VCA4D
VALUE CHAIN ANALYSIS FOR DEVELOPMENT

agrinatura for European Commission

Green beans value chain in Kenya

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The information and knowledge produced through the value chain studies are intended to support the Delegations of the European Union and their partners in improving policy dialogue, investing in value chains and better understanding the changes linked to their actions

VCA4D uses a systematic methodological framework for analysing value chains in agriculture, livestock, fishery, aquaculture and agroforestry. More information including reports and communication material can be found at: https://europa.eu/capacity4dev/value-chain-analysis-for-development-vca4d-

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ACRONYMS

AAK	Agrochemicals Association of Kenya
AFA	AgriFood chain Analysis; software for economic analysis of value chains
AFFA	Agriculture, Fisheries and Food Authority
AIRC	Agricultural Information Resource Centre
ASAL	Arid and Semi-Arid Lands
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASCU	Agricultural Sector Coordination Unit
ASDS	Agriculture Sector Development Strategy
AU	African Union
CAGR	Compounded Annual Growth Rate
CIF	Cost Insurance and Freight
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
COLEACP	Europe-Africa-Caribbean-Pacific Liaison Committee
COMESA	Common Market for Eastern and Southern Africa
DAP	Di-ammonium Phosphate
DEVCO	EC *Directorate-General for International Cooperation and Development (DG DEVCO)*
EAC	East African Community
EAG	East African Growers
EASEED	East African Seed Company Limited
EC	European Commission
EDES	Strengthening Food Safety Systems through SPS measures
ERC	Energy Regulatory Commission
EUD	European Union Delegation
FAK	Fertiliser Association of Kenya
FAO	Food and Agriculture Organization of the United Nations
FAQ	Fair Average Quality
FB	French beans, term used synonymously with green beans (GB)
FBVC	French beans value chain
FCI	Farm Concern International
FEWSNET	Famine Early Warning Systems Network
FFM	Fit for Market
FPEAK	Fresh Produce Exporters Association of Kenya
FTF	Feed the Future
GBP	Great British Pound
Ha	Hectare
AFA-HCD	Agriculture and Food Authority – Horticultural Crops Directorate
HCD	Horticultural Crops Directorate
ICBT	Informal Cross-Border Trade
IFPRI	International Food Policy Research Institute
IGS	Intermediate Goods and Services
IPDM	Integrated Pest and Disease Management
ITC	International Trade Centre
JKIA	Jomo Kenyatta International Airport

KAINet	Kenya Agricultural Information Network
KALRO	Kenya Agricultural and Livestock Research Organization
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Services
Kg	Kilogram
KHE	Kenya Horticultural Exporters
KNBS	Kenya National Bureau of Statistics
KES/KSh	Kenyan Shilling
MoALF	Ministry of Agriculture, Livestock and Fisheries
MRLs	Maximum Residue Limits
MT	Metric Tonne, Ton
NGO	Non-Governmental Organization
NPK	Nitrogen, Phosphorus, Potassium
NRI	Natural Resources Institute, University of Greenwich
PCPB	Pest Control Products Board
PHL	Post Harvest Losses
PIP	Pesticides Initiative Programme
PMG	Producer Marketing Group
PMU	Project Management Unit
ppb	Parts Per Billion
PSDA	Promotion of Private Sector Development in Agriculture
RRA	Rapid Rural Appraisal
SACCO	Savings and Credit Cooperative Society
SHG	Smallholder groups
SHF	Smallholder farmers
SNV	Netherlands Development Organisation
SPS	Sanitary and Phyto-Sanitary
Sqm	square metre, m^2
SSA	Sub-Saharan Africa
T/ha	Metric tonnes per hectare
UK	United Kingdom
USAID	United States Agency for International Development
USAID-KAVES	Kenya Agricultural Value Chain Enterprises Project
USAID-KHCP	Kenya Horticulture Competitiveness Project
VA	Value addition
VAT	Value Added Tax
VC	Value Chain
VCA4D	Value Chain Analysis for Development

Exchange rates (April to June 2017)

US Dollar (USD) 1 = Kenyan Shillings (KES) 103.

Euro (EUR) 1 = Kenyan Shillings (KES) 110 – 118; exchange rate of EUR 1 = KES 115 taken for analysis.

Great British Pound (GBP) 1 = Kenyan Shillings (KES) 129 – 134.

EXECUTIVE SUMMARY

The authors would like to thank the stakeholders of the Kenyan green beans value chain for their support and information provided during the course of this study. In particular, thanks are due to the many farmers, processors, traders, private sector organizations, and government officials who have freely given of their time and provided information. The support and encouragement by colleagues and the PMU are gratefully acknowledged. We are grateful to the EC *Directorate-General for International Cooperation and Development (DEVCO)* and the EU Delegation to the Republic of Kenya for funding and supporting the study. The views expressed in this report are those of the authors and do not necessarily represent the views of EC DEVCO or the EU Delegation in Nairobi.

1 SUMMARY AND RECOMMENDATIONS

1.1 Functional Analysis

Green beans (also called French beans in this report; "Vigna spp., Phaseolus spp.") are almost exclusively produced for the export of fresh or processed (e.g. canned) beans. In particular, the export of fresh green beans dominates the value chain. The total quantity of green beans produced in 2017 is estimated to be 62,092 MT, produced on 7,542 hectares of land, which would give an average yield of 8233 kg per hectare. The yields vary from about 6,000 kg/ha to 12,500 kg/ha, depending on the farming practices, varieties grown (e.g. for export of fresh or processed produce), and general agricultural production conditions (e.g. availability of water through rainfall or irrigation). Green beans are considered a labour- intensive crop in that several agricultural activities demand substantial inputs of manual labour (in particular harvesting, but also planting, irrigation, weeding, spraying of chemicals, and fertiliser application). Even mechanised farms, which would use tractors for land preparation and pump irrigation (together with pivot or drip irrigation systems) still rely on large numbers of hired workers to undertake manual tasks. The daily wage rates for hired workers are of the order of KES 250 – 300 per day in rural areas. In urban areas (e.g. Nairobi) daily wage rates are about KES 500 per day.

The green beans value chain can be considered a medium size value chain in that it is smaller than the value chains of major staple foods in Kenya (e.g. maize). However, it is still substantial, in that it is a major foreign exchange earner for the country, and a contributor to poverty reduction in that about 52,000 producers (i.e. mainly smallholder farmers) and a large number of hired workers (about 40,000 to 70,000) in fields (belonging to both small and large-scale farms) and factories earn at least part of their livelihoods from green beans. In addition, the domestic part of the trading sector employs about 147 brokers, 357 wholesale traders, and 2700 retailers. Wholesalers and especially retailers also trade in other horticultural produce besides green beans.

The annual value of fresh green beans exported is of the order of KES 7.87 billion (€68.4 million), which is based on an export quantity of 34,215 MT of fresh green beans in 2016 (ITC statistics, June 2017), and an average export value of KES 230 per kg. The main export markets for fresh green beans are United Kingdom, followed by Netherlands and France. The quantity of processed beans exported has been 898 MT in 2016 (according to ITC statistics, June 2017), however a new processing company has started production towards the end of 2016, and it is expected that export quantities are of the order of 2100 MT in 2017. The main importing countries of processed beans are France, followed by Belgium and United Kingdom.

Fresh beans exports range from loosely packed produce to beans that have undergone a substantial amount of value addition in the form of sorting, trimming, packaging in small units on trays or punnets, weighing and packing. The export of both fresh and processed green beans entails substantial post-harvest losses in the form of beans rejected for export and wastage, considered to be 42% in the case of the fresh beans value chain, and 30% in the case of the processed beans value chain. The beans rejected for export are mainly used for three different purposes, namely: (a) domestic consumption in Kenya by households, restaurant and hotel customers, or institutional buyers such as schools; (b) use of green beans as animal feed, whereby livestock keepers obtain beans from farmers or packhouses after sorting of the produce; and (c) beans used as compost in that those beans that have not been harvested or sorted out in the field

are ploughed into the field. The total quantity of green beans rejected for export and entering the three domestic sub value chains is estimated to be 8569 MT p.a. in each case (i.e. 25,706 MT in total).

The bulk of the analysis is based on market prices, including for land value given that a substantial proportion of land is hired for bean production.

1.2 Economic analysis

The economic analysis consists of four parts, namely, (1) Financial analysis, (2) Effects within the national economy, (3) Viability within the global economy, (4) Growth inclusiveness.
The financial analysis shows that large-scale farms and smallholder farmers (SHF) who have links with exporters (e.g. contracts), operate efficiently and can make a profit. Scattered smallholder farmers (i.e. those without links), appear to struggle to make significant income from green beans production on a continuous basis. Occasionally, they may make a high income when green beans farmgate and export prices are high, but this is counterbalanced by periods of low prices when they make little income. Also, due to lack of organisation into groups, they rely on brokers for the sale of their produce, which tends to reduce their farmgate price. Smallholder farmers producing for the canning industry only make a small profit from green bean production which is partly due to their small plot size (i.e. 200 sqm) and the low price they obtain for their produce.

As for the economic analysis (Table 1-1, and Figure 1.1), value added includes wages, rented land, financial charges, taxes, depreciation, and operating profits (i.e. KES 7.8 billion in total, including both direct and indirect value addition). In addition, imported inputs are estimated at KES 1354 million, and remaining, intermediate goods and services (IGS) are KES 227 million. It is large-scale producers and smallholder farmers (SHF) with links to exporters, that generate the highest value addition in the production part of the value chain (totals of KES 1.2 billion and KES 1.3 billion respectively, which excludes imports and remaining IGS). There are only few large-scale farms producing beans for the canning industry, and given that the latter is only small compared to the export of fresh produce, total value addition is relatively small (KES 39 million). Scattered SHF producing for packhouses and SHF producing for canning factories generate the remainder of value addition on the production side (totals of KES 471 million and KES 77 million, respectively). The value of hired labour created by green bean production is about KES 1.27 billion, bearing in mind that even smallholder farmers require hired workers for labour intensive activities such as harvesting. The value of net profit generated by smallholder farmers is about KES 1 billion, which also covers their family labour inputs.
As for processors, it is packhouse operators who are responsible for the highest amount of value addition of the entire green beans value chain (i.e. about KES 3.9 billion in total p.a.), compared to a total value addition of the value chain of KES 7.8 billion. About KES 2.4 billion represent profits for packhouse operators and other agents active in this part of the value chain (e.g. suppliers of inputs such as energy or materials required by packhouses). Packhouses and processing factories (e.g. canning industry) that have relatively recently started their business are likely to be saddled with debts, resulting in substantial financial charges and lower profits. Total value addition created in the form of labour is KES 955 million per annum, out of which KES 839 million is generated by the packhouse industry, and the remainder by the canning industry.

Domestic trade has been subdivided into brokers, who operate as agents on behalf of fresh produce exporters, mainly buying from farmers that are scattered (i.e. without direct links or contracts with exporters) and then selling to packhouse operators. Another group of traders encountered are wholesalers and retailers dealing with green beans that have been rejected for export, and which are consumed by local households, in restaurants, hotels, or institutional consumers (e.g. schools). It is estimated that one third of green beans rejected for export (i.e. 8,569 MT p.a.) enter the domestic human consumption chain. The total value addition generated in trading is of the order of KES 199 million, 106 million, and KES 210 million, respectively. The total value addition created through labour in the trading sector is KES 86 million, which may be in the form of driving trucks as part of transport, or handling of produce.

The remaining two thirds of green beans rejected for exports (i.e. 17,137 MT) are either used for animal feed (worth KES 85 million), or as compost. In the latter case, producers (e.g. large-scale farmers) plough green beans into the ground.

The green beans value chain of Kenya is well integrated into the local economy, which is reflected by a coefficient of 0.83 (i.e. total value added of KES 7.8 billion divided by a total value of production of KES 9.4). A domestic resource cost (DRC) ratio of 0.36 shows that the value chain is viable within the global economy.

Table 1-1 Summary of total production, value addition, and imports per stage in the value chain, and by enterprise groups (KES p.a. & Euro p.a.) provides a summary response to the economics related framing questions of the assignment.

Stages:	Green beans production					Processing: fresh exp & canning		Trade: brokers, wholesalers & retailers			Total production (KES p.a.) & value addition	
in KES **Current, average situation**	**Large farms (canning)**	**Large farms (fresh exports)**	**SHF linked (fresh exports)**	**SHF scattered (fresh exports)**	**SHF linked (canning)**	**Packhouses**	**Canning factories**	**Brokers**	**Wholesalers**	**Retailers**		**Total, current**
IGS Imports	5,073,819	330,060,749	119,452,824	50,372,739	9,735,880	637,189,122	124,475,531	33,625,086	7,240,557	36,845,440	**IGS Imports**	1,354,071,748
Remaining IGS	762,317	36,494,722	18,032,013	9,303,334	1,576,344	108,576,830	30,359,470	9,438,621	1,970,803	10,282,448	**Remaining IGS**	226,796,902
Rented land	174,450	4,856,957	19,663,793	16,386,494	1,466,667	7,148,491	3,705,010	-	-	-	**Rented land**	53,401,862
Hired labour	14,897,563	558,552,737	410,526,672	267,578,211	16,876,552	839,420,619	115,165,356	38,344,397	5,869,564	41,986,664	**Hired labour**	2,309,218,335
Financial charges	2,018,240	68,467,371	16,063,589	7,480,893	1,396,032	320,233,557	96,408,656	4,719,310	985,401	5,141,224	**Financial charges**	522,914,274
Taxes/dues	1,844,641	49,932,663	27,329,998	15,105,333	2,290,904	241,623,177	23,293,078	20,057,069	11,824,816	61,694,690	**Taxes/dues**	454,996,369
Subsidies	-	-	-	-	-	-	-	-	-	-	**Subsidies**	-
Depreciation	4,221,000	226,821,853	29,495,690	12,289,871	4,400,000	163,840,971	36,000,000	-	-	-	**Depreciation**	477,069,385
Net profit	16,007,970	258,588,810	775,228,526	152,405,539	50,257,621	2,374,310,089	75,028,094	129,781,034	87,786,403	101,110,743	**Net profit**	4,020,504,829
Sums, total production	**45,000,000**	**1,533,775,862**	**1,415,793,103**	**530,922,414**	**88,000,000**	**4,692,342,857**	**504,435,196**	**235,965,517**	**115,677,545**	**257,061,210**	**Sums, total prod**	**9,418,973,704**
VA, excl imports and remaining IGS	39,163,864	1,167,220,391	1,278,308,267	471,246,341	76,687,776	- 3,946,576,905	349,600,195	- 192,901,810	106,466,184	209,933,322	Sums, VA	7,838,105,055

in Euro	Exchange rate (KES/Euro):		115									
											Total production (Euro p.a.)	
Current, average situation	**Large farms (canning)**	**Large farms (fresh exports)**	**SHF linked (fresh exports)**	**SHF scattered (fresh exports)**	**SHF linked (canning)**	**Packhouses**	**Canning factories**	**Brokers**	**Wholesalers**	**Retailers**	**& value addition**	**Total, current**
IGS Imports	44,120	2,870,093	1,038,720	438,024	84,660	5,540,775	1,082,396	292,392	62,961	320,395	**IGS Imports**	11,774,537
Remaining IGS	6,629	317,345	156,800	80,899	13,707	944,146	263,995	82,075	17,137	89,413	**Remaining IGS**	1,972,147
Rented land	1,517	42,234	170,990	142,491	12,754	62,161	32,217	-	-	-	**Rented land**	464,364
Hired labour	129,544	4,856,980	3,569,797	2,326,767	146,753	7,299,310	1,001,438	333,430	51,040	365,101	**Hired labour**	20,080,159
Financial charges	17,550	595,368	139,683	65,051	12,139	2,784,640	838,336	41,037	8,569	44,706	**Financial charges**	4,547,081
Taxes/dues	16,040	434,197	237,652	131,351	19,921	2,101,071	202,549	174,409	102,824	536,476	**Taxes/dues**	3,956,490
Subsidies	-	-	-	-	-	-	-	-	-	-	**Subsidies**	-
Depreciation	36,704	1,972,364	256,484	106,868	38,261	1,424,704	313,043	-	-	-	**Depreciation**	4,148,429
Net profit	139,200	2,248,598	6,741,118	1,325,266	437,023	20,646,175	652,418	1,128,531	763,360	879,224	**Net profit**	34,960,912
Sums, total production	**391,304**	**13,337,181**	**12,311,244**	**4,616,717**	**765,217**	**40,802,981**	**4,386,393**	**2,051,874**	**1,005,892**	**2,235,315**	**Sums, total prod**	**81,904,119**
VA, excl imports and remaining IGS	340,555	10,149,743	11,115,724	4,097,794	666,850	- 34,318,060	3,040,002	- 1,677,407	925,793	1,825,507	Sums, VA	68,157,435

TABLE 1-1 SUMMARY OF TOTAL PRODUCTION, VALUE ADDITION, AND IMPORTS PER STAGE IN THE VALUE CHAIN, AND BY ENTERPRISE GROUPS (KES P.A. & EURO P.A.)

Nb: The figures reflect total production, as well as total value addition within the value chain. The value addition in this case (total production minus IGS imports and remaining IGS) includes both direct and indirect value addition.

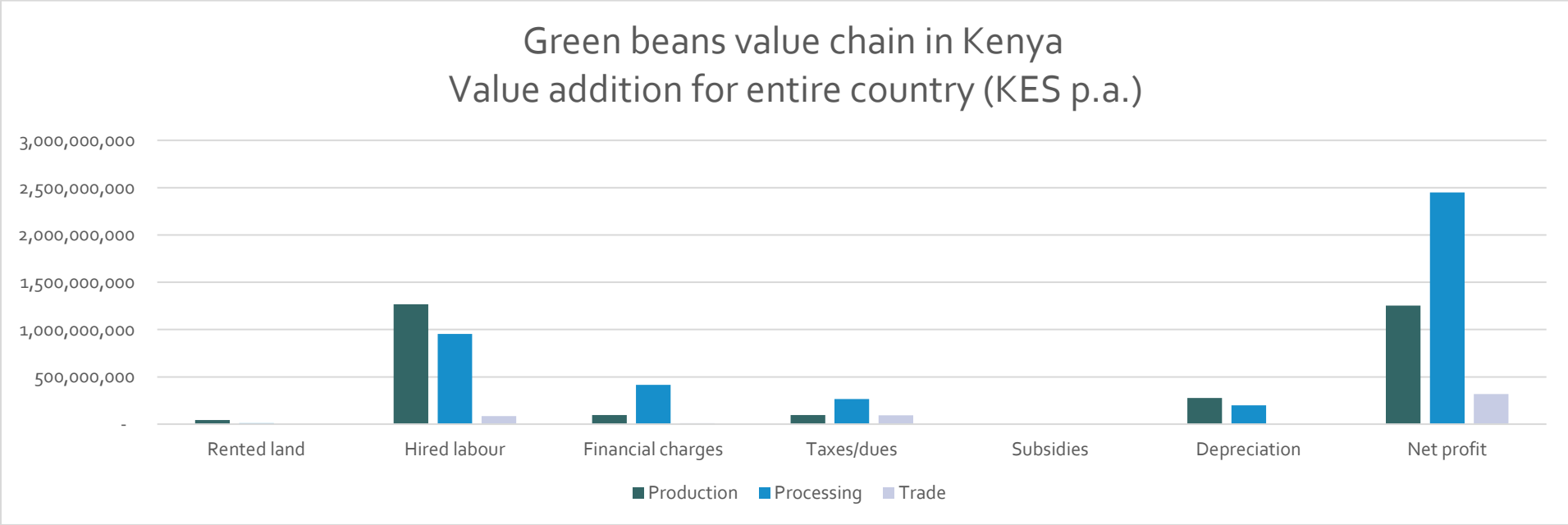


FIGURE 1.1: TOTAL VALUE ADDITION BY GREEN BEANS VALUE CHAIN IN KENYA

Analysis		Key Issues/observations/conclusions
Framing Question	*Core Questions*	
What is the contribution to Economic Growth (*Required indicators: profitability, value added, public funds balance, balance of trade, nominal protection coefficient, domestic resource cost ratio*)	*How sustainable are the VC activities for the entities involved?* *What is the contribution of the VC to GDP?* *What is the contribution of the VC to agriculture sector GDP?* *What is the contribution to public funds?* *What is the contribution of the VC to the balance of trade and balance of payments?* *Is the VC economically sustainable at the international level?* *What are the risks of growth sustainability at each level of the VC?*	• The VC activities are sustainable for the entities involved, in that all value chain agents are making a profit. At the same time, there is some fluctuation as far as smallholder producers of green beans are concerned. Partly, this may be the result of their need to rotate crops, but also some farmers may be deterred from producing green beans on a continuous basis due to risk (e.g. pests and diseases, and fluctuating demand) or the low profit margins that can be achieved. • The contribution of the green beans value chain to the agriculture sector GDP of Kenya is 0.33%. • The contribution of the green beans VC to public funds is KES 455 million. • The net contribution to the balance of trade is KES 7.1 billion which represents 1.5% of total annual exports. • The green beans value chain of Kenya is well integrated into the local economy, which is reflected by a coefficient of 0.83 (i.e. total value added of KES 7.8 billion divided by a total value of production of KES 9.4). • A domestic resource cost (DRC) ratio of 0.36 shows that the value chain is viable within the global economy. • Risks of growth sustainability at each level of the VC include, at production level, not enough support for smallholder organisations, climate change (e.g. water shortages, increase of pests and diseases), declining soil fertility, and at processing/export level, competition from other exporting countries, exports not meeting overseas markets food safety and other regulations, exporters neglecting workers' rights making produce difficult to accept in overseas markets, insufficient capacity building of brokers playing an intermediary role between exporters and scattered producers.
Is this economic growth inclusive? (*Required indicators: total*	*How is income distributed through the VC levels and actors?* *How is employment distribution in the value chain?*	• The value of hired labour (KES 2.3 billion in total) represents 29% of value addition, compared to profits of packhouse operators (30%), and farmers (16%). It should be noted that the latter also includes family labour. • Labour income is split between different sub-sectors of the value chain, with large farms for export of fresh green beans (29%) and packhouses (also 29%) representing the main employers. Other important

farm income, total wages, income distribution, number of jobs)	*How are marginalised groups involved in the VC?*	employers include smallholder farmers (SHF) with links to exporters (19%), and scattered SHF without links (13%). • It is estimated that women represent 80% of the workforce involved in the VC. Smallholder farmers produce around 60% of total French bean output and their farms represent 48% of the land currently under FB production. The labour intensive production and processing stages provide employment opportunities for 40,000 – 70,000 people who might otherwise have limited options to earn an income. • The marketing and governance arrangements in the Kenyan green beans value chain resemble a combination of hierarchical and multi-polar governance system with overseas retailers (in the driver's seat) and Kenyan packhouses playing a lead role. Smallholder farmers are underrepresented at all levels. A comparison of the value chain sub-sectors shows that the farmgate price in the case of fresh exports is 26% of the export (FoB) price, whilst it is 16% in the case of canned green beans. At the same time, the farmgate price of fresh green beans in Kenya represents about 8% of the sales price in UK supermarkets.
	Impact of the organisation/governance on income distribution?	

TABLE 1-2: ECONOMIC ANALYSIS – SUMMARY RESPONSE

1.3 Environmental analysis

To evaluate the environmental impacts of the main French bean value chains for export in Kenya, an LCA study was done, including a critical review (Annexe 4). The more precise question asked was: what are the environmental impacts from the main French bean value chains in Kenya on the three commonly-used areas of protection: Human health, Ecosystem quality and Resources.

Methods

The fresh and the canned French bean value chains for export to the UK were both evaluated from a cradle-to-market-gate perspective using 1 kg of raw French bean processed as a functional unit. During field visits and later by the local team of experts primary data were collected for all inputs and outputs (yield and rejects) for a sample of 33 farms over 5 counties and 2 packhouses for the fresh French bean value chain and for a sample of 9 farms over two counties and 1 canning factory for the canned French bean value chain. In accordance with the other dimensions of the evaluation, a typology of the farm systems was proposed to account for the diversity of situations. Overall, 4 farm types were defined for the fresh FB: one large-farm, one medium-farm, one small-holder farm contracted and one small-holder farm scattered and 2 for the canned FB: one large-farm and one small-holder farm contracted. The life cycle of the products consisted of 5 main stages: agricultural production (cradle-to-farm-gate), transport by road before processing, processing (packhouse or canning factory), transport by road after processing, intercontinental transport by air-freight for fresh FB and by sea-freight for canned FB.

Overall, the field work was very intensive and certain gaps had to be filled, especially for water use and energy use for irrigation. Pesticide applications particularly required an intense work to collect and describe the 33 different pesticides used over the farm sample. Data from the processing stage: packhouse and canning factory were also difficult to collect and assumptions had to be made. Overall, the data collected constituted a reasonably reliable dataset with a Data Quality Index of 2.3, corresponding to “basic quality”. Best available methods for field emissions were used and adapted when possible to local conditions such as for the estimation of P losses. For background processes two consistent inventory databases were used: Ecoinvent 3 (Alloc Rec) and Agri-footprint (economic allocation). The Endpoint ReCiPe 2008 method was used to calculate the impacts to produce an answer for each of the three areas of protection. The method proposed by Pfister et al (2011) was also used for calculating the water deprivation indicator since it proposes compatible characterization factors with the Endpoint ReCiPe method.

Results/interpretation

The potential impact on Human health of fresh FB at market-gate is 1.5E-05 – 1.6E-05 DALYS and 1.7E-06 – 3.1E-06 at FOB. The potential impact on Ecosystem quality of fresh FB at market-gate is 9.8E-08 – 1.24E-07 species*year and 3.4E-08 – 6E-08 at FOB. The potential impact on Resources of fresh FB at market-gate is around 0.5 $ and 0.07 – 0.09 at FOB.

For the fresh French bean product, at market-gate the four systems studied had close results for Human health and Resources and showed greater differences for Ecosystem quality. For Ecosystem quality the SHF-scattered system had greater impacts, followed by the large-farm system and then SHF-contracted and finally the medium-farm system. The main impact categories contributing to Human health were climate change around 77-78% of total impact and particulate matter formation around 20%. For Ecosystem quality, Climate change was again the main contributor with contributions between 54 to 66%. Agricultural land occupation was the second

contributor at 16 – 21% and water deprivation was the third most important impact category at 12 – 18%. For the resource area of protection, fossil depletion appeared as the only major contributor at about 98-99% across all studied systems.

The contribution of 4 key stages in Kenya: farm, transport by road before pack house, pack house and transport by road after pack house and the stage of air-freight from Nairobi to London was analysed. It revealed that air-freight had a major contribution for most impact categories while farm production had a major contribution for water deprivation, freshwater eutrophication, terrestrial ecotoxicity and agricultural land occupation.

For the fresh FB products, the cradle-to-Free-On-Board results ("Kenyan-footprint") expressed in percent of the cradle-to-market-gate results constituted 11-19% of Human Health, 35-49% of Ecosystem quality and 14-17% of Resources.

Cradle-to-farm-gate results for fresh French bean revealed much greater differences across the four studied systems. For Human health and Resources, the large-farm had the greatest impacts, the medium-farm the least, SHF-contracted and SHF-scattered showing intermediate results. For Ecosystem quality, SHF-scattered had the greatest impact followed by large-farm and then by SHF-contracted and Medium-farm. Therefore, the medium-farm system always had the least impacts. This was mostly explained by the yield and the fertilizer use on plots. The main contributor to the impacts at farm-gate were the fertilizer production and associated field emissions, the water and energy use for irrigation and the land use. Impacts due to pesticide applications were relatively small.

GWP in kg CO2-eq/kg raw FB were well in line with existing literature at market-gate and farm-gate and confirmed the very high environmental impacts of air-freight.

The potential impact on Human health of canned FB at market-gate is 8.5E-06 – 9E-06 DALYS and 7.5E-06 – 8E-06 at FOB. The potential impact on Ecosystem quality of canned FB at market-gate is 5.6E-08 – 7E-08 species*year and 5.3E-08 – 6.8E-08 at FOB. The potential impact on Resources of canned FB at market-gate is 0.285 – 0.287 $ and 0.27 at FOB.

For the canned products at market-gate, the contribution of impact categories to the three Endpoints was similar to that for the fresh products but the terrestrial toxicity contributed more in relative terms. Across the main cradle-to-market-gate stages for canned products the canning factory was the main contributor for Human health (50%) and Resources (67%) while agricultural production and canning factory were the main contributors for Ecosystem quality at 40 and 37%, respectively. Road transport in Kenya had similar or more impacts than sea-freight. For the canned FB products, the cradle-to-Free-On-Board results expressed in percent of the cradle-to-market-gate results showed great contributions in relative terms: 88% for Human Health and Resources and 95-96% for Ecosystem quality.

Framing Question	Summary Response
Is the Value Chain **environmentally sustainable** ?	The evaluation of fresh and canned FB value chains, including the main steps of the value chain up to the market-gate in the UK and several types of farmers, provided knowledge on the most environmentally friendly options and margins for improvement for each value chain. Although needing to be associated to certain limits and explanations, the environmental impacts of fresh and canned products were compared per kg of raw French bean processed. From cradle-to-market-gate, all fresh FB products had impacts about twice those of the canned FB products. The main impact categories responsible for this difference were mostly climate change and fossil depletion in relation to air-freight of fresh products. The only greater impact category for canned products was the metal depletion in relation to the steel can packaging of the products. However, a fairer comparison of fresh and canned products should cover the whole life cycle of the products (or at least the consumption stage) since canned FB are cooked and fresh FB are not. However, cooking at home is generally less efficient than in a factory and the fresh products will encounter extra losses until their end of life while canned FB are stabilized for 4 years. Furthermore, the purpose of this LCA study was not to produce a comparative LCA of fresh versus canned FB. If we look at the impacts from cradle-to-FOB, (so-called the Kenyan footprint) for canned products, they were similar for Ecosystem quality to those for fresh products, but 4 times that for fresh ones for Human health and Resources. This was due to greater impacts from factory and road transport. Across the 6 studied systems, the cradle-to-farm-gate stages had a similar contribution with more variations across farm types producing for fresh than for canned. This LCA study of the fresh and canned value chains in Kenya provided up-to-date references regarding their environmental performance and allowed identifying margins for improvement at both farm and processing stages. The canning value chain may be an interesting alternative to the fresh value chain from an environmental point of view considering impacts at market-gate (UK market). It is not the case at the national level.

1.4 Social analysis

The French Bean Value Chain (FBVC) contributes to inclusive growth and social sustainability through the involvement of two, key, beneficiary groups – firstly; small scale (smallholder) producers who produce relatively small quantities of high quality beans on small plots of land, and

secondly; a predominantly informal, casual and temporary workforce that supports what is a highly labour-intensive system of production and processing. Women in particular benefit from employment opportunities as they carry out most of the tasks associated with FB production and processing, and make up the majority of the workforce (approximately 80%). The potentially high returns that can be achieved on relatively small plots of land, and large proportion of smallholder farmers in the VC also provide opportunities for entrepreneurs through peripheral small businesses and support services. Additional social benefits accrue from investment in the infrastructure and services associated with the horticultural sector, plus the targeted social investments made by large export and processing companies in response to internationally recognised standards, guidelines and corporate social responsibility.

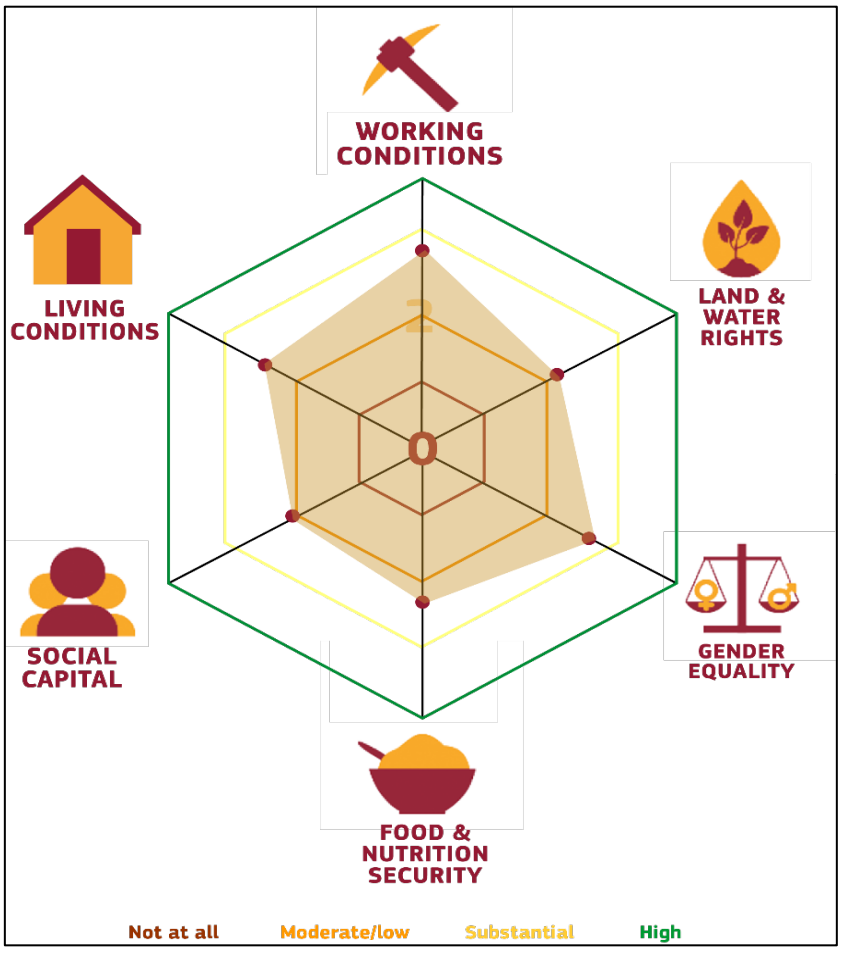


FIGURE 1.2: SPIDERGRAM SHOWING THE FINAL SCORES FROM THE SIX DOMAINS OF THE SOCIAL ANALYSIS

Based on the Economic Analysis, it is *estimated* that the FBVC currently engages somewhere in the region of **52,000 smallholder farmers** each year, **who are responsible for approximately 60% of the total FB produced in Kenya.** In addition, the annual production and processing of French Beans is estimated to require somewhere in the region of 7,566,797 days of labour input each year, which is predominantly offered on an informal, casual and temporary basis. Without further research, it is difficult to say how many people benefit from employment within the FBVC, due to the variability in demand for labour from week-to-week and day-to-day. As a result, the FBVC cannot provide job or income security. Anecdotal evidence suggests that, depending on the stage of the VC, a person may get as little as one days work a week, or up to four or five days work. The study therefore estimates the FBVC may employ between 40,000 – 70,000 individuals, of whom approximately 80% are women.

Summarising the findings of the VCA4D study against each of the six social domains, the social study concludes as shown in Table 1-3.

Social Assessment	Summary Findings	Score
Working conditions	Kenyan laws reflect international conventions and includes minimum wages, terms and conditions of employment. There is talk of creating a Horticultural Wages Order. Workers are free to join a union, and the KPAWU is active, although possibly not representative of FBVC at present. There are no CBAs directly linked to FBVC. Demand for labour is highly variable, and in response, the majority of the workforce is employed on an informal, casual or temporary basis, which influences terms and conditions. Wages are in line with national standards, although casual employment does not provide sufficient job and income security and is unlikely to be sufficient for a living wage in high cost areas such as Nairobi. Workers are likely to need to supplement their income by other means. No evidence of child labour or forced labour was found. The operationalization of mandatory and voluntary standards mean health and safety levels are good at most points along the FBVC.	**3**
Land & water rights	Under the new Constitution, legislation is much improved but its application in practice, levels of awareness amongst people, access to complaint mechanisms and accountability amongst leaders and institutions contribute to there still being many issues in this area. No references found to VGGT and application of due diligence guidelines was difficult to assess during study. Horticultural farms are not extensive, but do require access to water resources which can result in impacts on other land uses. Land speculation is increasingly common due to its high value. Inheritance reduces landholding size and increases likelihood of selling or leasing land among smallholder farmers in particular.	**2.3**
Gender equality	Women are very active in the FBVC, making up approximately 80% of the workforce. They carry out many of the production and processing tasks, and division of labour is unequal. The FBVC provides employment opportunities and a degree of financial independence. Women are represented in positions of responsibility ranging from SHG committee members, shop-floor supervisors and export company directors. However, rights to land tenure and inheritance are currently unequal. The degree of financial control and decision-making exercised by men and women is also varied, and to some extent, dependent on local circumstances and traditional norms.	**2.7**
Food & nutrition security	French beans are not considered a food crop and there is a limited (but growing?) consumption of FB by Kenyans particularly in urban areas. Income from FB production means smallholder farmers have more income to spend on food, investing in their farms, property, other businesses, their children's education and healthcare. Food inflation is an issue,	**2.3**

Social Assessment	Summary Findings	Score
	which makes it less affordable particularly for those on a limited or insecure income, and where other costs of living are high such as Nairobi. Fresh fruit and vegetables in the local market have been found to be contaminated.	
Social capital	Producer organisations are increasingly a key element of SHF engagement with the FBVC, supported by GlobalGAP. They provide farmers with a stronger negotiating platform and can help reduce the transaction costs of companies' engagement with SHF. However, most SHG are given very little support or training and as a result governance is often weak and leadership accountability can be low, which reduces their effectiveness. Many SHG are 'groups of convenience'. The level of communication between SHF and some buyers, and flow of information, is very variable and unequal, which contributes to the degree of trust felt between both parties.	**2.1**
Living conditions	Commercial farms and processing factories provide a degree of healthcare for their workforce, ranging from on-site facilities or staff to regular health checks. Some also contribute local education and health facilities. Income from SHF FB production is often used to pay for school fees, healthcare and in improving housing. Quality of healthcare and education facilities will vary geographically, with greater availability in urban areas. Many migrate for work, which means they are dependent on the level of job and income security to cover their costs. The cost of living in Nairobi is high compared with other urban centres.	**2.5**

TABLE 1-3: SOCIAL ANALYSIS – SUMMARY FINDINGS

a) Response to the Framing Questions

The French Bean Value Chain (FBVC), as a component of Kenya's horticultural industry, has the capacity to continue to make a meaningful contribution to the reduction of poverty, unemployment and inequality because it provides opportunities for income generation and employment to groups that might otherwise have few, or an ever-reducing number of options available to them (Table 1-4).

Framing Question	Summary Response	Score
Is this economic growth **inclusive**?	The FBVC benefits an estimated **52,000*** small-scale farmer producers and an annual workforce of probably somewhere between **40,000 – 70,000 people***, of whom 80% are likely to be women. While there are agro-ecological constraints to FB production, there are potential areas that have not yet been developed. For example, FB are now also being grown successfully in Trans Nzaoria in the west. Returns from small-scale production can be high compared to other smallholder products, and income benefits the local economy and are invested in children's education, health care, housing, small businesses and the farm. Employment opportunities can provide women in particular, a degree of financial independence. The FBVC also present opportunities for small-scale investment, small businesses and entrepreneurs.	**Substantial**
Risks and Vulnerabilities		
• Anecdotal evidence that the number of Smallholder farmers (SHF) engaged with the FBVC has declined significantly over the last 5 years • Exporters express less enthusiasm for engaging with SHF, citing transaction costs and reliability issues, which may exacerbate this decline • Engaging in FB production can generate good returns for SHF, but is high risk for them due to variable demand and high input costs		
Is the Value Chain **socially sustainable**?	Engagement with export markets, particularly Europe, has raised awareness of companies' social responsibilities which has influenced their operations on the ground. Kenyan legislation is evolving positively in key areas of labour and land tenure. The majority of the workforce is employed on an informal, casual or temporary basis due to the variable demand, which impacts on terms of employment plus job and income security. There is the possibility of a Horticulture Wage Order being created, which could address some of these issues. No evidence was found of child labour within the FBVC. Women are represented in positions of responsibility and decision-making, and have gained a degree of financial independence, although Kenya is still a predominantly patriarchal society. Many export companies expressed less enthusiasm for working with SHF in future because of the relatively high costs of management and reduced of control over inputs. More effective and better governed SHF SHG would contribute to reducing transaction costs. An increase in the number of large commercial farms producing FB would increase job opportunities and encourage further migration for work. Whether this translates as expanding existing farms or creating new ones, land tenure and fair and transparent land acquisition/consolidation will be important.	**Substantial**

Risks and Vulnerabilities
• The majority of the workforce (mainly women) is employed on an informal, casual or temporary basis due to variable demand for labour. This impacts on job and income security. • If FBVC does not provide consistent employment and the shortfall cannot be made up through other mainstream opportunities, there is a risk that the workforce struggle to earn a basic living wage and living standards will decline over time, increasing the likelihood of people engaging in high risk activities. • Migration for work, which appears to be quite common, may exacerbate declining living standards through increasing cost living and disconnection from social support networks • A balance needs to be found between maintaining flexibility in the workforce (for employers) and ensuring effective labour rights (for employees) in order to keep the sector competitive and attractive. • Smallholder farmers have little or no voice or influence within the FBVC. They are not represented in key fora, particularly at policy level. • Self Help Groups are often 'groups of convenience' and receive little or no support to enable them to achieve good levels of governance and sustainability • Retaining young people at smallholder farm level will be linked to land tenure/inheritance, and whether SHF can be retained within the FBVC and it remains an attractive option • Extensive land holdings are not currently a major feature of the FBVC, and social due diligence appears to have had little use. Any move away from SHF will result in an increase in commercial production, and potentially lead to the creation of new or expanded farms.

TABLE 1-4: SOCIAL ANALYSIS – SUMMARY RESPONSE

**The actual number is not known. This is an estimate based on the Economic Analysis, but the actual total may be much higher.*

The retention of SHF in the FBVC will be an important contributor to maintaining inclusive growth and there are positive examples of how commercial companies are maintaining a reliable supply largely from SHF, e.g. Frigoken & Meru Greens. However, exporters appear increasingly sensitive to the transaction costs of engaging with SHF, and the reduced control they have over the production process in what is a highly regulated and residue-sensitive export markets, despite the fact that SHF produce the best quality FB. Although no data is available to evidence this, it seems likely that the number of SHF engaged in the FBVC dropped off significantly as a result of the 2013 residue issues. This move away from SHF towards commercial production, a greater number of larger farms over time. While there are opportunities to improve quality and production output from SHF at the individual farm level, the best way to achieve more sustainable involvement of SHF in the FBVC would be to find ways in which the interface between SHF and exporters can be improved, such as helping to develop stronger and improving communication and information flows along the VC.

There are several factors that characterise the labour market that supports the fresh vegetable sector. The FBVC is reliant on a workforce that are employed on an informal, casual and temporary basis in order to respond to the highly variable demand for labour. AS a result, the sector is likely to be very sensitive to any changes in the terms and conditions of employment such as the establishment of a Horticultural Wages Order, and implementation of the 2014 legislation requiring all employers to deduct 6% of casual employees earnings as a contribution to the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF). Having systems in place to do this, and maintaining accurate records is recognised as a challenge, and the system is still in a transition period. For commercial level producers and processors, managing a

workforce under these circumstances requires an investment in human resource management. Unless alternative employment opportunities are available to them, workers in the FBVC are exposed to job and income insecurity and lower levels of formal employment benefits. Where costs of living are high (e.g. Nairobi), and the shortfall in income cannot be made up, workers may end up in very reduced circumstances and exposed to high risk strategies such as prostitution. All this may reduce the attractiveness of the fresh vegetable sector as an employer. There are suggestions that the creation of a Horticulture Wages Order may be possible. If this can be developed in collaboration with stakeholders, it can reflect the challenges faced by employers and provide a degree of certainty for employees.

1.5 Recommendations

The green beans value chain represents an important foreign exchange earner and employment generator for Kenya. In view of this it is recommended that support for the sector be continued through a range of activities benefitting farmers and workers deriving their livelihoods from the green beans value chain.

Well-established processing companies (i.e. those that are operational for a while and are not burdened with substantial debts) seem to make good profits. This should allow them to absorb future salary and wage increases for factory and field workers.

Processing companies should be encouraged to invest more in the development of outgrower schemes involving smallholder farmers, including technical extension and supply of inputs.

European retailers who are trading in green beans from Kenya should be encouraged to co-fund and support development initiatives in the green beans value chain through their corporate social responsibility (CSR) schemes.

The prices of green beans paid to farmers by processing companies (i.e. exporters of fresh and canned beans) appear to be on the low side, bearing in mind that they have been at a similar level for quite a few years now. If inflation is taken into account, then the real prices that farmers obtain for their produce has declined for several years now.

Water use appears to be quite high and inefficient in many cases. Water use for irrigation seems to be more restricted by factors such as energy use (e.g. electricity or petrol for pumps) rather than the amount of water used. The latter is free apart from a nominal user fee, producers have to pay. Given the water problems Kenya is likely to encounter over the years to come, also as a result of climate change, it is recommended that more investments are undertaken in water management. This can include investments in drip irrigation, thereby reducing the use of irrigation systems whereby part of the water is poorly used. More efficient water management should be considered an investment for the future for both companies and country.

Overall, good agricultural practices in green bean production should be based on a better recording of actual practices and input use. As shown in this study, the ratio kg of N fertilizer per kg of FB can be high in certain farms and is a key driver of their eco-efficiency. Water use on farm is generally unknown. To reduce or optimize the amount of water use, the latter should be monitored through the installation of flowmeters. Regarding pesticide use, a few forbidden molecules are still used and pest management practices are not always optimal. Mistakes could be avoided by a better training of farmers but also of technical staff. Some companies appear to have undertaken efforts in this direction, but more efforts are required.

In order to avoid problems with food safety regulations such as EC 669/2009, it is recommended that more training and capacity building in the value chain is implemented. For example, brokers dealing with scattered farmers (i.e. those that are not linked to exporters through contracts either with individuals or farmer self-help groups) should receive training which they can then use as part of extension services they can undertake for smallholder farmers. Also, brokers should be registered (e.g. by FPEAK, or HCD), thereby avoiding misuse of poor practices. Poor practices such as side-selling of inputs by spray-teams leading to a poor crop with negative consequences for farmers is to be discouraged.

In future, research and development could be devoted to explore new and more stabilized FB products with high added value which could be sea-freighted.

The following, detailed, recommendations are linked to, retaining smallholder farmers (SHF) in the value chain, identification of ways in which flows of information from the market to farmers (particularly SHF) can be improved, establishing due diligence protocols for the potential commercialisation of FB production, and supporting ongoing social benefits of the FBVC labour market.

Retaining smallholder farmers (SHF) in the Value Chain

- There is currently no accurate data for the number of SHF that are currently involved in the FBVC, their attrition (or churn) rate, and their geographical location. In order to monitor the ongoing pattern of SHF involvement in the FBVC, an accurate baseline needs to be developed. This information would be of interest to Government, private sector and donors. It is a study that could easily be done through a neutral body, such as a university as a post-graduate research project, and in partnership with key FBVC stakeholders such as FPEAK. It would also map out current and prospective areas where FB production was feasible.
- As the transaction costs of engaging SHF are being cited as one of the reasons for companies possibly moving away from SHF, along with difficulties in the relationship between buyers and SHF, it will be important to identify and support ways of reducing the transaction costs of engaging with SHF, to encourage companies to continue involving them. Mitigation strategies to encourage retention of SHF in the VC could include:
    - Where buyers play a role in supporting more effective farmer group formation and capacity development;
    - Building the capacity of farmer groups can be supported for better governance, financial management and business skills,
    - Supporting farmer groups to give them the capacity to take a stronger role in monitoring their members' farming practices,
    - Look to help broadening the remit of FBVC SHGs so that group function is more embedded in wider farmer livelihoods (e.g. savings and transferrable skills to improve production of other crops/livestock).
- Identify ways in which flows of information from the market to farmers, particularly SHF, can be improved so that they have a better understanding of demand, prices, etc. and are able to negotiate terms with buyers more effectively.
- Support mechanisms for improved communication between buyers and SHF, to reduce misunderstandings, increase transparency and maintain good relations.
- Look to Identify and support ways to improve the technical support provided to SHF by engagement with SHF by technical services provided by private sector. Key questions include, what is the current ratio of technical staff to farmers? What is the number of people on the ground, their level of educational attainment amongst technical staff, farmer:technical

personnel ratio? Also, brokers could play a role in passing on information, training and capacity building.

- Include modules on communication and engagement in training programmes for extension and technical staff.
- Support greater inclusion of SHF or their representatives in key decision-making fora at different levels, so that farmers' voices can be heard on issues that affect them.
- Maintaining SHF involvement in the FBVC over time will also be crucial if it is to be attractive to young people, and offer a long-term future for them. Opportunities for involving young people, and addressing some of the challenges facing SHF, might include working with groups of young farmers to; build capacity for group governance and business skills; mitigate small landholding size; pool resources, etc. Companies could be encouraged to reach out to young farmers as part of their outgrower schemes.

<u>Establishing due diligence protocols for the potential commercialisation of FB production in future</u>

- Identify and promote the use of guidance to private sector investors on how to ensure their investments are inclusive, sustainable, transparent and respect human rights, such as The Analytical Framework for Land-Based Investments in African Agriculture, which is being promoted by Grow Africa. The Framework was jointly developed by land experts from the African Union, UN Food and Agriculture Organisation (FAO), and several donor governments. Grow Africa have been seeking companies willing to trial the use of this analytical framework in Africa, and a Kenyan pilot in the horticulture sector could be a valuable opportunity to benchmark the sector.

<u>Supporting ongoing social benefits of the FBVC labour market</u>

- Support the development of a well-researched, evidenced and sensitive Horticulture Wage Order, to ensure that it addresses the challenges faced by employers and provide an effective range of benefits for casual and temporary employees in the formal employment market. The same can be said about the patterns of formal employment in the FBVC, and how casual employment impacts on job and income security. Any changes in terms and conditions of employment could have negative impacts for the FBVC. If the creation of a Horticulture Wage Order is a possibility, supporting dialogue between key stakeholders and research can help ensure it is effective and sensitive.

<u>Protecting workers rights and benefits</u>

- Support research to allow decision makers to better understand the dynamics of formal employment within the FBVC in order to identify what contribution the sector makes to workers' overall living wage, frequency of employment, alternative income sources and standards of living. This would be of direct benefit to the development of the Horticulture Wage Order, and would need to involve all relevant stakeholders in the value chain.
- Identify opportunities to support FBVC companies to implement their legal obligations to ensure that casual/temporary employees are able to contribute to the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF).
- Identify and support mechanisms whereby smaller FBVC companies, who do not have the capacity to maintain full in-house HR functions, might benefit from alternative mechanisms of workforce management such as the use of employment agencies. This strategy can also offer opportunities to reduce job and income insecurity for employees by increasing access to a range of other employment options.

2 FUNCTIONAL ANALYSIS

2.1 Introduction

2.1.1 Background to the study

The objective of the study was to produce knowledge about the growth, inclusiveness and sustainability of the Green Beans Value Chain (VC) in Kenya. In this context, the expert team orientated their analysis along the following four leading questions: 1) what is the contribution of the VC to economic growth? 2) Is this economic growth inclusive? 3) Is this VC socially sustainable? 4) Is the VC environmentally sustainable?

The objective of the study was the description and analysis of the Green Beans Value Chain in particular linked to exports and to market compliance requirements, using the tools and methods included by DEVCO/C1 in the "Methodological support for analysis and development of inclusive and sustainable value chains". It was also intended to identify key indicators which could be applied in value chains interventions in Kenya and more particularly within the Kenya AgriFI framework.

The methodological framework (VCA4D) elaborated by the EC included an evidence-based, largely quantitative, analysis toolkit. It consisted of a robust diagnosis system to describe the state of affairs for the functioning of the chain (VC system, technical diagnosis and governance) and the three dimensions of sustainability (economic, environmental, and social).

The study team consisted of the following team members:

- Ulrich Kleih, team leader and economist, Natural Resources Institute, University of Greenwich;
- Dr Andrew Edewa, national expert, Nairobi, Kenya;
- Catherine Allen, social development expert, associate of NRI, University of Greenwich;
- Dr Claudine Basset-Mens, environmental/lifecycle analysis expert, CIRAD, France;
- Nicholas Mati, member of Dr Edewa's team;
- Dr Baqir Lalani, economist, NRI, University of Greenwich.

The study consisted of the following phases:

- Montpellier, CIRAD: Training of economists in AFA (Agri-Food Chain Analysis) software to be used for economic analysis, 8 – 9 February 2017.
- Brussels: Briefing at VCA4D PMU and DG-DEVCO, 6 – 7 April 2017.
- 1st round of fieldwork: April 2017, Nairobi, Meru, and Thika.
- 2nd round of fieldwork: May 2017, field survey with 40 smallholder farmers in Machakos, Muranga, Meru, Kirinyaga, and Trans Nzoia Counties.
- 3rd round of fieldwork: June 2017, visits to producers, processors, traders, and public services in Nairobi, Naivasha, Nakuru, and Machakos, plus stakeholder workshop at KEPHIS on 15 June 2017.
- Analysis and report writing: July to September 2017.
- Debriefing at VCA4D PMU and DG-DEVCO, Brussels: 19 October 2017.
- Finalisation of report: November 2017.

2.2 Methodology

The methodology employed for the study used the following tools:
Data collection:

- Review of published and grey literature.
- Consultation of websites.
- Discussions with stakeholders belonging to the public and private sectors, using semi-structured checklists. At farmer level, a mix of rapid and participatory rural appraisal methods were employed.
- Questionnaire for data collection at producer and processing level. The survey with 40 smallholder farmers (SHF) in May 2017 (in 5 counties) served to provide a picture of "typical" small-scale production in different parts of the country. Given the small sample size, which was due to resource and time constraints, it was not possible to have a fully representative sample of small-scale farming at national level.

Analysis:

- Spreadsheet calculations for the functional and economic analysis, and the use of AFA (AgriFood Chain Analysis) software for the financial analysis of VC agents' budgets.
- Analysis of key social development questions.
- Lifecycle analysis for environmental analysis.

The main objective of the study was to obtain and analyse information regarding the Kenyan part of the value chain. Also, the study focused on production of green beans for fresh exports and canning. Processing of frozen beans has not been analysed, given that there was little or no evidence of this taking place in view of EU supermarkets being supplied by EU production. This is also based on market information obtained from company or price comparison websites, extracts of which are given in the annexes.

It should be noted that not all stakeholders in the green beans value chain have been equally forthcoming in providing information. Whilst some members of the value chain have been very open in sharing information, others were reluctant to meet the study team. In view of this some of the data had to be estimated. Also, despite a relative abundance of data on green bean production, at times the information is contradictory or there are gaps in the information (e.g. little analysis on the domestic use of green beans).

Plate 1 shows the map where fieldwork took place for the green beans value chain analysis in Kenya between April and June 2017.

PLATE 1: MAP OF KENYA AND LOCATIONS WHERE FIELDWORK TOOK PLACE

2.3 Importance of agricultural sector and horticultural exports

2.3.1 The agricultural sector is the mainstay of Kenya's economy

According to World Bank report, agriculture contributed 32.4% of GDP in 2016 up from 26% in 2014. The agricultural sector directly contributes 32.4% of the Gross Domestic Product (GDP) in 2016 and 27% of GDP indirectly through linkages with manufacturing, distribution and other service related sectors (World Bank Report, 2016). Approximately 45% of Government revenue is derived from agriculture and the sector contributes over 75% of industrial raw materials and more than 50% of the export earnings. The sector is the largest employer in the economy, accounting

for 62 per cent of the total employment (in rural areas, this figure is closer to 80%). The agricultural sector employs at least 30% of all workers in the formal sector and about 62% of jobs in the informal sector. Due to these reasons the Government of Kenya (GoK) has continued to give agriculture a high priority in national development. According to the Kenya Economic Survey 2014, the leading agricultural sub-sectors in 2014 were dairy, tea, and horticulture in that order.

The World Bank's Kenya Economic Update projected a 5.9% GDP growth in 2016, up from 5.6% in 2015. This outlook is attributed to low petroleum prices, good agricultural performance, supportive monetary policy, and ongoing infrastructure investments. A strengthening of the global economy is assumed, which is expected to have a positive impact on the Kenyan economy through Kenya's exports (including, horticultural products, as stated in the report), remittance flows, and tourist arrivals (World Bank Group, 2017)[1].

Table 2-1 shows how the different agricultural sectors have contributed of GDP growth. It is notable that whilst growing of crops showed growth rates of between 2.8% and 5.5% between 2012 and 2016, it is support activities to agriculture that experienced a wide range of growth rates from 15.8% in 2012, and -18.9% in 2016.

Percent (2009 Prices)

Industry	2012+	2013+	2014	2015	2016*
Agriculture, forestry and fishing	2.8	5.4	4.3	5.5	4.0
Growing of crops	2.2	6.6	5.9	7.2	6.4
Animal production	1.7	2.0	1.3	2.7	0.3
Support activities to agriculture	15.8	3.8	-6.9	2.0	-18.9
Forestry & logging	7.9	5.0	3.3	0.9	5.6
Fishing & aquaculture	5.1	5.9	2.1	-8.5	-17.3

TABLE 2-1: GROWTH RATE OF GDP BY ACTIVITY SOURCE: KENYA NATIONAL BUREAU OF STATISTICS (KNBS)

World Bank Group (2017) states that all key commodities were affected by weather patterns in 2016. For example, coffee and horticulture production saw an increase in Q1 of 2016, however, in Q2 and Q3 2016, it declined and is expected to have been even lower in Q4 2016 due to the delayed and less than average rains. The rainfall forecast for the first half of 2017 was as depicted in Figure 2.1, with projections suggesting that the long rains from March to May to be depressed across the country. The weather patterns encountered during the fieldwork for the study between April and June 2017 reflected a delayed onset of the rains, which were below average in most parts of the country. According to the Kenya Meteorological Department[2], most parts of the country experienced below-normal rainfall that was mainly recorded in April and May 2017. The distribution, both in time and space, was generally poor over most parts of the country including the western and central regions. The seasonal rainfall onset was very late over the entire country with most areas remaining sunny and dry throughout the month of March 2017.

[1] World Bank Group (2017), Kenya Economic Update, April 2017, Update No. 15; Housing – unavailable and unaffordable.

[2] Review of Rainfall during the 2017 "Long Rains" (March to May Season) and the Outlook for June-July-August (JJA) 2017; (http://www.meteo.go.ke/pdf/seasonal.pdf; accessed: 04-08-2017).

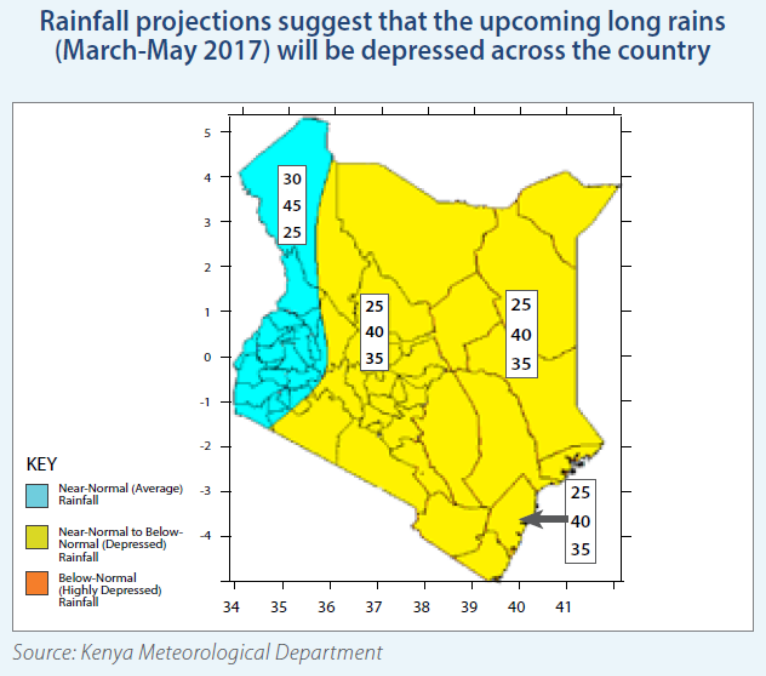


FIGURE 2.1: RAINFALL PROJECTIONS FOR MARCH – MAY 2017. IN: WORLD BANK GROUP (2017)

2.3.2 The role of horticultural production and exports

In 2014, vegetables contributed 36 percent to the domestic value of horticulture (Table 2-2). The latter includes vegetables, flowers, fruits, nuts, and Maps (e.g. medicinal plants). The area dedicated to vegetable production was 326,837 Ha, yielding 4.1 million MT of output, valued at KES 70.9 billion. The area under vegetables, production, and value increased by 26, 12, and 11 percent, respectively. The leading vegetables in production and value were Irish potatoes, tomatoes, cabbages, kales, sweet potatoes, and French beans (HCD, 2014).

Product	2012			2013			2014			Percent share by 2014 value
	Area (Ha)	Qty (Ton)	Value (Million KES)	Area (Ha)	Qty (Ton)	Value (Million KES)	Area (Ha)	Qty (Ton)	Value (Million KES)	
Vegetables	239,994	3,191,908	54,096	258,354	3,629,762	63,686	326,837	4,076,981	70,867	36
Flowers	4,039	108,306	64,963	4,049	105,544	55,975	4,085	114,764	59,893	30
Fruits	205,354	2,831,007	46,342	232,715	3,118,588	50,042	159,301	3,329,363	51,354	26
Nuts	67,528	141,568	7,388	86,901	171,278	9,283	103,801	224,231	9,601	5
Maps	12,567	185,333	6308	14,855	232,269	7,941	16,293	176,874	6,946	2
Total	529,482	6,458,122	179,097	596,874	7,257,441	186,927	605,057	7,882,028	195,899	100

TABLE 2-2: HORTICULTURE INDUSTRY PERFORMANCE BY CATEGORY (2012 – 2014). SOURCE: HCD, 2014

According to HCD (2014), the total production of French bean in 2014 was 122,666 MT valued at KES 5.04 billion (Table 2-3). While the area decreased 4,707 hectares in 2013 to 4,572 hectares in 2014, the output and value increased from 112,409 MT to 122,666 MT and KES 4.4 to 5.04 billion, respectively. The leading counties producing French beans were Kirinyaga, Murang'a, and Meru which accounted for over 80% percent of total output (Table 2-4). French bean is primarily grown for exports with a small quantity consumed in the domestic market. The farm gate prices for the product have remained constant in recent years averaging KES 40 a kilogram (HCD, 2014). At the same time, it is important to note that the HCD data does not include production from large scale farms. Table 2-3 provides an overview of the performance of selected exotic vegetables between 2012 and 2014. It shows the importance of French beans in comparison with other vegetables.

Produce	2012			2013			2014			% of value
	Area ('000 Ha)	Qty ('000 MT)	Value (Million KES)	Area ('000 Ha)	Qty ('000 MT)	Value (Million KES)	Area ('000 Ha)	Qty ('000 MT)	Value (Million KES)	
Potatoes	114	1,570	22,170	117	1,759	25,081	131	1,757	26,706	42.7%
Tomatoes	19	364	10,386	21	384	11,652	24	400	11,803	18.9%
Cabbages	15	412	4,517	16	451	5,144	15	443	4,931	7.9%
Sweet potatoes	22	311	3,349	23	300	3,556	23	365	4,767	7.6%
Kales	24	308	4,153	24	353	4,277	24	349	4,844	7.7%
Garden peas	9	39	882	11	43	1,016	11	43	1,021	1.6%
Runner beans	0.375	2	162	0.345	2	129	0.404	2	174	0.3%
French beans	5	84	5,245	5	112	4,382	5	123	5,038	8.0%
Carrots	6	170	2,150	5	199	2,645	6	90	1,952	3.1%
Green maize	1	4	76	1	5	109	26	111	821	1.3%
Butter nut	1	12	208	1	8	171	1	13	224	0.4%
Sweet pepper	1	9	278	1	14	415	2	12	325	0.5%
Grand total	217	3,285	53,576	225	3,630	58,577	268	3,708	62,606	100.0%

TABLE 2-3 : PERFORMANCE OF SELECTED EXOTIC VEGETABLES, 2012 – 2014 (HCD, 2014)

County	2012			2013			2014			Percent share by 2014 value
	Area (Ha)	Qty (Ton)	Value (Million KES)	Area (Ha)	Qty (Ton)	Value (Million KES)	Area (Ha)	Qty (Ton)	Value (Million KES)	
Kirinyaga	1,813	51,148	2,455.6	1,481	45,626	2,053.78	1,536	47,440	2,372.81	47.1%
Murang'a	861	3,848	1,186.3	885	36,810	1,268.21	847	34,690	1,268.10	25.2%
Meru	326	16,615	616.63	367	13,328	530.32	407	17,030	681.33	13.5%
Machakos	329	1,760	75.22	522	2,415	106.01	398	11,139	433.15	8.6%
Narok	105	1,575	94.50	120	900	54.00	120	900	54.00	1.1%
Kiambu	221	4,149	55.95	226	3,832	45.83	191	3,749	47.00	0.9%
Taita Taveta	48	1,191	42.23	134	3,514	147.59	58	1,245	43.74	0.9%
Embu	58	746	25.85	43	639	34.33	35	490	26.03	0.5%
Nyeri	139	428	623.85	148	431	9.38	143	525	16.36	0.3%
Bomet	-	-	-	-	-	-	54	240	13.68	0.3%
Makueni	74	379	16.52	62	376	16.43	97	421	13.68	0.3%
Kajiado	88	478	17.04	95	580	25.38	81	863	13.09	0.3%
Others	894	1,529	36	624	3,958	91	605	3,934	55	1.1%
Total	4,956	83,846	5,245	4,707	112,409	4,382	4,572	122,666	5,038	100.0%

TABLE 2-4: PRODUCTION OF FRENCH BEANS IN SELECTED COUNTIES. SOURCE: HCD, 2014

According to USAID/KAVES (2015), green beans are Kenya's largest vegetable export crop, accounting for 42 percent of the value and 44 percent of volume of total fruit and vegetable exports.

exports (HCD 2013 Fresh Exports Statistics). Other than fresh beans, Kenya also exports processed beans that accounted for 32 percent of total French bean exports in 2013. Earnings from fresh and processed beans exports amounted to approximately KSh9.93 billion and KSh1.88 billion in 2013, respectively (HCD 2013 Fresh Exports Statistics).

