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Evaluation of the cost-beneficial improvement of first mile access on small-scale farming and agricultural marketing

Phase 3 Report

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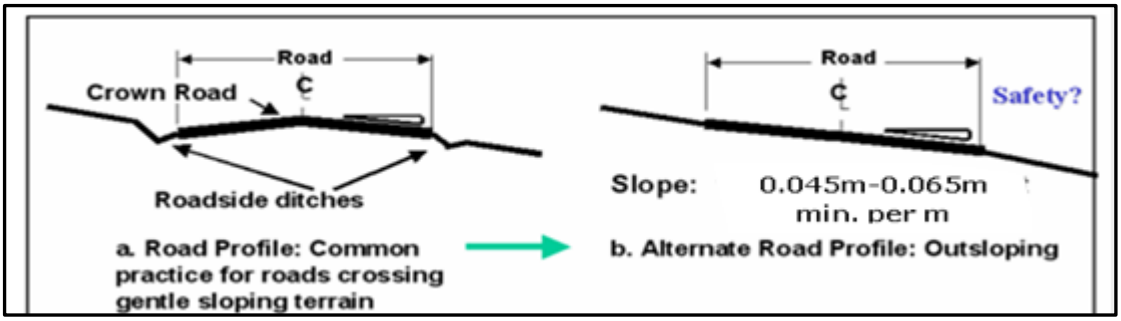

Abstract

TRL Limited and the International Forum for Rural Transport and Development (IFRTD) have been commissioned by the DFID funded Research for Community Access Partnership (ReCAP) to deliver this project which evaluates the cost-beneficial improvement of first mile access on small-scale farming and agricultural marketing. The project is concerned with improvement of 'First Mile' access and the transport services associated with transferring harvest produce on the initial stages of movement from the farm to established road access.

The Phase 2 Report provided a comprehensive literature review covering five key themes around First Mile access and the effect of road condition on agricultural marketing. A stakeholder workshop was conducted in each country in July 2017, at which two research sites were agreed for each country. The Phase 2 report set out the data collection methodology for Phase 3, including the mixed methods approach to fieldwork comprising questionnaire surveys, key informant interviews and focus group discussions.

The project has now conducted fieldwork in Kenya and Tanzania to explore transport service and engineering solutions for the provision of improved access to markets for small scale farmers. This data collection was undertaken from November 2017 to May 2018 at the two selected sites both in Kenya and in Tanzania. This data has been analysed in this report and some tentative conclusions have been drawn. The data analysis will be discussed at forthcoming stakeholder workshops in September 2018, held in each country. These workshops will also discuss recommendations and potential actions that can be included in the Phase 4 Final Report.

Key words

Transport services improvements; Transport services indicators; Traffic counts; Rural mobility; Rural road outcomes; Rural road impacts; Rural road preservation; Rural road provision

Acronyms, Units and Currencies

4WD	Four-Wheeled Drive
AfCAP	Africa Community Access Partnership
AsCAP	Asia Community Access Partnership
DFID	Department for International Development, UK (UKAid)
eg	for example
EU	European Union
FGD	Focus Group Discussion
GIS	Geographical Information System
GPS	Global Positioning System
HDM-4	Highway Development and Management Model
IFRTD	International Forum for Rural Transport and Development
IRF	International Roads Federation
IRI	International Roughness Index
KII	Key Informant Interview
LVRR	Low-Volume Rural Road
MDA	Ministries, Departments and Agencies
PIARC	Permanent International Association of Road Congresses
PMU	Project Management Unit
RAI	Rural Access Index
ReCAP	Research for Community Access Partnership
RTS	Rural Transport Services
RTSi	Rural Transport Services Indicator
SARF	South African Roads Federation
SSATP	Sub-Saharan Africa Transport Policy Program, World Bank, USA
ToR	Terms of Reference
TRL	Transport Research Laboratory
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
USA	United States of America

GBP	Great Britain Pound (UK pound sterling)
£	Great Britain Pound (UK pound sterling)
kg	kilogram
km	kilometre
KSh	Kenya Shilling
m	metre
s^2	per second squared
TSh	Tanzania Shilling
US$	United States Dollar

Executive Summary

TRL Limited and the International Forum for Rural Transport and Development (IFRTD) are delivering this project on the evaluation of the cost-beneficial improvement of first mile access on small-scale farming and agricultural marketing, on behalf of DFID for the Research for Community Access Partnership (ReCAP). The project is concerned with the improvement of the initial transport segment and the transport services associated with transferring harvest produce from the farm to established road access in Kenya and Tanzania.

This report sets out the key activities undertaken during Phase 3, including the data collection at all four study sites and subsequent analysis that has been included in this report. The report includes a full description of each site visited and information on the agricultural background, environment and road infrastructure situation.

Data collection was carried out using a variety of quantitative and qualitative tools. The survey instruments were agreed and tested before the full data collection commenced and are included in Annex 1 of this report. Quantitative tools included farmers and transporters questionnaires, and market surveys. Qualitative tools included key informant interviews and focus group discussions. IFRTD staff and local enumerators organised and carried out these surveys.

A large amount of data was collected and analysed at the TRL offices in UK. Results were disaggregated to highlight gender issues. A discussion section has been included which identifies the main findings from the research and how they are relevant to the main themes of this research. Some tentative recommendations have been identified which will be further discussed at the forthcoming country level workshops in September 2018.

The main findings were that:

- Overall the different analyses suggest that initial transport costs and crop losses account for reductions in the region of 30 to 40 % of net incomes of potatoes and pineapples in Tanzania. While for French beans in Kenya, the associated reduction in net incomes is around 10 to 15%.
- Another key factor affecting farmers' incomes was the degree of competition amongst buyers, especially in Kenya. Farmers in Meru received approximately half the price for their French beans than those in Kithimani. The buyer in Meru also discouraged the formation of a farmers' association.
- Initial high transport costs of head/backloading and other low capacity forms of transport are many times more expensive, expressed per tonne-km, than by trucks. Overall the analysis demonstrates the importance of reducing first mile transport costs and the associated crop losses to a minimum.

The report also includes sections on further research and next steps. Section 7 has identified areas where further research will enhance the understanding of farmers livelihoods as a result of road condition, such as looking at the secondary transport segment and understanding some of the less obvious results of the data collected. In Section 8 the team consider the next steps for the project, including planning for the forthcoming country level workshops and the final stakeholder workshop, as well as how capacity building and uptake and embedment can be achieved. Finally the tasks for Phase 4 are considered.

The project has had one scientific paper accepted at the SARF conference in Durban in October 2018. It has also had an abstract accepted at the PIARC conference in Arusha in November 2018. These two events will provide a good opportunity to disseminate the results of the project and build awareness of the issues related to First Mile access. A scientific paper for publication in a relevant journal is under preparation and will be completed by the end of the project in December 2018.

This research will add value to the body of evidence on First Mile access through investigation of a large sample of the small-scale farming population, taking account of the differences in transport costs and access constraints for well-connected and remote rural farmers located in the same market catchment, growing the same crops. It also assesses the potential for low-cost engineering measures to be used in the primary transport segment as part of community driven development projects going forward.

1 Background

1.1 Project Overview

The issue of 'First Mile' research was previously explored by IFRTD in two pilot studies covering the transport and marketing of onions in Kenya (Njenga et. al. 2014), and tomatoes in Tanzania (Njenga et al. 2015). The concept of 'First Mile' looks at the potential exploitable benefits of smallholder farming productivity and the impact that improved access to rural markets can have for local small-scale economies. The aim of this research is to extend the evidence base for the benefits associated with access improvements to small-scale farmers, and the potential impact that those benefits have on food security and poverty reduction on a much wider scale.

The second phase of the research included the following four key activities:

- A literature review of previous work on First Mile access
- Definition of the research questions and scope of work
- Identify research sites in Kenya and Tanzania
- Organise stakeholder workshops in Kenya and Tanzania

The Phase 2 Report can be located on the ReCAP website.

This third phase of the research has the following key objectives:

- Undertake targeted data collection as outlined in the Phase 2 report
- Summarise the implications of the research
- Identify how the research can be carried forward into practical applications
- Hold stakeholder workshops in Kenya and Tanzania

This report is a culmination of the activities shown above and provides a record of progress up to the end of Phase 3. During this time we have worked with counterparts from Ministries, Departments and Agencies (MDAs) in both countries and have visited the trial sites to monitor and advise on data collection. This report will be used to present the results of the data analysis at the stakeholder workshops, which are designed to inform stakeholders on the immediate outcomes of the project and to obtain views on the way forward. A summary of the stakeholder workshops will be included in the final version of this report.

Phase 4 will include drafting the range of outputs and a knowledge dissemination exercise for those most suited to output uptake at the farm and village level. A joint national/regional stakeholder workshop will be held in either Kenya or Tanzania to present the final outcomes and the proposed way forward.

1.2 Research Objective

The main objective of this project is to provide guidance on cost-beneficial improvement of all-season access at a range of levels from policymakers down to villages and small-scale farmers. The expected impact is improved access to markets for small-scale female and male farmers with reduced overheads and improved timeliness, with meaningful contributions to poverty reduction and food security.

The research will culminate in:

- Identification of the specific elements of the transport system that can be improved in order to unlock growth in the smallholder value chain sector.
- Better advice to road planners on the best location for access improvements.
- Quantification of the economic benefits of better initial access.
- A framework to provide advice to farmers and the authorities on the best pattern of transport in different circumstances.

- Better understanding of the role of different forms of transport in the small-scale agricultural environment, and the gender dimensions therein, and the needs to regulate them.

This research is being undertaken with the basic principles of capacity building, knowledge transfer, uptake and embedment in mind.

1.3 Approach and Methodology

The fieldwork has adopted a mixed methods approach comprising quantitative data collection, using detailed questionnaires across a large sample of the rural farming population, and qualitative data collection, using participatory techniques to engage with communities and stakeholders.

The field research was conducted at two site locations in each country. The sites were chosen to be characteristically similar with regards to the challenges that small-scale farmers experience in getting agricultural inputs from the market to the farms, and produce from the farms to the market. The main crop grown and marketed at each site did vary, to help establish any links between the road condition of the primary transport segment (First Mile), and its effect on the condition and quality of the agricultural produce.

The enumerators tried to identify a mixture of farmers that have 'well connected' First Mile access and those that have 'remote' First Mile access, but that produce and market the same principal crop for the same market catchment. This allowed us to compare farms in the same location and identify aspects of First Mile access that affect the economic returns for farmers as a result of impact on crop losses and productive capacity. This approach resulted in a smaller sample size in each location, but enabled us to compare different types of agricultural produce in geographically different areas of each country, within well-connected and remote rural communities.

All sites were restricted to smallholder farming and not large-scale cash crops or plantations, and at each location we obtained detailed information on commodity/farm produce prices, as well as costs of passenger transport and goods transport.

1.3.1 Engineering data collection

The method of engineering data collection was generally as proposed in the Phase 2 report. The condition assessment was carried out using a variety of means:

- Traditional visual surveys using a drive-through methodology, with the engineer and a technician in a 4WD vehicle. The vehicle stops at structures such as culverts to allow the engineer to exit the vehicle and inspect them. A representative sample of roads was assessed using this methodology, as it was deemed to be the most accurate.
- DashCam videos of the roads, mainly taken by the enumerators and assessed in the office by the engineer. This was used to assess all roads, as well as to clarify any issues and audit any conditions that were disputed. The limitations of this method include the accurate assessment of structures; for example to determine the condition of a culvert, it is necessary to inspect the inside of the culvert to see if it is obstructed or damaged. The underneath or inside of structures are not visible from these videos, although major damage can be noticed.
- Road roughness is usually measured in terms of the International Roughness Index (IRI). IRI is a standardised roughness measurement related to that obtained by response-type road roughness measurement systems, with recommended units: metres per kilometre (m/km). It is a ratio of accumulated suspension motion of a vehicle (m.) divided by the distance travelled by the vehicle during the test (km). It therefore follows that roads with high IRI will have a high detrimental effect on vehicle suspensions and the goods they carry.

New methods of measuring road condition and roughness are currently being developed. A quantitative assessment of road roughness in the study areas was measured using three methods:

- Maximum comfortable achievable vehicle speed. The World Bank scale for speed against condition was used for this assessment (Sayers et al, 1986). The DashCams recorded speed on all roads, with

the maximum and average speed recorded for each video, as well as continuous speed display throughout the videos.

- Smartphone app (RoadLab) developed by the World Bank to measure IRI using the accelerometer and gyroscope within the smartphone (Wang et al, 2016). Other apps have been developed for the same purpose, but the World Bank app was used because it is freely available to download. The results from these apps are considered to be variable as they depend greatly on the vehicle speed, how and where the vehicle is driven and the vehicle details (weight, suspension, tyre pressures, etc.), so the RoadLab results were used as a double-check only.
- Individual accelerometers were placed in goods vehicles; in amongst the produce when the vehicles were loaded. This method has been used in different instances in the past (Pretorius et al, 2012; Jarimopas et al, 2005). The accelerometers are switched on when they are placed, then retrieved and switched off when the vehicle reaches its destination.

The engineering focus of this research is unpaved roads which constitute the 'First Mile' access, with the majority being informal, unclassified, roads. Most of these 'First Mile' roads in the study area are of earth construction, with the main access roads (referred to hereafter as 'feeder' roads for ease of recognition) being gravel in Tanzania and paved in Kenya. In the context of this research, feeder roads lead from collection point to final market or factory. The measurements with the accelerometers were predominantly taken on earth roads that linked farms to collection points. Some were taken on main gravel access roads, but readings were only taken on a limited number of paved roads, for comparison purposes.

Readings were taken in May 2018, immediately following the wet season. This is when most of the roads were in a poor condition as they had been damaged during the rains and had not yet received any maintenance. This situation was similar in both Kenya and Tanzania.

1.3.2 Transport services data collection

The sample size for this research was proposed in the Phase 2 report and was based on providing statistically robust results and obtaining the necessary diversity to properly represent the population.

The fieldwork and data collection took longer to complete than expected, mainly due to poor weather and an extended wet season at the end of 2017/beginning of 2018. In Kenya there were also delays due to elections and consequent security concerns which prevented the teams from visiting field sites. Data collection began with a period of survey design, followed by enumerator training and piloting before field surveys began in earnest in January 2018.

The data collection tools comprised of the following:

- Farmer's household questionnaire
- Transport operator's questionnaire
- Farmer/seller market data questionnaire
- General market data questionnaire
- Focus group discussions
- Key informant checklist – Agriculture
- Key informant checklist - Infrastructure

The questionnaires and checklists are provided in Annex 1.

Quantitative data collection

In terms of quantitative data collection, the team used farmers' household questionnaires and transport service operators' questionnaires to gain information on the key dynamics of transportation and its relationship to the road condition of the First Mile. The questionnaires captured a wide range of information from details about the farmer and the crops they grow, quality and price, to transportation, accessibility and roads.

Data collection was challenging due to adverse weather and the geographic spread of farms in some areas, such as Machakos in Kenya. In both countries the enumerators visited the areas a second time in order to locate and survey additional farms. However, to extend the study area further would have meant including farmers who used different markets and routes, which was not acceptable within the original aims of the research. The number of responses are listed in Table 1.

Table 1: Survey Sample Size

Survey instrument	Kenya		Tanzania		Total
	Meru	Machakos	Matola	Madeke	
Farmer's Questionnaire	126	129	132	139	526
Transporter's Questionnaire	35	35	90	26	186
Market, seller/farmer produce data	4		10		14
Collection point/market general data	5		4		9
Key informant interviews	6		3		9
Focus Group Discussions	2		5		5

The final number of farmer's questionnaires completed was 271 for Tanzania, and 255 for Kenya and the teams have exhausted the possibilities for farmer's interviews in the extended areas selected, as noted above.

A rural transport service provider questionnaire was administered to boda boda (bicycle or motorcycle taxi) operators and traders who market produce using trucks, tractors and other motorised and non-motorised means of transport between the farms and markets. The estimated target sample size was 50-100 questionnaires in each country. In Kenya a total of 70 questionnaires were completed (35 in Meru, 35 in Machakos), and in Tanzania 116 were completed (26 in Madeke, 90 in Matola). The total was therefore 186, exceeding the expected number of responses.

