subsequent outcomes* should lead to *final impacts* on productivity, income, and well being at the value chain, enterprise and household levels.

The expected results lead to four key hypotheses:

Hypothesis 1: Program activities in the value chain contribute to greater *integration* between smallholders and lead firms through the following:

- improved access to product markets for smallholders
- strengthened supporting markets
 - increased use of appropriate, high-quality inputs (agrochemicals, plant stock and other supplies)
 - improved/increased quality and quantity of extension, advisory and information services provided by lead firms and fee-based providers
- improved inter-firm cooperation/collaboration (vertical and horizontal linkages)

Hypothesis 2: Greater integration of smallholders and lead firms contributes to improved *enterprise performance and household well-being* through the following:

- increased production in participating enterprises
- increased revenues in participating enterprises
- increased employment and employee earnings in participating enterprises
- increased income in participating smallholder households
- reduced vulnerability through asset building in participating smallholder households

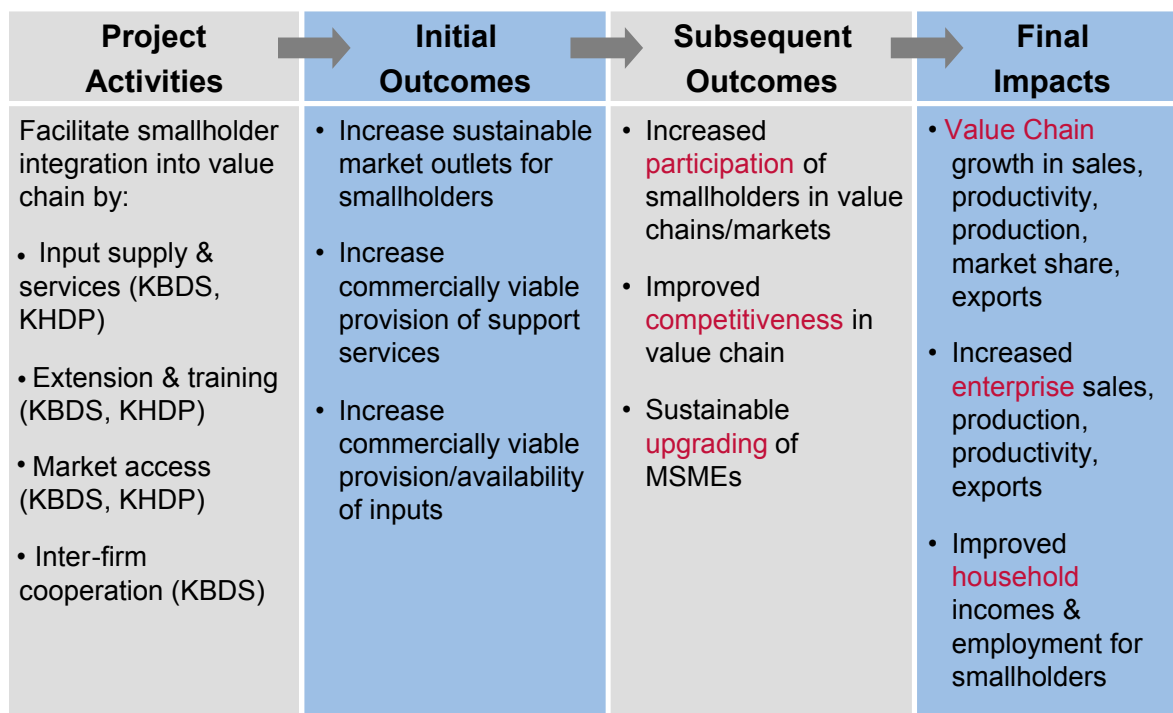
Hypothesis 3: Greater integration between smallholders and lead firms contributes to the *sustainability of impacts* through increased investment and upgrading in smallholder enterprises through the following:

- planting or grafting of new or improved varieties
- investment in farm equipment
- adoption of improved agricultural techniques

Hypothesis 4: Greater integration between smallholders and lead firms contributes to the *improved functioning, competitiveness, and growth of the value chain* through the following:

- increased production by the value chain as a whole
- increased average productivity
- increased share of production marketed
- increased share of production exported
- improved inter-firm cooperation (horizontal and vertical coordination and business arrangements)

Figure 4. Causal Model of Tree Fruit Programs in Kenya



IV. RESEARCH DESIGN

The study combines quantitative and qualitative methods to study the impact of program interventions on smallholder farmer enterprises, their households, and the overall functioning of the tree fruit value chain.

A. SURVEY OF SMALLHOLDERS

The quantitative component of the study involved a panel survey of smallholder tree fruit producers. Data were collected in two rounds, two years apart. The smallholder survey was quasi-experimental in design, with data collected on a sample of participating and non-participating smallholders. This longitudinal quasi-experimental design allowed for a comparison of changes over time in enterprise- and household-level variables between participating and non-participating smallholders. Differences in performance between participants and non-participants in the inter-survey period indicated the impact of the programs on the variables studied.

Field teams from Research International Kenya (RI) carried out the first round of survey data collection between November 2004 and January 2005 and the second round between December 2006 and February 2007.

I. QUESTIONNAIRE DESIGN

The survey questionnaires asked about sources of market information, the tree stock, production, productivity, sales, the use of capital, labor and material inputs, participation in training, use of extension services and market linkages. Household-level questions focused on changes in household income sources, consumption expenditures and assets. As needed, questions were adapted to accommodate the specific fruit (e.g., measures of productivity, descriptions of varieties or sales outlets). Questionnaires were translated from English into Kikuyu and Kiswahili. The questionnaires were pre-tested at the beginning of the study and refined based on these tests. The questionnaires took just under one hour per household to administer on average.

2. SAMPLE SELECTION

The original sample design was based on the total population of smallholders participating in (or targeted by) the KBDS tree fruit and KHDP passion fruit activities and the population of smallholder farmers in similar geographic areas, but—as far as possible—outside the sphere of influence of the program.

From these populations, a sample of participant and non-participant tree fruit farmers was drawn for the survey. Participant respondents were drawn from participant lists provided by KHDP and KBDS. In finalizing the sample design, the program team decided to eliminate four KBDS subcomponents from the study, either because they were not moving forward in their implementation, because the wide geographic dispersion of trainees and indirect link to smallholders made sampling problematic, or in one case because remote location made data collection very expensive and logistically difficult.

The original sample design for the baseline survey was to include 1,380 participants and 1,380 non-participants, but these numbers were reduced to 1,024 participants and 923 non-participants for a total sample size of 1,947. The reduction occurred because of a decision to exclude passion fruit program participants on the list who did not already have some passion fruit growing. (Many intended to start growing at some point in the future, but had not taken action to do so.) Those included in the sample were all the farmers on the passion fruit program lists who already had at least five vines of passion fruit growing. The size of the control group was also reduced because the field teams could not find enough passion fruit and mango growers in the relevant matched districts.

Table 5. Survey Sample Size

	Baseline			End line		
	Participant	Control	Total	Participant	Control	Total
Avocado	250	250	500	227	217	444
Mango	420	349	769	359	337	696
Passion Fruit	354	324	678	274	226	500
Total	1,024	923	1,947	860	780	1,640

The study sample covered a total of 8 districts, 33 divisions, and 191 villages in Central, Eastern, and Rift provinces as follows:

Table 6. Geographic Location of Sample

	Districts	Divisions	Villages
Avocado	1	1	30
Mango	3	17	57
Passion fruit	4	15	104
Total	8	33	191

For KBDS, the sample included participants in four sub-projects. These consisted of: participant avocado farmers in Kandara Division and non-participant farmers in areas of the same division; participant mango farmers in Makueni, Machakos, and Mbeere and non-participants in divisions of Makueni District that the program had not reached but where mangos are grown; and passion fruit growers participating in the program in Embu District and non-participating farmers in neighboring Kirinyaga District. Ministry of Agriculture and program officials were consulted in the selection of non-program but similar fruit-growing areas. For KHDP, participant farmers were selected from Uasin, Gishu and Kieyo Districts, while non-participants were from non-program divisions of the same districts. Selection of the non-participant sample continued until the survey teams could not locate any more eligible respondents in these regions.

3. DATA COLLECTION

For both rounds of field work, interviewers were selected from RI's regional pool of interviewers. Forty-two interviewers collected baseline and end line survey data. Each interviewer underwent a thorough two-day briefing in their respective regions before starting their work. Six supervisors/coordinators from RI oversaw the work in the field. They had a one-day briefing with RI's quality control group in Nairobi. The supervisors were based in the regions and worked with the interviewers on a daily basis. An RI team manager supervised the overall data collection effort.

The survey teams encountered several challenges in the field. It was difficult to find equal numbers of participants and controls. In addition, there were expectations among some of those interviewed that the researchers would be providing some help. Finally, keeping respondents focused on the questionnaire was sometimes difficult, especially when the interviews took more than an hour.

4. DATA LIMITATIONS

One limitation of the study is that project activities had begun in some areas before the baseline. The KBDS avocado groups in Central Province had been linked to training and had already established sales contracts with exporters involving embedded spraying services. In Central Province, KBDS had supported the mobilization of some passion fruit groups, but most other activities had not yet begun. In Rift Province, KHDP staff had initiated their broader work on horticulture development, but activities with respect to passion fruit were limited to a few demonstration

plots. To address this issue, the qualitative research attempted to identify changes associated with the projects that may have occurred prior to the study. Where relevant, this is noted in the analysis. It is important to note that the quantitative data do not capture change that occurred before the baseline and are therefore likely to underestimate total impacts, especially for avocado smallholders.

Another problem was that the initial data set provided by Research International did not properly match the baseline and end line respondents. RI corrected the database, but the process revealed other problems with the reliability of data on some (not all) variables for some (not all) respondents. Working with the data supplied by RI, analysis took place at the Developing Areas Research and Teaching (DART) Program at the University of Colorado, Boulder where researchers further subjected the database to a variety of validity tests and cleaning techniques in order to render it as useable as possible. Cases were automatically eliminated where the data failed to meet basic logical relationships, for example, when the reported number of fruit sold was greater than the reported number of fruit picked or when farmers reported pieces picked and sold but indicated they had no mature trees (those bearing fruit). Many of the problems were resolved after significant interaction among RI, DART, and members of the research team. However, despite these efforts, data from the baseline and end line still did not match up well for some key variables which compromised comparisons over time using statistical tests. The sheer size of the database negated the possibility of visually checking for specific problems in most cases. For some of the variables, the reliability of the data was insufficient for meaningful analysis at the end line. Nonetheless, it was possible to discover most problems through descriptive statistics and frequency runs. The quantitative analysis presented in this report is based on data that stood the test of this process.

In testing for impacts, ANCOVA (analysis of covariation) was not appropriate because the slopes of the regression lines for test and control groups were very dissimilar. An alternative would be to use regression analysis with an interaction term, but analysis of the scatter plots of the data showed that the relationship between the base line and end line data for many of the variables was so indistinct that it would not generate useful results. Our analysis of program impact (see Section D, below) is therefore less definitive than we would have wished.

Another limitation was the lack of reliable secondary data on tree fruits to measure market level changes in production, productivity, and exports (Hypothesis 4). The annual data that are available from the Horticulture Crops Development Authority on volumes and values exported suggest some general trends and comparisons, and this is discussed in the body of the report, but the data are insufficient to test the hypothesis.

5. PANEL ATTRITION

For a study of this size and duration, panel attrition was minimal. From the original 1,947 households sampled in the baseline, 1,640 were sampled in the end line, resulting in an attrition rate of slightly less than 16 percent. The percentage loss between participant and control groups was nearly the same.

B. QUALITATIVE STUDY OF THE TREE FRUIT VALUE CHAINS

The qualitative component of the impact assessment included focus group discussions and individual interviews with a sub-sample of value chain actors: smallholders, input suppliers, facilitators and service providers, exporters, brokers, other buyers, processors and producer group leaders. The purpose was to help understand the context of enterprise-, household- and market-level impacts. It also explored factors that influence the linkages between Kenyan smallholders, buyers and supporting market actors, and the overall functioning of the value chain. A qualitative research team from RI conducted focus group discussions and individual interviews at two points in time to correspond to the timing of the smallholder surveys. Some of the interviews and all the focus group discussions were recorded and transcripts were produced. The qualitative results were summarized in analysis tables and findings from the two rounds were compared.

The qualitative sample for the baseline included 50 actors in the avocado, mango and passion fruit value chains. This included 30 smallholder farmers, producer group leaders, 4 input suppliers/stockists, 1 nursery operator, 4 extension agents, 3 brokers, and 2 exporters. They were all associated in some way to tree fruit interventions supported by Kenya BDS and KHDP. The qualitative sample for the end line covered 65 actors in these value chains. They included 33 smallholder farmers¹⁴, 6 producer group leaders, 6 facilitators/linkage service providers, 5 other service providers, 4 brokers, 3 processors, and 8 exporters or other large buyers. The qualitative research also involved periodic meetings and interviews during the study with the directors and field staff of the programs.

Table 7. Framework for Studying Impacts

Levels of analysis	Domains of impact	Indicators of change	Sources of information
Tree fruit Smallholders	Increased integration of smallholders into tree fruit value chain	Increased sales/market linkages Increased price received Increased marketing channels used Increased/improved use of agricultural inputs Increased/improved use of extension services	Survey Individual interviews Focus group discussions
	Improved production processes	Skills, knowledge and practices Use of market information Use of technology Capital investment (tools and equipment)	Survey Individual interviews Focus group discussions
	Improved smallholder performance	Increased revenues Increased productivity Increased employment	Survey Individual interviews Focus group discussions
Smallholder Households	Increased incomes	Proxy measure of increased household income (assets as proxy measure) Higher ranking of tree fruit income as source of household income	Survey Individual interviews Focus group discussions
	Reduced vulnerability	Diversification of household income sources Increased assets	Survey Individual interviews Focus group discussions
Markets	Improved functioning of value chain for smallholders	Improved and sustainable market access Improved and sustainable input supply Improved and sustainable extension, advisory, and information services	Survey Secondary information Interviews with buyers, input suppliers, service providers
	Growth of tree fruit value chain	Increased production Increased productivity, Increased employment Increased sales Increased exports Improved inter-firm cooperation	Secondary information Interviews with buyers (brokers and lead firms)

The qualitative research focused on understanding incentives and risks for tree fruit smallholders associated with upgrading and accessing new markets. It also considered the experience of exporters and service providers in working with smallholder tree fruit producers. It looked at the nature of cooperation and coordination among actors within the value chain as they relate to smallholder participation and competitiveness, specifically the extent to which lack of trust, power asymmetries and cultural biases may be affecting smallholder participation and overall functioning of the value chain. The study also explored household-level factors that affect smallholder participation in the value chain.

