

Chapter 5

**MODERN LOGISTICS FOR HIGH
VALUE AGRICULTURAL PRODUCTS IN
SUB-SAHARAN AFRICA**

Niklas Sieber, PhD^{1,} and Peter Njenga^{2,†}*

¹Heidestraße, Stuttgart, Germany

²International Forum for Rural Development IFRTD, Kenya

ABSTRACT

This paper describes the experiences from a research project on modern logistic chains in the Mount Kenya region. It demonstrates how small scale farmers got organised and trained, how important infrastructures such as rural roads, grading sheds and appropriate cooling devices were, as well as Intermediate Means of Transport in combination with modern cooling logistics and communication technologies. Regional planning can do a lot to facilitate the development of modern Value Chains

* Corresponding Author's E-mail: niklas.sieber@gmx.de, website: www.niklas-sieber.de.

† International Forum for Rural Development IFRTD, Executive Director and Coordinator East and Southern Africa.

by applying an interdisciplinary planning approach that includes not only infrastructures, but as well organisation and management issues.

1. INTRODUCTION

Seventy percent of rural populations worldwide are affected by extreme poverty (IFAD 2010). Nearly two-thirds of the population in Africa are from rural areas. Even though rural development may not be part of main stream thinking, one of the most important issues in developing countries remains the alleviation of rural poverty.”

The present rapid urbanisation in Africa and the surging demand for fresh, high quality, agricultural products in international markets has opened new income opportunities for farmers, rural food processing industries and transport companies. According to the World Development Report (2008), new markets for high value agricultural produce – driven by rising incomes, liberalised trade, advanced logistics systems and use of ICTs - have proliferated in many African countries. Supermarkets are expanding in many places in Africa. Likewise the adoption of higher value export crops - particularly green beans, flowers, fruits- is also changing the patterns of harvesting, transport and marketing. In Europe, customers are buying French Beans from Kenya or Tomatoes from Senegal. Nowadays, high value products represent a considerable share of marketed value and have enabled many small scale farmers to escape the poverty trap.

How can these new opportunities be widely used in Sub-Saharan Africa (SSA) to reduce rural poverty for small holder farmers and traders? Quite often, investments in rural roads is referred as the main solution for linking farmers to markets. However, as Jonathan Dawson and Ian Barwell observed (1993), “Roads are not enough”. Modern transport services for rural areas require an integrated regional planning approach (Rwelamira 2003), which encompasses disciplines such as agriculture, logistics, manufacturing, transport, business development and ICT applications. At the regional level, conventional and modern transport chains may be planned using the approach of basic access provided by multimodal transport, embedded in the

concept of central locations and combined with modern communication infrastructures (Sieber 2009).

This chapter describes the experiences from an African Community Access Programme (AFCAP) funded research project in the Mount Kenya region, Kenya (KENDAT et al. 2013). The paper demonstrates how small scale farmers got organised and trained, how important infrastructures such as rural roads, grading sheds and appropriate cooling devices were, as well as Intermediate Means of Transport in combination with modern cooling logistics and communication technologies.

2. THE LOGISTIC CHAINS RESEARCHED

Seven horticultural and agricultural value chains were analysed that target mainly the national as well as the international consumer markets. The crops involved are French Beans, Bananas, Potatoes and Onions. Some of this produce ends up in the immediate local (within 10km) and regional market centres or towns (within 50-200km). It is not unusual for some of the produce to find its way to distances over 500km, and even into neighbouring countries like Uganda, Tanzania and Southern Sudan. Four chains focus on French Beans and the remaining three on Bananas, Potatoes and Onions. In five of the chains, small scale farmers are the key producers. These are compared to one medium sized producer and one large scale producer, located respectively within the Central Province and Rift Valley¹ areas of Kenya.

3. GENERAL OUTLINE OF A LOGISTIC CHAIN

The figure below shows the main ingredients of a smallholder Logistic Chain, containing the production, collection point, processing units and the export market. The “First Mile” from the farm to the collection point has

¹ A map and a table with the main features of the logistic chains researched is given in the annex.

proven to be a notable transport bottleneck. The length of the researched chains ranged between 100 and 300 km. Transport is undertaken by Light and Heavy Goods Vehicles (LGV resp. HGV) or Intermediate Means of Transport (IMT).