Qualitative data collection

The qualitative data collection included Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), the checklists for which are provided in Annex 1. The methodology outlined in the Phase 2 report was followed for these meetings. KIIs were also carried out in each location, with a total of six undertaken in Kenya and three in Tanzania.

2 Overview of First Mile and the Provision-Preservation-Services Continuum

ReCAP projects are set within the provision – preservation – services continuum, which is particularly relevant to this project and transport on the 'First Mile' in general. This project considers the provision and preservation of the 'First Mile' in terms of the roads that are constructed and how they are maintained, against how they are used and what transport services are able to use them.

It is accepted that the condition of a rural road will influence the transport that is able to use the road. This research is designed to explore the effect that road condition has on the farmers who rely on the road to transport their crop from the farm to first collection point or market. In reality, the 'First Mile' can be very short, at a few hundred metres or less, up to several kilometres. The distance of the initial transport therefore also has a bearing on the condition of the crop, because if the crop is being damaged over a short length of poor road, this damage will be multiplied for longer lengths of road. The distance of the initial transport is therefore also an important aspect of road condition in terms of damage to the crops being transported.

Planning of rural roads very seldom includes consideration of the transport services that will eventually use them, apart from predicted traffic growth. This is where the 'services' part of the continuum needs to be considered at the provision stage, to ensure that the roads being constructed are appropriate and fit for purpose. There are plenty of examples worldwide of poor planning of rural roads, which consequently inhibits the development of transport services on those roads. This research was designed to inform the rural road planning process so that road construction and maintenance is appropriate for the use to which the rural road will be put, particularly with respect to the transportation of agricultural goods on those roads.

3 The Study Areas

It has proven to be difficult to select areas that have a variation in the condition of First Mile access roads. For consistency it is necessary that the farmer's data is collected in an area that has the same markets, so that the data collected can be compared on a consistent basis. It was hoped that there would be a wide variation in the quality and condition of the access roads that bear the burden of First Mile transport in these project study areas. However, in all cases the variation was found to be less than was hoped.

Logically this should not be surprising, because of the fact that the farms were in the same administrative area, so the access roads were all constructed in similar terrain and geology with similar materials, and receive similar attention in terms of maintenance. The roads were also constructed using similar technology and specifications within each administrative area, which means that they would be expected to exhibit similar modes and rates of deterioration. It is therefore entirely reasonable to expect the majority of roads to be showing the same condition. This is likely to be the case in the majority of administrative areas, due to the facts noted above.

There were two study areas in each country. These areas were selected in Phase 2 and were confirmed following the country level stakeholder workshops.

3.1 Kenya

In Kenya the study areas were located in Meru and Machakos respectively. This section introduces the two study sites in terms of location and environment. The map in Figure 1 shows the location of the two sites in Kenya.

Meru

The Meru County site is located in the Eastern Province, approximately five hours or 250 km north east of Nairobi by road, to the east of Mount Kenya with an altitude of 1,300 to 1,400 metres. It has a total population of about 1.4 million people and its inhabitants are made up of various ethnicities, including the Ngaa, Kikuyu, Embu and Kamba, amongst others. The climate is described as cool/warm, with temperatures ranging from highs of 20^{o}C in the cold season to 33^{o}C in the warm season. The average rainfall is up to 1,600 mm per year (Figure 2). This mix of good agricultural soils and favourable climatic conditions makes Meru one of the most agriculturally productive areas in Kenya, with crops varying from maize, sorghum and millet in the highlands, to bananas, tea and tobacco in the lower areas.

Figure 1: Study site locations in Kenya

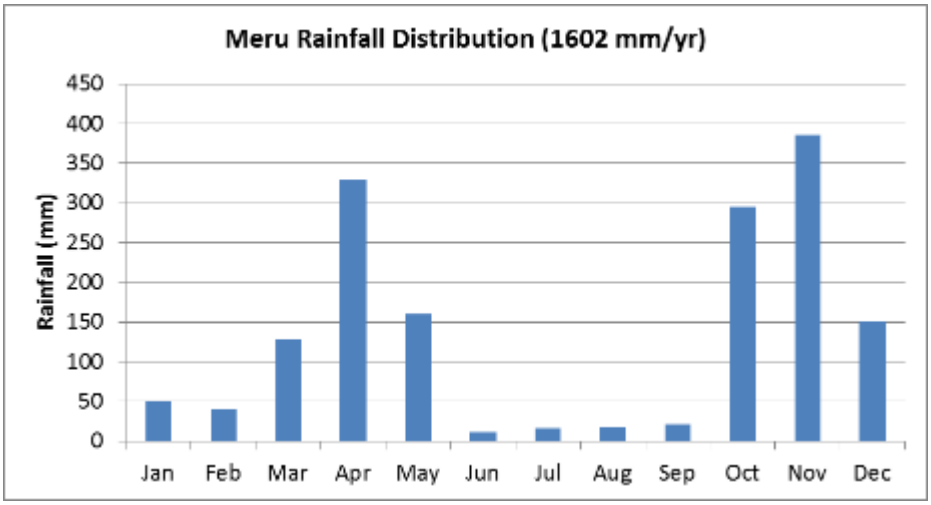

Figure 2: Meru rainfall distribution

source: https://en.climate-data.org

Source of data:

http://meru.go.ke/file/20140114_meru_county_media_profile.pdf

http://www.future-agricultures.org/wp-content/uploads/2018/01/Land-and-agricultural-commercialisation-in-Meru-County-Kenya-evidence-from-three-models.pdf

Machakos

The Machakos site is located to the north east of Nairobi, approximately 2 hours by road. It has a population of about 1.1 million people and its inhabitants are mainly of the Akamba ethnicity. The climate is described as semi-arid, with temperatures ranging from highs of 21°C in the cold season to 28°C in the warm season. The average rainfall is approximately 800 mm per year (Figure 3) and the altitude ranges from 1,000 to 1,600 metres. There are reasonable agricultural soils in Machakos, but rainfall is low, so irrigation or drought resistant crops are necessary. The main crops are beans and maize.

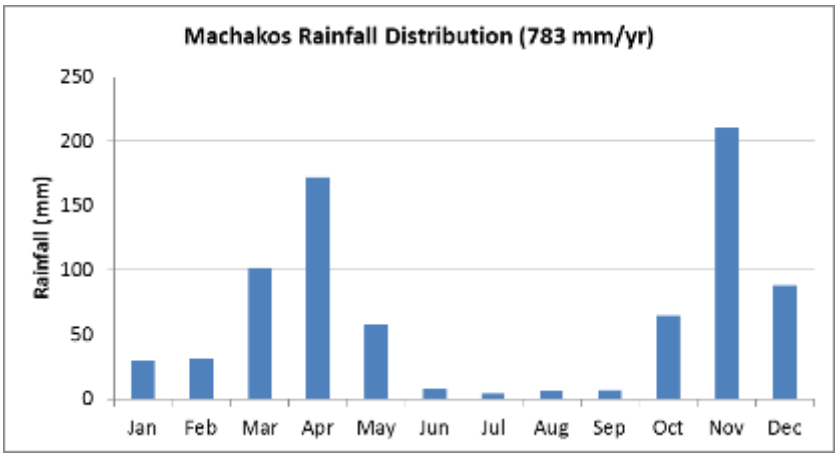

Figure 3: Machakos rainfall distribution

source: https://en.climate-data.org

Source of data:

http://countyonline.co.ke/machakos/

http://www.fao.org/docrep/x5301e/x5301e06.htm

3.1.1 Farming

Meru

The study area in Meru County is a fertile farming area. The specific farms that were investigated are located in a series of valleys east of Meru town. The main crops grown in the area are French beans and Arrowroot, with a variety of secondary crops. As the fields are in valleys, they have generally good access to water and an irrigation system is present, although there can be a lack of water during the dry season when areas have to be watered by hand, which is an onerous process.

There are many individual farmers with relatively small plots, some of which are owner-farmed and some are leased. There is no farmer's association or cooperative, so the farmers deal with the buyer directly at the collection point. The buyers do everything for the farmers, including providing seeds and fertiliser (on a cash-loan basis). The most productive farmers are retained in the future, which acts as an incentive to produce a high yield. Farmers must have an account in Equity Bank.

Machakos

Machakos is also a fertile area, but unlike Meru most of the farms are on higher ground and water has to be pumped from nearby streams or canals during dry periods. A canal was constructed in the area several decades ago and serves most of the area with water. The main crop is French beans, which are grown by the majority of farms. There are several other types of secondary crop grown, of which maize is the most popular, but French beans are by far the largest in volume.

Farms are mainly producer owned, but some are rented. The average area of the farms is larger than in Meru, but they are more widely spread. Collection and storage sheds are well organised and commonplace.

Some have a cooling facility that is made with charcoal walls that when damped will cool the produce inside and maintain its quality.

3.1.2 The road network

Meru

Access to the general agricultural area where the farms are located is good and the main collection point for the crops is located on a paved road with direct access to main routes to Nairobi, as shown on the map in

Figure 4. However, there is no effective road access from the main road where the collection point is situated to the valleys where the crops are grown. Roads were constructed by the local Counties some years ago, but the alignments were too steep and consequently quickly washed out. In some areas there are gullies up to 3 m deep where the road used to be. Five access roads were visited during the field trip and none were motorable by even light vehicles, with only one being accessible by motorcycle.

There is, therefore, a lack of motorable access to the farms in the study area, which means that crops must be carried by hand for between one and three kilometres from farm to collection point. There is no cooling facility at the collection centre, so ideally the crops should be transported on the same day that they are harvested. Farmers did express an interest in assisting with maintenance of the access roads, if they could be given some instruction on how to construct and maintain them.

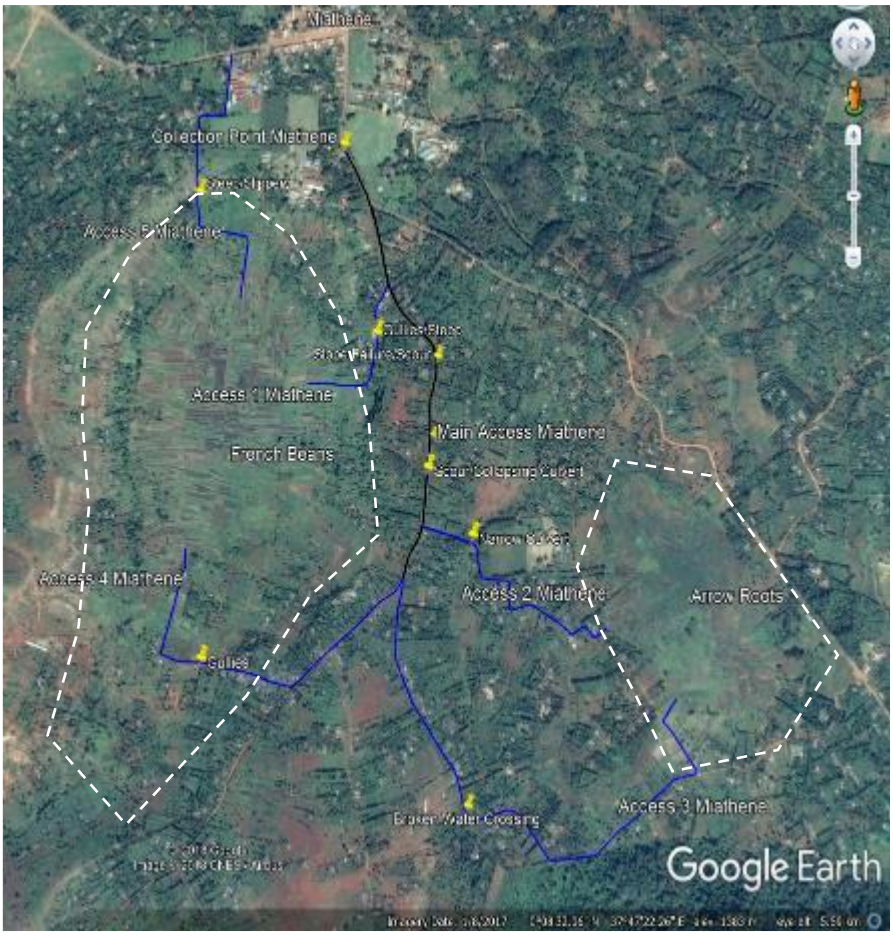

Figure 4: Meru study area

Machakos

The farms in Machakos are quite widely spread, with longer access roads on average than Meru. There are a variety of different conditions present on the access roads, but most are apparently motorable for the majority of the year. No complete washouts or inaccessible areas have been reported. The map in Figure 5 shows the main study area and key access roads. The main feeder road to the paved highway is in fair to good condition and provides good onward access.

Figure 5: Machakos study area

Machakos main feeder road

Figure 6 shows the feeder road from the main town Kalandini (outlined in red) to the study area, and is shown in colour, predominantly green and yellow. This is the GPS track downloaded from RoadLab, and the colours indicate the road roughness, with Green representing good, Yellow representing Fair and Red representing Poor.

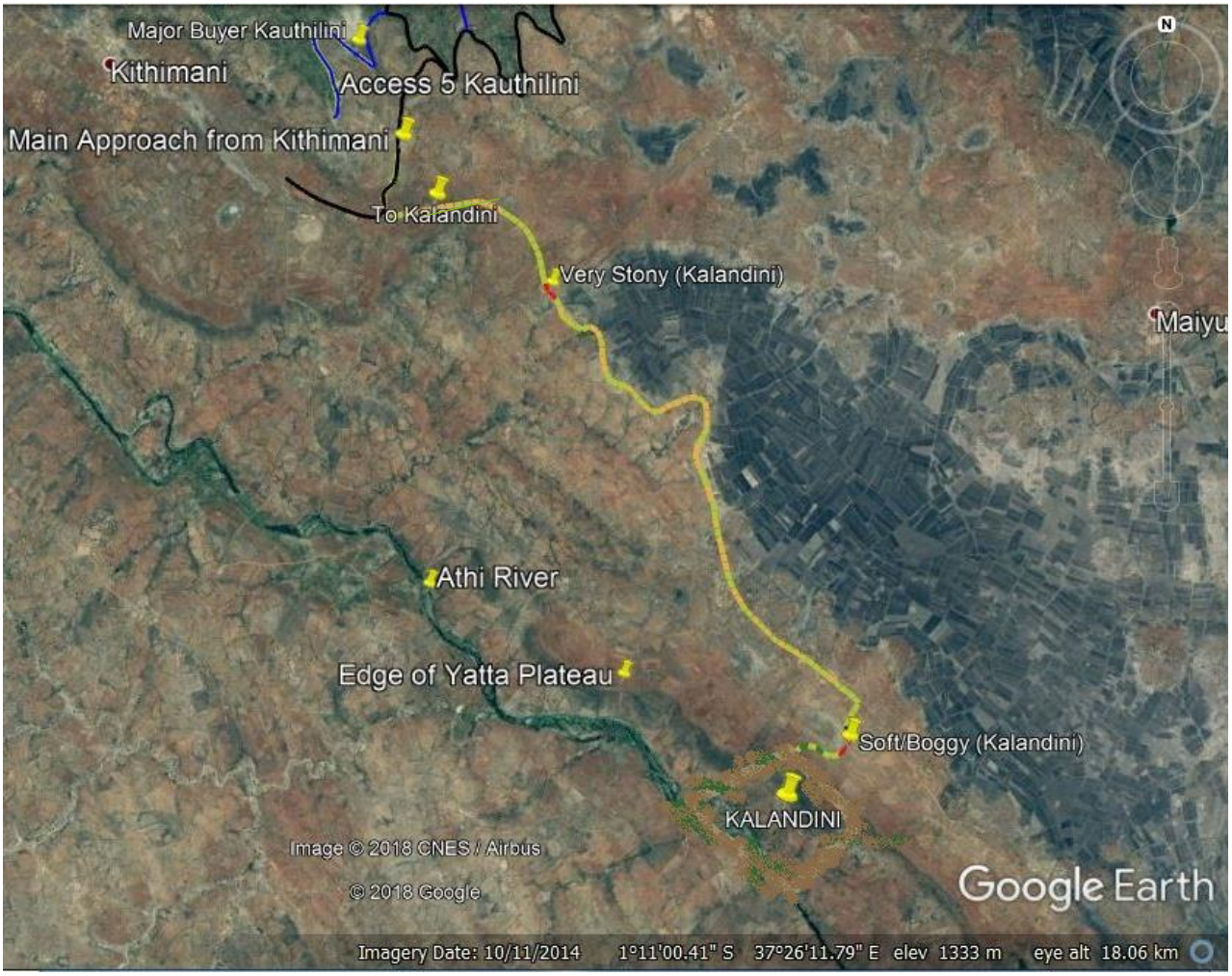

Figure 6: Machakos main feeder road

3.2 Tanzania

In Tanzania the study areas were located in Madeke and Matola respectively. This section introduces the two study sites in terms of location and environment. The map in Figure 7 shows the location of the two sites in Tanzania.