The findings from the qualitative research have been integrated into the overall report.

¹⁴ To the extent possible in the qualitative research we attempted to interview the same farmers at both the baseline and end line but both samples include repondents interviewed only once.

V. FINDINGS

In reporting findings, it is important to note that both projects undertook a wide range of interventions in the program areas studied between the baseline and end line. Many were designed to broaden and deepen commercial relationships engaging smallholders in the tree fruit value chains but started out as subsidized demonstration or pilot activities. In some cases they involved the introduction of new or untested services; in others, they forged new linkages and relationships within the value chains. In many instances the new service providers were unknown to the farmers and/or buyers and did not receive their full trust. Some activities have been more successful than others. The flexibility of the projects, however, allowed for shifts in the approach of several of the interventions. For example, a hybrid embedded service model that was being tested with EAGA and avocado smallholders during the baseline study period evolved through stages into an independent out-source linkage service by the end line. This assessment therefore focuses on the impact of not one but a mix of interventions targeting the two tree fruit value chains. The interventions have changed over time, involved different market actors, and reached different groups of farmers.

Another issue to note in considering these findings is the difference in approach between KBDS and KHDP. While KBDS focuses on market linkages (primarily to support export markets) and the development of commercial business services specific to tree fruits, KHDP has focused more on supporting the overall development of the horticulture market through research on new varieties, demonstration plots, training, extension services, and market information. The only tree fruit they focused on was passion fruit, and their passion fruit work comprised only a small part of the overall KHDP program.

The rest of this section presents the findings on the hypotheses listed earlier.

A. HYPOTHESIS ONE:

PROGRAM ACTIVITIES IN THE VALUE CHAIN CONTRIBUTE TO GREATER INTEGRATION BETWEEN SMALLHOLDERS AND LEAD FIRMS.

The projects succeeded in bringing smallholders and lead firms closer together by supporting a number of new actors and new relationships to overcome constraints within the avocado and passion fruit value chains. The aim has been to facilitate the development of high-quality commercial services that are used by farmers to upgrade their products to meet the demand of buyers. While some of these actors and relationships have worked out better than others, they have had an influence on how both of these value chains function.

I. AVOCADO

NEW ACTORS AND RELATIONSHIPS

KBDS has engaged new actors and encouraged new relationships in the avocado value chain which have helped to bring smallholders and lead firms closer together.

To increase smallholders' supply of export quality avocados, KBDS has facilitated the entry of new actors in the value chain including:

- 465 Avocado producer groups
- Four fee-based market linkage firms
- A commercial spraying service
- 60 independent grafting and pruning service providers organized into groups

- An association of grafting and pruning service providers
- Five exporters engaged to link directly to smallholders (EAGA, Kakuzi, Indu-Farm, and Sunripe)
- Three avocado oil processors

Working through these actors, and building on known functions, the project has supported the development of new horizontal and vertical relationships within the value chain. The aim has been to develop a broader and deeper network of commercial relationships that engage and support smallholders. These relationships have helped to increase the supply of export quality avocados and improve access to product markets by smallholders.

HORIZONTAL RELATIONSHIPS

The KBDS project has promoted horizontal efficiencies in linking avocado smallholders to exporters and other buyers by supporting the mobilization of farmers groups.

Creating economies of scale among producers is crucial for integrating smallholders into higher-value chains. Groups can facilitate the assembly of adequate quantities of fruit to attract the interest of export-oriented buyers and access to services by their members. The mobilization of producer groups has been an important element of the KBDS program in promoting cooperation among farmers and providing a link between producers, exporters and service providers. To date, KBDS has mobilized 465 avocado groups. While not all of these groups still function, many are supplying Grade 1 fruit to exporters and lower grade fruit to processors.¹⁵ These are the only organized avocado farmer groups in Kenya.

Producer group membership was nearly universal among avocado participants in the survey and remains widespread. It declined between surveys amid various problems and producer disillusionment. However, farmers generally have positive views of the groups.

Table 8 reports the numbers of survey respondents who reported that either they or their spouse was a member of a producer group at the time of the survey. Practically all the producer groups to which respondents belonged at the baseline were organized by the programs under study. That is why the survey found very high group membership among participants at the baseline and very low membership among controls. By the end line, however, some of the members had apparently slipped away from group membership. Meanwhile, more control group members were joining groups. The latter development may reflect spread of the buying arrangements promoted by the projects into the control areas late in the study period. A large majority of program participants considered groups to be “very useful” or “fairly useful.”

Table 8. Percentage of Respondents who are Members of Producer Groups and Reported Contract Sales in the Past Year

		<i>Baseline</i>	<i>End line</i>	<i>Baseline</i>	<i>End line</i>
		<i>Percent who are members of producer groups</i>		<i>Percent reporting contract sales in past year</i>	
Avocado Central	Participant	99	86	80	52
	Control	0	12	12	18

The groups have helped farmers access product markets in several ways. They have negotiated contracts with buyers. In addition, the Avocado Central farmers’ association maintains two centers for EAGA pickup. They meet to track what each farmer delivers and keep records on this. These records are related to EUREPGAP certification. The group leaders have been given training on EUREPGAP, which is one of the benefits of being a leader. Large farmers do not participate in the group because they have the capacity to deal directly with the buyers. Farmers with fewer than five

¹⁵ Source: KBDS Monitoring Data on all tree fruit program areas covered by the project

trees also do not participate—they either do not have time for the group or do not tend the trees in a way that produces marketable fruit.

There was an umbrella organization of group leaders when the farmer groups were first organized and there was more interaction between farmer groups at that time. The umbrella collapsed because intermediaries wanted to work directly with the groups. Farmers say that cooperation within the groups is good. If someone does side selling or otherwise breaks the rules, a meeting is convened to discuss his or her conduct. If someone owes money to the group, the local chief will pursue the case. Disagreements typically are sorted out amicably.

Overall, members of the avocado groups were able to bypass brokers in selling their high-grade avocados to exporters through contracts and their lower-grade fruit to oil processors.

VERTICAL RELATIONSHIPS

The KBDS project has experimented with two models to bring smallholders closer to lead firms (exporters and processors) within the avocado value chain. One links farmers, exporters, extension service providers and financial service providers through an embedded service model, in which exporters provide extension services to farmers organized in groups and deduct the costs from their payments to smallholders who supply fruit on contract. The other model involves a stand-alone market linkage firm that links farmers, extension service providers, financial service providers and buyers on a fee basis.

The embedded service model was underway during the baseline study period. KBDS facilitated initial market linkages and sales contracts between farmer groups and EAGA. To help ensure high-quality avocados, EAGA identified a number of individuals from the production area who were trained and hired as sprayers by the exporter. This was the first time a lead firm had provided embedded support services to tree fruit farmers, and a few issues arose. Farmers complained that the spraying was not conducted efficiently or in a timely manner, while EAGA worried that once trees had been sprayed farmers were still selling fruit to other buyers. Ultimately EAGA decided to phase out of direct provision of spraying through this embedded service model for contracted farmer groups.

KBDS subsequently experimented with linking farmers, exporters, and service providers through stand-alone market linkage firms. By the end line, four new market linkage firms had been created by KBDS supported facilitators. They linked avocado farmers in groups with five exporters and three avocado oil processors. These new vertical relationships helped smallholders access inputs and services and sell their Grade 1 fruit directly to exporters on contract at higher prices. Exporters benefited by being able to access Grade 1 fruit and processors Grade 2 avocados directly from producer groups. While the costs of field staff working for these firms initially were subsidized, by 2007 they were operating with no operational subsidies. However, the commercial feasibility of these market linkage firms for avocados is still in question.

As new actors in the value chain, the market linkage firms also have been challenged to establish themselves as trustworthy service providers to farmers, exporters, horticulture service providers and financial service providers. Focus group discussions with tree fruit farmers indicated that trust was building slowly, but continued to be an issue for farmers in their relationships with the market linkage firms, as well as with the buyers and service providers they were linked to through these firms.

The market linkage firms created by KBDS-supported facilitators have provided access to new market channels for avocado smallholders and enabled large-scale buyers to source tree fruit directly from smallholders.

At the time of the baseline survey, only one exporter (EAGA) was engaged with KBDS, but by the end line study period four more exporters (KHE, Kakuzi, Indu-Farm and Sunripe) had entered, raising the total to five. Between the

baseline and end line surveys, over 20,000 tree fruit farmers joined farmer groups to access product and service markets.¹⁶

Traceability and quality control are major incentives for exporters to buy through groups rather than from brokers. Traceability of supply is an increasingly important issue for competitiveness, especially for exports of fresh fruit to Europe. KBDS has tried to develop, in collaboration with exporters, quality management systems (QMS) that improve traceability and quality control. EUREPGAP is also required by some exporters, but the issue of the cost and maintenance of EUREPGAP certification is still outstanding. KBDS contracted local consultants to determine the cost of EUREPGAP certification for small-scale producers in Kenya and explore various options for cost recovery and allocation among the various stakeholders. KBDS encouraged farmer groups to establish group bank accounts for the accumulation of funds to cover the costs of eventual group EUREPGAP certification.

By the end line, KBDS was working with selected farmer groups to prepare them for EUREPGAP certification and serve as models for possible replication by the other groups. In supporting group management, the market linkage firms promote agriculture practices in line with EUREPGAP and record keeping to facilitate traceability. KHDP worked on EUREPGAP awareness activities and training but had scaled back these activities by the end line.

The bottom line for competitiveness is that value chain actors need to work together to meet market requirements. A lesson here is that meeting this requirement takes more than training to fill a knowledge gap; it takes relationships of trust and cooperation, innovations to meet requirements competitively, and a flow of benefits that support these relationships and innovations.

The KBDS project has encouraged the development of commercial oil processing firms. A market for Grade 2 avocados is an incentive for smallholders to invest in commercial tree fruit production by ensuring a market for the portion of their crops that that may be flawed due to weather or disease.

At the baseline, avocado oil processing was just beginning. KBDS conducted a census of avocado trees to support the feasibility of avocado processing. By the end line, three avocado oil processors were operating in the Thika area and purchasing Grade 2 fruit from over 7,700 farmers supported by KBDS. Because of the widespread black spot disease problem during the 2006-2007 season, there was ample supply of Grade 2 fruit. The oil produced by Kenyan processors for export is crude (unrefined). At the end line, a new facility for avocado oil processing and refining was being developed by an investor from New Zealand. If established, this plant could provide further market opportunities for Grade 2 fruit from small-scale farmers. The end uses of avocado oil are cosmetic or edible oil products. The free fatty acid content should be low for food applications but higher for cosmetic uses. Processors prefer the high oil content of Fuerte variety avocados.

SUPPORTING MARKETS

The development of independent grafting and pruning service providers has helped avocado smallholders access extension services needed to upgrade the quality of their products.

Spraying fruit trees is critical to improve productivity and the quality of the fruit; proper application of certified chemicals is necessary for EUREPGAP certification. During the baseline survey period, KBDS was working with an exporter (EAGA) to provide spraying services as an embedded support to its contracted farmer groups. A spraying protocol was developed and pilot tested by EAGA. Issues of spraying efficiency and timeliness, side-selling of fruit (to other buyers after EAGA already sprayed), and cost recovery eventually led EAGA to phase out of providing this service. Yet through this period farmers began to recognize the value of spraying and demand for spraying services was created. KBDS sought to develop a new model of stand-alone, fee-based spraying to meet smallholder demand.

¹⁶ Source: KBDS Monitoring Data on all tree fruit program areas covered by the project

By the time of the baseline survey, Ideal Business Link (IBL) was selected as a facilitator to support the development of individual providers of spraying and grating/pruning services for small-scale farmers. IBL identified community-based providers and provided technical training and capacity building of these providers. By the end line, there were approximately 60 individual grafting and pruning providers.

Independent grafting/pruning services show possible commercial feasibility. However, problems in the quality of spraying by independent providers have continued. Spraying requires more technical expertise and a larger investment. IBL changed its model from facilitation to being a director provider (and consolidator) of spraying services. By the end line, IBL Matundu Ltd. had been created as a for-profit company to offer integrated spraying services to small-scale tree fruit farmers. At this time, IBL Matunda also expanded into the provision of market linkage services; they were selected by local farmers in Kandara and EAGA to broker contracted supplies. With time, IBL Matundu has become an increasingly important actor in linking avocado farmers to supporting markets.

The development of an innovative value chain financing scheme linking a commercial spraying service and a financial service provider has helped avocado smallholders access extension services needed to upgrade their products.

KBDS facilitated an innovative value chain financing scheme linking IBL Matundu Ltd, Equity Bank, exporters and farmer groups to finance the provision of avocado spraying services. Equity Bank now extends credit to groups, based on an exporter supply contract, to access IBL Matundu's spraying services. Since exporter payments to the farmer groups are channeled through Equity Bank, loan repayments are easily deducted.

In 2006-2007, KBDS piloted a two-pronged intervention to train and equip commercial sprayers and launch a loan product through Equity Bank to enable farmers to access spray services on credit. By the end of the 2007 harvesting season, three Equity Bank branches approved loans for 130 groups, with a total of Kshs 1,751,909 disbursed. To help ensure services responded to EUREPGAP protocols, 42 sprayers were housed within a rural-based company. Through the intervention 3,055 farmers were reported to have accessed commercial spray services reaching 23,916 trees. Repayment from the first year of Equity Bank agrochemical financing is said to exceed 95 percent. Equity Bank is replicating this type of value-chain financing scheme for the delivery of agrochemical spray services in the mango and coffee sectors.¹⁷

KBDS has supported the establishment of two new associations of grafting and pruning service providers to improve the quality, consistency and sustainability of services.