Horticulture is a key foreign exchange earner alongside tea, remittances from Kenyans living abroad and tourism. The value of exports of fresh horticultural produce increased from US$816 million in 2014 to US$877 million in 2015. This was attributed to better unit prices for vegetables and higher volumes of fruits exported. The value of vegetables exported increased by 11.2 per cent from US$182 million in 2014 to US$203 million in 2015. Kenya's earnings from horticulture exports rose 20% to KES 77.81 billion ($755 million) in the first nine months of 2016 compared to 2015 (KNBS, 2016). In order to improve margins, Kenya has focused on enhancing production efficiency and diversifying to other non-traditional export markets such as the Middle East, China, Japan, Australia and New Zealand. It also sought to maintain competitive advantage by focusing on products that have higher standards, SPS and others, by increasing variety and product differentiation, and by shipping direct to the major supermarket chains

Table 2-5 shows the importance of green bean exports for Kenya, in terms of value and volumes of fresh produce exported per annum according to the International Trade Centre (ITC). Exports declined from 33,365 tonnes to 30,221 tonnes between 2012 and 2014, before recovering again to 35,025 tonnes in 2015, and 35,539 tonnes in 2016, respectively. United Kingdom (47.7%), Netherlands (20.3%), and France (15.3%) are the principal importers of Kenyan fresh beans. The exports of processed beans are comparatively small, in that, according to ITC, only 898 tonnes of green beans (steamed, boiled, frozen) have been exported in 2016, with France (48.6%), Belgium (23.5%), and United Kingdom (15.7%) being the main importers.

	Total value (USD '000)	Export quantity (tons)	Export value ($ per kg)
2012	115,180	33,365	3.45
2013	96,782	32,081	3.02
2014	76,786	30,221	2.54
2015	128,403	35,025	3.67
2016	116,059	34,539	3.36

TABLE 2-5: GREEN BEAN EXPORTS FROM KENYA. SOURCE: INTERNATIONAL TRADE CENTRE (ITC, AUGUST 2017)

2.4 Core Processes in Green Beans Production and Trade

Green beans are very sensitive to production and handling stresses and can easily deteriorate in quality and safety aspects if proper guidelines are not followed. As such beans are produced using specific protocols aiming at producing for certain high value markets across the world. The green beans come in many different varieties used for different purposes. Some are produced for fresh produce markets while others are targeted for processing. The primary production stages and activities are more or less the same for the different bean types. However, it should be pointed out that green beans to be sold in the fresh produce market is the main product that defines the chain.

The core functions in production process include: sourcing of inputs and supplies; primary production; agro-processing and trade. A few actors dominate the value chain and make the chain largely buyer-driven.

2.5 Stakeholders in the green beans value chain

There are many actors involved in Kenya's export vegetable value chain, with several interactions between them. At the micro level are private sector actors involved directly with vegetable production and marketing activities. This includes inputs providers, vegetable producers, assemblers, transporters, wholesalers, processors, supermarkets, hotels, exporters and other individual service providers.

At the meso level are actors who are either farmer associations or business member organizations, or government institutions providing services directly to micro level actors. In the private sector, the Agro-chemicals Association of Kenya (AAK) is a business member association for manufacturers and distributors of agricultural chemicals and associated supplies. Other associations include producer co-operatives, and the Fresh Produce Exporters Association of Kenya (FPEAK). In the public sector are government institutions such as the Agriculture and Food Authority (AFA); Kenya Agricultural Research Organization (KALRO); Universities; Kenya Plant Health Inspectorate Service (KEPHIS); Horticultural Crops Development (HCD); Pest control Products Board (PCPB), and the Kenya Bureau of standards (KEBS).

Actors involved at the macro level are those generally touching on policy, and include mainly the different government Ministries, development partners and apex private sector associations. International trade agreements and regional trade contexts influence decision makers at policy level. At the same time policies developed at macro level provides the framework conditions in which fresh fruits and vegetables value chain actors operate.

The stakeholders in the Kenyan horticultural industry can be categorized as belonging to the public and private sectors, and development partners and projects including NGO activities (Figure 2.2 Table 2-6).

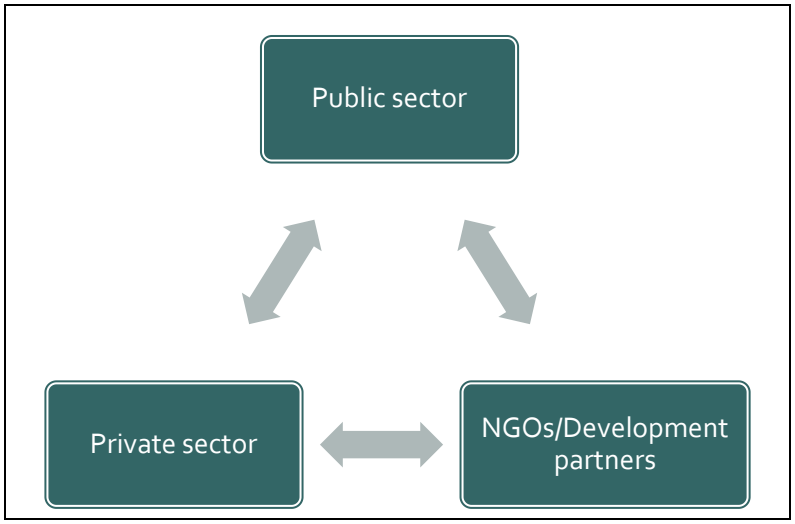


FIGURE 2.2: LINKS BETWEEN PUBLIC AND PRIVATE SECTORS, AND DEVELOPMENT PARTNERS AND PROJECTS

Public sector	Private sector	NGOs/Development partners
- Ministry of Agriculture, Livestock and Fisheries - Agriculture and Food Authority - Horticultural Crops Directorate - Kenya Plant Health Inspectorate Service - Pesticide Control Products Board - Kenya Bureau of Standards - Kenya Agricultural and Livestock Research Organization - Local Government	- Smallholder farmers - Outgrowers (small and large) - Large-scale farms belonging to exporters - Exporters: packhouses/ factories - Fresh Produce Exporters Association of Kenya (FPEAK) - Traders/brokers, supplying exporters and domestic market - Agrovet input dealers - Private service providers (research, extension, studies, etc) - Cargo companies - Importers	- Farm Concern - USAID/Kenya Agricultural Value Chain Enterprises project - COLEACP (PIP and EDES) - EU Delegation/ European Commission: Development and trade partner - ICIPE - SNV

TABLE 2-6: GREEN BEAN VALUE CHAIN STAKEHOLDERS IN PUBLIC AND PRIVATE SECTORS, NGOS AND DEVELOPMENT PARTNERS.

2.6 Public sector

Ministry of Agriculture, Livestock and Fisheries

Within the Ministry of Agriculture, Livestock and Fisheries (MoALF), it is the State Department of Agriculture which, amongst other things, has the responsibility of coordinating the horticultural value chain. The mandate of the State Department of Agriculture is to promote and facilitate production of food and agricultural raw materials for food security and incomes; advance agro-based industries and agricultural exports; and enhance sustainable use of land resources as a basis for agricultural enterprises (Source: MoALF website, 17/05/2017[3]). In 2010, the Government of Kenya developed the Agriculture Sector Development Strategy (ASDS) covering the period 2010-2020. The vision of the Ministry of Agriculture, Livestock and Fisheries is: "a food-secure and prosperous nation", with the mission of an "innovative, commercially-oriented and modern agriculture". The overall goal is to achieve an average growth rate of 7 per cent per year, which is anchored on the strategic thrusts of increasing productivity, commercialization and competitiveness of agricultural commodities and enterprises; and developing and managing the key factors of production (Edewa, 2017).

Agriculture and Food Authority

The Agriculture and Food Authority (AFA) is a government agency under the Ministry of Agriculture, Livestock and Fisheries (MoALF). The Agriculture and Food Authority Act of 2013 is an Act of Parliament to provide for the consolidation of the laws on the regulation and promotion of agriculture generally. The Act provides for the establishment of the Agriculture and Food Authority

[3] http://www.kilimo.go.ke/agriculture/index.php/about-us/mandate/ ; accessed 17/05/2017)

(AFA), making provision for the respective roles of the national and county governments in agriculture excluding livestock, fisheries and related matters. The mandate of the Authority is to: (1) Administer the Crops Act; (2) Promote best practices and regulate, the production, processing and marketing of agricultural products; (3) Collect, collate data and maintain a database on agricultural products (4) Determine the research priorities in agriculture; and (5) Advise the national government and the county governments on agricultural levies for purposes of planning, enhancing harmony and equity in the sector.

The Horticultural Crops Directorate (HCD) is a directorate belonging to the Agriculture and Food Authority (AFA), which regulates the French bean industry through licensing of exporters, registration of marketing agents, and issuing of export certificates (USAID/KAVES, 2015). Also, HCD is mandated to enforce contract farming for export crops and provide market information. Amongst other things, with the participation of other value chain stakeholders it carries out an annual data validation exercise on the performance of the horticulture sector (HCD, 2014). The reports are meant to provide information to the industry on performance of the fruits, vegetables, and flowers grown in all the Counties for the purpose of planning, research, development, and investment.

Kenya Plant Health Inspectorate Service

The Kenya Plant Health Inspectorate Service (KEPHIS) was created in 1996 to undertake quality control services in agricultural inputs, plant variety protection and plant health. KEPHIS as the National Plant Protection Organization (NPPO) is required to ensure importation of plants, plant product and regulated articles to conform to set rules. KEPHIS is responsible for coordinating all matters relating to plant health, and quality control of agricultural inputs and products in Kenya in line with the KEPHIS Act (2012). KEPHIS inspects imports of plants, seeds, and fruit (other than canned or bottled), and is responsible for inspecting quality conformity of horticultural produce destined for the export market. KEPHIS is also Kenya's National Enquiry Point for Phytosanitary matters and a focal point for OECD Standards for fruits and vegetables.

Pest Control Products Board

The Pest Control Products Board (PCPB) is in charge of regulating the importation, registration, use, and disposal of plant protection products in Kenya. Plant protection products manufactured and distributed by several domestic and multinational companies are widely available in *agrovet* shops in the main horticultural production areas.

Kenya Bureau of Standards

The Kenya Bureau of Standards (KEBS) is a government agency responsible for provision of Standards, Metrology and Conformity Assessment (SMCA) services. It is the public organization responsible for developing, setting and implementation of standards in Kenya, and is the National Enquiry Point in support of the WTO Agreement on Technical Barriers to Trade (TBT) and is the National Contact Point for Codex (Edewa, 2016).

Kenya Agricultural and Livestock Research Organization

The mandate of the Kenya Agricultural and Livestock Research Organization (KALRO) is to promote, streamline, coordinate and regulate all aspects of research in agriculture and livestock development, and also promote the application of the research findings and technologies in the

country. This is stated in its strategic objectives, which are as follows: (1) To generate and promote technologies and innovations for demand-driven agricultural and livestock product value chains. (2) To develop and promote markets and marketing strategies for agricultural and livestock product value chains. (3) To facilitate and advocate policy option for enhancing demand-driven agricultural and livestock product value-chains. (4) To strengthen the capacity for implementing agricultural and livestock product value chains research. (5) To enhance availability of knowledge, information, and technologies on agricultural and livestock product value chain research[4].
In addition to KALRO, Universities and KIRDI are also involved in agricultural research and development.

Local Government (LG)

Kenya's political decentralization is an ambitious devolution process with new governance challenges and opportunities as the country builds a new set of county governments from scratch (World Bank[5]). Notably, the Constitution of Kenya 2010 provided for a major devolution—not only of resources and functions, but also creating a whole new layer of county government. Elections in March 2013 marked the official launch of decentralization, as 47 new county governors and county assemblies were elected and began the challenging work of setting up new institutions, as well as a new national senate representing each county. Functions and funds have been transferred to the new counties, and new county institutions are gradually taking shape. Amongst other things, county governments have agricultural departments which have functions such as priority setting (e.g. selection of value chains to be promoted by ASDS) or decentralized delivery of extension services.

2.7 Private sector

Smallholders

Growers of green beans are a key stakeholder category within the value chain. Previous studies (e.g. SNV 2012, USAID/KAVES 2015) have estimated that about 50,000 farmers are engaged in green bean production. The majority of these farmers produce on small farms with less than two acres overall size. The plots on which green beans are produced are of a size of 180 – 250 sqm. At the same time, the study is being conducted to determine to what extent there are changes in the number of smallholder farmers engaged in the green bean value chain due to new market compliance requirements (e.g. EC 669/2009), affecting the production and export system. For example, it has been reported that the new regulations have led to a reduction of smallholder green bean production, and more supply taking place on larger-scale farms, which are easier to control by the export sector. The majority of smallholder farmers engaged in French bean production are estimated to have contracts or other close ties with export companies and their agents. Nonetheless, in addition there are other small-scale farmers who do not have these close ties. Depending on their situation, they may be scattered in more remote areas, or in easier to access communities. They depend for their sales on brokers or middlemen, which can leave them open to exploitation by the latter.

Outgrowers

Outgrowers are actors within the value chain who can be smallholder farmers, medium or larger-scale producers. Smallholders are often organised in self-help groups which are easier to deal with

[4] Source: http://www.kalro.org/vision-and-mission; accessed: 17/05/2017)
[5] http://www.worldbank.org/en/country/kenya/brief/kenyas-devolution; accessed: 17/05/2017)

by export companies. The latter and farmers have a contract, which specifies the responsibilities of the parties involved and provides details of the produce to be supplied, as well as terms of transactions.

Large-scale farms

As indicated, large-scale producers may be outgrowers who produce for exporters. Vegetable production may represent only part of their business in that they may be engaged in flower production or other businesses. At the same time, exporters have also invested in large-scale production of French beans and other horticultural crops.

Categories of French bean producers

The analysis of the French bean production sector, which is based on farm sizes here[6], leads to three categories of producers, namely:

- Smallholders: < 2 hectare (5 acres) total farm size; production of beans on 1 to 5 plots of about 200 sqm each;
- Medium-scale producers: 2 - 10 hectares total farm size, with bean production on 0.1 ha to 1 or 2 hectares;
- Large-scale producers: >10 hectares of green bean production.

These categories are explored in more detail in Section 2.9.2.

Fresh Produce Exporters Association of Kenya

The Fresh Produce Exporters Association of Kenya (FPEAK) is Kenya's trade association representing growers, exporters and service providers in the horticulture industry[7]. Established in 1975, when export horticulture was in its infancy, the Association has grown to become Kenya's foremost sectoral trade association. Members of the Association are involved in growing and/or exporting fresh cutflowers, fruits, and vegetables. FPEAK provides a focal and coordination point for the horticulture export industry. The Association supports growers and exporters by providing technical and marketing information and training, act as an information center, and run active lobbying and advocacy programs to enhance the sector's competitiveness. The budget of FPEAK is covered through members' contributions, as well as government and development partners' support.

Exporters

Exporters of horticultural produce play an important role in Kenya's economy in that they are large employers, and generate substantial amounts of foreign exchange earnings for the country. Due to their good links with the importers of vegetables and other produce in the UK and other parts of the world, they have a governance function in the value chain. They receive the orders for produce and will then source the products from smallholder farmers or from their own large-scale farms. Amongst other things, this will also include the implementation of food safety or pesticide application regulations. The extent to which supply of French beans is shifting towards larger-scale production at the expense of smallholder farmers is being explored in this study. Exporters play several functions in the value chain which can include production of vegetables (if they have land),

[6] A more detailed analysis of the farming sector is provided below and in the social development part of the study
[7] http://fpeak.org/index.php/about-us/

provision of inputs and extension services, buyers of produce, operators of pack-houses or factories, and exporters.

Kenya Association of Fresh Produce Growers and Exporters (KEFE)

KEFE is comprised of Kenyan horticultural exporters with the aim of growing and expanding their businesses by bringing resources together to fight challenges together, seek more markets and promote efficiency for a better business environment. Launched in 2013, KEFE is a leading association that is at the forefront of the technical changes sweeping the horticultural sector. KEFE has invested in its members and their networks, connecting more than 5,000 farmers across Kenya. In pursuit of its vision to promote and advocate good agricultural practices that lead to efficient resource use and maximization of returns for its members. KEFE takes the responsibility of mobilizing resources for capacity building, conducting market surveys & research and periodically vetting the member companies therefore helping benchmark them against international agricultural standards.

Kenya Horticultural Council (KHC)

The Kenya Horticultural Council is an umbrella body bringing together leading horticulture associations in Kenya namely the Kenya Flower Council (KFC), the Fresh Produce Exporters Association of Kenya (FPEAK) and the Kenyan Association Exporters of Fruits & Vegetables. The overarching objective of the Council is to provide high level lobbying, advocacy, and capacity building for sustained market access for Kenyan horticultural products. KHC has two main objectives: (1) to undertake advocacy aimed at improving the business environment both locally and abroad; and (2) to establish an effective and efficient communication system that will raise the profile of the industry and manage crisis. This will involve keeping engaged with both local and international stakeholders on all pertinent issues affecting the industry, gathering information, dissemination of the information, building and creating strategic relationships with relevant stakeholders.

Processing factories

Packhouse operators, who export fresh green beans to Europe and other destinations, play an important role in the value chain in that they also represent the most important category of exporters. As far as processing is concerned, only two types of processing of green beans take place in Kenya, namely canning and freezing. Given that there was little evidence of frozen green beans exports (e.g. export statistics, availability in European markets), the focus will be on canning of green beans in the value chain analysis.

Traders / brokers

Traders, brokers, or middlemen tend to play a role when farmers do not have close ties or contracts with an export firm. In this case, they rely on intermediary traders or brokers to purchase their produce and sell it to exporters. Given that brokers sometimes buy produce on credit in the hope that they will be able to sell it to exporters, it is understood that there have been cases where brokers have not been able to sell the produce, resulting in low or no income for farmers. Also, it has been reported that traders would disappear with farmers' produce, which again results in no income for the latter. Also, traders or brokers will supply the domestic vegetable market if they are not able to export their produce due to rejection if export quality standards are not adhered to. The produce thus entering the domestic market will either be supplied by farmers, or they obtain it from pack-houses or factories.

Agrovet dealers

In all major horticultural production areas, there are shops supplying producers with inputs such as seeds, chemicals (e.g. pesticides, herbicides, fungicides), fertilizer, and tools needed for production (e.g. knapsack sprayers, irrigation equipment, hoes). Given that Kenya is a centre for horticultural production, there is a wide range of inputs available, which is produced locally (also by multinational companies) or imported.

The Agrochemicals Association of Kenya (AAK)

The manufacturers and distributors of plant protection products have formed the Agro-chemicals Association of Kenya (AAK) which is a business members' association that advocates for concerns of its members. The AAK is the national representative of the International Agrochemicals Industry represented worldwide by CropLife International (formerly GIFAP). The AAK is, therefore, the umbrella organization in Kenya for manufacturers, formulators, repackers, importers, distributors, farmers and users of pest control products (pesticides).

Private service providers

There are private firms that are specialized in the delivery of services such as extension, research or studies. Often, they would be employed by projects working for the Government or NGOs with the support of development partners.

Cargo companies

Cargo companies are important in that especially smaller exporters do not have their own networks to handle the export of produce and freight arrangements at the international airport of Nairobi. On the other hand, larger-scale exporters would have their own cargo handling staff based at the airport. Fresh produce is usually air-freighted to Europe or other markets. Most of the known passenger airlines also have cargo subsidiaries which have branches at Nairobi airport. It was reported that a cargo aircraft has a payload of about 100 MT of horticultural produce and the fuel consumption for the Nairobi to London route would be 100,000 litres of aircraft fuel (6,840 kms). The cost of air-freight from Kenya to London was quoted at US$ 1.40 – 1.55 per kg of horticultural produce.

Importers

Importers in overseas markets include specialized companies (e.g. category managers) who focus on the import of fresh produce and take care of the cargo on arrival at the airport. They will handle the import formalities, re-pack the cargo or undertake processing if necessary before delivering it to the buyer, which are mostly large-scale retailers. The latter may have their own import subsidiaries through which they handle importation formalities and delivery of the produce to their distribution centres. The other option is that Kenyan exporters of fresh produce have importation branches in the UK or other overseas markets. Lastly, a share of the fresh produce imports go through horticultural wholesale markets such as New Spitalfields or New Covent Garden Market, from where they are distributed to small retail shops, restaurants, or institutional buyers such as hospitals or schools.

2.8 NGOs/Development Partners

Farm Concern International

Farm Concern International (FCI), a highly specialised Africa-wide Agri-Market Development Agency, is an African organization and has graduated to be a leading strategic direct implementing partner in Africa[8]. As a hybrid organization, FCI has a multi-dimensional institutional framework based on a blend of best practices from the private sector and from development organizations. According to its website, the core competence and strategic pillars of FCI include the following: (1) Value chain analysis; (2) Private sector partnerships; (3) Traditional informal markets; (4) Commercial villages market access; (5) Women enterprises & youth employment; (6) Capacity building and eTraining; (7) Commercial villages model scale-up. Amongst other things, in support of the French bean value chain, the NGO has recently undertaken a value chain analysis in this respect.

In one of FCI's programmes, the Domestic Horticultural Markets (DoHoMa) Program, funded by the Bill and Melinda Gates Foundation, there is a recorded increase in the number of people employed by smallholder farmers. It is shown that in the year 2014-2015, a total of 1,300,288 casual and 1,031,314 full time employees were engaged in the various farm activities such as land preparation, planting, weeding, harvesting and commodity value addition. With regard to trade and markets, thousands of others are engaged in offering loading, offloading, cleaning and security services. The job opportunities created are mostly taken up by young people who could have otherwise been unemployed.

USAID/KAVES project

The goal of the Kenya Agricultural Value Chain Enterprises (USAID-KAVES) project is to increase the productivity and incomes of smallholders and other actors along targeted agriculture value chains, thereby enhancing food security and improving nutrition. Amongst other things, as part of its activities the project carried out a detailed analysis covering the French bean value chain to identify critical constraints/gaps and prioritize high-return program interventions that will contribute to the program's core objectives. Other value chains targeted by the project include maize, dairy, mango, and potato.

USAID (United States Agency for International Development) has in the past directly and indirectly supported the horticultural sector through a range of other initiatives (e.g. Kenya Horticulture Competitiveness Programme).

COLEACP

COLEACP has a long-standing presence in Kenya, in particular through their substantial and well-received PIP and EDES initiatives.[9] 85 export companies have been supported by PIP since 2001. This has mainly targeted the implementation of food safety systems, but increasingly companies are also requesting help to meet the demands of their buyers for evidence of good environmental and social practices. Support provided has covered:

[8] http://www.farmconcern.org/ (accessed: 23/05/2017)

[9] COLEACP (no date), COLEACP and its PIP and EDES programmes. pip.coleacp.org; edes.coleacp.org;
COLEACP (2016) Value chain management – COLEACP experience in the Fruit & Vegetable sector; Presentation in Abuja, 23 March 2016.
COLEACP (2015) Annual Report.

- capacity building of middle management (training needs analysis, hygiene, safe use of pesticides, crop protection, traceability, integrated pest management, risk analysis, internal audit, occupational health and safety, food safety, environment and social standards, sustainable farming practices);
- implementation of food safety and traceability systems at field and packhouse levels (diagnostic, implementation, pre-audit, certification);
- environment-friendly production, ethical production and development of crop productions protocols.

In addition, numerous service providers (55), five smallholder support structures (including EAFF); one professional organisation (Fresh Produce Exporters Association of Kenya, FPEAK), and three public sector bodies (Horticulture Directorate HCD (ex-HCDA), Kenya Plant Health Inspectorate Service, KEPHIS, and the Pest Control Products Board (PCPB), one university (Jomo Kenyatta University of Agriculture and Technology, JKUAT) and one research institute (Kenya Agricultural Research Institute, KARI); three companies developing biopesticides and one local/regional auditing and certification body (AfriCert), and The National Task Force on Horticulture, a public-private sector stakeholder platform, have obtained support through PIP.

Since 2012, the Kenyan horticultural sector is facing Pesticide Residue Exceedances in Peas and Beans with Pods as well as phytosanitary noncompliances leading to reinforced controls from the EU. Kenyan authorities responded proactively to the crisis and came together to develop and oversee a coordinated and cohesive national action plan. The PIP program has provided training and coaching sessions for the growers, export companies and extension services. Trials to generate data on pesticide residue levels and the development and registration of alternative pesticides were also conducted.

In November 2010, a framework agreement, including the EDES activities in Kenya, was signed by the Ministry of Health on behalf of the Kenyan Government. The following trainings were organized for various public services:
- Risk assessment and risk communication
- Organisation and implementation of Official controls,
- Organisation and methodology of the health risk assessment;
- Risk assessment and Microbiological risk assessment. Three Self-assessment guides were developed for Fisheries products, Passion fruit and for Beans and Peas, plus drafting of risk profiles for the 3 products.

At the End of 2013, the EDES support was adapted and increased as a response to the MRL crisis that had emerged in the peas and beans sector:
A pesticides' residues monitoring plan was developed for the vegetable sector, including French beans and snow peas; KEPHIS lab was supported through an intensive collaboration with the laboratory from University of Almeria (UAL) to improve its pesticide residue analysis performance whereas PCPB was assessed and trained on pesticide quality monitoring. Regarding improvement of the laboratory network capacity, the following actions have been organized for various laboratories: Detailed technical audits for 4 laboratories, twinning arrangements for staff at KEPHIS with FERA and UAL for pesticides residue analysis and methods validation; training on Microbiological pathogens analysis and method validation; on Heavy metal analysis and methods validation, on Mycotoxins analysis and method validation, on Laboratory business management and quality assurance and on laboratory business plan drafting.

In addition, support to the Department of Fisheries and to the Department of Veterinary Services was provided including interventions such as, technical assistance for the revision and update of

the inspection procedures in the fisheries sector; and support for DVS in the development of a post marketing surveillance system for veterinary medicines services and to coach the new Task force on Antimicrobial Resistance to issue its strategy and road map in 2014.

As part of the on-going (2016 – 2020) Fit for Market (FFM)[10] programme COLEACP supports companies producing and exporting fresh and processed fruits and vegetables from ACP countries in partnership with civil society and professionals in the public and private sectors. In order to access the FFM programme, the following three steps need to be adhered to: (a) Request COLEACP support (send an email), (b) Building an action plan with COLEACP, and (c) Implement the action plan involving, technical assistance, training, research and development, networks, information and communication. The conditions of access to the FFM programme are: (a) Engage on a continuous improvement path by signing the COLEACP Sustainability Charter, and (b) Adhere to COLEACP.

The support private companies receive is targeted to:

- Develop and improve market access,
- Train and sustain their human resources,
- Implement an environmental management policy,
- Improve their competitiveness,
- Facilitate access to finance.

EU Delegation

The EU Delegation supports the agricultural sector through direct and indirect measures. For example, together with other development partners, this includes assistance to the GoK initiative Agricultural Sector Development Support (ASDS). Other support may be directly targeted at the agricultural sector, for example through the COLEACP programmes PIP, EDES, and MarketFit. In all these cases, the support will be developed in collaboration with Kenyan stakeholders.

ICIPE

The International Centre of Insect Physiology and Ecology (ICIPE) focuses its work on issues related to agricultural pests and diseases, including in the livestock sector. At the same time, it also touches on wider aspects of agricultural development such as climate change or the management of water resources. Noting the importance of Green Beans in Kenya, ICIPE has produced a pocket manual that summarises common pests and diseases of the crop and recommends Integrated Pest Management (IPM) methods that can be used to combat them and meet the increasingly stringent regulations imposed by importers, such as the EU, on pesticide residue levels in vegetables.

SNV

Amongst other things, SNV, the Netherlands Development Organisation, have produced an analysis of the green beans value chain in Kenya (SNV, 2012). The objective of the study was to prepare an analysis of and a strategy for the green bean sub-sector which is consistent with the M4P (Markets for the Poor) framework. SNV Kenya also implemented the HortIMPACT project together with Solidaridad, HIVOS and Delphy and funded by the Dutch Ministry of Foreign Affairs. The project started in January 2015. HortIMPACT capitalises on opportunities in the Kenyan horticulture sector that also addresses key challenges including food safety for produce destined

[10] http://www.coleacp.org/en/system/files/file_fields/2016/12/09/fitformarketpresentationleaflet.pdf

to the domestic market. The project focuses on the development of fruit, vegetable, and potato value chains. The project supported implementation of food safety systems for the domestic market, among other objectives.

Global Communities

Global Communities is a global development organization committed to working in partnership with communities worldwide to bring about sustainable, impactful changes that improve the lives and livelihoods of the vulnerable. Global Communities is implementing the Agribusiness Investment for Market Stimulation (AIMS) program to bolster trade by increasing access to financing for small and medium enterprises (SMEs) engaged in agribusiness in Kenya. Through FPEAK, Global Communities is working towards supporting the fruits & vegetables subsector access business finance and to access high value markets globally.

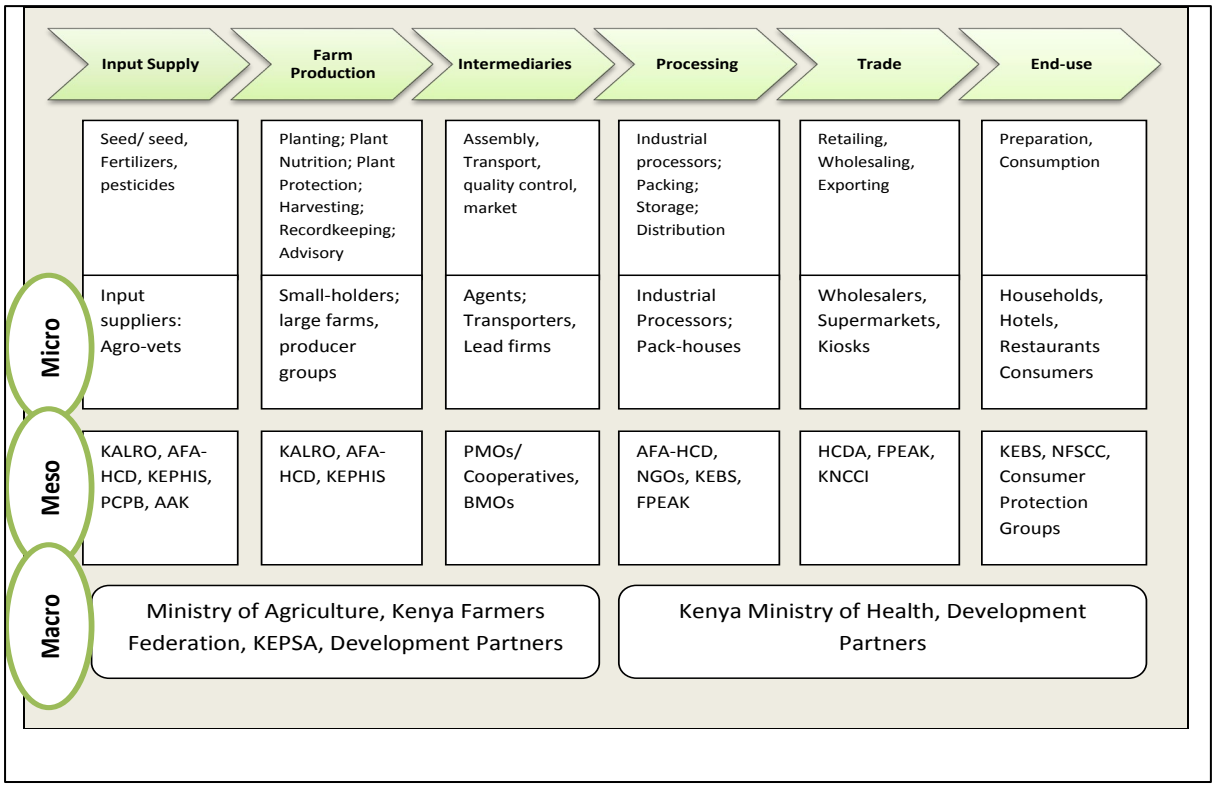


FIGURE 2.3: KEY ACTORS IN KENYAN GREEN BEANS VALUE CHAIN

2.9 Green Beans Production

Production conditions

Two types of French bean are produced in Kenya, one for the fresh export market and the other for processing. Green bean production is considered attractive to farmers because of its short life cycle (matures within 45-60 days of planting, depending on environment) and distributed harvesting (three times a week) for three weeks. The production conditions for green beans are very good in Kenya, including the type of soil (e.g. silty loam or heavy clay soils with a pH of 6.5 – 7.5), temperature range (20 – 25C°), altitude (1000 – 2000 metres), and annual rainfall (600 – 1500 mm) (adapted from USAID/KAVES, 2017). The bulk of the beans are produced within the Mount Kenya Region. In particular, the three Counties of Kirinyaga, Murang'a and Meru supply over 80% of green beans produced by smallholder farmers.

There are different production models adopted by producers of green beans in Kenya. Smallholder producers largely organise themselves into producer groups in order to benefit from economies of production scale, and to be able to produce minimum volumes that would maintain their market relationship. Producer groups and individual farms often enter contractual arrangements with their buyers, although some producers still produce green beans out of the contractual system. Where contractual agreements are signed, specific aspects are agreed upon on quantities and quality produced, and minimum production conditions. The varieties to be grown and details of husbandry practices, post-harvest handling and payment are all outlined in the farming contract. The contracts are binding, but there are persistent failures in honouring the terms and conditions in the contracts.

Green beans require knowledge and skills in production, processing and marketing processes. This knowledge is provided through field agronomists (technical assistants) who supervise farmer production activities. The County Governments and AFA occasionally organise training and support to producers depending on availability of resources from government or development partners. Monitoring and crop assessment is done by Technical Assistants until crop attains maturity. These Field Staff also advise the groups on good agricultural practices (GAP) and other farm-related technical matters.

There are many risks associated with production of green beans. Such risks range from weather conditions to management aspects of the business and quality of the produce. In this regard, risk assessments are necessary to reduce the likelihood or impact of occurrences. Producers linked to exporters carry out formal risk assessments as a part of the implementation of Good Agricultural Practices and standards. Where risks are imminent producers plan their production system (including on irrigation and crop protection products when appropriate) in order to guarantee effective management of possible production risks.

As modern farming requires investment for better crop management and efficient use of resources, it is essential that investments optimize production and profits. Farmers invest in irrigation systems and appropriate farm machinery and equipment. The producers are also required to have in place waste management systems, provide training to their workers, and provide high quality and safe working environment. The produce groups must establish administrative structures and construct input storage and produce handling facilities in order to comply with buyer requirements demanded by their buyers.

Records have to be kept as part of Good Agricultural Practice and are a prerequisite for traceability. Some producers visited had basic records of agronomic activities on the farm including choice of variety, planting dates, quantities and sales. Others, particularly those not in formal contracts, did not keep any records. The record system needs improvement in order to ensure that all activities on the farm are recorded in accordance with production and marketing standards.

Farming system

The farming system regarding green beans is based on smallholder farmers, which traditionally produce the bulk of the product, medium-scale farms and large-scale farms. The majority of smallholder farms have a total land size of less than 2 hectares, and would produce green beans on a portion of the farm, in addition to other crops such as maize, Irish potato, cabbage, tomato, sugar cane, bananas, avocado, plus some livestock (e.g. 1 or 2 cows, a heifer or calf, goats, chicken).

The French Bean Value Chain (FBVC) contributes to inclusive growth and social sustainability through the involvement of two, key, beneficiary groups – firstly, smallholder producers, and

secondly the predominantly casual workforce that supports, what is, a highly labour intensive system of production and processing. Women are responsible for the majority of these labour-intensive tasks and are likely to make up the majority of the workforce.

For the purpose of this study, French bean producers in Kenya have been divided into three broad groups (see Function Analysis) that describe key production and socio-economic factors that characterise their ability to engage with, and benefit from the FBVC. At a basic level, these three categories are:

	Contribution to Output	Farm size
Smallholder Farmers	~ 60% of FB produced	<2ha
Medium Sized Farms		Between 2 - 10ha
Large Commercial Farms	~ 40% of FB produced	Over 10 ha

PLATE 2: EXAMPLE OF SMALLHOLDER GREEN BEAN PRODUCTION IN MERU COUNTY

Based on feedback from those stakeholders who contributed to the FBVC study, the Economic Analysis has estimated that there are currently 52,000 Smallholder Farmers (SHF) engaged in the FBVC in Kenya in 2017. They are responsible for approximately 60% of all French Beans (FB) currently being produced for the frozen, canned and fresh produce markets. The remaining 40% of FB output is grown by, an estimated, 56 large commercial farms (LCF). Within these two categories sit a number of producers who do not easily fit into either group, but whose output is likely to be contributing to the 60% total ascribed to SHF and are included as medium sized farms (MSF) for the purpose of this study. It is important to note that for *all* the farms engaged with the FBVC, irrespective of size or scale, FB represented only one component of a diverse livelihood portfolio or wider business strategy. Therefore, FB production should not be viewed in isolation.

Looking at characteristics that affect their ability to engage with, and benefit from the FBVC, the producer typology can be further described through key socio-economic characteristics as follows (Table 2-7). Additional detail can be found in Section 4.1.

Characteristics	Risks/Vulnerabilities
Smallholder Farmers • Total land holdings of less than 2ha • Location restricted to areas where altitude/soil type/climate/water availability is ideal for production • Exclusively owner occupier – family farm • Geographically scattered • Cropping area (FB) limited by labour capacity • Growing FB is only one of a portfolio of on-farm and off-farm livelihood activities • Engages with FBVC as individuals or through groups (predominantly SHG) • Little or no representation in formal decision making for a at national, regional or local level • Relationship with FBVC through formal/verbal contracts or without contract, direct to exporters or via brokers • Access to information is limited and communication flows between buyer and farmer are unequal	• Limited capacity to increase land holding size (either by renting or buying) and area given over to FB (limited labour capacity and ability to hire additional labour) • Limited 'voice' or ability to influence terms of trade • Undermined by often limited capacity for effective group governance • Limited access to buyers; challenge to find and engage with them • Reactive household economy affects decisions and actions that can impact on agreements with FB buyers
Medium Sized Farms • Total land holdings of between 2 -10ha • Highest socio-economic group within community (owner occupier), or able to rent land where it is affordable • Access to financial capital/support to invest in high value infrastructure • Production systems associated with more commercial/intensive strategies, with a view to supplying markets • FB are only one component of a range of business strategies	• High set up costs requiring capital or access to credit • Small business ventures dependent on good access to high value markets in order to service loans

Characteristics	Risks/Vulnerabilities
• Able to engage with buyers as individuals • Relationship can be contract based or informal, at the discretion of the farmer • Able to negotiate their own terms of trade characterised by a higher degree of trust • Dependent on hired labour • May not live 'on site' • Well connected to market, services and buyers • Good information and communication flows	
Large Commercial Farms • Total land holdings of over 10ha • Mix of owned and rented properties (owned by export company or as an out grower) • Often existing (historically) large farm properties, and grown by consolidation of surrounding land • Good access to natural resources (or able to buy technology to do so) and transport links • Access to high value financial resources (e.g. ICF) • Often have production, processing and back office infrastructure on one site • Farms run by contracted manager and core staff • Completely reliant on hired labour • Supported by administrative and HR functions • Well connected to the market and overseas buyers	• Dependent on access to a large and reliable workforce • Greater degree of control over inputs and practices but at the cost of quality and wastage • Growing FB on site (rather than outsourcing to SHF/outgrowers) increases exposure to variation in demand from export buyers, requiring mitigation strategies

TABLE 2-7: GREEN BEAN PRODUCTION SYSTEMS ENCOUNTERED DURING THE SURVEY

Smallholder Farmers (SHF)

SHF grow FB on only 1 – 2 'units', which is the maximum area that can be cultivated using household labour. Due to the high risks associated with FB production, the majority of SHF are likely to be within the higher socio-economic strata of their community. SHF income/expenditure is often managed reactively, due to erratic cash flow and competing priorities for its use. As a result, decisions may be taken that can pose a challenge existing agreements (e.g. repayment of bank loans, contracts with exporters) or jeopardise long-term outcomes (e.g. having to use cash to buy more cattle feed instead of paying for additional help for weeding, thus reducing overall yield). As individuals, they have limited capacity to negotiate terms of trade with buyers and are vulnerable to lack of transparency, poor communication and manipulation. Working as a member of a SHG gives greater negotiating power and is more attractive to buyers, as they can collectively guarantee higher volumes of produce. SHF have limited choice over which buyers they deal with – buyers often only work in specific geographic areas. In the main, SHF are reliant on buyers coming to them rather than the other way round. They have a bank account but limited access to formal loans.

Medium farms

Are predominantly the top socio-economic group within their community and are farming a comparatively 'large' farm for their geographic area. Alternatively, and probably more common, they are entrepreneurs who have access to sufficient financial capital to rent a large enough plot. Characterised by a commercial approach to production, they are run as a business and invest in high value assets such as greenhouses, pumps, irrigation systems, equipment, farm buildings, etc. The farm is managed on a more business-like footing, with record keeping and accounts. They have with sufficient income predictability to allow for long-term investment planning. They will seek out extension advice and be able to adopt new technology and techniques. They are able to engage with the FBVC as individuals, and negotiate terms of trade on a basis that benefits them. They are likely to have the wherewithal to challenge many elements of an unequal relationship/transparency, etc. and can probably find/choose who they sell to. The owner of the farm, with contribution from their family will be directly involved in the day-to-day tasks on the farm either supervising or doing some of the work themselves, but are reliant on hired labour. They may not live on site.

Large farms

Commercial farms are considered as farms of more than 10ha, although most commercial farms are much larger. Predominantly rented land on long-term lease. Either owned by the buyer/export company or contracted to them. Farms are run by a management team with support from admin staff, all of whom are employed by the owner/parent company. They are entirely dependent on a regular supply of workers to carry out day-to-day tasks, and their inputs are managed in a shift pattern. Workers are employed on a more formal contracted basis, either as permanent staff or casual workers. Workers are drawn from the surrounding community and may include a significant proportion of migrant labour who are drawn into the area in search of work. Large farms have a large enough workforce that they require some form of HR function, either provided by the parent company or amongst the management/admin team.

As for the shift of production from the smallholder sector to large-scale farms, it appears no one is 'dealing with it' per se, and the 'voice' of SHF is not heard in the value chain. Because there aren't

any accurate figures for the number of SHF involved in the system, it is very difficult to evidence a decline, but there is pretty solid anecdotal evidence that the number has fallen significantly over the last 10 years, with 2013 having a significant, continuing, impact. Companies appear to be spending less on the staff and functions that engage with SHF, as an attempt to cut costs.

Plate 3: Example of green bean production in Naivasha

Plate 4: Example of green bean production in Machakos

Contractual Arrangements

Prior to planting producers have to acquire certified seed provided through buyers of produce. It is not uncommon, however, to find producers who are not in contractual arrangements sourcing for cheap seed either from previous season crop or cheaper commercial outlets. For those contracted, seed may be provided through on loan basis. Varieties planted are determined by buyers in accordance with their market demands.

Bean varieties

The bean varieties grown include:

- For fresh beans export: Belle Campo, Vanilla, Samantha, Serengeti, Boston, Star, Soria, Lomami.
- For canning: Goal, Source, Catarina, Caledonia, Sagana.

Bean varieties destined for processing have higher yields than those varieties destined for export in fresh form. Yields of beans for fresh exports are of the order of 6,000 kg to 10,000 kg per hectare, depending on whether they have been produced by scattered farms (i.e. those without links to export companies, and few extension services), mechanised, large-scale farms, or smallholder farms (SHF) with links in the form of contracts and extension services with export companies. Yields of beans produced for the canning industry are of the order 10,000 to 12,500 kg per hectare.

Land Preparation

To some extent Table 2-7 above gives an overview of some of the agricultural practices prevailing in green beans production. In particular, those farmers linked to exporters through contracts are expected to follow the agricultural practices recommended by the exporters' extension staff.

Whilst in most cases land preparation is done by hand (using hoe and machete) on smallholder farms, ox-ploughs are also used in a few cases, whilst medium-scale farms may use manual land preparation or ploughing by tractors on their farms. Tractors are always used on large-scale farms for land preparation.

Relay planting, intercropping, and crop rotation

Most smallholder farmers plant the green beans under irrigation (e.g. gravity irrigation using sprinklers) in relays on small plots of land ranging from 0.5 to 0.25 acres of land. Relay planting of small plots facilitates management of the crop, but also allows buyers and exporters scaling of supply according to quantities required.

Intercropping is rare to take place (e.g. green beans intercropped with kale), amongst other things due to the fact that different crops in one field are likely to require different pest and disease control measures (e.g. spraying with chemicals), which can then affect their marketability.

Crop rotation is common in that it is not recommended to produce beans twice on the same plot in succession (e.g. due to pest and disease prevalence, soil fertility issues). For example, smallholder farmers would have a crop succession of green beans, Irish potatoes, maize, and cabbage before planting green beans again. This depends on farmers' requirements and markets, also bearing in mind that beans are nitrogen fixing crops. A well worked out crop rotation is

important, because certain crops most not precede green beans because they share similar pests and diseases.

Management and Use of Inputs

Planting is always done by hand (e.g. 20kg of seed per acre). Whilst family labour is common for this task on smallholder farms, large-scale farms would employ hired planting teams, mainly composed of women. Land preparation and planting often involves the first round of fertiliser application (e.g. DAP, 4kg of DAP per kg of seed, i.e. 80kg of DAP per acre). Compost based on plant matter would be ploughed into the soil during land preparation, whilst it is not recommended (also as part of GlobalGAP practices) to use animal based manure for the production of green beans. In this case the manure would be applied to the previous crop and last two cycles of crop production.

The next rounds of fertiliser application are done in intervals, for example in the 3rd week CAN (80kg per acre) would be applied, and $N_{17}P_{17}K_{17}$ (80kg/acre) would be applied in the 5th week. Also, different forms of NPK can be applied for bean growing, however it is common that fertilisers with a higher nitrogen content are applied in the early, growing, stages of the crop, whilst lower nitrogen content fertilisers are applied in later stages. As indicated, fertiliser application is done in combination with other tasks, such as planting, or weeding. Liquid fertiliser (e.g. foliar feeds) is applied during the spraying of chemicals or during irrigation (e.g. pivots on large-scale farms).

As indicated, irrigation, which is common in green bean production, takes a range of forms, depending on the source of the water, terrain, and the size of the farm. Whilst smallholders in mountainous terrain would often use water from rivers or sources, which arrives through pipes and in some cases tanks at the farm. There farmers would use sprinklers, or the water would be directly applied from the plastic hose to the field. Furrow irrigation also involves gravity but the water be directed into a field's furrows (e.g. water coming from a dam and through canal). Whilst drip irrigation has not been widely adopted (also due to cost reasons), some medium to large-scale farms have been encountered which have adopted it. At the same time, large farms would also use other mechanised equipment for irrigation such as pivots (e.g. capable of irrigating 24 hectares per day).

As for the amount of water used for the irrigation of green beans it proved difficult to get exact figures, partly also because there are no charges for the amount of water used. Farmers would pay a maintenance fee for water use, which may be of the order of KES 300 p.a. for a smallholder farmer (for all crops), ranging to KES 10,000 per month for a large-scale farm.

In view of this the amounts of water used are estimates. For example, for a large-scale farm it was estimated that 3600 cubic metres of water are used per hectare in one cycle of bean crop production (lasting about 3 months), using both drip and pivot irrigation.

In the case of smallholder farming, the amount of irrigation water was further estimated to be 20 litres of water per square metre, which would equate to 4000 cubic metres of water used per hectare over a 10-week period (hand irrigation twice a week).

A technical assistant (TA) of a medium-sized exporter indicated that 1000 m^3 of water are required per acre (i.e. 2500 m^3 per ha) per cycle of green bean production, although this was not measured given that farmers in the area use gravity furrow irrigation from a canal (water originates from dam).

Pest and disease control involves a range of chemicals, mainly insecticides and fungicides. Whilst smallholder farms may use a range of four different chemicals, large-scale farms may apply around seven different chemicals.[11] It is not advised to use the same chemical twice in succession in order to avoid build- up of resistance. Spray teams specialised in the application of chemicals have often been trained by exporters' extension staff based in farming communities. Nevertheless, some exporters' extension staff recommend that farmers take care of spraying either by spraying themselves or hiring spray teams. This is due to some spray teams reportedly using lower dosages of chemicals and side-selling the rest on the open market. Herbicides are less common, however if they are used they are pre-emergence herbicides.

In general, there are a variety of challenges related to the management and rational use of inputs on farms. There is need to promote good practices in management of farm inputs including implementation of Integrated Pest Management (IPM) principles, minimizing use of pesticides, optimizing fertilizer investments, among others. The producers must observe and ensure compliance with legal requirements of produce, including using crop protection products registered in Kenya, observance of maximum residue limits (MRLs) and defined pre-harvest intervals (PHI). Workers must also operate in a safe environment, so equipping producers to understand health, safety and welfare aspects is a task that government and private sector has to jointly support.

Harvesting and Yields

Harvesting is considered the most labour intensive part of green beans production, and tends to require substantial numbers of hired labourers (often women). Large and medium-scale farms would entirely rely on hired labour, whilst smallholders would harvest some of the beans using family labour and some using hired labour. This would depend on the plot size, and number of plots.

Harvesting would start about 50 to 60 days after planting, and typically last for 3 weeks, and be undertaken twice per week. Harvesting is the most labour intensive part of bean production and most farmers, whether small or large-scale, would employ hired labour for this task. For example, whilst two to three people (partly family partly hired labour) are sufficient to harvest on a small plot of green beans, large farms would employ 60 persons per hectare of crop, mostly consisting of women. The crop is then often transported in crates to a near-by collection point next to the field, and from there after some initial sorting either to the packhouse (e.g. in the case of large-scale farms) or to another, larger collection centre for a group of farmers (in the case of small to medium-sized farms).

Yield figures for green beans can be quite varied, as shown as follows:

- With efficient use of inputs and access to supplementary irrigation, growers can achieve a yield of 3.7 MT per acre (USAID/KAVES, 2015). A 7% of rejects would give a supply of 3441 kg per acre (or 8499kg per hectare).
- Technical assistants of export companies reported that yields of about 10 MT per acre are expected from farmers. However, the range can be quite wide with yields reaching about 20 MT/ha and yields as low as 4 MT/ha.
- Managers of large-scale farms reported that yields were in the range of 6 - 12 MT per hectare.
- One kg of bean seed is expected to yield about 200kg of green beans.

[11] More details on the use of chemicals (e.g. insecticides or fungicides) and fertilisers are contained in the section in the study dealing with environmental aspects.

- The results of a survey with 41 smallholder farmers in May 2017 showed an average yield of 6787 kg/ha.
- Yields assumed for the economic calculations in the study are:
    - 10 MT/ha for large-scale farms if beans are destined for processing;
    - 8 MT/ha for large-scale farms if beans are destined for exports in fresh form;
    - 10 MT/ha for smallholder farmers which are linked (usually through groups and by contract) to exporters;
    - 6 MT/ha for smallholder farmers which are scattered (i.e. not directly linked to exporters, relying on brokers for sales); and
    - 12.5 MT/ha for smallholder farmers producing for canning industries because they produce on smaller areas (e.g. 200 sqm plots), and thereby more intensively.

Post-Harvest Handling and Losses

Once produce is harvested, care is required to maintain safety and quality of the produce. Post- harvest handling of produce on-farm should be done in appropriate grading sheds in compliance with criteria required for compliance with available standards such as KS1758, KENYAGAP or GLOBALGAP. Possibilities of contamination at the sheds are high, calling for special hygiene awareness and training.

Buyers of produce face the challenge of receiving poor quality crops from the farmers. The quality of the crops deteriorates due a number of reasons including overuse of chemicals, poor crop handling and bad weather resulting to massive losses to the farmer. A significant quantity of farmers' crop is rejected time and again as long as they do not meet the quality standard set by the exporter. The producers are informed about the rejects, and they communicate the same to producers. However, the issue of rejected produce requires more interventions and discussions at contractual level because it is affecting productivity and performance.

The issue of post-harvest losses in the green beans value chain is a contentious one in that different figures exist according to source of information. This can be shown as follows:

- USAID / KAVES (2015) base their assessment on a "conservative" estimate of actual national losses, at the farm and export levels, being 12 percent.
- According to SNV (2012), in 2010 only 34% of the total Kenyan green bean production (55,841 MT) has been exported; i.e. 18,725 MT valued at 4.4 billion KES (based on HCDA, 2010).
- Based on information obtained between April and June 2017, the study team estimates that total losses in the green beans value chain are 25,706 MT, representing 42% of total production in the case of fresh exports, and 30% in the case of processed exports (e.g. canned beans).

During the survey between April and June 2017, the study team obtained a range of figures. Whilst at packhouse level, the loss rates were indicated at 20 – 30%, the losses at farm level depend on the season in that during the rainy season the losses are higher (i.e. increased prevalence of pests and diseases), whilst they are lower during the dry season. Some exporters stated that wastage can be 40% during the dry period but can go to 50% or higher during the rainy season. In view of this, the following loss figures have been estimated for export of fresh green beans: total losses are 42%, split between 12% of losses occurring at the farm level, and 30% at packhouse level. In the case of processed beans, little or no losses are encountered at farm level, and 30% are rejected at factory level.

As for the use of wastage, during the field survey it was stated that some of the green beans rejected for export enter the food chain (e.g. household consumption, restaurants, hotels), whilst another part is used for animal feed, and another part is used for compost in that beans not fit for export are ploughed into the ground. It has been estimated that each part destined for the domestic part of the value chain represents 8,569 MT (i.e. a third each of the total loss representing 25,706 MT).

PLATE 5: GREEN BEANS FIELD IN MERU COUNTY

2.10 Post-Harvest Processes

Green bean post-harvest processes can be categorised into two categories, namely packhouse operators, and processing factories for canning and freezing of beans.

Packhouses

Packhouses are specialised in preparing fresh horticultural produce for exports, mainly by plane to European Union countries and other destinations. In particular, packhouses add value to produce prior to export. Whilst packhouses belonging to large-scale exporters form part of vertically integrated enterprises, smaller packhouses may rely on the supply of green beans from a smaller number of farmer groups or brokers who purchase produce on behalf of them.

Often packhouses are designed so that a range of produce can be prepared for exports, including fruits (e.g. mangoes or avocadoes) and vegetables (e.g. green beans, sugar snaps, mange touts, baby corn). In particular, packhouses specialised in the conditioning and export of vegetables rely on a steady supply of green beans during the main export season (October to May), and in some cases throughout the whole year.

Value addition operations may include cleaning, sorting, grading, trimming, weighing, packaging, and cooling of produce. For these operations packhouse operators rely on hired labourers. Some of the workers are employed on a permanent basis, whilst others are temporary workers who are employed depending on the requirements. Packhouses may have 50 workers in the case of a medium sized operator, and 300 in the case of a large-scale operator. More details about employment and workers' conditions are provided in the social development section.

Packhouse premises may belong to the company or may be hired from the owner of the building and then equipped with the necessary equipment (e.g. office, produce reception area, packing hall with tables, scales, refrigerated storage chamber). Other equipment includes trucks to collect produce from production areas and delivery of packed produce to the airport.

Medium to larger-scale packhouse operators tend to have a supply team in the field which in charge of motivating farmers to produce for the company. Supply teams may consist of technical assistants (TAs) based in the growing areas, who are supervised by an agronomist at the headquarter of the company. The TAs are often in charge of providing extension services plus key inputs for production such as seed, and liaising with the collection teams. This includes arranging harvesting operations with farmers (e.g. who has to harvest when and what quantities) and then coordination of a first round of sorting at the collection shed.

Packhouse operators tend to be members of the Fresh Produce Exporters Association of Kenya (FPEAK). They have to pay for export licenses to the Horticulture Crops Directorate (HCD) and arrange for inspections of produce by the KEPHIS.

PLATES 6: GREEN BEANS BEING HARVESTED

PLATE 7: GREEN BEANS READY FOR EXPORT

Processing factories

As far as processing is concerned there are only two types of processing of green beans taking place in Kenya, namely canning and freezing. Given that there was little evidence of frozen green beans exports (e.g. export statistics, availability in European markets), the focus here will be on canning of green beans.

Compared to the export of fresh green beans, the export of canned produce is a relatively minor activity. Activities in a processing factory include: reception of produce, sorting, washing, blanching (steaming or brief cooking), quality assurance, canning into cans or jars, and storage of the latter in stores prior to shipment.

Given that washing of produce is common in processing factories, water consumption tends to be higher in these factories compared to packhouses. *Given the long shelf-life of canned green beans they tend to be exported by truck to Mombasa and from there by ship to their destination*.

PLATE 8: STUDY TEAM WITH OPERATORS OF PROCESSING FACTORY

2.11 Marketing

Two main markets have been distinguished here for green beans, namely (a) the export market and (b) the domestic market. Given that green beans are predominantly produced for export, it can be assumed that only those beans enter the domestic market which have been rejected for the export market.

2.11.1 Export markets

Table 2-8 and Table 2-9 demonstrate the importance of green beans for the export economy, in that horticultural crops represent one of the main foreign exchange earners of Kenya (together with tourism and tea), and green beans are the main vegetable crop exported.

Indicator	2012	2013	2014	Percent (%) Increase in 2014
Area (ha)	529,482	596,574	605,057	2.0
Production (million MT)	6.46	7.26	7.88	9.0
Value (Millions KES)	179,097	186,927	195,899	5.0
Export volume ('000 kg)	205,728	213,884	220,248	3.0
Export value (millions KES)	89,869	83,381	84,084	0.8

TABLE 2-8 : TRENDS OF HORTICULTURE CROPS PERFORMANCE, 2012 – 2014 (SOURCE: HCD, 2014). SOURCE: HCD, 2014

Year	2012		2013		2014	
	Volume (Tons)	Value (Million KES)	Volume (Tons)	Value (Million KES)	Volume (Tons)	Value (Million KES)
Flowers	108,306	64,964	105,554	55,976	114,764	59,893
Fruits	31,070	4,680	31,107	4,483	35,149	5,411
Vegetables	66,352	20,226	77,172	22,923	70,335	18,781
Total	205,728	89,869	213,833	83,382	330,248	84,085

TABLE 2-9: HORTICULTURAL EXPORTS ARE AN IMPORTANT FOREIGN EXCHANGE EARNER. SOURCE: HCD (2014), HORTICULTURE VALIDATED REPORT, 2014

	2012	2013	2014	2015	2016
Horticulture (total, million KES)	81,129	89,339	97,105	100,963	110,338
Horticulture (KES/kg)	221	227	223	228	220

TABLE 2-10: VALUE OF HORTICULTURAL EXPORTS. SOURCE: KENYA NATIONAL BUREAU OF STATISTICS (2016)

Figure 2.4 shows to what extent the United Kingdom, France, Netherlands, South Sudan, and India are the main importing countries of green beans from Kenya. Other importing countries include other EU countries, United Arab Emirates, Hong Kong/China, South Africa, etc (see trade figures in annex, based on ITC trade map).

At international level, Kenya competes as an exporter of green beans with developing countries such as Morocco, Mexico, Egypt, Guatemala, Senegal, Oman, and Tanzania (see Figure 2.5). France, Netherlands, USA, and Spain are the leading exporters of green beans in developed countries (some of this are re-exports). Figure 2.6 shows to what extent Guatemala, Morocco, and Mexico have seen positive growth rates of green bean exports, whilst Kenya has experienced a decline of exports, according to trade statistics by the International Trade Centre (ITC).

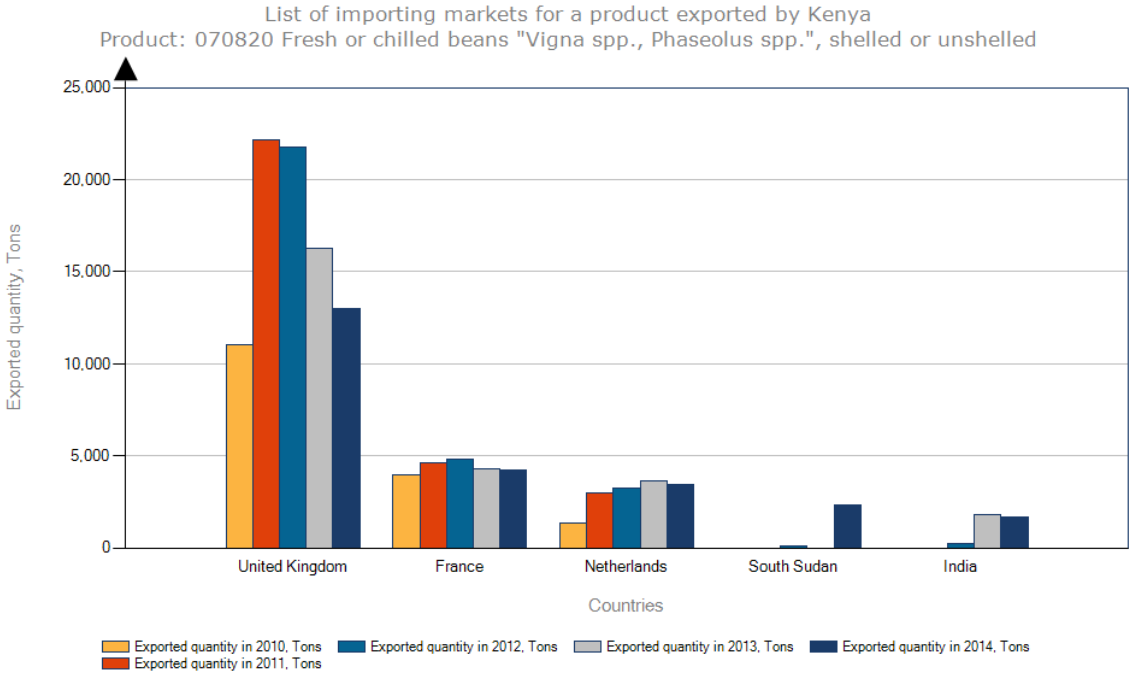


FIGURE 2.4: LIST OF IMPORTING MARKETS FOR GREEN BEANS FROM KENYA. SOURCE: ITC TRADE MAP

Impact of EU regulations

Given that the European Union is the principal importer of green beans produced in Kenya, regulations by the EU greatly affect horticultural exports of the country. According to COLEACP (2016), the application of Regulation EC 669/2009 in Kenya can be summarised as follows:

- 2009, 34,997 tons of French beans were exported from Kenya to the European Union.
- Between 2009 – 2012, increase in the number of interceptions of Kenyan beans at EU borders due to pesticides MRL exceedances.
- In January 2013, Kenyan beans were listed as "highrisk" under Regulation EC 669/2009, and subject to increased testing on EU entry at a level of 10%.
- Setting up of National food safety coordinating committee.
- National action plan to:
    - improve practices and procedures in the supply chain
    - improve practices and procedures in inspection services and in pesticides residue monitoring.
- Request COLEACP support for implementation and work with other agencies / donors.
- MRL - trouble shooting mission to conduct, amongst other things, with the private sector:
    - Review of GAP in 37 companies, focus pest management problems.
    - Training of technical staff / middle managers (key messages).
    - Coaching sessions (particularly with the spraying team) and follow up
- On the public sector side, support has been provided to KEPHIS, PCPB, KALRO, HCD, which, amongst other things, included laboratory support and training sessions.
- Following monitoring by EU authorities of public and private sector actions, green beans from Kenya are no longer listed as "highrisk" and subject to increased testing on EU entry at a level of 10%.

According to USAID/KAVES (2015), the EU Directive affected the competitiveness of Kenyan exports in three ways:

- Delays in produce reaching EU supermarket shelves;
- Increased cost of MRL testing; and
- Potential loss of consumers' confidence in fine beans from Kenya. It was reported that in January 2013 alone more than 25 percent of Kenya's vegetable exports to the European market were rejected after being found to contain traces of dimethoate (CTA, 2013).

Based on the above reports and experience from the fieldwork for this study, the impacts of the Regulation EC 669/2009 can be summarised as follows:

- Decline of exports in the wake of the application of the Regulation;
- Reduced competitiveness of Kenyan vegetable exports;
- Private and public sector measures in Kenya, also with useful support of projects by COLEACP and other organisations;
- Expansion of green bean production on large-scale farms owned by exporters or large-scale outgrowers, to some extent at the expense of smallholder farmers;
- Rebound of export volumes; at somewhat reduced values and margins.