Madeke

The Madeke site is located approximately 100 km north east of Njombe, near Lupembe, in the south of Tanzania. This is a hilly area at altitudes ranging from 1,035 to 1,350 metres. Climate is temperate for most of the year, with average rainfall of about 1,800 mm per year (Figure 8). Njombe is the nearest main town/market.

Access is dependent on the road, and is unpredictable. If the road is inaccessible by the buyers' trucks, local transporters will make a deal with the farmers to try and take their produce to market and sell it, but this is unpredictable and the crop is often spoiled or undersold.

Figure 7: Tanzania study sites

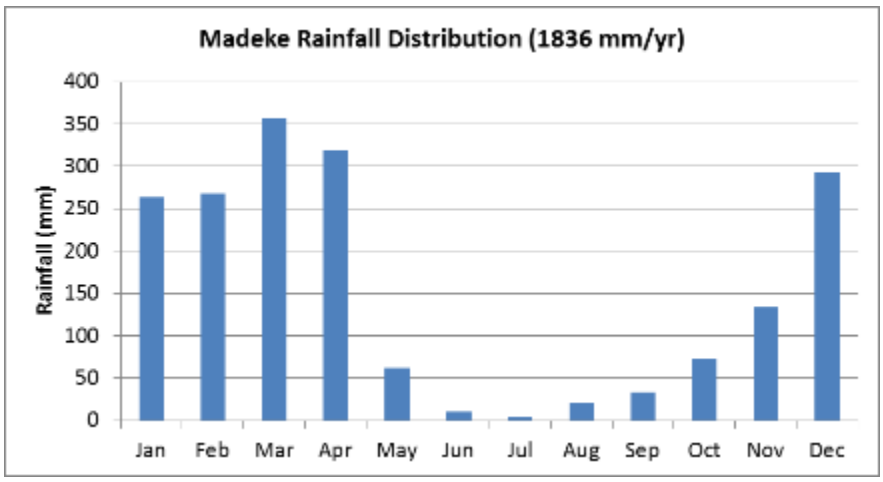

Figure 8: Madeke rainfall distribution

source: https://en.climate-data.org

Source of data:

http://www.kilimo.go.tz/index.php/en/maps/view/njombe-district

https://journalissues.org/wp-content/uploads/2016/04/Ngereza-and-Pawelzik.pdf

Matola

The Matola site is located approximately 60 km south east from Njombe, which is the nearest main town. Matola is a village and ward with a population of about 14,000. The climate is moderate, with the average temperature ranging from 15°C in the cold season to 21°C in the hot season. The annual rainfall is about 1,000 mm (Figure 9) and the farms are located at an altitude of approximately 2,100 to 2,300 metres.

Madeke and Matola are both in Njombe region, in which the Bena and Hehe ethnicities predominate.

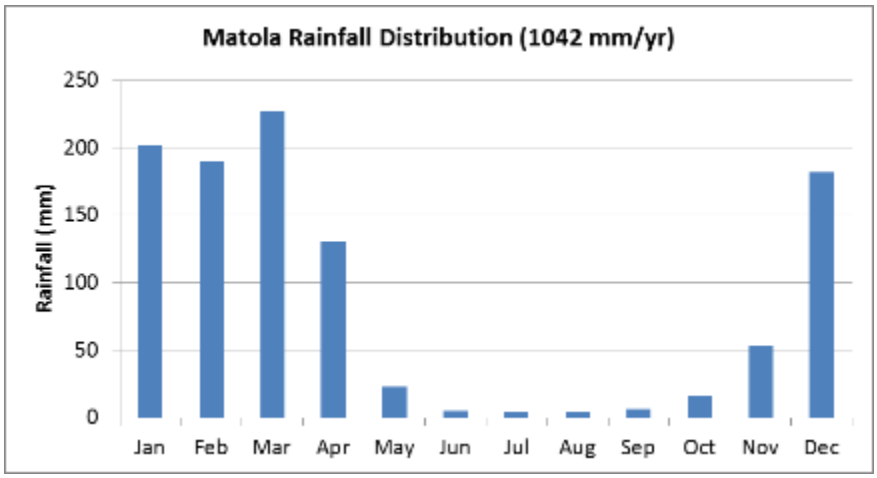

Figure 9: Matola rainfall distribution

source: https://en.climate-data.org

Source of data:

http://www.kilimo.go.tz/index.php/en/maps/view/njombe-district

http://ms-nado.blogspot.com/2008/12/nado-and-njombe-district.html

3.2.1 Farming

Madeke

The main crop in Madeke is pineapples, which are grown on steep slopes in relatively small farms. There is a government pineapple processing plant near Madeke, but it has never been operational and is only used for storage of crops at present. The agricultural area beyond 79 km on the main feeder road has been designated by the government for growing organic produce only.

Matola

The main crop is potatoes, with both round potatoes and Irish potatoes being grown. The average farm size is between 0.5 and 2 acres. The main issue is the lack of organised collection points, so farmers just bring their crop to the roadside when they can.

3.2.2 The road network

Madeke

The main feeder road from Njombe to Lupembe is gravel and of varying roughness. It is a long section, almost 100 km from the main road to the farms, so there is potential for crop damage during transportation on this road, in addition to that caused on First Mile access roads. There are also vulnerable sections that will render the road unmotorable during periods of prolonged heavy rain. Overall the gravel road is fair, with poor sections. The access roads that run from this road to the pineapple farms are mainly of earthen construction and in poor condition. One was impassable, even with little rain. In most cases the farmers bring their crops to the main road, where the buyers collect them.

The study area is shown in Figure 10 with a short section of the main feeder road to Njombe visible. The whole of the area shown is committed to growing pineapples.

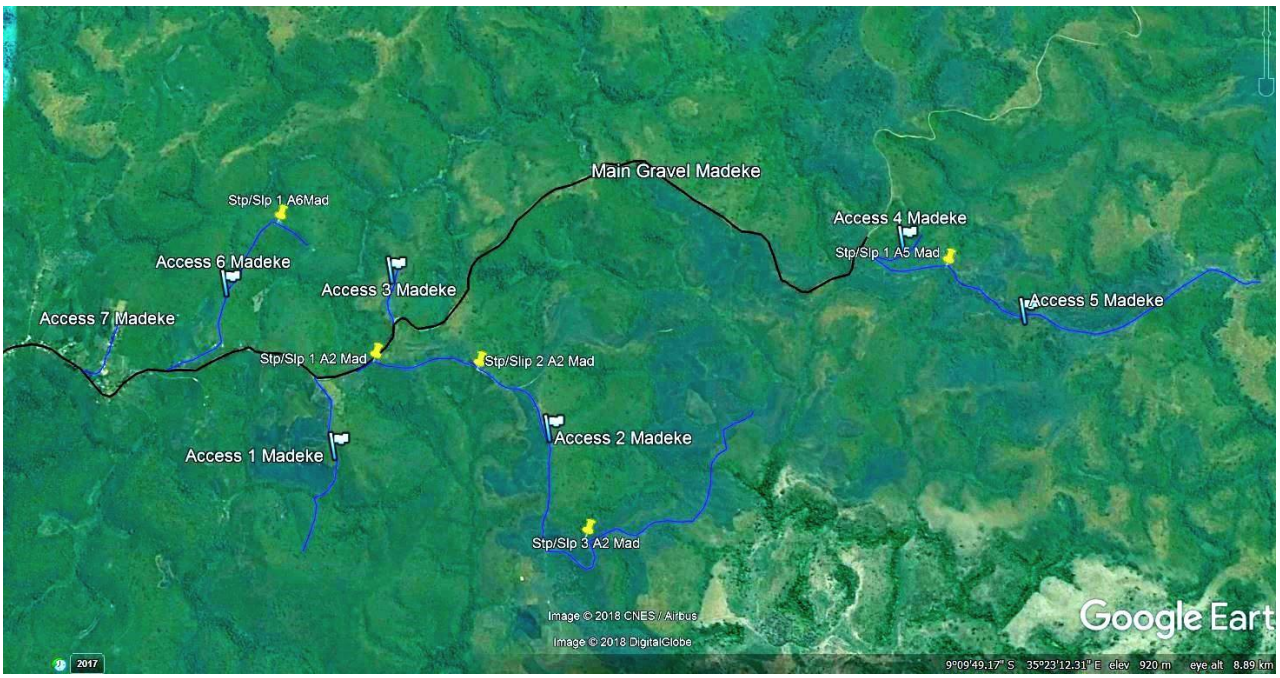

Figure 10: Madeke study area

Matola

Access from Njombe to Matola is via a fair to poor condition gravel road, which is vulnerable to seasonal rainfall. Farm access (First Mile) roads are predominantly of earthen construction, in fair to poor condition and are liable to closure during heavy rains. The length of these roads varies from less than 100m, up to 7 km.

Figure 11 shows the Matola study area, both sides of the main feeder road. The main feeder road runs through Matola on the way to Njombe. Most of the area to the west of Matola town is committed to growing potatoes.

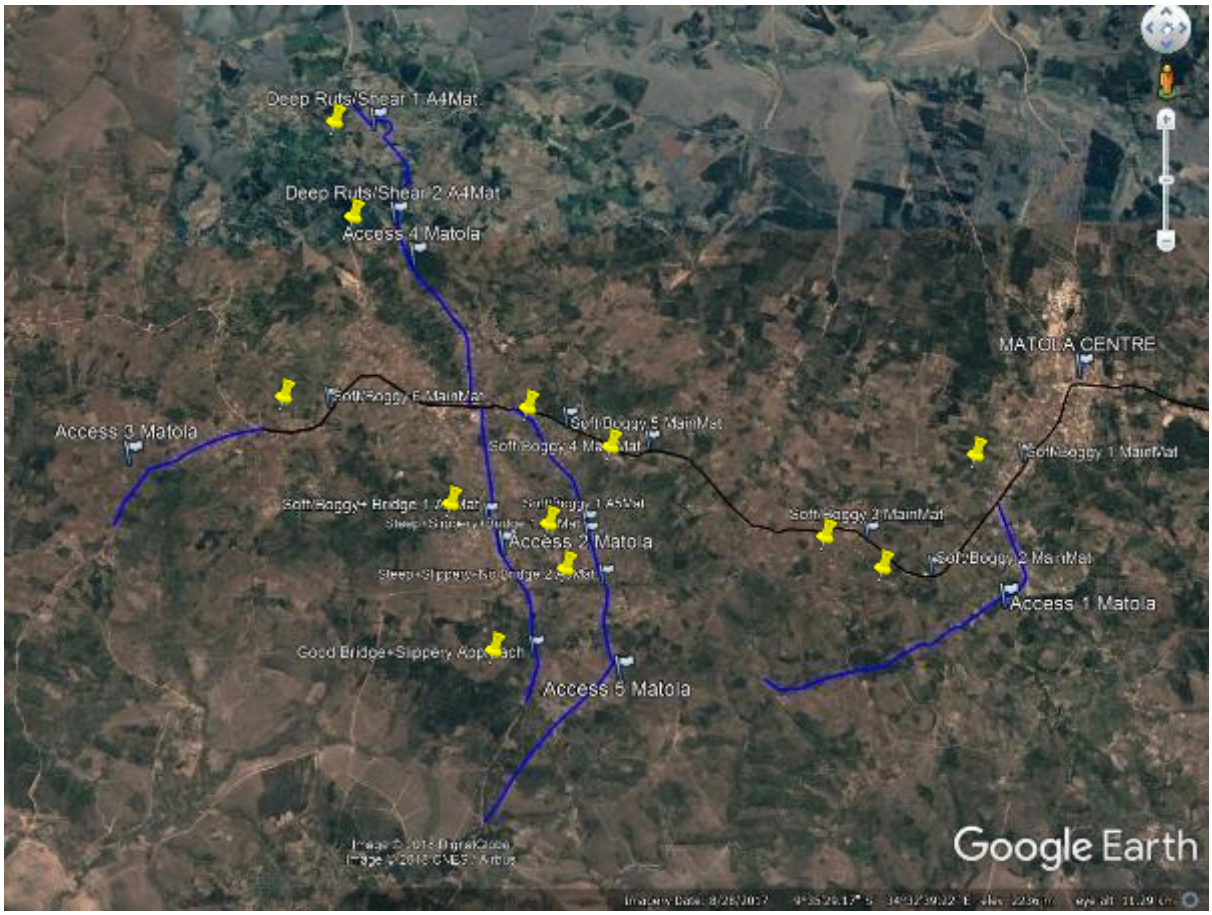

Figure 11: Matola study area

4 Survey Procedures: Data Collection and Auditing

4.1 Methodology for Data Collection

Access to the study/farming areas starts from primary roads with bituminous roads and leads to tertiary gravel roads into the farming villages/communities. From there it is necessary to access minor earth roads and tracks into the farms, which means that the first mile access to the majority of the study areas is along earth roads and tracks.

Data collection on 'First Mile' roads and tracks using standard survey equipment such as roughometers is not usually possible. The main reason for this is the poor condition of the roads, which means that the machines are unable to achieve the minimum required measurement speeds, often around 20 km/h. Also, the Roads Organisation is often concerned that the equipment will be damaged on very rough roads. The predominant method of condition assessment for gravel roads in the study countries is visual, normally from a vehicle.

The assessment of road/track condition for this project was therefore revised to take into account local conditions and accessibility. The revised methodology therefore comprised a combination of:

- Driving along the road to obtain an overview of the overall condition of the surface and visible drainage, normally side drains and turnouts.
- Walking along sections of the road/track and taking detailed notes of surface condition, as well as drainage condition and issues.
- Taking GPS coordinates of bottleneck spots and any issues that would affect the transport of produce.
- Review of videos recorded during the field exercise. These videos were taken with a DashCam fixed inside the vehicle and have mainly been used to assess road surface and side drainage condition. They also record the speed travelled, which can be used to estimate condition.
- Where the speed of travel permitted, estimates of road roughness were measured using the smart mobile phone application 'RoadLab Pro'. RoadLab Pro is an application developed by the World Bank and is freely available for download and use on smart mobile phones. The application requires a minimum travel speed of at least 15 km/h, if this is not achieved the app will not record any data.
- Since this speed is not easily attainable on most of the farm roads/tracks, portable accelerometers were used to measure the vertical accelerations experienced on these roads/tracks at comfortable travel speeds (usually less than 15 km/h). The vertical accelerations are a proxy for the bumpiness (roughness) experienced on the roads. The measurements enable an objective comparison of the condition of the roads/tracks.

Portable accelerometers have the advantage of being able to make measurements at any speed of travel. They are able to do this due to their high sensitivities and sampling rates (12 – 400 readings per second). Under this project, measurements were made on a very good road newly rehabilitated with asphalt overlay (IRI = 1.0 m/km) and on a good bituminous surfaced road (IRI = 3.0 m/km), to enable the reader to relate to the significance of the values obtained on the farm roads/tracks. The readings on the very good and good roads are provided in Table 2, whereas the readings on the farm roads/tracks are shown in subsequent sections of this report.