To improve the quality of grafting and pruning services, KBDS has supporting efforts to mobilize independent grafting and pruning service providers into groups and establish two associations. The purpose of the association is to professionalize and self-regulate services. A local facilitator (Ideal Business Links) initiated discussions with the Ministry of Agriculture to formulate an accreditation policy for training service providers and a Code of Conduct for the associations and a mandate to accredit individual service providers. As members of the association, service providers agree to honor a uniform service price list, adhere to proper labeling, supply only certified grafting material from approved mother blocks, and "re-graft" if the initial service fails. Each member of the association also has an identification card to protect against fraudulent providers and serve as a system for vetting quality. The groups and associations are still relatively new but have potential for further improving the quality standards, consistency and sustainability of services provided to tree fruit farmers.

¹⁷ USAID Kenya BDS Project, Emerging Markets Group. 2007. *Year 5 Annual Report*.

2. PASSION FRUIT

NEW ACTORS AND RELATIONSHIPS

There has been somewhat less experimentation with new actors and relationships in the passion fruit value chain compared to the avocado value chain.

The most prominent new actors in the passion fruit value chain are farmers who are growing passion fruit as a commercial crop for the first time. Production of passion fruit by smallholders in both the Rift and Central program areas expanded rapidly between the baseline and end line studies.

To encourage the production of passion fruit as a commercial crop, KHDP has worked directly and through existing research, extension and government institutions to increase the volumes and improve the quality and standards required in domestic and export markets. In the Rift program area, KHDP introduced grafted seedlings, taught new planting, pruning and spraying techniques through demonstration plots linked to existing farmer groups. There was less direct focus on developing a network of commercial relationships. It tried to encourage small-scale and independent nurseries to supply grafted passion fruit seedlings but met with limited success.

In the Central program area KBDS took a different approach, placing more emphasis on market linkages. They promoted horizontal cooperation by mobilizing passion fruit farmer groups. They promoted vertical relationships by linking farmers in these groups to buyers selling to the export markets through contract sales. To facilitate this process, they encouraged the establishment of a market linkage firm similar to that for avocados. They also facilitated relationships between farmers and supporting markets by linking farmers in these groups to training related to passion fruit cultivation and certification standards. KHDP also worked in an adjacent area of Central Province. They provided technical support and equipment for the development of a new juice factory to produce larger volumes of concentrate to sell to fruit canning factories within Kenya. They facilitated links between this factor and smallholders to sell fruit on contract

HORIZONTAL RELATIONSHIPS

Horizontal cooperation among passion fruit farmers has focused more on linking to buyers than to supporting markets

Rather than starting new groups, KHDP worked through existing farmer groups in the Rift program. These groups established passion fruit demonstration plots to teach farmers improved cultivation practices. The groups were not specifically formed for passion fruit, nor did they play a formal role in linking to buyers or supporting markets. While some of the participant groups in the study had been linked to local and export markets through a lead farmer in previous years, this relationship had ended. However, some women in the groups (or wives of male group members) joined together informally to sell to traders and brokers. They worked cooperatively to negotiate prices for the groups and developed close relationships with some of the buyers. Between the baseline and end line, the proportion of participant farmers in groups remained high, but the percent who sold on contract went down (Table 9). The groups still exist, but activities around passion fruit are limited.

The KBDS mobilized 104 new passion fruit groups in the Central program area. The initial purpose was to provide farmer training to expand production. They subsequently took on the role of linking farmers to lead firms. At the end line, KBDS reported that 98 groups (with 2,450 farmers) had signed supply contracts with exporters. The survey data show that the proportion of Passion Fruit Central participants still in groups at the end line declined, but the proportion of controls who joined groups increased. In the total Passion Fruit Central study sample, there was an increase in the number of farmers in groups. The proportion of both participants and controls selling on contract also increased (Table 9). This suggests the value to farmers of the market linkage function of the groups.

Table 9. Percentage of Passion Fruit Farmers who are in Groups and Sell on Contract

		Baseline	End line	Baseline	End line
		Percentage of farmers in groups		Percentage of farmers who sell at least part of their crop on contract	
Passion Fruit Rift	Participant	98	94	67	49
	Control	2	7	26	27
Passion Fruit Central	Participant	95	84	35	44
	Control	4	22	6	14

VERTICAL RELATIONSHIPS

Brokers remain dominant in the passion fruit value chain. The projects have helped some farmers bypass brokers in selling to the export market through contracts; they also have linked some producers to a juice processing factory outside Nairobi.

Similar to its work with avocado farmers, KBDS has supported the establishment of a fee-based market linkage firm that links passion fruit farmers to lead firms. The linkage function is less complex for passion fruit than for avocados, and focuses strictly on linking producers to buyers. It does not involve linkages to spraying or other extension services. Commercialization of these functions for passion fruit appears to have limited potential because farmers do it themselves. Nor are financial service providers involved. Although it does not bring producers into a wider network of commercial relationships, the market linkage appears to be working well. While brokers remained the dominant channel for passion fruit sales for farmers, over 2,400 farmers are selling to exporters through this market linkage. Moreover, several exporters now buy all their passion fruit for export from groups through this market linkage firm.

KHDP did not focus specifically on market linkages, but did link passion fruit farmers to a juice processing firm in Thika.

SUPPORTING MARKETS

Supporting markets for passion fruit are still underdeveloped.

KHDP promoting the development of small-scale nurseries to produce and sell grafted passion fruit seedlings, which are more resistant to root disease. However, grafted seedlings were something new, an added expense, and required more technical knowledge and skills for upkeep. Farmers were hesitant to invest as they were not convinced of the added return. This attempt to develop a supporting market for passion fruit did meet with success.

Most of the support to passion fruit farmers still comes from government or quasi-governmental research and extension services which have limited outreach. The potential for commercializing these functions remains to be seen.

In general, there has been somewhat less experimentation with new actors and relationships in the passion fruit value chain compared to the avocado value chain. Nevertheless, the market is vibrant and production is increasing, but demand is still unmet. Continued experimentation with incentives for upgrading—for example, through grafted root stock and effective use of approved chemicals—can help to meet the demand from exporters and juice processors for increased volumes and quality.

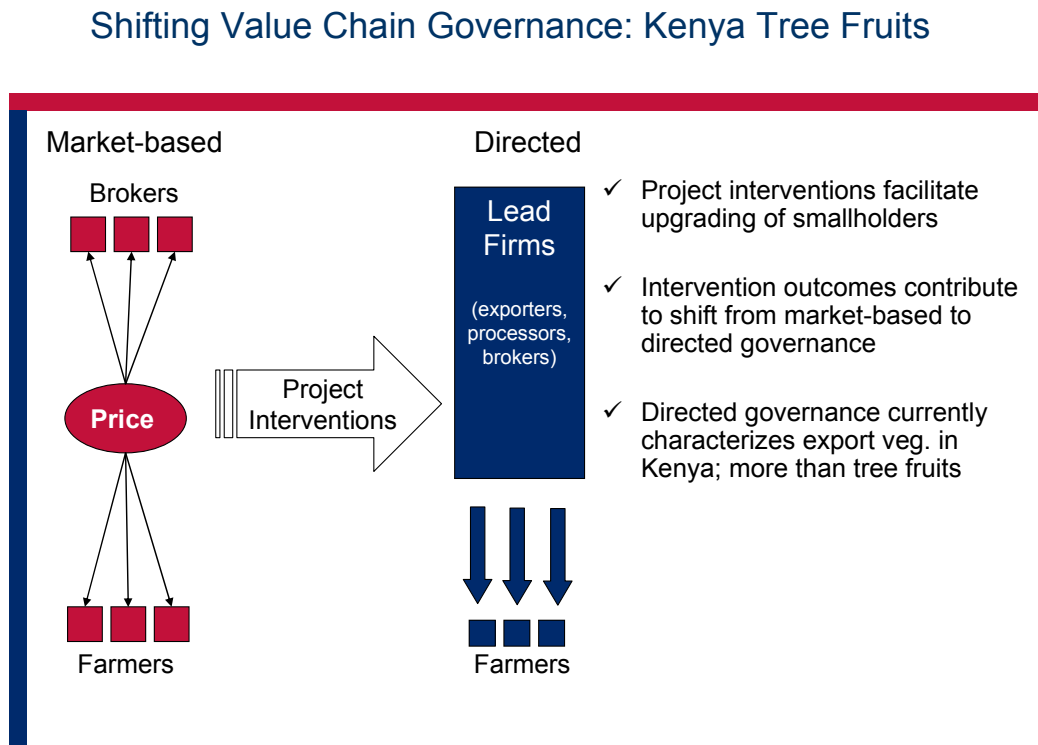
3. VALUE CHAIN GOVERNANCE

The two projects created closer relationships within the tree fruit value chain by mobilizing farmer groups, linking farmers to lead buyers and to supporting markets, and encouraging cooperation among smallholders. In this sense, the projects have had an influence in moving avocado and passion fruit growers (especially in the Central province

program area) into a more directed governance structure through contract sales and embedded or linked services (see Figure 6). However, trust issues remain in some of the relationships.

The exception to this trend towards a more directed governance structure is reflected in the experience of one farmer group in the Passion Fruit Rift sample, who were early adopters of passion fruit. As the value chain developed, they moved from a fairly tight, directed structure of governance to one that was more market-based (Figure 6). At the time of the baseline study, they were actively involved in passion fruit production and had been closely linked to an influential lead farmer. He sold his own passion fruit to a trader in Uganda and to exporters selling in Europe. He played a role in encouraging his neighboring farmers to produce passion fruit and linked them to his buyers. As the demand for passion fruit from the regional market in Uganda grew, more and more farmers in the area started planting passion fruit and production expanded rapidly. Many brokers entered the market and the relatively directed value chain dominated by this lead farmer and his buyers became much more open and market based. The farmers originally linked to this value chain found themselves in a more competitive environment. As seen in the next section, initially high levels of production and sales among Passion Fruit Rift participants leveled out (even went down for some farmers) by the end line.

Figure 5. Shifting Value Chain Governance: Kenya Tree Fruits



Many issues of trust emerged.

Trust among actors is critical for the value chain as a whole in responding to new market opportunities or changes in markets. That said, mistrust is a recurrent theme in the relationships between producers, buyers and service providers.

The interviews and focus group discussions revealed many issues of trust. In the avocado value chain, for example, farmers do not trust sprayers to do a good job, to use the correct amount of chemicals, or to know what they are doing. Farmers do not fully trust the EAGA buyers and believe they are “side buying” from the brokers. They have mixed feelings about brokers. Some farmers said they are easier to deal with because they are always around and one can negotiate directly with them and choose the broker who gives the best price. A few are from the locality and

related to the farmers. In some cases, farmers have had longstanding relationships with the brokers. Most farmers complain about the low prices they pay, but depend on them to buy the lower grade fruit rejected by the exporters.

Avocado exporters are more like business acquaintances. Farmers do not meet them face-to-face, as compared with brokers—the relationship is much newer and more distant. They are only present during production season although farmers would like to have more support from them during the off season. Companies do provide information and training in pruning. The farmers ranked EAGA 1-4 on a scale of 1-7 for trustworthiness. At the baseline, they said EAGA had not honored a part of their agreement that promised sprayers to the farmers. By the end line, this provision had been taken out of the MOU, other wrinkles were ironed out, and farmers said that EAGA was honoring its agreements. However, farmers believe they still have no control over prices, which are set by the exporters.

At the baseline, the avocado farmers had an umbrella group, which was their main link to the exporters. This group—made up of male group leaders—disbanded between the baseline and end line study periods with the introduction of a fee-based market linkage firm. Some of the farmers felt that this was “a divide-and-rule tactic” and that brokers or other vested interests were behind it.

Passion Fruit Rift farmers ranked Ugandans as the most trustworthy buyers. While Nairobi export buyers give a better price, they are distant and relatively inaccessible because of bad roads. The Uganda trade is closer and the buyers come all year round. Farmers have had longstanding relationships with the buyers; some have been selling to Ugandan buyers since 1988 when they first started selling passion fruit. With the upsurge in production, many local brokers have entered the market in recent years but Ugandan buyers are preferred. To date, they still keep their word. In the past, there were some cases in which the Ugandans knocked down prices when they knew the fruit had already been picked. In response, farmers now negotiate price before the fruit is picked. While farmers still have to negotiate with them, they are trusted and farmers feel they will keep their word. They are so reliable that farmers are willing to sell to them on credit.

The projects work to build trust among actors in the value chain.

The projects worked to build trust. For example, to build trust between farmers and service providers KBDS supported efforts to establish codes of conduct for grafting and pruning service providers through two associations. This followed farmer complaints that service providers were diluting their sprays. KBDS also worked to establish trust between avocado farmers and Equity Bank by supporting a scheme that links the repayment of loans (for spraying services) to payments from exporters to farmer groups. The market linkage firms have tried to mediate some disagreements among value chain actors, although they themselves are not always trusted because they are new enterprises unknown to farmers.

B. HYPOTHESIS TWO:

GREATER INTEGRATION OF SMALLHOLDERS AND LEAD FIRMS CONTRIBUTES TO IMPROVED ENTERPRISE PERFORMANCE AND HOUSEHOLD WELL-BEING.

I. ENTERPRISE PERFORMANCE

SCALE OF SMALLHOLDINGS

Tree fruit smallholdings are measured in numbers of trees owned, production and productivity levels, cultivation methods, attention to quality, and manner of fruit sales. Holdings in Kenya range from very small scale and casually operated to relatively large and seriously commercial. The number of trees/vines decreased for participants and increased for controls during the study period.

The average number of trees of the targeted vines¹⁸ varies widely among smallholdings. A few farmers operate substantial commercial enterprises, while others have only a handful of vines. Both projects tried to increase commercialization of tree fruit cultivation and marketing in Kenya. KHDP generally worked with larger-scale farmers than KBDS. The mean number of trees and vines was higher for program participants than the control groups at both the baseline and end line survey periods. However, among program participants, the mean number of trees/vines decreased between the two survey years in all locations. Among the control groups, the mean number of trees/vines rose at all sites. Table 10 shows the distribution of trees/vines at the end line as well as total numbers of trees for the baseline.¹⁹

Table 10. Number of Trees/Vines per Smallholding by Survey Area: End Line Distribution and Growth Since Baseline

		Useable Sample	1-19	20-49	50-99	100-200	201+	Baseline Mean # of trees/vines	End Line Mean # of trees/Vines
Avocado Central	Participant	158	92	54	9	4	0	26	24
	Control	168	141	22	3	1	1	12	15
	Total	326	223	76	12	5	1	19	20
Passion Fruit Rift	Participant	129	0	0	7	14	108	828	737
	Control	97	0	0	0	18	79	385	541
	Total	226	0	0	7	32	187	638	653
Passion Fruit Central	Participant	89	0	4	6	36	42	331	286
	Control	96	7	7	19	33	30	163	250
	Total	185	7	11	25	69	72	243	267

¹⁸ Passion fruit grows on vines rather than trees.