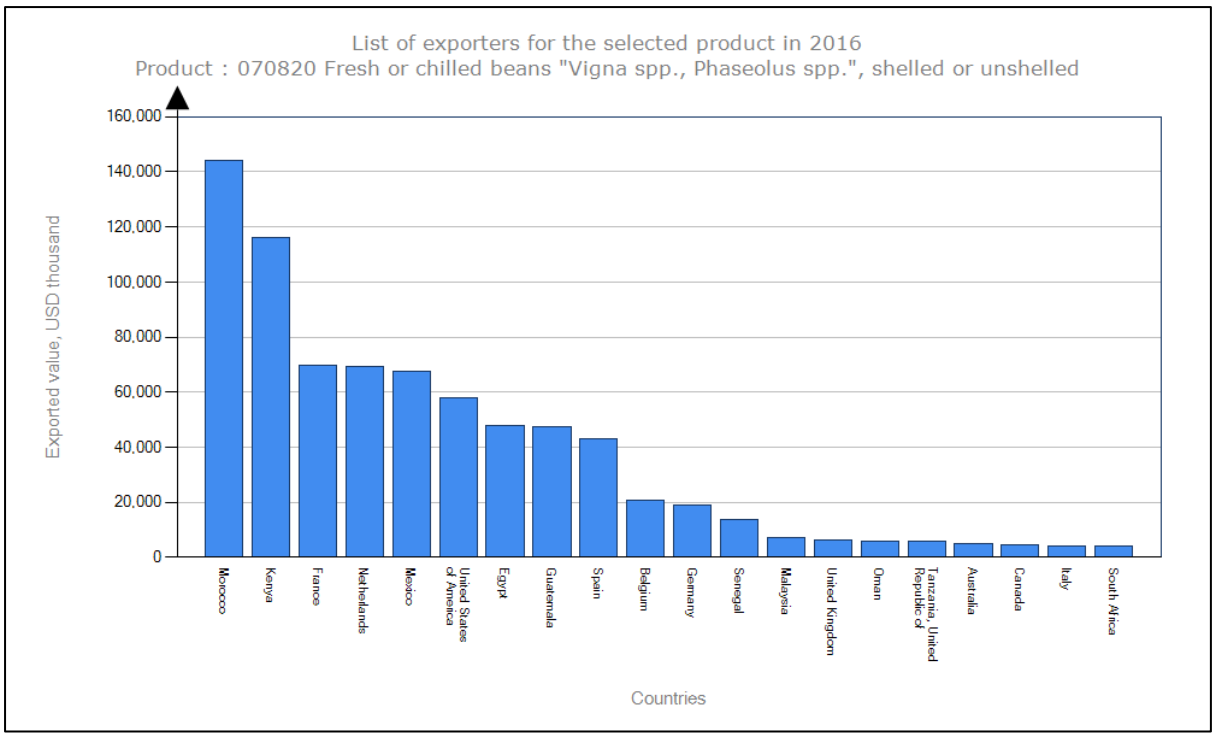


FIGURE 2.5: LIST OF COUNTRIES EXPORTING FRESH OR CHILLED GREEN BEANS

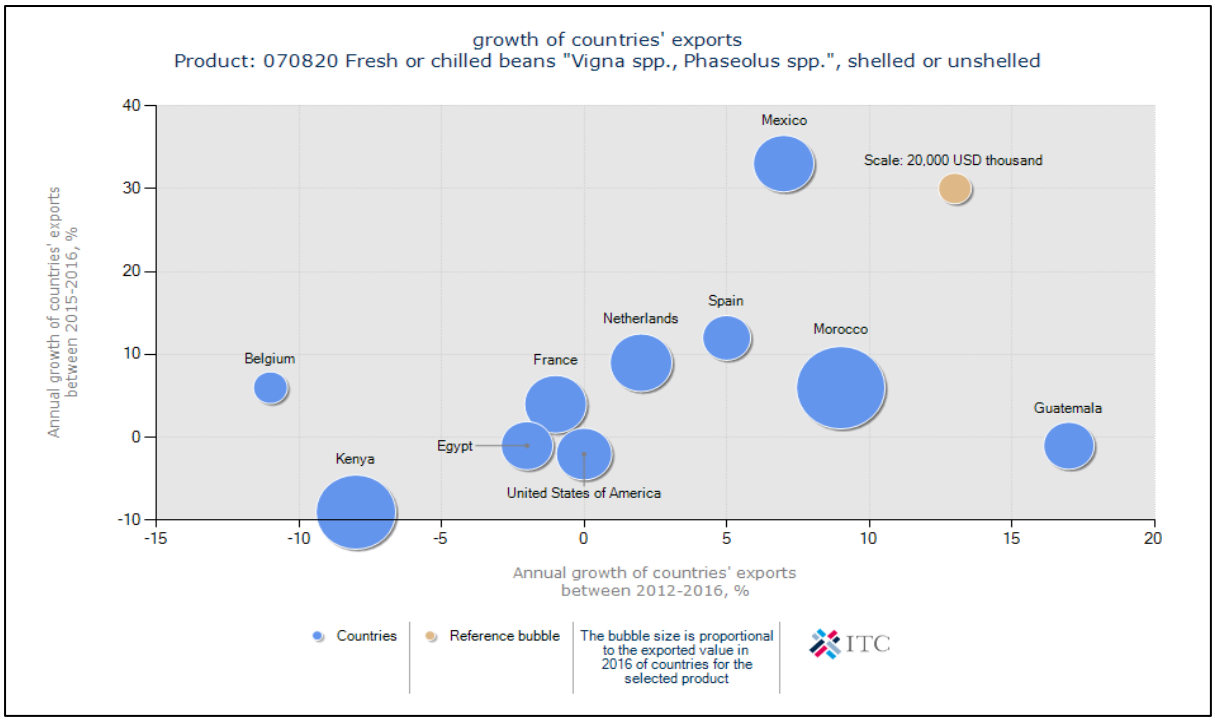


FIGURE 2.6: GROWTH OF COUNTRIES' EXPORTS OF GREEN BEANS. SOURCE: ITC TRADE MAP

2.11.2 Domestic market

As indicated, green beans are primarily grown for export. In view of this, domestic consumption relies the quantity of green beans rejected for export. As found during the survey and in the literature, there is a wide range of rejects or also wastage of green beans.

During the survey, three main uses of green beans have been identified, namely:

- Human consumption,
- Use as animal feed,
- Use as compost.

In particular, human consumption of green beans will be further analysed using data from literature and from the survey carried out between April and June 2017. As indicated above, under the current situation (2016/2017) the following loss figures have been estimated for this study: total losses: 42%, representing 25,706 MT. In the case of fresh beans exports, it is estimated that 12% of the loss occurs at farm level and 30% at packhouse level. As for beans destined for processing, the losses are estimated at 30% at packhouse level.

As for the use of wastage, during the field survey it was stated that some of the green beans rejected for export enter the food chain (e.g. household consumption, restaurants, hotels), whilst another part is used for animal feed, and another part is used for compost in that beans not fit for export are ploughed into the ground. It has been estimated that each part destined for the domestic part of the value chain represents 8,569 MT (i.e. a third each of the total loss representing 25,706 MT).

As for the domestic market, visits have been undertaken to horticultural markets in Nairobi, as well as interviews have been undertaken with restaurant or hotel operators in different parts of the country.

The visits to the main horticultural wholesale market in Nairobi revealed that there are about 50 traders engaged in trading of green beans. The bulk of the beans traded is procured from fresh beans exporters' packhouses near Jomo Kenyatta International Airport, although some green beans are also transported from producing counties to the market.

Traders would buy green beans rejected for exports at a price of KES15/kg (June 2017), transport them to the market and sell them there mainly to retailers and hotel or restaurant owners (at about KES30/kg). A few of the traders own their means of transport (e.g. pick-up truck) although the majority hire transport. Whilst the range of quantities traded is quite large (e.g. 1 bag of 100kg of green beans to 10 MT traded per day), it is estimated that the average quantity traded by traders in the wholesale market is 200 kg of green beans per day. This may be predominantly green beans, or beans in addition to other crops such as cabbage or tomatoes. Assuming that 10 MT of green beans are traded per day in the main horticultural wholesale market of Nairobi would imply that the annual turnover would be 3650 MT.

Visits to retail outlets in Nairobi showed that only relatively small quantities of green beans are traded on a daily basis (i.e. 1 - 10kg). Staple horticultural products such as cabbages or tomatoes are much more widely sold. In middle income or upmarket retail outlets (e.g. supermarkets or specialised green grocers) green beans are packed like those destined for the export market. Prices are in a range of KES60 per 250 grams of beans to KES99 per 500 grams. Loosely packed beans would be sold at KES 100/kg. However, these are prices for buyers belonging to the middle to higher income bracket.

It is estimated that retailers selling in neighbourhoods for lower or middle income strata, would buy and sell 10 kg of green beans over 2 – 3 days. Losses at wholesale and retail level are estimated to be relatively small (i.e. 5% at wholesale level and 10% at retail level). Details of the income calculations for wholesalers and retail traders are contained in the economics section of the study.

Hotel operators interviewed during the course of the study indicated that they would purchase about 3 kg of beans per day on the local retail market or from suppliers at a price of KES 60/kg (June 2017). If there is a conference taking place at the hotel and larger quantities of food would be required, then 10kg of green beans would be bought by the hotel.

Brokers (i.e. intermediary agents) are a category of trader operating predominantly between green bean producers and exporters of produce. In particular, farmers who are not affiliated with an exporter (i.e. scattered producers) would rely on them for sales but also for extension advice. At the same time, given their limited training in agronomic and food safety practices brokers may not always provide appropriate advice to farmers. In the study, it has been assumed that an average broker would buy and sell 1000 kg of green beans per day on 80 days of the year. Purchase prices would be of the order of KES45/kg and selling prices of the order of KES65/kg.

A study of horticultural consumption patterns of households in Nairobi (Table 2-11, Ayieko et al, 2003) revealed that only 16% of households purchase French beans, and the mean quantities bought by those purchasing were 3.9 kg per month, and the median quantities were 1.5 kg per month. The average monthly expenditure on French beans over all households (i.e. KES 13 at the time) corresponded to about 1.6% of average total monthly purchases of vegetables over all households (i.e. KES 799 at the time).

Item	% of Households purchasing	Monthly purchases among those purchasing				Average monthly expenditure over all Hhs
		Quantity (kg)		Value (Ksh)		
		Mean	Median	Mean	Median	
VEGETABLES						
Tomatoes	96%	9.8	8.3	239	180	229
Onions	94%	4.5	3.0	121	78	114
Sukuma wiki (Kales)	82%	12.7	10.0	121	130	99
Cabbage	77%	3.8	2.8	88	60	68
Irish potatoes	77%	22.7	24.2	187	180	144
Carrots	67%	5.0	3.5	91	52	61
Cooking bananas	35%	13.3	8.4	136	80	48
Sweet potatoes	24%	6.7	4.0	97	64	23
French beans	16%	3.9	1.5	84	50	13
Average total monthly purchases of vegetables over all households (Ksh)						**799**

TABLE 2-11: WEIGHTED HOUSEHOLD PURCHASES OF MAJOR FRESH VEGETABLES IN NAIROBI

2.12 The Green Beans Value Chain

The following two figures illustrate the current functioning of the value chain based on fieldwork carried out as part of the VCA4D study "Kenya Green Beans Value Chain Analysis", which is used for the economic analysis of the value chain. A more detailed analysis, also exploring situations which fall outside average type production, processing, and trading systems will be explored in the social development section of the report.

Given that only few medium-scale farmers have been encountered during the survey, the emphasis has been put on smallholder farmers and large-scale producers. Amongst smallholder farmers (SHF) three different sub-categories can be distinguished, namely SHF having links with exporters of fresh produce, those that also produce for fresh exports but without links (i.e. scattered farmers), and SHF producing on small plots for the processing industry.

Processors indicated here mainly consist of packhouses (for export of fresh green beans) and canning factories (for export of green beans in jars). Little or no freezing operations have been encountered or their existence seen. If the freezing operations exist then only to mix frozen beans with other vegetables such as baby corn, peas, or sugar snaps.

Three categories of traders have been distinguished as highlighted above, namely brokers (intermediary agents selling to exporters), wholesalers, and retail traders (also selling to restaurants or hotels). Their operations and accounts will be analyzed in the other sections of the report.

The green bean value chain in Kenya is driven by the export sector, namely fresh beans, and, to a lesser extent, processed beans. Given that 34,215 MT of fresh green beans have been exported in 2016 (ITC, June 2016), and the percentage of beans rejected for exports (e.g. due to quality) estimated to be 42%, the quantity of green beans produced in this sub-sector is of the order of 58,991 MT. Other quantities of green beans produced for other sub-sectors is much smaller (e.g. estimated to be 3000 MT for canning, and 100 MT for freezing, respectively). In view of this, the total quantity of green beans produced in Kenya in 2017 is of the order of 62,091 MT.

In the case of fresh beans, it is estimated that nowadays 40% of the supply is coming from large-scale farms, and the remainder from smallholder farmers (i.e. 40% being farmers with links to exporters, often through contracts, and 20% being farmers who do not have close links with exporters in that they are “scattered”, and who mainly rely on intermediary agents or brokers for their sales).

About 52,000 producers (i.e. mainly smallholder farmers) and a large number of hired workers (about 40,000 to 50,000) in fields (belonging to both small and large-scale farms) and factories earn at least part of their livelihoods from green beans. In addition, the domestic part of the trading employs about 147 brokers, 357 wholesale traders, and 2700 retailers. Wholesalers and especially retailers also trade in other horticultural produce besides green beans.

Figure 2.7 - Figure 2.9 and Plate 2 provide an overview of the green bean value chain and its functioning.

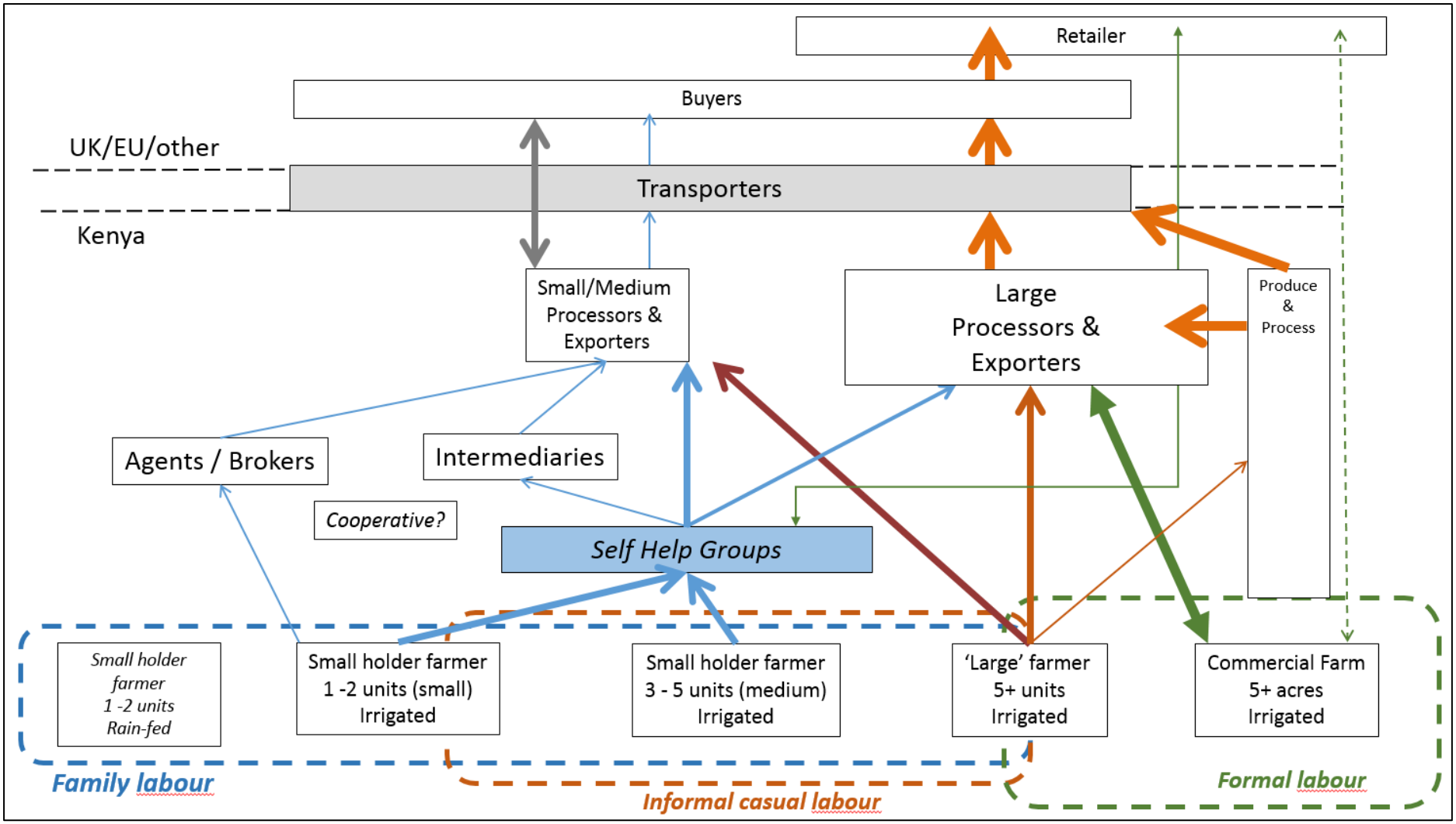


Figure 2.7: Green beans value chain in Kenya

Background information

Country:	Kenya		Utilisation of crop - products				
Crop:	Green beans		Fresh beans, export	34,215,000	kg	(Source, ITC, 2016)	
			Canned beans, export	2,100,000	kg	(Estimate)	
Production (total annual):	62,091,379	kilograms p.a.	Human consumption, domestic trad	8,568,707	kg	(Estimate)	
Area planted (total annual):	7,542	hectares p.a.	Animal feed, domestic	8,568,707	kg	(Estimate)	
Farms (total hectarage)			Compost, domestic	8,568,707	kg	(Estimate)	
Commercial/large-scale	3,040	ha					
Smallholders (linked, fresh exports)	2,360	ha					
Smallholders (scattered, fresh exports)	1,966	ha					
Smallholders (linked, canning)	176	ha					
	-	ha					

Explanations:

* The analysis covers production of green beans, processing (packhouse or canning factory), and domestic use (human consumption, animal feed, and compost)
* IGS stands for Intermediate Goods and Services (i.e. inputs that are not directly value added but require a break-down into their components in order to calculate value addition)

Production of Green Beans in Kenya

Part of value chain	Type of supply / producer	Percentage contributed %	Total supply (kilograms)	Assumed yields (kg/ha)	Land needed for bean production (ha)	Land used for green beans per type of farn (avge ha p.a.)	Number of producers (rounded figures)
		% of supply	58,991,379				
Fresh beans exports	Large farms	40%	23,596,552	8,000	2,950	50	59
	SHF linked/contr	40%	23,596,552	10,000	2,360	0.1	23,597
	SHF scattered	20%	11,798,276	6,000	1,966	0.1	19,664
		% of supply	3,000,000				
Canned beans exports	Large farms	30%	900,000	10,000	90	50	2
	SHF linked/contr	70%	2,100,000	12,500	168	0.02	8,400
	SHF scattered			8,000	-	0.02	-
		% of supply	100,000				
Frozen beans exports	Large farms						
	SHF linked/contr	100%	100,000	12,500	8	0.02	400
	SHF scattered						
Total production of Green Beans			**62,091,379**	**kilograms**	**7,542**	**hectares**	**52,121** **producers**

Processing/packing

Fresh beans export	**34,215,000**	**kilograms**	Source: International Trade Centre (ITC)
Canned beans export	**2,100,000**	**kilograms**	Estimate
Frozen beans export	**70,000**	**kilograms**	Estimate

Beans entering domestic market	Beans for human cons, animal fe	**25,706,379.31**	**kilograms**	**Percentage of beans rejected for export** **42%**
	Domestic trade, human consumpt	**8,568,793**	**kilograms**	**Losses in domestic trade** **10%**

FIGURE 2.8: BACKGROUND INFORMATION ON GREEN BEANS VALUE CHAIN IN KENYA

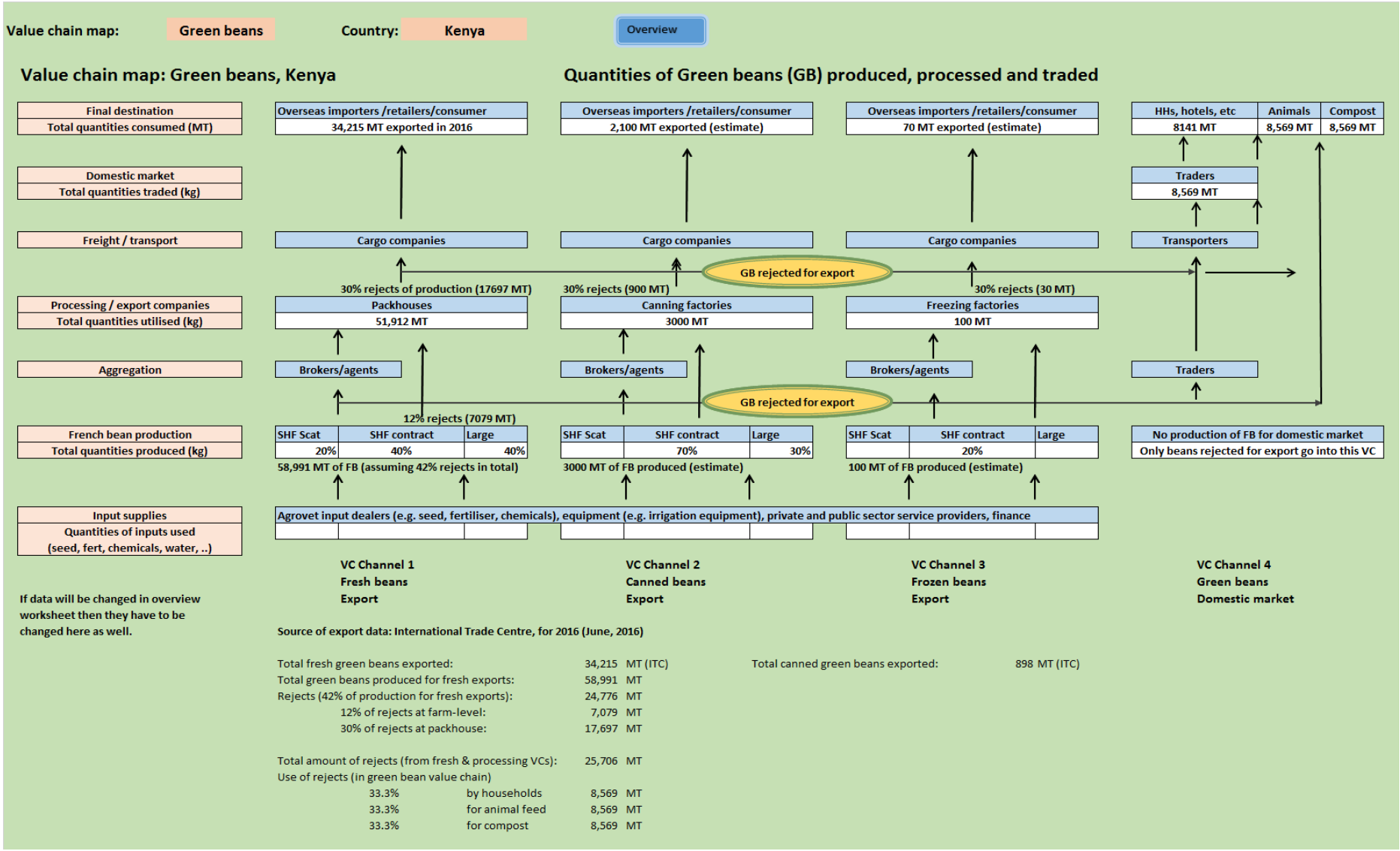


FIGURE 2.9: VALUE CHAIN MAP

PLATE 2: MAP OF KENYA INDICATING MAJOR SUPPLY ROUTES OF GREEN BEANS TO NAIROBI

2.13 Governance of the Value Chain

In particular, this section deals with who are the main players in the value chain and who are its drivers. Large retail companies in the European Union are playing a key role in determining the volumes, quality of produce, and prices of green beans imported from Kenya. Whilst some green beans enter "traditional" market chains involving wholesale and retail markets, this is considered to be of less importance given the market share of large retailers. EU retailers are in a position to determine what production and processing standards are necessary for export produce to be accepted (e.g. GlobalGAP for production, and BRC or IFS standards for processing).

Kenyan exporters represent another group driving the value chain in that they form an intermediary group of players between retailers in Europe and producers in Kenya. Given this role they conform with market requirements of buyers but also influence production, processing, and trading patterns in Kenya. This may include a partial shift away from smallholder production towards larger-scale farms. For example, this is reported to have happened following the application of food safety or MRL regulations in the EU.

Regarding the latter, the application of EU regulation EC 669/2009 has been a driver of the value chain in that related actions influence the quality and quantities of produce traded. Usually, the application of regulations is followed by periods of adaptation leading to reduced volumes exported, possibly by fewer exporters able to comply with the regulation. In the case of EC 669/2009 a sample of 10% of all green beans imported into the EU from Kenya have been subjected to checks. In the meantime, this requirement has been removed for Kenyan green beans imported into the EU. Whilst quantities traded have more or less recovered, regulations such as EC 669/2009 can force a sector to adapt but also create uncertainty in the value chain.

The Government of Kenya promotes agricultural development and supports value chains that generate foreign exchange earnings (e.g. through zero-rated value added tax). Horticultural exports such as green beans are recognized to be a major export sector and as such supported by the Government (e.g. through institutions such as KEPHIS, AFA-HCD, or KALRO). The private sector is organised into private sector associations such as FPEAK, which takes a guiding role in sector development. Also, task forces encompassing both the private and public sectors are set up when required (e.g. to tackle issues in the value chain related to regulations in overseas markets).

At the same time, amongst 47 Counties only Muranga has selected French beans amongst the top three value chains to be promoted in relation to the ASDSP programme. The ASDSP is a Government of Kenya programme to support value chain development in each of the 47 counties (co-funded from July also by the EU). The fact that Local Governments have in many cases selected value chains for local food products reflects their priorities, whilst other organisations belonging to the private and public sectors are seen as the main promoters of export commodities such as green beans.
Development partners such as the EU Delegation or USAID support projects, in particular to reduce poverty and aid developmental targets. Given the importance of the green beans value chain, development partners would for example strengthen the involvement of smallholder farmers (e.g. outgrowers) in the value chain, assist private and public sector stakeholders in the chain to meet regulatory requirements, or support projects which have a wider, more cross-sectoral remit (e.g. climate change related measures). Some international or national NGOs obtain financial support from development partners for these initiatives.

Another category of stakeholders influencing the value chain may be NGOs such as Oxfam, highlighting issues related to social and environmental aspects. For example, related activities would lead to improved worker conditions, also in light of consumer behavior in importing countries, and corporate social responsibility (CSR) initiatives by companies.

In sum, the marketing and governance arrangements in the Kenyan green beans value chain resemble a combination of hierarchical and multi-polar governance system with overseas retailers (in the driver's seat) and Kenyan packhouses playing a lead role, whilst organizations such as the European Commission (e.g. through their regulatory powers, leading, for example, to EC 669/2009) and Kenyan stakeholders (e.g. KEPHIS through their inspection functions) have additional roles to play, which influence the market (Lee and Gereffi, 2015). Over the years, Kenyan suppliers of green beans have moved up the value chain into higher-value product lines (e.g. preparation and packaging of green beans in Kenya), thereby creating more value addition in-country (Gereffi and Kaplinsky, 2001). At the same time, buyers (e.g. European retailers) are in a position to stipulate what standards have to be met at production and processing levels (e.g. GlobalGAP, BRC). Also, European buyers, which constitute the principal market for Kenyan green beans, have a diverse supply base including countries such as Kenya, Egypt, Morocco, Tanzania, Mozambique, Guatemala, Senegal, and European suppliers during the summer months, which allows them to spread risk (also in terms of an oligopolistic supply situation).

3 ECONOMIC ANALYSIS

3.1 Summary

The total quantity of green beans produced in 2017 is estimated to be 62,092 MT, produced on 7,542 hectares of land, which would give an average yield of 8233 kg per hectare. The yields vary from about 6,000 kg/ha to 12,500 kg/ha, depending availability of water, farming practices and varieties grown.

The financial analysis shows that large-scale farms and smallholder farmers (SHF) who have links with exporters (e.g. contracts), operate efficiently and can generate some income (e.g. about KES 30,000 per 1000 sqm plot in one cropping cycle). Scattered smallholder farmers (i.e. those without links), appear to struggle to make significant income from green beans production on a continuous basis (i.e. estimated to be KES 6390 on average per 1000 sqm plot in one cropping cycle). Smallholder farmers producing for the canning industry only make a small income (estimated at KES 5098 per plot of 200 sqm).

Total value added (i.e. direct and indirect value added), including wages for hired labour, value of rented land, financial charges, taxes, depreciation, and operating profits, is highest for large-scale producers (for export of fresh beans) and smallholder farmers (SHF) with links to exporters on the farming side of the value chain (i.e. KES 1.2 billion and KES 1.3 billion, respectively).

In the case of processing it is by far the export sector of fresh green beans which has the highest total value added, namely, KES 3947 million, of which about KES 2374 million represent profits for packhouse operators and other agents active in this part of the value chain (e.g. suppliers of inputs such as energy or materials required by packhouses), and labour (i.e. KES 839 million). Compared to this the processing (i.e. canning) industry is relatively small (KES 349 million total value added), in that only about 3 companies are active in this field. Canning industries that have relatively recently started their business are likely to be saddled with debts, resulting in substantial financial charges and lower profits. Total value addition created in the form of labour is estimated to be KES 115 million in the canning industry.

The total value added generated in trading by brokers, wholesalers, and retailers is of the order of KES 193 million, 106 million, and KES 210 million, respectively. The value addition created through labour in the trading sector is KES 86 million, which may be in the form of driving trucks as part of transport, or handling of produce. The profit generated in the trading sector is KES 130 million, KES 88 million, and KES 101 million, respectively.
The total value added of the green beans value chain is KES 7.8 billion. In addition, imported inputs are estimated at KES 1354 million, and remaining, intermediate goods and services (IGS) are KES 227 million. The value of hired labour is KES 2.3 billion, compared to net profits of the order of KES 4.0 billion. It should be added that the net profit also includes the income of smallholder farmers (e.g. KES 775 million in the case of linked SHF), and a substantial part of this may reflect the value of family labour employed in green bean production.

The green beans value chain of Kenya is well integrated into the local economy, which is reflected by a coefficient of 0.83 (i.e. total value added of KES 7.8 billion divided by a total value of production of KES 9.4). A domestic resource cost (DRC) ratio of 0.36 shows that the value chain is viable within the global economy.

The net contribution to the balance of trade is KES 7.1 billion (i.e. KES 8.5 billion green bean exports minus KES 1.4 billion imported inputs) or 1.5% of annual exports by Kenya.

Kenya's Gross Domestic Product was USD 70 billion in 2016, of which the agricultural sector contributed 32.4% (i.e. USD 22.68 billion, corresponding to KES 2,336 billion). In view of this, value addition in the green beans value chain (KES 7.8 billion) corresponds to about 0.33% of the agricultural GDP of Kenya.

The contribution of the green beans value chain to public finances is estimated to be KES 455 million, including taxes paid by actors in the export part of the value chain, as well as the domestic part of the chain, and input suppliers.

3.2 Introduction

The economic analysis consists of four parts, namely, (1) Financial analysis, (2) Effects within the national economy, (3) Viability within the global economy, (4) Growth inclusiveness.

As further detailed in the functional analysis report of this study, green beans (also called French beans in this report; "Vigna spp., Phaseolus spp.") are almost exclusively produced for the export of fresh or processed (e.g. canned) beans. In particular, the export of fresh green beans dominates the value chain. The total quantity of green beans produced in 2017 is estimated to be 62,092 MT, produced on 7,542 hectares of land, which would give an average yield of 8233 kg per hectare. The yields vary from about 6,000 kg/ha to 12,500 kg/ha, depending on the farming practices, varieties grown (e.g. for export of fresh or processed produce), and general agricultural production conditions (e.g. availability of water through rainfall or irrigation). Green beans are considered a labour- intensive crop in that several agricultural activities demand substantial inputs of manual labour (in particular harvesting, but also planting, irrigation, weeding, spraying of chemicals, and fertiliser application). Even mechanised farms, which would use tractors for land preparation and pump irrigation (together with pivot or drip irrigation systems) still rely on large numbers of hired workers to undertake manual tasks. The daily wage rates for hired workers are of the order of KES 250 – 300 per day in rural areas. In urban areas (e.g. Nairobi) daily wage rates are about KES 500 per day.

The green bean value chain can be considered a medium size value chain in that the total value addition generated is of the order of KES 7.8 billion per annum. This is smaller than the value chains of major staple foods in Kenya (e.g. maize). However, it is still substantial, in that it is a major foreign exchange earner for the country, and a contributor to poverty reduction in that about 52,000 producers (i.e. mainly smallholder farmers) and a large number of hired workers (about 40,000 to 50,000) in fields (belonging to both small and large-scale farms) and factories earn at least part of their livelihoods from green beans. In addition, the domestic part of the trading employs about 147 brokers, 357 wholesale traders, and 2700 retailers. Wholesalers and especially retailers also trade in other horticultural produce besides green beans.

The annual value of fresh green beans exported is of the order of KES 7.87 billion (€68.4 million), which is based on an export quantity of 34,215 MT of fresh green beans in 2016 (ITC statistics, June 2017), and an average export value of KES 230 per kg. The main export markets for fresh green beans are United Kingdom, followed by Netherlands and France. The quantity of processed beans exported has been 898 MT in 2016 (according to ITC statistics, June 2017), however a new processing company has started production towards the end of 2016, and it is expected that export quantities are of the order of 2100 MT in 2017. The main importing countries of processed beans are France, followed by Belgium and United Kingdom.

Fresh beans exports range from loosely packed produce to beans that have undergone a substantial amount of value addition in the form of sorting, trimming, packaging in small units on trays or punnets, weighing and packing. The export of both fresh and processed green beans entails substantial post-harvest losses in the form of beans rejected for export and wastage, considered to be 42% in the case of the fresh beans value chain, and 30% in the case of the processed beans value chain. The beans rejected for export are mainly used for three different purposes, namely: (a) domestic consumption in Kenya by households, restaurant and hotel customers, or institutional buyers such as schools; (b) use of green beans as animal feed, whereby livestock keepers obtain beans from farmers or packhouses after sorting of the produce; and (c) beans used as compost in that those beans that have not been harvested or sorted out in the field are ploughed into the field. The total quantity of green beans rejected for export and entering the

three domestic sub value chains is estimated to be 8569 MT p.a. in each case (i.e. 25,706 MT in total).

The bulk of the analysis is based on market prices, including for land value given that a substantial proportion of land is hired for bean production (i.e. estimated at 50% in the case of smallholders, and 10% in the case of large-scale farms).
The analysis focuses on the calculation of financial and economic indicators for the following categories of value chain agents:
Producers:

- Large farms producing for export of canned green beans
- Large farms producing for export of fresh green beans
- Smallholder farmers (SHF), linked to companies, producing for export of fresh green beans
- Smallholder farmers (SHF), scatted / not linked to companies, producing for export of fresh green beans
- Smallholder farmers (SHF), linked to companies, producing for export of canned green beans

Processors:

- Packhouses, estimated to have on average a monthly capacity of 100 MT (1200 MT p.a.) of green beans raw material use, and output of 70 MT (840 MT p.a.) of fresh green beans per month for export. It is estimated that 41 of these average size packhouses are operational in Kenya.
- Canning factories are also estimated to have an average monthly capacity of 100 MT of green beans raw material use, and 70 MT of output per month for export (i.e. 840 MT p.a.) It is estimated that 3 packhouses of this size are operational in Kenya.

Traders:

- Brokers / agents buying green beans, in particular from scattered farmers (i.e. those who are not linked or contracted to companies), and selling them to packhouses for the export of fresh green beans. The total turnover of such a trader can be 80 MT p.a. (i.e. 1 MT per trip).
- Wholesalers, buying green beans which have rejected for export, mainly from packhouses, but to a lesser degree also from farmers (i.e. annual turnover of 22.8 MT p.a.).
- Retailers, buying relatively small quantities from wholesalers, in order to sell the green beans together with other horticultural produce to household customers, hotels, restaurants and institutional buyers (i.e. about 2.7 MT p.a.).

The following stakeholders have not been analysed in detail:

- Processing industry of frozen green beans, in that the quantities going into this part of the value chain appear to be very small (i.e. estimated at 100 MT p.a.), and the team was not able to collect data from companies;
- Part of the green beans rejected for export are used for animal feed and compost (estimated to be each one third of the green beans rejected for export). The value of green beans used for animal feed are of the order of KES 85,687,070 assuming their value is KES 10/kg. Green beans for animal feed are obtained by livestock keepers either from farmers or processors after sorting of the beans.

Figure 2.8 and Figure 2.9 provide background information to the value chain and the economic analysis, in that they outline the key processes, agents, and product flows in the value chain.

Background information

Country:	**Kenya**		**Utilisation of crop - products**				
Crop:	**Green beans**		**Fresh beans, export**	**34,215,000**	**kg**	(Source, ITC, 2016)
			Canned beans, export	**2,100,000**	**kg**	(Estimate)
Production (total annual):	**62,091,379**	**kilograms p.a.**	**Human consumption, domestic trad**	**8,568,707**	**kg**	(Estimate)
Area planted (total annual):	**7,542**	**hectares p.a.**	**Animal feed, domestic**	**8,568,707**	**kg**	(Estimate)
Farms (total hectarage)			**Compost, domestic**	**8,568,707**	**kg**	(Estimate)
Commercial/large-scale	**3,040**	**ha**				
Smallholders (linked, fresh exports)	**2,360**	**ha**				
Smallholders (scattered, fresh exports)	**1,966**	**ha**				
Smallholders (linked, canning)	**176**	**ha**				
	-	**ha**				

Explanations:

*** The analysis covers production of green beans, processing (packhouse or canning factory), and domestic use (human consumption, animal feed, and compost)**
*** IGS stands for Intermediate Goods and Services (i.e. inputs that are not directly value added but require a break-down into their components in order to calculate value addition)**

Production of Green Beans in Kenya

Part of value chain	Type of supply / producer	Percentage contributed %	Total supply (kilograms)	Assumed yields (kg/ha)	Land needed for bean production (ha)	Land used for green beans per type of farn (avge ha p.a.)	Number of producers (rounded figures)
		% of supply	**58,991,379**				
Fresh beans exports	Large farms	40%	23,596,552	8,000	2,950	50	59
	SHF linked/contr	40%	23,596,552	10,000	2,360	0.1	23,597
	SHF scattered	20%	11,798,276	6,000	1,966	0.1	19,664
		% of supply	**3,000,000**				
Canned beans exports	Large farms	30%	900,000	10,000	90	50	2
	SHF linked/contr	70%	2,100,000	12,500	168	0.02	8,400
	SHF scattered			8,000	-	0.02	-
		% of supply	**100,000**				
Frozen beans exports	Large farms						
	SHF linked/contr	100%	100,000	12,500	8	0.02	400
	SHF scattered						

Total production of Green Beans		**62,091,379**	**kilograms**	**7,542**	**hectares**	**52,121**	**producers**

Processing/packing				
	Fresh beans export	**34,215,000**	**kilograms**	Source: International Trade Centre (ITC)
	Canned beans export	**2,100,000**	**kilograms**	Estimate
	Frozen beans export	**70,000**	**kilograms**	Estimate

Beans entering domestic market	Beans for human cons, animal fe	**25,706,379.31**	**kilograms**	**Percentage of beans rejected for export**	**42%**
	Domestic trade, human consumpt	**8,568,793**	**kilograms**	**Losses in domestic trade**	**10%**

FIGURE 3.1 : BACKGROUND INFORMATION ON GREEN BEANS VALUE CHAIN IN KENYA

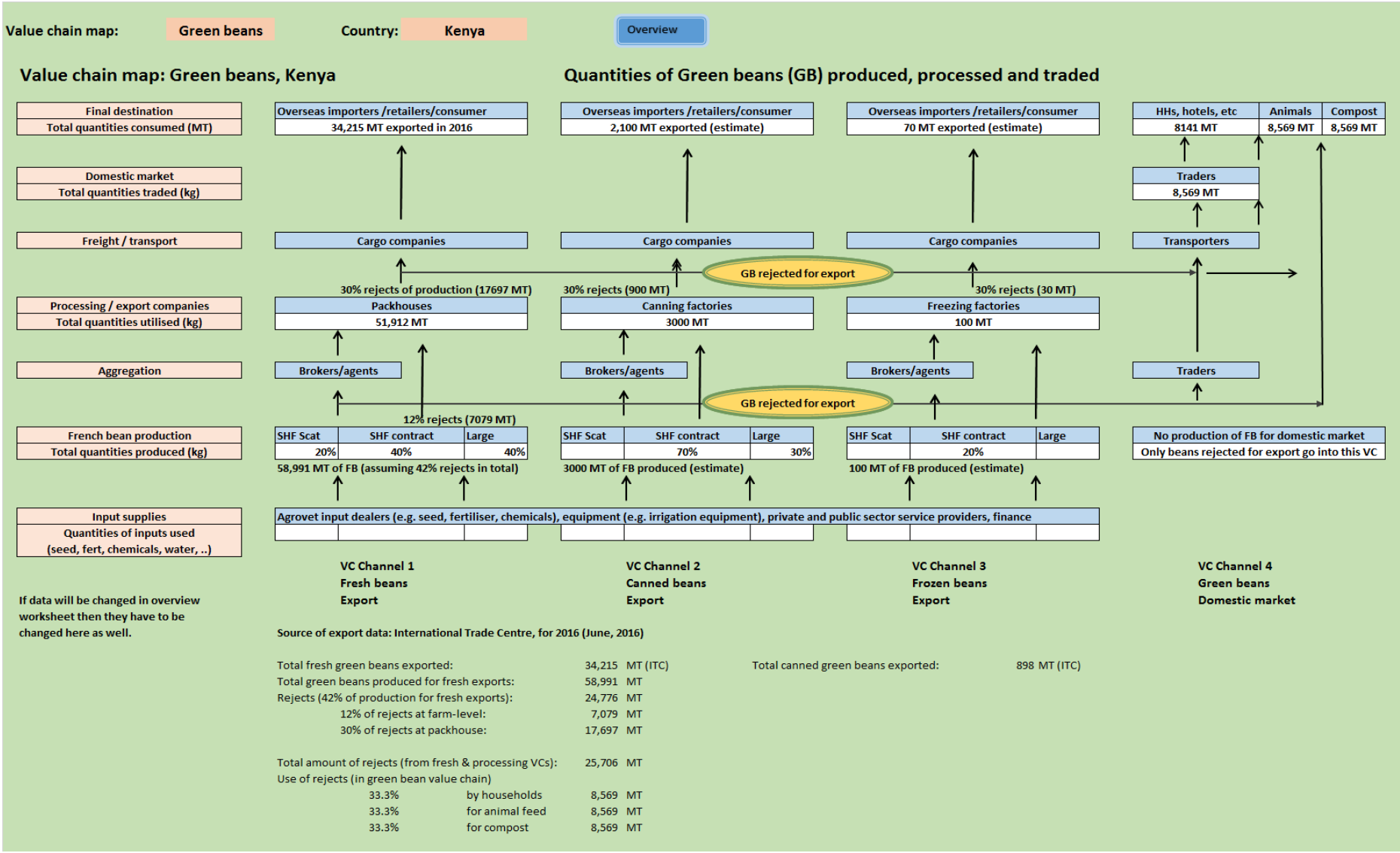


FIGURE 3.2: VALUE CHAIN MAP

3.3 Financial Analysis of Agents' Operations

Value chain agents' operating accounts have been calculated based on the following outline:

- Production / output
- Farmgate / sales price
- Value of production
- Cost of Production
  - Intermediate Goods and Services
  - Value Addition (direct VA)
    - Value of rented land
    - Value of hired labour
    - Financial charges
    - Taxes / duties
    - Subsidies
- Gross profit
  - Depreciation
- Net profit

3.3.1 Production of green beans

The financial analysis shows that large-scale farms and smallholder farmers (SHF) who have links with exporters (e.g. contracts), operate efficiently and can generate some income (e.g. about KES 30,000 per 1000 sqm plot in one cropping cycle). This assumes that family labour does not represent a cost for the farmer and contributes to SHF's profit. Hired labour and the value of land rental are taken into account (assuming that 50% of SHF land is rented, and 10% of large farms).

Scattered smallholder farmers (i.e. those without links), appear to struggle to make significant income from green beans production on a continuous basis (i.e. estimated to be KES 6390 on average per 1000 sqm plot in one cropping cycle). Occasionally, they may make a high income when green beans farmgate and export prices are high, but this is counterbalanced by periods of low prices when they make little income. Also, due to lack of organisation into groups, they rely on brokers for the sale of their produce, which tends to reduce their farmgate price. Smallholder farmers producing for the canning industry only make a small income (estimated at KES 5098 per plot) from green bean production which is partly due to their small plot size (i.e. 200 sqm) and the low price they obtain for their produce. There are cases where smallholder farmers producing for the processing industry grow green beans on more than one plot (e.g. three).

In the course of the survey, it has been reported that during recent years a change in horticultural production patterns has taken place in that more large-scale farms are being used for the production of green beans and other horticultural produce. Reasons for this include better control of production practices and input use (e.g. this includes avoiding problems related to improper chemicals use).

	Large farms canning	Large farms fresh	SHF linked fresh	SHF scattered fresh	SHF linked canning
Green bean farm or plot size (ha)	50	50	0.1	0.1	0.02
Yield (kg/ha), converted	10,000	8,000	10,000	6,000	12,500
Farmgate price (KES/kg)	50.0	65.0	60.0	45.0	40.0
Value of production	500,000	520,000	600,000	270,000	500,000
Costs of Intermediate Goods and Sercies (IGS) (KES/ha)	132,329	241,840	125,460	69,740	145,950
Rented land (KES/ha/crop cycle)	1,647	1,647	8,233	8,233	8,233
Hired labour (KES/ha)	148,229	160,210	151,875	121,875	65,938
Financial charges (KES/ha)	15,370	10,000	-	-	-
Taxes/duties (KES/ha)	-	-	-	-	-
Subsidies (KES/ha)	-	-	-	-	-
Gross profit (KES/ha)	202,425	106,303	314,432	70,152	279,879
Depreciation (KES/ha)	46,900	76,900	12,500	6,250	25,000
Net profit (KES/ha)	155,525	29,403	301,932	63,902	254,879
Total cost of production (KES/ha)	344,475	490,597	298,068	206,098	245,121
Cost of production (KES/kg)	34.4	61.3	29.8	34.3	19.6
Farm income (KES/farm)	7,776,258	1,470,167	30,193	6,390	5,098

TABLE 3-1: PRODUCTION OF GREEN BEANS IN KES (OPERATING ACCOUNTS/FINANCIAL ANALYSIS)

3.3.2 Processing of green beans

Packhouses that are well-established and have little or no financial obligations appear to make substantial net profit (estimated at KES 52 million p.a., or € 453,464 per enterprise). Factories that have recently been established and which are saddled with substantial debt make a much smaller profit (estimated at about KES 5 million p.a., or € 43,254).

	Packhouse for export of fresh beans	Canning factory of beans
Output, kilogram, per annum, per factory	840,000	846,360
Sales prices (KES/kg)	230.0	287.0
Value of production (KES)	2,318,400,000	2,914,528,681
Costs of Intermediate Goods and Sercies (IGS) (KES/p.a.)	114,937,224	179,907,033
Rented land (KES/p.a.)	-	-
Hired labour (KES/p.a.)	15,079,500	22,619,250
Financial charges (KES/p.a.)	6,000,000	24,592,262
Taxes/duties (KES/p.a.)	1,012,500	- 3,039,588
Subsidies (KES/p.a.)	-	-
Gross profit (KES/p.a.)	56,170,776	16,974,192.94
Depreciation (KES/p.a.)	4,022,400	12,000,000
Net profit (KES/p.a.)	52,148,376	4,974,193
Total cost of production (KES/p.a.)	141,051,624	236,078,957
Cost of production (KES/kg of output)	167.9	278.9

TABLE 3-2 : PROCESSING OF GREEN BEANS IN KES (OPERATING ACCOUNTS/FINANCIAL ANALYSIS)

3.3.3 Trading of green beans

Brokers (i.e. agents buying mainly from scattered farmers and supplying exporters of fresh green beans) make a profit of KES 784,000 per annum per enterprise (€ 6817), wholesale traders supplying local retailers are estimated to make a profit of KES 237,600 per annum per enterprise (€ 2066), and retailers supplying the domestic market, who tend to sell small quantities and also trade in other horticultural produce, would make an annual profit of KES 25,500 per annum per enterprise (€ 222) from the sale of green beans.

	Brokers for exporters of green beans	Wholesalers trading in domestic market	Retailers trading in domestic market
Output, kilogram, per annum	80,000	22,800	2,700
Sales prices (KES/kg)	65.0	30.0	65.0
Value of production (KES)	5,200,000	684,000	175,500
Costs of Intermediate Goods and Sercies (IGS) (KES/p.a.)	4,240,000	415,200	126,000
Rented land (KES/p.a.)	-	-	-
Hired labour (KES/p.a.)	160,000	7,200	9,000
Financial charges (KES/p.a.)	-	-	-
Taxes/duties (KES/p.a.)	16,000	24,000	15,000
Subsidies (KES/p.a.)	-	-	-
Gross profit (KES/p.a.)	784,000	237,600	25,500
Depreciation (KES/p.a.)	-	-	-
Net profit (KES/p.a.)	784,000	237,600	25,500
Total cost of production (KES/p.a.)	4,416,000	446,400	150,000
Cost of production (KES/kg of output)	55.2	19.6	55.6

TABLE 3-3: TRADING OF GREEN BEANS IN KES (OPERATING ACCOUNTS/FINANCIAL ANALYSIS)

3.4 Economic analysis – calculation of value addition

The value addition calculated in this section includes both the direct and indirect value addition in the green beans value chain. In particular, the economic analysis is based on a break-down of the Intermediate Goods and Services (IGS) into their value addition components, namely: value of rented land value, hired labour value, financial charges, taxes / dues, subsidies, gross profit. Investment costs in the form of depreciation are deducted from the gross profits, resulting in the net profit. In addition, the values of the imported component of IGS and the remaining component of IGS is determined.

The sums of indirect value addition obtained from IGS are added to the direct value addition components calculated in the financial analysis, resulting in total value addition. As a result, the value addition calculated in the economic analysis includes the indirect effects, or backward linkages, created in terms of value addition in other parts of the economy, notably input provision. This can be compared with the amount of foreign exchange required for the value chain (i.e. imported goods and services). The indirect effects of the remaining intermediate goods and services (e.g. inputs from maintenance workshops) could have been calculated, however the data to do this analysis is not easily available.

The bulk of the analysis is based on market prices, including for land value given that a substantial proportion of land is hired for bean production (i.e. estimated at 50% in the case of smallholders, and 10% in the case of large-scale farms).

As for the economic analysis, it is large-scale producers (for exports of fresh beans) and smallholder farmers (SHF) with links to exporters, that generate the highest amount of production (i.e. value of output, including imported and remaining IGS) in the green bean production part of the value chain (KES 1.5 billion and KES 1.4 billion respectively. The total value added (excluding imported and remaining IGS) generated by these two groups of agents is KES 1.2 billion and KES 1.3 billion respectively.

There are only few large-scale farms producing beans for the canning industry, and given that the latter is only small compared to the export of fresh produce, the total value added is relatively small (KES 39 million). Scattered SHF producing for packhouses and SHF producing for canning factories generate the remainder of the total value added amongst producers (KES 471 million and KES 77 million, respectively).

In the case of large-scale producers (for export of fresh beans) and smallholder farmers (SHF) with links to exporters, respectively, the value of imported inputs is estimated at KES 330 million and KES 119 million, respectively, and depreciation of investments at KES 227 million and KES 29 million in the two cases. Also, there are sums for remaining, intermediate goods and services (IGS) which are KES 36 million and KES 18 million (e.g. value of inputs of maintenance workshops). The total value of hired labour generated by green bean production is about KES 1.3 billion (for all production systems), bearing in mind that smallholder farmers require hired workers for labour intensive activities such as harvesting.

In the case of processing it is by far the export sector of fresh green beans (i.e. packhouse operators) which has the highest total value added, namely, KES 3947 million. Imported IGS are KES 637 million, remaining IGS are KES 109 million, and depreciation of investments are estimated at KES 164 million. About KES 2374 million represent profits for packhouse operators and other agents, active in this part of the value chain (e.g. suppliers of inputs such as energy or materials required by packhouses). Packhouses and processing factories (e.g. canning industry) that have relatively recently started their business are likely to be saddled with debts, resulting in substantial financial charges and lower profits. Total value addition created in the form of labour is KES 955 million per annum, out of which KES 839 million is generated by the packhouse industry, and the remainder by the canning industry. It is estimated that the canning factories generate a total value added of KES 350 million per annum. The main parts of canning factories' value addition are hired labour (KES 115 million), and financial charges (KES 96 million). Imported IGS represent KES 124 million, and remaining IGS KES 30 million.

Domestic trade has been subdivided into brokers, who operate as agents on behalf of fresh produce exporters, mainly buying from farmers that are scattered (i.e. without direct links or contracts with exporters) and then selling to packhouse operators. Another group of traders encountered are wholesalers and retailers dealing with green beans that have been rejected for export, and which are consumed by local households, in restaurants, hotels, or institutional consumers (e.g. schools). It is estimated that one third of green beans rejected for export (i.e. 8,569 MT p.a.) enter the domestic human consumption chain.

The total value added generated in trading is of the order of KES 193 million, 106 million, and KES 210 million, respectively. The value addition created through labour in the trading sector is KES 86 million, which may be in the form of driving trucks as part of transport, or handling of produce.

The profit generated in the trading sector is KES 130 million, KES 88 million, and KES 101 million, respectively.

The remaining two thirds of green beans rejected for exports (i.e. 17,137 MT) are either used for animal feed (worth KES 85 million), or as compost. In the latter case, producers (e.g. large-scale farmers) plough green beans into the ground.

Table 3-4 provides a summary of the above discussed figures.

Details of how the total value added is distributed within different enterprise categories and for the entire country is shown in Table 3-4 and Figure 3.3 - Figure 3.9.

3.4.1 Summary data of production, value addition, imports, and remaining IGS

Stages:	Green beans production					Processing: fresh exp & canning		Trade: brokers, wholesalers & retailers			Total production (KES p.a.)	
in KES	Large farms	Large farms	SHF linked	SHF scattered	SHF linked						& value addition	
Current, average situation	**(canning)**	**(fresh exports)**	**(fresh exports)**	**(fresh exports)**	**(canning)**	**Packhouses**	**Canning factories**	**Brokers**	**Wholesalers**	**Retailers**		**Total, current**
IGS Imports	5,073,819	330,060,749	119,452,824	50,372,739	9,735,880	637,189,122	124,475,531	33,625,086	7,240,557	36,845,440	**IGS Imports**	1,354,071,748
Remaining IGS	762,317	36,494,722	18,032,013	9,303,334	1,576,344	108,576,830	30,359,470	9,438,621	1,970,803	10,282,448	**Remaining IGS**	226,796,902
Rented land	174,450	4,856,957	19,663,793	16,386,494	1,466,667	7,148,491	3,705,010	-	-	-	**Rented land**	53,401,862
Hired labour	14,897,563	558,552,737	410,526,672	267,578,211	16,876,552	839,420,619	115,165,356	38,344,397	5,869,564	41,986,664	**Hired labour**	2,309,218,335
Financial charges	2,018,240	68,467,371	16,063,589	7,480,893	1,396,032	320,233,557	96,408,656	4,719,310	985,401	5,141,224	**Financial charges**	522,914,274
Taxes/dues	1,844,641	49,932,663	27,329,998	15,105,333	2,290,904	241,623,177	23,293,078	20,057,069	11,824,816	61,694,690	**Taxes/dues**	454,996,369
Subsidies	-	-	-	-	-	-	-	-	-	-	**Subsidies**	-
Depreciation	4,221,000	226,821,853	29,495,690	12,289,871	4,400,000	163,840,971	36,000,000	-	-	-	**Depreciation**	477,069,385
Net profit	16,007,970	258,588,810	775,228,526	152,405,539	50,257,621	2,374,310,089	75,028,094	129,781,034	87,786,403	101,110,743	**Net profit**	4,020,504,829
Sums, total production	**45,000,000**	**1,533,775,862**	**1,415,793,103**	**530,922,414**	**88,000,000**	**4,692,342,857**	**504,435,196**	**235,965,517**	**115,677,545**	**257,061,210**	**Sums, total prod**	**9,418,973,704**
VA, excl imports and remaining IGS	39,163,864	1,167,220,391	1,278,308,267	471,246,341	76,687,776	- 3,946,576,905	349,600,195	- 192,901,810	106,466,184	209,933,322	Sums, VA	7,838,105,055
in Euro	Exchange rate (KES/Euro):		115									
	Large farms	**Large farms**	**SHF linked**	**SHF scattered**	**SHF linked**						**Total production (Euro p.a.)**	
Current, average situation	**(canning)**	**(fresh exports)**	**(fresh exports)**	**(fresh exports)**	**(canning)**	**Packhouses**	**Canning factories**	**Brokers**	**Wholesalers**	**Retailers**	**& value addition**	**Total, current**
IGS Imports	44,120	2,870,093	1,038,720	438,024	84,660	5,540,775	1,082,396	292,392	62,961	320,395	**IGS Imports**	11,774,537
Remaining IGS	6,629	317,345	156,800	80,899	13,707	944,146	263,995	82,075	17,137	89,413	**Remaining IGS**	1,972,147
Rented land	1,517	42,234	170,990	142,491	12,754	62,161	32,217	-	-	-	**Rented land**	464,364
Hired labour	129,544	4,856,980	3,569,797	2,326,767	146,753	7,299,310	1,001,438	333,430	51,040	365,101	**Hired labour**	20,080,159
Financial charges	17,550	595,368	139,683	65,051	12,139	2,784,640	838,336	41,037	8,569	44,706	**Financial charges**	4,547,081
Taxes/dues	16,040	434,197	237,652	131,351	19,921	2,101,071	202,549	174,409	102,824	536,476	**Taxes/dues**	3,956,490
Subsidies	-	-	-	-	-	-	-	-	-	-	**Subsidies**	-
Depreciation	36,704	1,972,364	256,484	106,868	38,261	1,424,704	313,043	-	-	-	**Depreciation**	4,148,429
Net profit	139,200	2,248,598	6,741,118	1,325,266	437,023	20,646,175	652,418	1,128,531	763,360	879,224	**Net profit**	34,960,912
Sums, total production	**391,304**	**13,337,181**	**12,311,244**	**4,616,717**	**765,217**	**40,802,981**	**4,386,393**	**2,051,874**	**1,005,892**	**2,235,315**	**Sums, total prod**	**81,904,119**
VA, excl imports and remaining IGS	340,555	10,149,743	11,115,724	4,097,794	666,850	- 34,318,060	3,040,002	- 1,677,407	925,793	1,825,507	Sums, VA	68,157,435

TABLE 3-4 : SUMMARY OF PRODUCTION, VALUE ADDITION, IMPORTS, AND REMAINING IGS PER STAGE IN THE VALUE CHAIN, AND BY ENTERPRISE GROUPS

Nb: The figures reflect total production, as well as total value addition within the value chain. The value addition in this case (total production minus IGS imports and remaining IGS) includes both direct and indirect value addition.

3.4.2 Production – figures of value addition

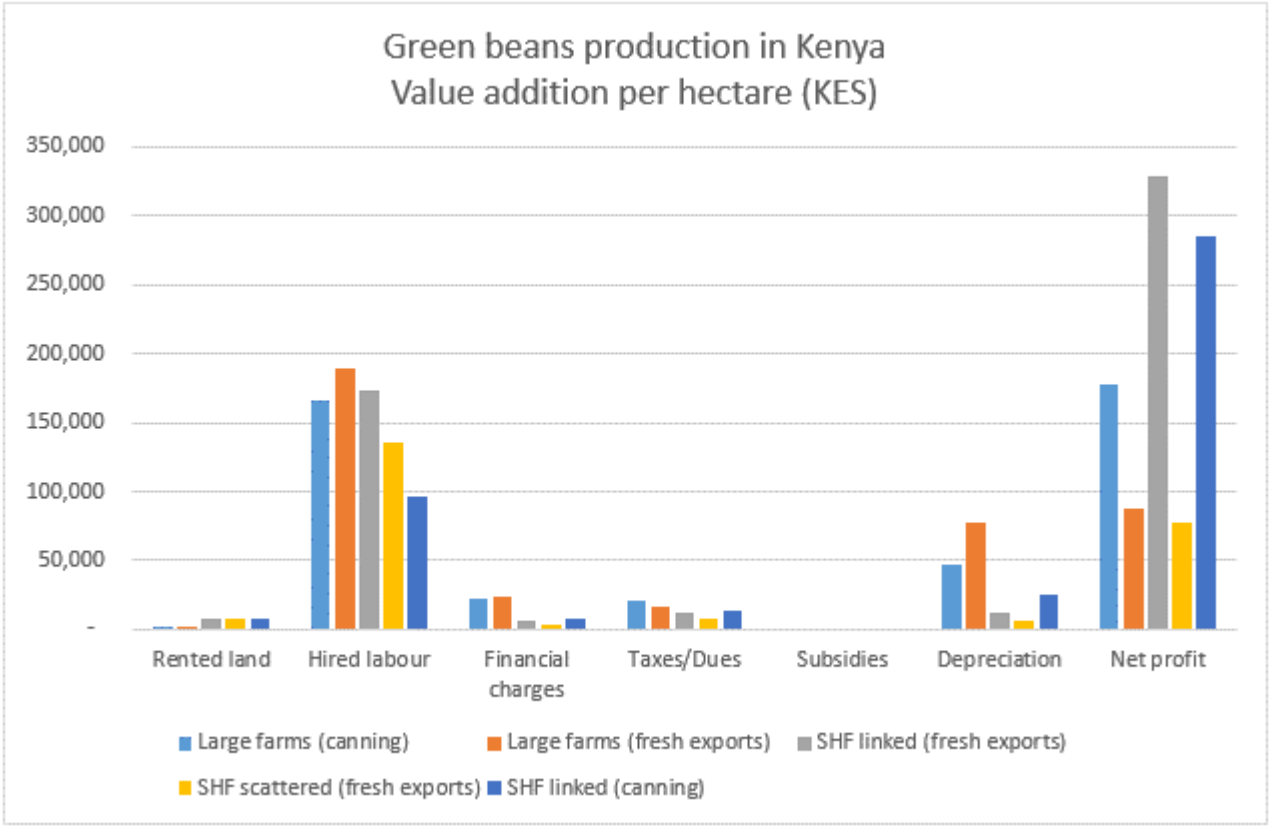


FIGURE 3.3: TOTAL VALUE ADDITION OF GREEN BEANS PRODUCTION IN KENYA (PER HECTARE)

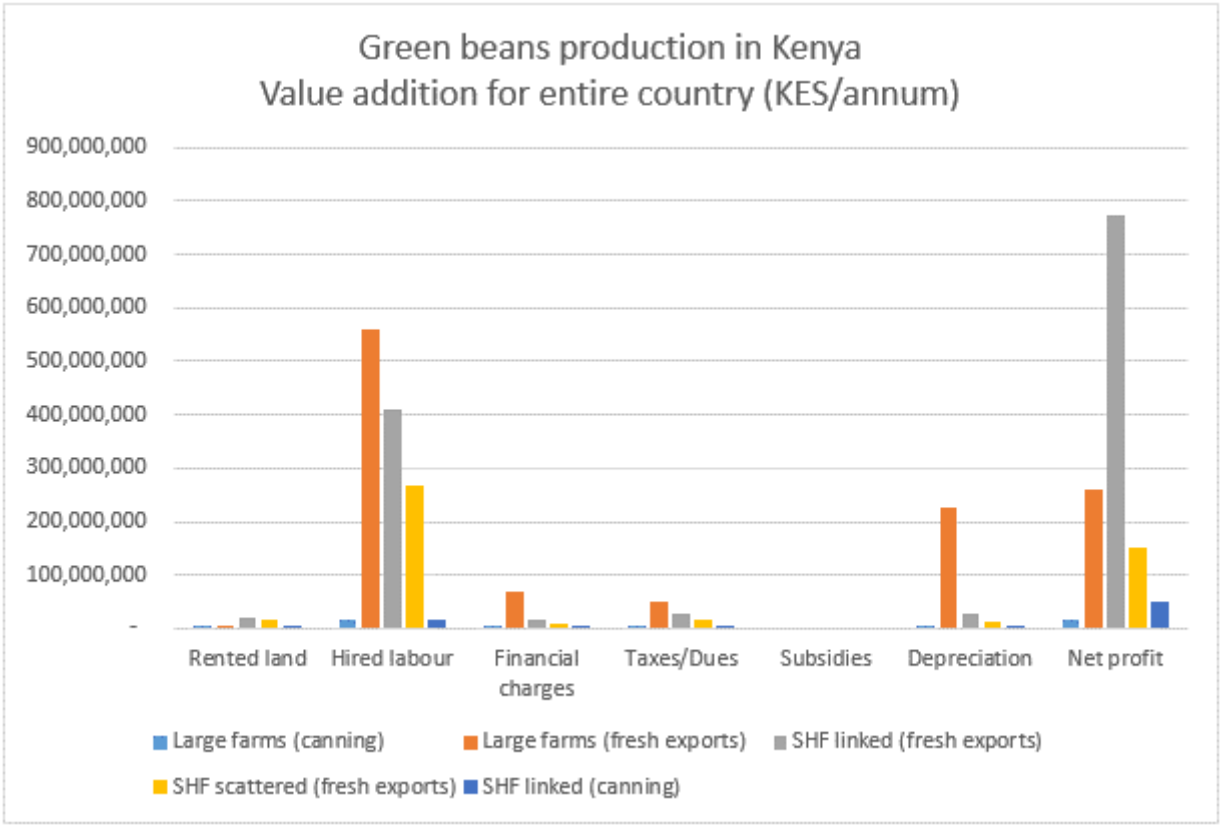


FIGURE 3.4: TOTAL VALUE ADDITION OF GREEN BEANS PRODUCTION IN KENYA FOR ENTIRE COUNTRY (PER ANNUM)

3.4.3 Processing – figures of value addition

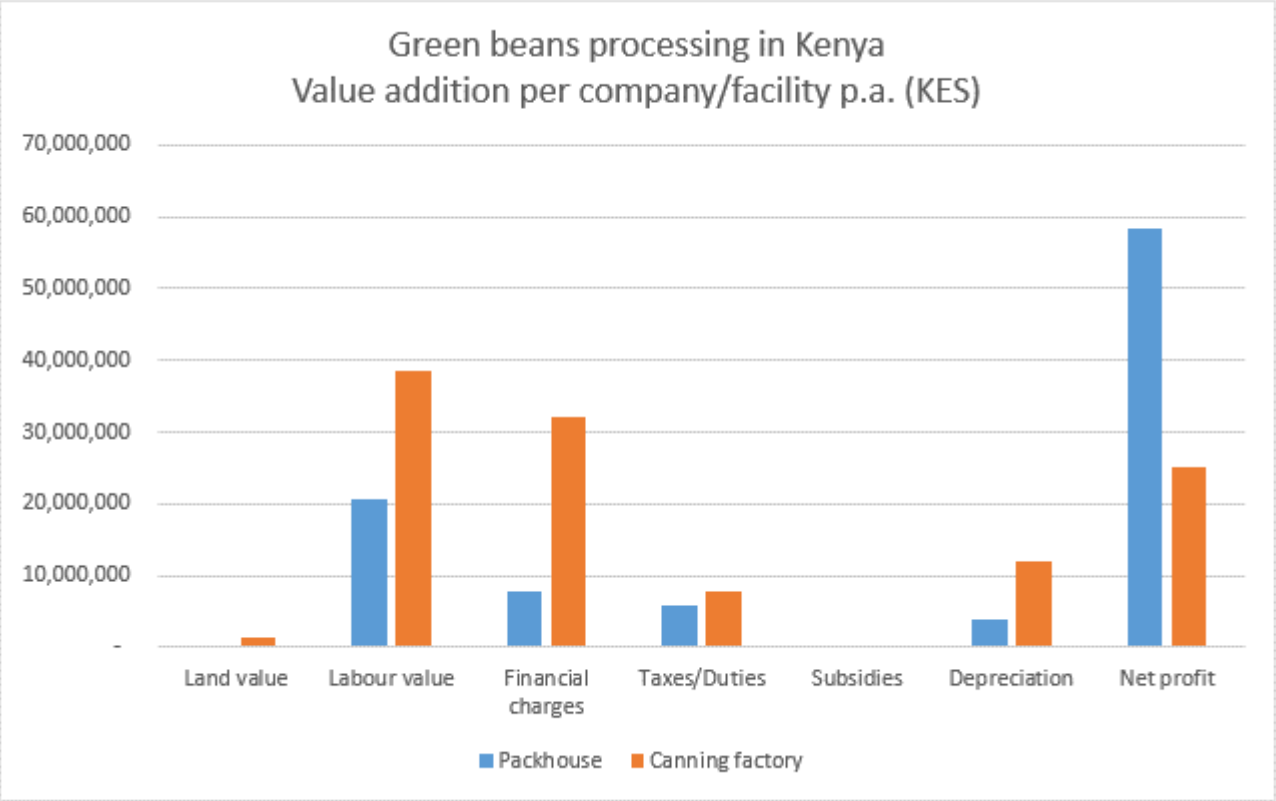


FIGURE 3.5: TOTAL VALUE ADDITION FOR INDIVIDUAL PROCESSING ENTERPRISE (KES/COMPANY/P.A.)