Table 2 Reference for comparison of vertical acceleration values

IRI (m/km)	Vertical Acceleration/ Bumpiness (m/s^2)	Vehicle Travel Speed at which Vertical Acceleration was Measured (km/h)	Description of Road Surface Condition
1.0	0.13	30	Very Good New Asphalt Overlay
1.0	0.16	80	
3.0	0.22	8	Good Bituminous Surfaced Road
3.0	0.28	17	
3.0	0.34	30	
3.0	0.43	80	

The road condition forms available in Kenya and Tanzania are not primarily designed for small farm access roads. The forms do not cater for the kinds of bottlenecks that greatly inhibit 'First Mile' access, for example slippery sections, boggy sections, etc. As a result, modifications had to be made to the forms to fit

the objectives of this study. The key used to describe the condition of the roads is as shown in Table 3. This is based on the Defect Identification and Data Collection Manual developed for Tanzania in 2005 (SMEC, 2005), which is the main guideline for condition surveys and inventory establishment in Tanzania.

Table 3 Guidance key to description of drainage and road conditions

Drainage Condition Key		**Road Surface Condition Key**	
Condition	**Description**	**Condition**	**Equivalent IRI (m/km) range**
1 = Good	Good shape and level, functioning effectively	1 = Good. Positive camber, effectively sheds water off the carriageway. No or few defects	5 – 10
2 = Fair	Defects and silting evident but drainage capacity adequate	2 = Fair. Medium frequency of defects, shape minimum to shed water off the carriageway	10 - 15
3 = Poor	Significant defects and silting evident, drainage capacity impaired	3 = Poor. Camber insufficient, water ponding, severe defects of medium frequency	15 - 20
4 = Bad	Serious scouring or complete blockage of significant length	4 = Bad. Substantial loss of camber, High frequency of severe defects, ruts 150 - 300 mm and gullies	>20
N = Non-existent	No planned side drains evident, manifested as slippery areas, extreme scour, muddy and boggy areas		

4.2 Road Condition Data

4.2.1 Kenya

Miathene, Meru

The biggest challenges in this study area are steep grades and slippery carriageways. Motorcycles cannot, or are unwilling, to traverse these tracks, as determined at the Focus Group Meeting. Head-loading therefore remains the principal means of transporting goods and produce. The condition of the roads and tracks are shown in Table 4. The steep grades (maximums of 34% on Access 1 and 18% on Access 4) are due to poor alignment of the roads/tracks. The alignments cut the contours at almost right angles in many cases, which means that the roads have been aligned directly down the slope, probably because this is the shortest route. In such situations it is good practice for road alignments to gradually rise or fall and incorporate hairpin bends to facilitate a reasonable gradient for the road. This however means longer roads incurring higher costs, and encroachment of farm land, so is not often a popular solution.

Table 4 Condition of the roads/tracks in Miathene, Meru

Road/Track No.	Length (km)	Overall Condition		Number of Bottlenecks	Mean Comf.[1] Speed (km/h)	Vertical Acceleration at Comf. Speed (m/s^2)		Bottlenecks Encountered Along Access
		Drain	Surface			Mean	Max	
Access Road 1	0.6	N	4	2	10	0.7	3.6[2]	Steep/Gullies/Slippery
Access Road 2	0.9	N	3	2	10	0.8	4.8	Scour/Collapsing Culvert
Access Road 3	2.0	N	3	2	10	0.7	4.0	Broken Water Crossing
Access Road 4	1.3	N	4	2	10	0.9	6.4[2]	Steep/Gullies/Slippery
Access Road 5	1.0	N	3	2	10	0.6	4.6[2]	Steep/Gullies/Slippery
Main Road to Collection	1.3	3	2	3	20	0.6	6.0	Slope Failure / Scour / Culvert

Notes:
1 Comf. = comfortable
2 Measured only on motorable section of the track

On the main gravel feeder road to the collection point there is a broken culvert that has narrowed the carriageway from 6 m to 3 m. Local people have used logs to support the broken part of the culvert. Heavy scouring from a culvert in another location on the same road will soon lead to the eventual collapse of a large section of the carriageway. The First Mile access roads lead from this road. On Access Road 2, there is also a collapsed/broken off culvert (see Figure 13), which has narrowed the road width. On Access Road 3 there is a broken water crossing structure / causeway totally cutting off access in the rainy season. There are deep gullies (up to 1.5 m deep – see Figure 12) on Access Road 4, thus leading to a narrowing of the width to less than 2 m at one point. As a result of this, the collection point was moved from only 500 m away to Miathene, 2.6 km away. These access routes are all slippery when wet.

Figure 12 Extreme gully and road with narrowing on Access Road 4, Miathene

Figure 13 Broken off culverts and road width narrowing on Access Road 2, Miathene

Regarding accelerometer readings, the overall indicator of the condition of the access road (including bumps) is the mean acceleration; the maximum acceleration value is a proxy indicator of the magnitude of

particular defects, for example a bump or a pothole. The bumps represent possible impact damage to goods when a loaded vehicle encounters them. In Note 2, below Table 4, states that measurement is carried out only on motorable sections because the condition of some access routes is so bad that no acceleration measurement can be made on the non-motorable sections. Therefore, it should not be surprising that a road with the poorest rating by visual condition assessment may not necessarily have the highest vertical accelerations because on some non-motorable sections it will not have been possible to take readings.

In both Kenya and Tanzania a visual condition survey is the recognised method of assessment of gravel and earth road conditions, so the result of these surveys would override the accelerometer readings. The accelerometer readings provide an objective descriptor of the road condition for motorable sections. In most cases the mean acceleration values are similar to each other, indicating that there are no major differences in the overall road condition. A relatively good condition road can have bumps, whereas a poorer condition road may have fewer bumps, but other issues such as slipperiness and soft areas, thus indicating a better ride condition on the poorer road with lower risk of goods damage caused by bumping.

The mean vertical acceleration and the maximum vertical acceleration are a potential method of objective comparison of the tracks. Access Road 4 has the highest values and indeed, it has the worst access when assessed using visual condition surveys. In addition, the maximum vertical acceleration usually occurs at locations of bumps (due to potholes or gullies) that represent potential locations for the damage of crops/produce, which are susceptible to damage by impact. For short sections and roads that are in poor condition, it can be hard to use these results to conclusively determine differences in condition, especially when there are only three categories, i.e. Good, Fair and Poor.

Description of road/track condition by Key Informant – Frigoken Field Agent Susan Kawira

Head/back loading is the main mode of transport and the travel time is 1-2 hours due to the steep terrain and poor access roads. Men use their shoulders and head, while women use their backs, to carry produce using sacks. The average weight of each sack is 30 kg.

The condition of the First Mile in Meru affects the quality of the produce due mainly to increased travel times. This increased travel time means that produce is exposed to the heat for longer periods and also spends longer in the carrying container.

Kauthilini and Kalandini, Machakos

There is no problem of steep gradients in the Kauthilini village area, however the track surfaces are slippery when wet and in some places where rainwater accumulates, soft muddy areas are created. Fortunately, this location receives lower levels of rainfall, up to 780 mm/year, so these adverse track conditions only last for a short part of the year. The access roads are poorly designated in terms of where they officially start and end, and are narrow in width. This prevents trucks from getting close to the farms, which means that motorcycle transport is therefore preferable. The conditions of the roads/tracks are given in Table 5.

The main problems affecting the roads/tracks in this area are illustrated in Figure 14. The delays encountered as a result of the road condition problems can lead to spoilage of produce through deterioration. On Access Road 4, there is a broken box culvert that has been rudimentarily repaired by the local motorcycle association. It was reported that overloaded trucks transporting sand led to the collapse of this culvert. On the major gravel feeder routes to the area, there are spots of seasonal flooding that cut off the village for a number of hours whenever the water crossings flood. Access road 5 exhibits no bottleneck to access for any vehicle type.

The overall visual surface condition shows little difference between the access roads or tracks. Likewise, the mean vertical acceleration readings show only minor differences between them. The maximum vertical acceleration on Access Road 4 at 9.7 m/s^2 is however significantly higher than for other tracks, which show values up to 6.6 m/s^2. The mean acceleration values have little correlation with lack of traction through slipperiness or muddy areas, indicating that there are no major differences in the overall road condition. A good condition road can have bumps whereas a poorer condition road may have fewer or no bumps thus indicating a better ride condition on the poorer road with lower risk of goods damage due to bumping.

Table 5 Condition of the roads/tracks in Kauthilini, Machakos

Access/Track No.	Length (km)	Overall Condition		Number of Bottlenecks	Mean Comf.[3] Speed (km/h)	Vertical Acceleration at Comf. Speed (m/s^2)		Bottlenecks Encountered Along Access
		Drain	Surface			Mean	Max	
Access Road 1	1.4	N	3	1	15	0.9	5.5	Slippery when wet
Access Road 2	1.0	N	3	1	15	0.7	5.5	Slippery when wet
Access Road 3	1.6	N	3	1	15	0.7	6.5	Slippery when wet
Access Road 4	2.6	N	3	3	20	0.8	9.7	Flooding/Water Crossing/Broken Culvert
Access Road 5	2.7	N	2	0	20	0.7	6.6	No bottlenecks
Main Access from Sofia	8.5	N	2	1	15	0.8	6.9	Flooding/Boggy Sections
Main Feeder from Kithimani	6.2	3	2	2	15	0.8	6.5	Flooding/Water Crossing
Main Road to Kalandini	12.3	3	2	3	25	0.6	6.7	Stony/Soft/Boggy Sections

Figure 14 Slippery muddy/boggy spot on Access Road 4, Kauthilini

A comparison of the vertical accelerations to which the crops are subjected during transportation is shown in Table 6. It is not surprising that transport by motorcycle subjects the crops to the highest values, but truck transport also shows high vertical acceleration results. As expected, the lowest values occur on bituminous surfaced roads as compared to earth or gravel roads. Fortunately, French beans are not highly susceptible to damage by impact compared to other crops and fruits.

Table 6 Comparison of vertical accelerations - Kauthilini, Machakos

Vehicle/Route/Loading	Surface Type	Vertical Acceleration at Typical Travel Speed (m/s^2)	
		Mean	Max
Car: Canal Rd: Loaded 8 bags	Gravel/Earth	0.7	8.8
Car: Canal Rd: Not loaded	Gravel/Earth	0.7	6.6
Motorcycle: Canal Rd: Loaded 6 bags	Gravel/Earth	1.7	14.8
Truck: Kauthilini - Kithimani: Loaded	Gravel/Earth	1.6	11.6
Truck: Kithimani - Nairobi: Loaded	Bituminous	0.6	6.9
Car: Kithimani-Nairobi: Not loaded	Bituminous	0.7	3.6

Description of road/track condition by Key Informant – Agronomist- Johnstone Kisingu Ndeng'e

This key informant describes the challenges facing the transport of crops by ox-cart, as shown in challenges.

Table 7. It is evident that the main challenge is the wet season impassability due to slippery and muddy surfaces. The steep climb at the edge of the Yatta plateau at Kalandini and the crossing of the Athi River also present significant challenges.

Table 7 Road condition challenges – Key Informant, Machakos

Area	Challenges	How it is challenging
Ndalani	Some feeder roads are impassable	Motorcycles and ox-carts cannot access during the rainy season
Kithimani	Some feeder roads are impassable	Motorcycles and ox-carts cannot access during the rainy season
Kinyata	Impassable roads due to hard-core rocks and steep hills	No other means except donkeys and head/back loading
Ekalakala	It is an island in Athi river, no feeder roads	Boats and donkeys take the produce to the nearest feeder roads

Description of road/track condition by Key Informant - Ox-cart Owner and COPIA household distributor- Joyce Mwongela

This key informant describes the challenges facing transport of crops by ox-cart as follows:

- Difficulty in crossing Kangalani Bridge and Katitika stream during the wet season. In the past a cart overturned at the bridge while transporting bananas to Sofia market.
- Slippery road surfaces. During the wet season the road is very slippery and the oxen will struggle to pull the carts. This increases the transport time and the produce will take longer to reach the market, leaving more time for deterioration.

Bottlenecks as described by farmers and transporters of the study areas in Kenya

Some farmers have their own means of transport and occasionally transport their crop to the collection point. Farmers and transporters were asked to list the four most crucial bottlenecks on the roads/tracks in their areas of operation. The results (Table 8) show that the three most mentioned challenges are thick mud when wet, slippery surfaces and steep gradients. When transporters were asked whether the condition of the path/track/road ever negatively affected the condition or value of the produce, about 51% said yes (

Table 9). The number seems low, probably because French beans are less susceptible to damage by impact from road condition than other crops such as potatoes, pineapples and other fruit. There was an overwhelming response by both groups that high roughness is the major challenge to transporters on the

roads/tracks in the dry season. The difference in perceptions could be due to the fact that farmers only occasionally experience the stated conditions, but transporters actually experience them all the time.

Table 8 Perception of bottlenecks by farmers and transporters, Kenya

Bottleneck	Farmers		Transporters	
	Number of responses	Percentage Responses	Number of responses	Percentage Responses
Vegetation too dense	50	9%	0	0%
Thick mud when wet	70	13%	57	35%
Slippery surface	118	22%	46	28%
Gradient too steep	158	30%	31	19%
Difficult waterway crossing	30	6%	29	18%
Path/track too narrow	107	20%	0	0%

Table 9 Effect of road condition on value of produce, Kenya

Question	Yes		No	
	Number of responses	Percentage Responses	Number of responses	Percentage Responses
Has the condition of the path/track/road ever negatively affected the condition or value of the produce?	36	51%	34	49%

4.2.2 Tanzania

Tanzania – Matola

The terrain is rolling with very few steep spots and the surface is very slippery in the wet season. The road leading to the farming community of Matola is very rough. Tracks to the farms can be accessed by truck in the dry season, but in wet weather the biggest challenges in this area tend to be slippery carriageways and boggy spots where trucks get stuck. The condition of the roads/tracks is shown in Table 10.

Table 10 Condition of the roads/tracks in Matola, Njombe

Access/Track No.	Length (km)	Overall Condition		Number of Bottlenecks	Mean Comf.[1] Speed (km/h)	Vertical Acceleration at Comf. Speed (m/s^2)		Bottlenecks Encountered Along Access
		Drain	Surface			Mean	Max	
Access Road 1	2.5	N	3	2	<15	0.8	5.8	Steep and Slippery spots
Access Road 2	2.1	N	3	2	<15	0.9	7.2	Slippery/Soft/Boggy spots
Access Road 3	3.0	N	3	2	<15	0.7	3.6[2]	Deep ruts/shear
Access Road 4	2.9	N	3	3	<15	1.2	6.4	Deep ruts/shear
Access Road 5	3.3	N	3	4	<15	0.7	5.7	Slippery/Soft/Boggy spots
Access Road 6	1.6	N	3	0	<15	1.0	7.9	No bottlenecks
Main Gravel Road (Matola)	8.6	2	2	6	25	0.7	3.4	Soft/Boggy spots

Notes

1 Comf. = comfortable
2 Measured only on motorable section of the track

All the access roads exhibit bottlenecks associated with weak soft subgrades, as shown in Figure 15. Access Roads 3 and 4 exhibit areas with deep ruts, and so still present an accessibility problem for trucks and ox–carts. Rather surprisingly, the main gravel road leading to the access tracks exhibits several spots that are soft and boggy, where apparently trucks often become stuck. Water levels at crossings located on some of these tracks swell seasonally with heavy rain, inhibiting access for all means of transport.

The overall visual surface condition shows no major difference between the tracks. However, the accelerometer readings do show some significant differences between them. This is explained by the limited ability of visual condition survey systems to capture bumpiness of roads/tracks. The mean vertical acceleration and the maximum vertical acceleration are a good method to objectively compare the tracks. Access Road 6 has the highest values, but no bottlenecks were observed along its length. This is because the road is generally rough, but does not have slippery sections or muddy/boggy sections.