The logistics chain can be segmented into 3 parts. This consists of the *first mile*, representing the distance from the farm to a designated collection point or a market hub; (a more detailed discussion of the *first mile* can be found in the section that follows). The *second transport* segment consists of the distance covered by traders or transport companies to consolidate loads along a series of collection points in the rural hinterland, and then onto a secondary market or storage point; and a *third logistic* section that operates after full consolidation of the produce and then onto the regional and national markets or the airport termini.

From Figure 2 the lengths of the various transport segments for the products in the study can be seen. SUNRIPE, a large scale producer has no *first mile* at all as the all the consolidation happens on the farm where produce is picked for direct transportation to the final depot at the airport. Only one company in the study, Mt Kenya Gardens has a second stage chain, which consists of transporting bananas from the *first mile* stage to its ripening depot in a regional hub before transport to the national markets in Nairobi. The chain covers the longest distance at approximately 300 kilometres. The Kinangop potato chain is short, covering a distance of 90-110kms to Nairobi.

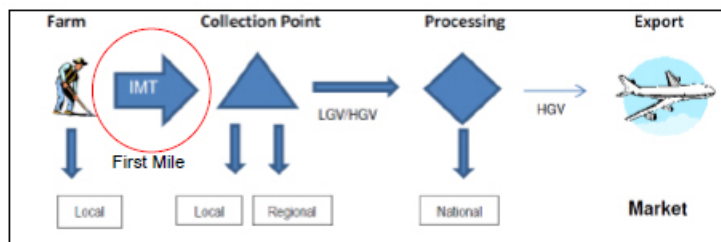


Figure 1. Structures of modern logistic chains.

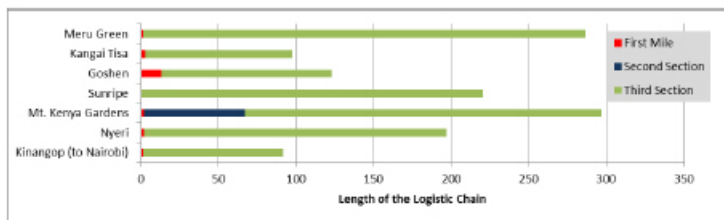


Figure 2. Length of logistics chains.

4. FIRST MILE OPERATIONS

The *first mile* is a term that is used analogously to the last mile in distribution systems that are usually the most expensive part of the transport chain. In the case of agricultural transport this term means the very first segment of a journey –in the context of small holder farmers - consisting of individual fragmented volumes transported from the farm to a collection point or a primary market.

In the context of rural transportation, the *first mile* is typically the segment beyond the rural road networks where non-motorised transport dominates. In agriculture, *the first mile* transport is related to the first stage logistics of evacuating agricultural produce from the fields to the nearest point of commercial interface. The produce is gathered on the farms, and transported to a roadside collection point. Transport in this segment is conducted on local paths and tracks. Means of transport are human portorage, donkey carts, bicycles, ox-carts, motorcycles and in some cases, tractors and pick-up trucks.

The transport costs on the first mile were closely linked to the mode of transport used as depicted in Figure 3. Human portorage is the most expensive means of transport with hugely variable cost of between Kshs² 1000 and 2500 per tonne-km. A tremendous reduction of transport costs can be achieved by substituting human portorage with Intermediate Means

² At the time of study 1US\$=79KShs

of Transport (IMT) such as bicycles and motorcycles. For example in Meru a change from portage to motorcycle was shown to reduce overall costs by roughly one third; in Mwea (Kangai Tisa) the shift from portage to oxcart contributed to halving overall transport costs.

Donkey or ox carts are mainly used for larger loads or bulky products, such as onions and potatoes. An exception is Mwea where ox carts are used to transport French Beans. For heavy loads, donkey carts and especially ox carts are much cheaper than motorcycles. Pickups and tractors are the cheapest means of transport for first mile when fully loaded. However, the constraint is their availability. Since investment costs for these means are high and depreciation is considerable, a constant usage is needed to justify the investments. In rural areas this is often not the case. It was observed that there was no human portage for potatoes owing to their bulky nature. Human portage for Banana is most expensive, followed by onions, with French Beans being significantly lower.