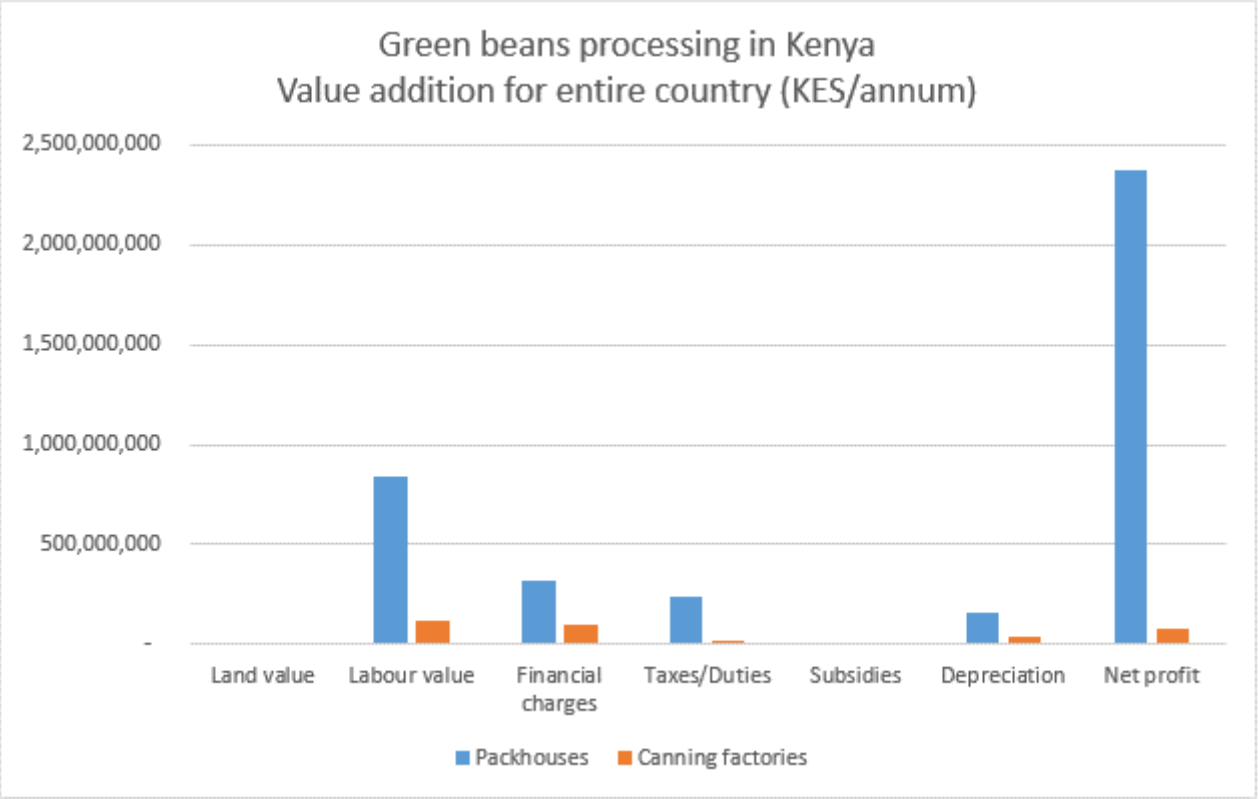


FIGURE 3.6: TOTAL VALUE ADDITION FOR GREEN BEAN PROCESSING FOR ENTIRE COUNTRY

3.4.4 Trading – figures of value addition

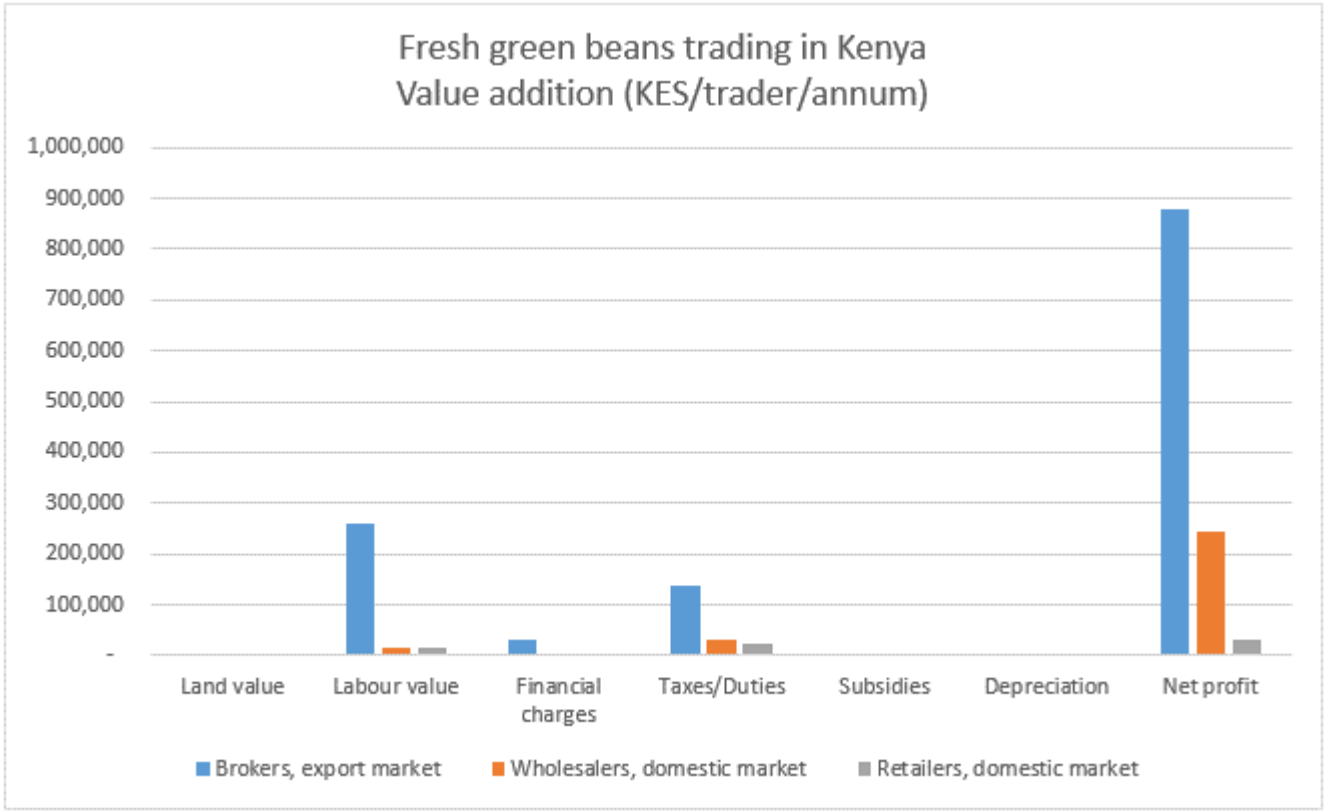


FIGURE 3.7: VALUE ADDITION FOR INDIVIDUAL TRADING COMPANIES (KES/ENTERPRISE/ANNUM)

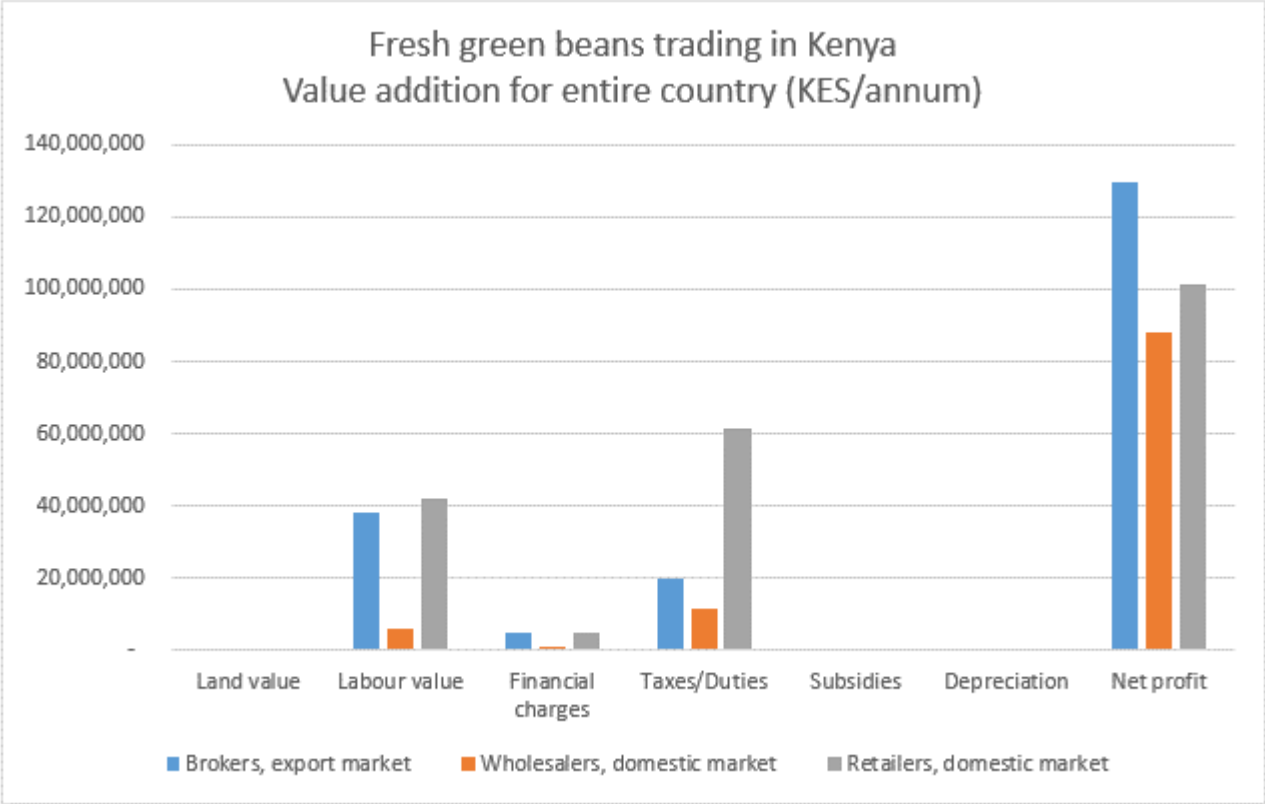


FIGURE 3.8: VALUE ADDITION BY GREEN BEAN TRADING SECTOR FOR ENTIRE COUNTRY (KES)

3.4.5 Kenya green beans value chain – total value addition

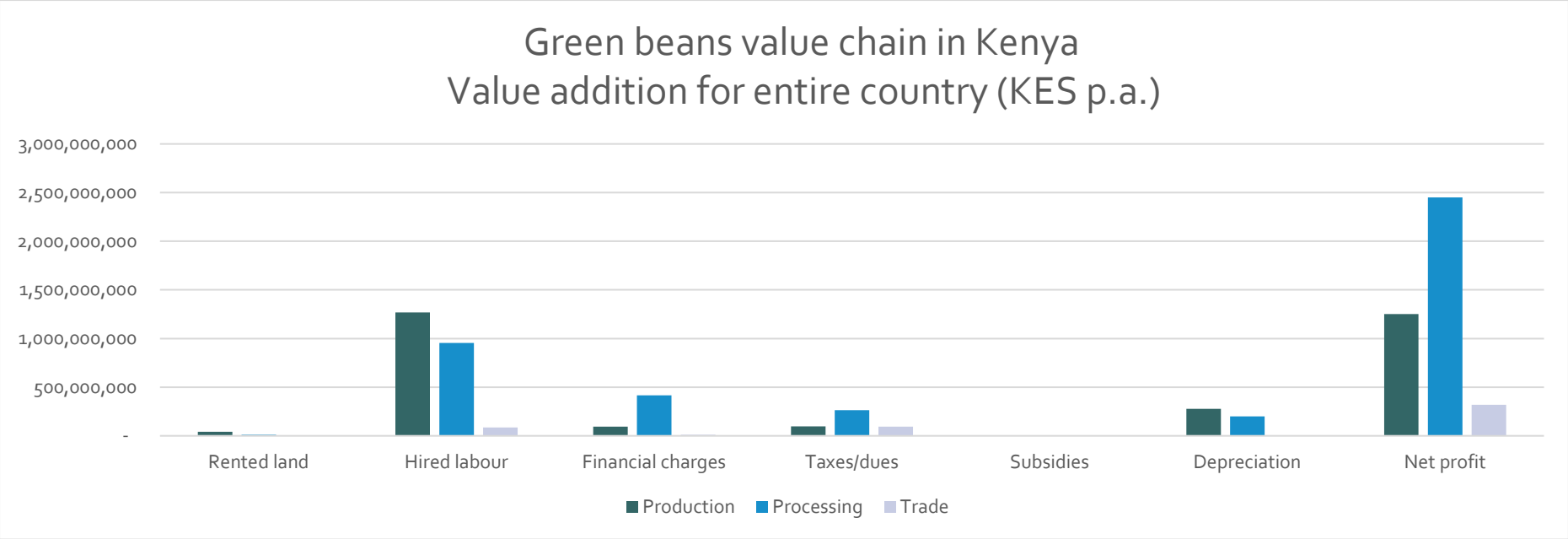


FIGURE 3.9: TOTAL VALUE ADDITION BY GREEN BEANS VALUE CHAIN IN KENYA (IN KES)

The total value added of the green beans value chain comprises direct value added plus indirect value added, including wages, rented land, financial charges, taxes, depreciation, and operating profits (i.e. KES 7.8 billion). In addition, imported inputs are estimated at KES 1354 million, and local, intermediate goods and services (IGS) are KES 227 million.

Kenya's Gross Domestic Product was USD 70 billion in 2016, of which the agricultural sector contributed 32.4% (i.e. USD 22.68 billion, corresponding to KES 2,336 billion). In view of this, value addition in the green beans value chain (KES 7.8 billion) corresponds to about 0.33% of the agricultural GDP of Kenya.

The rate of integration into the economy is total value added divided by the total production of the value chain. Total value added includes the sums of rented land, value of hired labour, financial charges, taxes, depreciation and operating profits. The green beans value chain of Kenya is well integrated into the local economy, which is reflected by a coefficient of 0.83 (i.e. total value added of KES 7.8 billion divided by a total value of production of KES 9.4

The contribution of the green beans value chain to public finances is estimated to be KES 455 million (Euro 3.96 million), including taxes paid by actors in the export part of the value chain, as well as the domestic part of the chain, and input suppliers. It should be noted that this figure is based on estimates in that tax payments vary depending on the stakeholders. Also, the figure is relatively modest in that agricultural inputs and export production benefit from zero rated value added tax (as explained in Annex 4).

The net contribution to the balance of trade is KES 7.1 billion (i.e. KES 8.5 billion green bean exports minus KES 1.4 billion of imported inputs). The green beans exports are 1.5% of the annual exports by Kenya (USD 5537 million or KES 570 billion) in 2015.

3.4.6 Viability within the global economy

The domestic resource cost (DRC) ratio is used as an indicator to assess to what extent a value chain depends on imported inputs and indicates its viability within the global economy. A DRC of 0.36 (i.e. <1) shows that the value chain is viable within the global economy. In order to calculate the DRC, the sum of domestic production factor costs is divided by the total output of the value chain minus tradeable inputs (i.e. imported inputs). Farm family labour has been given an opportunity cost of zero in this case and the value of land takes into account only the proportion that is rented (10% in the case of large-scale farms, and 50% of small-scale farms).

3.4.7 Growth inclusiveness

As for the distribution of income between labour and profits, this is shown in the above tables and figures, for different parts of the value chain as well as for the entire value chain. As for the latter, the value of hired labour is KES 2.3 billion, compared to net profits of the order of KES 4.0 billion. It should be added that the net profit also includes the income of smallholder farmers (e.g. KES 775 million in the case of linked SHF), and a substantial part of this may reflect the value of family labour employed in green bean production. Similarly, the net profit of traders covers their time spent in their trading business.

Figure 3.10 shows the distribution of value added within the Kenyan green beans value chain, demonstrating the importance of the value of hired labour and operating profits. In particular, the value of hired labour represents 29% of value addition, compared to profits of packhouse operators (30%), and farmers (16%). It should be noted that the latter also includes family labour.

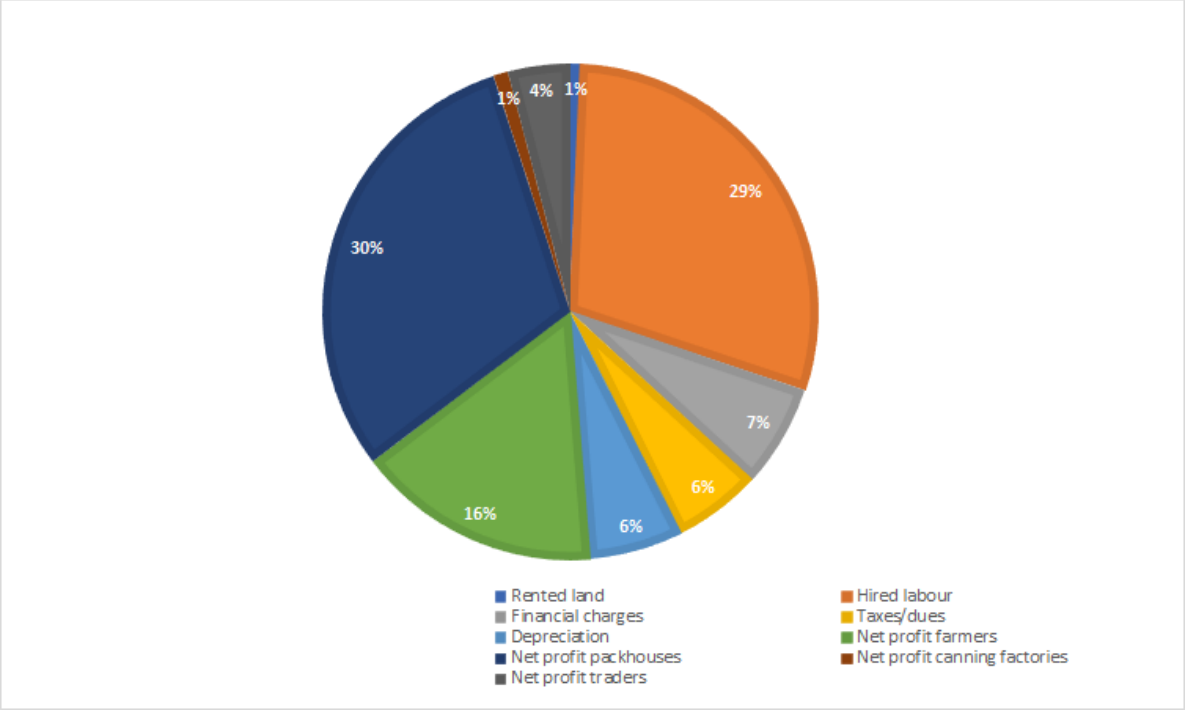


FIGURE 3.10: MAIN COMPONENTS OF VALUE ADDITION IN KENYA'S GREEN BEANS VALUE CHAIN

Graph XY shows how labour income is split between different sub-sectors of the value chain, with large farms for export of fresh green beans (29%) and packhouses (also 29%) representing the main employers. Other important employers include smallholder farmers (SHF) with links (19%) to exporters, and scattered SHF (13%) without links, in that smallholder farmers also employ workers for labour intensive tasks (e.g. harvesting).

The calculation is based on the following assumptions: total value of hired labour is KES 2.3 billion, average income of workers is between KES 250 and KES 400 per day (taking location of processing factories in rural and urban areas into account), 170 days worked per annum by each worker across the board. This leads to a total number of 41,875 workers, the income of which is split as shown in Figure 3.11.

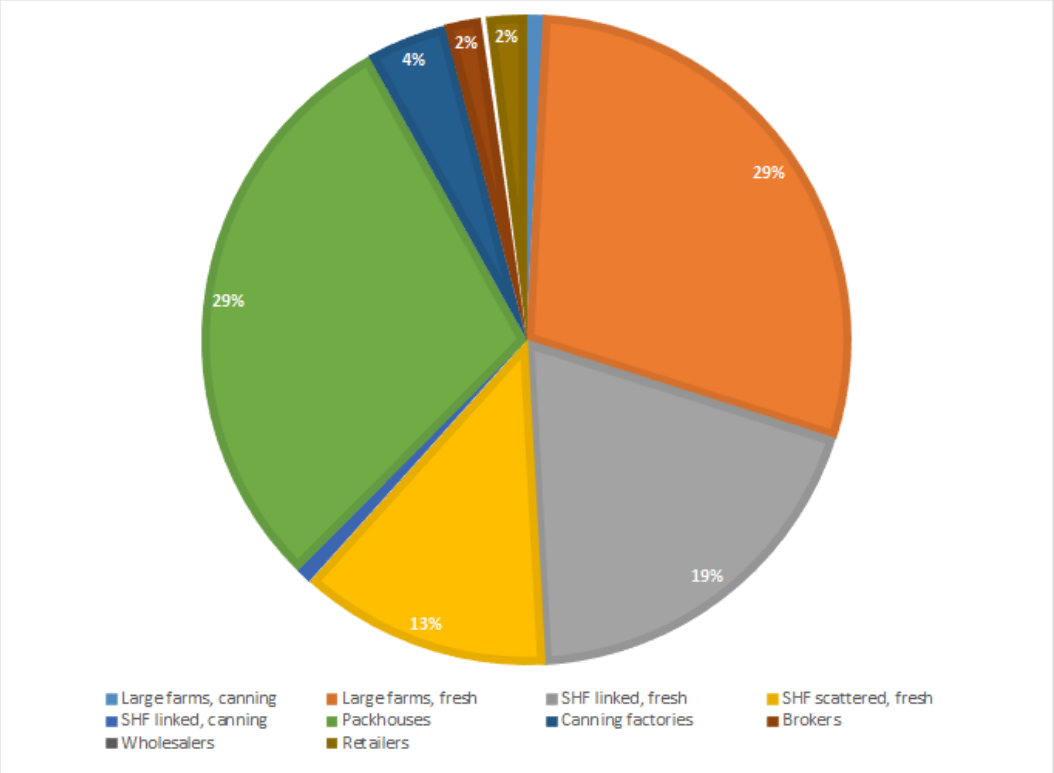


FIGURE 3.11: SPLIT OF INCOME FROM HIRED LABOUR IN THE KENYAN GREEN BEANS VALUE CHAIN

Inclusiveness in the value chain can also be demonstrated by the price formation in different sectors of the value chain. In the case of green beans this is demonstrated by how price formation looks like in the case of fresh green beans exports and processed green bean exports (Graph YZ). In the case of canned prices, several prices and costs had to be estimated (e.g. freight costs, CIF price, and supermarket price.

A comparison of the sub value chains (Figure 3.11) shows that the farmgate price in the case of fresh exports is about 26% of the export (FoB) price, whilst it is 16% in the case of canned green beans. At the same time, the farmgate price in Kenya represents about 8% of the sales price in UK supermarkets.

	Fresh green beans (KES/kg)	Canned green beans (KES/kg)
Farmgate price	60	45
FOB price	230	286.97
Freight costs	160	~30
CIF price, UK	390	~316.97
Supermarket, UK	780	~455

FIGURE 3.12: FORMATION OF GREEN BEAN PRICES IN KENYAN VALUE CHAIN

4 SOCIAL ANALYSIS

4.1 Social considerations in the French beans value chain

The French Bean Value Chain (FBVC) contributes to inclusive growth and social sustainability through the involvement of two, key, beneficiary groups – firstly, smallholder farmers, and secondly the predominantly casual workforce that supports, what is, a highly labour intensive system of production and processing. Women are responsible for the majority of these labour intensive tasks and are likely to make up the majority of the workforce.

For the purpose of this study, French bean producers in Kenya have been divided into three broad groups (see Function Analysis) that describe key production and socio-economic factors that characterise their ability to engage with, and benefit from the FBVC. At a basic level, these three categories are:

	Contribution to Output	Farm size
Smallholder Farmers	60% of FB produced	<2ha
Medium Sized Farms		Between 2 - 10ha
Large Commercial Farms	40% of FB produced	Over 10 ha

Based on feedback from those stakeholders who contributed to the FBVC study, the Economic Analysis has estimated that there are currently around **52,000 Smallholder Farmers (SHF)** engaged in the FBVC in Kenya in 2017. They are responsible for approximately 60% of all French Beans (FB) currently being produced for the frozen, canned and fresh produce markets. The remaining 40% of FB output is grown by, an estimated, **56 large commercial farms (LCF)**. Within these two categories sit a number of producers who do not easily fit into either group, but whose output has been included in the 60% total ascribed to SHF, for the purpose of the Economic Analysis. They are described here as **medium sized farms (MSF)** for the purpose of this study. It is important to note that for *all* the farms engaged with the FBVC, irrespective of size or scale, FB represented only one component of a diverse livelihood portfolio or wider business strategy. Therefore, FB production should not be viewed in isolation.

Looking at characteristics that affect their ability to engage with, and benefit from the FBVC, the producer typology can be further described through key socio-economic characteristics as follows:

	Geographic Location	Land holding status	Relationship to FBVC	Labour Capacity	Communication and information	Vulnerabilities
Smallholder farms	Farms are mainly located in high output areas such as Meru, …. and ….. where the climate and soil conditions are suitable. There are new areas opening up to FB production, such as Trans Nzoir. Farms are therefore scattered geographically. At a local level, FB farms are restricted to locations where there is easy access to water for irrigation.	*Farms are almost exclusively owner occupied*, with a limited capacity to rent land in the immediate vicinity from or to neighbours. Lease agreements are most often informal, verbal and made according to locally agreed land values/terms.	SHF are engaged with the FBVC either as individuals or as Self Help Groups (SHG). They sell their produce directly to export companies, or to an agent working for the company. Other options include brokers, who may be local or come from outside the area. Farmers also act as brokers. Contracts to sell produce are either exclusive, formal written contracts, or can be verbal and non-binding. Some farmers grow without any agreement, in the hope that their produce will be bought.	The size of the plot(s) on which SHF grow FB is restricted by household labour capacity. The majority of SHF produce FB exclusively through family labour. Where additional help is needed (and can be afforded) - for highly labour intensive or time bound tasks such as weeding and picking. - this comes from within the local community and on an informal basis.	Communication and information flows between buyers and SHF are unequal. Access to information restricted to what is publically available through the media, word of mouth, or comes from the buyer	• Limited capacity to significantly increase production as individual farmers, due to lack of access to additional land and labour • Limited strength, as individuals, to negotiate/influence terms of trade with buyers (individual farmers without contracts and who are not members of SHGs = most vulnerable element of this group) • Many SHG being undermined by capacity for effective self-governance and lack of support to develop these skills • Challenge to find and engage with buyers directly due to geographic separation from them (distance to Nairobi & lack of contacts) • Household economy is often reactively managed – there are likely to be competing priorities placed on any cash coming into the household, which means farmers are sometimes attracted to offers of higher farm gate prices/cash in hand offered by unscrupulous brokers

	Geographic Location	Land holding status	Relationship to FBVC	Labour Capacity	Communication and information	Vulnerabilities
Medium sized farms	Areas where land values are more affordable, or where there are existing large farms or presence of land speculators	May grow on own farm (would be in the highest socio-economic group within their community, and probably have a comparatively 'large' farm) or have sufficient financial wherewithal to rent their farm. Can access sufficient financial capital to invest in high value infrastructure (pumps, irrigation equipment, greenhouses, spraying equipment). Their production system is can be characterised as commercial, in that they grow predominantly for the market.	Will engage with buyers as individuals and negotiate their own terms. Agreements may not be formally contractual, and are based on a higher degree of trust	The farm is worked and managed by the owner, who is reliant on hired labour to carry out work. The owner may well not live on site	Well connected to the market, services and the buyer.	• High set up costs, requiring capital or credit • Small business ventures dependent on good access to high value market to pay back capital investment

	Geographic Location	Land holding status	Relationship to FBVC	Labour Capacity	Communication and information	Vulnerabilities
Large commercial farms	Mainly based in areas with a history of existing large properties, e.g. Naivasha and Thika, with good access to resources and transport links	Large scale commercial farms, predominantly on rented land of over 10acres (on long lease). Often owned by a company, run by a contracted manager and with a sufficiently large workforce to require HR function. Processing facilities and offices usually on site	Will produce FB as only one of several specialist crops, either directly for the parent company or on contract to an exporter.	Completely reliant on hired casual labour, with a core management, administrative and technical staff on long-term contracts.	Well connected into the market and Head Office.	• Dependent on access to a reliable labour force • Commercial scale production likely to result in wastage, due to need to produce enough to cope with varying demand for FB from the export market • Greater control over the logistics of production, but quality may not be as good

Smallholder Farmers

Grow FB on only 1 – 2 'units', which is the maximum area that can be cultivated using household labour, with the possible addition of some locally, and ifnormally, hired labour. Due to the high risks associated with FB production, the majority of SHF are likely to be within the higher socio-economic strata of their community. SHF income/expenditure is often managed reactively, due to erratic cash flow and competing priorities for its use. As a result, decisions may be taken that can pose a challenge existing agreements (e.g. repayment of bank loans, contracts with exporters) or jeopardise long-term outcomes (e.g. having to use cash to buy more cattle feed instead of paying for additional help for weeding, thus reducing overall yield). As individuals, they have limited capacity to negotiate terms of trade with buyers and are vulnerable to lack of transparency, poor communication and manipulation. Working as a member of a SHG gives greater negotiating power and is more attractive to buyers, as they can collectively guarantee higher volumes of produce. SHF have limited choice over which buyers they deal with – buyers often only work in specific geographic areas. In the main, SHF are reliant on buyers coming to them rather than the other way round. They have a bank account, and make use of mobile banking facilities, but have limited access to formal loans.

Medium farms

Are predominantly the top socio-economic group within their community and are farming a comparatively 'large' farm for their geographic area. Alternatively, and probably more common, they are entrepreneurs who have access to sufficient financial capital to rent a large enough plot of land and associated infrastructure. Characterised by a commercial approach to production, they are run as a business and invest in high value assets such as greenhouses, pumps, irrigation systems, equipment, farm buildings, etc. The farm is managed on a more business like footing, with record keeping and accounts, and they produce a variety of crops specifically for local and export markets. They have sufficient income predictability to allow for long-term investment planning. They will seek out extension advice and be able to adopt new technology and techniques. They are able to engage with the FBVC as individuals, and negotiate terms of trade on a basis that benefits them. They are likely to have the wherewithal to challenge many elements of an unequal relationship/transparency, etc. and can probably find/choose who they sell to. The owner of the farm will often not live on site but, with contribution from their family, will be directly involved in the day-to-day tasks on the farm either supervising or doing some of the work themselves, but are otherwise largely reliant on hired labour. Terms of employment may be formal or informal.

Large farms

Commercial farms are considered as farms of more than 10ha, although most commercial farms are much larger. Often, but not exclusively, on rented land on long-term lease, they are either owned by a commercial buyer/export company or are contracted to them as commercial outgrowers. Either owned by the buyer/export company or contracted to them. Farms are run by a management team with support from admin staff, all of whom are employed by the owner/parent company. They are entirely dependent on a regular supply of workers to carry out day-to-day tasks, and their inputs are managed in a shift pattern. Workers are employed on a more formal contracted basis, either as permanent staff or casual workers. Workers are drawn from the surrounding community and may include a significant proportion of migrant labour who are drawn into the area in search of work. Large farms have a large enough workforce that they

require some form of HR function, either provided by the parent company or amongst the management/admin team.

4.2 Working Conditions

Social Assessment	Summary Findings	Score
Respect of labour rights	Kenyan law & a range of standards cover most labour rights. Regular third party audits encourage adherence. The labour intensive FBVC offers opportunities for paid employment. However, there are challenges – A lot of the workforce, particularly in urban areas, are migrants and women. Employment is predominantly on a casual/informal basis which gives low levels of job security, reduces access to benefits and the ability for workers to negotiate terms.	**2.6**
Child labour	Very little evidence of, or apparent opportunity for, child labour was found during the VC4D study. It was therefore considered a low risk but should be monitored for any change. While SHF producers rely on family labour capacity, they frequently cited using money earned from FB to invest in their children's education.	**4**
Job safety	The main risk areas were (i) exposure to harmful agrochemicals and their inappropriate application, with SHF and their families considered most at risk, and (ii) elements of the pack-house/processing environment such as cold storage handling, use of sharp knives, hot water and steam. Health and safety practices appear to be well understood, with training and equipment supplied in most cases.	**3**
Attractiveness	Horticulture is not covered by its own Wage Order, and Minimum wage rates and basic contract terms currenare covered by Kenyan law. Main risks are that earnings do not cover the cost of living in Nairobi. It supports a large number of migrant workers, predominantly women. Youth more likely to be attracted to jobs in urban areas, rather than agricultural production	**2.5**

4.2.1 Respect of Labour Rights

- *To what extent do companies involved in the value chain respect the standards elaborated in the 8 fundamental ILO international labour conventions and in the ICESCR and ICCPR?*
- *Is freedom of association allowed and effective (collective bargaining)?*
- *To what extent to workers benefit from enforceable and fair contracts?*
- *To what extent are risks of forced labour in any segment of the value chain minimised?*
- *To what extent are any risks of discrimination in employment for specific categories of the population minimised?*

The Kenyan Government has ratified the International Covenant on Economic, Social and Cultural Rights (ICESCR), the International Covenant on Civil and Political Rights, and seven of the eight core

ILO Labour Conventions[12], and these are reflected in Kenyan legislation. While freedom of association and the right to organise are guaranteed by the Kenyan Constitution, and workers are free to join a union of their choice, Kenya has not ratified the Convention on Freedom of Association. As a result, there are some restrictions on the right to strike and rights to organise under Kenyan Law.

In order to access export markets, companies involved in the FBVC are subject to mandatory international and national Codes of Practice and Technical Regulations along with a range of voluntary private (third party) and public standards. These cover both food safety & quality standards, and also ethical, social and environmental responsibilities. Examples of voluntary third party standards include; Global GAP, Tesco Nature Choice (Nurture), British Retail Consortium, and Ethical Trade Initiatives. During the final stages of the study, Part 2 of the Kenyan Horticultural Codes of Practice; KS 1758, was launched, which covered the fruit and vegetable sector (Part 1 = Floriculture). KS1758 represents the baseline for Kenyan producers, processors and exporters, and has been developed in line with international standards. Although it is not legally binding, and the application of international standards will supersede KS1758, it sets the bar for good practice in Kenya and support the promotion of Kenyan horticultural produce as a serious 'brand' on the world stage.

> ***Box 1: Marks & Spencer*** *(UK supermarket) are signatories to the UN Global Compact and UN Women's Empowerment Principles, and commit themselves to respect the principles and guidance contained in the UN Guiding Principles on Business and Human Rights. They also comply with the UK Groceries Supply Code of Practice and support the work of the Gangmasters & Labour Abuse Authority. These commitments are reflected in their internal policies and code of ethics, which in turn inform the 'third-party' standards that guide the contractual relationship between M&S and their suppliers in Kenya (Flamingo/AAA Growers Ltd, and Provenance-Vegpro). All standards are audited on an annual basis, and a summary of the findings are made publically available online.*

These mandatory and third party standards are regularly audited and the Kenyan Government has largely allowed the fresh produce sector to 'self regulate'. The critical role that standards play in in safeguarding all-important export contracts means that, while there is still room for improvement in their application, the social conditions under which people are employed in the sector are supported by a good guiding framework. However, the demand for beans is highly variable and this impacts on the labour market, presenting challenges for both employers and employees. To be able to respond to this variation in demand, the majority of the workforce is employed on an informal, casual[13] or temporary basis. This means lower levels of job and income security and comes with different employment conditions. These types of arrangements can also make it difficult for people to access and maintain links with safety nets such as the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF).

The interests of exporters, producers and agricultural workers within the FBVC are represented by three key groups:

- Fresh Produce Exporters Association (FPEAK)

[12] Forced Labour Convention, Right to Organise and Collective Bargaining Convention, Equal Remuneration Convention, Abolition of Forced Labour Convention, Discrimination (Employment and Occupation) Convention, Minimum Age Convention and Worst Forms of Child Labour Convention.

[13] A casual contract ends automatically at the end of each day and the casual employee is paid on a daily basis. A casual employee becomes a temporary employee if they work for a period (whether continuous or not) of not less than one month or where a casual performs work that will take three months or more to complete.

- Kenyan Agricultural & Plantation Workers Union (KAPWU)
- Agricultural Employers Association (AEA)

During meetings with representatives from the Ministry of Labour, KPAWU, FPEAK and AEA it was clear that there is general consensus that the horticulture industry, and fresh produce in particular, would benefit from its own Wages Order. The seasonality of production, perishable nature of the produce and need to move goods quickly to market in response to demand creates unique challenges for the value chain. A Wage Order would help the horticulture industry to manage its input costs more effectively, offer more attractive employment conditions and maintain good export prices (*pers comm*). There was plenty of support for this from all stakeholders. The Ministry of Labour were willing to carry out the research necessary to evidence a separate Horticultural Order, but lacked the funds to do so.

The VC4D Study Team are not aware of any Collective Bargaining Agreements (CBA) within the fresh produce sector of the horticulture industry. However, AEA and KAPWU have been involved in negotiating CBAs for in the floriculture sector and as many of the larger export companies, such as VP Group (Vegpro), are involved in both floriculture and horticulture often on the same properties, casual and temporary employees involved in FB production and processing benefit from them by association. Commercial farms often dominate an area, like the farms around Lake Naivasha, as they tend to congregate around key natural resources. For example, **VP Group (Vegpro)** and **Flamingo** have interests close enough to **AAA Growers**' Hippo Farm in Thika County that together they attract a workforce somewhere in the region of 25,000 employees. Their terms of employment will be well known to the local communities, and this is likely to result in a degree of harmonisation between them, in employment conditions, so that they can maintain access to a reliable workforce.

The Kenyan Plantation and Agricultural Workers Union (KPAWU) represent the interests of employees in the horticultural sector. At the time of writing this report, KPAWU reported that they have around 345,000 members of whom approximately 45% work in the horticulture sector and approximately 29% of their members were women (*pers comm*). These figures are somewhat at odds with what was reported in a recent study by Otiento (2017), and will need to be followed up.

Union	Est. No. Members	Male	Female	Adults	Youth	Gain over 5 years	Loss over 5 Years
Kenya Plantation & Agricultural Workers Union	180,000	80,000	100,000	80,000	100,00	8,000	3,00

FIGURE 4.1: BREAKDOWN OF KPAWU MEMBERSHIP. SOURCE: ASSESSMENT OF THE STATE OF TRADE UNIONS IN KENYA BY OWIDHI GEORGE OTIENO, 2017

An employer needs to have a minimum of 5 employees, and for 51% of their workforce to be registered with the union, for an official 'recognition agreement' to be established between the union and the company. Large scale commercial farms are said to dislike union representation amongst their workforce and may actively discourage it. As yet, there is limited union membership within the horticulture sector. The fluctuation in the workforce is likely to make it difficult for KPAWU to gain entry into the horticulture sector. Union subscriptions are deducted by the employer and paid directly to the union. When the majority of the workforce is employed on a casual or temporary basis, it will be very difficult to manage this system, and so union membership is likely to be more common amongst long-term employees. Where KPAWU has penetrated the

floriculture sector, which has its own Wages Order. KPAWU have actively negotiated Collective Bargaining Agreements (CBA) within the floriculture sector with flower specialists; Aquilla and those who grow flowers and vegetables; Panda, VP Group (Vegpro), Flamingo (Congoni River Farm) and Frigoken. VP Group (Vegpro) and Panda have signed a CBA that covers both their floriculture and horticultural workers. The agreement covers the terms and conditions of employment, including housing allowance, transport, provision of PPE and spraying protocols (health & safety). The implementation of CBA is audited by HDC inspectorate.

The Kenya Private Sector Alliance (KPSA), and Agricultural Employers Association (AEA) are voluntary membership bodies that can represent the interests of the agriculture sector. The majority of AEA members work in the floriculture sector, with some also growing vegetables, such as VP Group (Vegpro). AEA has 293 members, including about 80-90 large scale ranches, conservancies and mixed farms. AEA provides legal advice to its members on disputes and helps them negotiate CBA. It is estimated that there are somewhere in the region of 120 CBA in the floriculture sector alone.

The FBVC is very labour intensive, and variations in demand for FB from the market translates into busy and slack periods of employment from week-to-week and month-to-month. To cope with this variation, the majority of the workforce is employed on a casual or temporary basis so that they can be brought in when needed without the company having to be responsible for a workforce in the long-term. In general, the VC4D Study Team found that most companies have a core of permanent staff who represent the management and administrative functions, plus long-term technical or supervisory roles. A core group of people who are known to, and trusted by, the company, will be employed on a more frequent and regular (but still casual or temporary) basis and will likely possess specific skills and experience that are needed for particular stages in the processing line. Beyond this core group, people will be brought in as demand dictates. The preference will always be for someone who is known to the company, or has been recommended by someone who is. In this way, social networks are very important for people seeking employment in the FBVC.

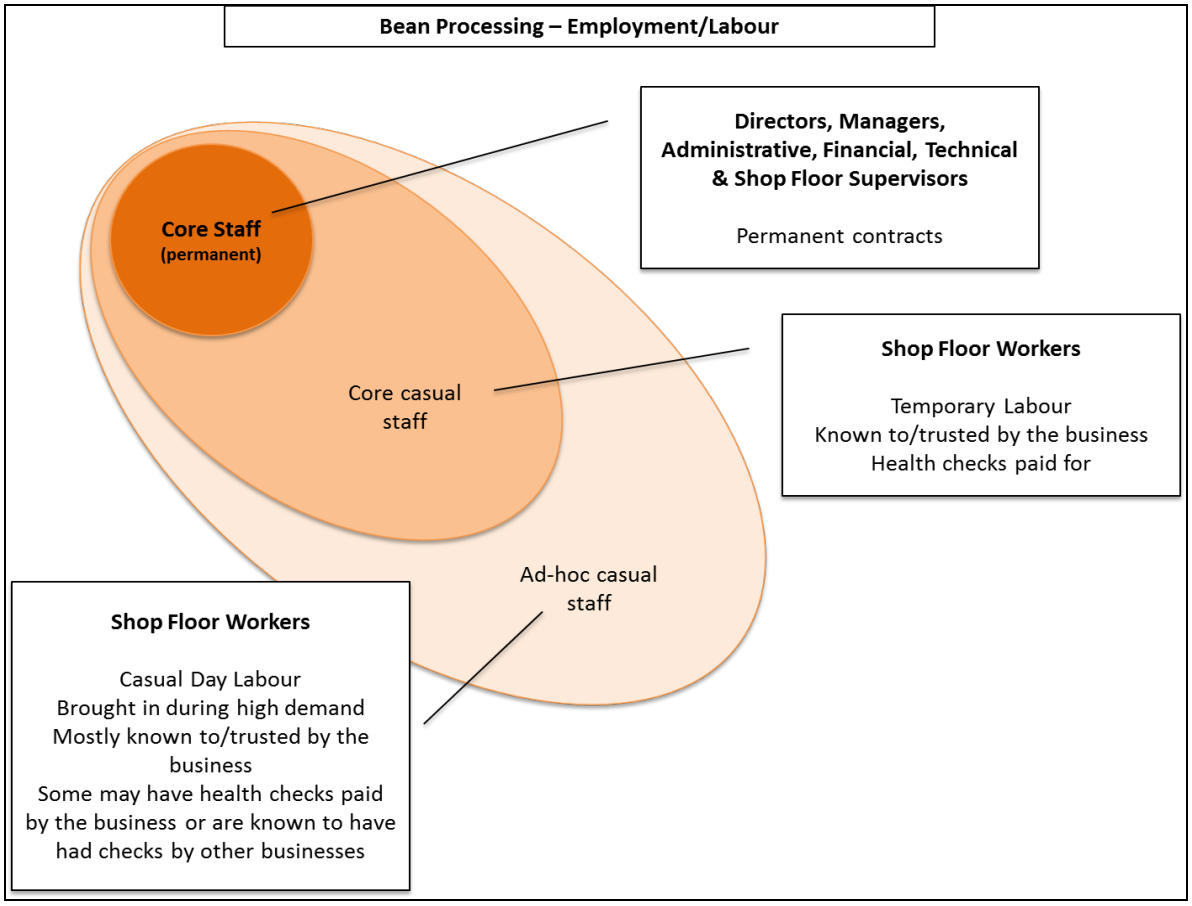


FIGURE 4.2: A GENERIC EXAMPLE OF THE CHARACTERISTICS OF THE WORKFORCE OF A PROCESSING FACTORY

The workforce of a commercial farm will work in a similar way, although there may be less fluctuation in numbers of workers needed as most farms grow several different crops. One key difference is that the workforce is drawn from among the neighbouring communities, and there may be times when employers find it much harder to recruit the workforce they need, as people prioritise working on their own farms.

In simple terms, the different types of contract include:

- An open ended contract, which does not specify a period of employment, but which can be terminated by either party giving notice.
- Temporary contract for a specified period of time, usually over 3 months
- A contract for a particular task (piecework employment). Once the task is complete, the contract is terminated.
- A casual contract where the individual is paid at the end of every day and who should not be engaged for more than 24hrs at a time

Being employed on a casual basis does not provide job or income security. In principle, it leaves the person looking for work on a daily basis, and while casual employment is still governed by Kenyan Law, it can come with fewer employment benefits than regular employment. Based on observations during the field visits, maintaining a sufficient and regular income would require there to be a range of employment options available, and for the person seeking work to have a good understanding of these options and contacts that are willing to help them gain access to work. Although anecdotal, through brief interactions with staff at two processing factories visited during the field work, suggest that existing social networks are very important particularly for

people who have migrated for work and are therefore on unfamiliar territory. The presence of family members and people from the same community are likely to be a focal point for migration into an area for work, and they are more likely to help each other find work.

During the study, it was not possible to explore how casual employees were maintaining sufficient income to cover daily expenditure, and what other income generating options were available to them. However, one possible way in which job and income insecurity might be minimised, is to work through an employment agency. As an example, the VC4D Study Team interviewed **Volt**, an agency, who offer a range of recruitment and labour force management services for a range of clients, mainly in Nairobi. They currently have a Service Level Agreement (SLA) with **Keitt** in Nairobi to manage the company's casual labour force and supply around 350 employees, as and when needed. Employees were recruited locally based on the skills needed for the work, passed through Volt's in-house process of vetting and screening, and successful applicants were then contracted directly to Volt. The contracts are given on a 6month basis. They offer the possibility of near 100% employment because Volt are able to place people with any of the clients on their books during quiet times, when Keitt have no need for them. The SLA with Keitt includes a service charge and agrees to top up the basic minimum wage to KSh 527/day, to ensure employment is attractive. Keitt is a medium sized processor/exporter in the FBVC, and by handing over HR functions to Volt it has freed up management time to focus on the business which more than offsets the cost of the SLA, and reduced its vulnerability to legal action. Volt keep all HR files up to date, ensure staff have the appropriate medical checks, provide public liability for their employees and manage their NHIF and NSSF contributions. Volt is auditable and so will not take risks that might harm its reputation. It screens all prospective clients before entering into an MOU or SLA. Volt does not take responsibility for working conditions at the processing factory, but relies on the client's own audit trail.

4.2.2 Child Labour

i) Degree of school attendance in case children are working (in any segment of the value chain)?
ii) Are children protected from exposure to harmful jobs?

The VC4D Study Team saw no evidence of child labour within the FBVC. The only segment where children[14] may contribute their labour to some degree is at smallholder farmer level, where growing FB depends on family labour capacity. However, this is balanced by the near universal feedback from SHF during the field visits, that they invested the income they earned from FB production in their children's education (see Section 2.4.1) and the standard of educational attainment had increased dramatically as a result of their involvement in the value chain. The risk of children being exposed to harmful jobs was therefore considered to be very low indeed, with possible accidental exposure to agrochemicals being the only risk that could be identified.

4.2.3 Job Safety

iii) Degree of protection from accidents and health damages (in any segment of the value chain)?

Health and safety risks are present in all segments of the FBVC, from production to processing and transportation. Risks include; heavy manual lifting or crates and boxes, use of machinery such as fork-lift trucks and tractors, use of sharp knives for trimming beans, exposure to scalding hot steam and water during cooking processes, exposure to cold temperatures through working in chilled environments, exposure to chemicals during spraying, repetitive physical tasks, or long periods spent standing in one place. The complex requirements of the mandatory and voluntary

[14] Article 260 of the Constitution (2010) defines a child as any individual who has not attained the age of eighteen years

standards applied to the FBVC, many of which include workers' welfare, health and safety, provide a good framework. The degree to which the application of these standards are required to be audited, either by the Kenyan Government or third parties, provides confidence in maintaining good working conditions. The impact of these requirements filters down the supply chain, to SHF, although monitoring and auditing at this level is more problematic. During the field visits, the VC4D Study Team visited pack-houses and processors and saw first-hand, the conditions under which people worked and the use of PPE.

Under the Kenyan Working Injury Benefits Act (2007), or WIBA, employers are required to provide at least a basic level of assurance cover for their employees, against work related injuries or death. There have been instances (*pers comm*) where casual employees have taken legal action against companies, claiming they were injured at work. The difficulty in maintaining accurate and traceable records of individuals in a constantly changing workforce, can make it difficult to confirm how and where incidents might have taken place, unless they are reported at the time and it is for this reason that some medium sized companies have outsourced their workforce management to agencies. Larger companies, such as Flamingo, have the resources to provide for their own HR department. In addition to benefitting from WIBA, casual employees must now contribute 6% of their earnings towards the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF). This scheme only became available to casual employees in 2014 and requires the employer to deduct this from their wages, and then remit the Government. Having systems in place to do this, and maintaining accurate records is recognised as a challenge, and the system is still in a transition period.

It has not been able to provide evidence of the exposure to risks in informal employment, although it is assumed that there is risk and employees do not benefit from the same degree of support.

4.2.4 Attractiveness

iv) To what extent are remunerations in accordance with local standards?
v) Are conditions of activities attractive for youth?

Kenya upholds a basic minimum wage and conditions of employment under the Labour Institutions Act of 2007, which supports the development and review of an overarching General Wages Order and a number of sector specific Wage Orders that cover particular trades and industries. These orders are monitored and reviewed by their corresponding National Remunerations Boards and Councils; bodies made up of representatives from employers, unions and government. Many sector specific Wage Orders have been established through the active lobbying of government by employers and unions in response to a clear need for legislation that responds to their unique operational circumstances. For example, the Floriculture Wages Council was established in 2012 after concerted lobbying by key organisations for an Order that reflected the industries independence from rain-fed agriculture (through irrigation) and year round export of produce. Despite its importance to the Kenyan economy, the horticulture sector does not yet have a dedicated Wages Order. Employment within the FBVC falls under the General Wages Order (for factory workers involved in processing) and the Agricultural Industry Wages Order (covering farm workers and pack-house workers). There has been an 18% rise in the minimum wage rate under the General Wages Order, effective from 1st May 2017. The Official Gazette outlining this increase had not been released when this report was being written. A recent study by Global Living Wage Coalition (2017) looked at the issue of whether wages in the horticulture sector (mainly floriculture) constitute a living wage. Overall, the conclusion is that wages have fallen in real terms due to rising costs, amongst others. The report also acknowledged the

challenges facing export companies who face competition from other countries and experience pressure from their buyers to keep prices down.

The Kenyan National Youth Policy defines 'youth' as being someone aged between 15 – 30years. There are a plethora of initiatives aimed at encouraging young entrepreneurs into the horticulture sector, and the high returns and quick turnover associated with FB production makes it an attractive crop for farmers under 40years old. However, the availability of land can be a challenge for young people wanting to get involved in agriculture. Inheritance fragments landholdings, and some parents are often reluctant to pass land to their children while they are still alive. During the visit to Meru County, the VC4D Study Team met with a farmer (Julius) who owned 8ha of land and had given each of his four sons a 0.5ha parcel of his property, in lieu of their inheritance. Two of the sons had then sold their share (with the permission of their father), as land values in that part of Meru County were very high. They had both used the money from the sale, to buy 3 ha of land each in a different part of Meru County where values were lower. One son was focusing on cattle and wheat production on his new farm, as this was the most suitable crop to grow in the area.

For many young people farming is seen as 'hard work' and is associated with poverty. The requirements of certification and need to adopt new practices may also put young people off involvement in FB production. With a better level of education, and no apparent viable options in their home community, many young people are migrating to urban areas for work. All of the people seen working in the processing factories, pack-houses and farms during the VC4D study appeared to be under the age of 40years. This might be simply down to the need for speed and accuracy in many of the tasks, self-selecting for more nimble hands and eyes.

4.3 Land and Water Rights

Assessment Category	Summary of Findings	Score
Adherence to VGGT	Unable to evidence VGGT in the FBVC. SHF are the largest land holders, with commercial horticultural farms being relatively 'small'. Many on existing properties, or acquired additional land through consolidation, so large scale land acquisition does not appear to be a feature.	**2.5**
Transparency, participation and consultation	The Constitution (2010) and subsequent land tenure legislation is creating a more coherent land and water rights framework, awareness of rights, their practical application and accountability has still a way to go. Large scale acquisitions of land are not a current feature of FBVC.	**2**
Equity, compensation & Justice	Land tenure is a sensitive issue in Kenya. Only the Kenyan Government is allowed to compulsorily purchase land. Land values are high and speculative land acquisition is taking place.	**2.5**

4.3.1 Adherence to VGGT

- *Do the companies/institutions involved in the VC declare adhering to the VGGT?*
- *If large scale investments for land acquisition are at stake, do the involved companies/institutions apply the "Guide to due diligence of agribusiness projects that affect land and property rights"?*

None of the companies that the VC4D Study Team engaged with made any mention of the VGGT, and no examples of its use in the horticulture sector were found during this study. However, FAO have recently used VGGT in Kenya with the pastoralist Wayu community in Tana River County from January 2014 to July 2016, as part of a pilot project working. The pilot combined the FAO Participatory Land Delimitation (PLD) methodology, which focuses on community participation and consultation, with the use of international tools that included VGGT to secure community land tenure. The legal framework to formalize ancestral community land rights was incomplete at the time the project took place, and so the lessons from this pilot were able to help develop policy that could better address tenure security through grazing management. A paper on this case study was submitted to the Committee on World Food Security (CFS) 43rd session in October 2016.

In general, the FBVC in Kenya is not characterised by extensive landholdings as only a relatively small proportion of each farm is given over to FB production at any one time, both at smallholder and commercial level. In terms of total land area cultivated each year, the Economic Analysis estimates that smallholder farmers account for 48% more land used for FB production (4502ha/year) than large scale commercial farms (3040ha/year), so the vast majority of farm land involved in the FBVC is in the hands of owner-occupier smallholder farmers. Without any statistically representative data being available on land holdings and land distribution for large commercial farms (farms over 10ha), it has not been possible to assess the scale of the investment in agricultural land acquisitions for the FBVC. According to a recent study (Jayne et al, 2015), farms over 10ha are likely to account for 28% of total area under cultivation in Kenya and in this category, there has been a decrease in the number of farms and a subsequent 230% increase in average land holding size (i.e. fewer, but larger farms) between 1994 - 2006. In the same time period, there has been a sharp rise in the proportion of farms smaller than 1ha from 44.8% to 67.2%. Also, urban households account for a disproportionately large share of national farm holdings over 20ha. It is estimated that about 10% of urban households own between 10% to 35% of total agricultural land. At the other end of the scale, farmland held by large-scale domestic owners is possibly grossly under-reported, with somewhere in the region of 14% of cultivable land being held by a few very influential families.

Most companies involved in FB production have controlling interests in a number of large farms, either leased or owned, and FB represents only one component of their business strategy. To meet demand for FB from their buyers, all companies work with out-growers and SHF to a greater or lesser extent. For example; **AAA Growers** started production in 2000 on a single 35ha farm in Thika County, called Hippo Farm. It now runs 4 farms, growing a range of fresh produce including flowers, herbs, chilli and vegetables for export. The farms range in size from the smallest; Turi Farm (52ha), to the largest; Simba Farm (400ha), both in Laikipia County. French Beans are only grown at two of the farms; the original Hippo Farm, which has been expanded to 100ha, and Chestnut Farm in Nyeri County, which is 84ha in size. In 2013, AAA Growers decided to bring their FB production 'in-house' and now work with only a very small number of local commercial out-growers. The **VP Group** (formerly known as the **Vegpro Group**) currently own 6 farms in Kenya and works with approximately 1700 smallholder farmers to produce a range of fruit and vegetables. In 2012, the company reported controlling up to 2,500ha of land of which 70% was owned and 30% was on long-term lease. At the other end of the scale, **Frigoken Ltd** work almost entirely with SHF and boast a network of more than 70,000 registered small scale farmers spread around Kenya.

Establishing large farms and the infrastructure needed to integrate them into the value chain requires a great deal of capital. In 2000, AAA Growers gained financial support from the International Finance Corporation (IFC) to establish Hippo Farm, which means the project would have come under the scrutiny of the IFC Performance Standards on Environmental and Social

Sustainability of the time. VP Group (Vegpro) received $7million from IFC recently (2010) to expand into Ghana. The loan was secured against non-moveable assets in Kenya and again, and would have required VP Group to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities could be enhanced. Given the trend in land ownership characteristics in Kenya, it is likely that most large farms are pre-existing properties. With French Beans representing only a small proportion of the output from a farm, an increase in FB production could easily be achieved by changing the proportion of land given over to it as a crop rather than buying another farm. Another strategy is to increase the size of the existing farm by incorporating surrounding properties, as has happened with AAA Growers' Hippo Farm since it was established in 2000.

One area where future agri-investment may increase is in locally owned medium sized farms that don't fall within the remit of internationally recognised due diligence frameworks. Instead, they will come under the risk management strategies of which ever national lending institution is supporting their development, plus Kenyan legislation governing land tenure. For example, land speculation is very common in Kenya and "*greenhouses for real estate plot*" is being used as a way to exploit the horticulture industry to add value to investment land. For example; a Nairobi based company called **Diamond Property Merchants**, have seen an opportunity to achieve value addition from larger investment properties by subdividing it into plots and providing basic water distribution infrastructure to each plot so that they can be irrigated. This is a horticulture initiative and is managed by **Nguzo International Limited**, who specialise in greenhouse farming. Investors are expected to set up greenhouses with the intention of producing high value horticultural crops. Diamond Property Merchants have partnered with supermarket chains and processing factories to provide investors with a reliable market for their produce. Investors pay set up costs, production costs (irrigation) and ground rent, which gives a good return on the land for all parties. The VGGT recognize that governments play the most important role in recognizing and protecting tenure rights, food security, human rights and the environment. Governments also play a crucial role in regulating investments and investors. At a smaller scale the MSF; **Josfhat Kimani Ericheru** in Naivasha County, rents 10ha directly from the owner of a 300ha property who has subdivided it into smaller farms. The lease is reviewed every year in January, and he paid two years rent in advance to establish the farm.

4.3.2 Transparency, participation and consultation

- Level of prior disclosure of project related information to local stakeholders?
- Level of accessibility of intervention policies, laws, procedures and decisions to all stakeholders of the value chain?
- Level of participation and consultation of all individuals and groups in the decision making process?

As mentioned in the previous section, where initiatives are large enough to involve financial institutions such as the IFC, they will trigger internationally recognised performance standards for managing environmental and social risks and impacts which link into appropriate Kenyan legislation. For example, the **National Agricultural Rural Inclusive Growth Project (NARIGP)** valued at $190 million, aims to link farmers and common interest groups, including vulnerable and marginalised groups[15], with key value chains and into markets. Vegetable production has been identified as a priority value chain in Nakuru County. NARIGP has triggered several of the operational safeguards, including OP4.12 – Involuntary Resettlement and OP 4.10 – Indigenous Peoples. As part of the initiative, NARIGP will build the capacity of key stakeholders, from

[15] The Kenyan Constitution, section 260, provides criteria has been used as the basis for profiling communities and groups that could be identified as "Marginalized Communities" and "Marginalized Groups"

Community Development Committee members to county level line department staff, in the application of the environmental and social safeguards. This includes, but is not limited to, training on social audits, conflict resolution, stakeholder engagement and gender screening.

Without access to an example of a recent large scale land purchase in the FBVC, this study is not able to go into detail of the process and level of engagement and consultation. There are initiatives aimed at providing guidance to private sector investors on how to ensure their investments are inclusive, sustainable, and transparent and respect human rights, such as The Analytical Framework for Land-Based Investments in African Agriculture, which is being promoted by Grow Africa. The Framework was jointly developed by land experts from the African Union, UN Food and Agriculture Organisation (FAO), and several donor governments. Grow Africa have been seeking companies willing to trial the use of this analytical framework in Africa, and a Kenyan pilot in the horticulture sector could be a valuable opportunity to benchmark the sector.