A comparison of the vertical accelerations to which the potatoes are subjected during transportation is shown in Table 11, with the highest being 9.5 m/s^2. Since transporters have reported damage to these crops during transport, such high values of acceleration due to the road condition are an indicator of damage expected on other roads of similar standard. Potatoes are susceptible to damage by impact, compared to other crops like French beans (Kenya).

Table 11 Comparison of vertical accelerations – Matola, Njombe

Vehicle/Route/Loading	Surface Type	Vertical Acceleration at Typical Travel Speed (m/s^2)	
		Mean	Max
Car: Matola Area (Accesses)	Earth	0.9	6.1
Car: Mbega-Matola (Main Gravel)	Gravel	0.5	6.0
Truck: Farm-Mbega 1 (Access): Loaded	Gravel	0.7	5.6
Truck: Farm-Mbega 2 (Access): Loaded	Gravel	0.9	9.5
Truck: Matola-ilala (Main Gravel): Loaded	Gravel	1.2	7.5
Truck: Mbega-Matola (Main Gravel): Loaded	Gravel	0.8	8.3
Truck: Mbega-Matola 2 (Main Gravel): Loaded	Gravel	0.8	5.2

Figure 15 Soft/Boggy spot leading to water crossing in Matola

Tanzania – Madeke

In Madeke the terrain is hilly/mountainous (very steep in places). Deep side drains (no proper crossing) often inhibit access from the main gravel roads to the farm tracks. The tracks are often very steep (grades of up to 25% on many tracks), and in some cases run perpendicular to the map contours – as they do in Miathene, Meru. The surfaces are very slippery (black clays underlain by plastic red clays), and to aggravate the situation further, the area receives high rainfall of more than 1800 mm/year on average. The conditions of the roads/tracks are shown in

Table 12.

The main gravel road has coarse gravel surfacing on many steep sections, this solves the problem of slipperiness in the wet season, but the coarse gravels present a problem of high roughness.

Table 12 Condition of the roads/tracks in Madeke, Njombe

Access/Track No.	Length (km)	Overall Condition		Number of Bottlenecks	Mean Comf.[3] Speed (km/h)	Vertical Acceleration at Comf. Speed (m/s^2)		Bottlenecks Encountered Along Access
		Drain	Surface			Mean	Max	
Access Road 1	1.2	N	3	6	<15	0.8	5.8	Side drain / Steep / Slippery when wet
Access Road 2	4.4	N	3	5	<15	0.9	7.2	Side drain / Steep / Slippery when wet
Access Road 3	0.4	N	3	2	<15	0.7	3.6	Steep/Slippery when wet
Access Road 4	0.5	N	3	2	<15	1.2	6.4	Steep/Slippery when wet
Access Road 5	3.0	N	3	2	<15	0.7	5.7	Steep/Slippery when wet
Access Road 6	1.6	N	3	2	<15	1.0	7.9	Steep/Slippery when wet
Access Road 7	0.5	N	3	0	<15	0.7	3.4	Steep/Slippery when wet
Access Road 8	4.3	N	3	5	<15	1.0	9.1	Side drain / Steep / Slippery when wet
Main Gravel Road (Madeke-A1)	12.2	2	2	0	50	0.5	3.9	

All the access roads exhibit bottlenecks associated with steep and slippery surfaces, as shown in Figure 16. The main gravel road leading to the village of Madeke exhibits several spots that are soft and boggy (see Figure 17). Apparently, trucks often become stuck in these areas.

As mentioned before, the mean vertical acceleration and the maximum vertical acceleration are a good method of objective comparison of the tracks. The overall visual surface condition shows no difference between the tracks, however the accelerometer readings do show some significant differences. A marked difference is also observed between the main gravel road and the farm tracks.

A comparison of the vertical accelerations to which the pineapples are subjected to during transportation is shown in Table 13. During truck transport, the pineapples are subjected to high vertical accelerations (highest recorded 13.1 m/s^2). Since transporters have reported damage to the crop during transport, such high values of acceleration due to the road condition are an indicator of damage expected on other roads of similar standard. Pineapples are susceptible to damage by impact compared to other crops like French beans (Kenya).

Figure 16 Steep and slippery section in Madeke, Access Rd. 7

Figure 17 Slippery, rutted and boggy spot on major route to Madeke, A1

Table 13 Comparison of vertical accelerations – Madeke, Njombe

Vehicle/Route/Loading	Surface Type	Vertical Acceleration at Typical Travel Speed (m/s^2)	
		Mean	Max
Car: Madeke Area (Main Gravel): Not Loaded	Gravel	0.5	3.9
Car: Madeke Area (Accesses): Not Loaded	Earth	0.9	6.1
Truck: Farm-Collection Point (Access): Loaded	Earth	0.6	5.4
Truck: Madeke - Igombola (Main Gravel): Loaded	Gravel	0.6	6.9
Truck: Collection Point - Igombola (Main Gravel): Loaded	Gravel	0.7	13.1
Truck: Madeke - Ipulwa (Main Gravel): Loaded	Gravel	0.7	8.0

Description of road/track condition by Key Informant – Eng. Kalesi, is a District Engineer for Njombe District Council

The main access problem from farm to collection point is:

a) High road roughness

b) Water crossing, slippery surface and steep gradient

These issues can be addressed by:

a) Constructing standard gravel roads and providing drainage structures such as bridges and culverts.

For rural feeder roads the main access problems are:

a) Water crossing, slippery surface and steep gradient

These issues can be addressed by:

a) Constructing standard gravel roads and providing drainage structures such as bridges and culverts.

Challenges faced in the provision of roads constructed to serve small scale farms are:

a) Insufficient funds for maintenance of the roads

b) Lack of training to the community in labour based technologies for road construction

Bottlenecks as described by farmers and transporters of the study areas in Tanzania

Some farmers have their own means of transport and occasionally transport their crop to the collection point. Farmers and transporters were asked to list the four most crucial bottlenecks on the roads/tracks in their areas of operation. The results (see Table 14) show that the three challenges of thick mud when wet, slippery surface, and steep gradients still feature strongly – as in Matola. However, for farmers, the three most important challenges are steep gradients, narrow tracks and slippery surfaces. Whereas for transporters, the three most important challenges are difficulties with water crossings, slippery surfaces and thick mud when wet. Again, the difference in perceptions is likely to be due to the fact that farmers only occasionally experience the conditions, but transporters actually experience them all the time. It is unusual that transporters are not concerned with steep gradients, but are more concerned with water crossings. When transporters were asked whether the condition of the path/track/road ever negatively affected the condition or value of the produce, about 97% concurred (see Table 15) - compared to 51% in Kenya. This is because potatoes and pineapples (Tanzania study area) are more susceptible to damage by impact from road condition in comparison to French beans (Kenya study area). In the dry seasons, there is an overwhelming response by both groups that high roughness is the major challenge on the study roads/tracks.

Table 14 Perception of bottlenecks by farmers and transporters, Tanzania

Bottleneck	Farmers		Transporters	
	Number of responses	Percentage Responses	Number of responses	Percentage Responses
Vegetation too dense	14	4%	0	0%
Thick mud when wet	43	13%	23	29%
Slippery surface	68	21%	27	34%
Gradient too steep	99	30%	0	0%
Difficult waterway crossing	21	6%	30	38%
Path/track too narrow	82	25%	0	0%

Table 15 Perception of negative effects of road condition on produce, Tanzania

Question	Yes		No	
	Number of responses	Percentage Responses	Number of responses	Percentage Responses
Has the condition of the path/track/road ever negatively affected the condition or value of the produce?	113	97%	3	3%

Interesting changes in road condition

Measurements with the portable accelerometer show that unsurfaced roads exposed to heavy rain experience a significant increase in vertical acceleration (see Table 16). This is due to increased deterioration (gullies, potholes, etc.) caused by rainfall runoff and the action of traffic.

Table 16 Comparison of condition before and after rainy season

Road/Access	Before Rainy Season		After Rainy Season	
	Mean	Maximum	Mean	Maximum
Main Feeder from Sofia	0.8	6.9	1.2	8.7
Main Feeder from Kithimani	0.8	4.9	1.3	11.1

Measurements with the portable accelerometer show that grading and compaction significantly decrease the vertical acceleration (see Table 17). It further shows that the vertical acceleration increases significantly some weeks after the maintenance intervention, implying that deterioration back to a poor condition is rapid.

Table 17 Comparison of conditions after grading

Road/Access	3 Months before grading and compaction		Immediately after grading and compaction		Weeks after grading and compaction	
	Mean	Maximum	Mean	Maximum	Mean	Maximum
Major Gravel Road from Njombe to Matola Town/Village	0.7	9.1	0.4	3.4	0.5	6.1

4.2.3 Road condition discussion

The First Mile access tracks/roads studied are generally of earth construction with no engineered design. In many cases, especially in Miathene (Kenya), Madeke and Matola (both study areas in Tanzania), the tracks/roads have been constructed using the 'trench-type' construction (see Figure 18). This allows rainfall to run directly along the carriageway, creating gullies and/or a very slippery carriageway. It is understood that this type of construction minimises the risk of vehicles running off the edge of the carriageway in steep areas.

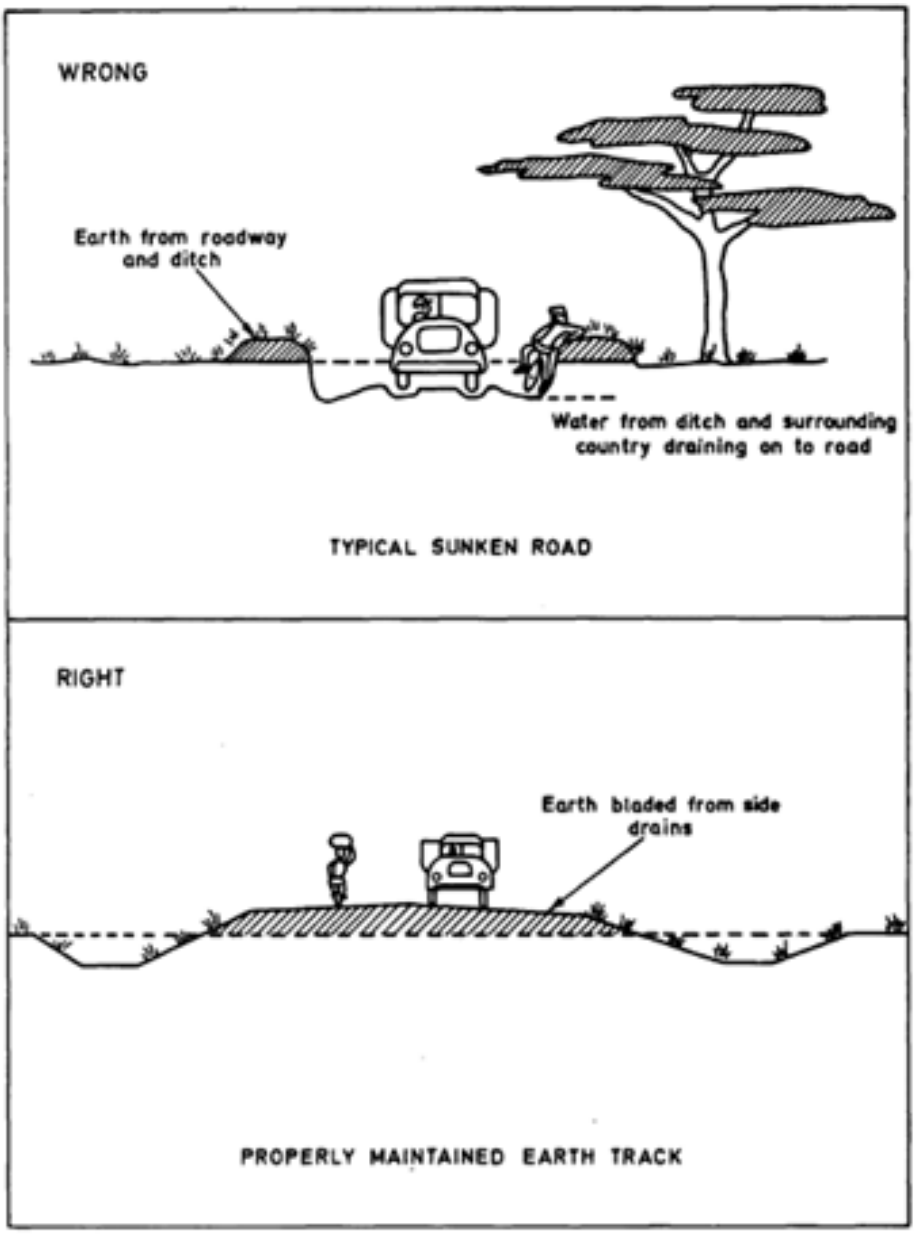

Figure 18: Trench-type construction and its correction

Source: (O'Reilly & Millard, 1969)

As discussed in Section 4.2.1, the condition of the access roads can be regarded as poor with few, but significant, bottlenecks. Since the majority of the access roads are not engineered, the drainage system is very poor. As a consequence of the poor drainage, the tracks/roads develop muddy/boggy spots or deep gullies that run haphazardly along the length of the carriageway. These two major defects strongly discourage or prevent access to trucks. Motorcycles are more manoeuvrable in these conditions, but the often wet and slippery subgrades have led to riders falling from their motorcycles.

Broken culverts/water crossings and seasonally flooded water crossings also present major bottlenecks. As there is no guarantee that these roads will be accessible, transporters are forced to take other often longer routes.

Steep gradients pose a major challenge and hindrance to all forms of transport. In some cases these tracks/roads have extreme gradients of more than 18%, which cannot be navigated by heavily loaded trucks. The problem is aggravated in the rainy season when these steep gradients are accompanied by slippery road surfaces.

To solve the problems of thick mud and slippery surfaces, there is a need to upgrade the tracks to a minimum standard of engineered earth roads with proper and adequate side drains. The 'First Mile' roads included in this study overwhelmingly have no drainage. On sections that turn out to be muddy and boggy the shape of the earth road and the drainage is very important to prevent standing water, which will quickly soften the surface. Gravel should be applied, but will only be effective if drainage and shape are maintained. Ox-carts can be used to haul these gravels or better soils if they occur nearby. It is possible that the farmers would be willing to do this.

In such terrain as Matola and Madeke (both Tanzania study areas), the 'trench-type' carriageway geometry could be used if effective drainage could be installed (Figure 19), although this would be a last resort as trench type roads are inherently a poor option. This would also necessitate farmers to accept drain water to be discharged over their farmland, which may be resisted. If the 'trench-type' construction was to be retained for vehicle safety reasons, then outlets for rainfall runoff should be provided at regular intervals to improve drainage and prevent overly wet carriageways and the formation of gullies.

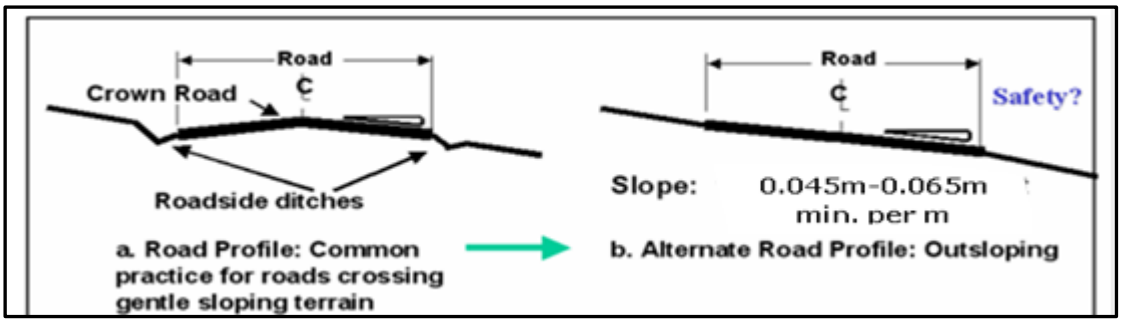

Figure 19: Crown vs Outslope

Source: (Gesford & Anderson, 2006)

Engineered earth roads with appropriate drainage will dry out more quickly and allow the slippery surfaces to return to normal after a few hours or days.