The average length of the first mile transport segment ranges between 1.5 to 13 km. This makes up only 0.4% to 10.6% of the distance of the entire chain. However, the significance of the 1st mile becomes apparent when transport costs are assessed: the first mile can make up one fifth of the total transport costs of the chain as depicted in Figure 4 and may even rise up to 37%. Even if distances of the first mile are short, its transport costs can make up a considerable share of the overall transport costs. This is consistent with findings from developed countries where freight costs for *last mile* distribution to retail networks can contribute up-to 28% of the total transport costs.

5. OPERATIONS BEYOND THE FIRST MILE

A different picture is produced if long distance transport costs are analysed as presented on Figure 5 below. The transport costs from the field to the market range between 5,000 and 21,000 Kshs per tonne-km. Of course this price is dominated by the distance, but here as well the importance of the 1st Mile may be easily perceived.

Even though a larger vehicle is used to transport the potatoes from Kinangop, transport costs reported are high. This is attributed to two main reasons

- The roads are generally in a bad condition,
- Transport is conducted by private brokers who operate as quasi monopolies. They charge excessive transport rates to cover for high local running costs and as insurance against volatility and uncertainty of prices at destination markets.

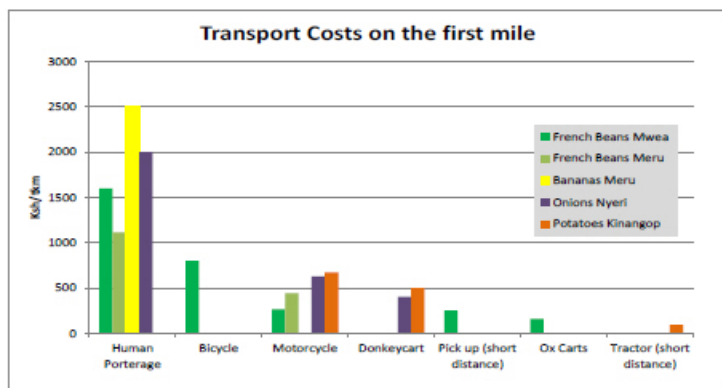


Figure 3. Transport costs on the 1st mile.

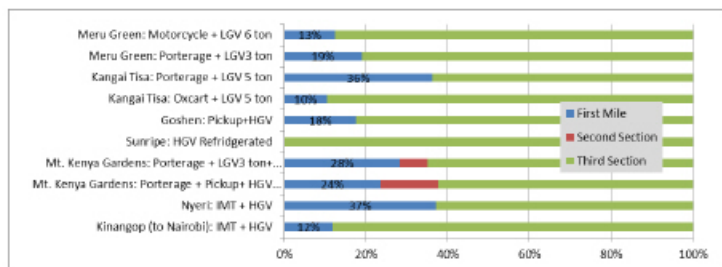


Figure 4. Cost share of transport sections of the logistic chains.

The case of onions in Nyeri where farmers coordinate their production and marketing shows that even in a steep and difficult transport terrain good organisation of the marketing system saves heavy local running for traders and this can drastically reduce the transport cost.

However, the cost efficiency of the chains, depicted in Figure 7, gives a better picture of the competitiveness. For the researched chains, it ranges between 16 and 72 Ksh/tonne-km. Highest specific costs are generated in Mwea for Kangai Tisa, where human portering makes up 36% of total transport costs. This again demonstrates the importance of the first mile. The graph shows as well, that the choice of the mode on the first mile has a considerable impact on overall costs. For example in Mwea (Kangai Tisa) the shift from portering to oxcart can half overall transport costs; in Meru the change from portering to motorcycle can reduce overall costs by roughly one third.

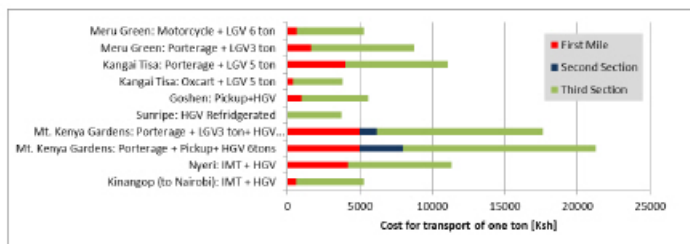


Figure 5. Costs to transport one ton on the logistic chains.