4.3.3 Equity, compensation and justice

- Do the locally applied rules promote secure and equitable tenure rights or access to land and water
- In case disruption of livelihoods is expected, have alternative strategies been considered?
- Where expropriation is indispensable, is a system for ensuring fair and prompt compensation in place (in accordance with the national law and publically acknowledged as being fair)?
- Are there provisions foreseen to address stakeholder complaints and for arbitration of possible conflicts caused by VC investments?

The dynamics of tenure and control is complex, and it is not possible to cover all the issues in this report. One important point to note is that awareness of the changes in legislation, and who takes administrative responsibilities for what elements of its operationalisation, is not well understood by many people. At the smallholder level, there is a general pattern of fragmentation through inheritance, accumulation of small parcels of land by speculators or nearby medium/large farms, and dispossession as smallholders are compelled to sell their land in order to cope with a sudden crisis or because they are of increasingly limited means. Transparency International, operate three Advocacy and Legal Advisory Centres (ALAC) in Kenya in Nairobi, Nakuru and Mombasa – offering free and confidential advice, reported that land and succession issues represented 14% of all cases reported to them in 2013/2014. They consider a lack of awareness and understanding of land legislation and citizen's rights, inaccessibility of land related complaint mechanisms and diminished accountability from leaders and institutions to be contributory factors.

Only the Kenyan Government can compulsorily purchase land, and only for the purpose of 'public goods' such as transport infrastructure and utilities. In the Kenyan Constitution, Article 40(3) provides for compensation for land that is compulsorily acquired for a public purpose while Article 40(4) provides for compensation to occupants in good faith of acquired land who may not hold a title to the land. Further in the Land Act 2012, section 5 recognizes Customary land rights whether documented or not, as one of the forms of land tenure in the country. In the Community Land Act, 2016, section 5(3) emphasizes the fact that customary land rights have equal force and effect in law with freehold and leasehold rights. It is estimated that approximately 60% of land in Kenya is not registered yet. For interest, Wanyonyi, et al (2017) have provided a useful summary of lessons learnt in the application of the law and best practice in relation to the identification and compensation of legitimate landowners during compulsory purchase of land in Kenya.

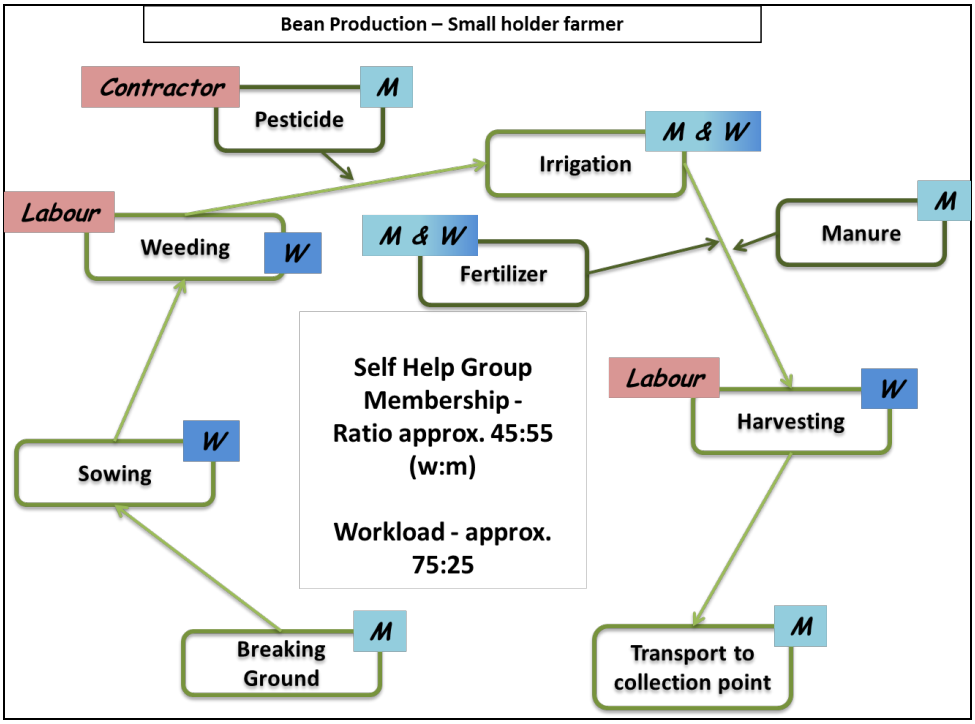
4.4 Gender Equality

Assessment Category	Summary of Findings	Score
Economic activities	The FBVC provides women with access to economic opportunities, and the ability to be financially independent. Women are active at all stages in the value chain, although there are constraints and barriers that will need to be addressed.	**3.5**
Access to resources and services	Women do not have equal access to assets, including land and through inheritance, although the Constitution and legislation is attempting to address this. There are barriers to women's access to credit, and in being able to take advantage of training.	**2.49**
Decision making	Women are able to earn an independent income, and have an increasing degree of control over what they earn. The degree to which they are able to make/contribute to decision making will vary.	**2.6**
Leadership and empowerment	Women are active participants at all stages in the FBVC, from being members of SHG to having senior roles in private sector entities (including as owners), and in lobbying bodies such as FPEAK.	**2.5**
Hardship and division of labour	Women make up the majority of the FBVC workforce, and balance their participation in these activities with domestic work and child care. The opportunities to reduce women's workload are linked to the ability to access additional labour capacity, effective childcare and awareness.	**2.49**

4.4.1 Economic activities

vi) Are risks of women being excluded from certain segments of the value chain minimised?
vii) To what extend are women active in the value chain (as producers, processors, workers, traders, etc)?

Overall, the success of the FBVC is underpinned by women's participation. They make up the majority of the workforce (approx. 80%) and are to be found actively involved in almost every segment of the value chain. At the farm level, women carry out most of the tasks associated with FB production, particularly the more time and labour intensive activities such as weeding and harvesting (see Diagram 2). Some of the activities have a culturally rooted gender association, such as breaking ground and manure application, because livestock is considered the man's domain. Spraying is most often carried out by men, and frequently by a contractor employed by the company, but not exclusively; the VC4D Study Team came across at least three accounts of women who had been trained in agrochemical application, and were as members of a contracted spray team. The VC4D Study Team also found women to be active members of the SHG who took part in the study, although there are geographic and social variations (e.g. more women active in SHG in Meru than some parts of Kirinyaga).



Key: M = men
W = women

FIGURE 4.3: OVERVIEW OF TASKS CARRIED OUT DURING FRENCH BEAN PRODUCTION

Women make up the majority of the workforce for commercial production and processing, too (see Diagram 3). The ratio of men to women in the workforce is estimated to be on average around 70:30, while Keitt reported it could get as high as 90:10 during peak times (compared to a near 50:50 split on their fruit processing and packing line).

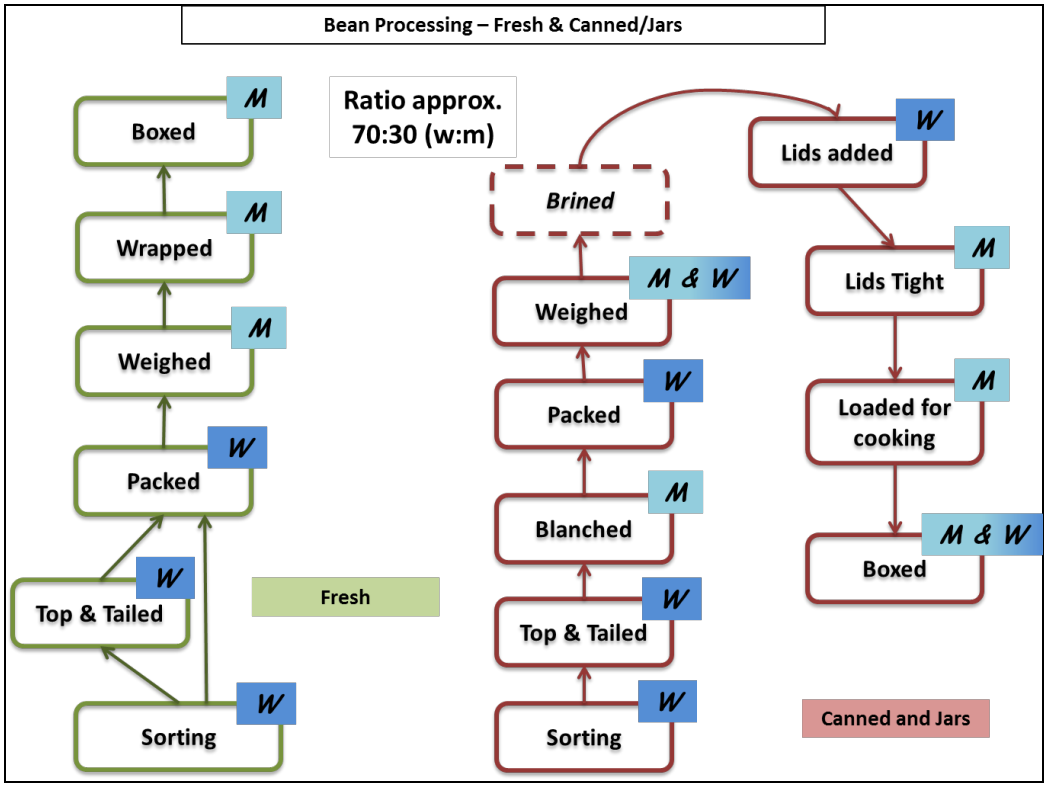


FIGURE 4.4 OVERVIEW OF TASKS CARRIED OUT DURING FRENCH BEAN PROCESSING

In addition to their involvement in production and processing of French Beans, women are also represented as business leaders and in positions of influence. For example; Rosemary Muthomi is the Director and co-founded Meru Greens, while Purity Naisho, the Marketing Director of Interveg, also holds the position of Vice Chair of the Board of FPEAK. Women were also observed as small-scale traders at the X market in Nairobi, selling relatively small quantities of FB in the local market. Therefore the FBVC provides the opportunity for women to engage at a range of levels, for income generation and to gain a degree of financial independence, either through employment or as producers, and this was backed up during the field visits where some of the women from the Unity SHG in Kirinyaga identified this as a key benefit of their participation in the FBVC. Although it had not been possible to organise focus group discussions with pack house or processing factory employees, brief interactions with those employees met during the visits also support this finding.

Overall, the opportunities for income generation through production, wage labour and business offer women a degree of empowerment, are changing power relationships within households and financial independence, but being able to realise the full potential of these is still problematic.

Some issues affecting women's involvement at SHF level

Kenya is a traditionally patriarchal society and the existing gender roles within many smallholder farming households often reflect this. Horticulture has traditionally been a woman's domain. These types of traditional roles form the starting point for understanding any subsequent engagement with the FBVC (i.e. in a household where women have more control over assets or decisions, this will enable them to take a more active role in any subsequent activities). On top of this, the nature of the relationship between the buyer and the SHF producer also has the capacity to influence men and women's involvement in the FBVC. Exporters prefer to do business with producers who are reliable and have continuous day-to-day contact with the crop. A recent study

by Veltel and Dannenberg (2014) in Meru County suggests that, where companies sought a contractual relationship with producers as either groups or individuals, this could as easily be with a woman as a man, particularly where non-farm and off-farm employment opportunities meant the men of the household were away from the homestead on a regular basis. So, formal contracts between buyers and producers can be (but not always) gender neutral. Women are still restricted by their limited access to land title to underwrite loans, and their lower educational attainment and access to capacity building opportunities. Where male members of the household were absent, or focused on other activities, this results in women playing a more proactive role (as may be demonstrated by their higher active membership of SHGs seen during the field visit). In these situations, women were exposed to the training provided by the company, better access to finance, their own bank or m-PESA accounts, and were seen to gain in self-confidence. If the relationship between buyer and producer was less formal and higher risk (e.g. non-exclusive verbal agreements and selling to a broker), these types of transaction were more likely to be entered into by a male member of the household. These types of relationships also come with less support and training, and less involvement in decision making, but not in the burden of work, by women. This was also found to be the case where the husband did not have alternative activities, and so he took over the more representative tasks of export production and the wife was more excluded from contracting, training, sales and decision-making. In terms of the impact that FB income has on workload, it is likely that a regular and secure income stream (through a formal contract and where household income is boosted by earnings from other members), it is possible for SHF to hire in informal labour for weeding and harvesting, which has the effect of reducing the physical burden on women. As there are often competing priorities for cash-in-hand income at the household level, the degree of regularity in hiring additional labour could vary – as evidenced during the interview with Josephine and her husband in Meru County, where they had made the decision to use money to buy cattle feed (which had run out) for their dairy cows rather than hire in labour to help with weeding. This would have consequences for Josephine and might also impact on the quality of the crop.

Some issues affecting women's involvement in the formal workforce

The FBVC labour market is characterised by insecure informal, casual and temporary employment which is often concentrated in particular areas, e.g. commercial farms in Thika and Naivasha, and processing factories and exporters in Nairobi. In order to access these employment opportunities, unless they are living nearby, women have to migrate which removes them from the family labour pool and places them in environments where their social support networks are weaker. A study carried out by Oxfam and International Procurement and Logistics Ltd (IPL) in 2013 found that temporary employment on casual and short-term contracts could expose women to discrimination and sexual harassment by any unscrupulous members of staff who have the power to hire in labour. Childcare is also an issue for women in the workforce, as they retain responsibility for their children. Where women are able to access employment opportunities close to home (e.g. AAA Growers recruits labour for Hippo Farm from the surrounding community, and will send transport up to 25km from the farm), they can often draw on the support of other family members and trusted friends within the community to provide childcare while they are working. However, where women have migrated away from home and are living in rented accommodation, childcare becomes more problematic and potentially of lower quality. During the VC4D study, the team met with one female supervisor working with Interveg who had mitigated against this by bringing a younger female cousin with her to look after the children. While this ensured a better standard of childcare, it also increased her financial burden as she was now supporting a larger household.

4.4.2 Access to resources and services

viii) Do women have ownership of assets (other than land)?
ix) Do women have equal land rights as men?
x) Do women have access to credit?
xi) Do women have access to other services?

According to a recent report by CARE in 2016, the primary constraints that affect women more than men
In horticultural value chains in Kenya include:

- Limited ownership of land and other assets, which restricts access to credit and loans;
- Restricted access to afford inputs including mechanized farming and processing equipment;
- Domestic responsibilities limits time available to take part in training and capacity building activities;

As described in Section 2.2, women do not have equal access to land tenure, although the Constitution (2010) and subsequent legislation is attempting to address this issue. Without land title, women have less access to credit, because they lack the security it provides. There are also similar issues around women's inheritance of household assets when their husbands pass away. During the field visit, the VC4D Study Team met with at least two widows who were producing FB but the land itself would almost certainly have been in the control of their son(s), who had the title and could therefore disposes them of their livelihood, if they chose to do so. In contrast, one farmer who was interviewed as part of the study, had given each of his children a portion of his property in lieu of their inheritance, including his daughter.

In general, Government policies, legislation and regulation in the horticultural sector is gender neutral, in that it does not actively or deliberately address constraints faced by women in participating equitably in national, regional and global value chains. With regard to horticulture and the FBVC in particular, the Kenyan Government acts as a regulator, but providing the necessary legislative framework to enable the private sector to thrive, with the market forces of demand and supply determining the produce prices. The number of voluntary, third-party safety and quality standards (e.g. GlobalGAP) is evidence that it is the private sector that drives the sector. While the FBVC has the ability to create inclusive growth, and through women's role in the sector to create more opportunities for women, this is outside the remit of the private sector.

4.4.3 Decision making

xii) To what extend do women take part in the decisions related to production?
xiii) Are women autonomous in the organisation of their work?
xiv) Have control over their income?
xv) Earn independent income?
xvi) Take part in the decisions on the purchase, sale or transfer of assets?

See other sections, including Sections 2.3.1 and 2.3.2, for an overview of women's involvement in decision making. To summarise; women do take part in decisions over FB production, but this will vary depending on the dynamics of the household, whether the husband is present or absent, if they sell as a group or an individual and what sort of relationship they have with their buyer and the level of knowledge and training on technical issues.

The degree of control they are able to exert over income will also be influenced by these factors. An additional observation, made by a representative of SNV, linked control over income from FB

with who brought the FB to the collection point and therefore interacted with the buyer. As transporting beans is predominantly done by men, this often skewed payment for produce to them. However, m-PESA has changed the dynamics of women's finance by allowing women to save and control their money although women still appear to prefer cash. GSMA carried out a very detailed study on how mobile banking services were being used by women, which gives a good insight into the changing nature of the relationship.

4.4.4 Leadership and empowerment

xvii) Are women members of groups, trade unions, farmers organisations?

XVII. Do women have leadership positions within the organisations they are a part of?

XVIII. Do women have the power to influence services, territorial power and policy decision making?

XIX. Do women speak in public?

The VC4D Study Team found women were often active members of SHG, and some held positions of responsibilities in these groups. The study also found women to be m embers of the KPAWU (see Section 2.1.1.), although it is not clear how representative this is of the FBVC, and more work needs to be done to confirm how insecure casual employment affects women's ability to take advantage of union membership. There are also good examples of women who own or co-own businesses in the FBVC and have positions of influence and responsibility in bodies such as FPEAK, HDC (e.g. the officer representing HDC in Meru was a woman) and other government bodies. There is a strong correlation between educational attainment and holding a position of responsibility and influence. How much their voice is heard will depend on the type of organisation they are a part of.

4.4.5 Hardship and division of labour

XVII. To what extent are the overall work loads of men and women equal (including domestic work and child care)?

XVIII. Are risks of women being subject to strenuous work minimised (e.g. by using labour saving technologies)

See other sections, including Sections 2.3.1 and 2.3.2, for an over view of the division of responsibilities for tasks at smallholder farm level. Women traditionally take responsibility for domestic work and child care, and their involvement in FB production largely takes place in addition to these tasks. At SHF level, production is dependent on household labour capacity. Where it is possible for SHF to cover the cost of additional labour, this can reduce the burden on the wife and other women in the household. The ability to pay for labour is a feature of larger scale production (e.g. medium sized farms), along with use of tractors, irrigation equipment and other tools.

4.5 Food & Nutrition Security

Assessment Category	Summary of Findings	Score
Availability	FB are considered a cash crop rather than a food crop, so there is very little domestic demand. Income from FB production improves household spending power in the market, and is also reinvested in the farm to improve production.	**3**
Accessibility	Income limits accessibility and food inflation in Kenya is high. Wages are likely no to be keeping pace with rising cost of food. FBVC characterised by job and income insecurity.	**2**
Utilization and nutritional adequacy	Unable to make more than anecdotal comments on this issue, but evidence of contaminants and pesticide residues on fresh produce in the domestic market does exist. Where household income is struggling to meet dietary needs, coping strategies usually reduce utilization.	**n/a**
Stability	As mentioned previously, Kenyan food inflation is problematic. Income from FBVC provides more spending power in the market for households, although this may not be enough to ensure all needs are met on a regular basis.	**2**

The VC4D study was not able to look in detail at food markets during the study. Observations are based on observations during the course of the field work and secondary information. The observations should be considered as a starting point, and this section will require further investigation in future, if it is considered a key element of the FBVC.

4.5.1 Availability of food

4.5.1 Does the local production of food increase?
4.5.2 Are food supplies increasing on local markets?

French beans are considered by farmers to be a cash crop grown for the export market. At SHF, the study has found that wastage is normally ploughed back into the field, composted or fed to livestock. It therefore does not contribute to household food. However, the income from FB production is often re-invested in the farm through purchase of livestock, equipment and better and this will have a positive impact on productivity, increasing the likelihood that farmers can produce a surplus of other crops for the market.

SHG members perceive their involvement with FB production as having a very positive effect on their households, as well as associating FB production with changes that they have observed within their communities over recent years. Asked what their community looked like 10years ago, members of the Unity SHG from Kirinyaga County described their farming system as being more focused on traditional crops. There was a lot of reliance on casual employment, with few opportunities. The women described men as being often idle and drunk. Children were unlikely to stay in school beyond Year 8. It is not possible to attribute community level changes solely to FB production, as other crops and initiatives have taken place over the last 10 years, but Table 4-1 summarises the responses from members of the Unity SHG when were asked what benefit they got from FR production.

Gender of respondent	What benefit do they get/have they seen from involvement in French Bean Value Chain
Male	• New knowledge on agricultural practices • Bought a motorbike • Pay school fees • Food for the family • Better access to loans • Opened a bank account • Bought livestock (dairy cows, goats, chickens)
Female	• Pay school fees • Less reliant on husband • Pay for medical treatment • No longer reliant on casual work on other people's farms • Invested in petty trading business • Better diet and more food for the family • Built better quality housing • Bought furniture • Better understanding of banking and financial management • Fewer arguments with husband • Bought livestock (dairy cow)

TABLE 4-1: PERCEPTIONS OF THE BENEFITS OF INVOLVEMENT WITH FB PRODUCTION BY SHG MEMBERS

Most Kenyans make purchases through local markets or directly from farmers. These markets tend to sell products that have never been refrigerated, which reduces their quality. Consumers generally cannot afford the higher quality products that would come from an established cold chain system. A significant proportion of the food produced in Kenya is lost due to post-harvest spoilage and wastage, including in some cases from toxin causing micro-organisms. Losses are often substantial for grain and produce (fruits and vegetables) along with spoilage of animal products including milk, meat and fish. Losses of stored maize are estimated to be as high as 30-40% per annum.

4.5.2 Accessibility of food

4.5.3 Do people have more income to allocate to food?
4.5.4 Are (relative) consumers food prices decreasing?

The degree to which urban and rural households are able to access food is limited by their income. In urban areas, there is often a disparity between the cost of food for different socio-economic groups. Those with limited income will buy food in smaller quantities from local petty traders, who often charge a higher price. Urban are dependent on their earnings, as they have no alternative means of providing food, whereas rural households have land on which to grow food (although it may not be enough to meet their needs, and they are vulnerable to drought, etc).

In the Living Wage Report for Kenya (2017) for the floriculture sector, the study used a 'model diet' to benchmark food costs in the study areas. They found that the model diet for rural Mount Kenya was 15% lower per day (KSh67.92), than for Lake Naivasha for June 2015. Other expenditure included in the assessment of what constitutes a living wage includes housing, healthcare and education. Overall, the study found that many workers in the Mount Kenya and Lake Naivasha area were earning below what was considered a living wage, and this would impact on their ability to access a healthy diet.

However, it is important to bear in mind that the labour market in the floriculture sector will be very different from those in the FBVC. For example, flower production and export is more consistent, so labour requirements are more predictable and regular. There is a separate Floriculture Wage Order covering minimum wage, and most commercial producers (flower production is large done on large commercial farms) are covered by Collective Bargaining Agreement, and employees have a more secure contract. All this translates as more job and income security for people working in this sector. The FBVC labour market is highly variable, beyond the gross seasonality of the October – April high season for fresh beans. After that, labour requirements vary from day-to-day and week-to-week, in keeping with fluctuating demand for beans from export markets. As a result, employment is largely offered on a casual or temporary basis and people are likely to experience a higher degree of job and income insecurity.

4.5.3 Utilisation and nutritional adequacy

4.5.5 Is the nutritional quality of available food improving?
4.5.6 Are nutritional practices being improved?
4.5.7 Is dietary diversity increased?

Food utilization will be affected by increasing food prices or an insecure income, as both situations will trigger coping strategies, such as eating a cheaper and less diverse diet. There are also some differences between, including eating street foods (in urban areas) which are readily available but of low quality. The range of foods available in urban areas is much higher than in rural areas, and people's diet varies accordingly. For example, someone living in an urban area may eat more processed or prepared foods, such as the readily available street foods. They are convenient, and often quite cheap, but the cleanliness of the preparation process can be poor.

Some of the key issue that the VC4D Study Team encountered (but are unable to quantify) that impacts on the quality of fresh produce available in the local market is contamination with residues, plus poor storage. This is largely down to weak enforcement of safety standards for the domestic market (e.g. KEBS KS 1758) and fresh produce that has been rejected for export making its way into domestic markets. A study of fruits and vegetables in the local markets of Nairobi, Nakuru and Machakos by the University of Nairobi and Strathmore University in 2016, found calcium carbide in ripened bananas, mangoes and oranges and heavy metals (lead and cadmium), pathogenic micro-organisms and pesticide residues in leafy vegetables.

Other food safety hazards originate during storage, transportation and retailing, as a result of poor hygiene and handling practices. The use of tables or platforms is limited, and it is not uncommon to find produce in informal markets placed on the ground and on walkways, in contact with dirt. It is not unusual in some markets to find garbage bins or waste piles next to traders selling fruits and vegetables. Furthermore, unscrupulous suppliers and traders also use chemicals to hasten the ripening of fruits like mangoes and bananas. Actors in informal markets rarely have formal training in food safety, and few are aware of food safety risks related to the produce that they sell, and regulations that apply to their activities.

4.5.4 Stability

4.5.8 Is risk of periodic food shortages for household reduced?
4.5.9 Is excessive food price variation reduced?

The cost of food in Kenya is remarkably volatile, with the recent rise in price of maize being a good example. Overall, the cost of food in Kenya has increased 13.57% in August 2017, compared to

the same month in 2016. Food Inflation in Kenya averaged 11.28% from 2010 to 2017, reaching a high of 26.20% in October 2011, and a record low of 1.44% in October 2012.

GRAPH 1: FOOD INFLATION BETWEEN SEPTEMBER 2016 AND AUGUST 2017

The Government has attempted to stabilise prices, particularly for maize, by using a range of tactics, such as providing input subsidies to reduce the cost of production. The recent rise in the price of maize between January and April 2017 was exacerbated by the drought that hit parts of East Africa. In January 2017, the Government imposed an export ban to prevent Kenyan maize leaving the country and then in April 2017, it waived the tariff for imported maize. When this proved insufficient to curb rising maize prices, the Government subsidised packed maize flour by paying millers to supply flour at a set price to the market.

4.6 Social Capital

Assessment Category	Summary of Findings	Score
Strength of producer organisations	Commercial farms and export companies are members of well organised and coordinated alliances such as FPEAK, with good links into the enabling policy environment. Smallholder FB producers are often organised into SHG, with associated benefits to group members and their buyers. Membership is not often inclusive, and SHGs have limited 'voice' beyond being able to influence the relationship they have with their buyer.	**2.49**
Information and confidence	Flows of information are unequal, with large commercial farms and export companies having good access to a wide range of information and actors, while SHF/SHG are reliant on the media and what is communicated to them by their buyers. SHG/SHG appreciate the training received. The level of trust between buyers and SHF is influenced by the level of engagement and communication, and their formal/informal contractual reliability.	**2**
Social involvement	The primary purpose of SHG in the FBVC is more around contractual risk management and reducing transaction costs, than social involvement. The level of support given to SHG by companies varies. Groups involved with NGOs are likely to have a broader focus which includes livelihood and community issues. Informal *chana* groups are more focused on community good.	**2**

4.6.1 Strength of producer organisations

- *Do formal and informal farmer organisations/cooperatives participate in the value chain?*
- *How inclusive is group/cooperative membership?*
- *Do groups have representative and accountable leadership?*
- *Are farmer groups, cooperatives and associations able to negotiate input or output markets?*

Based on the estimated land area being cultivated for FB production, and percentage contribution to the total output, the FBVC is currently dominated by smallholder farmers, who number approximately 60,000[16]. They participate in the value chain as individuals as well as members of formal and informal groups. There are a number of factors that influence whether a farmer engages with the FBVC as a group member, and the companies and buyers who purchase FB have their own reasons for adopting a strategy of engaging with groups or individuals, using formal contracts or verbal agreements, while groups are actively encouraged through GlobalGAP. Therefore formal and informal groups are a key stakeholder in the FBVC as they are an important, but very limited, mechanism through which the interests of SHF can be represented.

In comparison, large scale producers and export companies are well represented in national and local engagement spaces through membership of well organised alliances and partnerships such as Fresh Produce and Exporters Association of Kenya (FPEAK). As a result, they have the controlling interest over export markets and earnings, while the Kenyan Government plays a regulatory and enabling role in the horticulture sector through the development and implementation of policies and legal frameworks. Some of the mechanisms through which companies and large scale producers are able to engage with, lobby and influence the enabling environment include the following:

- State led actors under the Agricultural Sector Development Strategy (ASDS) including technical and thematic working groups;
- National Task force on Horticulture- composed of Horticulture Crops Directorate, Kenya Flower Council, Export Promotion Council, FPEAK, KEPHIS
- Sector Panels convened by the Export Promotion Council
- County Budget & Economic Forum chaired by the County Governor at the County level
- Kenya National Economic Partnership Agreement forum coordinated by Ministries in charge of Trade & Tourism, Agriculture, Planning, Finance, relevant SAGAs, private sector and CSOs
- Parliamentary Committee on Agriculture, Livestock and Fisheries 3. Main Stakeholders and Agents 7 Main Stakeholders and Agents
- Civil Society forums e.g. CAADP, Climate Change
- Private sector forums through KEPSA's Public private dialogues
- Kenya National Chamber of Commerce and Industry through relevant Standing Committees such as Economic & development, Export and Tourism promotion, Women in Business, Agriculture committee.
- National farmers assembly (KENAFF) that brings together cooperative societies, self-help farmers groups and county farmers associations to address issues in the agricultural sector.

Kenya has a long history of collective working in the dairy, tea and coffee sectors. Although there is no accurate data available on how many farmer groups are involved in the FBVC, field observations during the VC4D study and interviews with stakeholders and key informants clearly demonstrate that smallholder farmer groups are common. Many export companies prefer to work with farmer groups in order to reduce the transaction costs associated with certification,

[16] No accurate figures available. Estimates taken from the Economic Analysis.

record keeping and the contracting and management of a large number of scattered farms. From the farmers' perspective, group membership can offer better access to the market and credit facilities and the potential to negotiate a better deal with buyers. A good overview of the benefits and risks of different types of group is provided by Grow Africa (2015).

Groups can be (and often start as) an informal coming together of members of a community, also called a *chama*. They often go on to gain formal recognition by registering with the County as a Self Help Group or Association (SHG) but this does not give them legal status. They are still social groups, rather than being a business entity. This was the only type of group the VC4D Study Team interacted with during the study. In order to register as a certified SHG, some basic criteria must be met:

- All members must have a common goal or business interest
- There must be at least 10 members (5 for an association), and all members must be named
- There must be some evidence of by-laws or a constitution governing the running of the group
- Group officials are named
- KSh1000 registration fee

Another, but far less common option is for a group to register with the Attorney General's office as a private enterprise, partnership or society, but this is mainly associated with a for-profit business venture or larger scale investment. The VC4D Study Team did not meet with any groups that came into this category during the study. Cooperatives are not popular in Kenya for historical reasons.

From the sample of SHG encountered during the VC4D study, it would seem that the effectiveness of SHG governance is highly variable. This could be due to the circumstances under which the groups were formed. Where export companies and their agents play a role in group formation, they exert a strong influence over the characteristics of these groups by insisting that prospective members meet certain criteria. Reputation, reliability and farm size were some of the factors mentioned during the field visits. Other examples of SHG encountered include "groups of convenience", who formed solely because a buyer had come into the area through a key contact; either someone who was known to the company, or had taken the initiative to $_{\text{contact}}$ the company in the first place. This contact person then recruited farmers to the group and often became the gate keeper between the buyer and the group members, controlling channels of communication and taking a key role in its governance. Under these circumstances, it can be assumed that group membership reflects more on contractual risk reduction than on being socially inclusive. That said, the Unity Self Help Group from Kirinyaga, who were set up in 2015 with support from Keitt, had included a widow plus a woman who was supporting her disabled husband, as members. However, it was not possible to explore the socio-economic status of group members during the field visits, and it is assumed that the majority of SHF engaged in FB production are likely to come from the higher socio-economic groups in the community because of the cost of production and risks of engaging with the market.

The governance and cohesion of the groups encountered during the field visit was very variable. This had a lot to do with the level of support they received when they were formed (older groups were assumed to be more effective because they had remained operational). As was learned during the field visits, the level of interaction between the company and SHGs and amount of support received varies. For example; Keitt has supported the Unity Self Help Group with training both in crop production and setting up a bank account, but also helped them apply to the **Micro Enterprises Support Programme Trust** for funding to build a collection and grading house. Farmers take responsibility for pest and disease control, and supply their own equipment. It is

understood that Frigoken operate a dedicated spraying team and so farmers receive less training, and are more likely to work with Frigoken as individuals rather than groups. Overall, export companies rarely provide any support or training that focuses on building the capacity of groups for effective governance. The VC4D Study Team came across a number of cases where SHGs had been unable to deal with problems through lack of accountability, including the mismanagement of payments (where payments were made by the buyer to one member of the group, who could not be held accountable for the way in which these funds were managed).

Non-Government Organisations (NGOs) such as SNV and Farm Concern International, also work with SHF groups to build their capacity to benefit from profitable markets. There is some criticism within the NGO community that while GlobalGAP encourages group as part of the value chain, it does not take into account the motivation of its members. To summarise; the NGO approach will take into account the wider livelihood priorities of the community and group members, and embed these into the focus of the groups they support. In some cases, this might mean developing a savings component to the group, and including other farm activities such as poultry or household nutrition. Farm Concern International, on the other hand, has developed their Commercial Villages approach which takes a much broader and holistic view of the factors that build capacity and create sustainability. This degree of engagement and support is beyond the scope of commercial export companies to provide, but learning from some of the successful partnerships that exist between the private sector and civil society can help address some of the issues of poor SHG governance, effectiveness and sustainability and help reduce transaction costs within the FBVC.

4.6.2 Information and confidence

- *Do farmers in the VC have access to information on agricultural practices, policies and market prices?*
- *To what extent is the relation between value chain actors perceived as trustworthy?*

Unlike other crops, such as tea, coffee and maize, the Government is not actively involved in the provision of extension services or subsidising inputs for the horticulture sector. Instead, farmers access these through the private sector at cost. Engagement with the FBVC has exposed SHF to new practices and techniques, which some farmers then adapt to other components of their farming system. The training provided by export companies to SHF is well received (feedback from farmers during the field visits) and SHF are 'hungry' for more. A study carried out by USAID in 2014 identifies technical capacity building as being one of the key steps to improving the FBVC as a result of:

- Slow adoption rate by smallholders new to French beans production
- Limited expertise in the new areas of production
- Limited understanding of export market requirements by farmers
- Low management capacity among new growers
- Time needed for group cohesion to promote collective marketing

These constraints can all be addressed through technical capacity building and awareness building.

However, there is a degree of information asymmetry in the system. Large commercial farms, packhouses, processors and export companies are well embedded into the enabling environment and have controlling interest over the FBVC. They have access to information about the status of market prices and legislation, and can influence the outcome of policy, practice and, to some

extent, contractual arrangements. Smallholder farmers, on the other hand, have access to whatever information is publicly available through the media (newspapers, radio & TV) and on what is communicated to them through their relationship with their buyers, whether export companies or their agents, or the brokers in their area.

The level of engagement and communication between the buyer and farmer, and degree of trust are major issues in shaping the relationship between SHF and the export companies. Overall, it was observed that the level of trust between SHF and export companies and their agents is weak. From the field visits, it is clear that the in recent years, the level of engagement between farmer and buyer has not been seen as a long-term investment. For example, two of the SHG who participated in the field study had sold to at least three different companies over the course of 5years. Both groups had contracts with the buyer, which they renewed until the point where one side or the other became unhappy with the relationship because of issues that included increasingly erratic payments, poor communication or side-selling. From the perspective of the SHF that took part in the study, instances of poor communication included buyers not explaining the reasons for altering a payment, changing a deduction or rejecting a consignment of French beans. Miscommunication was more common between SHF who sold into the FBVC as an individual, through an informal and verbal agreement with an agent or broker. However, being a member of a SHG with a contractual arrangement did not prevent poor information flows as members of SHG are often reliant on the integrity of a 'gate keeper' who was the main point of contact between the group and the buyer, and had control over the flow of information.

A study carried out by Ondieki-Mwaura et al (2013) in Kirinyaga looked at some of the reasons behind the choices farmers made about how they sold FB into the value chain. It considered a range of factors including the frequency of FB production and relationship between buyers and farmers. Overall, it suggests that that seeking a contractual relationship with the buyer and selling as part of a SHG are often risk mitigation strategies on the part of farmers, against a relationship where trust was uncertain. Having a contract helped both sides agree on issues such as price, collection times and quality.This goes some way to tackling the issue of often poor communication. Dealing with a buyer as a group helped farmers' negotiate more effectively, which makes the group-exporter channel more attractive for producers. From the buyers' perspective, contracting a group decreases the likelihood that members will side-sell to brokers by providing a degree of certainty over market access, and also reducing compliance risks as the group helped with monitoring its members.

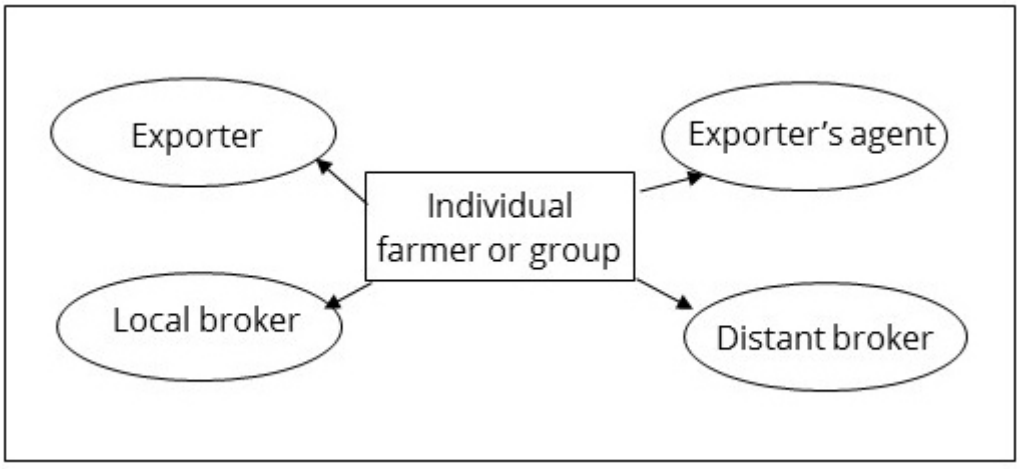


FIGURE 4.5: THE DIFFERENT MARKETING ROUTES USED BY FARMERS AS INDIVIDUALS OR AS A GROUP

Side-selling was cited as an ongoing issue by some of the companies at the FPEAK meeting in Nairobi in June 2017. It is a key issue that has undermined trust in many company-SHF relationships. From the companies' point of view, they have an obligation to supply a certain quantity of FB to their buyer, and have made a considerable investment in the farmer to ensure that they can meet their obligations. Brokers have unique skills – knowledge of the local market, flexibility, and often a long-term relationship with the community. They don't have the same overheads, and can offer a higher price or cash-in-hand payments. For farmers who have lost confidence in a contract with a buyer, through erratic payments, or are in desperate need of cash because of competing priorities or a crisis, they may be more likely to sell to a broker. A broker who is also a farmer and comes from the same area is more likely to be trusted than a buyer who is not a local. However, a farmer might be willing to sell to a broker or buyer from outside the area if there have been problems with the quality of the crop, as an outsider is likely to be less discerning than a local buyer. Any circumstance that limited the ease with which brokers could access a FB farmers group was exploited. During the field visits, the VC4D Study Team visited one community who could only be accessed through a Kenyan Youth Service facility which had a security gate, which had the additional benefit of keeping brokers out.

4.6.3 Social involvement

- *Do communities participate in decision that impact their livelihoods?*
- *Are there actions to ensure respect of traditional knowledge and resources?*
- *Is there participation in voluntary communal activities for benefit of the community?*

Large scale producers and export companies are well represented in national and local engagement spaces through membership of well organised alliances and partnerships such as Fresh Produce and Exporters Association of Kenya (FPEAK). They have the controlling interest over export markets and earnings, while the Kenyan Government plays a regulatory and enabling role in the horticulture sector through the development and implementation of policies and legal frameworks. Many of existing spaces for engagement in the horticultural sector are state-led and private-sector led, and there are a limited number of opportunities for civil society as well as small-scale growers to address issues in horticultural sector. The Self-Help Associations Bill (2015) sought to strengthen the effectiveness of SHG, and establish steering committees at the National and County levels to advise on policy, action plans and training.

Companies who operate large commercial farms contribute to local community benefits such as health, education and housing through their commitments to workers well-being and corporate social responsibility programmes. The VC4D Study Team did not encounter any examples of respect of traditional knowledge or practices, although there are clearly some areas where this may be important in land tenure and grazing rights. As previously mentioned, SHG are more likely to be involved in wider livelihoods and community issues where they are supported by an NGO, or have started as an informal *chama* group.

4.7 Living Conditions

Assessment Category	Summary of Findings	Score
Health services	Access to healthcare linked to income. Services more prevalent in urban centres. Companies provide access to health services for workforce, either on site or through a local service.	**2.6**
Housing	Migrant workers rent accommodation. Quality dependent on income.	**3**
Education & training	Education is a key concern for SHF and workers, but access dependent on income.	**2.5**
Mobility	Ability of labour force to migrate is important but with majority of labour force being women, safety and security for themselves and their families is paramount.	**2**

4.7.1 Health Services

The Kenyan healthcare system can be split into three subsystems; the Public Sector, Commercial Private Sector, and Faith Based Organisations (FBOs). The Public Sector is the largest in terms of the number of healthcare facilities, followed by the Commercial Private Sector and the FBOs. There is a large disparity among these health facilities, especially in rural areas.

The government spends approximately 6% of GDP on healthcare, which is low compared to other countries in the region. Approximately 25% of the Kenyans are covered by a public, private or community-based health insurance scheme. The cost of healthcare is high, and poses a barrier to access for many people. Therefore the ability to access to health services is closely linked to income. A medical emergency or ongoing treatment for a chronic condition can result in a household becoming impoverished. For example; two of the women members of Unity Self Help Group from Kirinyaga who were interviewed as part of this study, were relying on the income from FB production to pay for medical expenses. One lady suffered with high blood pressure, which required ongoing treatment that she had previously had to rely on other members of her family to pay for. The other lady was supporting her husband, who was disabled due to an accident.

Through the increased awareness of ethical and responsible business amongst buyers, and application of third-party standards, export companies involved in the production and processing of FB now provide some degree of support towards housing, education, transportation, medical services, pensions and medical insurance for their employees. For example, AAA Growers is supporting a local dispensary close to Hippo Farm because the nearest hospital is 20km away. They have provided the dispensary with a fridge so that they can store vaccines, and are currently constructing three new rooms, which will be used for the treatment of TB and HIV. The presence of the dispensary benefits the workers Hippo Farm along with their families and the local community. Some commercial farms maintain a nurse or other health worker on site.

4.7.2 Housing

Workers who migrate for employment will rent accommodation in the area. The cost (and quality) will be based on their financial capacity to pay for it. According to data from the 2005/06 Kenyan Integrated Household Budget Survey, the 2007 Health Expenditure and Utilization Survey and the 2008/09 Demographic and Health Survey, only 26% of rural houses in Kenya have a cement floor, only 23% have concrete/stone/cement walls, only 10% have a flush toilet/ ventilated improved pit toilet, and only 38% have piped water, borehole, or protected well (although around 76% of rural houses have a zinc iron roof). Only 8% of rural homes had electricity according to 2008/09 DHS, but this percentage is known to have increased significantly in recent years.

The Living Wage Report (2016) visited four rented properties in the Mount Kenya to assess housing quality for workers. They found the rooms were without any facilities such as indoor water or toilet. Their wood walls consisted of very poorly joined slats that let in so much air that tenants lined the inside of their walls with cardboard. Their outdoor pit toilets were all in very poor condition. These four unacceptable rentals rented for KSh600-1,300 per month excluding utilities and cost KSh66.7 per square meter on average. Most families own their home in rural Kenya and do not rent (81% own their house according to the 2008/09 DHS). As a result, there is not much of a rental housing market in rural Kenya and the rental housing that is available is often substandard.

Whether renting is done as an individual, or as a group (either as a group of friends or family), would need further investigation. The cost of accommodation will be higher in urban centres such as Nairobi. Some of the large commercial farms provide accommodation for some of their workers, along with facilities such as water and sanitation. For example: AAA Growers provide housing on-site for their security staff, so that they have a constant presence on site.

Where employees are living in company housing that has no access to electricity, Finlays has rolled out solar lights to reduce their use of kerosene, a major cause of poor air quality and subsequent ill health. This will reduce the use of kerosene by over 15,000 of their employees (mainly tea workers).
AAA Growers has been promoting energy efficient cooking stoves amongst its employees. They have also provided clean water to nearby communities.

4.7.3 Education & training

Most of the SHF involved in the study cite 'investing in their children's education' as one of the main befits from growing French Beans. They are able to keep their children in school for longer, allowing them to gain a greater level of educational attainment and increase their employment potential. For workers on commercial farms, packhouses and processors, the impact on children's education is less clear and it was not possible to ascertain this first hand. The standard of education will depend on the families ability to pay school fees, and availability/quality of educational establishments in their area. Where workers have migrated away from their home, and into urban areas (e.g. Nairobi), this may increase the range of education options available, but at a cost (see earlier section on wages)

Companies involved in FB production offer training to their farm workers in the jobs they expect them to carry out. The majority of tasks do not require skill, but there are a small number of more technical tasks (e.g. pest management/spraying, or use of machinery) where an employer will either look for someone who has already been trained, or will provide training in-service. These roles will come with an element of greater job security. Where companies work with SHF, they will provide a extension support to farmers. This will depend on whether they expect the farmers to deal with pest and disease management themselves, or if this is done through an extension team. They will also train the farmer on grading, quality control, etc. All training is at cost to the SHF, since it will be factored into the price the buyer will give the farmer at the gate. There is evidence to suggest that the quality of extension support staff may be declining, as companies reduce their costs by hiring fewer and less well qualified staff. All farmers SHF who took part in the study, who had interacted with technical staff were very appreciative of this input and requested more. At the packhouse/processing end of the value chain, employers will provide in-service training on the tasks employees are expected to carry out. It is likely that an employer will give preference to an employee with previous experience, or train up an existing and reliable

employee in a new task. Very little training is being provided on group formation and management, financial management, running a business, etc. but more would be welcomed.

4.7.4 Mobility

Production and processing is very labour intensive, and so labour is the main cost to the FBVC. The demand for labour varies according to demand for beans, and the FBVC needs to remain responsive. Therefore the ongoing success of the VC depends on retaining access to a flexible (informal, casual & temporary), low skilled/semi-skilled workforce. The presence of commercial horticultural and floricultural farms, packhouses and processing factories attract people from the surrounding area, but also from low potential areas of Kenya, in search of work. The majority of tasks are carried out by women and the majority of the workforce are women (approx. 80%). They often leave family behind, or bring a relative with them to help care for younger children while the parent(s) are working. Access to reliable childcare, rented accommodation and social support networks are important to ensure migrant workers and their families stay safe and continue to benefit from the work opportunities the horticultural/floricultural VC afford. Employers prefer to work with people they 'know' (i.e. are known to be reliable and work to a high standard). Job security is constrained by the variable nature of the job market. For migrant workers, maintaining a steady stream of work will mean being able to turn their hand to a diverse range of different jobs (not just in the horticulture sector) and on the strength of their social netowrk, i.e. having existing contacts within the industry who are kith and kin, and being able to offer an employer experience. The emergence of employment agencies might offer an opportunity to counteract an element of job insecurity by being able to offer those it employs a more secure range of casual job opportunities.

4.8 Conclusions and Recommendations

The French Bean Value Chain (FBVC) contributes to inclusive growth and social sustainability through the involvement of two, key, beneficiary groups – firstly; small scale producers, and secondly; a predominantly informal, casual and temporary workforce that supports the labour intensive system of production and processing. Women in particular benefit from employment opportunities as they carry out most of the tasks associated with FB production and processing, and therefore make up the majority of the workforce. The potentially high returns that can be achieved on relatively small plots of land and large proportion of SHF in the VC also provide opportunities for small businesses and entrepreneurs. Additional social benefits accrue from investment in the infrastructure and services associated with the horticultural sector, plus the targeted social investments made by large export and processing companies in response to internationally recognised standards and guidelines and corporate social responsibility.

Based on the Economic Analysis, it is estimated that the FBVC currently engages somewhere in the region of about 52,000 smallholder farmers each year, who are responsible for approximately 60% of the total FB produced in Kenya. In addition, the annual production and processing of French Beans is estimated to require somewhere in the region of 7,566,797 days of labour input each year, which is predominantly offered on an informal, casual and temporary basis. Without further research, it is difficult to say how many people benefit from employment within the FBVC, due to the variability in demand for labour from week-to-week and day-to-day. As a result, the FBVC cannot provide job or income security. Anecdotal evidence suggests that, depending on the stage of the VC, a person may get as little as one days work a week, or up to four or five days work. The study therefore estimates the FBVC may employ between 40,000 – 70,000 , plus informal, casual and temporary employment for an estimated 40,000 to 50,000 individuals, ofindividuals, of whom approximately 80% are women. Summarising the findings of the VC4D study against each of the six social domains, the study concludes:

Social Assessment	Summary Findings	Score
Working conditions	Kenyan laws reflect international conventions and includes minimum wages, terms and conditions of employment. There is talk of creating a Horticultural Wages Order. Workers are free to join a union, and the KPAWU is active, although possibly not representative of FBVC at present. There are no CBAs directly linked to FBVC. Demand for labour is highly variable, and in response, the majority of the workforce is employed on an informal, casual or temporary basis, which influences terms and conditions. Wages are in line with national standards, although casual employment does not provide sufficient job and income security and is unlikely to be sufficient for a living wage in high cost areas such as Nairobi. Workers are likely to need to supplement their income by other means. No evidence of child labour or forced labour was found. The operationalization of mandatory and voluntary standards mean health and safety levels are good at most points along the FBVC.	**3**
Land & water rights	Under the new Constitution, legislation is much improved but its application in practice, levels of awareness amongst people, access to complaint mechanisms and accountability amongst leaders and institutions contribute to there still being many issues in this area. No references found to VGGT and application of due diligence guidelines was difficult to assess during study. Horticultural farms are not extensive, but do require access to water resources which can result in impacts on other land uses. Land speculation is increasingly common due to its high value. Inheritance reduces landholding size and increases likelihood of selling or leasing land among smallholder farmers in particular.	**2.3**
Gender equality	Women are very active in the FBVC, making up approximately 80% of the workforce. They carry out many of the production and processing tasks, and division of labour is unequal. The FBVC provides employment opportunities and a degree of financial independence. Women are represented in positions of responsibility ranging from SHG committee members, shop-floor supervisors and export company directors. However, rights to land tenure and inheritance are currently unequal. The degree of financial control and decision-making exercised by men and women is also varied, and to some extent, dependent on local circumstances and traditional norms.	**2.7**
Food & nutrition security	French beans are not considered a food crop and there is a limited (but growing?) consumption of FB by Kenyans particularly in urban areas. Income from FB production means smallholder farmers have more income to spend on food, investing in their farms, property, other businesses, their children's education and healthcare. Food inflation is an issue, which makes it less affordable particularly for	**2.3**

Social Assessment	Summary Findings	Score
	those on a limited or insecure income, and where other costs of living are high such as Nairobi. Fresh fruit and vegetables in the local market have been found to be contaminated.	
Social capital	Producer organisations are increasingly a key element of SHF engagement with the FBVC, supported by GlobalGAP. They provide farmers with a stronger negotiating platform and can help reduce the transaction costs of companies' engagement with SHF. However, most SHG are given very little support or training and as a result governance is often weak and leadership accountability can be low, which reduces their effectiveness. Many SHG are 'groups of convenience'. The level of communication between SHF and some buyers, and flow of information, is very variable and unequal, which contributes to the degree of trust felt between both parties.	**2.1**
Living conditions	Commercial farms and processing factories provide a degree of healthcare for their workforce, ranging from on-site facilities or staff to regular health checks. Some also contribute local education and health facilities. Income from SHF FB production is often used to pay for school fees, healthcare and in improving housing. Quality of healthcare and education facilities will vary geographically, with greater availability in urban areas. Many migrate for work, which means they are dependent on the level of job and income security to cover their costs. The cost of living in Nairobi is high compared with other urban centres.	**2.5**

4.8.1 Response to the Framing Questions

The French Bean Value Chain (FBVC), as a component of Kenya's horticultural industry, has the capacity to continue to make a meaningful contribution to the reduction of poverty, unemployment and inequality because it provides opportunities for income generation and employment to groups that might otherwise have few, or an ever reducing number of options available to them. It also generates crucial forward and backward linkages with other sectors including manufacturing, micro and small enterprises, informal sector business and distribution services, etc. The following summary is based on the situation at the time of the study, but makes reference to risks and vulnerabilities for the future, based on observed trends.

Framing Question	Summary Response	Score
Is this economic growth **inclusive**?	The FBVC benefits an estimated **52,000*** small-scale farmer producers and an annual workforce of probably somewhere between **40,000 – 70,000 people***, of whom 80% are likely to be women. While there are agro-ecological constraints to FB production, there are potential areas that have not yet been developed. For example, FB are now also being grown successfully in Trans Nzaoria in the west. Returns from small-scale production can be high compared to other smallholder products, and income benefits the local economy and are invested in children's education, health care, housing, small businesses and the farm. Employment opportunities can provide women in particular, a degree of financial independence. The FBVC also present opportunities for small-scale investment, small businesses and entrepreneurs.	**Substantial**
Risks and Vulnerabilities		
• Anecdotal evidence that the number of Smallholder farmers (SHF) engaged with the FBVC has declined significantly over the last 5 years • Exporters express less enthusiasm for engaging with SHF, citing transaction costs and reliability issues, which may exacerbate this decline • Engaging in FB production can generate good returns for SHF, but is high risk for them due to variable demand and high input costs		
Is the Value Chain **socially sustainable**?	Engagement with export markets, particularly Europe, has raised awareness of companies' social responsibilities which has influenced their operations on the ground. Kenyan legislation is evolving positively in key areas of labour and land tenure. The majority of the workforce is employed on an informal, casual or temporary basis due to the variable demand, which impacts on terms of employment plus job and income security. There is the possibility of a Horticulture Wage Order being created, which could address some of these issues. No evidence was found of child labour within the FBVC. Women are represented in positions of responsibility and decision-making, and have gained a degree of financial independence, although Kenya is still a predominantly patriarchal society. Many export companies expressed less enthusiasm for working with SHF in future because of the relatively high costs of management and reduced of control over inputs. More effective and better governed SHF SHG would contribute to reducing transaction costs. An increase in the number of large commercial farms producing FB would increase job opportunities and encourage further migration for work. Whether this translates as expanding existing farms or creating new ones, land tenure and fair and transparent land acquisition/consolidation will be important.	**Substantial**
Risks and Vulnerabilities		

- The majority of the workforce (mainly women) is employed on an informal, casual or temporary basis due to variable demand for labour. This impacts on job and income security.
- If FBVC does not provide consistent employment and the shortfall cannot be made up through other mainstream opportunities, there is a risk that the workforce struggle to earn a basic living wage and living standards will decline over time, increasing the likelihood of people engaging in high risk activities.
- Migration for work, which appears to be quite common, may exacerbate declining living standards through increasing cost living and disconnection from social support networks
- A balance needs to be found between maintaining flexibility in the workforce (for employers) and ensuring effective labour rights (for employees) in order to keep the sector competitive and attractive.
- Smallholder farmers have little or no voice or influence within the FBVC. They are not represented in key fora, particularly at policy level.
- Self Help Groups are often 'groups of convenience' and receive little or no support to enable them to achieve good levels of governance and sustainability
- Retaining young people at smallholder farm level will be linked to land tenure/inheritance, and whether SHF can be retained within the FBVC and it remains an attractive option
- Extensive land holdings are not currently a major feature of the FBVC, and social due diligence appears to have had little use. Any move away from SHF will result in an increase in commercial production and potentially lead to the creation of new or expanded farms.

**The actual number is not known. This is an estimate based on the Economic Analysis, but the actual total may be much higher.*

The retention of SHF in the FBVC will be an important contributor to maintaining inclusive growth and there are positive examples of how commercial companies are maintaining a reliable supply largely from SHF, e.g. Frigoken & Meru Greens. However, exporters appear increasingly sensitive to the transaction costs of engaging with SHF, and the reduced control they have over the production process in what is a highly regulated and residue-sensitive export markets, despite the fact that SHF produce the best quality FB. Although no data is available to evidence this, it seems likely that the number of SHF engaged in the FBVC dropped off significantly as a result of the 2013 residue issues. This move away from SHF towards towards commercial production, a greater number of larger farms over time. While there are opportunities to improve quality and production output from SHF at the individual farm level, the best way to achieve more sustainable involvement of SHF in the FBVC would be to find ways in which the interface between SHF and exporters can be improved, such as helping to develop stronger and improving communication and information flows along the VC

There are several factors that characterise the labour arket that supports the fresh vegetable sector. The FBVC is reliant on a workforce that are employed on an informal, casual and temporary basis in order to respond to the highly variable demand for labour. AS a result, the sector is likely to be very sensitive to any changes in the terms and conditions of employment such as the establishment of a Horticultural Wages Order, and implementation of the 2014 legislation requiring all employers to deduct 6% of casual employees earnings as a contribution to the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF). Having systems in place to do this, and maintaining accurate records is recognised as a challenge, and the system is still in a transition period. For commercial level producers and processors, managing a workforce under these circumstances requires an investment in human resource management. Unless alternative employment opportunities are available to them, workers in the FBVC are

exposed to job and income insecurity and lower levels of formal employment benefits. Where costs of living are high (e.g. Nairobi), and the shortfall in income cannot be made up, workers may end up in very reduced circumstances and exposed to high risk strategies such as prostitution. All this may reduce the attractiveness of the fresh vegetable sector as an employer. There are suggestions that the creation of a Horticulture Wages Order may be possible. If this can be developed in collaboration with stakeholders, it can reflect the challenges faced by employers and provide a degree of certainty for employees.

4.8.2 Recommendations

Retaining SHF in the Value Chain

- There is currently no accurate data for the number of SHF that are currently involved in the FBVC, their attrition (or churn) rate, and their geographical location. In order to monitor the ongoing pattern of SHF involvement in the FBVC, an accurate baseline needs to be developed. This information would be of interest to Government, private sector and donors. It is a study that could easily be done through a neutral body, such as a university as a post-graduate research project, and in partnership with key FBVC stakeholders such as FPEAK.
- As the transaction costs of engaging SHF are being cited as one of the reason for companies possibly moving away from SHF, along with difficulties in the relationship between buyers and SHF, it will be important to identify and support mitigation strategies to encourage retention of SHF in the VC. These could include:
    - Where buyers play a role in supporting more effective farmer group formation and capacity development;
    - Ways in which farmer groups can be supported to gain additional capacity for better governance, financial management and business skills,
    - Supporting farmer groups to take a stronger role in monitoring their members farming practices,
    - Look to broaden the remit of FBVC SHGs so that their remit is more embedded in wider farmer livelihoods (e.g. savings and transferrable skills to improve production of other crops/livestock).
- Identify ways in which flows of information from the market to farmers, particularly SHF, can be improved so that they have a better understanding of demand, prices, etc. and are able to negotiate terms with buyers more effectively.
- Support mechanisms for improved communication between buyers and SHF, to reduce misunderstandings, increase transparency and maintain good relations.
- Identify and support ways to improve the technical support provided to SHF by private sector – what is the current ratio of technical staff to farmers? What is the level of educational attainment amongst technical staff?, Also brokers, who could play a role in passing on information, training and capacity building.
- Support greater inclusion of SHF or their representatives in key decision making fora at different levels, so that farmers voices can be heard on issues that affect them.
- Maintaining SHF involvement in the FBVC over time will also be crucial if it is to be attractive to young people. Opportunities for involving young people, and addressing some of the challenges facing SHF, might include working with groups of young farmers to; build capacity for group governance and business skills; mitigate small landholding size; pool resources, etc. Companies could be encouraged to reach out to young farmers as part of their out-growers schemes.

Establishing due diligence protocols for the potential commercialisation of FB production in future

- Identify and promote the use of guidance to private sector investors on how to ensure their investments are inclusive, sustainable, transparent and respect human rights, such as The Analytical Framework for Land-Based Investments in African Agriculture, which is being promoted by Grow Africa. The Framework was jointly developed by land experts from the African Union, UN Food and Agriculture Organisation (FAO), and several donor governments. Grow Africa have been seeking companies willing to trial the use of this analytical framework in Africa, and a Kenyan pilot in the horticulture sector could be a valuable opportunity to benchmark the sector.

Supporting ongoing social benefits of the FBVC labour market

Support the development of a well-researched, evidenced and sensitive Horticulture Wage Order, to ensure that it addresses the challenges faced by employers and provide an effective range of benefits for casual and temporary employees in the formal employment market.

- Support research into thfe dynamics of formal employment within the FBVC to identify what contribution the sector makes to workers overall living wage, frequency of employment, alternative income sources and standards of living. This would be of interest to the development of the Horticulture Wage Order, and would need to involve all relevant stakeholders in the value chain.
- Identify opportunities to support FBVC companies to implement their legal obligations to ensure that casual/temporary employees are able to contribute to the National Social Security Fund (NSSF) and National Hospital Insurance Fund (NHIF).
- Identify and support mechanisms whereby smaller FBVC companies, who do not have the capacity to maintain full in-house HR functions, might benefit from alternative mechanisms of workforce management such as the use of employment agencies. This strategy can also offer opportunities to reduce job and income insecurity for employees by increasing access to a range of other employment options.

5 ENVIRONMENTAL ANALYSIS

5.1 Abstract

To evaluate the environmental impacts of the main French bean value chains for export in Kenya, an LCA study was done, including a critical review (Annexe 4). The more precise question asked was: what are the environmental impacts from the main French bean value chains in Kenya on the three commonly-used areas of protection: Human health, Ecosystem quality and Resources.

Methods

The fresh and the canned French bean value chains for export to the UK were both evaluated from a cradle-to-market-gate perspective using 1 kg of raw French bean processed as a functional unit. During field visits and later by the local team of experts primary data were collected for all inputs and outputs (yield and rejects) for a sample of 33 farms over 5 counties and 2 packhouses for the fresh French bean value chain and for a sample of 9 farms over two counties and 1 canning factory for the canned French bean value chain. In accordance with the other dimensions of the evaluation, a typology of the farm systems was proposed to account for the diversity of situations. Overall, 4 farm types were defined for the fresh FB: one large-farm, one medium-farm, one small-holder farm contracted and one small-holder farm scattered and 2 for the canned FB: one large-farm and one small-holder farm contracted. The life cycle of the products consisted of 5 main stages: agricultural production (cradle-to-farm-gate), transport by road before processing, processing (packhouse or canning factory), transport by road after processing, intercontinental transport by air-freight for fresh FB and by sea-freight for canned FB.

Overall, the field work was very intensive and certain gaps had to be filled, especially for water use and energy use for irrigation. Pesticide applications particularly required an intense work to collect and describe the 33 different pesticides used over the farm sample. Data from the processing stage: packhouse and canning factory were also difficult to collect and assumptions had to be made. Overall, the data collected constituted a reasonably reliable dataset with a Data Quality Index of 2.3, corresponding to “basic quality”. Best available methods for field emissions were used and adapted when possible to local conditions such as for the estimation of P losses. For background processes two consistent inventory databases were used: Ecoinvent 3 (Alloc Rec) and Agri-footprint (economic allocation). The Endpoint ReCiPe 2008 method was used to calculate the impacts to produce an answer for each of the three areas of protection. The method proposed by Pfister et al (2011) was also used for calculating the water deprivation indicator since it proposes compatible characterization factors with the Endpoint ReCiPe method.

Results/interpretation

For the fresh French bean product, at market-gate the four systems studied had close results for Human health and Resources and showed greater differences for Ecosystem quality. For Ecosystem quality the SHF-scattered system had greater impacts, followed by the large-farm system and then SHF-contracted and finally the medium-farm system. The main impact categories contributing to Human health were climate change around 77-78% of total impact and particulate matter formation around 20%. For Ecosystem quality, Climate change was again the main contributor with contributions between 54 to 66%. Agricultural land occupation was the second contributor at 16 – 21% and water deprivation was the third most important midpoint category at 12 – 18%. For the resource area of protection, fossil depletion appeared as the only major contributor at about 98-99% across all studied systems.

The contribution analysis of the 5 key stages revealed that air-freight had a major contribution for most impact categories while farm production had a major contribution for water deprivation, freshwater eutrophication, terrestrial ecotoxicity and agricultural land occupation.

For the fresh FB products, the Free-On-Board results ("Kenyan-footprint") expressed in percent of the cradle-to-market-gate results constituted 11-19% of Human Health, 35-49% of Ecosystem quality and 14-17% of Resources.

Cradle-to-farm-gate results for fresh French bean revealed much greater differences across the four studied systems. For Human health and Resources, the large-farm had the greatest impacts, the medium-farm the least, SHF-contracted and SHF-scattered showing intermediate results. For Ecosystem quality, SHF-scattered had the greatest impact followed by large-farm and then by SHF-contracted and Medium-farm. Therefore, the medium-farm system always had the least impacts. This was mostly explained by the yield and the fertilizer use on plots. The main contributor to the impacts at farm-gate were the fertilizer production and associated field emissions, the water and energy use for irrigation and the land use. Impacts due to pesticide applications were relatively small. The modelling of impacts due to pesticide applications is still an area of intense scientific research.

GWP in kg CO_2-eq/kg raw FB were well in line with existing literature at market-gate and farm-gate and confirmed the very high environmental impacts of air-freight.