¹⁹ The terms baseline and end line refer to the situation reported in the baseline and follow-up surveys respectively. If the reference is to a point in time, the time concerned is the date of the survey (late 2004-early 2005 and late 2006-early 2007 respectively). If the reference is to a period of time, the period concerned is specified in the context. It may be the past month, past year, past season, etc.

PRODUCTION AND PRODUCTIVITY

Production grew from 2005-2007 for most participant groups. It soared for passion fruit growers.

Fruit production (pieces of fruit harvested in the past year for avocados and kilograms for passion fruit) also varied widely from farm to farm. Production increased for avocado growers participating in KBDS, who reported definite improvements in production and sales (Table 11). Some of them said they have become more careful in the harvesting process (what, when, and how avocados are picked). Lack of timely information on volumes and grades demanded by the buyers continues to be a problem that results in wastage. The avocado control group also increased its production.

Passion fruit production experienced a surge in the areas served both by KHDP and by KBDS (Table 12). The surge extended to both the passion fruit control areas and reflected the maturation of vines and rising interest among smallholders in cultivating the crop, once grown exclusively by larger farmers and regarded as difficult for smallholders, especially because of its potential for disease problems. However, passion fruit participants in the Rift program area—who started at the highest levels—experienced smaller increases than other groups. The qualitative research found that some passion fruit farmers in Rift Province have lost many vines to disease. Many are frustrated and have opted not to grow passion fruit again. Efforts to promote grafted passion fruit among farmers have had mixed results due to the expense of the seedlings and other inputs and the technical requirements of caring for them.

Table 11. Average Pieces of Avocado Picked in Past Year: Baseline and End Line

		<i>Baseline Average</i>	<i>End Line Average</i>
Avocado Central	Participant	8,877	11,079
	Control	6,347	6,940
	Total	7,573	8,946

Table 12. Average Kilos of Passion Fruit Picked in Past Year: Baseline and Endline

		<i>Baseline Average</i>	<i>End Line Average</i>
Passion Fruit Rift	Participant	5,986	6,611
	Control	1,932	5,845
	Total	4,246	6,282
Passion Fruit Central	Participant	1,055	13,844
	Control	826	9,467
	Total	935	11,581

Productivity rose in all areas.

The productivity of the smallholdings in the survey is defined as annual production per mature tree or vine. In the avocado study area productivity rose for both participants and controls; participants continued to get somewhat lower yields than controls, as they had in the baseline survey period (Table 13).

Table 13. Pieces of Avocado Picked in the Past Year per Mature Tree

		<i>Baseline Average</i>	<i>End Line Average</i>
Avocado Central	Participant	618	685
	Control	742	773
	Total	682	730

At the time of the baseline survey, productivity was two and a half times as high among KHDP passion fruit participants in the Rift area as among KBDS passion fruit participants in the Central program area participants (Table 1414). Between the two surveys, however, the productivity of the former group rose slowly, while that of the latter increased dramatically, creating a three-to-one productivity differential in favor of the KBDS participants. Productivity

rose sharply for the control group in Passion Fruit Central.²⁰ The increases across the board in productivity suggest successful process upgrading among smallholders in both participant and control groups.

Table 14. Kilograms of Passion Fruit Picked in Past Year per Mature Tree

		<i>Baseline Average</i>	<i>End Line Average</i>
Passion Fruit Rift	Participant	26	42
	Control	14	22
	Total	21	34
Passion Fruit Central	Participant	10	144
	Control	10	138
	Total	10	142

SALES

Sales also grew, except for participants in the passion fruit Rift program area.

At both survey points, 80-90 percent of the fruit picked was sold in some market. The traditional mode of sale was to a broker or local trader.

Demand for avocados is high, but supply problems persist. Farmers say they would like to sell more fruit to exporters, but exporters do not buy all the fruit offered to them. Reasons include limited trucking capacity, quotas on how much they buy from groups (at a premium), and the quality of the fruit—especially the problem of diseased fruit, which arises primarily with the Fuerte variety. Wastage continues to be a problem.

With one exception, the groups surveyed increased the cash value of tree fruit sales over the survey period, in many cases substantially (Table 15). Earnings from fruit sales by participants in the avocado Central program area nearly doubled and producers in Passion Fruit Central, whose vines matured during the period, experienced more than ten-fold increases in average shilling sales. However, sales declined for passion fruit participants in Rift area.

Passion fruit growers had far larger earnings from sales than avocado growers.

Table 15. Sales of Fruit in Past Year in Kenya Shillings

		<i>Average sales at baseline (Ksh 000)</i>	<i>Average sales at end line (Ksh 000)</i>
Avocado Central	Participant	14	27
	Control	6	11
	Total	10	11
Passion Fruit Rift	Participant	190	170
	Control	68	115
	Total	138	147
Passion Fruit Central	Participant	39	411
	Control	22	252
	Total	30	328

There was a small increase in the number of farmers selling to the export market.

Smallholders sell fruit to many types of buyers, who channel it to domestic and foreign markets (Table 16). Relatively few sell directly to consumers. Many participants sell on contract to exporters (directly or through brokers), while most control group farmers sell on a spot basis to brokers and local traders. Contract sales generally garner higher

²⁰ The extremely low baseline productivity levels reported for Passion Fruit Central might be questioned.

prices, in part because they involve higher-quality fruit. At the end line, Avocado Central participants received an average of Ksh 2.98 per mango sold while control group members in the same area received Ksh 2.00. Similarly, participants in both passion fruit areas—who sell primarily through contracts—received higher prices than members of the corresponding control groups.

Avocado brokers come out early in search of fruit. They offer lower prices than EAGA but pay on the spot in cash, while contract sellers have to wait to be paid. Brokers pay lower prices per fruit but may provide higher gross income because they take blemished fruit for sale in local and Middle Eastern markets. Grading standards have been a continuing problem for avocado farmers selling to exporters through contracts. They say they are getting stricter, change according to how much buyers want to buy, and are not always fair.

Table 16. Smallholdings Selling Fruit to Different Types of Buyers

		Buyers selling to export market		Buyers selling to domestic market		Total Number of Buyers	
		Baseline	End line	Baseline	End line	Baseline	End line
Avocado Central	Participant	231	239	378	226	609	465
	Control	116	115	428	271	544	356
	Total	347	354	806	497	1153	851
Passion Fruit Rift	Participant	272	214	213	240	485	454
	Control	90	145	165	151	255	296
	Total	362	359	378	391	740	750
Passion Fruit Central	Participant	92	110	173	161	265	271
	Control	51	49	157	193	208	242
	Total	143	159	330	354	473	513

Avocado processing factories help with the wastage problem, but they buy fruit only later in the season, when the oil content is high. Wastage of lower-grade or blemished fruit continues earlier in the season.

The trade in passion fruit for sale in Uganda has taken off. Some farmers take fruit to the border, some use Kenyan buyers, and sometimes the Ugandans come to the farms. Local traders sell in the local market, to the Ugandans, and to people in Nairobi. The most trusted brokers come and give cash when they book an order. Others place an order and set a price when they book, but do not pay cash.

During the inter-survey period, the prices at which fruit was sold appear to have risen for avocado growers (for both the Hass and the Fuerte varieties), but have fallen for passion fruit cultivators.

The number of participants selling on contract was higher than control group members at the baseline; by the end line, the number of participants selling on contract was still higher than control group members, but fell, while the number of control group members selling on contract rose from initially low levels.

The KBDS project tried to increase contract sales, in part to encourage the use of embedded producer services. Because of problems with the data, it is not clear whether this objective was achieved in the areas studied,²¹ but it is known that the percentage of farmers reporting any contract sales in the past year declined for all participant groups except those in passion fruit Central program area (Table 17). Control group members were much less likely to have contract sales at both the baseline and end line, but increased their use of this sales method during the inter-survey period. As discussed above, growers sometimes have incentives to make spot sales and at other times are forced to do so by economic pressures.

Participants in the avocado Central program area sell on contract through their groups (not as individuals) but note that exporters do not buy their whole crop—only the top-grade fruit or the grades they are looking for at a particular

²¹ Information on the percentage of sales made to different types of buyers was inconsistent because of inadequate field checking.

time. Exporters buy a very specific size of avocado and reject other sizes. There have been only some small problems with this. Price agreements have been honored. Farmers also have a written agreement with Fineline, the linkage service provider. They have no written or unwritten agreements with brokers.

Table 17. Percentage of Farmers Reporting Contract Sales in Past Year

		<i>Baseline (percentage)</i>	<i>End line (percentage)</i>
Avocado Central	Participant	80	52
	Control	12	18
	Total	47	35
Passion Fruit Rift	Participant	67	49
	Control	26	27
	Total	62	40
Passion Fruit Central	Participant	35	44
	Control	6	14
	Total	22	29

When demand for their fruit is high, passion fruit growers are sometimes paid a deposit on their crop. Women farmers trust Ugandan buyers to take their fruit and return later with the payment.

ACCESS TO INFORMATION

Participant households had access to more sources of information than control households at both the baseline and end line, but the control households narrowed the gap by the end line.

Access to information by producers is critical for responding to market signals about price, quantity, product quality or design. There are many possible channels for obtaining information related to markets including cell phones, internet, television or radio, newspapers, television, extension workers or farmers groups.²² Participants in all program areas had access to more sources of information than controls at both the baseline and end line. However, the control households increased their access between the baseline and end line, while while the participant households did not. Overall, male-headed households have slightly better access to information than female-headed households.

Passion fruit farmers were more likely than avocado farmers to have cell phones or fixed line phones and more likely to use them for their tree fruit business.

The end line qualitative research found that all the passion fruit farmers in the Rift area had cell phones or fixed line phones or access to them through neighbors, group leaders or a nearby center. They use the phone to get prices from other farmers, to call brokers directly to discuss prices, and to receive calls from brokers telling when they will be in the area. They call to arrange meetings, give weather information and exchange information on which roads are bad. The phone saves time and transport costs.

²² To study potential changes in access to information among smallholders, survey data on farmers' access to these sources of information was used to construct an *Information Access Index*. This is a simple additive index with respondent households getting a "1" for each yes answer to the following list: has cell phone; has TV black and white; has TV color; has Radio; has Radio Cassette Player; Have you watched TV in the 7 days?; Have you read a newspaper in the last 7 days? Have you had access to the internet in the past 4 weeks? Have you made changes in agricultural practices at the prompting from various groups (up to 3 responses); Whether they got any useful technical advice, information training or other help in the past 12 months; Whether received any useful advice, information or training from any of the following groups (up to 7 possible responses); Whether you are a member of a group or association of farmers; Whether you attended a producer group meeting in past 6 months. See Annex A.

Female passion fruit farmers in the Rift area also use cell phones to communicate. They call brokers, traders and buyers as well as other group members to arrange meetings and discuss prices. At the end line, they said that phone communication is cheaper now, saves travel time and makes work easier.

Fewer avocado Central farmers have cell phones, perhaps due to the hilly terrain. In one focus group discussion, 4 out of 13 participants had a cell phone while nearly half had access to a land line, usually at market centers. However, they only occasionally use their phones to get avocado information. When they do use their cell phones, they used voice, not text messaging. When the harvest was ready, buyers usually called their group leaders and information flows from farmer to farmer by word of mouth.

Availability of market information is still a problem for avocado farmers.

In interviews, avocado farmers said that they have better information on export markets than before but information is still a problem. Brokers do not provide information, and the collapse of their umbrella group—made up of avocado farmer group leaders—that used to meet and negotiate with exporters has left farmers “in the dark.” Lack of forward information on what exporters require in terms of volume and grade continues to be a problem. This results in wastage and brokers sweeping in to purchase what exporters leave behind at a lower price. Farmers feel they are being cheated, as they believe some of the brokers sell the left fruit to the same exporters.

CULTIVATION AND BUSINESS PRACTICES

Irrigation use declined for passion fruit farmers but increased slightly for avocado farmers.

The majority of passion fruit growers used irrigation at the baseline, but this declined at the end line for both participant and control groups. From anecdotal reports, it may be that the rains during the survey period were sufficient (in fact resulting in flooding in some areas), so irrigation was not used so extensively at the end line. Fewer avocado farmers used irrigation, but the percent of farmers who used irrigation increased from 10 to 21 percent for participants and 4 to 6 percent for controls between the baseline and end line (Table 18).

Fertilizer use was high among passion fruit farmers at both the baseline and end line; fertilizer use was lower among avocado farmers, declining slightly for the participant group between the baseline and end line.

The great majority of passion fruit growers used fertilizer at both the baseline and end line survey periods (over 90 percent for most groups). Fewer avocado farmers used fertilizer. Use decreased for participants (from 39 to 34 percent) and increased for controls (from 16 to 24 percent) between the baseline and end line survey periods (Table 18).

Spraying and grafting had mixed results.

For farmers in the avocado Central program area, grafting Hass avocados has been successful, but spraying has been problematic. Disease continued to affect avocados during the study period and participant farmers accused those responsible for spraying—exporters at the baseline, and independent spraying service providers at the end line—of poor service. They said the sprayers sent by exporters came at the wrong times and the independent spraying service providers over-diluted the chemicals and sprayed only one side of the fruit to reduce their costs. Three different groups have been involved in spraying, and farmers have complaints about all of them. Disease associated with poor spraying was the most frequently cited problem in our interviews and focus group discussions with avocado farmers.

Passion fruit vines are very susceptible to disease. Using grafted root stock and spraying are the two main ways to reduce the risk of disease. However, they are technically complex and relatively expensive, and neither is foolproof. Over four-fifths of passion fruit farmers in the sample used sprays, and there was very little difference between the participant and control groups or between the baseline and end line study periods (Table 18). There are tradeoffs in

using available sprays; the stronger sprays are more effective in reducing disease but leave chemical residue levels unacceptable in export markets. Farmer associations have advised using ‘lighter’ sprays that meet these standards, but they are less effective in controlling disease. Farmers in the Rift program area complained of lack of good information from agro vets on which sprays to use for passion fruit.