The gradient of steep tracks can be mitigated by realignment. In many cases, as in Miathene (Kenya), the steep gradients have led to severe erosion and gullies. However, realigning the tracks would require cooperation between the farmers since additional land would be required, and this land is likely to be productive arable land. This is not easy to achieve as farmers will be reluctant to lose land, so a cooperative approach could be employed whereby the famers who lose land would be compensated from within the farming community. A more expensive alternative to realignment for roads up to 12% is to provide bituminous surfacing and lined drains, otherwise stone or concrete is more appropriate.

To solve the issue of water crossings, more capital-intensive intervention is required in the form of constructing box culverts and causeways at strategic locations to provide year round access.

Narrow tracks should be widened if farmers are willing to give up land for the widening.

For all these proposed solutions, the community could provide inputs such as labour and simple tools. Ox-carts could be used to ferry gravel or better soils from nearby locations.

It has also been noted that the feeder roads in this study present very high roughness (Figure 20) and include several bottlenecks (e.g. muddy/boggy spots - Figure 17). Note the high roughness values, in blue and maroon in Figure 20, of the feeder roads. These obviously lead to deterioration of the quality of some crops. Owing to the higher speeds of travel in the feeder, there could even be a higher level of damage on these roads – this can only be confirmed or refuted by carrying out research that would track the deterioration of different kinds of harvest from farms, through the different transport segments, until the airport where they are exported.

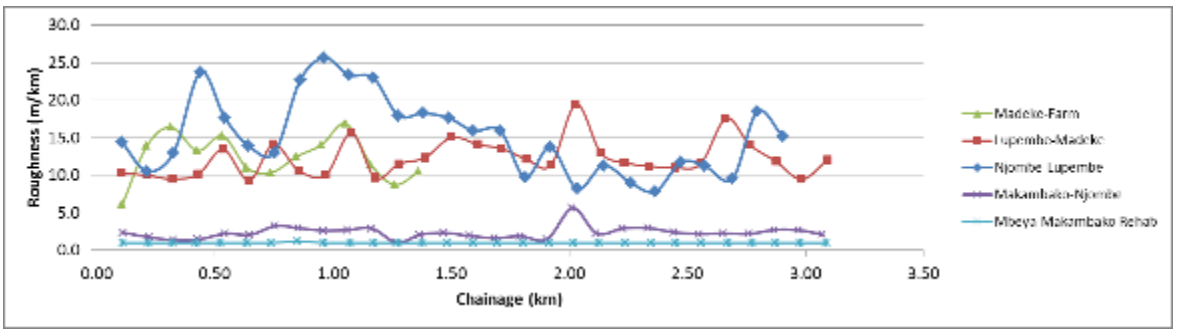

Figure 20: Comparison of road roughness

4.3 Farmers' Production and Transportation Data

4.3.1 Kenya

Kenya Farmer Surveys

In Kenya, 128 farmers were interviewed in Kithimani, Machakos district, and 126 farmers were interviewed in Meru district. Thirty nine per cent of those interviewed were women. Most had primary education and farming was the main business for over 90% of all farmers. On average, the total farmed area was 1.4 acres in Kithimani and 0.6 acre in Meru. Most of the land holdings were on one plot. The farmers' legal relationship to their farmed land varied, with 'customary rights' being the most prominent, accounting for 47% of the total. Basic data is shown in Table 18.

Table 18: Kenya Farming: Background Survey Data

Characteristic	Kithimani	Meru
Farmers interviewed	128	126
Men	76	79
Women	52	47
Mean age	40 years	42 years
Education level:		
No Formal education	7	16
Primary	60	98
Secondary	56	12
Tertiary	5	0
Farming main business?		
Yes	121	115
No	7	11
Total Acres Farmed (all crops)		
Mean	1.43 acres	0.58 acres
Median	1 acre	0.5 acres
Maximum	6 acres	3 acres
One Plot Location?		
Yes	96	83
No	32	43
Mean distance between plots	0.86 km	0.67 km
Farmer's relationship to land.		
Rented	22	49
Customary rights	69	52
Owned outright	36	22
Leasehold	1	3
total	128	126

Kenya Transporter Surveys

In each location 35 interviews were carried out with transporters. The interviews covered people transporting produce via head and back loads, as well as by motorcycle and animal carts. Most of the head and backloaders were also farmers, sometimes working on their own account. Basic data is given in Table 19.

Table 19: Transporter Interviews: Basic Data

	Machakos	Meru
Interview respondents (no):	35	35
Transport Modes		
Head/Backloaders	9	24
Motorcycles	19	9
Animal carts	7	1
Saloon cars	-	1
Age	32 years	37 years
Males	28	14
Females	7	21
Education		
Primary	22	31
Secondary	10	4
Tertiary	3	-
Head/Backloaders role:		
Operator	3	5
Farmer	6	18
Motorcycles role:		
Owner	2	1
Owner-operator	8	7
Operator	8	-
Farmer	1	1
Animal carts role:		
Owner	1	-
Owner-operator	3	1
Farmer	3	-
Saloon car: Owner-operator	-	1

Production and Income Data

In both locations, details of the production and transport were collected on French beans, which is the main 'cash crop'. Production and income data are shown in Table 20 and Table 21. Although the farmed acreage is much lower in Meru, the yields in Meru are three times those of Kithimani. However, the median price received by the farmers are half as much. The mean net income per year for French beans in Meru is just KSh 15,800 (US$ 158) while in Kithimani the net income was KSh 34,700 (US$ 347). In both locations, men achieve higher average yields and incomes than women.

Table 20: Production and Income from Kithimani, French Beans Main Crop

	Area farmed Acres	Yield Kg	Yield/acre Kg/acre	Gross Income (1000 K.sh)	Gross Income /Acre (1000 KSh)	Price Received KSh/Kg	Net Income (1000 KSh)
Mean	1.8	1,350	1,297	72.8	68.5	70.2	36.6
Median	1.0	700	800	49.0	48.0	60	26.8
Men average	1.2	1,541	1,410	80.2	69.0	68.4	40.1
median	1.0	700	775	49.5	49.0	60.0	26.7
Women							
average	1.2	1,074	1,132	62.1	67.7	72.8	31.5
median	1.0	700	900	48.0	46.7	60	25.9

Table 21: Production and Income from Meru, French Beans Main Crop

	Area farmed Acres	Yield Kg	Yield/acre Kg/acre	Gross Income (1000 K.sh)	Gross Income /Acre (1000 KSh)	Price received KSh/Kg	Net Income (1000 KSh)
Mean	0.4	1,005	3,596	32.2	106.6	34.4	17.1
Median	0.25	900	2,725	29.7	83,3	30.0	14.4
Men							
average	0.43	1,080	3,651	35.1	112.3	34.8	17.9
median	0.25	1,000	2,750	30,0	83.2	31.7	16.1
Women							
average	0.36	888	3,511	27.7	97.8	33.7	15.9
median	0.25	750	2,260	26.0	82.0	30.0	12.8

Crop transport from the farm

Farmers face a range of challenges in arranging for their produce to be taken from the farm. Table 22 identifies these issues. Overall 90% of farmers in Meru felt it was difficult to arrange for the sale and transport of their crop, compared with 50% of farmers in Kithimani. In both locations the biggest problems appeared with the farms being too remote and the route too difficult. Marketing problems such as "not enough buyers", "quantity too small", "prices too low" and problems of consolidating loads were next in importance. Issues relating to produce being spoilt and produce quality were less important.

Table 22: Challenges farmers face in organising transporters and buyers to take produce

	Kithimani			Meru		
Is it easy to organise transport?	Yes: 64; No: 64			Yes: 11; No: 111		
	1st Problem	2nd Problem	Other Problems	1st Problem	2nd Problem	Other Problems
Farm too remote	46	14	1	33	11	30
Quantity too small	6	15	6	18	25	27
Not enough buyers	13	1	2	19	8	6
Route too difficult	21	23	5	38	39	29
Market price too low to make trip worthwhile	0	5	5	1	0	18
Difficult to amalgamate loads	1	10	17	9	5	20
Transports and buyers do not always honour promise to come	0	0	2	1	0	0
Not enough transporters	1	5	1	4	3	4
Difficulty in making agreements because prices fluctuate	3	4	11	0	2	5
Complaints about produce quality	0	1	7	0	1	1
Unsatisfactory credit arrangements	0	1	2	0	0	0
Produce spoilt on journey	0	0	4	2	4	6
Poor Mobile Network Coverage	0	2	6	0	1	0

Information on the distance from farm to first collection point and means of transport used is given in Table 23. Out of 126 farmers in Meru only one reported truck access to the farm, compared with 34 out of 125 in Kithimani. In Meru 112 farmers used head and backloading as the first method to convey their produce to the collection point, with one using a motorcycle. In Kithimani, although a majority did use head and backloading, there was a more diverse range of other means of transport used.

Table 23: Transport from farm to collection point

	Kithimani Area	Meru Area
Distance to first collection point:		
Mean	1.4 km	1.5 km
Median	1 km	1.5 km
Truck Access to Farm?		
Yes	34	1
No	91	125
First means of transport:		
Head/Backloading	63	112
Animal Cart	13	0
Donkey	8	0
Motorcycle	28	1
Wheelbarrow	4	0
Truck	3	0
Is a second means of transport used?		
Yes	39	20
No	86	93
Second means of transport:		
Boat (river crossing)	22	0
Oxcart	1	0
Motorcycle	11	18
Wheelbarrow	2	0
Truck	1	0
Pickup	2	0
bicycle	0	1

Data on the farmers' ownership of mean of transport is shown in Table 24. In both areas, motorcycles were the most common form of transport. As expected, Kithimani had a wider range of vehicles owned by farmers.

Table 24: Farmer's ownership of transport modes

	Kithimani	Meru
Does the farmer own any means of transport?		
Yes	71	24
No	57	102
Modes owned:		
Car	0	2
Motorcycle	23	17
Animal Cart	17	0
Bicycle	9	4
Donkey/horse	14	0
Pushcart/wheelbarrow	9	1

In both areas farmers tend to hire in transport to convey their crops. They also use their own transport, or carry it themselves. In Kithimani, it was reported that buyers paid for transport in 12% of cases, while in Meru this happened in less than 1% of cases (see Table 25).

Table 25: Who pays for first transport to collection point? (Farmers' data)

	Kithimani	Meru
Farmer specifically hires transport	63	74
Farmer pays as part of other farming	-	10
Farmer uses own transport	43	28
Buyer pays for transport	15	1

Details of loads, distances and transport charges are given in Table 26. The reported load weights (53 kg for Kithimani and 68 kg for Meru) for head and back loading probably relate to an agreed consignment weight, rather than the load carried on one trip, and for these high weights multiple trips would be made for the

specified price and load. In fact more realistic load weights (19 kg for Machakos and 36 kg for Meru) are reported for head and backloading from the transporters' survey (see Table 27). Particularly in Meru, transport charges for head and backloading to the collection point are often a part of the harvesting labour costs. Although, where specified, this has been excluded from the data it may nevertheless have contributed to reducing the reported head and backloading costs. Nevertheless, as can be seen from the Kithimani data, head and back loading is the most expensive per tonne/km, with donkeys and animal carts being the least expensive. Much higher head and backloading transport costs, per tonne/km are reported in the transporters' data shown in Table 27, than in the Farmer's data in Table 26.

Table 26: Transport data, to collection point by means of transport (Farmers' data, mean values)

	Load kg	Distance km	Transport Charge KSh	Transport Charge per KSh/tonne/km
Machakos				
All modes	98.6	1.4	73	1,570
Head/backloading	52.7	1.19	64	2,020
Motorcycle	141	1.9	125	1,390
Animal Cart	234	0.68	148	640
Donkey	113	2.2	72	630
Meru				
Head/backloading	68.1	1.48	68	930

In Table 27 here we can see that head and backloading (per tonne/km) is reported to be in the region of five times the cost of motorcycle transport and eight times the cost of transport by animal cart. For the different modes, charges were reported to increase during rainy days.

Table 27: Transporters' data for different modes

	Distance km	Normal Day, travel time mins	Normal load Kg.	Normal Day Journeys per day	Normal Day Charge KSh.	Normal Day Charge KSh/tonne/km	Rainy Day Charge KSh/tonne/km
Machakos							
Headloading	0.9	25	19	7.1	35	6,100	7,600
Motorcycle	2.0	14	536	3.3	145	1,278	1,818
Animal cart	3.3	32	102	2.5	836	721	1,071
Meru							
Headloading	1.5	52	36	1.3	87.5	1,971	3,727
Motorcycle	6.1	22	130	12.2	113	350	411

Payment arrangements and the transfer of ownership

Different farming systems vary in payment arrangements, and the transfer of ownership of crops. Table 28 provides information on when transfer of ownership takes place between farmer and buyer, and when the farmer gets paid. For both Kithimani and Meru, transfer of ownership mostly takes place at the collection point or market. However, the farmer is paid sometime after the buyer takes possession. In these cases the farmer is at risk if the crop is spoilt on the journey to the collection point. In most cases there is also a credit arrangement covering the supply of farm inputs (seeds fertilizer, sprays etc.) from the buyers.

The relative responsibilities, between farmer and buyer, for paying for packing, loading, transporting, and unloading are shown in Table 29. In Kithimani the buyer tends to pay more frequently for transport from the farm, compared with the situation at Meru.

Table 28: Transfer of Ownership (farmers' data)

	Kithimani	Meru
When does farmer transfer ownership?		
At farm before harvest	1	0
At farm after harvest	42	2
At collection point or market	82	111
When is the farmer paid?		
An advance by buyer before transfer of ownership	9	0
When the buyer takes possession	3	4
After the buyer takes possession	113	107
What credit arrangements are there?		
Through farm inputs (seeds, fertilizer, sprays, etc.)	78	95
None	10	2
Does Buyer travel to collection point?		
Yes	33	85
No	31	19
Sometimes	61	9

Table 29: What does the farmer and buyer pay for and what penalties arise? (Farmers' data)

	Kithimani		Meru	
	% Buyer pays for:	% Farmer pays for:	% Buyer pays for:	% Farmer pays for:
Harvesting	0 %	100 %	0 %	100%
Packing	1.6 %	98.4 %	0 %	100%
Loading at farm	12.0 %	88.0 %	0 %	100%
Transport from farm	41.6 %	58.4 %	3.5 %	96.5%
Unloading at collection point	33.6 %	66.6 %	0.9 %	99.1%
Onward transfer to market or factory	100 %	0 %	100 %	0 %
Is farmer penalised if crop is found to be damaged after transport?	Yes 88 %	No 12 %	Yes 100 %	No 0

Crop Spoilage

French beans are not subject to a high spoilage rate; nevertheless farmers did identify factors promoting spoilage as shown in Table 30.

Table 30: Factors in French beans crop spoilage (Farmers' data, 1= High Priority, 12 = Low Priority)

	Kithimani Priority Ranking	Meru Priority Ranking
Diseases and mould	1	1
High Temperature	2	7
Pests (rodents and insects)	3	2
Lack of adequate storage at farm	4	4
Lengthy delays before 1st transport	5	5
Being left unprotected	6	8
Poor storage at Collection Point	7	9
Lack or poor packaging materials for 1st transport	8	6
Lengthy Delays before 2nd transport	9	10
Bruising caused by loading/unloading for 1st transport	10	3
Bruising caused by loading/unloading for 2nd transport	11	11
Getting Wet	12	12

A very similar result for operational factors promoting crop spoilage was found for Kithimani and Meru. These factors are combined together and shown in Table 31. As one can see factors deemed to promote "high spoilage" received a negligible score.

Table 31: Estimated spoilage of French beans at Kithimani and Meru due to different operations

	No spoilage	Low spoilage	Medium spoilage	High spoilage	Total
Storage on farm or house	63	123	49	2	237
Waiting for first transport	45	157	33	2	237
Loading/unloading	70	127	40	0	237
During 1st transport from farm	27	146	62	2	237
Waiting at collection point	63	136	38	0	237
Further transport onto market	157	65	14	1	237

The breakdown of the spoilage and destination of the harvested French beans crop is given in Table 32. It was estimated that only 9% of the Kithimani crop and 3% of the Meru was spoilt. It was reported that in both Kithimani and Meru all French beans are transported to collection point on the day of harvest. Temporary storage is on the farm, mostly under the shade of a tree.