For the canned products at market-gate, the contribution of impact categories to the three Endpoints was similar to that for the fresh products but the terrestrial toxicity contributed more in relative terms. Across the main cradle-to-market-gate stages for canned products the canning factory was the main contributor for Human health (50%) and Resources (67%) while agricultural production and canning factory were the main contributors for Ecosystem quality at 40 and 37%, respectively. Road transport in Kenya had similar or more impacts than sea-freight. For the canned FB products, the cradle-to-Free-On-Board results expressed in percent of the cradle-to-market-gate results showed great contributions in relative terms: 88% for Human Health and Resources and 95-96% for Ecosystem quality.

Although needing to be associated to certain limits and explanations, the environmental impacts of fresh and canned products were compared per kg of raw French bean processed. From cradle-to-market-gate, all fresh FB products had impacts about twice those of the canned FB products. The main impact categories responsible for this difference were mostly climate change and fossil depletion in relation to air-freight of fresh products. The only greater impact category for canned products was the metal depletion in relation to the steel can packaging of the products. A fairer comparison of fresh and canned products should cover the whole life cycle of the products (or at least the consumption stage) since canned FB are cooked and fresh FB are not. However, cooking at home is less efficient than in a factory and the fresh products will encounter extra losses until their end of life while canned FB are stabilized for 4 years. Furthermore, the purpose of this LCA study was not to produce a comparative LCA of fresh versus canned FB.

This LCA study of the fresh and canned value chains in Kenya provided up-to-date references regarding their environmental performance and allowed identifying key contributors. The canning value chain may be an interesting alternative to the fresh value chain from an environmental point of view.

5.2 Introduction

The environmental analysis of the French bean (FB) value chain in Kenya is based on the Life Cycle Assessment methodology described in two ISO norms (ISO 14040 and 14044). This methodology includes 4 steps as described in Figure 5.1, which will represent the 4 parts of this analysis. Although the relevance of this framework for evaluating the environmental impacts of agricultural and food products has been demonstrated, its application to horticultural products in Africa is recent and represents several key challenges. As part of the DEVCO project, methodological guidelines have been designed for a reliable and consistent application of LCA to these systems (See Annexe II of ToR and Anonymous, 2015). These guidelines will be followed in this study.

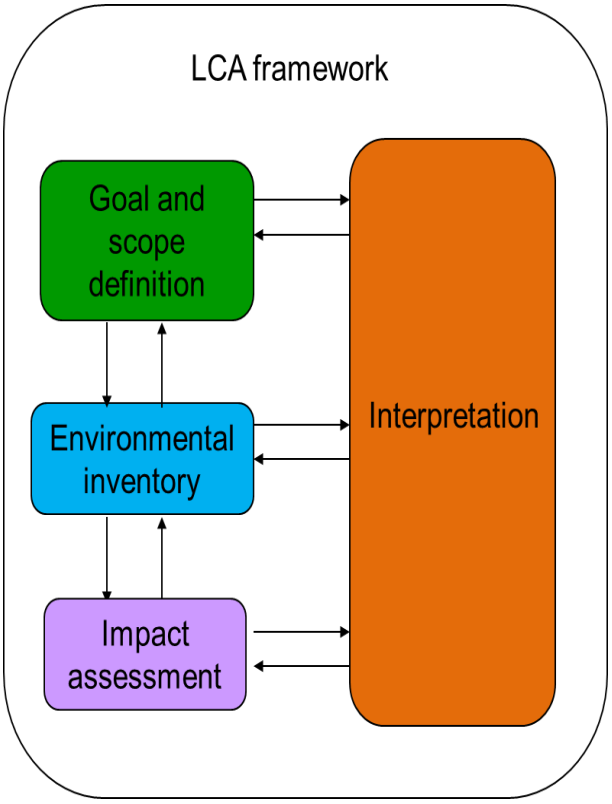


FIGURE 5.1. THE FOUR STEPS OF THE LCA FRAMEWORK.

5.3 Goal and scope definition

5.3.1 Question

In view of the challenges identified by the different stakeholders interviewed and the terms of references of this study, the question asked in this LCA study is:
"What are the environmental impacts associated to the current value chains of FB produced in Kenya and consumed in the UK, including the fresh and the main manufactured sub-chains for export from cradle-to-market-gate in the UK?" The UK was selected as main export market for Kenyan FB products. The main FB manufactured sub chain: canned beans, was selected for this study.

5.3.2 Objectives

In more detail, the key objectives of this LCA study are:

- To evaluate the impacts of the main FB sub-chains at market-gate: Fresh FB for export on one side and canned FB for export on the other
- To calculate the contribution of the main stages of the life cycle for the two products
- To present and discuss specifically the impacts for fresh and canned FB sub-chains at Kenya-gate
- To evaluate and compare the main cropping system types identified at farm-gate for the fresh sub-chain: in terms of size (smallholder farmers, medium and large-scale farmers), and affiliation or not to exporters.

Except from a strict economic value view point (economic margin), the two sub-chains cannot be formally compared because their functions and products are not comparable from the points of view of their end-market and their nutritional value. The two sub-chains will therefore be evaluated independently. However, a discussion is proposed with caution and limitations at the

end on the comparison of the results for the two sub-chains fresh/canned, expressed in kg raw French bean processed at market-gate (see next section).

5.3.3 System boundaries

Given the objectives of this LCA study, the system boundaries were set from cradle-to-market-gate in the UK as main export market. Cradle-to-market-gate stages constitute the smallest "common denominator" in terms of scope of analysis for produce imported to a country. After this stage all imported fresh FB (or canned FB, respectively) be it from Morocco or Mexico have the same story. Due to feasibility issues and time constraints, we choose to stop the analysis at market-gate but a cradle-to-grave analysis would have been even more informative.

For the fresh FB, results will be presented at three levels to allow for their in-depth analysis: i) at market-gate, ii) at Kenya-gate and iii) at farm-gate for a more detailed evaluation of farmers' practices and situations. For canned FB, results will be presented i) at market-gate and ii) at Kenya-gate. The studied systems for the two sub-chains are presented in Figure 5.2 and Figure 5.3.

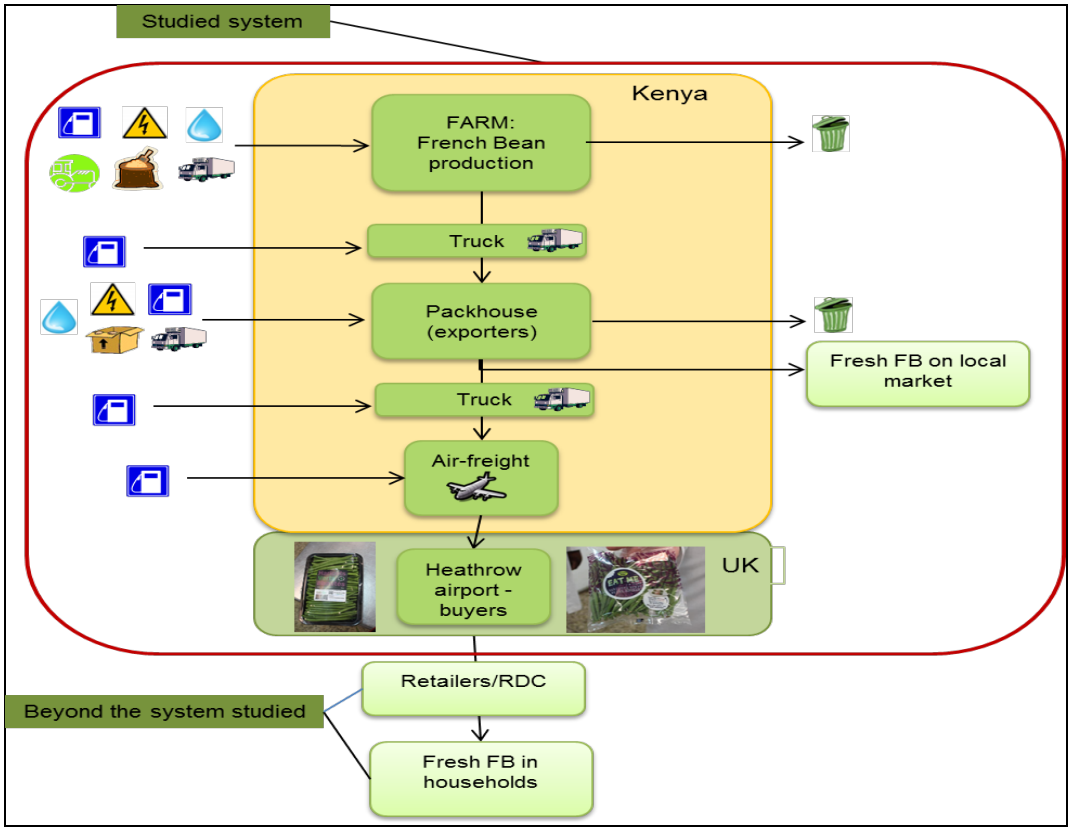


FIGURE 5.2. FLOW DIAGRAM FOR FRESH FB VALUE CHAIN IN KENYA EXPORTED TO THE UK

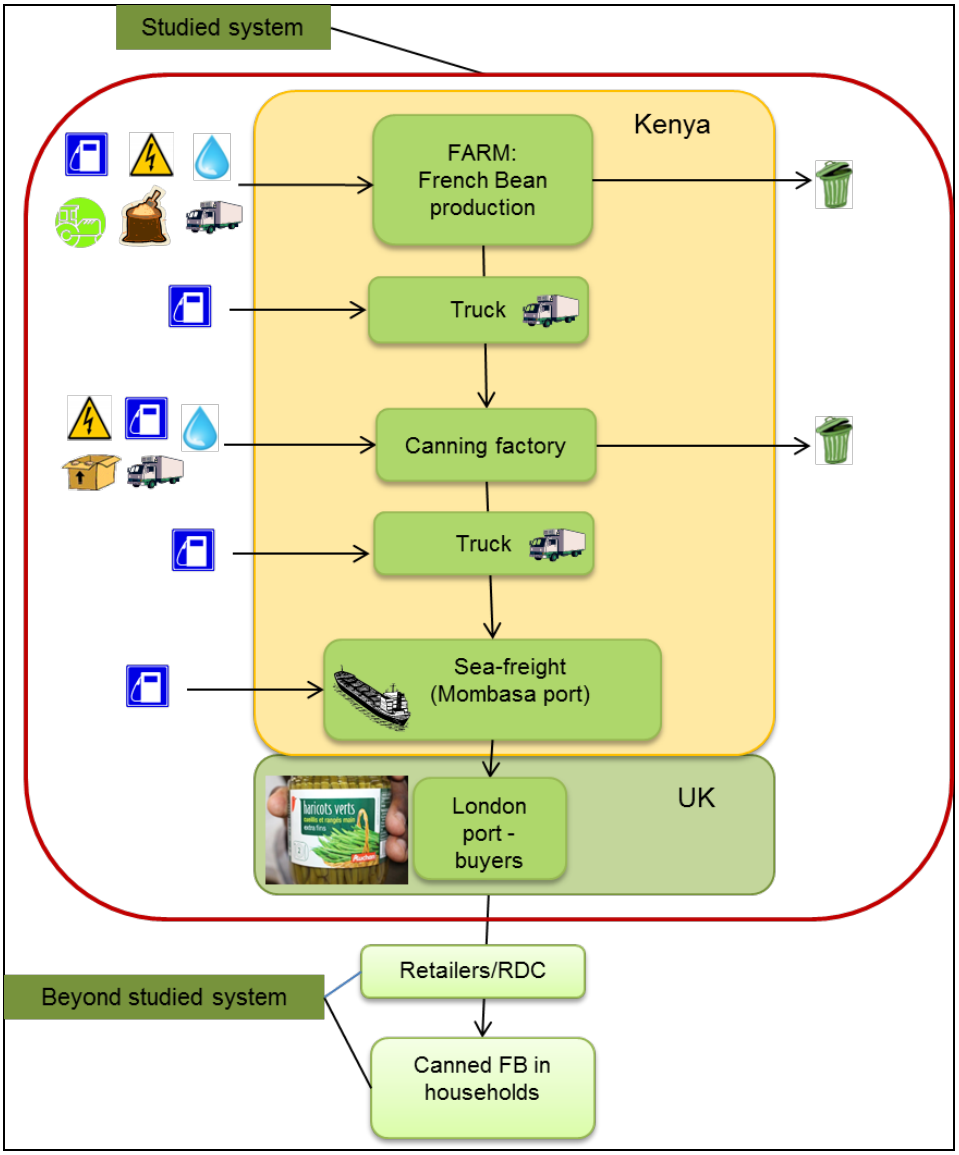


FIGURE 5.3. FLOW DIAGRAM FOR CANNED FB VALUE CHAIN IN KENYA EXPORTED TO THE UK

The production of all key inputs: fertilisers, pesticides, fuel use for irrigation and land preparation were included in the analysis as well as their use and emissions on the plots. Their transportation from regional storehouse to the farm was not included due to lack of data and because their contribution was expected to be small. The transportation of FB by truck was included. The manufacturing and transportation of small materials and machines such as chemical sprayers, basins, wheelbarrow, watering cans and pumps were excluded due to their very small expected contribution. Only for the large-farm, agricultural machinery was included for land preparation by using a complete process available in the Ecoinvent 3.3 database.

5.3.4 Studied systems

For small-holder farms (SHF), site-specific primary data were collected between April and June 2017, covering all cropping stages from sowing to harvesting and including irrigation, weeding, organic and mineral fertilization and crop protection for a sample of 39 farms over 5 counties in Kenya. Additionally, surveys were conducted in one medium-size farm in the Kirinyaga county producing for the fresh export market, in one large-scale farm producing for the fresh export market and in one large-scale farm producing for a canning factory.

5.3.4.1 French bean cropping system types

Individual data for all plots were aggregated into several types as presented in Table 5-2 and Table 5-3.

For the SHF contracted type for fresh FB market, weighted averages were calculated for all input and output data based on factors given by our local expert, Dr Andrew Edewa and representing the contribution of each county to the general production of fresh FB for export (Table 5-1). Due to the absence of SHF contracted from the Machakos county in our sample, we recalculated the weighting factors by assuming 100% of fresh French beans would be produced from the 4 other counties. It gave an overestimated weight to these four counties but at least allowed accounting for their relative contributions. For SHF scattered for fresh FB, given the lack of farms from 3 counties over 5 in our sample, we calculated a simple average from all individual data available. We did the same for the calculation of the average data for SHF contracted for canned production.

Value chain	Weighting factors for SHF contracted for FRESH		FRESH			CANNED			TOTAL
TYPES	Proposed factors by Andrew Edewa	Recalculated to adapt to sample constraints	Large-scale farm	Medium-size farm	SHF contracted	SHF scattered	Large-scale farm	SHF contracted	
Machakos	15%	0			0	9		1	
Meru	30%	35%			8	0		0	
Kirinyaga	50%	59%		1	5	1		0	
Murang'a	3%	4%			1	0		7	
Trans Nzoia	2%	2%			7	0		0	
TOTAL	100%	100%	1	1	21	10	1	8	42

TABLE 5-1. CROPPING SYSTEM TYPES DEFINED, ASSOCIATED NUMBER OF INDIVIDUAL PLOTS AND WEIGHTING FACTORS ASSUMED FOR CALCULATING WEIGHTED AVERAGES FOR AGRONOMIC DATA.

		FRESH					CANNED	
	Unit	Large-scale farm	Medium-size farm	SHF contracted weighted	SHF contracted not weighted	SHF scattered not weighted	Large-scale farm	SHF contracted not weighted
General information								
Plot size	m^2	NA	12145,75	1767,29	1499,90	1104,10	30000,00	866,79
Total yield	$kg.ha^{-1}$	8000,00	11279,67	7850,60	9483,26	4567,70	10000,00	4777,18
Rejects after sorting at farm level	$kg.ha^{-1}$	960,00	1353,56	1306,31	1298,11	409,30	500,00	0,00
Yield without rejects	$kg.ha^{-1}$	7040,00	9926,11	6544,29	8185,15	4158,40	9500,00	4777,18
Crop duration	days	90,00	90,00	90,00	90,00	90,00	90,00	90,00
Fuel use for land preparation	$l.ha^{-1}$	NA*	0,00	0,00	0,00	0,00	40,00	0,00
	$kg.ha^{-1}$	NA	0,00	0,00	0,00	0,00	33,60	0,00
Fertilization								
Organic fertilizer								
Compost on FB crop	$kg.ha^{-1}$	0,00	0,00	2173,85	5527,80	0,00	0,00	2118,06
Compost on preceding crop	$kg.ha^{-1}$	15000,00	15000,00	5294,12	5714,29	15000,00	15000,00	9375,00
N-org	$kg.ha^{-1}$	15,64	15,64	7,79	11,72	15,64	15,64	11,98
P2O5-org	$kg.ha^{-1}$	15,53	15,53	10,73	19,26	15,53	15,53	14,82
Mineral fertilizer								
Calcium-Ammonium-Nitrate (CAN)	$kg.ha^{-1}$	150,00	0,00	46,67	63,87	103,43	150,00	143,75
Di-Ammonium-Phosphate (DAP)	$kg.ha^{-1}$	200,00	73,46	46,95	50,68	102,44	150,00	131,25
NPK unknown (assumed to be 23-23-0)	$kg.ha^{-1}$	100,00	55,73	142,95	73,55	0,00	150,00	143,75
Calcium nitrate	$kg.ha^{-1}$	150,00	0,00	0,00	0,00	0,00	0,00	0,00
Mono Potassium Phosphate	$kg.ha^{-1}$	30,00	0,00	0,00	0,00	0,00	0,00	0,00
MgSO4	$kg.ha^{-1}$	100,00	0,00	0,00	0,00	0,00	0,00	0,00
K2SO4	$kg.ha^{-1}$	200,00	0,00	0,00	0,00	0,00	0,00	0,00
CuSO4	$kg.ha^{-1}$	5,00	0,00	0,00	0,00	0,00	0,00	0,00
NHSO4 (Ammonium sulfate)	$kg.ha^{-1}$	20,00	0,00	0,00	0,00	0,00	0,00	0,00
ZnSO4	$kg.ha^{-1}$	10,00	0,00	0,00	0,00	0,00	0,00	0,00
N total	$kg\ N.ha^{-1}$	149,84	44,62	63,36	56,71	65,58	122,89	112,01

P2O5 total	kg P_2O_5.ha^{-1}	168,13	70,21	70,37	65,07	73,91	135,53	122,69
Irrigation								
Water volume	m^3.ha^{-1}	3600,00	4000,00	3941,18	3166,67	4000,00	1800,00	4000,00
Fuel consumption	kg.ha^{-1}	0,00	27,66	147,52	97,69	61,86	0,00	0,00
Electricity for irrigation	KWh.ha^{-1}	1062,00	0,00	0,00	0,00	0,00	1888,83	0,00
Plant protection								
Insecticides								
BELT SC 480	l.ha^{-1}		0,00	0,00	0,00	2,15		0,30
KARATE 1.75 EC	l.ha^{-1}	0,35	0,11	0,80	0,89	0,02		0,73
Pegasus 500 SC	l.ha^{-1}		0,01	0,00	0,00	0,00		0,00
Confidor WG 70	l.ha^{-1}	0,29	0,00	0,77	0,83	0,00		0,00
Actara 25 WG	l.ha^{-1}		0,00	0,00	0,00	0,00		0,00
Duduthrin 1.75 EC	l.ha^{-1}		0,00	0,04	0,57	0,00		0,00
Lambex	l.ha^{-1}		0,00	0,00	0,00	0,00	0,50	0,00
THUNDER® 145 O-TEQ	l.ha^{-1}		0,00	0,00	0,00	0,00	0,50	0,00
DECIS 025 EC	l.ha^{-1}	1,00	0,00	0,06	0,02	0,00		0,13
PROVE 1;92 ec	l.ha^{-1}		0,00	0,00	0,00	0,00	0,20	0,00
BESTOX 100 EC	l.ha^{-1}		0,00	0,03	0,01	0,00		0,10
Dynamec 1.8 EC	l.ha^{-1}		0,00	0,06	0,02	0,00		0,00
Brigade 025 EC	l.ha^{-1}		0,00	0,15	0,07	0,01		0,55
FOLICUR 250 EC	l.ha^{-1}		0,00	0,00	0,00	0,00		0,08
MOSPILAN 200SP	kg.ha^{-1}	0,25						
TRACER 480 SC	l.ha^{-1}	0,20						
Thiocyclam hydrogen oxalate 50% SP	kg.ha^{-1}	0,50						
Applaud 40%SC	l.ha^{-1}	0,50						
Fongicides								
ORTIVA 250 SC	l.ha^{-1}		0,00	0,15	0,16	2,86		0,40
ORTIVA 50 SC	l.ha^{-1}		0,00	0,01	0,01	0,00		0,08
SCORE 250 SC	l.ha^{-1}	0,50	0,00	0,10	0,04	0,00		0,26

ORTIVA TOP	$l.ha^{-1}$	0,50						
DITHANE M45	$l.ha^{-1}$	2,50	0,00	2,21	2,38	0,00	0,33	0,00
DACONIL 720 SC	$l.ha^{-1}$		0,00	0,00	0,00	0,00	0,20	0,00
Champion 50 WP	$l.ha^{-1}$		0,00	0,00	0,00	0,00	0,83	0,00
Liquicop SL	$l.ha^{-1}$		0,00	0,00	0,00	0,00	0,20	0,00
Cupro Caffaro 50 WP	$kg.ha^{-1}$		0,33	1,11	0,48	0,00		1,22
ANVIL 5 SC	$l.ha^{-1}$		0,00	0,23	0,10	0,00		0,09
MILRAZ 76 WP	$kg.ha^{-1}$	2,50	0,03	0,00	0,00	0,00		0,00
Apron Star 42WS	$l.ha^{-1}$	0,10	0,00	1,01	1,09	0,00		0,00
Herbicides								
Dual Gold 960 EC	$l.ha^{-1}$	1,60	0,00	0,00	0,00	0,00		0,00

*TABLE 5-2. KEY AGRONOMIC DATA FOR FB CROPPING SYSTEM TYPES *: FUEL USE DIRECTLY ACCOUNTED FOR THROUGH AN OPERATION PROCESS FOR LAND PREPARATION IN SIMAPRO (ANNEXE 3).*

Packhouse and processing stages

Two companies sorting and packing fresh French beans for export were visited and surveyed. Based on these two datasets, an average scenario was built and adjusted for data gaps using an LCA study for green bean factory in the USA (Schenk, 2007). In particular, the amount of wood pallets was from Schenk (2007) (Table 5-3).

One company processing French beans into canned FB was surveyed. Unfortunately, this dataset was not consistent in terms of mass balance. We therefore built a scenario for the canning factory based on a mass balance of raw French bean, French bean processed (assuming 32% rejects, meaning not compliant with quality for canned FB for export) and end-products leaving the factory. We assumed that half of the processed French beans were canned in a 720 ml glass jar and half were canned in a 850 ml steel can. We used the data collected at the factory regarding water and energy used and completed the data for packaging especially for the use of pallets, cardboard box and polyethylene film. Data for the inventory of packhouse and canning factory are summarised in Table 5-3 below and in annexe 1 for canning factory.

		Packhouse			Canning factory	
Inputs	Units (per kg of FB processed)	Company N°1	Company N°2	Average scenario	Scenario based on canning factory survey	Schenk (2007)
Rejects		34%	34%	34%	32%	25%
Water use	m^3	0,002	0,1033	0,0527	0,028	0,026
Electricity	KWh	0,114	0,6576	0,3857	0,119	0,423
Fuel use	litres	0,007	0,0215	0,0145	0,000	0,000
Natural gas	Therms	0	0	0	0,000	0,066
Packaging						
Big plastic crates	kg		0,1291	0,1291		
Plastic punnets	kg	0,043	0,0194	0,0313		
Loose plastic bags	kg		0,0108	0,0054		
Cans	kg				0,175	0,216
Glass jars	kg				0,420	
Caps	kg				0,020	
Plastic film	kg		0,0011	0,0011		
PE	kg				0,001	0,001
Big carboard box	kg		0,0646	0,0323		
Carboard tray	kg	0,169		0,0844		
Carboard box	kg		0,0430	0,0215	0,014	0,014
Pallets	kg			0,0044	0,0044	0,0044

TABLE 5-3. SUMMARY OF DATA ESTIMATED FOR THE INVENTORY OF PACKHOUSE AND CANNING FACTORY AND COMPARISON WITH DATA FROM SCHENK (2007)

Transportation stages

The transportation schemes are quite variable across the different FB value chains. Even within the fresh value chain, the transportation stages can vary a lot. For instance, company N°1 reported average distances from field to packhouse of 150 km while the factory was located in Nairobi, therefore close to the airport. Conversely, company N°2 reported average distance from field to packhouse of 3 km since the farm stage belongs to the company and is located on-site, while the distance to the airport could vary from 68 up to 240 km. Due to these large differences, we defined a baseline scenario of transportation in Kenya by a lorry of 3.5 to 7.5 tonnes capacity over 50 km before packhouse and by a refrigerated lorry of same capacity over 50 km after packhouse. Regarding the transportation by air freight from Nairobi airport to London airport, we calculated the distance using the calculator available at: http://www.worldatlas.com/travelaids/flight_distance.htm. The distance we used based on this source is 6750 km.

For canned product, we used the distances by truck given by the only company surveyed: 600 km from field to factory and 484 km from factory to Mombasa port. For the sea freight from Mombasa port to London port, we calculated a distance of 11523 km using the calculator of sea-distances.org.

5.3.5 Functions and functional units

The studied functions are:

- Production in Kenya and delivery of packed fresh FB at London airport
- Production in Kenya and delivery of packed canned FB at UK sea port

Each sub-chains counts several end-products in relation to packaging. The fresh FB can be packed in a loose bag or in a punnet. The canned FB can be either stored in a glass jar or in a can. Therefore, each sub-chain should have had several functional units corresponding to each packed product found on the UK market; For the fresh sub-chain: 1kg of packed fresh FB in a loose bag and 1kg of packed fresh FB in a plastic punnet at London airport; For the canned sub-chain: 1kg of packed canned FB in a glass jar and 1kg of packed canned FB in a can at UK sea port. At the canning factory level, several sizes exist for the glass jars and for the cans. To express and allocate the results among these different products and corresponding functional units for each sub-chain, precise data on the different end-products at the packhouse and the canning factory level would have been required. However, it was not possible to collect complete and reliable data on these end-products in the timeframe of the study.

To keep it simple and feasible, we decided to express the results for the fresh sub-chain per 1 kg of raw fresh FB packed and for the canned sub-chain per 1 kg of raw FB processed and packed. In both situations, although the impacts of the packaging and its weight during transport have been accounted for, the functional unit (kg of raw FB) does not include the weight of the packaging but only of fresh FB processed.

Although the end-products from the two sub-chains are different: one is cooked, the other is fresh, an advantage of this proposition is that it makes it easier to discuss the results of the two sub-chains together. It could help answer to the following question: for 1kg of raw FB produced in Kenya, what is the best option for the environment: fresh or canned?

5.3.6 Handling multi-functionality

Farms producing fresh French beans for export have rejects after sorting of beans and prior to transportation to the packhouse. These rejected beans are used by the family for a third, composted and ploughed into the fields for another third and finally fed to the farm animals for a last third. We simply assumed that these co-products left the studied system at no cost. They were neither co-products, since they had no economic value, nor wastes, since they were used for other purposes.

At the packhouse level, based on discussions with packhouse managers we estimated that another 30% from the initial amount of beans harvested were rejected. Based on discussions with packhouse managers, one third of the rejected beans at the packhouse was assumed to be sold on the domestic market, one third as animal feed and one third to be composted. However, given the very low economic value of these co-products the economic allocation factors to these co-products would have been less than 1% each with an allocation factor of more than 98% for the packed fresh French beans for export. We therefore decided to neglect these allocation factors and allocate all impacts to the fresh French beans exported. The flows of fresh French beans for export including rejects are summarised in Figure 5.4.

Regarding the FB end-products at packhouse and factory level, as mentioned earlier, due to a lack of data on the diverse end-products (e.g. punnets versus loose bags), we defined an average product for both fresh packed French beans (be it in a loose bag or a plastic punnet) and canned French beans (be it in a glass jar or a can).

For multi-nutrient fertilizers, allocation factors based on the nutrient content of the fertilizer and the energy required for each specific process was used as recommended by Nemecek and Kägi (2007).

The allocation of nutrients from compost across the rotation is described in section 1.3.1. with the methods to estimate the emissions due to compost applications.

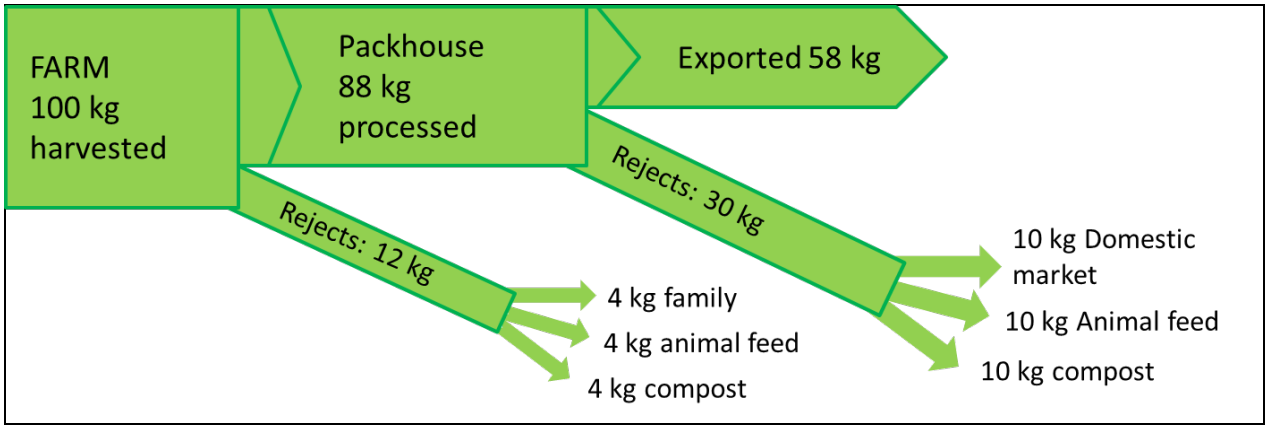


FIGURE 5.4. OVERALL SCHEME OF REJECTS OVER THE FRESH FRENCH BEAN VALUE CHAIN FROM CRADLE-TO-EXPORT MARKET

This means we considered that 58/88=66% of FB have been processed and 1-66%=34% have been rejected at the factory level.

5.3.7 Data quality

Field survey

Primary data were collected for 39 SHF from 5 counties, 1 medium-size farm and 2 large farms, one producing for canning and the other for fresh FB. After a first visit of the whole team of a sample of all farm types, original and specific data for all agronomic data were collected mostly by Dr Andrew Edewa and his team. A few gaps had to be filled though and were supported by the expertise of our local expert, Dr Andrew Edewa. The main gaps related to water use and energy use for irrigation that were most generally not available. The expertise of Andrew Edewa was used to estimate the water use as detailed in the section on inventory.

The application of pesticides was an area of intense field work with remaining gaps and inconsistencies. It was difficult to figure out if they corresponded to real inconsistencies in practice or mistakes in farmers' and technical advisors' declarations. In Annexe 2, the list of all commercial products used across our farm sample is presented. Over the 26 active ingredients, 2 were unknown by the EU Pesticide database while 3 were not approved: Diafenthiuron, hexaconazole, thiocyclam.

For compost use, it was assumed that when farmers did not apply compost on the French bean crop they would apply 15 tonnes/ha on the preceding crop. When no data for fertilizer inputs were available, we assumed that the recommended rates as given by Andrew Edewa were applied. We noticed that these rates were generally greater than the declared rates used by SHF. This could be explained by the use of compost on preceding crops but also shortages in cash for small farmers. Given the tight time-frame and also the large use of mineral fertilizers that leguminous crops will favour to the expense of nitrogen fixation, no N fixation was considered in the nitrogen inputs of the crops.

For the large-scale farm for fresh FB, not all fertilizers could be found in the database and simplifications had to be made. For instance, Mg, Cu and Zn sulfates were replaced by the same amount of potassium sulfate as a proxy. Moreover, borax and Earthlee fertilizers could not be accounted for due to a lack of data and time to develop a specific process. Their amount was small and their contribution was expected to be equally small.

Overall, the dataset was double-checked several times with the help of our local expert and sometimes the farmer himself. It constituted a valuable sample of farms with reasonably reliable data.

Surveys of processors and transporters

Fresh FB are transported in dedicated cargo planes with no passengers on-board. Only one air-freight company was visited and gave an estimate for the kerosene used per kg of FB product transported. However, we preferred to use an existing and complete process from the Ecoinvent database for air-freight to make sure that all aspects of the air-freight were accounted for in a consistent way.

Regarding processors, two packhouses were surveyed and one canning company. Despite their strong motivation to contribute to the study, it proved very difficult to collect all the required data from them, especially for the exact description of end-products and also for key input data such as water use and energy use. Key input data could finally be updated and validated with the company.

Data representativeness

All farms surveyed were part of the studied population. Although the sample size is quite small compared to the total population of farms and its inherent variability, we consider that our dataset constituted the best possible compromise in the time-frame. We also choose to calculate a weighted average for the SHF-contracted type for fresh FB to account for the contribution of the different counties to the total production of fresh FB.

Data gaps and uncertainties

The main gaps and uncertainties of our dataset are as follows:

- Potential mistakes on primary data themselves given the lack of formal records of farmers
- The uncertainty on farm inputs especially compost rates, water and energy use for irrigation
- The uncertainty due to the use of default emission factors for estimating field emissions and the non-inclusion of N fixation
- The uncertainty on input data for the canning factory: energy, water and packaging, especially the quantity of can needed per kg of raw product
- The uncertainty attached to the losses of FB across the supply chains
- The impossibility to separate the end-products at factory level
- The uncertainty on the road distances in Kenya

However, we do not expect these gaps to change drastically the main conclusions of our study.

Data quality assessment

The data quality of our dataset was assessed globally based on recommendations from the ILCD handbook (European Commission, 2010). This data quality assessment is based on six data quality indicators, namely: technological representativeness (TeR), geographical representativeness (GeR), time-related representativeness (TrR), completeness (C), precision and uncertainty (P), and methodological appropriateness and consistency (M). For each indicator a score between 1 and 5, 1 being the best score and 5 the worst, is given independently. Then, the overall quality of the dataset can be derived from the quality rating of the various quality indicators based on Eq. 1:

$$DQR = \frac{TeR+GeR+TrR+C+P+M+X_w \times 4}{i+4}$$

Eq. 1 with Xw the weakest quality level obtained among the data quality indicators and i the number of indicators scored.

Values given for the different data quality criteria were as follows: TeR: 1; Ger: 2; TrR: 1; C: 2; P: 3; M: 2, resulting in an overall value of DQR calculated for our datasets of 2.3, corresponding to a basic quality (between 1.6 and 3).

5.4 Environmental inventory

5.4.1 Field emissions and fluxes

For calculating field emissions and fluxes we chose to use different methods for each emission or flux as we believe is most appropriate. Our criteria are that the method should be state-of-the-art and at the level of detail for which we have enough information.

Given the lack of specific data on phosphorus and pesticide emissions in tropical conditions, we followed the recommendations from Nemecek and Kägi (2007) to estimate these emissions which corresponded to the most up-to-date guidelines for agriculture.

We also based our estimation of NOx emissions on these guidelines assuming a ratio of 0.21 kg of NOx per kg N2O emissions to respect a chemical balance between these substances. We used emission factors from IPCC (2006) to estimate direct (1% of nitrogen inputs) and indirect (1% of NH3 emitted and 0.75% of NO3 emitted) nitrous oxide emissions (N2O) and to estimate nitrate (NO3) leaching (as 30% of nitrogen inputs). Despite the lack of specificity of its emission factors, the IPCC report remains the most consensual method to estimate emissions in our context. For ammonia (NH3) emissions from mineral fertilizers, emission factors from Bouwman and Van Der Hoek (1997) were used since they correspond to tropical conditions (4% for NPK, 2% for CAN and DAP).

Composts of cow manure are used sometimes on the FB crop or more often on the preceding crop since GlobalGap rules require a complete analysis of the compost for a direct use on the FB crop. According to our local expert Andrew Edewa, the rates of application on the preceding crop are between 10 and 20 tons per ha. We therefore assumed a rate of 15t/ha on the preceding crop for all FB plots with no direct application of compost. To account for the nutrients provided to the FB crop from these applications of compost on the preceding crop we used recommendations from Arvalis web site (http://www.web-agri.fr/conduite-elevage/culture-fourrage/article/integrer-les-valeurs-fertilisantes-des-produits-organiques-1178-115410.html). Thirty percent of the P2O5, 15% of the nitrogen and 0% of the K2O from the compost applied on the preceding crop were allocated to the FB crop (Table 5-4). This was assuming that the compost was a well matured compost in which the organic nitrogen mineralized slowly over the crop rotation. Well-matured composts generally do not emit further ammonia emissions after their application on the field, while during the composting phase a large amount of ammonia is generally volatilized. To account for this ammonia volatilization during the composting process in a simple way, we used the IPCC emission factors of 20% of N content of the manure weighted by the percent of nitrogen allocated to the FB crop. These aspects could be further refined by searching for specific data on both the mineralization of composts and the emissions of the composting process under tropical conditions. No process was used for the compost production. Only the ammonia emissions were accounted for.

	Crop 1: application	Crop 2	Crop 3	Crop 4
N	15%	15%	15%	15% (etc...)
P2O5	70%	30%	0	0
K2O	100%	0	0	0

TABLE 5-4. ALLOCATION OF NUTRIENTS AND RELATED EMISSIONS FROM COW MANURE COMPOST OVER THE CROP ROTATION

For phosphorous losses to water, three components were included following the recommendations of Nemecek and Kägi (2007): leaching, runoff and erosion. For estimating P losses due to erosion, the quantity of eroded soil was estimated based on existing literature. Angima et al. (2003) estimated eroded soil using RUSLE 1.06b in a catchment based in the Embu District of central Kenya and using local data. These authors evaluated all key parameters for soil erosion prediction for different profiles of slope and crop in the catchment. In our farm sample, the slopes of the French bean plots ranged between 3 and 5-10% max. We therefore selected the eroded soil estimated for a profile of corn/bean rotation over 1 year on a slope of 5%: 30 t/ha/year. This annual soil eroded was allocated over the crop duration of 90 days. The P content of soil was estimated based on Zöbish et al. (1995) who measured a P content of 589 mg/kg soil on the topsoil in the depth range 0 – 5 cm at the Kabete Steep Lands Research Station of the University of Nairobi, Kenya.

Field water fluxes were generally unknown by the SHF themselves and it would be very useful to install some flowmeters over a sample of farms to gain better knowledge on the actual water withdrawn for irrigation on FB plots depending on the region. It was not possible to do a proper water balance to estimate the water actually consumed. The amount of water withdrawn was estimated based on the expertise of Andrew Edewa taking account of the rainfall levels in the different counties. An amount of 400 mm (20 l/m^2/irrigation, twice a week times 10 weeks) was assumed for all plots from Machakos, Meru, Murang'a and Kirinyaga counties while an amount of 150 mm was assumed for all plots from the Trans Nzoia county were rainfalls are more abundant. Overall, the water is generally transported to the farm at no energy and financial costs. For all counties except Trans Nzoia were no data was available for fuel use, only 6 farmers had declared fuel consumption for water pumps. This was quite consistent with the expertise from Andrew Edewa of about 10% of farmers needing a petrol pumps to pump water. In Trans Nzoia county given the flat topography of this region, based on Andrew Edewa's advice we assumed that all farmers needed to use a petrol pump for irrigation water. To estimate the amount of fuel use for these plots, we calculated the average fuel use for the 6 plots in other counties with primary data, corrected by the assumed amount of water used for irrigation in this county:

Liters of fuel use per ha for irrigation in Trans Nzoia = average amount of fuel use in liters per ha for irrigation for the 6 plots with data in other counties * (1500/4000).

5.4.2 Background processes

Background data for energy production (Dones et al., 2007), fertilizer production (Nemecek and Kägi, 2007) and pesticide production (Sutter, 2010) were mostly based on processes from the Ecoinvent database (Ecoinvent 3 Allocation, recycled content, Unit) and the Agri-footprint database with economic allocation (Blonk Agri-footprint BV), available in the SIMAPRO software (version 8.3.0.0). The transportation stages from the Ecoinvent processes for energy materials and inputs were not adapted to the Kenyan situation since this was not expected to have an important effect on the results.

For developing the inventory of multi-nutrient fertilizers which are used extensively in French bean crops, we applied the method from Nemecek and Kägi (2007). In each process, the allocation of the impacts between the different nutrients was based on a combination of the nutrient content of the fertilizer and the energy required for the specific process for each nutrient production for N, P2O5 and K2O, respectively (Table 5-5).

	N	P2O5	K2O
Average energy input for manufacturing each nutrient in MJ/t nutrient	44388,25	10151,7	8409

TABLE 5-5. ENERGY REQUIRED FOR THE MANUFACTURING OF EACH NUTRIENT. FROM NEMECEK AND KÄGI (2007).

Gaseous emissions from petrol combustion were calculated according to recommendations from Nemecek and Kägi (2007).

For the manufacturing of pesticides, no specific product was found for each active ingredient. The process "Pesticide, unspecified" was used but according to the mass of active ingredient present in the commercial product. The process "pesticide, unspecified" is expressed in kg while certain pesticides are liquid and their dosage is expressed in liters. We made the assumption that average density was around 1 and used kg instead of liters. The expected contribution of pesticide manufacturing is small, so this assumption would not affect the results so much.

An overview of the processes selected for background processes is given in Annexe 3.

5.5 Environmental impacts

5.5.1 Life-cycle impact assessment methods used

In order to answer in the most straightforward way to the three questions asked by DEVCO regarding the environmental dimension, an Endpoint life cycle impact assessment method was selected. An Endpoint LCIA method allows calculating integrated environmental impacts for the three commonly used areas of protection: Human health, Ecosystem quality and Resources. We selected the Endpoint version of the ReCiPe (Hierarchist) LCIA methodology (www.lcia-recipe.net). Each area of protection is expressed in Endpoint units: DALY (Disability Adjusted Life Years) for Human health, species*year for Ecosystem quality and $ for Resources and consists of several impact categories. Endpoint results will also be presented per impact category.
Regarding toxicity impacts, a huge field work and desk work was done for their inventory at field level (see annexe 2). After checking the method proposed in ReCiPe to evaluate their impacts only about 60% of the active ingredients used in our inventory were characterised, meaning that for 40% of them no impact was accounted for. We looked for the substance group of the pesticides to propose proxies. For Emamectin benzoate and Spinosad, which are micro-organism derived, we did not find a simple method to define a proxy. Betacyfluthrine was unknown from the EU pesticide database and from the Environmental Footprinting with USEtox platform. Thiocyclam hydrogen oxalate was mentioned as “unclassified” in this platform and unknown in the EU pesticide database. For neonicotinoids: Thiametoxam, Imidacloprid and Acetamiprid, we looked for other neonicotinoids characterised in ReCiPe but with no success. Only the diafenthiuron could be characterised according to the substance group’s factor (thiourea). For all active ingredients with no characterisation factors in ReCiPe, we calculated the max and the mean characterization factor (CF) for all pesticides used in our dataset. Testing both results, with the max CF and with the mean CF for pesticides with no CF, we decided to present results calculated with the mean CF.
For evaluating the impact of water consumption, we used the method from Pfister et al. (2011) which proposes compatible characterization factors with the Endpoint version of ReCiPe.

5.5.2 Environmental impacts for the fresh FB value chain

Cradle-to-market-gate results

For the human health area of protection, Large-farm system showed the greatest impacts followed by SHF-scattered, then SHF-contracted and finally medium-farm type. However, the cradle-to-market-gate Endpoint results were close among the four compared systems with differences of less than 10% between greatest and least impacts (Figure 5.5. a.). Climate change constituted most of the human health damage around 77-78% of the total impact for each system. The second most important contributor to human health endpoint was particulate matter formation, with contributions around 20% for all systems. All other midpoint categories had only minor contributions, the greatest being human toxicity around 2%.

For ecosystem quality (Figure 5.5. b.), the results among the four systems showed greater variations than for the human health area of protection with more than 20% difference between greatest and least impacts. Overall, SHF-scattered had the greatest impacts, Medium-farm the least, SHF-contracted and large-farm being intermediate. Climate change was again the main contributor with contributions between 54 to 66%. Agricultural land occupation was the second

contributor at 16 – 21% and water deprivation was the third most important midpoint category at 12 – 18%. Natural land transformation represented 4-5%.

For the resource area of protection, fossil depletion appeared as the only major contributor at about 98-99% across all studied systems (Figure 5.5. c.). Differences among the four studied systems were small, less than a 5% difference.

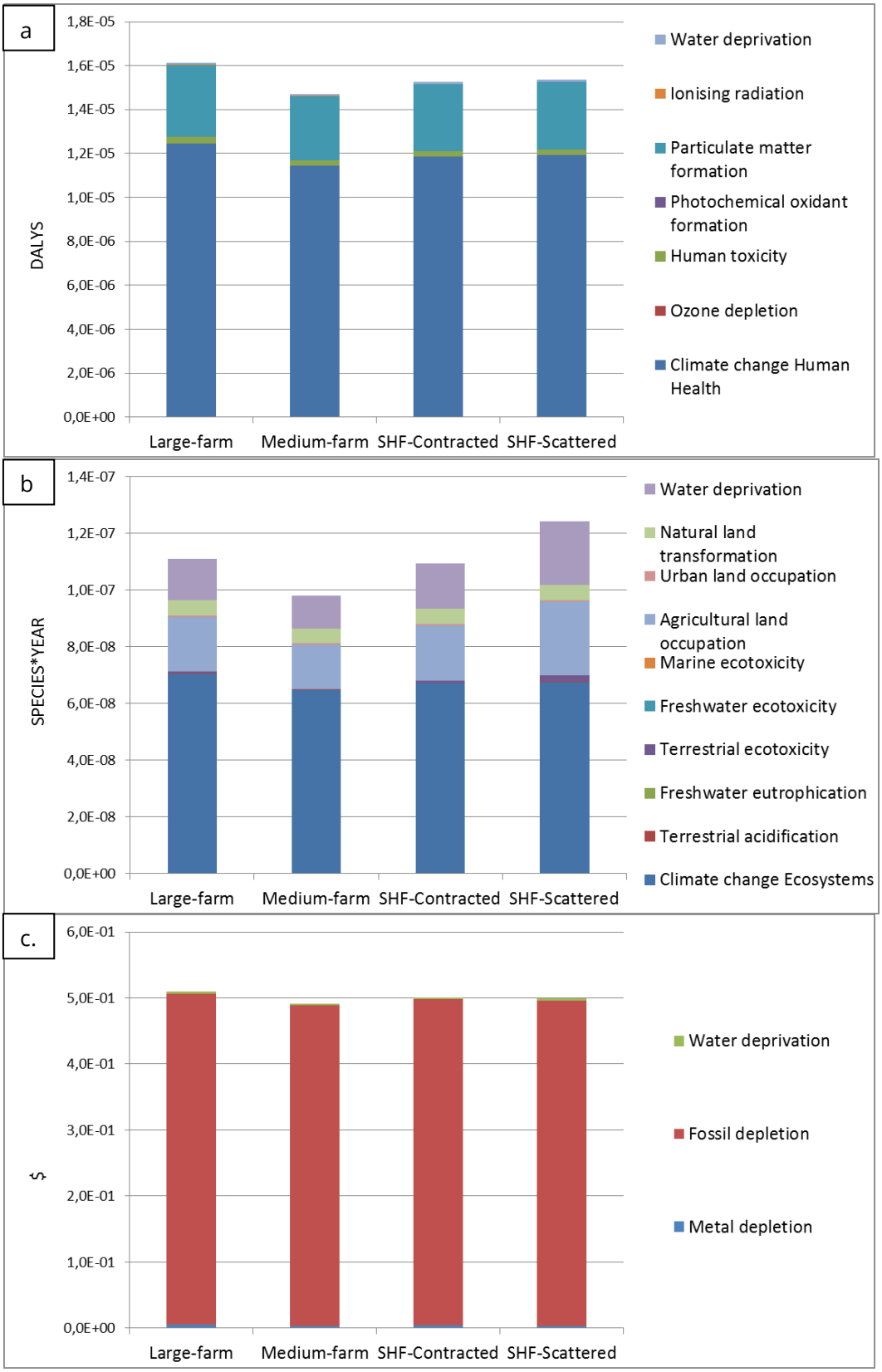


FIGURE 5.5. CONTRIBUTION OF IMPACT CATEGORIES TO ENDPOINT RESULTS FOR 1KG OF CRADLE-TO-MARKET-GATE (UK) FRESH FRENCH BEAN ACCORDING TO SYSTEMS: LARGE-FARM, MEDIUM-FARM, SHF-CONTRACTED AND SHF-SCATTERED, A. HUMAN HEALTH; B. ECOSYSTEM QUALITY; C. RESOURCES

The contribution profile of the impact categories to the Endpoint areas of protection was quite similar to the profile obtained for a tomato produced in Morocco and exported to France (Payen

et al., 2015) highlighting the large contribution of climate change, particulate matter formation, agricultural land occupation, water deprivation and fossil depletion. However, it is important to notice that this calculation is hampered by the current limitations of the models used, giving a probable overestimation of the best modelled impacts, such as climate change (Payen et al., 2015). Conversely, the modelling of more site-specific impacts such as water deprivation and ecotoxicity are still uncomplete and probably underestimated here.

Contribution of the life-cycle stages to the total results

The general Endpoint profile for our four systems can be explained by a contribution analysis of the main stages of the life cycle of the fresh FB products:

- cradle-to-farm-gate (agricultural) production,
- transport by road in Kenya from field to packhouse,
- packhouse,
- transport by road in Kenya from packhouse to airport
- and finally air-freight from Nairobi airport to London airport.

The first four stages are located in Kenya and could be labelled as the "Kenyan environmental footprint" of the fresh FB products (FOB) while the fifth stage corresponds to an intercontinental transport via the air. At market-gate, the four studied systems showed a similar profile. The variations across the 4 systems only depended on the impacts of the agricultural production which will be analysed in more detail in the next section.

As shown in Figure 5.6 a. for human health, air-freight had the main contribution to human health, ranging between 81 and 89% across the four systems. Packhouse had a relative contribution between 7 and 8% while agricultural production had a relative contribution between 2% (medium-farm) and 11% (large-farm). **The Kenyan footprint (impacts for all stages happening in Kenya) was respectively 11% for medium-farm, 15% for SHF-Contracted and SHF-Scattered and 19% for large-farm.** The transportation phases by road in Kenya showed very small contributions, less than 1% each and about 1% all together. Of course, the impacts for these phases are sensitive to the distances assumed. However, even doubling the distances would not give to these phases a large contribution to the cradle-to-market-gate impacts.

As shown in Figure 5.6 b. for ecosystem quality, air-Freight had the greatest contribution, between 51 and 65% across the four systems. Agricultural production contributed between 15% (medium-farm) and 33% (SHF-Scattered) while packhouse contributed between 15% (SHF-Scattered) and 19% (medium-farm). For this area of protection, road transport in Kenya had contributions around 0.5% all together. **The Kenyan footprint for ecosystem quality was 35% for medium-farm, 42% for large-farm and SHF-Contracted and 49% for SHF-Scattered.**

As shown in Figure 5.6 c. for Resources, air-freight had the greatest contribution, between 83% and 86% across the four systems. Packhouse had the second most important contribution, around 12%. Agricultural production contributed between 1 and 4%. Transportation by road in Kenya contributed around 1% all together. **The Kenyan footprint for Resources was 14% for medium-farm, 15% for SHF-Scattered, 16% for SHF-Contracted and 17% for large-farm.**

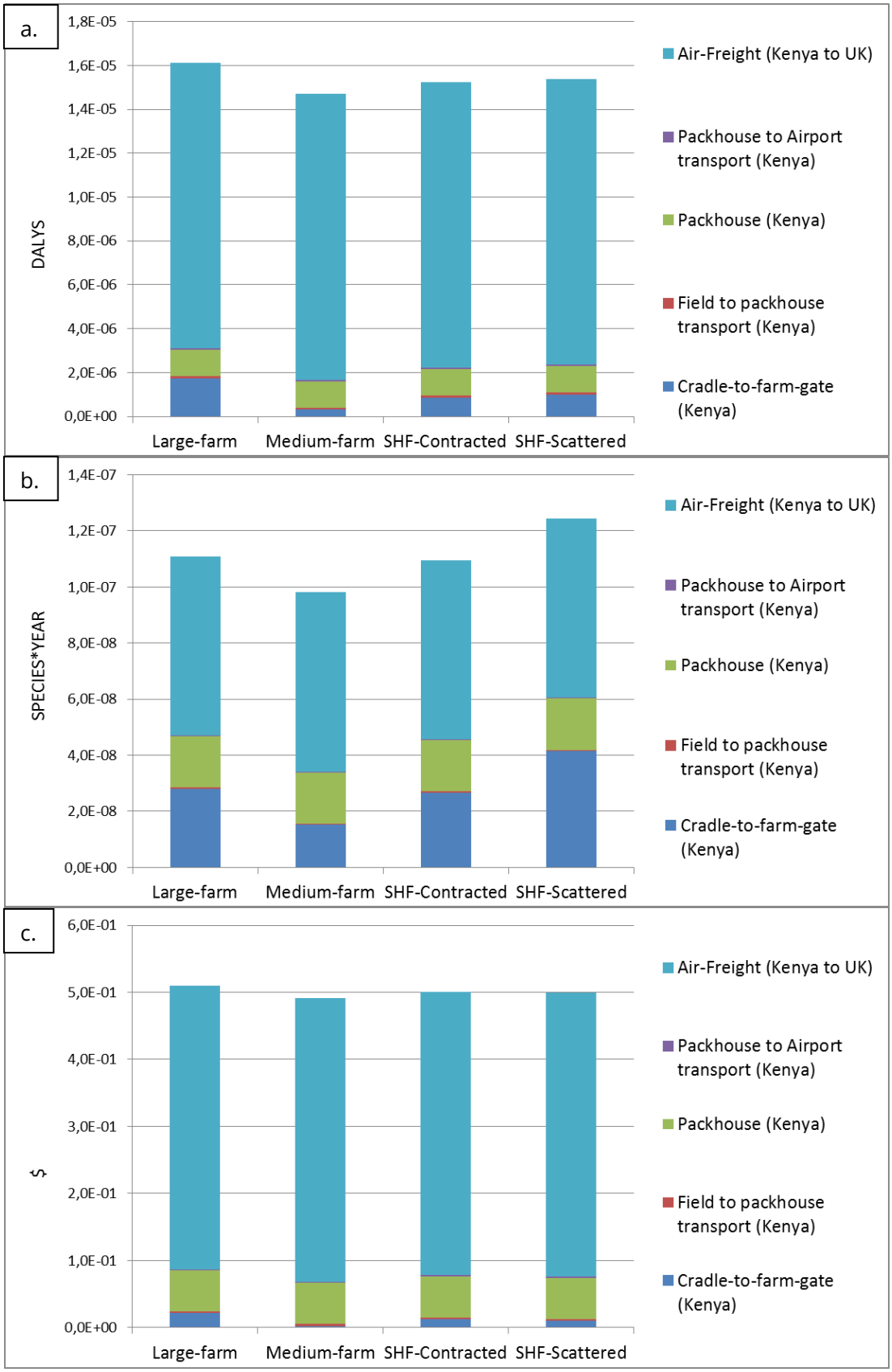


FIGURE 5.6. CONTRIBUTION OF THE MAIN CRADLE-TO-MARKET-GATE (UK) LIFE-CYCLE STAGES TO THE THREE AREAS OF PROTECTION FOR 1 KG OF FRESH FB PRODUCT ACCORDING TO SYSTEMS: LARGE-FARM, MEDIUM-FARM, SHF-CONTRACTED AND SHF-SCATTERED, A. HUMAN HEALTH; B. ECOSYSTEM QUALITY; C. RESOURCES

Cradle-to-farm-gate results

The contributions to the total Endpoint indicators at farm-gate of fertilizer production, N field emissions, P field emissions, pesticide production and emissions, land preparation, water use for irrigation, energy use for irrigation and land use were calculated for the four fresh FB systems and are shown in Figure 5.6 a, b, c. The large-farm system showed the greatest impacts for Human health and Resources, followed by SHF-scattered, SHF-contracted and then by the medium-farm system with the least impacts. SHF-scattered had the greatest impacts for Ecosystem quality.

For Human health, the main contributors at about 80% were fertilizer production and associated N emissions (N2O). For Ecosystem quality, the two main contributors were water for irrigation and land use. For Resources, the main contributors were fertilizer production and energy use for irrigation. We can also notice that the land preparation done mechanically for the large-farm contributed 9% of Human health and 18% of Resources.

These contributions can be explained by the agronomic data shown in Table 5-2 for all systems especially the yield and the key input rates such as fertilizer use, water use and energy use. The large-farm uses almost 150 kg N and 170 kg P2O5 per ha against around 60 kg N and 70 kg P2O5 for the other systems. Large-farm and SHF-contracted have similar yields while medium-farm has a high yield at 9926 kg/ha and SHF-scattered has the least production per ha at 4160 kg. Overall, the fertilizer efficiency (kg N/kg FB) appeared as a key driver of the eco-efficiency of the FB farms in Kenya.

Among all systems, the pesticide applications contribute only a few percent of the total impact, the greatest contribution being obtained by the large-farm at 6.5% of the Resource Endpoint and SHF-Scattered with 5% for Ecosystem quality. This small contribution of pesticide applications reveals a very low weighting of the toxicity categories in the impact modelling up to the endpoint.

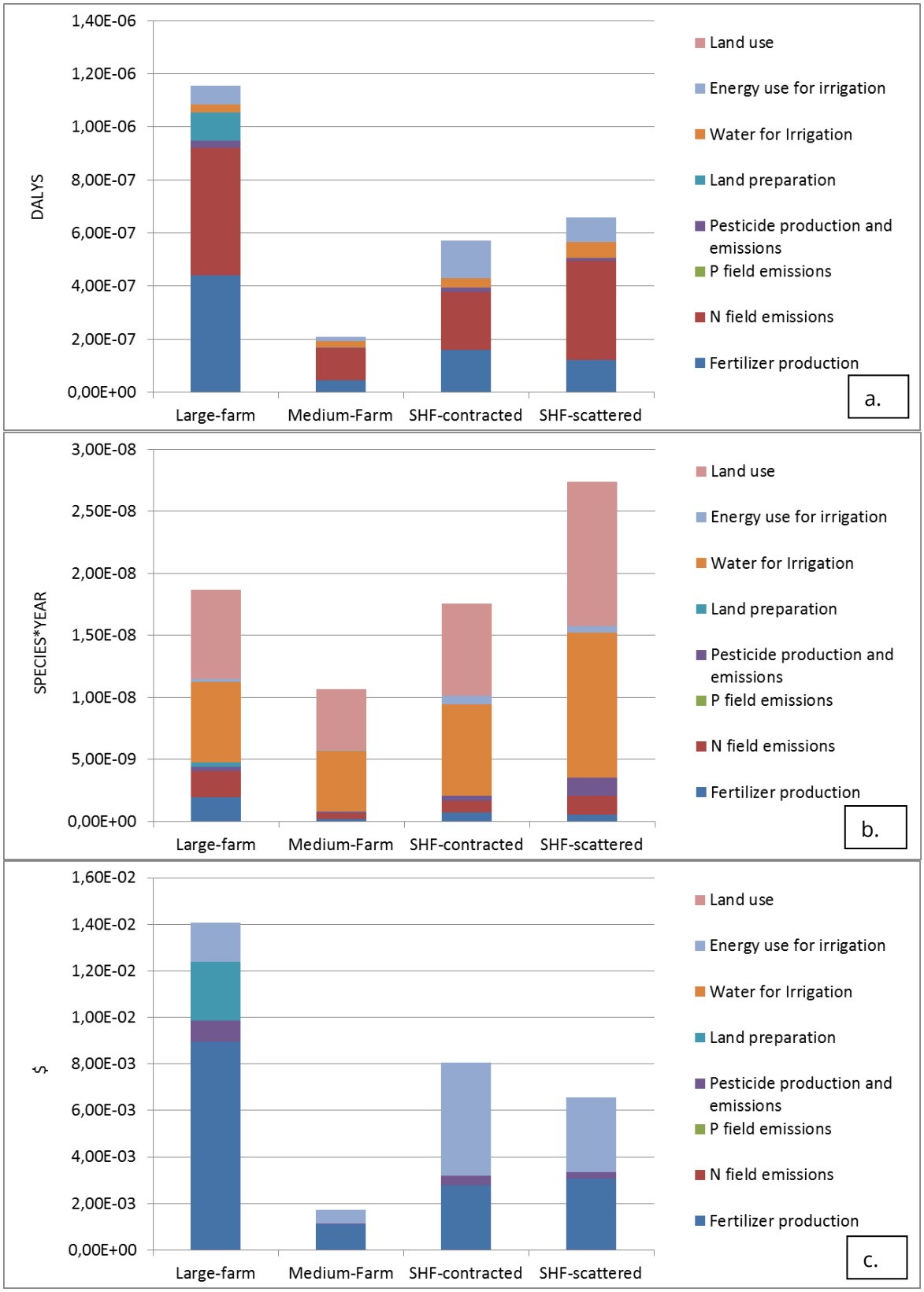


FIGURE 5.7. CONTRIBUTION ANALYSIS OF THE MAIN CRADLE-TO-FARM-GATE LIFE-CYCLE STAGES FOR THE FOUR FRESH FB STUDIED SYSTEMS TO THE TOTAL ENDPOINT RESULTS: A. HUMAN HEALTH, B. ECOSYSTEM QUALITY, C. RESOURCES.

5.5.3 Environmental impacts for the canned FB value chain

Endpoint results and contribution of impact categories

The Endpoint results for the two studied systems for canned French bean were similar for the Resource area of protection, very close for Human health and quite different for the Ecosystem quality (Figure 5.8 a, b, c). Similarly to the results for the fresh FB products, the contributions of climate change (54-55%) and particulate matter formation (36-37%) were predominant for Human health but the human toxicity was also present around 8-9% for each system. For Ecosystem quality, again climate change, agricultural land occupation and water deprivation were the three major contributors but terrestrial ecotoxicity was also visible for the large-farm system with a contribution of 11%. Finally, for the Resource area of protection, fossil and metal depletion had major contributions, respectively 53% and 46%. SHF-contracted always had the greatest impacts compared to the large-farm system which can be explained by a lower yield and greater water use for irrigation for the SHF-contracted.

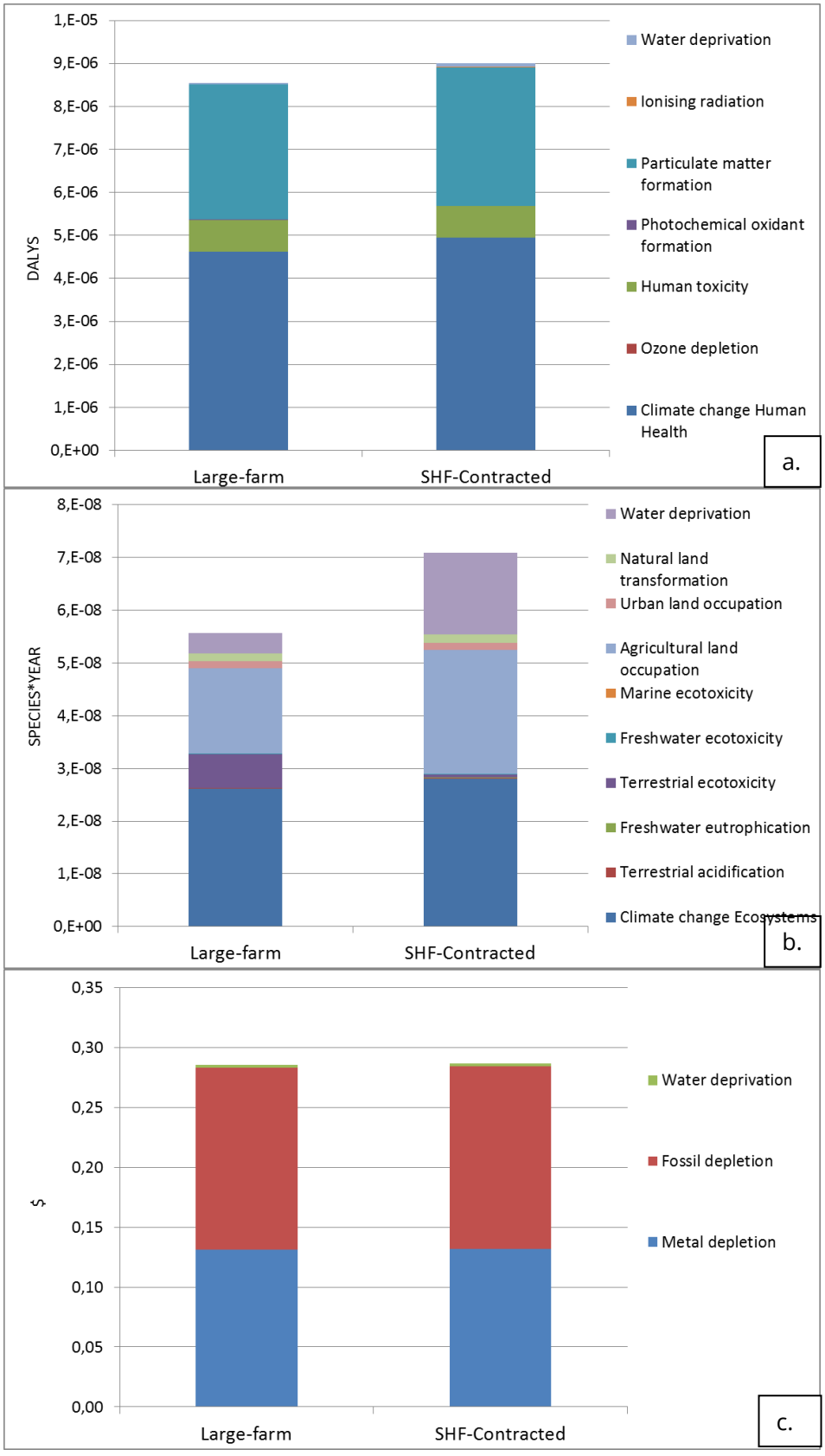


FIGURE 5.8. CONTRIBUTION OF IMPACT CATEGORIES TO THE ENDPOINT RESULTS FOR 1KG OF CRADLE-TO-MARKET-GATE (UK) CANNED FRENCH BEAN FOR LARGE-FARM AND SHF CONTRACTED SYSTEMS, A. HUMAN HEALTH; B. ECOSYSTEM QUALITY; C. RESOURCES.