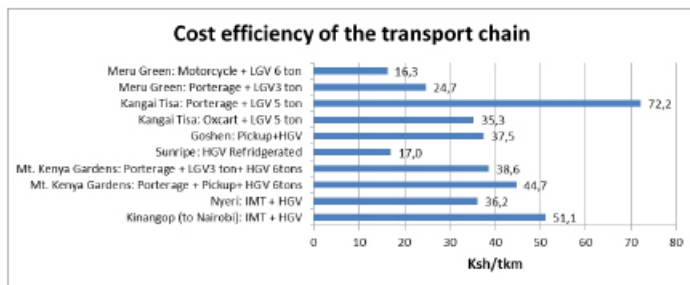


Figure 6. Overall cost efficiency of the chains.

The conventional approach would only analyse the costs of the motorised chain and try to improve its cost efficiency. A wider approach taking into account the first mile, finds that costs to transport products to collection points can make up a considerable share and thus influence overall costs considerably. These costs are mainly carried by the producers and thus reduce farmer's income significantly.

6. VALUE ADDED BY MODERN LOGISTIC CHAINS

A major source of income in developing countries can be generated through the processing of agricultural products. The common form of value addition across all the value chains consists of: production, sorting and grading, packaging, processing, transporting plus the profit margins. Value addition is described using the example of French Beans for consumption on the national market and for export to Europe. The wholesale price for French Beans on the national Kenya market ranges between Kshs 50 and 90 per kg. On the international markets wholesale prices of between Kshs 130 and 210 per kg may be achieved. For the purpose of this study, an average price of 70 Kshs/kg for national markets and 170 Ksh/kg for export markets has been assumed. Figure 8 below shows the national and international thresholds. Profit margins vary considerably. Clearly, international markets are extremely profitable but only for those that can access it and manage to stick to the stringent Global GAP regulations.

Production costs can be expressed through the farm-gate price, which farmers receive when selling their products at the farm-gate or at the grading shed. For French beans, these prices range between Kshs 30 and 55 per kg as depicted in Figure 7. Transport cost range between Kshs 3.7 and 5.9 per kg. Thus, transport only makes up a small share of the overall costs.

If export to the national wholesale market at average prices is assumed, the revenues for the farmers amount to between 43% and 79% of wholesale price (Figure 9). Transport cost only amount between 3% and 5%. The

remaining items contain the profit margin and the costs of the processing, packaging and grading. These vary between 5% and 16% of wholesale price. Thus, for the national markets profit margins are rather low. The latter rises considerably, if international markets are targeted. Profit margins may increase up to 79%. However, it has to be taken into account, that international markets only accept the highest quality. Even though profit margins seem to be low for the exporters, it is highly profitable to sell lower quality products to the national market instead of throwing it away.

Exporters reported that the international market is far from exhaustion. Thus, business growth for the French Bean commodity is only a matter of producing more high quality produce and transporting them to the export hubs.

7. FRAMEWORK FOR PLANNING OF MODERN LOGISTIC CHAINS

As already mentioned in the introductory text, the planning and implementation of Value Chains requires much more than just good roads.

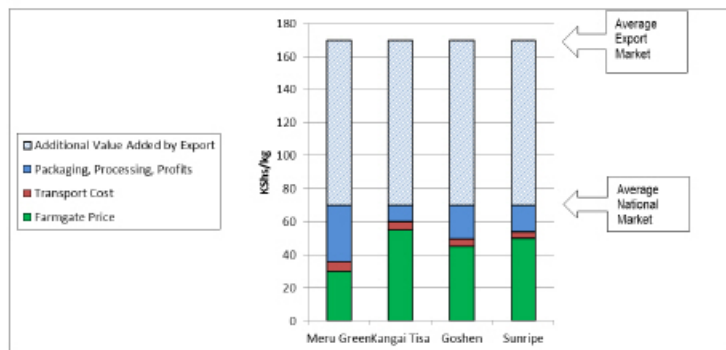


Figure 7. Value added to French Beans from farm to international market.

7.1. Essential Features of Modern Value Chains

Next to the above discussed transport issues, a number of features, such as grading, processing, packaging, storage and quality standards are essential for the functioning of value chains. The features, listed in Table 1, show that the requirements of logistic chains are dependent on the destination.

7.2. Impacts of Bad Roads on Transport Costs

Case examples from the research show that transport costs may increase considerably if roads are in a bad condition. During rains Mt Kenya Gardens has to use of a pickup instead of an 8-ton truck for the First Mile which increases overall transport cost by 16%. If the roads were in a good state and HGV could reach the fields in Nyeri directly, overall transport costs for potatoes could decrease by 59%.