Passion fruit farmers in the Central program were much more likely to plant grafted passion fruit than farmers in the Rift program area. In the Rift program area, very few farmers in the study sample planted grafted passion fruit. The farmer group interviewed in our qualitative research had a negative experience with grafted seedlings. KHDP provided them with 100 grafted seedlings for a demonstration plot, but it was bad batch from KARI, and they all died. Some group members hesitated to try it again because the grafted seedlings are expensive, and they are not convinced of the outcome and benefit. Farmers in the Central program area were much more likely to plant grafted passion fruit than Rift farmers, and their production surged. However, the proportion of their vines that were grafted went down between the baseline and end line (from 60 to 32 percent for the participant group and 44 to 24 percent for the control group). It may be that farmers initially adopted the grafted root stock, but that the benefits of using the grafted as opposed to normal root stock did not offset the added costs.

Table 18. Percentage of Farmers Using Irrigation, Fertilizer, and Sprays

		Use irrigation		Use fertilizer		Use sprays	
		Baseline	End line	Baseline	End line	Baseline	End line
Avocado Central	Participant	10	21	39	34	n/a	n/a
	Control	4	6	16	24	n/a	n/a
	Total	7	14	28	29	n/a	n/a
Passion Fruit Rift	Participant	51	39	92	98	88	98
	Control	51	21	92	97	89	97
	Total	51	32	92	98	89	97
Passion Fruit Central	Participant	67	58	97	95	85	91
	Control	72	69	91	85	87	83
	Total	69	63	94	90	86	87

Most participant farmers received useful technical advice, especially early in the two projects.

Almost all respondents in the participant groups reported receiving useful advice at the baseline, compared to very few control group participants. By the end line, there was an increase in the percent receiving useful advice among control group respondents, but a decline among participants (although the percent for participants was still higher than for the controls). Participant farmers received a lot of advice early on from the two programs, and by the end line may have already received all the useful advice they needed—or, if the messages were repeated, they may have become less useful with repetition. An example might be advice provided on EUREPGAP standards. At first, farmers thought it was useful, but later it probably became clear that there was no clear and affordable road to certification.²³

Few farmers use credit for tree fruit production.

At the baseline very few program participants and control group members reported borrowing for tree crop production. By the end line, the numbers were still low, but both groups were more likely to borrow to finance tree

²³ KBDS reports that passion fruit farmers have, on their own, opened up group-managed accounts for a “EUREPGAP levy” whereby a percentage of payment is deducted upon each sale to pay for eventual qualification. KBDS has contracted facilitator Standards & Solutions to develop the passion fruit QMS and train the group management officers of the brokerage firms to take selected passion fruit groups through certification.

activities. Passion Fruit Rift farmers were most likely to borrow.²⁴ Whether the impact of borrowing for tree crops is positive or negative is not clear from the data.

GENDER AND SOCIOECONOMIC DIFFERENCES

Women managed just over ten percent of the farms in the survey. They increased production faster than men and improved their relative productivity.

Women managed slightly more than ten percent the fruit farms in our survey panel. At the baseline, farms managed by female participants had lower production levels than farms managed by male participants in all areas except the passion fruit Central area. However, production growth for woman-managed farms compared favorably with production growth for man-managed farms. By the end line, woman-managed farms were out-producing man-managed farms in passion fruit Central program area.

Productivity differentials also favored men at the beginning, but women improved their position by the end line, especially in the passion fruit areas. Sales figures also favored men at the baseline. They sold more pieces/kilos and generally received slightly higher prices for their sales. However, women increased sales by more than men in most areas and the differentials therefore narrowed by the time of the end line survey. In general, therefore, woman-managed farms did relatively well during the two-year period surveyed.

Male participants reported substantial replanting activity in the baseline survey, especially in the two passion fruit sites, but much less in the end line survey. Women did little replanting in either round. Similarly, use of credit for tree fruit activities was largely limited to males. Unlike men, women in several areas reported receiving an increasing amount of useful technical advice by the end line.

Passion fruit growers reported on men's and women's roles in production. The male view was that the man does the heavy production work: putting up the poles and wires for the vines, digging the holes, and planting. Women do the weeding and pruning, sometimes with men's help. Young men do the harvesting, with a few women. Men do some of the selling, but if they are not around, they give instructions to their wives on what price to accept. Women say they do most of the selling, usually together with other women who they meet at the selling point. They sell to buyers who offer them best price. The woman makes the decision on price and does not discuss it with her husband. Spraying is done every two weeks, mostly by men with a few women. "Women take more time on the farm because the men are not around and women work wholeheartedly because what the fruit is going to generate will assist the entire family."

There was little difference in performance among farmers in the different asset classes.

As discussed elsewhere in this report, respondents were sorted into four quartiles based on the ranking on an asset index. The asset index served as both an independent variable and a dependent variable in our analysis. On one hand, respondents' asset class rankings in the baseline were used to identify any systematic differences in enterprise performance by asset class. On the other, ratings at the baseline were compared with ratings at the end line to see whether programs might have helped to bring about improvements between the two surveys. The latter relationship is analyzed in the household well-being section below (see section V.B.).

Overall, richer and poorer program participants seem to have done about equally well in the program areas surveyed. In the avocado Central program area, the upper quartiles may have done better than the lower quartiles. As a whole, however, evidence of any class bias is limited. This is a somewhat unexpected result, since the costs of entering the export market appear to disadvantage the smaller-scale and poorer farmers.

²⁴ Many of the avocado farmers interviewed in the qualitative research had loans for spraying from Equity Bank but did not regard this as a loan and did not report it as such because Equity paid the sprayers directly and was repaid by the farmers' associations' sales to EAGA.

2. HOUSEHOLD WELL-BEING

The survey shows that households growing fruit trees are similar to other rural households in Kenya in terms of household size (average of 5.3 members), dependency ratios (2.4) and landholding size. The average landholding was less than three acres for the avocado and passion fruit farmers in the fertile and populous Central Province. It was over ten acres for passion fruit farmers in the less populated Rift program area. Among participants, one-fifth of Avocado Central households and almost one-third of Passion Fruit Central households have one acre or less of land; very few Passion Fruit Rift households had so little land. Most households were headed by men (88 percent) but female-headed households were more likely to have one acre or less of land.

IMPORTANCE OF TREE FRUITS AS A SOURCE OF HOUSEHOLD INCOME

Households in the sample are quite diversified in their sources of income, with an overall average of three income sources. In addition to tree fruit, other sources of household income included livestock production and sale, cereals and tubers production and sale, other fruit sales, salaried labor, vegetable sales, business activities farm labor, non-farm labor and remittances. The average number of sources did not change significantly between the baseline and end line surveys or vary by gender of household head.

Tree fruit income continued to be an important source of household income for sampled households. It is more important for participants than controls.

Tree fruit sales were the primary source of household income for 53 percent of all households in the sample at the baseline and 60 percent at the end line. At the end line, tree fruit sales were the primary source of income for more participant households (70 percent) than control households (43 percent). They were the primary source of income for 91 percent of participants in the passion fruit Rift area. Analysis by socioeconomic group shows that fewer households in the lowest quartile asset group rank tree fruit as the primary source of income compared to households in the higher wealth groups.

Table 19. Percentage of Households Ranking Tree Fruit as the Primary Source of Household Income

		Baseline	End Line
Avocado Central	Participant	57	74
	Control	38	45
Passion Fruit Rift	Participant	81	91
	Control	55	84
Passion Fruit Central	Participant	49	44
	Control	29	32
TOTAL	Participant	63	71
	Control	40	43
	Total	53	60

The proportion of total household income from tree fruits increased between the baseline and end line study period for both participant and control household in all program areas, except for Passion Fruit Rift participants (Table 20). However, tree fruits generated a higher proportion of household income for participants than for controls at both the baseline and the end line, and this was consistent across program areas, female- and male-headed households, and asset groups.

Table 20. Percentage of Household Income from Tree Fruits (Estimated)

		Baseline	End Line
Avocado Central	Participant	41	54
	Control	34	42
Passion Fruit Rift	Participant	60	55
	Control	44	53
Passion fruit Central	Participant	38	49
	Control	29	43

When broken down by asset quartile the data show that households in the two lowest asset groups on average have fewer sources of income. Fewer households in the lowest asset group (Quartile 1) rank tree fruit as the number one source of income.

CHANGES IN HOUSEHOLD ASSETS

This study uses assets as a proxy indicator for household well being. The survey included a set of yes/no questions on a comprehensive list of household assets, mostly physical assets, drawing in part on a list used in Kenya’s Welfare Monitoring Survey.²⁵ The responses were used to construct an asset score²⁶ for each household in order to 1) divide the sample into asset quartiles to provide a basis for comparing the relative wealth of respondent households at the baseline, and 2) assess change in assets between the baseline and end line study periods.

Average asset scores increased between the baseline and end line for participants and controls in all program areas, except for the avocado control group.

Average asset scores increased during the study period for groups in all program areas except avocado controls, whose average asset score decreased significantly. Baseline asset scores were highest in the Passion Fruit Rift program area and similar for participants and controls. Change between the baseline and end line was minimal and significant only for the control group. By contrast, baseline assets were lowest for participant and control households in the Passion Fruit Central area. However, increases were highest there. In the Avocado Central program area, participants and controls had similar asset scores at the baseline. By the end line, asset scores for the participant groups had stayed the same, but for the control group they declined significantly (Table 21).

Looking at the data by gender of household head, baseline assets were lower for female-headed households in the control group than in other groups. However, no significant changes were found in analyzing the data by gender of household head (Table 21).

²⁵ Government of Kenya, Central Bureau of Statistics. 1997. *Second Report on Poverty in Kenya Volume II. Poverty and Social Indicators*. Nairobi. See questions 84-95 in the survey questionnaire for the list of assets.

²⁶ To statistically construct this score, the asset variables were combined and weighted. Using the Statistical Package for Social Sciences (SPSS) software, the variables were factor analyzed using a Varimax rotation. The factor analysis was statistically successful and the weightings derived were deemed appropriate. Each respondent household received a “factor score” based on the weighted value of all of the assets they listed. Statistically, this factor score is normally distributed across the sample and thus can easily be used in further statistical testing. Because factor analysis constructs scores around a mean of zero, about half the scores are negative. Because this makes the scores hard to interpret in the analysis, a constant of 2 was added to make all scores positive. This made it easier to understand and compare the findings. Based on the baseline asset scores, the total sample (participants and controls) was divided into quartiles. The range of scores in each quartile is given in Table 1. The baseline poverty status (quartile) was to be used as a basis for comparing findings across poverty groups

The largest increase in assets was for the poorest households (both participants and controls).

Households in the lower two asset groups significantly increased their asset scores between the baseline and end line, while households in the upper two asset groups decreased their scores. This was similar for participants and controls.

Summary on assets: The analysis of asset scores suggests that, as a whole, participants have higher scores than controls, Passion Fruit Rift households have higher asset scores than households in other program areas, and woman- and man-headed households have similar scores. Households in the lower half of the asset score distribution at the baseline experienced significant increases in their asset scores, while households in the upper half of the distribution experienced significant decreases. This was the case for both participants and controls, which suggests that the general upward trend in assets in poorer tree fruit households is unlikely to be related to project participation.

Table 21. Change in Mean Household Asset Scores by Program Area, Gender of Household Head, and Baseline Asset Group

		Baseline Average	End Line Average	Change	Change Significance
Avocado	Test	1.909	1.951	0.042	No
	Control	1.921	1.695	-0.226	0.0000*
Passion Fruit 1 (Rift)	Test	2.584	2.719	0.135	No
	Control	2.629	2.704	0.075	0.0010*
Passion Fruit 2 (Central)	Test	1.664	2.408	0.744	0.0000*
	Control	1.706	2.458	0.752	0.0010*
Women headed households	Test	2.020	2.164	0.144	No
	Control	1.806	2.050	0.244	No
Men headed households	Test	2.047	2.147	0.100	No
	Control	2.137	2.159	0.022	No
Asset quartile 1	Test	1.502	2.411	0.909	0.0000*
	Control	1.487	2.598	1.111	0.0000*
Asset Quartile 2	Test	1.767	2.011	0.244	0.0000*
	Control	1.781	1.866	0.085	0.0850
Asset Quartile 3	Test	1.903	1.727	0.176	0.0010*
	Control	1.905	1.631	0.274	0.0000*
Asset Quartile 4	Test	3.364	2.919	0.445	0.0010*
	Control	2.937	2.394	0.543	0.0000*
Total	Test	2.007	2.121	0.120	0.0000*
	Control	1.992	1.806	-0.126	No
	TOTAL	2.000	2.000	0.000	No

* indicates statistically significant difference at the 95 percent confidence level

C. HYPOTHESIS THREE:

GREATER INTEGRATION BETWEEN SMALLHOLDERS AND LEAD FIRMS CONTRIBUTES TO SUSTAINABILITY THROUGH INCREASED INVESTMENT AND UPGRADING IN SMALLHOLDER ENTERPRISES.

The projects succeeded in promoting upgrading in the avocado and passion fruit value chains.

As discussed earlier, the projects promoted product and process upgrading in the tree fruit value chains by developing new and improved relationships among input suppliers, service providers, training bodies and farmer groups. This has helped farmers respond to market opportunities and encouraged their continued participation in the value chains.

The research found that treefruit smallholders upgraded their treefruit enterprises in various ways:

- Introducing new varieties of tree fruit that have higher demand in export markets, such as Hass avocados. The survey found that the total number of Hass trees cultivated by participants in the program areas studied grew from 703 to 1,312 while the number cultivated by control group members increased from 79 to 730. Farmers continue to produce both varieties, as it diversifies the risk of disease and markets.
- Planting more disease resistant passion fruit seedlings—those that have purple passion fruit grafted onto heartier yellow passion fruit root stock.
- Protecting their crops through use of fertilizer and sprays.
- Beginning the process of documenting practices that comply with EUREPGAP certification (documentation required for tracability; use of chemicals, plant husbandry practices, sanitary practices).
- Selling through new market channels, for example, to avocado or passion fruit processing factories

As discussed earlier, many of these practices actually began at the start up of the project before the baseline was conducted, so the total changes have not been captured in the survey data. It is also notable that many farmers in the control group upgraded in many of these same areas during the course of the study, suggesting significant spillover effects (which are desirable from a programming standpoint). It is also apparent from both the qualitative and quantitative data that upgrading is not universal among farmers, the types of upgrading differ, and the pathways and steps to upgrading (i.e., changes in processes, products or market channels) are not always smooth or straightforward.