Contribution of the life-cycle stages to the total results

The contribution analysis for cradle-to-market-gate canned FB product for the two studied systems was quite different from that for the fresh FB product. As shown in Figure 5.9 a, b, c, the different stages had a more balanced contribution to the impacts and the canning factory was the main contributor for Human health (48-50%) and Resources (67%) while agricultural production and canning factory were the main contributors for Ecosystem quality at 37-51% and 30-38%, respectively. The two road transport stages in Kenya had a similar contribution to the three areas of protection at around 10% each, resulting in a total contribution around 20% of the total impacts. The great contribution of the canning factory is due to the use of water, energy and packaging, in particular the use of tin steel can and secondarily to the use of other packaging such as glass jars and wood pallets.

At FOB level (Kenyan-footprint), the contributions were greater in relative terms compared to the Fresh FB products. **The Free-On-Board results contributed 88% of Human Health and Resources and 95-96% for Ecosystem quality.** This greater relative contribution for the canned FB products is explained by the lesser contribution from the intercontinental transport by sea compared to the air-freight. It can also be explained by the greater contribution from the canning factory compared to the packhouse especially for Human health and Resources for which impacts are three fold that for packhouse per kg raw FB processed.

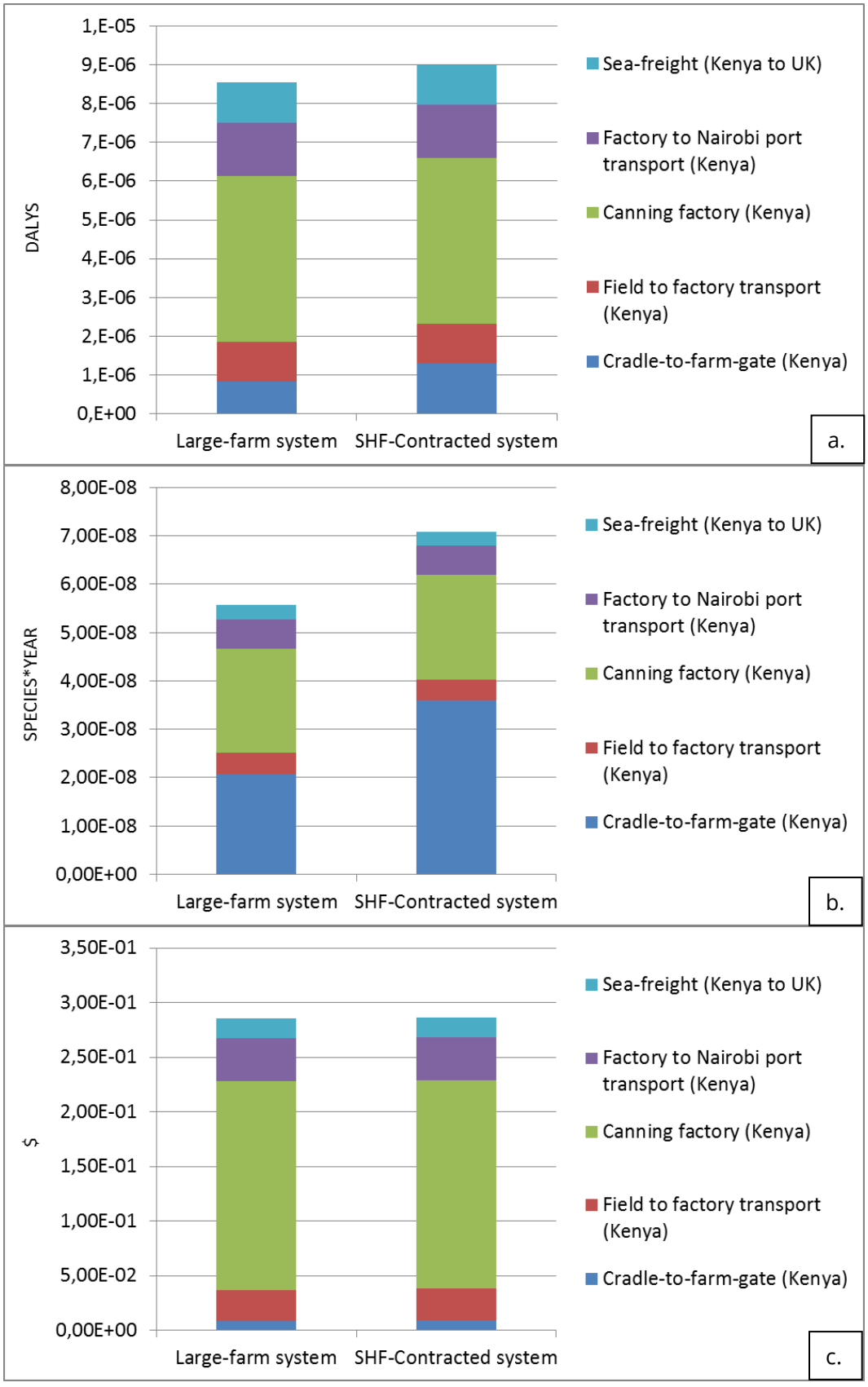


FIGURE 5.9. CONTRIBUTION OF THE MAIN CRADLE-TO-MARKET-GATE (UK) LIFE-CYCLE STAGES TO THE THREE AREAS OF PROTECTION FOR 1 KG CANNED FB PRODUCT – LARGE-SIZE FARM AND SHF-CONTRACTED TYPES: A. HUMAN HEALTH, B. ECOSYSTEM QUALITY, C. RESOURCES.

5.6 Discussion

Environmental impacts of the French bean end-products from Kenya

Fresh FB and canned FB are not comparable products in terms of hedonic, nutritional and economic values. To conduct a fair comparison of these two different products, a common functional unit should be defined and the complete life cycle of the products should ideally be covered by the analysis. It was not the purpose of this LCA study. However, from a decision-making point of view, contributing to answer to the question: "for 1 kg raw FB produced in Kenya, what is the most environmentally friendly option?" appeared interesting.

To properly present this comparison, it is important to bear in mind that, as already said, the two products are not comparable from hedonic, nutritional and economic viewpoints. However, these aspects are seldom accounted for in state-of-the-art LCA studies for food in general. A common, although imperfect functional unit between the two products could have been 1 kg of cooked FB ready for consumption which would have implied to expand the system boundaries at least up to the consumption stage. Again, this was not the study we did here. Our FU was 1kg raw French bean processed. Therefore, one was cooked, the other was not. However, because cooking at home is less efficient than cooking in a factory and extra losses will occur for the fresh FB after they have reached the UK market while canned FB are already cooked, stabilized for 4 years and require no refrigeration, we dared to present a comparison of the impacts for cradle-to-market-gate FB products expressed per 1 kg raw FB processed (Figure 5.10, a, b, c). However, these graphs must not be presented independently of these preliminary limits and explanations.

All fresh FB products had cradle-to-market-gate impacts about twice those of the canned FB products. The main impact categories responsible for this difference were mostly climate change and fossil depletion in relation to the air-freight of fresh products (not shown). From cradle-to-market-gate again, the only greater impact category for canned products was the metal depletion in relation to the use of steel for the can packaging of the products.

If we look at the impacts from cradle-to-FOB, (so-called the Kenyan footprint) for canned products, they were similar for Ecosystem quality but 4 times that for fresh ones for Human health and Resources. This was due to greater impacts from factory and road transport. Across the 6 studied systems, the cradle-to-farm-gate stages had a similar contribution with more variations across farm types producing for fresh than for canned. This may be partly explained by a greater sample size for fresh than for canned FB. Figure 5.10 a,b,c, presents a zoom on the cradle-to-FOB results for the 6 studied systems.

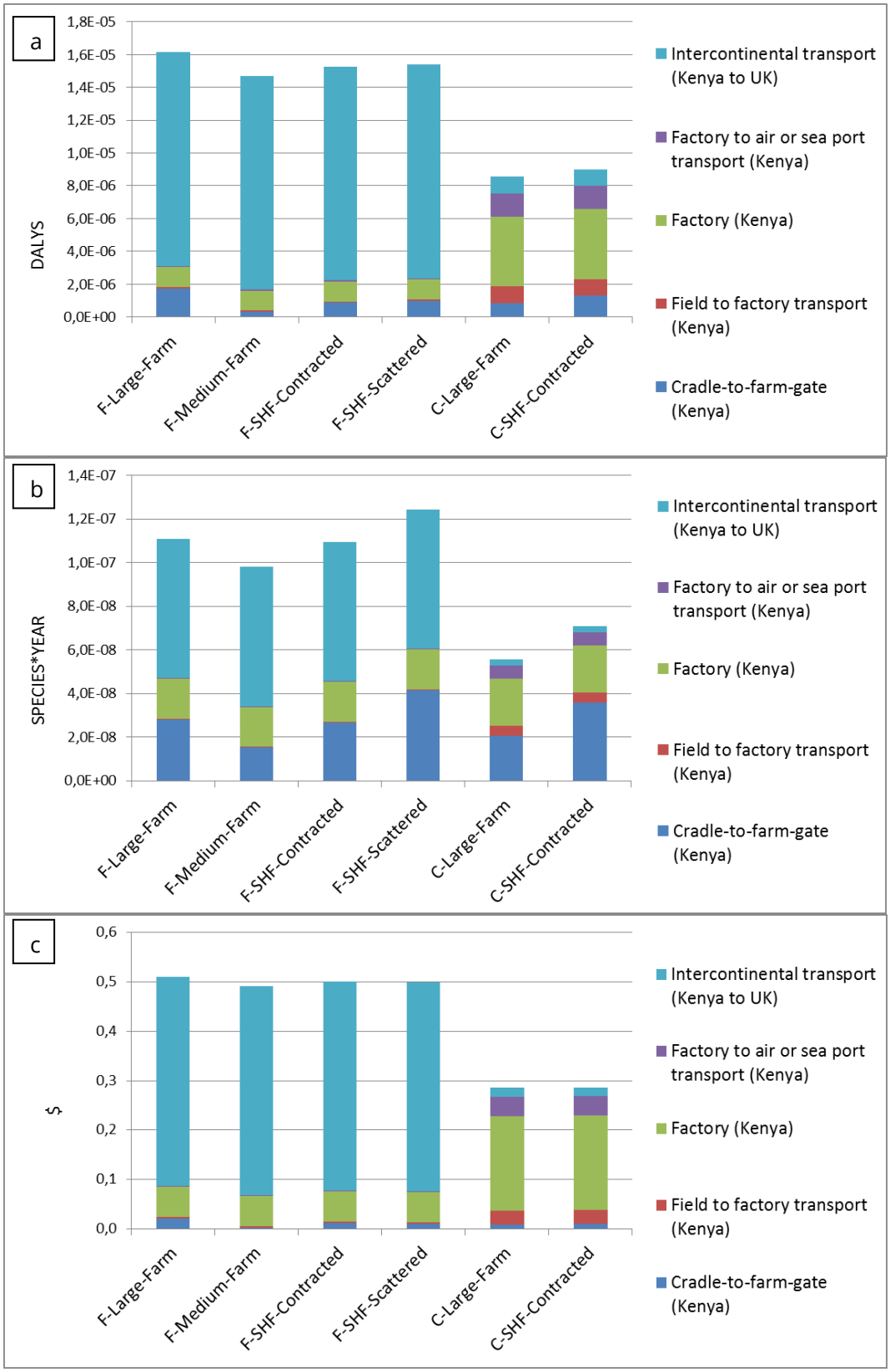


FIGURE 5.10. CONTRIBUTION OF MAIN CRADLE-TO-MARKET-GATE STAGES TO ENDPOINT RESULTS FOR THE FOUR STUDIED SYSTEMS FOR FRESH FB (F-LARGE-FARM; F-MEDIUM-FARM; F-SHF-CONTRACTED, F-SHF-SCATTERED) AND THE TWO STUDIED SYSTEMS FOR CANNED FB (C-LARGE-FARM, C-SHF-CONTRACTED) FOR 1KG OF RAW FB PROCESSED. A. HUMAN HEALTH, B. ECOSYSTEM QUALITY, C. RESOURCES.

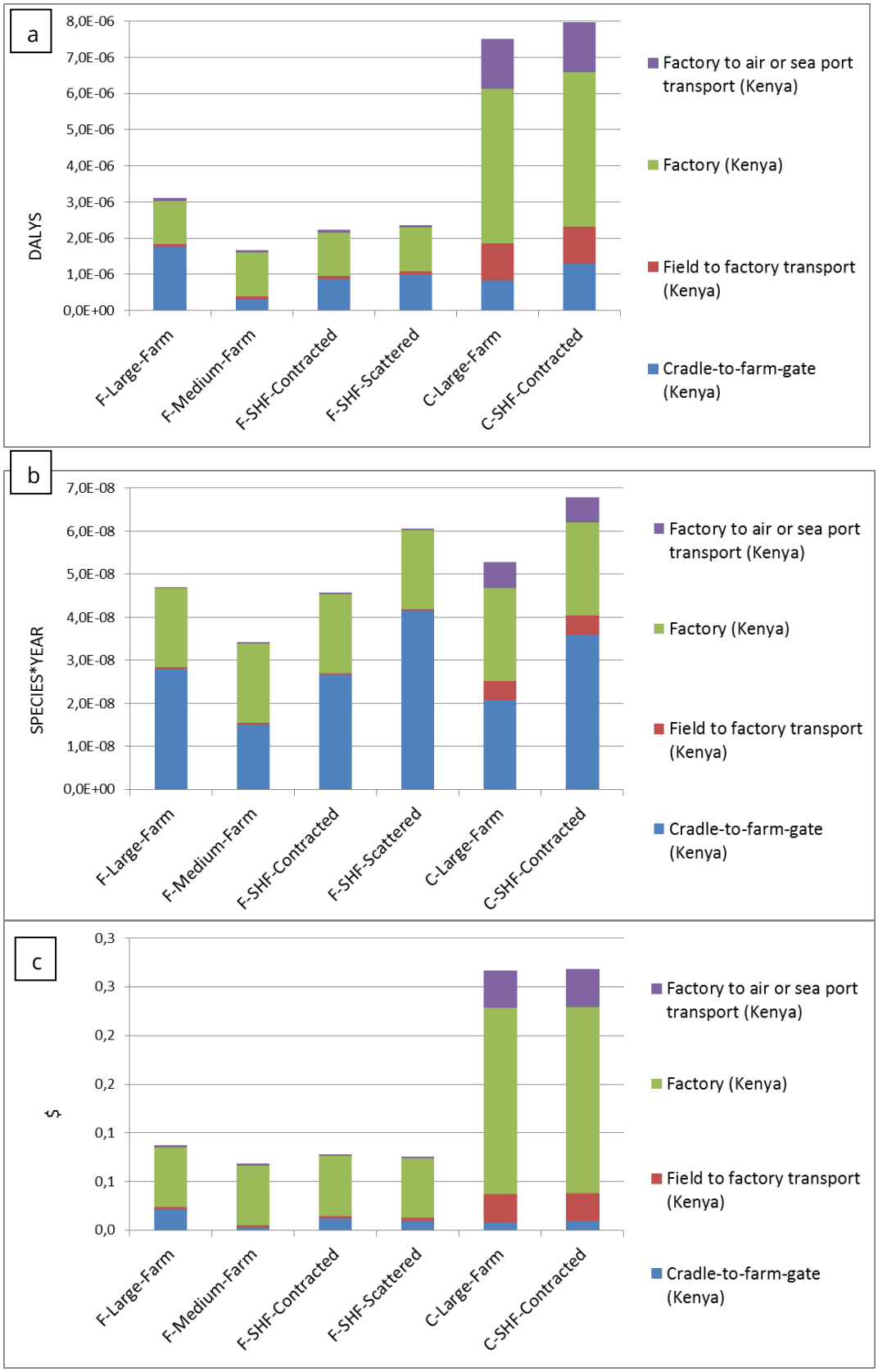


FIGURE 5.11. CONTRIBUTION OF MAIN CRADLE-TO-FOB STAGES TO ENDPOINT RESULTS FOR THE SIX STUDIED SYSTEMS FOR 1KG OF RAW FB PROCESSED. A. HUMAN HEALTH, B. ECOSYSTEM QUALITY, C. RESOURCES.

Comparison with literature references

Comparing LCA results is always difficult due to differences in goal and scope and methods used. Moreover, LCA studies generally present Midpoint indicators such as Global Warming Potential (GWP = Climate change) in kg CO2-eq. To compare our results with existing literature, we calculated the GWP in kg CO2-eq per kg raw FB and compared it with a review of cradle-to-farm-gate LCA studies on vegetable crops from Perrin et al (2014), with a study on FB exported to UK from Kenya by Mila i Canals et al. (2008) and with a study done by Stoessel et al. (2012) on carbon and water footprint of fruits and vegetables for a Swiss retailer. The comparison for fresh FB products is presented in Table 5-6.

	Fresh FB products (this study)	Mila i Canals et al. (2008)	Perrin et al. (2014)	Stoessel et al. (2012)
Cradle-to-farm-gate	0.0893 – 0.565	-	Averages for all vegetable product groups: -0.36* – 0.89 Green bean product average: 0.5	-
Cradle-to-market-gate	8.17 – 8.89	10	-	Air-freighted asparagus: 12.2 – 13.5

*TABLE 5-6. COMPARISON OF CRADLE-TO-MARKET GATE AND CRADLE-TO-FARM-GATE GWP (IN KG CO2-EQ/KG PRODUCT) FOR OUR FRESH FB SYSTEMS WITH EXISTING LITERATURE *: NEGATIVE VALUE IS DUE TO AN ASSUMPTION OF AVOIDED DUMPING OF ORGANIC WASTES*

At farm-gate and market-gate, our results are well in line with existing literature. The FB farms sampled show variable impacts but in the range of impacts for other open-field vegetables in general and green beans in particular. At market-gate, the studies from Mila i Canals et al. (2008) and Stoessel et al. (2012) confirm the very high environmental cost of air-freighted fresh vegetables.

Robustness of results and perspectives

If we exclude the uncertainty attached to the modelling of impacts, several sources of uncertainty due to data quality exist and have been listed in the dedicated section. With such a small sample of farms and factories surveyed, representativeness for such a large value chain cannot be claimed. However, the use of an expert-based typology to design a stratified sampling contributed to improve its relevance and was well in line with the resource and time-frame of this study. Of course, validating our results through the survey of a greater sample of stakeholders of the value chains would be valuable but also very time-consuming.

Air-freight arose as a very impacting stage in this LCA study. The Ecoinvent process used gave a similar result per kg of product transported as that found in a report from BioIS for ADEME in 2007 (Labouze et al., 2007). From this report, each kg of fruit transported by plane from Ivory Coast to France produced a GWP of 5.8 kg CO2-eq corresponding to 1 kg CO2-eq.kg fruit^{-1} for 840 km. The distance from Kenya to UK being estimated at 6750 km, using this reference we would have obtained exactly the same GWP per kg FB transported at (6750/840) ≈ 8 kg CO2-eq.

Given the importance of water for irrigation in an arid and semi-arid country, it would be very useful to install flowmeters in a wide range of farms across the different counties of Kenya

producing FB so that a more refined and spatialized assessment of the water deprivation impact could be produced.

In a future update of this study, it would also be relevant to expand the system boundaries to include the consumption stage and in particular the impacts on human health due to direct ingestion of pesticide residues. As demonstrated by Fantke and Jolliet (2016), this pathway generally has much greater impacts, especially for vegetables consumed fresh, than more indirect pathways through the environmental compartments. Expanding the scope of this LCA study could also permit a more reliable comparison between fresh and canned FB.

The contribution analysis is often sufficient to predict the effect of a change in a variable on the final results. However, more sensitivity analyses would also be valuable on key input rates and quantities of most impacting packaging, field emission estimates, losses at farm and factory gates and road distances.

Despite the uncertainty inherent to our methods and data, we trust that the orders of magnitude of the impacts evaluated in this study and the key contributors identified are robust.

5.7 Conclusions

To answer to the three questions asked by DEVCO regarding the environmental impacts of French bean (FB) value chains for export in Kenya on the three areas of protection: Human health, Ecosystem quality and Resources, an up-to-date LCA study was done for the two main FB value chains in Kenya.

Fresh FB products and canned FB products were evaluated from cradle-to-market-gate in the UK as main export market. The results were expressed per 1 kg of raw French bean processed at market-gate. The life cycle of the products consisted of 5 main stages: agricultural production (cradle-to-farm-gate), transport by road before processing, processing (packhouse or canning factory), transport by road after processing, intercontinental transport by air-freight for fresh FB and by sea-freight for canned FB. A typology of the farm systems was proposed to account for the diversity of situations. Overall, 4 farm types were defined for the fresh FB: one large-farm, one medium-farm, one small-holder farm contracted and one small-holder farm scattered and 2 for the canned FB: one large-farm and one small-holder farm contracted. The environmental inventory was based on an intensive field work in Kenya where primary data were collected for all inputs and outputs for a sample of 33 farms over 5 counties and 2 packhouses for the fresh FB and 9 farms over 2 counties and 1 canning factory for the canned FB. Several data gaps had to be filled, the most important relating to water and energy use for irrigation. The description of pesticide applications required also a lot of effort due to the partial records available on the farm and the great number of active ingredients used over the farm sample including not approved and unknown molecules by the European commission. At processing level, it was also difficult to collect all required data and this lack of detailed information on end-products at packhouse or factory-exit-gate implied to use the raw FB processed as functional unit. Representativeness for the two FB value chains cannot be claimed for such a small sample of farms and factories.

Using the Endpoint version of the ReCiPe 2008 method and Pfister et al (2011) for water deprivation, an integrated impact was produced and analysed for each area of protection.

For the fresh French bean product, at market-gate the four types had close results for Human health and Resources and showed greater differences for Ecosystem quality. For Ecosystem quality the SHF-scattered system had greater impacts, followed by the large-farm system and then

SHF-contracted and finally the medium-farm system. The main impact categories contributing to Human health were climate change around 77-78% of total impact and particulate matter formation around 20%. For Ecosystem quality, Climate change was again the main contributor with contributions between 54 to 66%. Agricultural land occupation was the second contributor at 16 – 21% and water deprivation was the third most important midpoint category at 12 – 18%. For the resource area of protection, fossil depletion appeared as the only major contributor at about 98-99% across all studied systems.

The contribution of 4 key stages in Kenya: farm, transport by road before packhouse, packhouse and transport by road after packhouse and the stage of air-freight from Nairobi to London was analysed. It revealed that air-freight had a major contribution for most impact categories while farm production had a major contribution for water deprivation, freshwater eutrophication, terrestrial ecotoxicity and agricultural land occupation.

Cradle-to-farm-gate results for fresh French bean revealed much greater differences across the four studied systems than at market-gate level. For Human health and Resources, the large-farm system had the greatest impacts, the medium-farm the least, SHF-contracted and SHF-scattered showing intermediate results. For Ecosystem quality, SHF-scattered had the greatest impact followed by large-farm and then by SHF-contracted and Medium-farm. Therefore, the medium-farm system always obtained the least impacts. From cradle-to-farm-gate, the main contributors to Human health and Resources were the fertilizer production and associated field emissions and also the energy use for irrigation. For Ecosystem quality the water for irrigation and the land use were the main contributors. Impacts due to pesticide applications were relatively small. One key driver identified for the eco-efficiency of FB plots, was the fertilizer efficiency (kg N/kg FB) which was not favourable for the large-farm.

For the canned products at market-gate, the contribution of impact categories to the three Endpoints was similar to that for the fresh products but the terrestrial ecotoxicity contributed more in relative terms. Across the main cradle-to-market-gate stages for canned products the canning factory was the main contributor for Human health (50%) and Resources (67%) while agricultural production and canning factory were the main contributors for Ecosystem quality at 40 and 37%, respectively. Road transport in Kenya had similar or more impacts than sea-freight.

Bearing in mind several key limitations and explanations, the environmental impacts of fresh and canned products could be compared per kg of raw French beans processed since a complete comparative LCA study would be expected to yield even worse results for the fresh FB. All fresh FB products at market-gate had impacts about twice those of the canned FB products. The main impact categories responsible for this difference were climate change and fossil depletion in relation to air-freight of fresh products. The only greater impact category for canned products was the metal depletion in relation to the steel can packaging of the products.

GWP in kg CO_2-eq/kg raw FB were well in line with existing literature at market-gate and farm-gate and confirmed the very high environmental impacts of air-freight.

This LCA study of the fresh and canned FB value chains in Kenya provided an up-to-date reference regarding their environmental performance and allowed identifying margins for improvement. Although all systems have their margins of improvement, the canned FB value chain may represent an interesting alternative to the fresh value chain from an environmental point of view.

6 Annexes

6.1 Annex 1: References and websites consulted

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6.2 Annex 2: Kenya Green Beans Value Chain Mapping

Value Chain level	Public Sector Institutions	Value Chain Players	Private Sector Service Providers	Other
Research & Development	• KALRO- Horticultural (Dr. LusikeWasilwa) • University of Nairobi- Kabete (Seed Enterprise; Teaching); • JKUAT-	Science, Technology and Innovation (STI)	• Real IPM; • Dudutech; a) Seed Companies • Monsanto; • Kenya Highland Seeds	
Community Level (Social Aspects)	• MOALF (Pro-poor Agric Policies); • County Governments MoA& Social services (Land; Extension service&Social services); • AFA- HCD (Registration of producers);	Farmer Mobilisation and capacity development *(Individual Producers; Producer Groups)*	• Kenya Association of Agric Producers (advocacy) • Social Enterprise (e.g. Todays Agriculture; Meru Greens) • CBOs	NGOs
Private Sector (Businesses)	• KEPHIS – Seed certification;	Sourcing of Farm Inputs/ supplies *(Distributors; suppliers; stockists of agro-inputs)*	• East Africa Seed Co; • Kenya Highland Seed Co.; • Monsanto K Ltd; • Starke Ayres • Amiran • Yara • Syngenta • Twiga Chemicals • Bayer • Osho	
Value Chain level	Public Sector Institutions	Value Chain Players	Private Sector Service Providers	Other
Primary production	**Research & Dev** KALRO; Universities	• KALRO Field /extension officers • University Researchers	• Real IPM; • Dudutech; a) Seed Companies • Monsanto; • Kenya Highland Seeds	
	Policies & Strategies Min of Agri, Liv & Fish (Central & County gov)	• Min of Agri, Liv & Fish • County govt	• FPEAK	
	Laws & regulations horticultural crops directorate (green beans) MOALF	• AFA-HCD • MOALF	• Code of Practice and product specifications • KEBS; FPEAK	

Value Chain level	Public Sector Institutions	Value Chain Players	Private Sector Service Providers	Other
	Testing & Analysis KEBS, KEPHIS, KALRO	• KEBS, KEPHIS, KALRO, • SGS, AgriQ,	• **Testing & Analysis** • SGS, AgriQ,	
	Inspections KEPHIS AFA-HCD PCPB	• KEPHIS, AFA-HCD, PCPB, SGS, Intertek, BVI, DNV	• SGS, Intertek, BVI, DNV	
	Verification AFA-HCD PCPB	• AFA-HCD • PCPB, SGS, Intertek, BVI	• SGS, Intertek, BVI	
	Certification AFA-HCD; KEPHIS PCPB	• AFA-HCD; KEPHIS • PCPB, SGS, Intertek, BVI, DNV, Africert	• SGS, Intertek, BVI, DNV, Africert	
AGRO-PROCESSING &VALUE ADDITION	KALRO; KIRDI; Universities	• **Research & Dev** • KALRO; KIRDI; • Universities	• Export companies	
	Min Industries, Trade & Cooperatives, County govts	• **Policies & Strategies** • Min Industries, Trade & Cooperatives , • County govts	•	
	Laws on processing and value added Min Industries, Trade & Cooperatives	L**aws & regulations** Min Industries, Trade & Cooperatives	**GMPs** KAM	
	KEBS, KALRO	**Testing & Analysis** KEBS, KALRO, SGS, AgriQ,	**Testing & Analysis** SGS, AgriQ,	
	KEBS; AFA-HCD	**Inspections** KEBS; AFA-HCD, SGS, Intertek, BVI, DNV	SGS, Intertek, BVI, DNV	
	KEBS; AFA-HCD	**Verification** KEBS; AFA-HCD, SGS, Intertek, BVI	SGS, Intertek, BVI	
	KEBS	**Certification** KEBS, SGS, Intertek, BVI, DNV	SGS, Intertek, BVI, DNV	
	Min Industries, Trade & Cooperatives, KEBS, MOALF	**Information, Education and communication** Min Industries, Trade & Cooperatives, KEBS, MOALF, FPEAK	FPEAK	
END-MARKETS AND TRADE	Min Industries, Trade & Cooperatives,AFA-HCD	**Laws & regulations** Min Industries, Trade & Cooperatives, AFA-HCD	-	
	KEPHIS, AFA-HCD	**Inspections** AFA-HCD, KEPHIS	-	
	-	**Certification-market standards eg GlobalGap** Africert, SGS, Intertek, BVI, DNV	Africert, SGS, Intertek, BVI, DNV	

Value Chain level	Public Sector Institutions	Value Chain Players	Private Sector Service Providers	Other
	-	**Export companies** Hortifresh ltd, frigoken, greenlands	Hortifresh ltd, frigoken, greenlands	
Consumer Protection and Health	AFA-HCD	L**aws & regulations** AFA-HCD		
	KEPHIS	**Testing & Analysis** KEPHIS, SGS, AgriQ	SGS, AgriQ	COFEK
		Certification SGS, Intertek, BVI, DNV	SGS, Intertek, BVI, DNV	
	AFA-HCD, KEPHIS	**Inspections** AFA-HCD, KEPHIS		
	KEBS	**Quality standards** KEBS		
Environment and sustainability (Environmental aspects)	NEMA	**Waste and pollution management** NEMA		**NGOs**
	Ministry of water and irrigation	**Climate change adaptation and mitigation** NIB, WARMA		
	KEPHIS AFA-HCD	**Inspections-on good practices** AFA-HCD, KEPHIS		
	PCPB	**Restrict/regulate**-on agro-chemicals usage		
		Certification-to ensure that good agricultural practices are followed DNV,A FRICERT	DNV,Africert	

6.3 Annex 3: Selected export data of Kenyan green bean sector

Table A3.1: Evolution of 20 top EU Agri-food imports from Sub-Saharan Africa, 2012 – 2016
Vegetables (fresh, chilled, and dried) are 10th most important EU agri-food import from Sub-Saharan Africa. In 2016 imports represented Euro 379 million.

		Imports						
		Value Mio €					%	
		2012	2013	2014	2015	2016	Share in all Agri 2016	Change 2015-2016
1	Cocoa beans	2 893	2 442	2 883	3 711	4 272	30.7	15.1
2	Cocoa paste and powder	934	1 087	1 304	1 510	1 424	10.2	-5.7
3	Tropical fruit, fresh or dried, nuts and spices	657	735	811	1 020	1 254	9.0	22.9
4	Unroasted coffee, tea in bulk & mate	1 196	981	917	1 134	1 161	8.3	2.4
5	Fruit, fresh or dried, excl. citrus & tropical fruit	793	954	947	1 028	1 015	7.3	-1.3
6	Raw tobacco	526	548	680	822	706	5.1	-14.1
7	Cut flowers and plants	608	599	651	672	673	4.8	0.1
8	Citrus fruit	435	504	460	579	631	4.5	9.0
9	Beet and cane sugar	764	822	760	596	476	3.4	-20.1
10	Vegetables, fresh, chilled and dried	327	331	370	382	379	2.7	-0.8
11	Wine, vermouth, cider and vinegar	394	429	387	396	373	2.7	-5.8
12	Preparations of vegetables, fruit or nuts	169	188	183	212	214	1.5	0.9
13	Bulbs, roots and live plants	138	145	142	133	130	0.9	-2.3
14	Gums, resins and plant extracts	90	98	84	126	128	0.9	1.6
15	Chocolate, confectionery and ice cream	22	13	29	104	116	0.8	11.5
16	Vegetable oils other than palm & olive oils	48	44	80	96	90	0.6	-6.3
17	Products non-attributable	36	68	89	67	88	0.6	31.3
18	Bovine meat, fresh, chilled and frozen	39	66	67	93	80	0.6	-14.0
19	Oilseeds, other than soyabeans	62	103	110	96	74	0.5	-22.9
20	Fruit juices	43	51	58	55	72	0.5	30.9
	Remaining Agri-food products	537	551	522	513	567	4.1	10.5

Source: AGRI-FOOD TRADE STATISTICAL FACTSHEET; European Union - Sub-Saharan Africa; EC/Directorate-General for Agriculture and Rural Development. February 2017.

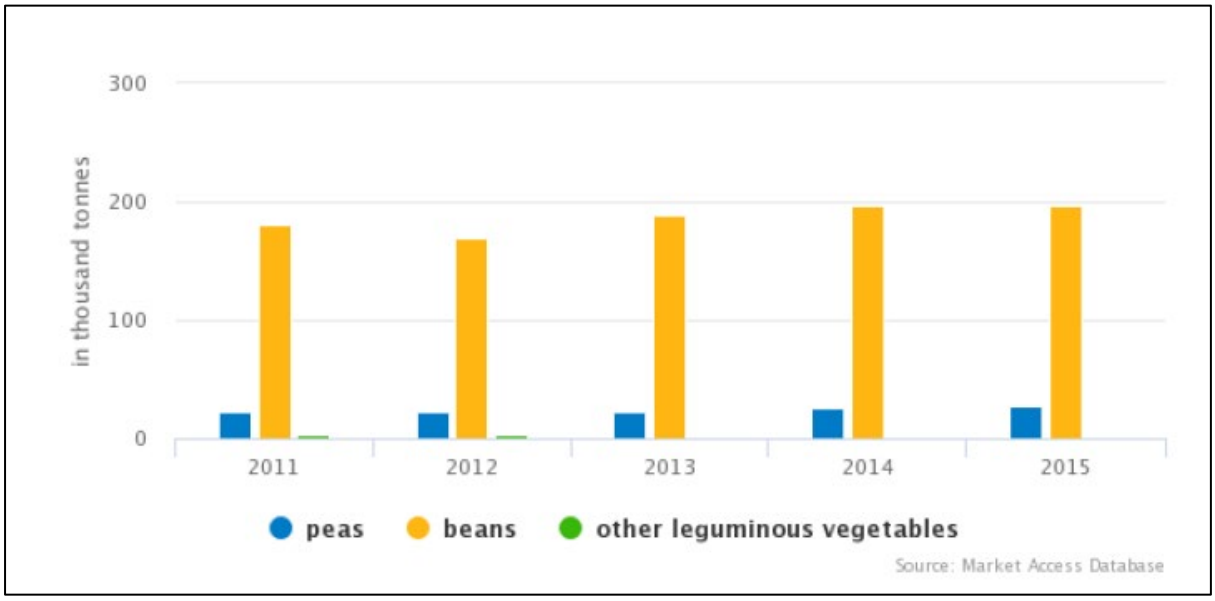


FIGURE 6.1: EUROPEAN IMPORT OF BEANS, PEAS, AND OTHER LEGUMINOUS VEGETABLES FROM DEVELOPING COUNTRIES, IN 1000 TONNES, 2011 – 2015. IN: CBI (NO DATE)

EUROPEAN IMPORTS OF FRESH BEANS AND PEAS FROM DEVELOPING COUNTRIES HAVE GRADUALLY INCREASED TO 225,000 TONNES IN 2015, ACCORDING TO CBI (NO DATE).

List of importing markets for a product exported by Kenya (in Euro thousand)
Product: 070820 Fresh or chilled beans "Vigna spp., Phaseolus spp.", shelled or unshelled

Importers	Exported value in 2012	Exported value in 2013	Exported value in 2014
World	89559	72864	57767
United Kingdom	59099	42687	30541
Netherlands	9911	11397	9689
France	8324	7313	7395
Belgium	4777	3024	2876
South Sudan	53	0	1222
United Arab Emirates	623	1102	783
Switzerland	647	816	750
Germany	2693	940	624
Hong Kong, China	617	649	582
South Africa	627	571	507
Ireland	1029	593	495
Canada	179	184	390
Pakistan	0	773	384
India	152	1132	347
Congo, Democratic Republic of the	0	157	326
Uganda	0	6	231
Somalia	25	8	101
Denmark	79	30	80
Qatar	146	129	72
Singapore	150	123	65

Norway	121	112	65
Luxembourg	23	24	59
Kuwait	26	29	37
United States of America	10	446	32
Bahrain	26	19	25
Yemen	0	71	17
Bosnia and Herzegovina	9	0	16
Italy	72	13	14
Saudi Arabia	19	27	12
Russian Federation	0	14	8
Seychelles	10	29	7
Bulgaria	0	0	4
Dominica	0	0	4
Israel	0	0	2
Nicaragua	0	0	2
Senegal	0	0	2
Djibouti	2	0	1
Ship stores and bunkers	0	1	1
Afghanistan	0	7	1
Tanzania, United Republic of	0	78	1

List of importing markets for a product exported by Kenya (in MT)

Product: 070820 Fresh or chilled beans "Vigna spp., Phaseolus spp.", shelled or unshelled

Importers	2012	2013	2014
	Exported quantity, Tons	Exported quantity, Tons	Exported quantity, Tons
World	33365	32081	30221
United Kingdom	21741	16250	12998
France	4824	4299	4249
Netherlands	3227	3641	3478
South Sudan	109	0	2337
India	230	1817	1665
Belgium	1276	1125	1175
Pakistan	0	1187	1097
Congo, Democratic Republic of the	0	320	650
United Arab Emirates	312	1049	578
Uganda	0	7	447
Germany	409	361	254
Switzerland	186	228	254
Ireland	323	192	227
Hong Kong, China	158	163	185
Somalia	11	6	182
South Africa	265	210	178
Canada	31	33	80

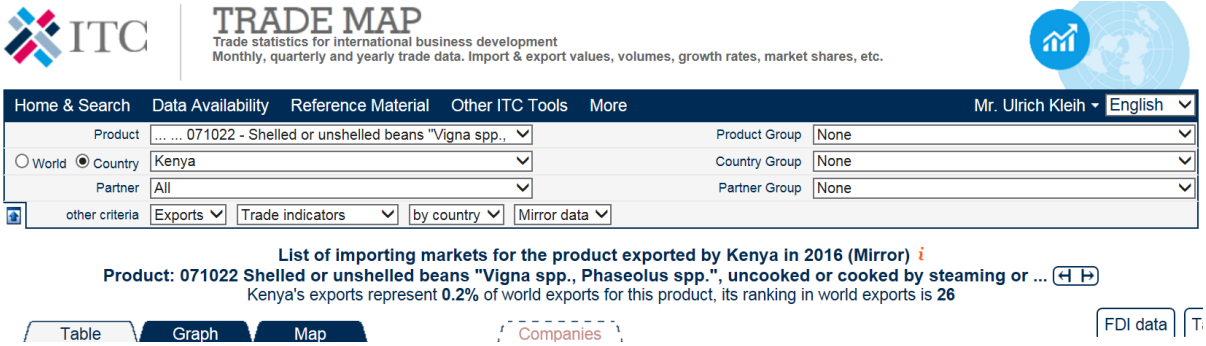
Qatar	49	44	31
Singapore	47	41	22
Yemen	0	103	20
Denmark	24	8	17
Kuwait	10	11	16
Norway	27	25	15
Luxembourg	10	10	13
Bahrain	10	7	10
Bosnia and Herzegovina	5	0	8
United States of America	5	86	7
Saudi Arabia	7	11	6
Seychelles	8	16	6
Italy	21	4	5
Russian Federation	0	3	3
Ship stores and bunkers	0	1	1
Afghanistan	0	4	1
Bulgaria	0	0	1
Dominica	0	0	1
Nicaragua	0	0	1
Tanzania, United Republic of	0	160	1

List of importing markets for a product exported by Kenya
Product: 070820 Fresh or chilled beans "Vigna spp., Phaseolus spp.", shelled or unshelled

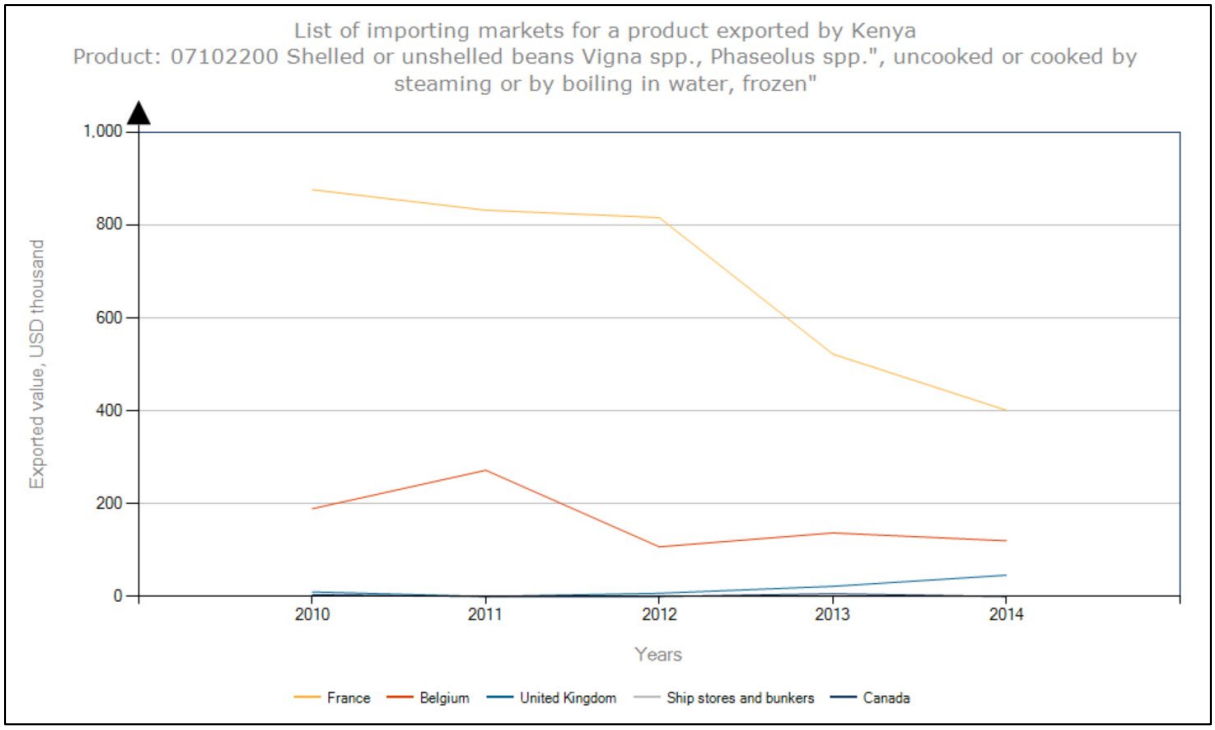
Unit : US Dollar thousand

Importers	Exported value in 2012	Exported value in 2013	Exported value in 2014
World	115180	96782	76786
United Kingdom	76006	56699	40597
Netherlands	12746	15138	12879
France	10706	9714	9830
Belgium	6144	4017	3823
South Sudan	68	0	1624
United Arab Emirates	801	1464	1041
Switzerland	832	1084	997
Germany	3464	1249	830
Hong Kong, China	793	862	774
South Africa	806	758	674
Ireland	1323	787	658
Canada	230	245	519
Pakistan	0	1027	510
India	196	1503	461
Congo, Democratic Republic of the	0	209	433
Uganda	0	8	307
Somalia	32	11	134
Denmark	102	40	106
Qatar	188	171	96
Singapore	193	164	87
Norway	155	149	86
Luxembourg	30	32	78
Kuwait	34	38	49
United States of America	13	592	42
Bahrain	33	25	33
Yemen	0	94	22
Bosnia and Herzegovina	11	0	21
Italy	92	17	18
Saudi Arabia	25	36	16
Russian Federation	0	18	10

Sources: ITC calculations based on Kenya National Bureau of Statistics
ITC calculations based on COMTRADE calculations



Bilateral trade at 8-digit	Importers	Value exported in 2016 (USD thousand) ▼	Trade balance 2016 (USD thousand)	Share in Kenya's exports (%)	Quantity exported in 2016	Quantity unit	Unit value (USD/unit)	Growth in exported value between 2012-2016 (%, p.a.)	Growth in exported quantity between 2012-2016 (%, p.a.)	Growth in exported value between 2015-2016 (%, p.a.)
	Total	829	827	100	361	Tons	2,296	-17	-31	130
⊞	France	400	400	48.3	157	Tons	2,548	-20	-20	115
⊞	United Kingdom	346	346	41.7	153	Tons	2,261		-51	497
⊞	Belgium	55	55	6.6	31	Tons	1,774	-21	-19	-25
⊞	Czech Republic	25	25	3	3	Tons	8,333	134		-22
⊞	Germany	1	1	0.1	1	Tons	1,000	-30	0	
⊞	Singapore	1	1	0.1	2	Tons	500			
⊞	Uganda	1	-1	0.1	14	Tons	71		93	

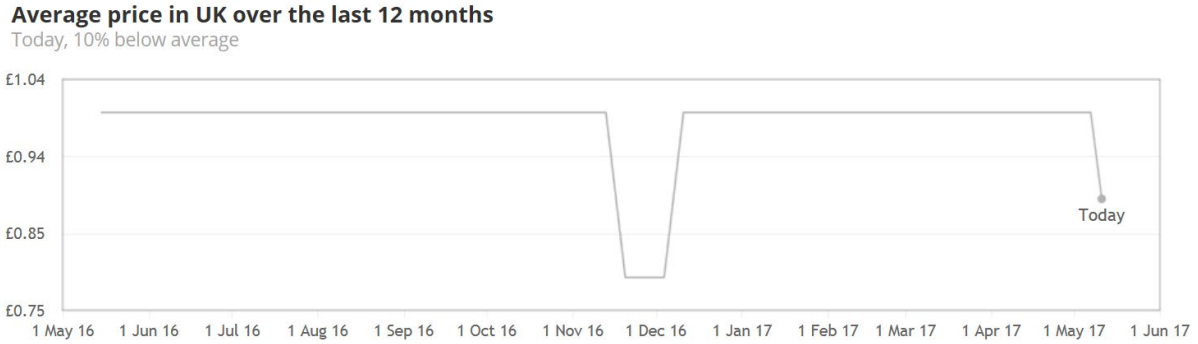

List of importing markets for a product exported by Kenya
Product: 07102200 Shelled or unshelled beans Vigna spp., Phaseolus spp.", uncooked or cooked by steaming or by boiling in water, frozen"
Exported value, USD thousand
1,000
800
600
400
200
0
2010
2011
2012
2013
2014
Years
France
Belgium
United Kingdom
Ship stores and bunkers
Canada

6.4 Annex 4: Summary of green beans retail analysis in the UK, May 2017

(all prices in GBP)

Retailer	Type of produce; price per unit	Green beans (£ per kg)			Origin
		Fresh beans	Canned	Frozen	
Sainsbury's	Fine beans, 200 gr, £1.00 per unit	5.00			Egypt, Gambia, Guatemala, Kenya, Mozambique, Senegal, Tanzania, UK
Sainsbury's	Green beans, basics, £0.80 per 200 gr	4.00			Egypt, Gambia, Guatemala, Kenya, Morocco, NL, Senegal, UK
Sainsbury's	Whole green beans, frozen, 1kg, £1.30 / unit			1.30	Belgium, UK
Sainsbury's	Whole French green beans in tin, 400 gr, £0.75 per unit		3.41		France
Tesco	Green beans, 220gr, £1/unit	4.55			UK, Egypt, Kenya, Morocco, Senegal
Tesco	Very fine whole green beans, frozen, 900gr, £1/unit			1.12	Produced in EU; Packed in UK
Tesco	Whole green beans in water, 400 gr, £0.80/unit		3.64		France
Tesco	Organic green beans, 225 gr, £1.12/unit, Offer	5.00			Egypt
ASDA	Cut/whole green beans in water; 400 gr; £0.74/unit		1.85		
ASDA	Freshly frozen whole green beans, 750gr, £0.80			1.07	
Morrisons	Fine green beans, frozen, 500 gr, £0.63/unit			1.26	
Lidl	Fresh green beans, 220gr; £0.89/unit	4.05			
Aldi	Fresh green beans, 220gr; £0.89/unit	4.05			
Ocado	Green beans, 220gr, £1/unit	4.55			

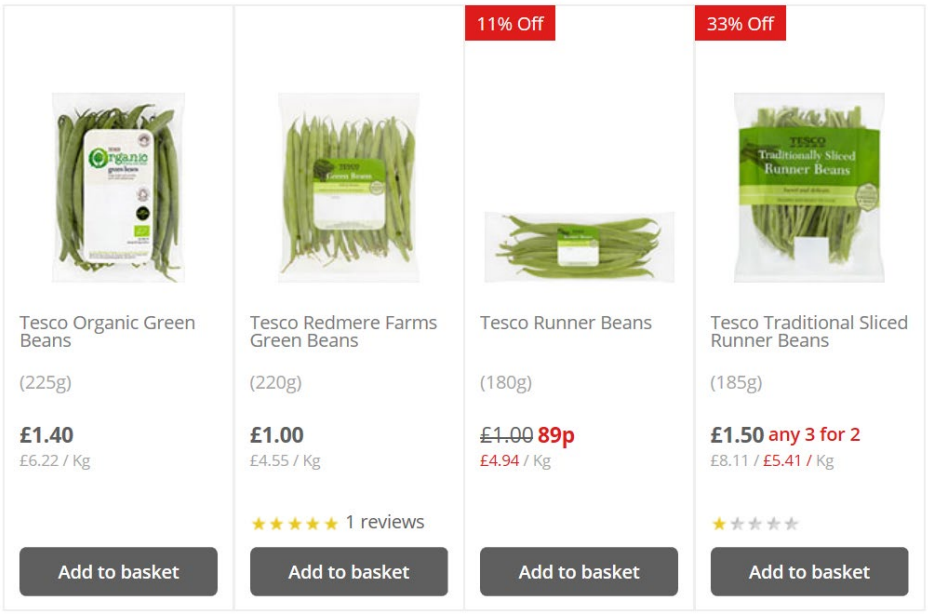
Price comparison: Fresh Green beans (£ per 200/220 gr units)



Source: https://www.mysupermarket.co.uk/lidl-price-comparison/Vegetables/Tesco_Green_Beans_220g.html (accessed: 12 May 2017)

Price comparison: Frozen Green beans (£ per 1 kg)

Fresh green beans on sale at Tesco supermarket in July 2017. Beans have been produced in countries such as Guatemala, Kenya, and United Kingdom.



Examples of green beans sold in France, Germany and the Netherlands (July 2017)

https://www.auchandirect.fr/rayons/149 (accessed: 13/07/2017)

Source: http://www.ooshop.com/courses-en-ligne/ContentNavigation.aspx?NOEUD_IDFO=24236 (Accessed: 13/07/2017)

AH Haricots verts voordeel

Prijs per KG €8,54
350 g

2.99 Voeg toe +

Haricots verts hebben delicate, zachte, typische bonen smaak. Haricot verts zijn heerlijk in verschillende roerbakschotels of Indiase currys. Ook heerlijk bij een Nederlandse maaltijd met aardappelen en vlees.

- Smaak: Haricots verts hebben delicate, zachte, typische bonen smaak.
- Bewaren: In de koelkast.

https://www.ah.nl/producten/product/wi164108/ah-haricots-verts-voordeel (accessed, 13/07/2017)

AH Haricots verts extra fijn

Prijs per KG €3,50
340 g

1.19 Voeg toe +

- Heerlijk zacht van smaak
- Direct van het land in de pot

https://www.ah.nl/producten/product/wi124522/ah-haricots-verts-extra-fijn

Green Gold Delikatessbohnen Kenianische Delikatessbohnen grün

0 Bewertungen Jetzt bewerten »

Kalorien pro 100 g: 22 Kcal / 92 kJ

0,99 bis 0,99 €

Preis pro 100 Gramm =
0,30 €

http://www.supermarktcheck.de/gruene-bohnen-konserven/produkte/
(Accessed: 07/07/2017)
Green Gold Delicates Beans from Kenya; sold in jars of about 300 grams (costing Euro 0.99)

6.5 Annex 5: Questionnaires and selected interview checklists used for study fieldwork

Questionnaire: Kenya French Bean Value Chain Analysis

Interviewer:_____ Please introduce the topic to the farmer, without raising expectations.

Location: _____ **Date:**_____ **Interviewee:** _____ **Time/season covered:** _____

Farm size (acres)	
Green bean plots size (m^2):	
Width (m)	
Length (m)	

	Tick
Beans for fresh sales	
Beans for canning	
Beans for freezing	

Buyer of green beans:
(name of company and relationship):

Questions related to farmer background:

1. Are you a member of a Self Help Group or Cooperative?
   a. If 'yes', What is it called? Then go to Qu. 2.
   b. If 'no', go to Qu. 7
2. How many members are there in your group? How many of these are men and how many are women? Then go to Qu. 3
3. How many women are on the committee? What position do they have? (i.e. Chairman, Treasurer, Secretary, etc.). Then go to Qu. 4
4. When was your group set up (year)? Then go to Qu. 5
5. Who helped you set up your group? What support did they give you? (looking for anything from inputs to training on group governance or accounts, etc) Then go to Qu. 6.
6. How often do you meet? Then go to Qu. 7

7. Who do you sell your French Beans to? Name……. Then go to Qu. 8
8. Do you have a written contract for this?
   a. If 'yes', has it been approved by HDC?
      i. If approved, go to Qu. 9
      ii. If not approved, why? Then go to Qu. 9
   b. If 'no', go to Qu. 9
9. What form of contract do you have? Describe. Then go to Qu. 10

10. Are you a member of a Union or similar (e.g. Employers Association)?
    a. If 'yes', please name & purpose. Then go to Qu. 11
    b. If 'no', please go to Qu. 11

11. Do you hire in labour to help with FB production?
    a. If 'yes', for what reason do you need it? Then go to Qu. 12
       i. How many people do you hire?
       ii. Where do they come from?
       iii. How many are men, and how many are women?
    b. If 'no', who does these jobs: Then go to Qu. 12
       i. Preparing ground/ploughing
       ii. Manuring
       iii. Sowing
       iv. Fertilizing
       v. Irrigation
       vi. Pesticide
       vii. Weeding
       viii. Harvesting
       ix. Transporting to collection point

12. (**particularly for large and commercial farmers**) How much of your farm do you own yourself (No. acres/ha)?
    How much of your farm do you rent/lease (No. acres/ha)?
    a. How did you acquire it?
       i. Inheritance
       ii. Bought from a family member
       iii. Bought from someone other than family – specify
       iv. Rented to/from a family member
       v. Rented to/from someone other than family – specify
       vi. Other?
    b. If rented/leased, on what basis is the agreement made (i.e. formal contract, traditional agreement, etc…)

Data collection form for French bean production operations (in KSh per acre or per plot. Please indicate)

	Operations	Labour requirements				Input requirements				Mode of operation			Comments on data quality			Notes
	(from first to last)	Pers-days	Fam/Hired	Cost/day	Total costs	Quantity	Units	Cost/unit	Total costs	Material or machine used	energy use (fuel or electricity)	units for energy use (e.g. l fuel/hour or total l of fuel)	actual records from farmer	estimate from farmer	guess from interviewer	
1	Land preparation I				-				-							
2	Land preparation II				-				-							
3	Planting (plus fert application)				-				-							
					-				-							
4	Transport of inputs from market															
5	Composting (transport of material)				-				-							
6	Composting (application of materials)				-				-							
7	Fertilizer application															
8	Irrigation				-				-							
	water volume															
	water origin															
9	Chemicals application				-				-							
	(Herbicide, pesticide, fungicide)															
10	Weeding															
									-							
11	Harvesting								-							
12	Transport to market/collection centre								-							
	Other															
	Other				-				-							
	Sum labour inputs - days & costs					**Sum input costs**			-							

Data collection form, continued

Information regarding French beans field and soil

Type of soil	
Slope of plot	
Depth of drainage system	
Irrigation system	
Tillage type	

Information regarding French beans harvest

Harvest date:	
Units:	
Total harvest (kg)	
Rejects (%, following sorting/grading)	
Weight sold (kg)	
Price per kg (KSh):	
Market tax (per box, KSh)	
Net price (per kg or box, KSh)	
Gross income (KSh)	
Net income (KSh) after costs	
Harvest, kg per plot	
Harvest, kg per hectare (converted)	

Other information:
including general comments from farmer

Comments from interviewer:

Interviewer: Please thank farmer for time and information given !

Questionnaire: Packhouse / factory information for LCA

Type of activity:

		yes	no
Packhouse	Sorting and packing fresh French beans (FB)		
Factory	Sorting and canning FB		
Factory	Sorting and freezing FB		
Factory	Sorting, canning or freezing FB		
Additional cold room	Refrigerated storage of produce		

Name of studied packhouse/factory:
Location:
Period or year of reference:

Products and wastes

Products received	Units	Fresh FB	Fresh carrot	Fresh baby	Fresh broco	Fresh etc...
Quantities of products received	tonnes?					
Products processed		Packed fres	Canned FB	Frozen FB	Frozen mixe	Others...
Quantities of products processed						
Rejects and wastes						
Rejects > local market						
Rejects > animal feed						
Rejects > compost						
Rejects > others						

Water use

	Unit	!017 (or else?)
Total water used		
origin of water (river, dam, well...)		

Energy use

	Unit	!017 (or else?)
Total electricity from the Kenyan grid	kWh	
Total fuel consumed (including for electricity generator)	**L** **Kg**	

DIESEL
0.84 kg/L

Packaging

Name of package	Composition	Suppliers	Weight per unit	Quantity of produce per package	Total quantity	Used for FB
Big plastic crates						
Plastic bannets						
Loose plastic bags						
Wok type platic boxes						
Plastic film						
Glass jars						
Lids						
Cans						
Big carboard boxes						
Carboard boxes						
Carboard tray						
White ribbon						
Pallets						
Others						

Infrastructure

Total area of building		**ha**

Questionnaire: Transport information for LCA

Transportation of fresh french beans up to UK airport

	Journey	Distance (km)	Transportation mode	Average load in tonnes of produce	if available, fuel consumption in litres
	Farm -> Packhouse				
	Packhouse -> Nairobi Airport				
	Nairobi Airport -> London Airport	6750.21	Cargo plane		

Transportation of french beans and processed beans to UK Sea port

	Journey	Distance (km)	Transportation mode	Average load in tonnes of produce	if available, fuel consumption in litres
	Farm -> Factory				
	Factory -> Mombasa port				
	Mombasa port -> London port	11523.14	frigerated sl	-	-

Thank you for adding any transportation stage missing here.

Data collection form for French bean processing operations (in KSh per kg. Please indicate)

	Operations	Input requirements				Comments on data quality			Notes
	(from first to last)	Quantity	Units	Unit cost	Total costs	actual records from company	estimate from company	guess from interviewer	
1					-				
2					-				
3					-				
4					-				
5					-				
6					-				
7					-				
8					-				
9					-				
10					-				
11					-				
12					-				
13					-				
14					-				
15					-				
16					-				
17					-				
18					-				
19					-				
20					-				
					-				
					-				
					-				
	Sum input costs				**-**				

Sales and revenue calculations

		Quantity	Units	Sales price	Sum revenue	Comments on data quality			
	Sales 1								
	Sales2								
	Sales 3								
	Total revenue				**-**				
	Costs				**-**				
	Profit margin before tax				**-**				
	Taxes								
	Proft margin after tax				**-**				

Other commenbts

e.g. losses
worker ratios (permanent, temporary, male, female)
etc

Data collection form for French bean trading operations (in KSh per kg. Please indicate)

	Operations	Input requirements				Comments on data quality			Notes
	(from first to last)	Quantity	Units	Unit cost	Total costs	actual records from company	estimate from company	guess from interviewer	
1	Purchase of green beans	200	kg	15	3,000				
2	transport (airport to market)	2	bags	150	300				
3	Council market fee	2	bags	80	160				
4	Packaging	2	plastic bags	80	160				
5	Market space, fee	1	daily fee	40	40				
6	Porterage	2	bags	30	60				
7					-				
8					-				
9					-				
10					-				
11					-				
12					-				
13					-				
14					-				
15					-				
16					-				
17					-				
18					-				
19					-				
20					-				
					-				
					-				
					-				
	Sum input costs				**3,720**				

Sales and revenue calculations

		Quantity	Units	Sales price	Sum revenue	Comments on data quality			
	Sales 1	**190**	**kg**	**25**	**4,750**				
	Sales2								
	Sales 3								
	Total revenue				**4,750**				
	Costs				**3,720**				
	Profit margin before tax				**1,030**				
	Taxes				**-**				
	Proft margin after tax				**1,030**				

Other commenbts

e.g. losses
worker ratios (permanent, temporary, male, female)
etc

estimated at 5%

6.6 Annex 6: History of horticultural exports from Kenya (USAID/DAI, 2012)

A. 1930's -1950's

The first significant horticultural export from Kenya was passionfruit juice in the 1930's and Kenya was a major exporter of temperate vegetables such as carrots, cabbages and tomato to the UK, during the Second World War. During the 1950s a pineapple plantation and canning industry was first established and during this time the first air freighted exports of fresh horticultural produce began intermittently to Aden to supply the needs of the oil companies expanding operations in the Middle East. In the late 1950's the first air shipments of high value fresh produce to the U.K. were made and directed to high-class stores and hotels in the winter off-season for temperate produce. These air freighted exports were pioneered by the Horticultural Cooperative Union (HCU) which had been created to provide marketing services for European growers in Kenya and to import a range of commodities into Kenya. However, shipment volume and regularity were tightly constrained by the lack of air freight space, and until the end of the colonial period, horticultural exports were dominated by canned pineapple.

B. 1960's -1970s

The decade following Kenya's independence in 1963 witnessed a substantial diversification in horticultural exports. In 1964 a vegetable dehydration plant was established at Lake Naivasha which exported almost its whole production and served as an important market outlet production by local growers. From the mid-1960s a number of large growers and wholesalers of fruits and vegetables followed the initiative of the HCU and began exporting fresh produce, mainly to the U.K. These export commodities were mostly off-season vegetables such as French beans, capsicums and courgettes. A number of Kenyan Asian and African farmers were encouraged to grow a range of Asian vegetables for export to the UK in order to satisfy the demand created by that country's growing immigrant population, mostly from South Asia.

The pineapple canning industry came to be dominated by Del Monte in the early 1970's, first through a management contract and later through a majority ownership of Kenya Canners Ltd. However, growth in canned products was poor and occasionally negative. It was not until the latter part of the 1970's that Kenya emerged as a major world supplier of canned pineapple products.

The Horticultural Crops Development Authority (HCDA) first was formed in 1967 with a wide legal authority to support and regulate the horticultural trade and to engage directly in trade itself. Soon after, in 1969, a Danish firm set up production of flowers near Lake Naivasha for air-freighted export to Europe but initial export volume was low and did not become significant until the early 1970"s when air cargo space increased. This increase in air cargo space combined with major expansion in horticultural production led to a rapid expansion of fresh produce exports. The number of smallholders supplying large growers or exporters expanded rapidly and a great many new exporters entered the arena. On the back of this enthusiasm and from market indications in Europe and the Middle East smallholdings increased plantings of mango and avocado.

C. 1980"s

By 1980 the flower export, industry had grown in importance to assume a major share of foreign exchange earnings; but the exports of off-season capsicums, aubergines and courgettes were rapidly losing market share in Europe to new competitors who had extended their harvest season in southern Europe and in West Africa. Cheaper air or sea transportation allowed these competitors to seriously undercut the price of the Kenyan airfreighted produce. In response, the Kenyan exporters concentrated expanding French bean and Asian vegetable exports in which Kenya had a clear edge in quality and productivity by virtue of climate.