Table 32: Spoilage and use of total harvested crop (average percentage)

	Kithimani	Meru
Percentage sold for external market	73%	93%
Percentage sold in local market	7%	0%
Percentage consumed domestically	6%	3%
Percentage kept for planting next year	5%	1%
Total percentage spoiled	9%	3%
Percentage sold as second quality	9%	4%
Per cent spoiled waiting for and loading 1st transport	3%	1%
Per cent spoiled during 1st transport	3%	2%
Per cent spoiled at collection point	3%	1%

4.3.2 Tanzania

Tanzania Farmer Surveys

In Tanzania, 139 farmers were interviewed in the Matola area, and 132 farmers were interviewed in the Madeke area. Sixty eight per cent of those interviewed were men. Most had primary education and farming was the main business for 89% of the farmers. On average the total farmed area was 2.8 acres in Matola and 5.1 acres in Madeke. In Matola a majority of farmers had plots in more than one location, while in Madeke most of the land holdings were on one plot. The farmers' legal relationship to their farmed land varied, with 'customary rights' being the most prominent, accounting for 47% of the total. Basic data is shown in Table 33.

Tanzania Transporter Surveys

In total 116 transporters were interviewed in different towns and villages in the area, including Njombe, Madeke, Matola and Mbega. Ninety respondents provided information on potato transport while 26 respondents provided data on pineapple transport. The surveys differed from those carried out in Kenya, in that all the respondents were men, with no interviews with head or backloaders. Basic data is given in Table 34.

Table 33: Tanzania background farmer survey details

Characteristic	Matola (Potato area)	Madeke (Pineapple area)
Farmers interviewed	139	132
Men	96	89
Women	43	43
Mean age	37 years	37 years
Education level:		
No Formal education	3	10
Primary	114	109
Secondary	16	9
Tertiary	6	4
Farming main business?		
Yes	121	120
No	28	12
Total Acres Farmed (all crops):	Acres	Acres
Mean	2.8	5.1
Median	2	3
Maximum	17	40
One Plot Location?		
Yes	52	80
No	87	52
Mean distance between plots	3 km	2.8 km

Table 34: Tanzania background transporter details

	Covering Potato transport	Covering Pineapple transport
Interview respondents (no):		
Trucks	28	8
Animal carts	26	-
Motorcycles	36	16
Saloon cars & pickups	-	2
Age:	31	31
Education: Primary	70	19
Secondary	20	7
Relationship to vehicle:		
Truck: Operator	26	7
Owner	1	-
Owner-Operator	1	1
Motorcycle: Operator	18	9
Owner	4	-
Owner-Operator	14	7
Animal Cart: Operator	11	-
Owner	1	-
Owner-Operator	15	-
Saloon/pick-up: Operator	-	1
Operator-owner	-	1

Production and Income Data

Detailed information on production and income data from potato growing in the Matola area is shown in Table 35, while the corresponding data for pineapple growing are shown in Table 36. The farmed area as well as gross and net incomes are far higher in Madeke than in Matola. The mean Matola potato yield (4 tons per acre, or 10 tonnes/hectare) is substantially lower than the average reported for Iringa Region (18 tonnes per hectare) https://agra.org/tanzania-southern-highlands-africas-potato-paradise/ and it is believed that poor weather has contributed to the lower yields. The mean net income is TSh 1.44 m (US$ 626) for Matola potato growing compared with TSh 10.6 m (US$4,714) for pineapple growing in Madeke. The Madeke pineapple area is part of a special organic farming area that provides relatively high incomes to organic fruit farmers (Negereza and Pawelzik, 2016). In both locations women have smaller farmed areas and lower incomes than men. However, women achieve much higher pineapple yields per acre.

Table 35: Production and Income from Matola, potato growing (farmers' interviews)

	Area farmed Acres	Yield Kg	Yield/acre Kg/acre	Gross Income (1000 TSh)	Gross Income/Acre (1000 TSh)	Gross Income/ Kg TSh	Net Income (1000 TSh)
Mean	1.9	8,093	3,997	2,451	1,187	296	1,417
Median	2	4,350	3,600	1,300	1,050	290	660
Maximum	10	67,500	15,720	21,250	5,568	444	13,023
Men average	2.2	10,049	4594	3,026	1,383	301	1,638
median				1,605			849
Women average	1.2	3,725	3080	1,168	966	313	773
median				560			370

Table 36: Production and income from Madeke, pineapple growing (farmers' interviews)

	Area farmed Acres	Yield(sold) Kg	Yield/acre Kg/acre	Gross Income (1000 TSh)	Gross Income/Acre (1000 TSh)	Gross Income/Kg TSh	Net Income (1000 TSh)
Mean	4.4	59,073	15,452	14,521	3,499	231	10,644
Median	3	30,870	12,000	6,921	2,519	211	4,354
Maximum	40	423,500	56,875	158,813	16,406	736	121,440
Men: average	5.2	62,853	12,141	16,073	3,105	256	12,080
median				9,870			5,800
Women: Average	2.7	51,251	19,163	10,623	3,976	207	7,597
median				3,841			2,499

Crop transport from the farm

Farmers face a range of challenges in arranging for their produce to be taken from the farm. Table 37 identifies these issues. It appears to be much easier to organise transport in Matola than Madeke, and in Madeke there appears to be a concern about a lack of buyers and transporters and poor phone coverage.

Table 37: Challenges of organising transport and buyers to take produce from farm (farmer's interviews)

	Matola Potato area		Madeke Pineapple area	
Is it easy to organise transport?	Yes: 108	No: 31	Yes: 34	No:129
	1st Problem	Other Problems	1st Problem	Other Problems
Farm too remote	7	1	1	0
Quantity too small	7	5	43	8
Not enough buyers	7	5	1	0
Route too difficult	1	0	2	1
Market price too low to make trip worthwhile	1	3	1	2
Difficult to amalgamate loads	0	0	2	0
Transports and buyers do not always honour promise to come	6	1	5	2
Not enough transporters	0	0	0	12
Difficulty in making agreements because prices fluctuate	0	3	2	1
Unsatisfactory credit arrangements	0	0	0	1
Produce spoilt on journey	0	0	35	1
Poor Mobile Phone Coverage	2	1	1	26
Poor road infrastructure	-	-		0

Details of farmers' ownership of transport modes are given in Table 38. Approximately one quarter of farmers own a motorcycle.

Table 39 provides details of transport from the farm to the first collection point. Although it is reported that a majority of farms in Madeke area have truck access to the farm, in fact virtually all pineapples are

carried by head or backloading. A much greater variety of means of transport are used to carry potatoes to the collection point.

Table 38: Farmer's ownership of transport modes (farmers' interviews)

		Matola (Potato area)	Madeke (Pineapple area)
Does the farmer own any means of transport?			
Yes		55	48
No		84	84
Modes owned:	Truck	4	1
	Pickup	0	2
	Car	2	1
	Motorcycle	30	41
	Animal Cart	4	1
	Bicycle	15	2

Table 39: Transport from farm to collection point (farmers' interviews)

	Matola Potato Area	Madeke Pineapple Area
Distance to first collection point:		
Mean	1.2 km	0.4 km
Median	0.5 km	0.2 km
Is there truck access to the farm?		
Yes	27	79
No	112	53
First means of transport:		
Head/ backloading	58	130
Ox-cart	16	0
Donkey cart/ donkey	31	0
Motorcycle	34	3
Is a second means of transport used?		
Yes	10	0
No	129	132
Second means of transport:		
Ox-cart	4	
Donkey cart/Donkey	3	
Motorcycle	2	
Tractor	1	

Table 40, Table 41 and Table 42 provide data on transport charges to the collection point. It is reported in the interviews that all farmers pay for this transport. Although the transport distances are relatively small, the transport charges represent a significant proportion of farm-gate prices. For potatoes it estimated to be around 8% and for pineapples, 18%.

Table 40: Transport charges to collection point (farmers' interviews)

	Matola Potato Area		Madeke Pineapple Area	
	mean	median	mean	median
Load	96.2 kg.	75.0 kg	37.6 kg	34.4 kg
Charge per trip	2103 TSh	2,000 TSh	1,221 TSh	1,125 TSh
Charge TSh per kg	22.2 TSh	20.7 TSh	34 TSh.	33.3 TSh
Charge TSh per kg-km	86.6 TSh	29.7 TSh	463 TSh	163 TSh
Produce value at farm-gate, Tsh per kg.	279 TSh	269 TSh	194 TSh.	183 TSh
1st Transport charge as % of farm-gate price:	8.0%	7.7%	17.5%	18.1%

Note. For the headloading of potatoes the typical bagged load is broken down into smaller loads so it can be carried. However the pricing is based on a typical load ranging from 72 to 105 kg.

Table 41 presents transport and farm yield data for potatoes by transport mode, and Table 42 provides data, by transport mode for pineapples. As expected, transport charges per kg/km are far higher for head/backloading, with ox-carts the least expensive. Where potatoes are carried by head/backloading the farm yields are lower, and significantly lower for donkey carts and motorcycles. This may be because it is easier to amalgamate loads, thus making it economic to use cheaper forms of transport. This was not observed for pineapples, but only three examples of motorcycles were used.

Table 41: Characteristics of different first modes of transport for Matola potatoes

	Headloading	Ox-Cart	Donkey Cart	Motorcycle
Observations	58	16	31	34
Distance:				
Mean	0.62 km	1.93 km	1.75 km	1.44 km
Median	0.14 km	1.50 km	1.00 km	1.00 km
Consignment load				
Mean	91.9 kg	123.4 kg	101.9 kg	85.7 kg
Median	75 kg	73.8 kg	107.3 kg	75 kg
Transport Charge Per Kg/km				
Mean	156.9 TSh	19.7 TSh.	40.3 TSh.	43.7 TSh.
Median	95.2 TSh.	15.2 TSh.	21.6 TSh.	21.0 TSh.
Farm yield				
Mean	5958 kg	6975 kg	9542 kg	10,938 kg
Median	3018 kg	4468 kg	8060 kg	4,863 kg

Table 42: Characteristics of different first modes of transport for Madeke pineapples

	Headloading	Motorcycle
Observations	130	3
Distance:		
Mean	0.36 km	1.25 km
Median	0.19 km	1.25 km
Consignment load		
Mean	37.1 kg	64.4 kg
Median	33.8 kg	64.4 kg
Transport Charge Per Kg/km		
Mean	468.9 TSh	41.1 TSh.
Median	178.6 TSh.	41.1 TSh.
Farm yield		
Mean	59,043 kg	44,575kg
Median	30,214 kg	40,500 kg

Table 43 presents typical transport data for different transport modes for carrying potatoes and pineapples. In this case, with the exception of animal carts and motorcycles carrying potatoes, the journeys are of a longer distance and represent the movement from collection points to final markets or factories. The economies of scale of truck transport, travelling long distances are very apparent. It can also be seen how charges increase on 'rainy days'. This is because of lighter loads, where there are difficult unpaved road surfaces, and extra delays.

Table 43: Transporters' data for different modes in Tanzania

	Distance km	Normal Day, travel time mins	Normal load, kg.	Normal Day Journeys per day	Normal Day Charge 1,000 TSh.	Normal Day Charge per tonne/km TSh/tonne/km	Rainy Day Charge per ton/km TSh/tonne/km
Potatoes							
Truck	582	936	10,512	1.2	1,162	190	228
Animal cart	2.5	57	494	5.8	11.3	8,922	10,149
Motorcycle	1.7	13	97	22.4	2.1	12,806	15,879
Pineapples							
Truck	194.5	349	3,505	1.0	397	582	726
Motorcycle	31.5	64	103	6.4	22	6,702	9,795
Saloon/pickup	107.5	240	813	1.5	150	1,717	1,997

Transfer of ownership and payment arrangements

In the survey, all farmers said that transfer of ownership takes place at the collection point. Furthermore, it is the responsibility of the farmer to pay for and to pack, load and unload the produce and take it to the collection point. The buyer is responsible for onward movement from the collection point. Table 44 provides details of when the farmer is paid. It can be seen that over 80% of potato farmers and just under 50% of pineapple farmers are paid when the buyer takes possession. About 16% of potato farmers and 12% of pineapple farmers are paid an advance before the transfer of goods.

If the produce is found to be damaged after the buyer takes possession it appears that most potato farmers are not penalised, however pineapple farmers are penalised. It is reported this is mostly because of the credit arrangements, which are more frequent for pineapple farmers.

Table 44: Farmers' payment arrangements for potatoes and pineapples

	Potatoes	Pineapples
When is the farmer paid?		
An advance before transfer of goods	22	15
When buyer takes possession	114	60
After buyer takes possession	2	5
Both an advance and when buyer takes possession	0	18
Both when buyer takes possession and afterwards	0	25
If there is a delay in payment, how long after the buyer takes possession, is the farmer paid?	3.6 days	4.1 days
Are farmers penalised if crop is found to be damaged after buyer takes possession?		
Not penalised	103	16
Are penalised	33	114
Sometimes penalised	3	2

Crop spoilage

Potatoes and pineapples are much more subject to spoilage than French beans. The likely factors that will cause spoilage are identified from the farmers' surveys and are shown in Table 45, Table 46 and Table 47. Getting wet and lengthy delays are important factors, as are diseases and mould, as well as pests. Comparing Table 46 and Table 47, a greater range of situations contribute to the spoilage of pineapples than potatoes.

Table 45: Factors in spoilage for potatoes and pineapples (1= High Priority, 12 = Low Priority) (identified by farmers)

	Potatoes Priority Ranking	Pineapples Priority Ranking
Diseases and mould	1	11
Getting wet	2	2
Lengthy delays at collection point	3	1
Pests (rodents and insects)	4	4=
Poor facilities at collection point	5	3
Bruising caused by loading and unloading for 1st transport	9	4=
High temperature	7	6
Being left unprotected	8	7
Lengthy delays before 1st transport	6	8
Bruising caused by loading/unloading for 2nd transport	10	9
Lack of adequate storage at farm	11	10
Lack or poor packaging materials for 1st transport	12	12

Table 46: Estimated spoilage of potatoes due to different factors (identified by farmers)

	No spoilage	Low spoilage	Medium spoilage	High spoilage
Storage on farm or house	69	29	30	11
Waiting for first transport	6	23	34	76
Loading/unloading	90	30	19	0
During 1st transport from farm	117	14	8	0
Waiting at collection point	64	26	24	25
Further transport onto market	72	52	15	0

Table 47: Estimated spoilage of pineapples due to different factors (identified by farmers)

	No spoilage	Low spoilage	Medium spoilage	High spoilage
Storage on farm or house	58	33	31	10
Waiting for first transport	12	33	44	43
Loading/unloading	24	45	45	18
During 1st transport from farm	10	42	45	35
Waiting at collection point	12	27	35	58
Further transport onto market	59	23	35	15

Table 48 provides details of local storage for the different crops. Most of the crops are stored on the ground while waiting for transport. It is common to protect them with leaves or bamboo or with a tent.

Table 48: Local Storage details (farmers' survey)

	Potatoes	Pineapples
Is the crop stored locally before sale?		
Yes	62	63
No	77	70
If so, where?		
on farm	43	14
at house	1	3
elsewhere locally	18	44
at collection point	0	1
How is it stored and protected?		
Covered with leaves	44	47
Covered by a tent	16	1
Stored on the ground without protection	0	14

Table 49 gives the composition of potatoes and pineapples that are sold, consumed, kept for seed or spoiled. Here, it can be seen that about 9% of potatoes and 14% of pineapples are reported to be spoiled in the first transport segment from the farm and at the collection point.