Table 1. Essential facilities and components of Value Chains

	Local Market	National Market	International Market
Production	Production standards according to destination market. Grading leaves lowest quality to the local market highest to international markets.		
First Mile	Usually not cooled, accessibility during harvesting essential, high transport costs per tkm, road condition is essential for costs		
Remaining Logistic Chain	Local means, no cooling	Heat insulated trucks, air vent cooling or overnight transport	Refrigerated transport, pre-cooling
Grading facilities	Local Grading Sheds	Modern grading facilities usually next to cold storage facilities	
Storage	Charcoal Cooler, solar panel cooler	Refrigerated warehouse	
Packaging, Processing	None	Kenyan Standards	International standards including branding
Quality Standards	Kenyan Standard often circumvented	Kenyan Standards, often circumvented	International Standards

Both examples show, that applying simple cost-benefit assessments for rural roads is not enough. Usually, these assessments would only capture the cost difference in vehicle operating cost on a bad road compared to the same stretch of way on a well maintained road. As demonstrated above, the impacts of rural roads are much larger, since they include large detours, higher frequencies of trips, usage of more expensive means of transport or even the loss of harvests, if no transport is available. However, these assessments would require case-by-case studies for each road, which is usually not done.

Example Mt Kenya Gardens Transport of Bananas

Bananas are usually picked up by an 8-ton truck. During rains the truck is not able to serve the first mile, even though the main feeder roads are tarmacked. Instead a one-ton pickup is used to carry the bananas 65 km to Mt Kenya Garden's de-greening plant and cold store. The costs on this part of the chain increase by the factor 2.5, entailing an overall increase of transport costs on the whole logistic chain by 16%. Usually this cost increase is handed over to the producer through decreased farm gate prices.

7.3. Vehicle Hiring Services

If no commercial marketers are present or farmers prefer to market their products on their own, the provision of transport services are essential. In Kenya, the Horticultural Crops Development Authority (HCDA) once provided a variety of vehicles that groups of farmers could hire at a subsidised cost. This business soon collapsed due to unprofitability. However, as is the case with onion farmers in Kieni area, farmers who market in groups are nevertheless likely to get reasonably priced transport services though by joint negotiation with transporters/traders. They may even be organised enough to have their own truck, if this proves to be profitable when volumes are definite and consistent. Single medium scale

farmers with own trucks easily get a network of farmers to engage in their system, to generate the volumes needed for transport.

7.4. Farmer Groups and Cooperatives

The above research shows the importance of farmers to get organised. Loads need to be consolidated in collection points, where traders may pick them up. Before this is done, they must be graded according to the relevant national and international quality standards. Until the loads are collected they need to be stored and protected against heat and pests. Thus considerable investments on the village level are necessary, that include grading sheds, charcoal or solar panel cooling storage facilities and possibly the purchase of Intermediate Means of Transport to evacuate the harvest from the fields. But the activities of cooperatives do not stop there: farmers need training to comply their production processes with the quality standards. In Kenya Commercial Villages and Agribusiness Clusters are some of the organised marketing models being tried under NGO and private sector initiatives. These make a great positive difference across the entire chain.

7.5. Planning of New High Value Chains

The above discussion shows that a simple planning approach that focuses exclusively on rural road improvements is far too narrow in order to facilitate the development of modern Value Chains. Only an integrated regional planning method may tackle these challenges. This needs to take into account:

- Improvement of road conditions;
- organisation of farmers for marketing of products;
- establishing contacts to commercial marketing enterprises;

- facilitation of private investments in grading sheds, local cooling facilities, warehouses, vehicle fleet;
- endowment with modern communication facilities;
- provision of transport and vehicle hiring services; and
- training for the production according to quality standards.

According to Sieber (2009), at the regional level, conventional and modern transport chains may be planned using the approach of basic access provided by multimodal transport, embedded in the concept of central locations and combined with modern communication infrastructures. Central locations form a system of rural development nodes that serve as rural hubs for trans-shipment. The first mile is transported by IMT using low cost tracks and roads. In Rural hubs cargoes are trans-shipped onto motorized goods vehicles, from where they may use well maintained rural roads. The rural hubs are placed in central locations that function as buying points or local markets and provide information, communication technologies (ICT) services for rural producers. In these central locations facilities for cooling, refrigeration, processing and packaging may be provided for modern supply chains. Superior centres may additionally provide transport hiring services. For regional planning an interdisciplinary approach and the involvement of stakeholders, especially the private business sector is essential. The South African Rural Transport Strategy, for example, defines a number of investments in central locations as listed in Table 2.