Independent research and development by the large flower exporters allowed them to retain their edge in exports through improved productivity and the regular introduction of newer varieties, mostly from their own breeding schemes. But while fruit and vegetable export industry required
relatively little in the way of capital investment, and thus attracted participation by large numbers of small entrepreneurs, the same could not be said of the flower industry. Here the investment in capital intensive technology had now become mandatory for success and the pattern of very few large and highly-integrated operations wholly dominating the cutflower export industry was set. As will be seen later, this pattern is, if anything, more permanent than ever.

Beginning in 1980, growth in fresh produce exports continued to expand steadily and peaked sharply in 1988 as a result of large volume exports of fresh pineapples to Italy. Encouraged by this steady growth, the Government of Kenya forecast further expansion in export volumes and foreign exchange earnings. However, this pineapple market was not sustained in 1989 and for the

last several years fresh produce exports have been flat at just below 50,000 tons. The probable reasons for the recent plateau of export volume are discussed later in this survey, but whatever the causes it is the likely consequences which are most important.

D. 1990's -Outlook

The recent levelling off of fresh produce export volume will adversely affect employment prospects. In addition, the switch by many of the larger exporters to lower volume but higher value commodities, such as pre-pack beans and more exotic flower lines, may have a further negative influence on employment. While some additional employment may be gained from the relatively immature but growing horticultural processing industries, Kenya must aggressively protect its existing market share while laying the foundation for growth if it is to enjoy improved employment prospects and foreign exchange earnings from its horticultural industry.

6.7 Annex 7: Euro/Kenyan Shilling Exchange rate

(Source: http://www.xe.com/currencycharts/?from=EUR&to=KES&view=10Y (accessed: 04/08/2017)

6.8 Annex 8: Selected maps of Kenya

Map of Kenya

Administrative map of Kenya indicating Counties


Turkana
Marsabit
Mandera
Wajir
West Pokot
Samburu
Trans Nzoia
Isiolo
Elgeyo Marakwet
Bungoma
Baringo
Uasin Gishu
Busia
Laikipia
Kakamega
Meru
Nandi
Vihiga
Siaya
Tharaka Nithi
Kisumu
Garissa
Kericho
Nyandarua
Nyeri
Nakuru
Kirinyaga
Homabay
Embu
Nyamira
Bomet
Kisii
Muranga
Migori
Kiambu
Narok
Nairobi
Machakos
Kitui
Tana River
Makueni
Lamu
Kajiado
Kilifi
Taita Taveta
Mombasa
Kwale

6.9 Annex 9: Breakdown of Intermediate Goods and Services (IGS) and Depreciation cost elements

Breakdown of Intermediate Goods and Services (production)

Costs (KES)	IGS Imports	IGS local	Land value	Labour value	Finance charg	Taxes/Dues	Subsidies	Gross Profit
Land preparation 1 - ploughing, diesel	49.5%	2.0%	0.0%	2.0%	5.0%	33.4%	0.0%	8.1%
Land preparation 2 - ripping, diesel	49.5%	2.0%	0.0%	2.0%	5.0%	33.4%	0.0%	8.1%
land preparation 3 - harrowing, diesel	49.5%	2.0%	0.0%	2.0%	5.0%	33.4%	0.0%	8.1%
Land preparation 4 - bed making, diesel	49.5%	2.0%	0.0%	2.0%	5.0%	33.4%	0.0%	8.1%
Transport of inputs, motorbike	40.0%	3.0%	0.0%	30.0%	5.0%	7.0%	0.0%	15.0%
Composting - compost	5.0%	10.0%	0.0%	47.0%	6.0%	7.0%	0.0%	25.0%
Planting - seed	50.0%	3.0%	0.0%	10.0%	5.0%	7.0%	0.0%	25.0%
Irrigation 1, electricity	35.0%	10.0%	1.0%	14.0%	5.0%	35.0%	0.0%	0.0%
Irrigation 2, petrol	45.5%	2.0%	0.0%	2.0%	5.0%	39.2%	0.0%	6.3%
Fertiliser 1 (during planting)	35.0%	10.0%	0.0%	20.0%	6.0%	7.0%	0.0%	22.0%
Fertiliser 2 (3rd week)	35.0%	10.0%	0.0%	20.0%	6.0%	7.0%	0.0%	22.0%
Fertiliser 3 (6th week)	35.0%	10.0%	0.0%	20.0%	6.0%	7.0%	0.0%	22.0%
Foliar fertiliser appl 1, vegetative	35.0%	10.0%	0.0%	20.0%	6.0%	7.0%	0.0%	22.0%
Foliar fertiliser appl 2, flowering	35.0%	10.0%	0.0%	20.0%	6.0%	7.0%	0.0%	22.0%
Chemical 1 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 2 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 3 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 4 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 5 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 6 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Chemical 7 (pesticides, etc)	55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%
Transport from field to sorting, motorbike	40.0%	3.0%	0.0%	30.0%	5.0%	7.0%	0.0%	15.0%
Transport from field to sorting shed, petrol	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Transport of beans from farm to factory	30.0%	3.0%	0.0%	25.0%	5.0%	25.0%	0.0%	12.0%
Certification costs (GlobalGAP)	50.0%	3.0%	0.0%	20.0%	5.0%	7.0%	0.0%	15.0%
Other Intermediate Goods and Services	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Break-down of intermediate goods and services (processing)

	Costs (KES)	IGS Imports	IGS local	Land value	Labour value	Financial char	Taxes/Dues	Subsidies	Gross Profit	Sum
Cost of green beans / raw material			not taken into account for value addition calculations to avoid double counting							0.00%
Export license							100%			100.00%
Nairobi City Council license							100%			100.00%
Health license							100%			100.00%
HCD cess							100%			100.00%
KEPHIS Inspection fees							100%			100.00%
Membership COLEACP							100%			100.00%
Membership FPEAK							100%			100.00%
BRC packhouse certification		75%			25%					100.00%
BRC preparation			10%		70%	5%			15%	100.00%
GlobalGAP (production costs)										0.00%
Staff training (e.g. IT training)					100%					100.00%
Energy (electricity)		35.0%	10.0%	1.0%	14.0%	5.0%	35.0%	0.0%	0.0%	100.00%
Fuel - diesel (e.g. back-up generator)		49.5%	2.0%	0.0%	2.0%	5.0%	33.4%	0.0%	8.1%	100.00%
Toll (at the airport)							100%			100.00%
Water consumption		10%	50%		15%	5%	10%		10%	100.00%
Packaging, fresh exports 1 (type: cartons)		40.0%	10.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
Packaging, fresh exports (type: punnets)		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Packaging, fresh exports (type: cling film)		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Packaging, fresh exports (strapping roles)		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Packaging, canning (type: jars)		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Packaging, canning (type: cans)		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Packaging, canning (type: caps)		40.0%	10.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
Building (rental cost)		10%	20%	5%	35%	5%	10%		15%	100.00%
Coats, protective clothing		10%	20%		40%	5%	10%		15%	100.00%
Maintenance of cold room		10%	10%		50%	5%	10%		15%	100.00%
Wrapper		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Sealing machines		55.0%	3.0%	0.0%	4.0%	6.0%	7.0%	0.0%	25.0%	100.00%
Knives			20%		50%	5%	10%		15%	100.00%
Crates		40.0%	10.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
Stationary		10%	20%		40%	5%	10%		15%	100.00%
Detergents, sterilisers,		10%	20%		40%	5%	10%		15%	100.00%
Tea, lunch			25%		50%		10%		15%	100.00%

Breakdown of Intermediate Goods and Services (Trading)

	Costs (KES)	IGS Imports	IGS local	Land value	Labour value	Financial char	Taxes/Dues	Subsidies	Gross Profit	
Cost of green beans			not taken into account for value addition calculations to avoid double counting							
Transport		35.0%	10.0%		15.0%	5.0%	20.0%		15.0%	100.00%
Cost of packaging		40.0%	10.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
Other		20.0%	30.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
Other		20.0%	30.0%		20.0%	5.0%	10.0%	0.0%	15.0%	100.00%
	Nb. Value of subsidies to be filled in with a minus sign									

6.10 Annex 10: Value addition created by green beans production, processing, and trading enterprises

Production

Total value addition created by a large farm (1 ha) producing for the canning industry

		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 1)	KES/ha	**56,376**	**8,470**	**292**	**17,299**	**7,055**	**20,496**	-	**22,341**	
		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Depreciatio	Net Profit
Option 1: Total of value addition, depreciation and net prof	KES/ha	**56,376**	**8,470**	**1,938**	**165,528**	**22,425**	**20,496**	-	**46,900.0**	**177,866**

Total value addition created by a large farm (1 ha) producing for the export industry of fresh beans

		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 2)	KES/ha	**111,901**	**12,373**	-	**29,158**	**13,213**	**16,929**	-	**58,267**	
		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Depreciatio	Net Profit
Option 2: Total of value addition, depreciation and net prof	KES/ha	**111,901**	**12,373**	**1,647**	**189,368**	**23,213**	**16,929**	-	**76,900**	**87,670**

Total value addition created by a smallholder farm (1 ha, aggregated) producing for the export industry of fresh beans, contracted

		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 3)	KES/ha	**50,623**	**7,642**	**100**	**22,102**	**6,808**	**11,582**	-	**26,603**	
		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Depreciatio	Net Profit
Option 3: Total of value addition, depreciation and net prof	KES/ha	**50,623**	**7,642**	**8,333**	**173,977**	**6,808**	**11,582**	-	**12,500**	**328,535**

Total value addition created by a smallholder farm (1 ha, aggregated) producing for the export industry of fresh beans, without links (scattered)

		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 4)	(KES/ha)	**25,617**	**4,731**	**100**	**14,202**	**3,804**	**7,682**	-	**13,604**	
		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Depreciatio	Net Profit
Option 4: Total of value addition, depreciation and net prof	(KES/ha)	**25,617**	**4,731**	**8,333**	**136,077**	**3,804**	**7,682**	-	**6,250**	**77,506**

Total value addition created by a smallholder farm (1 ha, aggregated) producing for the canning industry of fresh beans, contracted

		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 5)	**(KES/ha)**	**55,318**	**8,957**	**100**	**29,952**	**7,932**	**13,017**	-	**30,676**	
		IGS Imports	IGS local	Land value	Labour valu	Financial ch	Taxes/Dues	Subsidies	Depreciatio	Net Profit
Option 5: Total of value addition, depreciation and net prof	**(KES/ha)**	**55,318**	**8,957**	**8,333**	**95,890**	**7,932**	**13,017**	-	**25,000**	**285,555**

Processing

Total value addition created by a packhouse producing for export (Capacity 100 MT of raw material per month)

		IGS Imports	IGS local	Land value	Labour value	Financial charges	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 1)	KES p.a.	**15,643,398**	**2,665,630**	**175,500**	**5,528,810**	**1,861,937**	**4,919,503**	-	**6,142,446**	
		IGS Imports	IGS local	Land value	Labour value	Financial charges	Taxes/Dues	Subsidies	Depreciation	Net Profit
Option 1: Totals of value addition, depreciation and net prc	KES p.a.	**15,643,398**	**2,665,630**	**175,500**	**20,608,310**	**7,861,937**	**5,932,003**	-	**4,022,400**	**58,290,822**

Total value addition created by a canning factory producing for export (Capacity 100 MT of raw material per month)

		IGS Imports	IGS local	Land value	Labour value	Financial charges	Taxes/Dues	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 2)	KES p.a.	**41,491,844**	**10,119,823**	**1,235,003**	**15,769,202**	**5,719,716**	**10,803,947**	-	**20,035,172**	
		IGS Imports	IGS local	Land value	Labour value	Financial charges	Taxes/Dues	Subsidies	Depreciation	Net Profit
Option 2: Totals of value addition, depreciation and net prc	KES p.a.	**41,491,844**	**10,119,823**	**1,235,003**	**38,388,452**	**32,136,219**	**7,764,359**	-	**12,000,000**	**25,009,365**

Trading

Value addition by green bean brokering company (KES p.a.)

		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Gross Profit	
Sum of value addition (IGS, Option 1)	KES p.a.	**228,000**	**64,000**	-	**100,000**	**32,000**	**120,000**	-	**96,000**	
		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Depreciation	Net Profit
Option 1: Totals of value addition, including net profit	KES p.a.	**228,000**	**64,000**	-	**260,000**	**32,000**	**136,000**	-	0	**880,000**

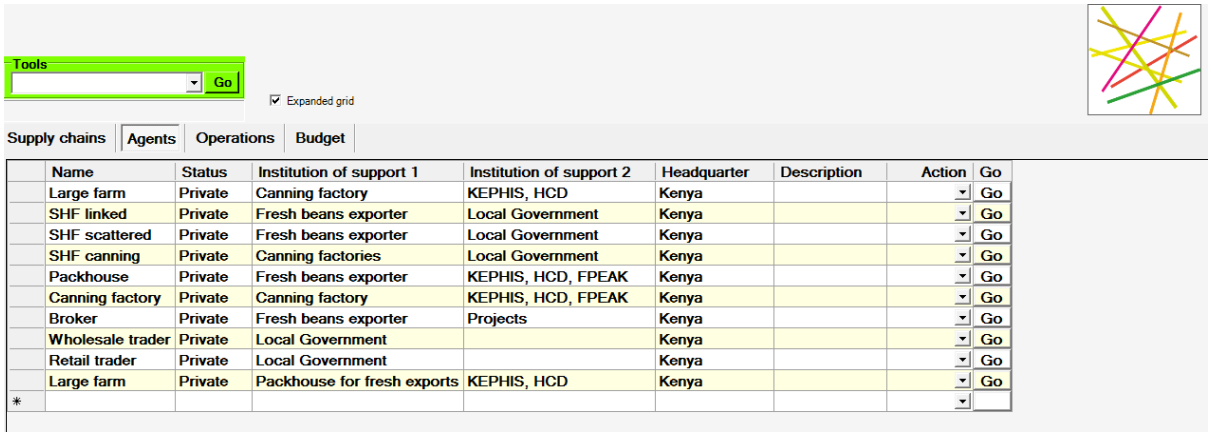
Value addition by green bean wholesaler (KES p.a.)

		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Gross Profit	
Sum of value addition (IGS and depreciation, Option 2)	KES p.a.	**20,280**	**5,520**	-	**9,240**	**2,760**	**9,120**	-	**8,280**	
		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Depreciation	Net Profit
Option 2: Totals of value addition, including net profit	KES p.a.	**20,280**	**5,520**	-	**16,440**	**2,760**	**33,120**	-	**0**	**245,880**

Value addition by green bean retailer (KES p.a.)

		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Gross Profit	
Sum of value addition (IGS and depreciation, Option 2)	KES p.a.	**12,900**	**3,600**	-	**5,700**	**1,800**	**6,600**	-	**5,400**	
		IGS Imports	IGS local	Land value	Labour value	Financial cl	Taxes/Due	Subsidies	Depreciation	Net Profit
Option 3: Totals of value addition, including net profit	KES p.a.	**12,900**	**3,600**	-	**14,700**	**1,800**	**21,600**	-	**0**	**30,900**

6.11 Annex 11: Calculation of VC agents' operational budgets using AgriFood chain Analysis (AFA) software



	Name	Status	Institution of support 1	Institution of support 2	Headquarter	Description	Action	Go
	Large farm	Private	Canning factory	KEPHIS, HCD	Kenya			Go
	SHF linked	Private	Fresh beans exporter	Local Government	Kenya			Go
	SHF scattered	Private	Fresh beans exporter	Local Government	Kenya			Go
	SHF canning	Private	Canning factories	Local Government	Kenya			Go
	Packhouse	Private	Fresh beans exporter	KEPHIS, HCD, FPEAK	Kenya			Go
	Canning factory	Private	Canning factory	KEPHIS, HCD, FPEAK	Kenya			Go
	Broker	Private	Fresh beans exporter	Projects	Kenya			Go
	Wholesale trader	Private	Local Government		Kenya			Go
	Retail trader	Private	Local Government		Kenya			Go
	Large farm	Private	Packhouse for fresh exports	KEPHIS, HCD	Kenya			Go
*								

The following budgets are for individual companies representing the above agent categories.

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Large farm

Operation : Large farm, canning Practice : mechanised Location : Kenya Descriptive 2 :Well Off
Short name : LFC Function : Primary production Reference Space : Rural Descriptive 1 : Male

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans	10,000.00 Kilogr	45 EUR	0		EUR			
Subsidy									
Consumable	Bed making, diesel	10.00 Liter	90 KES			KES	1.00		
	Cert costs (Global	1.00 Unitairy	5000 KES			KES	1.00		
	Chemical 1 (Labdex	0.50 Liter	2200 KES			KES	1.00		
	Chemical 2 (Dithan	0.33 Kilogram	950 KES			KES	1.00		
	Chemical 3 (Thunde	0.50 Liter	4800 KES			KES	1.00		
	Chemical 4 (Dacon	0.60 Liter	1560 KES			KES	1.00		
	Chemical 5 (Champ	0.83 Kilogram	1200 KES			KES	1.00		
	Chemical 6 (Proof i	0.20 Liter	5500 KES			KES	1.00		
	Chemical 7 (Liquico	0.20 Liter	5000 KES			KES	1.00		
	Compost	0.00	0 KES			KES	1.00		
	Fertiliser 1 (DAP)	150.00 Kilogram	60 KES			KES	1.00		
	Fertiliser 2 (NPK; 23	150.00 Kilogram	56 KES			KES	1.00		
	Fertiliser 3 (NPK; 17	150.00 Kilogram	56 KES			KES	1.00		
	Foliar 1	5,400.00 Unitairy	1 KES			KES	1.00		
	Foliar 2	5,400.00 Unitairy	1 KES			KES	1.00		
	Harrowing, diesel	10.00 Liter	90 KES			KES	1.00		
	Inputs trans, petrol	0.00	0 KES			KES	1.00		
	Irrigation 1, energy	29,166.70 Unitair	1 KES			KES	1.00		
	Irrigation 2, energy	5,833.30 Unitairy	1 KES			KES	1.00		
	Other IGS	0.00	0			KES	1.00		
	Ploughing, diesel	20.00 Liter	90 KES			KES	1.00		
	Ripping, diesel	10.00 Liter	90 KES			KES	1.00		
	Seed	50.00 Kilogram	880 KES			KES	1.00		
	Tr petrol, field to sh	0.00 Unitairy	1 KES			KES	1.00		
	Tr rent, field to she	0.00 Unitairy	1 KES			KES	1.00		
	Tr, farm to factory	0.00 Unitairy	1 KES			KES	1.00		
Service									
Salary	Total wage	148,229.30 Unita	1 KES			148229 KES	1.00		
Financial Cost									

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 Country :Kenya Curency :KES Year : 2,017

Amortization	Tractors		1.00 KES	18,100.00 KES	
	Irrigation (pivot)		1.00 KES	28,800.00 KES	
Taxes					

AGGREGATES AND INDICATORS OF THE OPERATION

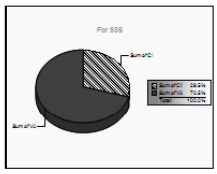
Resources

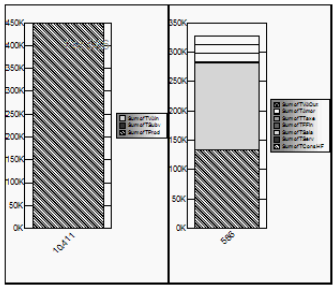
Production	450000
Subsidy	0

Uses

Consumable	132952
Service	0
Salary	148229
Financial Cost	0
Taxe	0
VAT to be repaid	0
VAT to be collected	0
Amortization	46900

Total Resource	450000
Total Uses	328082
Total Intermediate Consumption	132952
Value added	317048
Net operating surplus	121918





Indicators

Subsidy / TR =0.00
VA / TR =0.70
Salary / VA =0.47
Frais Financiers / VA =0.00

Taxe / VA =0.00
Amortization / VA =0.15
Ene / VA =0.38

ENE/Total expenses =0.62
Consumable/TR =0.30
Service/TR =0.00

Salary/TR =0.33
Frais Financier/TR=0.00

Amortization/TR=0.10
ENE/TR =0.27

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Large farm

Operation : Large farm, fresh ex | Practice : Mechanised | Location : Kenya | Descriptive 2 :Well Off
Short name : LFF | Function : Primary production | Reference Space : Rural | Descriptive 1 : Male

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans	8,000.00 Kilogra	55 KES	0		KES			
Subsidy									
Consumable	Chem 1 (Metalaxyl-	0.10 Kilogram	8200 KES			KES	1.00	AAA	
	Chem 10 (Lambda-	0.35 Liter	2058 KES			KES	1.00	AAA	
	Chem 11 (Spinosad	0.20 Liter	41000 KES			KES	1.00	AAA	
	Chem 12 (Deltametl	1.00 Liter	1200 KES			KES	1.00	AAA	
	Chem 13 (Calcium+	3.00 Liter	242 KES			KES	1.00	AAA	
	Chem 14 (Beuveria	0.50 Kilogram	7200 KES			KES	1.00	AAA	
	Chem 15 (Thiocycla	0.50 Kilogram	4800 KES			KES	1.00	AAA	
	Chem 2 (Imidaclopr	0.29 Liter	10278 KES			KES	1.00	AAA	
	Chem 3 (Propineb)	2.50 Kilogram	1300 KES			KES	1.00	AAA	
	Chem 4 (S-Metolacl	1.60 Liter	2300 KES			KES	1.00	AAA	
	Chem 5 (Buprofezin	0.50 Liter	4000 KES			KES	1.00	AAA	
	Chem 6 (Mancoceb	2.50 Kilogram	550 KES			KES	1.00	AAA	
	Chem 7 (Difenocon	0.50 Liter	5200 KES			KES	1.00	AAA	
	Chem 8 (Acetamipr	0.25 Liter	2800 KES			KES	1.00	AAA	
	Chem 9 (Difenocon	0.50 Liter	9450 KES			KES	1.00	AAA	
	Fert 1 (DAP)	200.00 Kilogram	48 KES			KES	1.00	AAA	
	Fert 10 (Borax)	5.00 Kilogram	128 KES			KES	1.00	AAA	
	Fert 11 (Earthlee)	6.00 Kilogram	3360 KES			KES	1.00	AAA	
	Fert 12 (ZnSo4)	10.00 Kilogram	116 KES			KES	1.00	AAA	
	Fert 2 (NPK)	100.00 Kilogram	52 KES			KES	1.00	AAA	
	Fert 3 (CaNo3)	150.00 Kilogram	36 KES			KES	1.00	AAA	
	Fert 4 (MPK)	30.00 Kilogram	48 KES			KES	1.00	AAA	
	Fert 5 (MgSo4)	100.00 Kilogram	26 KES			KES	1.00	AAA	
	Fert 6 (K2So4)	200.00 Kilogram	95 KES			KES	1.00	AAA	
	Fert 7 (CuSo4)	5.00 Kilogram	418 KES			KES	1.00	AAA	
	Fert 8 (CAN)	150.00 Kilogram	34 KES			KES	1.00	AAA	
	Fert 9 (NHSo4)	20.00 Kilogram	36 KES			KES	1.00	AAA	
	Seed	665,500.00 Unita	0 KES			KES	1.00	AAA	
Service									

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Salary	Land preparation -	1.00 Day	5000 KES	5000 KES	1.00	
	Land preparation -	2.00 Day	370 KES	740 KES	1.00	
	Raising the bed	18.00 Day	270 KES	4860 KES	1.00	
	Planting	52.00 Day	270 KES	14040 KES	1.00	
	Transport of inputs	2.00 Day	500 KES	1000 KES	1.00	
	Composting (transp	2.00 Day	270 KES	540 KES	1.00	
	Composting (applic	2.00 Day	270 KES	540 KES	1.00	
	Fertiliser applicatio	32.00 Day	270 KES	8640 KES	1.00	
	Irrigation	30.00 Day	270 KES	8100 KES	1.00	
	Chemicals applicati	15.00 Day	3510 KES	52650 KES	1.00	
	Weeding (1st and 2	30.00 Day	270 KES	8100 KES	1.00	
	Harvesting	200.00 Day	270 KES	54000 KES	1.00	
	Transport of worker	4.00 Day	500 KES	2000 KES	1.00	
Financial Cost						
Amortization						
Taxes						

AGGREGATES AND INDICATORS OF THE OPERATION

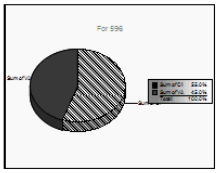
Resources

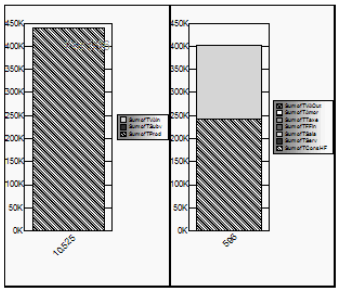
Production	440000
Subsidy	0

Uses

Consumable	241840
Service	0
Salary	160210
Financial Cost	0
Taxe	0
VAT to be repaid	0
VAT to be collected	0
Amortization	0

Total Resource	440000
Total Uses	402050
Total Intermediate Consumption	241840
Value added	198160
Net operating surplus	37950





Indicators

Subsidy / TR =0.00
VA / TR =0.45
Salary / VA =0.81
Frais Financiers / VA =0.00

Taxe / VA =0.00
Amortization / VA =0.00
Ene / VA =0.19

ENE/Total expenses =0.24
Consumable/TR =0.55
Service/TR =0.00

Salary/TR =0.36
Frais Financier/TR=0.00

Amortization/TR=0.00
ENE/TR =0.09

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : SHF linked

Operation : SHF Linked | Practice : Fresh exports | Location : Kenya | Descriptive 2 :Vulnerable
Short name : SHFL | Function : Primary production | Reference Space : Rural | Descriptive 1 : Female

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	SHFL		55 KES	0		KES			
Subsidy									
Consumable	Chemical 1, (Bosto	0.50 Liter	2800 KES			KES	1.00		
	Chemical 2, (Dacon	1.00 Liter	1560 KES			KES	1.00		
	Chemical 3, (Cyper	0.50 Liter	2700 KES			KES	1.00		
	Chemical 4 (Copper	2.50 Kilogram	1500 KES			KES	1.00		
	Composting	1.00 Unitairy	10000 KES			KES	1.00		
	Fertiliser 1	1.00 Unitairy	15000 KES			KES	1.00		
	Fertiliser 2	1.00 Unitairy	23500 KES			KES	1.00		
	Irrigation, fuel/energ	1.00 Unitairy	50000 KES			KES	1.00		
	Seed	50.00 Kilogram	1000 KES			KES	1.00		
	Transport of inputs	1.00 Unitairy	2000 KES			KES	1.00		
	Transport of produc	1.00 Unitairy	14000 KES			KES	1.00		
Service									
Salary	Hired labour	606.00 Day	300 KES			181800 KES	1.00		
Financial Cost									
Amortization	Various		12,500.00 KES			12,500.00 KES			
Taxes									

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

AGGREGATES AND INDICATORS OF THE OPERATION

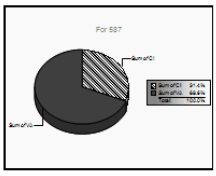
Resources

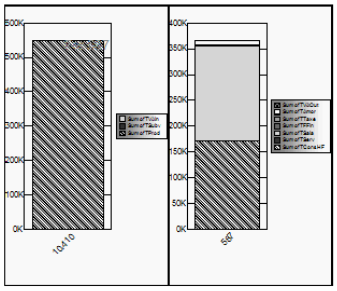
Production	550000
Subsidy	0

Uses

Consumable	172560
Service	0
Salary	181800
Financial Cost	0
Taxe	0
VAT to be repaid	0
VAT to be collected	0
Amortization	12500

Total Resource	550000
Total Uses	366860
Total Intermediate Consumption	172560
Value added	377440
Net operating surplus	183140





Indicators

Subsidy / TR =0.00
VA / TR =0.69
Salary / VA =0.48
Frais Financiers / VA =0.00

Taxe / VA =0.00
Amortization / VA =0.03
Ene / VA =0.49

ENE/Total expenses =0.94
Consumable/TR =0.31
Service/TR =0.00

Salary/TR =0.33
Frais Financier/TR=0.00

Amortization/TR=0.02
ENE/TR =0.33

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : SHF scattered

Operation : SHF Scattered | Practice : Private | Location : Kenya | Descriptive 2 :Vulnerable
Short name : SHFS | Function : Primary production | Reference Space : Rural | Descriptive 1 : Female

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans	8,000.00 Kilogra	50 KES		0	KES			
Subsidy									
Consumable	Chemical 1	1.00 Unitairy	700 KES			KES	1.00		
	Chemical 2	1.00 Unitairy	780 KES			KES	1.00		
	Chemical 3	1.00 Unitairy	680 KES			KES	1.00		
	Chemical 4	1.00 Unitairy	1880 KES			KES	1.00		
	Compost	1.00 Unitairy	10000 KES			KES	1.00		
	Fertiliser 1	1.00 Unitairy	15000 KES			KES	1.00		
	Fertiliser 2	1.00 Unitairy	23500 KES			KES	1.00		
	Irrigation, fuel/electri	1.00 Unitairy	50000 KES			KES	1.00		
	Seeds	1.00 Unitairy	20000 KES			KES	1.00	2nd hand see	
	Transport of inputs	1.00 Unitairy	2000 KES			KES	1.00		
	Transport, field - so	1.00 Unitairy	14000 KES			KES	1.00		
Service									
Salary	Hired labour	531.00	300 KES			159300 KES	1.00		
Financial Cost									
Amortization	Various		6,250.00 KES			6,250.00 KES			
Taxes									

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

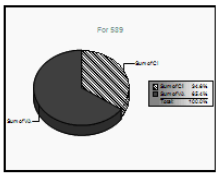
AGGREGATES AND INDICATORS OF THE OPERATION

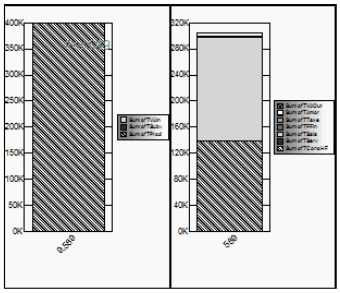
Resources

Production	400000	**Total Resource**	400000
Subsidy	0	**Total Uses**	304090
		Total Intermediate Consumption	138540
		Value added	261460
		Net operating surplus	95910

Uses

Consumable	138540
Service	0
Salary	159300
Financial Cost	0
Taxe	0
VAT to be repaid	0
VAT to be collected	0
Amortization	6250





Indicators

Subsidy / TR =0.00
VA / TR =0.65
Salary / VA =0.61
Frais Financiers / VA =0.00

Taxe / VA =0.00
Amortization / VA =0.02
Ene / VA =0.37

ENE/Total expenses =0.58
Consumable/TR =0.35
Service/TR =0.00

Salary/TR =0.40
Frais Financier/TR=0.00

Amortization/TR=0.02
ENE/TR =0.24

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Packhouse

Operation : Packhouse | Practice : Private | Location : Kenya | Descriptive 2 :Well Off
Short name : PHFB | Function : Transformation | Reference Space : Urban | Descriptive 1 : Male

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans	70,000.00 Kilogr	220 KES		0	KES			
Subsidy									
Consumable	Building, rental	1.00 Unitairy	262500 KES			KES	1.00		
	Coats, protective cl	1.00 Unitairy	10000 KES			KES	1.00		
	Crates	1.00 Unitairy	93750 KES			KES	1.00		
	Detergents	1.00 Unitairy	24000 KES			KES	1.00		
	Electricity	1.00 Unitairy	150000 KES			KES	1.00		
	Fuel, diesel, genera	1.00 Unitairy	42900 KES			KES	1.00		
	Green beans (raw m	100,000.00 Unita	70 KES			KES	1.00		
	Knives	1.00 Unitairy	2812 KES			KES	1.00		
	Maintenance of cold	1.00 Unitairy	22500 KES			KES	1.00		
	Marketing trips	1.00 Unitairy	450000 KES			KES	1.00		
	Packaging, cartons	1.00 Unitairy	903000 KES			KES	1.00		
	Packaging, cling filr	1.00 Unitairy	174000 KES			KES	1.00		
	Packaging, punnets	1.00 Unitairy	735000 KES			KES	1.00		
	Sealing machines	1.00 Unitairy	15000 KES			KES	1.00		
	Stationary	1.00 Unitairy	15000 KES			KES	1.00		
	Tea, lunch	1.00 Unitairy	45000 KES			KES	1.00		
	Water	1.00 Unitairy	3750 KES			KES	1.00		
	Wrapper	1.00 Unitairy	8625 KES			KES	1.00		
Service	Export licence	1.00 Unitairy	833 KES			833 KES	1.00		
	City Council Licens	1.00 Unitairy	7667 KES			7667 KES	1.00		
	Health license	1.00 Unitairy	10000 KES			10000 KES	1.00		
	KEPHIS Inspection	1.00 Unitairy	22500 KES			22500 KES	1.00		
	Membership COLEA	1.00 Unitairy	1375 KES			1375 KES	1.00		
	Membership FPEAK	1.00 Unitairy	10000 KES			10000 KES	1.00		
	BRC Packhouse ce	1.00 Unitairy	19283 KES			19283 KES	1.00		
	BRC preparation	1.00 Unitairy	3867 KES			3867 KES	1.00		
	Staff training (e.g. fi	1.00 Unitairy	2500 KES			2500 KES	1.00		
	Toll (at the airport)	1.00 Unitairy	9240 KES			9240 KES	1.00		
Salary	Labour	1.00 Unitairy	1256625 KES			1256625 KES	1.00		
Financial Cost	Interest		187500 KES			187500 KES	1.00		

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 Country :Kenya Curency :KES Year : 2,017

Amortization	Cold rooms	52,500.00 KES	52,500.00 KES		
	Tables (stainless st	10,125.00 KES	10,125.00 KES		
	Weighing scales	4,950.00 KES	4,950.00 KES		
	Big scale	3,625.00 KES	3,625.00 KES		
	Desks (office)	7,500.00 KES	7,500.00 KES		
	Chairs (office)	5,250.00 KES	5,250.00 KES		
	Computers	12,500.00 KES	12,500.00 KES		
	Air conditioning	2,500.00 KES	2,500.00 KES		
	Trucks	31,250.00 KES	31,250.00 KES		
	Pick-up	30,000.00 KES	30,000.00 KES		
	Motor cycles	8,750.00 KES	8,750.00 KES		
	Generator	50,000.00 KES	50,000.00 KES		
	All other investment	6,250.00 KES	6,250.00 KES		
Taxes	Income tax	KES	180000 KES	1.00	
	NSSF&NHIF	KES	16875 KES	1.00	
	Corporate tax	KES	412500 KES	1.00	
	VAT reimbursement	KES	-350000 KES	1.00	

AGGREGATES AND INDICATORS OF THE OPERATION

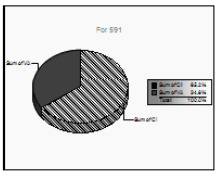
Resources
Production 15400000
Subsidy 0

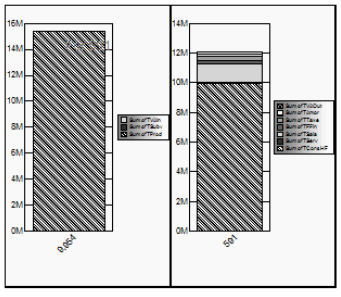
Uses
Consumable 9957837
Service 87265
Salary 1256625
Financial Cost 187500
Taxe 259375
VAT to be repaid 0
VAT to be collected 0

Amortization 335200

Total Resource 15400000
Total Uses 12083802
Total Intermediate Consumption 10045100

Value added 5354898
Net operating surplus 3316198





Indicators
Subsidy / TR =0.00
VA / TR =0.35
Salary / VA =0.23
Frais Financiers / VA =0.04

Taxe / VA =0.05
Amortization / VA =0.06
Ene / VA =0.62

ENE/Total expenses =1.63
Consumable/TR =0.65
Service/TR =0.01

Salary/TR =0.08
Frais Financier/TR=0.01

Amortization/TR=0.02
ENE/TR =0.22

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Canning factory

Operation : Canning factory | Practice : Private | Location : Kenya | Descriptive 2 :Well Off
Short name : GBCF | Function : Transformation | Reference Space : Secondary center | Descriptive 1 : Male

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans (canne	70,530.00 Kilogr	287 KES	0		KES			
Subsidy									
Consumable	Building (rental cost	1.00 Unitairy	2000000 KES			KES	1.00		
	Electricity	1.00 Unitairy	291695 KES			KES	1.00		
	Green beans (raw m	105,269.00 Kiloc	59 KES			KES	1.00		
	Packaging material	1.00 Unitairy	2196006 KES			KES	1.00		
	Packaging material	1.00 Unitairy	1810133 KES			KES	1.00		
	Packaging material	1.00 Unitairy	2084081 KES			KES	1.00		
	Water	1.00 Unitairy	205261 KES			KES	1.00		
Service	Export licence	1.00 Unitairy	833 KES			833 KES	1.00		
	Health licence	1.00 Unitairy	10000 KES			10000 KES	1.00		
	KEPHIS Inspection	1.00 Unitairy	57600 KES			57600 KES	1.00		
Salary	Labour	1.00 Unitairy	1256625 KES			1256625 KES	1.00		
Financial Cost	Interest		2561694 KES			2561694 KES	1.00		
	Insurance		152020 KES			152020 KES	1.00		
Amortization	Various equipment		00,000.00 KES			00,000.00 KES			
Taxes	Income tax paid by :		KES			180000 KES	1.00		
	NSSF&NHIF		KES			16875 KES	1.00		
	Corporate tax		KES			247326 KES	1.00		
	VAT reimbursement		KES			-350000 KES	1.00		

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

AGGREGATES AND INDICATORS OF THE OPERATION

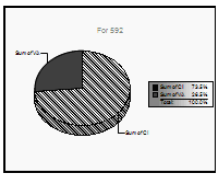
Resources

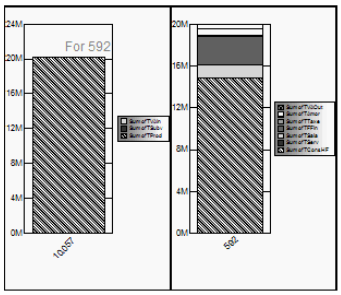
Production	20239990
Subsidy	0

Uses

Consumable	14814890
Service	68433
Salary	1256625
Financial Cost	2713714
Taxe	94201
VAT to be repaid	0
VAT to be collected	0
Amortization	1000000

Total Resource	20239990
Total Uses	19947863
Total Intermediate Consumption	14883320
Value added	5356667
Net operating surplus	292127





Indicators

Subsidy / TR =0.00
VA / TR =0.26
Salary / VA =0.23
Frais Financiers / VA =0.51

Taxe / VA =0.02
Amortization / VA =0.19
Ene / VA =0.05

ENE/Total expenses =0.06
Consumable/TR =0.73
Service/TR =0.00

Salary/TR =0.06
Frais Financier/TR=0.13

Amortization/TR=0.05
ENE/TR =0.01

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Broker

Operation : Broker | Practice : Private | Location : Kenya | Descriptive 2 :Well Off
Short name : GBBR | Function : Trade | Reference Space : Rural | Descriptive 1 : Male

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans, sales	500.00 Kilogram	70 KES		0	KES			
Subsidy									
Consumable	Green beans, raw m	500.00 Kilogram	50 KES			KES	1.00		
	Packaging	1.00 Unitairy	200 KES			KES	1.00		
Service	Transport	1.00 Travel	3000 KES			3000 KES	1.00		
Salary	Labour	1.00 Day	300 KES			300 KES	1.00		
Financial Cost									
Amortization									
Taxes	Duties		KES			200 KES	1.00		

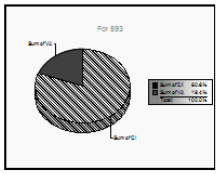
AGGREGATES AND INDICATORS OF THE OPERATION

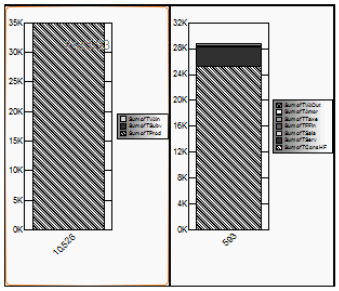
Resources

Production	35000	**Total Resource**	35000
Subsidy	0	**Total Uses**	28700
		Total Intermediate Consumption	28200
		Value added	6800
		Net operating surplus	6300

Uses

Consumable	25200
Service	3000
Salary	300
Financial Cost	0
Taxe	200
VAT to be repaid	0
VAT to be collected	0
Amortization	0





Indicators

Subsidy / TR =0.00
VA / TR =0.19
Salary / VA =0.04
Frais Financiers / VA =0.00

Taxe / VA =0.03
Amortization / VA =0.00
Ene / VA =0.93

ENE/Total expenses =12.60
Consumable/TR =0.72
Service/TR =0.09

Salary/TR =0.01
Frais Financier/TR=0.00

Amortization/TR=0.00
ENE/TR =0.18

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Wholesale trader

Operation : Wholesale trader | Practice : Private | Location : Kenya | Descriptive 2 :Well Off
Short name : GBWT | Function : Trade | Reference Space : Urban | Descriptive 1 : Female

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans	190.00 Kilogram	30 KES	0		KES			
Subsidy									
Consumable	Green beans, raw n	200.00 Kilogram	15KES			KES	1.00		
	Packaging	1.00 Unitairy	160KES			KES	1.00		
Service	Transport	2.00 Bag	150KES			300KES	1.00		
Salary	Labour	1.00 Day	300KES			60KES	0.20		
Financial Cost									
Amortization									
Taxes	Duties		KES			200KES	1.00		

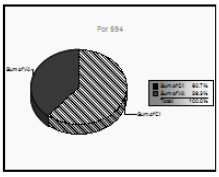
AGGREGATES AND INDICATORS OF THE OPERATION

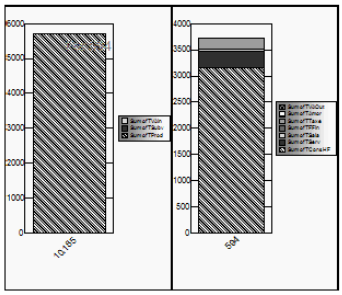
Resources

Production	5700	**Total Resource**	5700
Subsidy	0	**Total Uses**	3720
		Total Intermediate Consumption	3460
		Value added	2240
		Net operating surplus	1980

Uses

Consumable	3160
Service	300
Salary	60
Financial Cost	0
Taxe	200
VAT to be repaid	0
VAT to be collected	0
Amortization	0





Indicators

Subsidy / TR =0.00
VA / TR =0.39
Salary / VA =0.03
Frais Financiers / VA =0.00

Taxe / VA =0.09
Amortization / VA =0.00
Ene / VA =0.88

ENE/Total expenses =7.62
Consumable/TR =0.55
Service/TR =0.05

Salary/TR =0.01
Frais Financier/TR=0.00

Amortization/TR=0.00
ENE/TR =0.35

AgriFood chain Analysis
Budget

Value chain : Green beans, 02-08-2017 **Country :Kenya** **Curency :KES** **Year : 2,017**

Agent : Retail trader

Operation : Retail trader | Practice : Private | Location : Kenya | Descriptive 2 :Vulnerable
Short name : GBRT | Function : Trade | Reference Space : Urban | Descriptive 1 : Female

Category	Wording	Quantities in units	Price in curency unit	VAT	Lifetime	Value	Use Ratio	Source	Observation
Production	Green beans sales	19.00 Kilogram	60 KES	0		KES			
Subsidy									
Consumable	Green beans, raw n	20.00 Kilogram	30KES			KES	1.00		
	Packaging	1.00 Unitairy	50KES			KES	1.00		
Service	Transport	1.00 Travel	100KES			100KES	1.00		
Salary	Labour	1.00 Day	300KES			30KES	0.10		
Financial Cost									
Amortization									
Taxes	Duties		KES			50KES	1.00		

AGGREGATES AND INDICATORS OF THE OPERATION

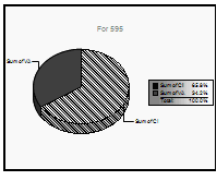
Resources
Production 1140
Subsidy 0

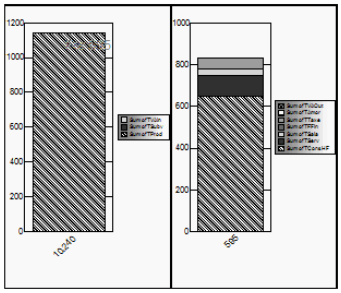
Total Resource 1140
Total Uses 830
Total Intermediate Consumption 750

Value added 390
Net operating surplus 310

Uses
Consumable 650
Service 100
Salary 30
Financial Cost 0
Taxe 50
VAT to be repaid 0
VAT to be collected 0

Amortization 0





Indicators
Subsidy / TR =0.00
VA / TR =0.34
Salary / VA =0.08
Frais Financiers / VA =0.00

Taxe / VA =0.13
Amortization / VA =0.00
Ene / VA =0.79

ENE/Total expenses =3.88
Consumable/TR =0.57
Service/TR =0.09

Salary/TR =0.03
Frais Financier/TR=0.00

Amortization/TR=0.00
ENE/TR =0.27

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6.12 Annex 12: Value Added Tax (VAT)

VAT Tax Rates

There are three tax rates as specified in the schedules to the VAT Act, which are:
16%: This is the general rate of tax and is applicable to most of taxable goods and taxable services.

12%: This is applicable to supplies falling under part II of the 1st schedule of the VAT Act eg. electrical energy and certain types of residual fuels and oils.

0%: This applies to certain categories of goods and services, which includes exports, agricultural inputs, pharmaceutical products, educational materials and supplies to privileged persons. The purpose of zero rating is to make the supplies cheaper as the dealers in these supplies are entitled to claim back any input tax incurred in the course of their business.

Source: Kenya Revenue Authority (KRA)
http://www.kra.go.ke/index.php/domestic-taxes/vat/about-vat/how-vat-works
(accessed: 15/09/2017)

Corporation Tax

Corporation tax is a form of Income Tax that is levied on corporate bodies such as Limited Companies, Trusts, and Co-operatives. Resident Companies are taxable at a rate of 30% while non-resident companies are taxable at the rate of 37.5% on their taxable profits.
Source: Kenya Revenue Authority (KRA)
http://www.kra.go.ke/incometax/pdf/incometaxataglance.pdf (accessed: 15/09/2017)

6.13 Annex 13: Breakdown of fuel costs in Nairobi

Breakdown of the costs of Super Petrol (PMS), Diesel (AGO) and Kerosene (DPK) in Nairobi: 15th May 2017 - 14th June 2017			
Cost Item	**Super Petrol**	**Diesel**	**Kerosene**
	KShs/Litre	**KShs/Litre**	**KShs/Litre**
Landed Cost (a)	**45.33**	**43.61**	**42.61**
Pipeline Transport (Msa-Nrb)	2.18	2.18	2.72
Road Transport (Msa-Nrb) - Bridging	1.03	1.03	0.00
Pipeline Losses	0.06	0.05	0.03
Depot Losses	0.42	0.22	0.15
Delivery within 40kms of Nrb	0.62	0.62	0.62
Storage and distribution (b)	**4.31**	**4.10**	**3.52**
Importers Margin	7.00	7.00	7.00
Dealers Margin	3.89	3.89	3.89
Oil marketing companies margins (c)	**10.89**	**10.89**	**10.89**
Excise Duty	19.90	10.31	7.21
Road Maintenance Levy	18.00	18.00	0.00
Petroleum Development Levy	0.40	0.40	0.40
Petroleum Regulatory Levy	0.12	0.12	0.05
Railway Development Levy	0.64	0.62	0.60
Taxes and levies (d)	**39.06**	**29.45**	**8.26**
Retail Prices in Nairobi (a) + (b) + (c) + (d)	**99.59**	**88.05**	**65.28**
Summary	**Super Petrol**	**Diesel**	**Kerosene**
	KShs/Litre	**KShs/Litre**	**KShs/Litre**
Products Costs (a)	45.33	43.61	42.61
Distribution and storage Costs (b)	4.31	4.10	3.52
Margins (c)	10.89	10.89	10.89
Taxes & Levies (d)	39.06	29.45	8.26
Retail Prices in Nairobi	**99.59**	**88.05**	**65.28**

Source: Energy Regulatory Commission (ERC), Nairobi, 02 June 2017

6.14 Annex 14: Kenya trade statistics

Balance of payments, current account (million US$)	2014	-6339	
Balance of payments, current account (million US$)	2010	-2369	
Balance of payments, current account (million US$)	2005	-252	
Exports (million US$)	2015	5537.0	2013.
Imports (million US$)	2015	16394.5	2013.
Balance (million US$)	2015	-10857.5	2013.
Major trading partners (% of exports)	2015	Uganda (11.9), United Kingdom (7.9), United Rep. Tanzania (7.7)	2013.
Major trading partners (% of imports)	2015	India (18.3), China (12.9), United Arab Emirates (8.3)	2013.

Source: United Nations Statistics Division
http://data.un.org/CountryProfile.aspx?crName=Kenya (accessed 23/09/2017)

6.15 Annex 15. Assumptions on end-products and inventory data and mass balance for the canning factory

Technical description of end products									
Possible green bean processed	Name	Total capacity (in ml)	Drained weight of FB (in g)	Undrained weight of FB (in g)	Weight of jar (in g)	Weight of cap (in g)	Total product weight (in g)		
example	*Glass jar of FB*	*720*	*345*	*660*	*290*	*14*	*964*		
Green bean processed 1 assumed	Glass jar of FB	720	345	660	290	14	964		
Green bean processed 2 assumed	Small can FB	425	220	400	77	0	477		
Green bean processed 3 assumed	Medium-size can I	850	440	800	154	0	954		
Mass balance for canning factory for one average month									
	units		Drained weight of FB (in kg)	Undrained weight of FB (in kg)	Weight of jar/can (in kg)	Weight of cap (in kg)	Total product weight (in kg)	Number of units	
Raw french bean	in kg	194000							rejects
Raw french beans rejected	in kg	62080							0,32
Raw french bean rejects deduced	in kg	131920	131920						
Green bean processed 1: glass jars	in kg		65960	126184,35	55444,64	2676,64	184305,62	191188,41	
Green bean processed 2	in kg		0	0	0	0	0	0	
Green bean processed 3: medium cans	in kg		65960	119927,27	23086,00	0,00	143013,27	149909,09	
							327318,90		
Energy use									
Electricity	KWh	15747							
Diesel	litres								
Petrol	litres								
Water use	m3	3690							

6.16 Annex 16 List of pesticides used across all FB farms surveyed in Kenya

Commercial product as named in Andrew's survey	Commercial product assumed	Active ingredient	Substance group	Concentration of pesticide (g/kg ou g/l)	Unit	Status of active ingredient in EU pesticide database	Characterization factor in ReCiPe	Proxy used as characterisation factor
BELT(pesticide}	BELT SC 480	Flubendiamide	Benzene-dicarboxamide	480	g/l	Approved	**No**	**Mean CF**
SCORE/HORTIVA	ORTIVA 250 SC	Azoxystrobin	Strobilurin	250	g/l	Approved	Yes	
	ORTIVA 50 SC	Azoxystrobin	Strobilurin	50	g/l	Approved	Yes	
	ORTIVA TOP	Azoxystrobin	Strobilurin	200	g/l	Approved	Yes	
		Difenoconazole	Systemic triazole	125	g/l	Approved	Yes	
SCORE/HORTIVA	SCORE 250 SC	Difenoconazole	Systemic triazole	250	g/l	Approved	Yes	
Pesticide (Karate)	KARATE 2,5 WG	Lambda-Cyhalothrin	Pyrethroid	2,5	g/l	Approved	Yes	
	KARATE 1.75 EC	Lambda-Cyhalothrin	Pyrethroid	17,5	g/l	Approved	Yes	
Herbicides (Pengasus)	Pegasus 500 SC	Diafenthiuron	Thiourea	500	g/l	**NOT APPROVED**	**No**	**Thiourea**
Fungicide (Mirrors)	MILRAZ 76 WP	Cymoxanil	Cyanoacetamide oxime	60	g/kg	Approved	Yes	
		Propineb	Dithiocarbamates	700	g/kg	Approved	Yes	
APRON STAR	Apron Star 42WS	Thiametoxam	Neonicotinoid	200	g/kg	Approved	**No**	**Mean CF**
		Metalaxyl-M	Phenylamide	200	g/kg	Approved	**No**	**Mean CF**
		Difenoconazole	Systemic triazole	20	g/kg	Approved	Yes	
CONFIDOR	Confidor WG 70	Imidacloprid	Neonicotinoid	700	g/kg	Approved	**No**	**Mean CF**
DITHANE M45	DITHANE M45	Mancozeb	Dithiocarbamate	800	g/kg	Approved	Yes	
ACTARA	Actara 25 WG	Thiamethoxam	Neonicotinoids	250	g/kg	Approved	**No**	**Mean CF**
Duduthrin	Duduthrin 1.75 EC	Lambda-Cyhalothrin	Pyrethroid	17,5	g/l	Approved	Yes	
Labdex, insecticide	Lambex	Lambda-Cyhalothrin	Pyrethroid	50	g/l	Approved	Yes	

Thunder, insecticide	THUNDER® 145 O-TEQ	Imidaclopride	Neonicotinoid	100	g/l	Approved	**No**	**Mean CF**
		Betacyfluthrine	NA	45	g/l	**UNKNOWN**	**No**	**Mean CF**
Daconil, fungicide	DACONIL 720 SC	Chlorothalonil	Chloronitrile	720	g/l	Approved	Yes	
Champion (copper)	Champion 50 WP	Copper hydroxide	Inorganic compound	Cupric hydroxide 77%(equiv. to 50% metallic copper)		Approved	Yes	
Proof, insecticide	Proove 1.92 EC	Emamectin Benzoate	Micro-organism derived	19,2	g/l	Approved	**No**	**Mean CF**
Liquicop (copper)	Liquicop SL	Copper ammonium acetate	Inorganic compound	Copper ammonium acetate (equiv. to 80g/l metallic copper)		**UNKNOWN**	**Yes**	
Deltamethrin	Decis 025 EC	Deltamethrin	pyrethroid	25	g/l	Approved	Yes	
Proof, insecticide	Prove 1.92 EC	Emamectin Benzoate	Micro-organism derived	19,2	g/l	Approved	**No**	**Mean CF**
	BESTOX 100EC	Alpha cypermethrin	Pyrethroid	100	g/l	Approved	Yes	
	CUPROCAFFARO 50 WP	Copper oxychloride	Inorganic compound	Copper Oxychloride - 85% equivalent to 50% metallic copper		Approved	Yes	
	ANVIL 5 SC	hexaconazole	Triazole	50	g/l	**NOT APPROVED**	**No**	**Mean CF**
	Dynamec 1.8 C	Abamectin	avermectine	18	g/l	Approved	Yes	
	Brigade 025 EC	bifenthrin	Pyrethroid	25	g/l	Approved	Yes	
	Folicur 250 EC	Tebuconazole	Triazole	250	g/l	Approved	**No**	**Mean CF**
	Dual Gold 960 EC	S-Metolachlor	Chloroacetamide	960	g/l	Approved	Yes	
	MOSPILAN 200SP	Acetamiprid	Neonicotinoid	200	g/kg	Approved	**No**	**Mean CF**
	TRACER 480 SC	Spinosad	Micro-organism derived	480	g/l	Approved	**No**	**Mean CF**
	Thiocyclam hydrogen oxalate 50% SP	Thiocyclam hydrogen oxalate 50% SP	Unclassified	500	g/kg	**NOT APPROVED**	**No**	**Mean CF**
	Applaud 40%SC	Buprofezin	NA	400	g/l	Approved	Yes	
	Bio-Power 1.15 WP	Beauveria Bassiania						

6.17 Annex 17. Key processes selected from Ecoinvent 3 and Agri-footprint databases

Developed processes for the study	Processes used from Ecoinvent 3 and Agri-footprint databases
Electricity mix, Kenya	Electricity, high voltage {RoW}| electricity production, hydro, run-of-river | Alloc Rec, U Electricity, high voltage {RoW}| electricity production, oil | Alloc Rec, U Electricity, high voltage {RoW}| electricity production, deep geothermal | Alloc Rec, U Electricity, high voltage {RoW}| electricity production, wind, 1-3MW turbine, onshore | Alloc Rec, U
Diesel production	Diesel {RoW}| market for | Alloc Rec, U
NPK fertilizers	Ammonium nitrate, as N, at regional storehouse/RER S Nitric acid, 50% in H2O, at plant/RER S Phosphoric acid, fertiliser grade, 70% in H2O, at plant/MA S Potassium chloride, as K2O, at regional storehouse/RER S
CAN	Calcium ammonium nitrate (CAN), (NPK 26.5-0-0), at regional storehouse/RER Economic
DAP	Di ammonium phosphate, as 100% (NH3)2HPO4 (NPK 22-57-0), at regional storehouse/RER Mass
Calcium nitrate	Calcium nitrate {RoW}| production | Alloc Rec, U
Mono Potassium Phosphate	Phosphoric acid, fertiliser grade, 70% in H2O, at plant/MA S Potassium chloride, as K2O, at regional storehouse/RER S
Potassium sulfate	Potassium sulfate, as K2O {RoW}| potassium sulfate production | Alloc Rec, U
Ammonium sulfate	Ammonium sulfate, as N {RoW}| ammonium sulfate production | Alloc Rec, U
Pesticide production	Pesticide, unspecified {GLO}| market for | Alloc Rec, U
Land preparation at large-farm for fresh FB	Harrowing, with rotary harrow (standard equipment), processing/RoW U Soil decompactation, processing/RoW U
Air freight of fresh french beans to UK	Transport, freight, aircraft {RoW}| intercontinental | Alloc Rec, U
Transport of raw French beans from field to packhouse / factory and from canned products to airport/port	Transport, freight, lorry 3.5-7.5 metric ton, EURO3 {RoW}| Alloc Rec, U
Transport of packed French beans from packhouse to airport	Transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, carbon dioxide, liquid refrigerant, cooling {GLO}| Alloc Rec, U
Sea freight of canned French beans to UK	Transport, freight, sea, transoceanic ship {GLO}| processing | Alloc Rec, U
Punnets	Polypropylene, granulate {RoW}| production | Alloc Rec, U
Cardboard box	Corrugated board box {RoW}| production | Alloc Rec, U
Glass jars	Packaging glass, white {RoW}| production | Alloc Rec, U
Caps	Steel, chromium steel 18/8, hot rolled {RoW}| production | Alloc Rec, U
Cans	Steel, chromium steel 18/8, hot rolled {RoW}| production | Alloc Rec, U
Wood pallets	EUR-flat pallet {RoW}| production | Alloc Rec, U
Plastic film	Packaging film, low density polyethylene {RoW}| production | Alloc Rec, U
Big plastic crates	Polyethylene, high density, granulate {RoW}| production | Alloc Rec, U

6.18 Annex 18. Review report "Value chain analysis of the French bean from Kenya – Environmental (LCA) evaluation"

Review report "Value chain analysis of the French bean from Kenya – Environmental (LCA) evaluation"
Tommie Ponsioen, Wageningen, 21 September 2017

This is a summary of the review on the draft version of the report submitted on 1 September 2017. The comments were discussed on 20 September 2017. Due to the short timeframe for finalising the report, no review was possible on the final version of the report. Note that the recommendations are not required when no compliancy to a standard is claimed. We concluded that for the objectives of the study, compliancy is not necessary. So, not all recommendations need to be implemented in the final report, but they may still be relevant for future LCA research on French beans.

Reference documents

The ISO standards 14040/44 are referred to and compliancy was suggested in the report. To claim compliancy to these standards, several adaptations would be required, while they are not necessary for the main objectives of the study. Considering these objectives and the budget/timeframe, the reviewer and the author concluded that it will not be feasible and not necessary to acquire compliancy. Nevertheless, the methodology as described in the ISO standards are followed as much as possible.

It would be good to also mention other reference documents, such as the ILCD handbook, PEF Guide, PAS2050-1 horticulture supplement, GHG Protocol, ENVI-FOOD protocol.

Comparisons

In the draft report, a direct comparison was made between fresh beans and canned beans. My recommendation is to remove tables or graphs that make this comparison and elaborate why it is not a fair comparison. To be able to compare the products, the functional unit needs to be the same or similar. This means that the scope needs to be extended to cradle to grave, to account for all possible losses in the life cycle and for preparation and consumption. We also discussed the possibility to account for quality differences by using the prices of the products, so the reference unit would be a monetary unit. On the other hand, the comparison in the report gives a rough idea of what the comparison would look like when taking all the limitations into account. A discussion on this comparison with more explanations and caution is therefore still valuable in the report.
We discussed that comparing with tomatoes from Morocco is not correct. It is understandable, on the other hand, that the author wants to give the reader a feeling for the magnitude of the impact from producing fresh beans. My recommendation was to refer to a range of vegetables from literature and databases, and only compare the midpoint indicator for climate change, kg CO2 equivalents, because this is a good indicator for many environmental impact categories of vegetables and is reported by almost all LCA studies on vegetables.

System boundaries

We discussed the importance of transport to the consumer market, especially in the case of fresh beans produced in Kenya and consumed in Europe. European companies, importers and retailers, NGOs and governmental institutes are increasingly becoming aware of the importance of air transport in the footprint of fruits and vegetables, such as table grapes, blueberries, asparagus and green beans. So, it is also very relevant for stakeholders in the countries of origin to be fully aware of this.

Choosing London as representative for the European market is a little limited, but the distances to other European markets from Kenya are similar. Recommendation is to discuss that the distances to the main markets in Europe are similar.

The way the system boundaries are described suggests that the cradle to market gate and the cradle to farm gate are 2 different scopes. Because the same functional unit is used for both these scopes, the latter scope (cradle to farm gate) is actually part of the first scope (cradle to market gate). So, it is merely a deeper analysis of the agricultural phase in the cradle to market gate scope. My recommendation is to mention only one scope: cradle to market gate and explain in the results that you do a deeper analysis on the agricultural phase.

Representativeness

The primary data in the study originates from a number of farms and companies in the post-harvest chain. Because the number is limited, the study cannot be representative for the selected regions, let alone the entire country. This needs to be explained and discussed. This is important for the conclusions of the report.

Functional unit

The functional unit is not described sufficiently in the draft. This is a very important topic, especially in the case of fresh or canned beans. The two different functional units should be described in detail in the functional unit section. Note that the reference flow does not need to be same as the functional unit. From the discussion, I understand that the same reference flow of one kg of fresh beans is used for canned beans. So for the latter, it is one kg of fresh beans that are later processed and canned.

Multi-functionality

A large share of the harvested beans are rejected on the farm and in the packaging/processing plants. The report argues that from an economic point of view, the rejects are not significant. On the other hand, the rejected beans could be important substitute for other local food, feed or fertilizer sources. To take this into account, a more detailed analysis could be interesting. However, as we discussed, this is not considered priority for the objectives of the study.

Pesticides

It is a common problem that for many compounds no characterization factor is available in the impact assessment method. Using no proxy actually means that you are using zero as impact a proxy. We discussed the possibility of using the characterization factor of the worst case or average of the factors of the pesticide substances for which factors are available, preferably within groups of pesticides. From the discussion I understand that no factor was available for groups of fertilizer. Recommendation is then to average the factors of the used pesticides and select the maximum of those factors to use as proxies for the used pesticides that are not characterized by the method. In summary, the recommendation is to do a sensitivity analysis with a worst case, an average, and best case (zero impact), and then decide which case you present.

Data quality

To do a Monte Carlo uncertainty analysis would be too much work and would not add much value to the study. A data quality assessment as suggested would be nice, but this would still take a considerable amount of time to apply consistently. For consistency, my recommendation would be to use the data quality requirement document of the PEF project, but this would still mean a considerable time investment. To get an overview of the uncertainties in the study that could be done quickly, my recommendation is to identify the most important environmental interventions modelled in the foreground processes and the most important links to background databases, and adapted background database processes, and indicate which of those are a concern regarding uncertainty for further improvement in the future and for consideration in the interpretation of the results.

Impact assessment

ReCiPe 2008 is used, but it is not clearly mentioned. A completely new version of ReCiPe is available in the recent update of SimaPro, ReCiPe 2016, so it is important to know which one is used. When presenting the results in graphs, there is no need to also report in tables. Endpoint results can be presented in graphs in absolute figures. My recommendation is to also present midpoint results for the most important impact categories. The reason is because almost all LCA

studies report these (alone or in combination with endpoint results). Endpoints are mainly used to determine which are the most important impact categories and to evaluate possible trade-offs between impact categories in comparisons. Midpoint indicators are used for reporting and comparing with other studies (though this should be done with caution as the quality of the studies varies). As stated before, the climate change indicator at midpoint can be used to get a feeling of the magnitude compared to other studies on French beans and other vegetables.

Interpretation

We discussed the importance of fertilizer use and yields in the agriculture phase, and the possible contribution of nitrogen fixation. I think a discussion on this topic is important. How efficient are the farmers in Kenya using nitrogen fertilizers on French beans? What is the variation between farmers within each group and between the groups? How well are the emissions from fertilizers and N-fixation estimated? What is the quality of the background data for fertilizer production? The air transport has a dominating contribution to the footprint of fresh beans. I therefore recommend a discussion on the robustness of the inventory data of air transport. I also recommend to discuss the uncertainty of the data from the processing companies in the canned beans chain and discuss the inability of separating the steel cans and glass jars. Losses are important in the value chain of fresh and canned French beans. So, a brief discussion on the sensitivity of the assumptions on these losses to the results is recommended.