Nevertheless, the benefits of upgrading—for farmers and for the overall value chain—are suggested by the increases in production and productivity and higher prices received from exporters for quality fruit (see section V.B). Current benefits associated with upgrading suggests incentives for upgrading within the value chain and the potential sustainability of impacts.

Farmers invested in planting new trees or vines at the start of the project.

Investment by farmers in planting new trees and vines also suggests the potential for sustainable impacts. In the baseline survey more than half the respondents said that they had invested in planting new trees or vines in the past year, and there was little difference between participant and control groups (except for controls in the passion fruit Central area). In the end line survey, investment in new trees and vines seems to have slowed down, perhaps because most had already done all their planting they planned to do.

Productive assets increased between the baseline and end line for both participant and control groups.

Investment in productive assets is another indicator of the potential for sustainable impacts. Respondents in the sample were asked whether or not they owned a range of productive assets related to crop production, irrigation, spraying, transport and storage. The index also includes cell and fixed line telephones.²⁷ Based on these responses, a productive asset score was constructed for each household in the sample.²⁸ Change in the productive asset score was measured between the baseline and the end line to study impacts in this area.

Average baseline productive asset scores ranged from a low of 1.7 for controls in the avocado Central area to 2.4 for participants in the passion fruit Rift area (Table 22). During the study period, there were improvements in these averages for both participants and controls in the two passion fruit areas but declines for growers in avocado Central. A breakdown by household asset index scores (an indicator of household wealth) shows that significant improvements in the productive asset index were confined to smallholders in the top quartile—that is, the best-off households—in avocado Central and passion fruit Central.²⁹

Table 22. Productive Asset Index by Program Area

		<i>Baseline Mean</i>	<i>End Line Mean</i>
Avocado Central	Participant	2.074	1.790
	Control	1.742	1.575
Passion Fruit Rift	Participant	2.376	2.446
	Control	2.243	2.420
Passion Fruit Central	Participant	1.916	2.206
	Control	2.092	2.119

D. TESTS FOR PROJECT IMPACT

ANALYSIS OF ENTERPRISE LEVEL IMPACTS

The previous section described a number of changes that occurred in the program and control areas surveyed in the period between the two survey rounds. This section discusses differences in these changes between farmers in the participant and control groups in the study in an attempt to learn what impact the two projects may have had on these behaviors.

At the enterprise level, two broad types of possible program impact are defined. *Two-year productive impacts* are improvements to enterprise performance during the inter-survey period that might be measured in terms of production, productivity, and sales and can be attributed to program interventions. (That is, they would not have occurred in the absence of the program.) *Upgrading/sustainability impacts* are actions taken during the inter-survey period that portend future increases in production, productivity and sales.³⁰ These actions include tree planting, grafting of passion fruit vines, shifting to higher-value varieties (e.g., from Fuerte to Hass avocados), increased use of fertilizer and other inputs, increased use of technical advice, improved farming and marketing techniques, increased use of credit and increased participation in organizations that may help increase production and sales. The KBDS and KHDP projects are hypothesized to have impacts of both types.

²⁷ See Annex 1 for the full list of productive assets included in the index.

²⁸ The same statistical procedure was used to construct the household asset score and the productive asset score. See Annex 1 for details.

²⁹ The top quartile of farmers in Passion Fruit Rift experienced a decline in their average productive asset index.

³⁰ Employment creation would also be included here, but we have no usable data.

The original analysis plan was to test for significance of program impact in two stages. The first stage would define areas of potential program impact. These are seen as instances that meet two conditions: 1) the performance measure improves significantly (using a t-test) for program participants; and 2) participants register larger improvements than the corresponding control group. The second stage would have used analysis of co-variance (ANCOVA) to determine whether the improvement registered by program participants is significantly greater than that registered by the corresponding control group. The data problems described earlier precluded the use of ANCOVA, however, so the analysis below is based solely on the first stage of the test. Because of these data limitations, conclusions about the impact of the projects cannot be reached with a high degree of confidence on the basis of this analysis.

Even if the second-stage test had been feasible and the results were positive, it could only have shown that there was probable, not definitive, impact. The main reason for this is that no account was taken of moderating variables that might affect the comparison. In particular, selection bias might slant the measured results in a positive direction and lead to overstatement of the actual impact of the program itself.³¹ The research team tried to guard against selection bias by choosing control groups that are similar in relevant ways to the program participants sampled. If the quality of the data had warranted it, the team could have extended the analysis to include measurable moderating variables,³² but even that would not have guaranteed that selection bias was eliminated because not all moderating variables are identifiable or measurable.

A possible bias in the opposite direction is that the approach could understate actual project impacts by failing to catch spillover benefits. Especially when the spread of potentially profitable knowledge about the cultivation and marketing of widely planted crops is involved, information that is provided directly to participants through the operation of the programs may quickly pass through a variety of informal communication mechanisms to farmers who are not considered program participants, including control group members. This can lead to understatement of program benefits when these benefits are measured as differences between participants and controls. Measures were taken to lessen this problem (which is a benefit for the program more broadly) through careful selection of control groups, but the degree of success achieved is unknown.

Another point is that actions of other (non-USAID) projects could have influenced the observed outcomes. We did not investigate this possibility.

For all these reasons, our analysis identifies what we conservatively characterize as potential impact and does not claim to prove that probable, let alone conclusive, impact took place.

Statistical analysis of enterprise changes between the baseline and the end line indicates that the KBDS project had “potential impact” in the avocado Central area (on production, sales in Ksh, tree planting, and fertilizer use) and in the passion fruit Central area (on production, sales in kg. and borrowing for tree crop production). No potential impact was found in the KHDP passion fruit Rift area, where experience may have been less favorable than in other areas where KHDP operated and which we did not study.

Table 23 lists eight cases that met the two conditions of potential impact—participants improved significantly between the baseline and end line and registered larger improvements than control groups. Most cases of potential impact occurred in two of the areas studied: avocado Central and passion fruit Central. In the avocado Central area, the test shows that the KBDS project had a probable impact on the production and sale of fruit by program participants. This is consistent with qualitative evidence that suggests that the KBDS avocado program in avocado

³¹ Selection bias can be defined as the disproportionate entry into the programs of farmers who are favorably disposed toward the kinds of changes the programs are trying to bring about. It could occur either as a result of decisions made by the farmers themselves (more progressive farmers are more likely to sign up) or through selection by program agents (e.g., farmer groups might deny membership to weaker farmers).

³² For example, age and gender of farmer, size of farm.

Central was the most successful of those studied. The project also appears to have induced participants to make greater use of irrigation.

In the passion fruit Central area, production and sales also appear to have been impacted in a positive way by KBDS activities.³³ Only one other instance of potential program impact was identified: in the passion fruit Rift area the KHDP seems to have stimulated borrowing for fruit production.

Table 23. Significant Changes at the Enterprise Level

	<i>Participants increased significantly?</i>	<i>Participants increased more than controls?</i>	<i>Is the difference significant?</i>
Avocado Central: Average pieces picked	Yes	Yes	0.000
Avocado Central: Average sales in shillings	Yes	Yes	0.000
Avocado Central: New trees planted	Yes	Yes	0.425
Avocado Central: Use of irrigation	Yes	Yes	0.000
Passion Fruit Central: Average pieces picked	Yes	Yes	0.045
Passion Fruit Central: Average sales in kilos	Yes	Yes	0.018
Passion Fruit Central: Productive assets	Yes	Yes	0.575
Passion Fruit Rift: Borrowing for fruit production	Yes	Yes	0.006
Avocado Central: Average pieces picked	Yes	Yes	0.000
Avocado Central: Average sales in shillings	Yes	Yes	0.000

HOUSEHOLD-LEVEL IMPACTS

Analysis of changes between the baseline and the end line indicates that the KBDS and KHDP projects had potential impact on the household asset index for the sample as a whole. It further shows that KBDS had potential impact on the household asset index for households in the avocado Central area, whose scores stayed the same while those of the control group declined.

To assess the impact of the project on household well being, the same test was applied to the household asset scores. The findings show that for the overall sample, the participant group had a higher asset index than the control group at both the baseline and end line survey period, and the change in these differences positively (and statistically significantly) favored the participant group as they moved from the baseline to end line. Thus the advantage the participant group had in assets increased significantly over the inter-survey time period (Table 24).

³³ In the avocado Central area, sales in shillings showed a probable impact, whereas in the passion fruit Central area, it was sales in physical units (kilos). We have no explanation to offer for this anomaly.

Analysis of the survey data by program areas did not find potential impact by program area (except for offsetting a decline for participants in the avocado Central area), gender of household head or socio-economic group. Impacts on other household variables were not detected.

Table 24. Significant Changes in Assets at the Household Level

	<i>Participants increased assets significantly?</i>	<i>Participants increased assets more than controls?</i>	<i>Is the difference significant?</i>
Avocado	No	Yes	Yes *
PF Rift	No	No	Not applicable
PF Central	Yes	Yes	No
Woman headed households	No	No	Not applicable
Man headed households	No	Yes	Not applicable
Q1	Yes	No	Not applicable
Q2	Yes	No	Not applicable
Q3	Yes	No	Not applicable
Q4	Yes	No	Not applicable
All households	Yes	Yes	Yes

* The asset index for avocado Central controls declined significantly but stayed the same for participants, indicating the project may have helped offset a decline for participants.

VI. DISCUSSION OF FINDINGS

Qualitative findings highlight how KBDS and KHDP program activities influenced value chain dynamics (upgrading, inter-firm cooperation, governance patterns).³⁴ This helps to explain the changes for smallholders covered in the two-year quantitative survey, but somewhat limited impacts on sample participants. It also suggests where there may be potential for more impacts in the future.

As seen in the discussion of Hypothesis One, new actors and relationships have definitely brought smallholders closer to lead firms. The findings on Hypothesis Two show continued demand for avocados and passion fruit, and growth in production and sales for these farmers. However, the assessment did not find a lot of difference between participants and controls in the amount of change. This suggests that the new actors and relationships engaging participants have not had a major impact, at least in the time frame of this study. This section draws on qualitative data to explore some of the possible reasons and possibilities for future impact.

Analysis of the value chain shows that trust among actors is an important factor influencing the response of smallholders (and the value chain as a whole) to end market opportunities. It is a key factor in the interplay between governance patterns, inter-firm cooperation and the development of business services that promote upgrading and market linkages. Trust also influences intra-household dynamics and decision making around tree fruit production, sale and upgrading.

In general, lack of trust among actors has affected the ability of the value chain to respond fully to market opportunities. Lack of trust has affected interfirm cooperation and hampered the emergence of a more directed governance pattern in both value chains (which would enable the supply of products that meet a broader range of standards required in export markets). This, in turn, has affected incentives for upgrading.

A. DYNAMICS IN THE AVOCADO VALUE CHAIN

KBDS support had mixed results in experimenting with ways to create new relationships in the avocado value chain. While the project had success in bringing producers and exporters together through vertical linkages, the relationships have been not always been smooth. At the same time, brokers have continued to operate and offer alternative market channels. A key lesson is that it takes time for new relationships to develop, for new actors to build trust in one another, and to negotiate mutually beneficial relationships. As this happens, there will be more benefits for smallholders, lead firms and supporting markets, more incentives for investment, and a value chain that is better able to compete.

INTERFIRM COOPERATION

Horizontal cooperation. Program participants interviewed said that cooperation within their groups is good, and the groups play a useful function in linking to exporters. They provide a channel for selling Grade One avocados at higher prices than paid by brokers. Some of the groups also link farmers to oil processing firms that buy lower grade fruit that would otherwise go to waste. The groups keep records of amounts delivered and other information needed for EUREPGAP.

Within the groups, members generally trust each other and trust their leaders. Members feel they have a say in how the groups are managed and were successful in reducing the frequency of meetings to avoid wasting time. The groups self select members and do not admit farmers with fewer than five trees. They have rules, and censure members who break the rules, for example, those who ‘side sell’ to brokers. Overall, the farmers feel the groups play a useful

³⁴ Ruth Campbell. USAID Briefing Paper, “The Value Chain Framework”. No date.

function and give them a voice. Through the groups they get better prices, practice better farming techniques, and see themselves to be better off since the groups were formed.

“Groups allow farmers to speak with one voice, bring money together, and remain stronger”

Vertical cooperation. For farmers, trust is a key factor in their relationships with other actors in the value chain. At the baseline, they described their historical mistrust of exporters and brokers. At the end line, they had trust issues in their relationships with many of the new actors in the value chain.

Farmers expressed faith in EAGA as an organization, but were mistrustful of some EAGA staff buyers who have continuing relationships with brokers (who now source avocados from other areas) and who, they say, have enjoyed kickbacks from the brokers in the past. These buyers tend to reject a lot of the avocados from the groups, claiming they do not meet grading standards; however, farmers believe it is an excuse to reject their fruit so they can continue to buy from the brokers. Some farmers said that the EAGA buyers change their grading standards based on the amount they wish to buy on a given day (which sometimes also relates to the space in their truck). This discourages some of the farmers.

When it comes to brokers, avocado farmers have mixed feelings. Local brokers are easier to deal with. They are always available to negotiate directly with, and this allows farmers to choose the broker who gives the best price. However, farmers continue to rely on brokers to buy their lower-grade avocados. Some are from the locality and related to the farmers. By contrast, brokers not from the community are highly mistrusted.

Avocado farmers had persistent problems with spraying service providers. While they recognize the importance of their role in documenting the use of certified chemicals, they felt the spraying was not effective in reducing disease and increasing yields. The independent sprayers were described as ‘outsiders’ who did not know the area and could not be trusted to use the correct amount of chemicals or spray properly. When farmers tried to talk to them about their problems, they said the sprayers told them “not to ask questions.”