Additionally, transport standards and other technical specifications of rural infrastructures are to be catered for by the central governments. Central government through decentralization and devolution programmes ensures local level planning is carried out by local actors including farmers and civil society. The participation of local stakeholders, from government, administration, private business and other non-government organizations is essential for the sustainability of the plans.

Table 2. Central locations and endowment as in the South African Rural Transport Strategy

Central Location	Function	Facilities for Traditional Supply Chains	Facilities for Modern Supply Chains	Communications Facilities
Satellite Centre	Buying point Trans-shipment hub	Short storage facilities Loading facilities	Pre-cooling facilities	Telephone Fax
Multi-Purpose Rural Service Centre	Local market Trans-shipment hub	Storage facilities Loading facilities Agricultural Extension Services Logistics Procurement Agency	Processing units Cooling and Refrigeration facilities Packaging houses Container handling	Telephone Fax Internet
Major Rural Service Centre	District market Trans-shipment hub	Additional to the above: Transport brokering service		

CONCLUSION

When the team visited Mwea it was surprised that seven commercial banks had their branches in this small town without any significant industries or major service enterprises. Obviously, the farming activities in the area were generating so much demand for credit and saving accounts that the banks were operating profitably. The team observed as well how fast the development in the region took place and people within a few years shifted from walking and bicycles to motorcycles. Obviously, modern value chains in the region were an important factor for local development and poverty alleviation.

The organisation of farmers played a salient role in the functioning of these value chains. One good example is Kangai Tisa, a cooperative that was formed in Mwea and now organises the marketing of French Beans. The

beans are grown by small scale farmers on 0.2 to half a hectare farmland, transported by IMT to the cooperative's charcoal cooler where they are graded and collected by commercial marketers, which bring them in cooled trucks to Nairobi. The highest quality is exported to Europe, while the rest is sold in the capital's supermarkets. Kangai Tisa ensures the compliance with the quality standards, the functioning of the cold storage and the maintenance of the grading shed. For this purpose, a share of the revenues is retained in the cooperative. In past years profits of the cooperative accumulated to an extent that the cooperative decided to finance the construction of a new maternity ward in the local hospital.

Other examples given in this article show that medium-scale producers, may profit equally from modern logistic chains. They typically lease medium size farms of 10-20 hectares and to supplement production, they may contract a number of small scale farmers around their core farm. For example Goshen farm has 10 active small scale contact farmers, who supply 10 - 20% of the volume for the enterprise. The farm has enough capital to purchase own vehicles and market their products on the national and international market.

The main question remains, how can planning stimulate such positive developments? One precondition is definitely a favourable agro-ecological farming environment, best with an irrigation system. Once this is given, regional planning can do a lot to facilitate the development of modern Value Chains by applying an interdisciplinary planning approach that includes not only infrastructures, but as well organisation and management issues. The above mentioned planning methodology from South Africa is a good example.

For rural road planning a widening of the approach is also necessary. A simple cost-benefit assessment will not reveal the full scale of benefits generated by rural road investments. The enabling environment of new road improvement has to be taken into account as well. However, as already discussed for decades, an adequate maintenance combined with spot improvements would help a lot.

Especially the transport costs on the first mile from the field to the collection point need more attention. Even though the average length of the

first mile makes up only 0.4% to 10.6% of the distance of the entire chain, it can make up one fifth of the total transport costs. The usage of Intermediate Means of Transport can reduce these costs significantly. Thus intermodal transport chains are an essential feature of agricultural Value Chains.

Finally, modern Value Chains provide not only benefits to the farmers, but as well to the service sector, such as marketers, forwarders, warehouse providers and the packaging industry. The research shows that the marketing of high value food items is much more profitable than the export of unprocessed products. The rising Kenyan middle class demands more high quality goods and European consumers are willing to pay for fresh products in the winter time. And even ecologically this makes sense, since the heating of greenhouses consumes more energy than transport by air. A win-win situation, which helps small scale farmers to escape the poverty trap.