In terms of their relationship with Equity Bank (which finances the spraying services and deducts payments from exporters payments to the farmer groups), many of the farmers were not informed by their group leaders of their loans and did not fully understand their obligations. They were more unhappy with the spraying service than with the bank, however. They generally consider Equity Bank to be trustworthy.

Farmers also expressed dissatisfaction with the market linkage firm. Many felt it was run by outsiders and that their group leaders could carry out the linkage role just as well.

“When a project for the poor comes up there are always people who are there to divert it for their well-being.”

Trusting relationships take time to develop, so it may be too early to tell whether these problems will be overcome. However, at this time, it has affected other dynamics in the value chain: upgrading and efforts to shift to a more directed governance structure.

UPGRADING

Avocado farmers have engaged in *product upgrading*, specifically shifting to the Haas variety of avocados to take advantage of market opportunities in Europe. They do this by grafting Hass on to older Fuerte trees, and by planting new trees. At the same time, most farmers continue to grow Fuerte, which diversifies their market. Their efforts to engage in *process upgrading*—for example, through spraying to reduce disease—have not met with as much success. While the problems they have experienced are partly due to weather, and partly due to quality of the spraying services, investments in spraying have not led to benefits. The mistrust that farmers have in the sprayers has been a disincentive for investment in spraying. Spraying helps to mitigate the risks of weather and is critical for producing the

volumes and quality of avocados demanded in the export market. In this respect, issues of mistrust have played a part in undermining the upgrading process, so critical to competitiveness.

The expense of introducing practices required to meet certification standards has also undermined process upgrading. This also is critical for taking advantage of export market opportunities.

GOVERNANCE STRUCTURE

A more directed governance structure in the avocado value chain would allow it to respond more effectively to export market opportunities and would help supply fruit that meets certification standards, is traceable, ensures volumes and offers higher prices to producers. However, efforts to promote a more directed governance structure—tighter relationships and better information flow between producers, service providers and exporters through a market linkage firm and/or embedded relations—have been challenged by the following factors:

- a history of mistrust between exporters and producers
- mistrust new intermediary actors, who are seen as ‘outsiders’
- continuing problems with disease despite investments to upgrade through spraying
- alternative open market channels dominated by brokers which provide another way for farmers to sell avocados (at a lower price, but higher volume), and exporters to buy avocados (at a lower price)
- continued dominance of brokers in the value chain
- the complexity and high cost of a more directed structure that may not be suitable or sustainable for avocados

Moreover, farmers feel they do not have much power in a more directed market channel:

“Group leaders don’t really negotiate. Ideal and Fineline negotiate for us. They don’t want farmers to know certain issues since they are educated and have higher bargaining power.”

The farmers’ groups initially had an umbrella group made up of group leaders which was the main link between the farmer groups and the exporters prior to the entry of the market linkage firm. However, this umbrella group was disbanded and a new market linkage firm entered. Some farmers said that entry of this linkage firm this was “a divide-and-rule tactic” supported by exporters to reduce the power of farmers.

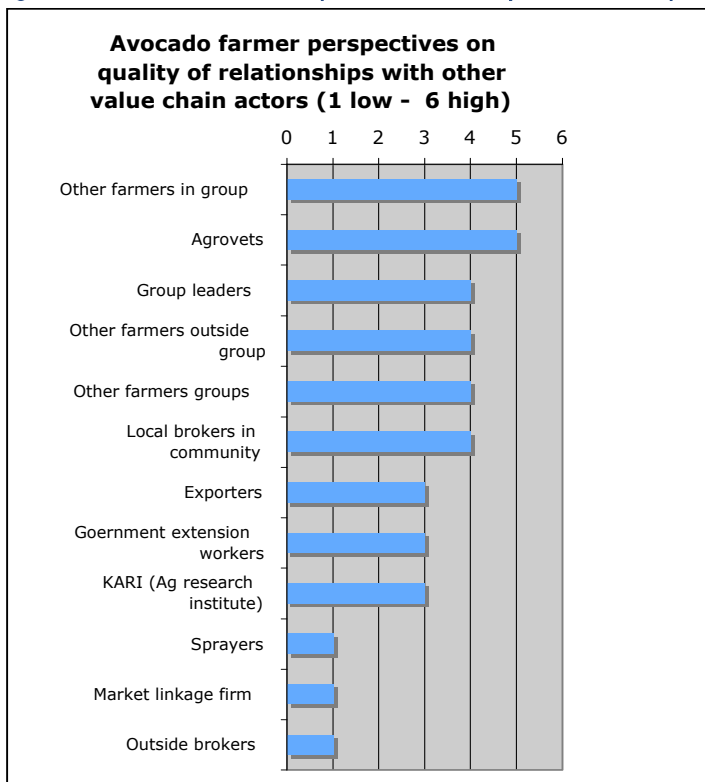
Some farmers prefer a more arm’s length relationship with buyers.

“Brokers are easier to deal with; you can have up to ten brokers on our farm and you can negotiate directly with them to get the best price.”

Some of the challenges in getting a more directed governance structure to work for avocados are indicated by how farmers in one group ranked the quality of their relationship with actors in this chain. The quality of their relationship was lower with new actors and higher with known actors.

In considering how socio-cultural factors play out as a factor affecting the value chain, qualitative data show that very poor farmers generally are not included in the groups. Group members said this is because they generally have fewer than five trees and limited time. In terms of gender, the farmer groups tend to be dominated by men; for example, although wives may attend the meetings, husbands are the registered members and hold the individual bank accounts in their name.

Figure 6. Avocado Farmer Perspectives on Quality of Relationships with Other Value Chain Actors



Source: Focus group discussion with Avocado Central participants, February 2007

B. DYNAMICS IN THE PASSION FRUIT VALUE CHAINS

INTER-FIRM COOPERATION

In general, the qualitative research found fairly good cooperation among actors in the passion fruit value chain. The main incentive for horizontal cooperation among farmers was to link to buyers, more so than to supporting markets. Farmers in the Central program areas linked to buyers through a market linkage firm and it reportedly worked well. By contrast, groups in the Rift program area did not have a mechanism to formally link to buyers, and without this incentive the groups lacked cohesiveness. In both program areas, vertical relationships in the value chain tended to reflect stronger cooperation between farmers and buyers than other actors, specifically, those in supporting markets related to process upgrading.

Horizontal cooperation. Both projects promoted horizontal cooperation among farmers through groups. In the Central program area their primarily role is linking farmers to exporters. They do not play a direct role in linking farmers to inputs or services.

In the passion fruit Rift program area, the groups played less of a formal role, mainly serving as a base for demonstration plots to promote improved cultivation practices. Male group members said their group was not cohesive and that no one could stick to prices or agreements. Although they have a constitution and are fully registered, they have no formal arrangements to sell to buyers and their activities have lapsed. By contrast, female group members said they have organized themselves into informal groups to sell to traders and brokers. As a group they negotiate a price with local buyers and pick their fruit only after they have reached agreement. This gives them more leverage with the buyers. Market linkages (even to brokers) appear to be a key incentive for groups to cooperate.

“We have a widespread agreement, no picking before selling, and this is kept.”

These informal women's groups are further held together by merry-go-rounds. They meet every Monday and collect money (usually from sales of passion fruit). Women use the merry-go-round funds to buy utensils, pay for school fees or hire labor. This suggests that there is more cooperation between women passion fruit producers than men.

Vertical cooperation. Farmers in the passion fruit Central area appear to have more trust and fewer problems with the market linkage firm compared to those in the avocado Central area. Since this particular market linkage firm focuses exclusively on links to exporters through contracts, with no involvement in links to extension services or input suppliers (other supporting markets), farmers cannot fault them for linking them to poor service providers, or blame them for diseased crops.

In the passion fruit Rift program area, the first round of qualitative research revealed a strong sense of cooperation and trust between farmers and Ugandan traders. The Ugandan brokers are all Muslim men while the producers are mainly Christian women, but this cultural difference had not affected the quality of their relationship, which appeared to be excellent. The Ugandan brokers even brought Ghanaian cloth to the women farmers from Kampala. They were in frequent contact with each other via mobile phone and met once a week on the farm of the woman who leads the informal group (she offers her farm as the central collection point).

However, as passion fruit production expanded rapidly in the Rift program area and many brokers entered the scene, the direct market link with Ugandan traders seemed to be overtaken by more diverse and aggressive market based relationships.

"This Ugandan trade has taken off. Some farmers take fruit to the border. Some Ugandans send Kenyan brokers. Some Ugandans come directly."

One social divide in the passion fruit Rift value chain is gender. Men dominate the formal activities of the passion fruit groups, while women do most of the production and selling. In one group, men attended all the training offered on passion fruit related to grafting and application of chemicals, even though it is women who do this work. Women expressed fear and lack of understanding about chemicals to prevent disease, historically a major problem in that area. They also expressed considerable lack of trust in small input suppliers in the area to direct them to safe and effective chemicals. Information on export certification standards, approved chemicals and improved production techniques flow to men through training but they do not transfer it to women, who are the main producers.

Price information flows have been facilitated by mobile phone contact between farmers and Ugandan buyers, farmers and brokers, farmers and farmers, and brokers and buyers. However, the research found in some cases information that group leaders had did not get transferred to other group members. The research found little trust between farmers and local brokers in the Rift program area (Figure 7).

UPGRADING

While production of passion fruit is expanding rapidly, upgrading in some areas is still limited and disease continues to be the major problem. While some farmers have upgraded to grafted root stock and use chemicals that meet certification standards for export, there are complaints about the effectiveness of the chemicals and benefits of investing in grafted root stock. While some of these problems are technical, closer relationships between farmers, exporters and supporting markets (suppliers of chemicals and grafted root stock) could probably help to reduce disease and further expand production of export grade fresh passion fruit. In this sense, upgrading could be promoted through a more directed governance structure in the value chain. The current unmet demand for all grades of passion fruit (for juice) may play against this, however, by reducing the incentive for many farmers to upgrade. Issues of trust would also have to be addressed in promoting closer interfirm cooperation.

Lack of trust was an issue with KARI, the agricultural research institute supplying grafted seedlings for the group demonstration plots. The first batch they provided to passion fruit Rift demonstration plots was defective and all the

plants died. Farmers in the focus groups discussed the risks associated with grafted root stock, questioned the added benefit, and expressed their reticence to invest in them. This generally reluctant attitude towards upgrading root stock might partially explain the lack of project impact among Passion Fruit Rift participants.

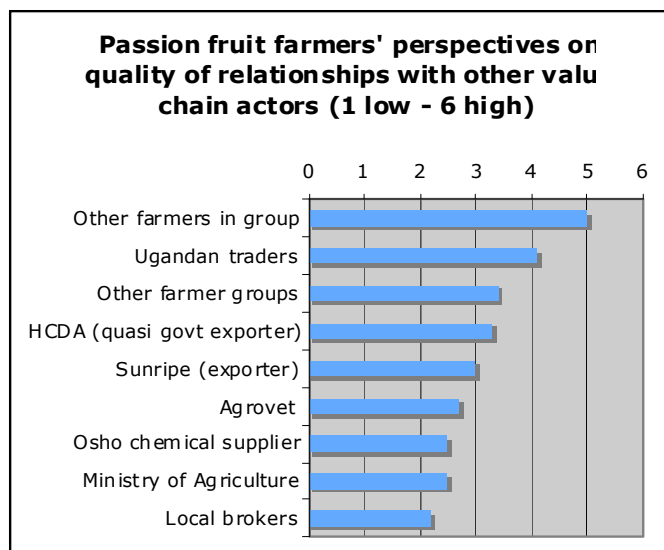
Farmers also said they did not trust input suppliers (agrovets and Osho) to provide them good information about which chemicals are safe and effective. This, in turn, has limited the success of efforts to reduce disease and meet certification standards. Passion fruit Central participants also had problems with sprays provided by suppliers; they said that heavy sprays do not meet certification and light sprays do not prevent disease.

VALUE CHAIN GOVERNANCE

The governance structure in the passion fruit value chain, for the most part, is market based. A more directed governance structure in this value chain could allow it to respond more effectively to unmet demand in domestic and export market by increasing volumes, improving quality and meeting certification standards. Supporting markets for upgrading (to reduce disease) are underdeveloped in their supply of effective chemical sprays, strong grafted root stock, technical training, and finance to farmers. A more directed governance structure bringing exporters, input and service providers, and farmers could be promoted by:

- focus on development and certification of safe and effective chemicals acceptable in export markets;
- experimentation with models to link farmers, reliable input suppliers, extension workers and buyers;
- continued technical training of farmers through groups;
- efforts to overcome farmer mistrust of chemical companies;
- continued efforts to improve the quality of grafted root stock; and
- efforts to improve the supply of grafted root stock.

Figure 7. Passion Fruit Farmers' Perspectives on Quality of Relationships with Other Value Chain Actors



Source: Focus group discussion with Passion Fruit Rift participants, February 2007

C. INTRA-HOUSEHOLD ISSUES

A number of intra-household factors can affect the supply response of farmers in the tree fruit value. This includes who assumes responsibility for doing the work in households, who makes management decisions and who controls the earnings. All of these factors can influence decisions regarding the investment of time and resources in tree fruits. Gender differences play a role in all of these areas.

For avocados, men pick and prune the trees and women do most other maintenance work. If there is a shortage of male labor within the family, women will hire male labor for picking fruit, but they also face labor shortages. Although women do most of the work cultivating avocados, group payments are made in the name of their husbands or sons. Women traditionally are responsible for negotiating with brokers, so they may lose some control over avocado income in working through groups. However, when asked about decision making, both men and women group members said that husbands and wives make decisions together about money earned from avocados. When asked who controls the income, they agreed that whoever had the cash income in hand controlled it. In most cases for avocado farmers, this is the men.

Passion fruit is mostly a woman's crop, and women make many of the decisions regarding production and sale. Men decide on the initial investment, but women make most other decisions. They also do much of the work. Men dig holes for the plants and install the poles and wire (one-off tasks) while women maintain the vines, harvest the fruit, and play a key role in sales to brokers. Men play a role in selling to exporters. Women sometimes hire male labor for picking, although they often face labor shortages, especially during the harvest season for other crops. Women's "ownership" of passion fruit is reflected in the comment of a farmer in Eldoret who accused a man of "stealing his wife's fruit and selling it for drink." Women are often the first to receive income from sales to brokers, and generally control this income. According to one woman farmer, income from the passion fruit goes to "obvious things" like school fees and paying off loans. If there is a surplus after covering these expenses, husbands and wives jointly determine the use of the surplus.