REFERENCES

- Dawson, Jonathan. & Ian, Barwell. (1993). *Roads are Not Enough: New Perspectives on Rural Transport Planning in Developing Countries*.
- FAO. (2003). *Trade Reforms and Food Security: Conceptualizing the Linkages*, Food and Agriculture Organization, Rome, Italy.
- International Fund for Agricultural Development IFAD. (2011). *Rural Poverty Report 2011*.
- KENDAT, IFRTD, TCP International. (2013). *Rural Logistics for Smallholder Farmers to Meet New Agricultural Market Demands: Analysis of various Horticultural Value Chains*, Project AFCAP/GEN/060.
- Njenga, P., Wahome, G. & Hine, J. (2014). *Pilot Study On First Mile Transport Challenges In The Onion Small Holder Sector*. AFCAP.
- Reardon, Thomas. (2007). Transformation of markets for agricultural output in developing Countries since 1950: How has thinking changed?, in: *Handbook of Agricultural Economics*, Volume 3, p. 2808-2855.

Sieber, Niklas. (2009). *Leapfrogging from Rural Hubs to New Markets, Rural Transport in Developing Countries*; The International Bank for Reconstruction and Development/The World Bank.

Staatz, John M. & Niama, Nango Dembélé. (2007). *Agriculture for Development in Sub-Saharan Africa*, Background Paper for the World Development Report 2008.

Starkey, P. (2007). *The rapid assessment of rural transport services A methodology for the rapid acquisition of the key understanding required for informed transport planning*, SSATP Working Paper No. 87-A.

WDR. (2008). *World Development Report 2008*, World Bank, Washington.

ANNEXES

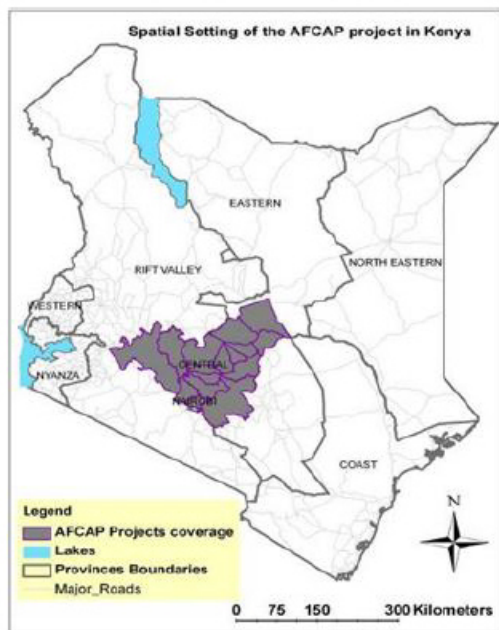


Figure 8. National spatial setting of the AFCAP project.

Table 3. Logistic chains studied

Marketer	Destination	Region	Product	Farm scale
Meru Greens Ltd	National Canning Factory for export	Meru	French Beans	Small scale
Kangai Tisa	Export Market	Mwea	French Beans	Small scale
Goshen Farm	Export Market	Mwala	French Beans	Medium scale
SUNRIPE Ltd	Export Market	Naivasha	French Beans	Large scale
Mt Kenya Gardens Ltd	National Niche Market (Supermarket)	Meru	Banana	Small scale
Commercial Villages: Farm Concern International	National Market	Nyeri	Onions	Small scale
Uncoordinated brokerage market	Local, Regional and National Market	Kinangop	Potatoes	Small scale



Figure 9.

Table 4. Organisational features of the observed value chains

Operational Aspect	Detail Aspect	Meru Greens beans	Kangai Tisa	Goshen Farm	Sunripe	Mt Kenya Gardens- Banana	Farm Concern Model	Kinangop Potato
Harvest	Minimise delays before cooling							
	Cool the product thoroughly as soon as possible							
Cooling	Store the produce at optimum temperature							
	Practice 'First in First out' rotation storage							
Temporary storage	Ship to market as soon as possible							
	Use refrigerated loading area							
Transport to market	Cool truck before loading							
	Avoid delays during transport							
	Monitor product temperature during transport							
Handling at destination	Use a refrigerated unloading area							
	Measure produce temperature							
	Move produce quickly to the proper storage area							
	Transport to retail markets in refrigerated trucks							
Handling at home or food service outlet	Display at proper temperature range							
	Store produce at proper temperature							
	Use the produce as soon as possible							

Legend:

	Carrying out practice		Shortcoming or limitations observed
--	-----------------------	--	-------------------------------------