In general, decisions to upgrade, join producer groups and use income from tree fruits are joint decisions within families, with women and men both playing a role. We did not find hard evidence of mistrust in these relationships. In our field research, both men and women said that spouses usually discuss these decisions and generally agree together what to do. Reallocation of significant household capital and labor to tree fruits did not emerge as a key household issue.

VII. SUMMARY AND IMPLICATIONS FOR FUTURE PROGRAMMING

Overall, the survey of farmers shows that production and productivity are up for both avocado and passion fruit farmers in the study. Moreover, tree fruit farmers in both value chains are selling to larger numbers of export buyers. The projects have succeeded in promoting upgrading in the avocado and passion fruit value chains. Farmers invested in planting new trees or vines at the start of the project. Productive assets increased between the baseline and end line for both participant and control groups.

In Central Province, avocado farmers are linked to an expanding network of commercial relationships involving exporters, spraying service providers, grafting and pruning service providers, financial services providers and oil processing firms. Both brokers and market linkage firms are involved in intermediation; farmers depend on both to market all grades of their avocados. Horizontal relationships are promoted through farmer groups and two associations of grafting and pruning service providers. In general, the survey data showed that participants started at a higher level than non-participants on most impact indicators at the baseline. Both groups improved between the baseline and end line, and while participants stayed ahead of controls, the analysis did not show significant difference between participants and controls in the amount of change between the baseline and end line for most variables.

In the passion fruit value chain in Central Province, there also is a growing network of commercial actors, including both market linkage firms and brokers who link passion fruit farmers to exporters. However, there is a more limited number of commercial relationships involving processors, input suppliers and service providers. Research and extension work still is largely provided through government or quasi government institutions. There was a boom in the production of passion fruit in Kenya during the study. Both participants and non-participants benefited from this boom, and, as with avocados, the survey data did not show significant differences between these two groups in most impact variables.

In Rift Province, passion fruit production has taken off and many new farmers have entered the market. The survey data show that production has increased at a slower rate (although from initially higher levels) for farmers initially linked to KHDP compared to other farmers who started at a lower level of production.

Overall, the integration of smallholders into a broader network of commercial relationships in the value chains and improvements in enterprise performance were accompanied by increased importance of tree fruits as a source of household income. Within the sample, tree fruit income continued to be more important for participants than for controls. With the exception of the avocado control group, average asset scores increased between the baseline and end line for participants and controls in all program areas. The largest increase in assets was for the poorest households (both participants and controls).

Fewer female- than male-headed households were represented in the sample, but they generally had similar characteristics and experienced similar changes between the baseline and end line study periods.

IMPLICATIONS FOR FUTURE PROGRAMMING

I. START WITH AN ASSESSMENT OF END-MARKET DEMAND

A broader assessment of global, regional and domestic markets should be a starting point in efforts to improve the competitiveness of value chains that benefit the poor. In assessing the potential of a value chain to benefit producers and poor households, in general, it is critical to consider end-market demand, how to create incentives within the

value chain for meeting this demand, and how it will benefit the poor. How great is demand? Where is it? What are the roles of consumer tastes and incomes? Can the value chain meet existing demand? Can it adapt to changes in demand? What part do new technologies play? Understanding end market demand in value chains is critical, as this drives the entire system.

Understanding of Kenya's competitive position against other countries is important before developing programs that link Kenyan producers to global value chains. Who are the competitors? How is Kenya viewed among them? For example, Kenya is ranked number 72 of 180 countries in Doing Business 2008. It is ranked number 99 of 131 countries in the Global Competitiveness Index 2007-2008. The World Economic Forum ranked Kenya as relatively strong in its business and financial market sophisticated but very weak in infrastructure and technological readiness. How do buyers in end markets view Kenya? What is Kenya's competitive advantage?

In the case of tree fruits, Kenya's competitiveness in the EU market is questionable at this time. Future growth of the industry may have to rely primarily on domestic and regional markets.

2. IDENTIFY SYSTEMIC WEAKNESSES THAT AFFECT THE FUNCTIONING OF THE VALUE CHAIN

Another role that donor projects can play at the start is to identify systemic weaknesses in a value chain that affect its ability to respond to markets. In the case of the avocado value chain, the lack of an effective intermediation function between farmer groups and exporters was a weakness that was not sufficiently identified at the beginning of the project. By default, KBDS initially played this function, and eventually commercialized the function and turned it over to a market linkage firm. The transition was challenging, and things might have been smoother if this function had been commercialized from the start.

3. CREATE INCENTIVES FOR THE DEVELOPMENT OF BROADER AND DEEPER NETWORKS OF COMMERCIAL RELATIONSHIPS SUPPORTIVE OF SMALLHOLDERS

The commercialization of previously non-commercial but essential functions and the 'layering' of commercial relationships can result in benefits and incentives for behavior changes that improve the functioning of a value chain. The network of commercial relationships that developed in the avocado value chain has resulted in benefits to smallholders in terms of higher prices. Higher volumes and better quality of Hass avocados have enabled Kenyan exporters to respond to market opportunities in Europe during months when the supply from other countries is low. The improved network of commercial relationships supporting smallholders and the flow of benefits to them have provided an incentive for farmers to upgrade processes and products related to avocado production.

4. RECOGNIZE THAT IN ANY ONE VALUE CHAIN THERE ARE MULTIPLE WAYS TO PERFORM A FUNCTION AND MULTIPLE ACTORS WHO CAN PERFORM THEM

There may not be one better or worse model for performing functions in a value chain. In the avocado value chain, for example, spraying services were provided in three different ways: vertically integrated (embedded), third party specialized (independent) and combined with other input services. As in the case of Kenyan avocados, multiple actors can be involved in providing these services. Programs to promote the development of value chains should recognize there is more than one way to provide a service, and this can improve the overall functioning and competitiveness of the value chain.

5. FARMER GROUPS CAN CREATE EFFICIENCIES IN BRINGING FARMERS INTO A BROADER AND DEEPER NETWORK OF COMMERCIAL RELATIONSHIPS IN THE VALUE CHAIN

Farmer groups, in and of themselves, will not integrate smallholders into value chains. Rather, it is the function that groups play in bringing farmers into a network of commercial relationships in the value chain. For example, farmer groups can play a role in organizing collection points, scheduling deliveries, keeping records, processing payments,

negotiating supply contracts and organizing horticulture services. These functions create horizontal efficiencies in linking producers to buyers and supporting markets. The groups add value when collective action and cooperation lead to specific benefits such as decreased transaction costs, better access to information, and links to services needed for upgrading.

6. ACCEPT THE REALITY OF COMPETITIVE PRESSURES THAT FOSTER SYSTEMIC CHANGE IN THE VALUE CHAIN

Competitive pressure should be part of any market facilitation strategy. Competitive pressure was evident in the passion fruit Central program area, with the entry of several export buyers and several independent market linkage firms. It also was evident in the the avocado value chain with the entry of four processing firms in the Central program area during the course of the study.

7. THINK BEYOND TRAINING

Training can play an important role in improving knowledge and skills of value chain actors. However, meeting market requirements (such as EUREGAP standards, quality standards, and so on) goes beyond filling knowledge gaps through training. Meeting market requirements depends on how the system functions in terms of the types and conduct of relationships and whether there are incentives for innovations that make it more competitive. This, in turn, depends on a flow of benefits that support effective relationships and innovation. Value chains will be better equipped to respond to end market demand if: 1) training goes beyond knowledge transfer to the promotion of behavior change in the value chain -- in terms of relationships (interfirm cooperation) and innovation; and 2) the system generates a flow of benefits to actors in the value chain as benefits are the main incentive to change.

8. VALUE CHAIN FINANCE SHOULD FOLLOW, NOT LEAD, THE FORMATION OF WIN-WIN RELATIONSHIPS AND BE LINKED TO THE GROWTH PROCESS

Finance first can be a problem for smallholders and other value chain actors if it does not increase income beyond the cost of finance. For example, meeting certification requirements (e.g., EUREPGAP standards) does not necessarily result in higher prices or farmer income; the costs of upgrading are not reflected in higher prices or farmer income. Benefits of upgrading to meet these standards do not flow to farmers (it is not a win-win relationship), so borrowing to cover these costs does not make sense.

9. CONSIDER SUSTAINABILITY OF VALUE CHAIN FUNCTIONS FROM THE BEGINNING

This is a driving principle of private sector development programs, but it does not always play out in the design of development projects. ‘Jump-starting’ certain value chain functions or targeting certain groups within value chains often involves subsidies. The ‘hand-holding’ function played by the KBDS project with avocado farmers at the beginning of the project may have made it more difficult for the commercial market linkage firms to enter the value chain. A vision of the longer-term systemic implications of targeting and subsidies should be considered ahead of time.

10. FLEXIBLE APPROACHES TO EXPERIMENTATION CAN PROMOTE INNOVATION AND LEARNING

Flexibility in programs provides an opportunity for innovation and learning. The private sector is dynamic and not always predictable, particularly in global markets. Interventions to improve the competitiveness of value chains and benefit the poor are relatively new. Innovation can be risky and the outcomes uncertain. Flexible approaches that support experimentation and learning—regardless of their success or failure—generate learning and hold promise of

finding new ways to jolt the system. In supporting value chain projects it is perhaps useful to think not only of profits and losses but also of gains and benefits in the short, medium and long terms.³⁵

One future programming idea growing out of these two projects in Kenya would be to experiment with three different approaches to linking smallholders to exporters. Each approach would be a variation on who brings smallholders together, promotes upgrading, sees that quality standards are met, and manages the logistics of getting products from smallholders to exporters:

- Exporters play this role
- A third party intermediary plays this role
- Farmers play this role

A learning question for the experiment would be how temporary subsidies can be used while minimizing market distortions.

II. CONSIDER A RANGE OF METHODOLOGIES TO STUDY IMPACTS

A final note concerns the challenge of evaluating the impact of value chain development programs. One lesson is that it has not been possible to take a simple approach, given the complexity of both the avocado and passion fruit value chains, the dynamic conditions surrounding them, and the nature of the interventions. Mixed methods are needed. We have learned the value of starting with an assessment of the structure and dynamics of the value chain in order to understand where the interventions fit in, how they are working, and what results they are having. We have also learned the need for evaluators to be realistic about difficulties of isolating the impact of interventions in the private sector. Finding a control group willing to stand back while others benefit is not easy.

In studying impacts, it is important to consider a range of qualitative and quantitative research methodologies and select those that match the particular policy or programmatic questions being asked, and the nature of the intervention.

Finally, it is important to be realistic about the time frame of impacts. If the aim is to achieve short-term impacts, then programs should support interventions that can be expected to have results in a short time frame. In the case of Kenya tree fruits, KBDS and KHDP were able to encourage the entry of new actors (by buying down their risk) and facilitate new relationships—some better than others. However, as time-bound projects they were not well positioned make dramatic changes in Kenya’s competitiveness. Nor could they rush the process of building trust, which has historical and socio-cultural dimensions that have had a profound influence on the functioning of the overall value chains.

³⁵ See: “Learning from Program Evaluation An Interview with Jonathan Mouton.” *Carnegie Reporter*, Vol 4 No 3. Carnegie Corporation of New York. Fall 2007.

ANNEX

Table I. Description of Household Asset Score

Asset Group	Baseline Range of scores for each quartile (total sample)	End Line Range of scores for each quartile(total sample)
Quartile 1	0 – 1.65	0-1.52
Quartile 2	1.66 – 1.81	1.53-1.89
Quartile 3	1.82 – 1.96	1.90-2.53
Quartile 4	1.97-10.45	2.54-8.92

HOUSEHOLD ASSET SCORE INDEX

The following assets were selected to indicate a household/farm’s standard of living:

Wall material is cement, stone or brick	Donkey or camel	TV color
Roof material if corrugated iron sheet or tile	Watertrough	Radio
Two-storey house	Knapsack sprayer	Radio cassette player
Sofa set	Motorized sprayer	Cell phone
Piped water	Drip irrigation	Fixed phone
Metal ladder	Sprinkler	CD player
Wheelbarrow	Storeroom	HiFi system
Hand cart	Trailor	Sewing machine
Animal cart	Gas or electric stove	Vacuum cleaner
Tractor	Gas or electric oven	Pickup or car
Plough for a Tractor	Freezer	Motorcycle
Plough for oxen	Pressure lamp	Bicycle
Borehole/dam	Generator	Truck or lorry
Water pump	Battery system for electricity	Floor material
	Electricity	
	TV black and white	

A wide variety of selected attributes helps to describe a complex reality called standard of living. Statistically, these variables were combined and weighted. Using the Statistical Package for Social Sciences (SPSS) software, the variables were factor analyzed using a Varimax rotation. The factor analysis was statistically successful and the weightings derived are deemed appropriate. Each Respondent Household receives a “factor score” based on a calculation involving the values of the variables listed above. This factor score is statistically normally distributed and thus can easily be used in further statistical testing. In order to make the score more compatible with the initial baseline asset index and to make all scores positive, a constant of 2 was added to the statistically derived scores (since some of the scores were negative). The new *Asset Index* thus ranges from 0 to 10. As opposed to the original baseline analysis, these scores were not grouped. Thus they retain the statistical power of interval variables.

PRODUCTIVE ASSET SCORE INDEX

Metal ladder	Sprinkler system	Hammer
Wheelbarrow	Water tank for farm or house and farm	Mask for spraying
Hand cart	Water pump	Gloves for spraying
Tractor	Picking crates	Apron for spraying
Plough for tractor	Store room specifically for fruit	Boots for spraying
Plough for oxen	Trailer (is that what is meant by "trailer"?)	Cell phone
Borehole/dam on farm	Shovel	Fixed phone
Water pump	Jembe (hoe)	Donkey/camel
Knapsack sprayer	Slasher	Pickup or car
Motorized sprayer	Panga	Truck or lorry
Wire		Motorcycle
Irrigation equipment (pipes)		Bicycle
Drip irrigation system		

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