Table 49: Spoilage and use of total harvested crop (average percentage)

	Potatoes	Pineapples
Percentage sold	62%	63%
Percentage consumed domestically	4%	4%
Percentage kept as seed for next year	10%	1%
Total percentage spoiled	24%	32%
Mean percentage sold as 2nd quality or worse	5%	22%
Percentage rejected at harvest	15.5%	16.3%
Per cent spoiled waiting for and loading 1st transport	5.3%	5.0%
Per cent spoiled during 1st transport	0.4%	4.3%
Per cent spoiled at collection point	3.0%	5.1%

5 Discussion

5.1 A Further Analysis of Transport Charges

An analysis was undertaken to explore how transport charges varied with distance. A wide scatter in the data was found, as can be seen in Figure 21 to Figure 25. The graphs relate to headloading, motorcycles, animal carts and truck transport. The first four graphs relate to short distance movements, while the last graph (Figure 25) relates to the long distance movement of potatoes in Tanzania.

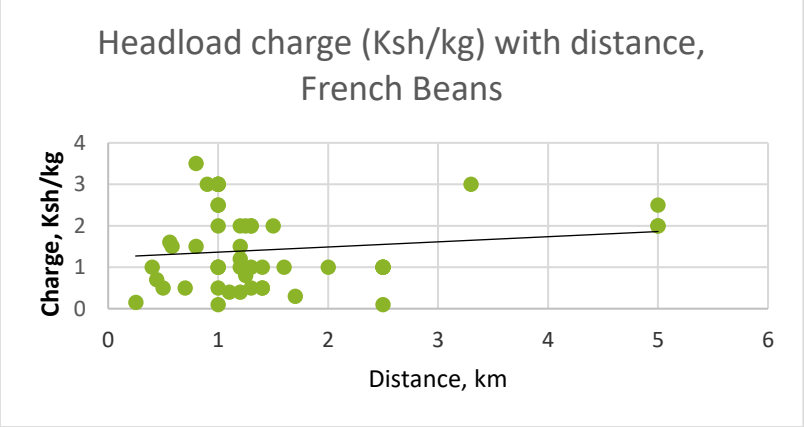

Figure 21: Headload charge with distance, Kithimani, Kenya

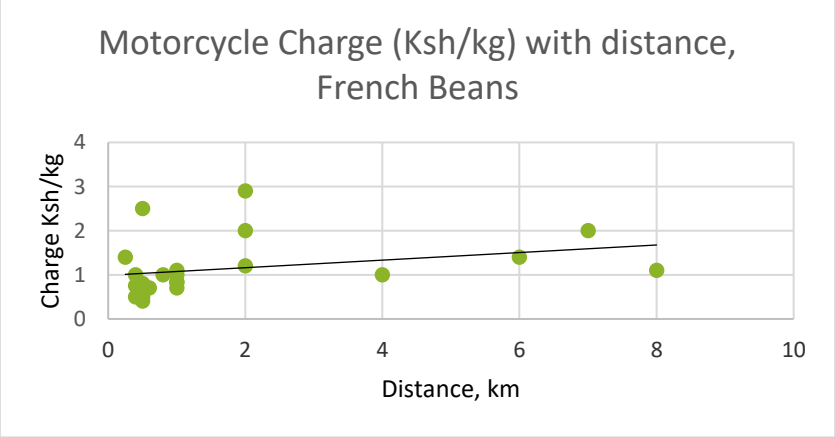

Figure 22: Motorcycle charge with distance, Kithimani, Kenya

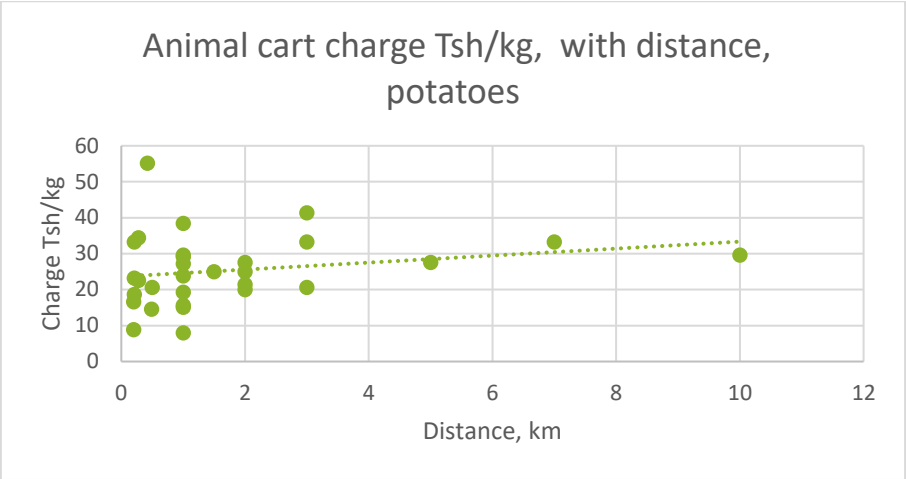

Figure 23: Animal Cart, charge with distance, Matola, Tanzania

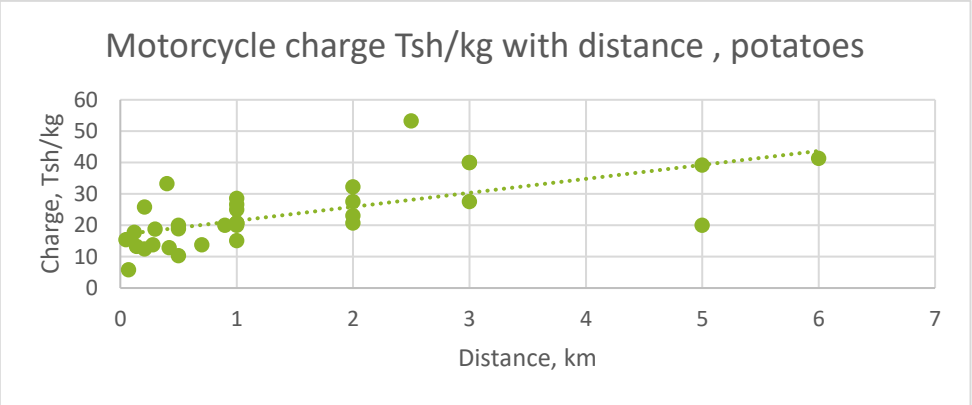

Figure 24: Motorcycle charge with distance, Matola, Tanzania

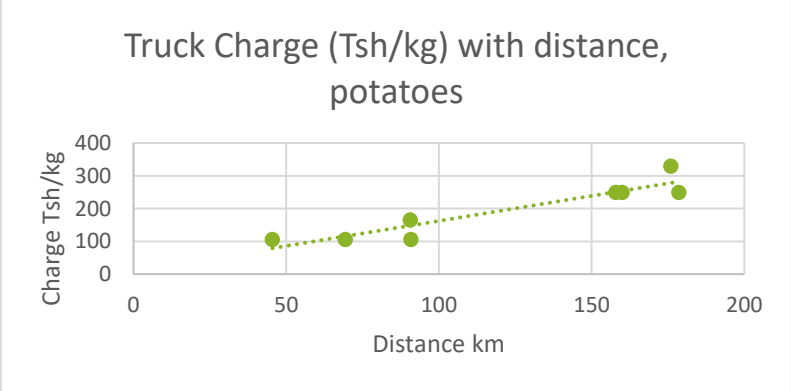

Figure 25: Truck charges with distance, Matola, Tanzania.

A regression analysis was undertaken for each, short distance, transport mode, whereby the transport charges per kg were regressed against distance. For the 17 sets of data (ten for Kenya and seven for Tanzania) sensible relationships, whereby charges per kg increased with distance, were found for 13 sets. However, for four of the Kenyan data sets a reverse relationship (where charges decreased with distance) were found. This can possibly be explained by a hidden correlation between load and distance, distorting

the results. From the regression coefficients, it was possible to model the transport charges for each of the different modes for varying distances (0.5, 1, 1.5, 2 km). The results are shown in Table 50 and Table 51.

Table 50: Kenya transport data for French beans

	Kithimani Farmers survey				Meru farmers survey	Machakos Transporters survey			Meru Transporters survey	
	Head-load	Motor-cycle	Animal cart	Donkey	Head load	Motor-cycle	Head-load	Animal cart	Head - load	Motor-cycle
Observations	50	23	11	7	82	19	7	5	12	8
Mean Load, kg	52.8	141.3	231.3	112.5	65	102.5	18.6	500	36.3	130
Mean Distance, km	1.43	1.8	1.35	2.2	1.53	2	0.47	3.8	1.43	5.9
Mean KSh/kg	1.49	1.14	0.74	1.2	1.11	1.55	1.9	1.6	2.56	0.82
Mean KSh/kg-km	2.03	1.39	0.65	0.63	0.95	1.3	6.1	0.72	1.97	0.35
Median KSh/kg-km	1.05	1.0	0.5	0.33	0.67	1	4.17	0.3	2	0.15
Modelled KSh/kg										
0.5 km	1.33	1.03	0.41	0.92	1.20*	1.61*	1.93	2.04*	3.46*	0.53
1.0 km	1.42	1.08	0.60	1.00	1.16	1.59	2.29	1.98	2.97	0.56
1.5 km	1.50	1.12	0.80	1.08	1.12	1.57	2.65	1.91	2.49	0.59
2 km	1.59	1.16	0.99	1.17	1.08	1.55	3.01	1.85	2.0	0.61
Distance 't' statistic	1.02	1.43	3.64	1.44	-1.74	-0.4	0.61	-1.19	-0.94	1.37

Note. Declines in charges (KSh/kg) with increasing distance are implausible, but these modelled results are shown here for completeness

Table 51: Tanzania Transport data for pineapples and potatoes

	Madeke Farmers survey Pineapples	Matola Farmers Survey, Potatoes				Matola Transporters Survey, Potatoes	
	Headload	Headload	Motor cycle	Donkey cart	Ox cart	Motorcycle	Donkey cart
Observations	126	53	34	30	14	36	27
Mean Load, kg	37.1	91.9	85.7	101.9	123.4	96.2	494.4
Mean Distance, km	0.34	0.67	1.44	1.78	2.15	1.67	2.56
Mean TSh/kg	33.9	18.9	23.4	24.9	24.9	23.7	23.8
Mean TSh/kg-km	468.9	120.9	43.7	40.3	19.7	20.3	12.25
Median TSh/kg-km	172.2	95.2	21.0	21.6	15.2	13.8	8.27
Modelled TSh/kg							
0.5 km	34.4	18.4	19.2	24.1	23.0	17.5	17.9
1.0 km	35.8	20.0	21.4	24.6	23.5	20.2	19.3
1.5 km	37.2	21.5	23.7	25.1	24.1	22.8	20.8
2 km	38.5	23.1	25.9	25.6	24.7	25.4	22.2
Distance 't' statistic	1.21	3.15	4.84	1.17	0.63	0.81	1.65

The results of the modelling show that a substantial part of the apparent difference in the charges of different first mile transport, between the different modes, might be explained by differences in transport distance.

It is well recognised that the best measure of transport costs is a weight distance charge, i.e. the charge per tonne/km, or per kg/km. Using this measure we find a substantial variation in transport charges between different modes and surveys. For example, the mean headloading charge for Madeke in Tanzania is 668.9 TSh per kg/km, which is 54 times as expensive as the donkey cart charge in Matola at 12.25 TSh per kg/km. However if a 2 km trip was made by both modes then the modelling suggests that the Madeke pineapple headloading charge would be just 38.5 TSh/kg compared with 22.2 TSh/kg for the donkey cart in Matola, i.e. just 1.6 times as expensive.

The transport charges in Kenya and Tanzania are similar when expressed in US dollar terms. For a one km trip in Kenya the charges would range between US$ 0.56 to 2.97 cents per kg. While for Tanzania the charge for a one km trip ranges between US$ 0.85 to 1.58 cents per kg.

One complication in the analysis relates to head/backloading. Many farmers employ labour to both harvest the crop and carry the produce to the first collection point, particularly in Meru. Where this was specified, the observation data was omitted from the analysis. However, it is recognised that some distortions in the overall analysis and findings may result.

Overall, the analysis suggests that the opportunities to substantially reduce transport charges by changing modes (through better transport links and load consolidation) for short distance trips, may be more limited than previously thought. For Tanzania the maximum potential saving for a one kilometre trip would be 46% of the current price. However, for Kenya the potential saving appears much higher at over 70%, but the local circumstances in each situation will inevitably reduce this. Probably, the most effective method of reducing transport costs would be by picking up farm produce at the farm and transporting directly to market, avoiding double handling at the collection point altogether. The marginal increase in costs for a few extra kilometres, for the truck involved, are likely to be minimal.

5.2 Relationship between Initial Transport and Incomes

There are a range of ways in which initial transport might affect farmers' incomes. Possible ways include:

- Through crop spoilage in getting produce to market
- Through paying for crop transport costs and thus directly reducing the net incomes
- Through increasing the costs of farm inputs (including labour) and thus reducing net incomes
- Through reducing the efficiency of farming production and of the marketing of produce, thus indirectly reducing net incomes.

Information on crop spoilage is presented in Sections 4.3.1 and 4.3.2. The estimated losses from crop spoilage are shown the Table 52, together with an estimate of crop transport costs on net incomes.

Table 52: Effect of crop losses and first transport on net incomes

	Kenya (French beans)		Tanzania	
	Kithimani	Meru	Matola (potatoes)	Madeke (pineapples)
Estimated crop losses of harvested crop relating to first transport				
Mean	8.7%	4.7%	8.8%	14.3%
Median	7.0%	3.5%	3.4%	6.3%
1st Transport costs as a % of net farmers' incomes				
Mean	6.4%	7%	23.8%	25%
Median	3.3%	5.8%	15.6%	21.5%

A separate regression analysis was also undertaken, to see whether net farming incomes, per acre might be predicted from a range of variables including transport costs and crop spoilage. An analysis of the Kenya Meru data did find a negative relationship between net farm incomes and transport costs, but it was not significant. A complication with this is that farmers in Meru often combine, and pay for, harvesting with first transport, and hence the first transport costs may be underestimated. Also, there was no clear relationship between net incomes and the percentage of crop spoiled. An analysis of Kithimani data did find a significant negative relationship between crop spoilage and net incomes, however there was a perverse, positive relationship, between transport costs and net farm incomes.

For Tanzania, for both pineapples and potatoes, net incomes were found to be negatively associated with first transport costs and crop losses. The independent variable of the regression was net income per acre, and other explanatory variables were crop acres, crop yield, crop sale price, transport costs and first transport crop losses. The details of the regression are shown in Table 53.

Table 53: Regression details explaining net income per acre for Matola potatoes and Madeke pineapples

Y= net income per acre	Matola potatoes		Madeke Pineapples	
Observations	98		129	
Regression R squared value:	0.855		0.673	
Regression F value	108.64		50.58	
	Coefficient	T value	Coefficient	T value
Intercept	-125227	-7.48	-1052645	-2.0
Acres	-16993	-1.17	3079.9	0.12
Initial transport costs (TSh/kg)	-11276	-4.46	-16980	-1.8
Yield (kg/acre)	216.32	20.8	166.16	15.1
Gross produce price (TSh/ kg)	3833.58	7.67	7570.5	4.42
First transport crop losses (%)	-205002	-0.47	-1498885	-1.44

In order to estimate the impact of transport costs and crop losses on incomes, the mean values of the independent variables were multiplied by the regression coefficients, as shown in Table 54. The results were then compared with the mean values of the net income per acre for the two crops. The table shows that for potatoes, initial transport costs are associated with an average reduction of net incomes by 35%, while crop losses are associated with an average reduction of 2%. Similarly, for pineapples, it was found that initial transport costs are associated with an average reduction of 22% in net incomes, while crop losses account for a further average reduction of 7%.

Table 54: Predicting the effects of transport costs & crop losses on net incomes from regression results

	Net income /acre	Acres	Transport costs TSh/kg	Yield kg/acre	Produce price TSh/kg	1st transport crop losses (%)	Intercept
Potatoes: Mean values of regression data	648,351	1.98	19.87	4,572	308	6.39	
Mean values x reg. coefficients % of net income/acre		-33,639	-224,098 **-34.56%**	988,991	1,182,433	-13,108 **-2.02%**	-1,252,227
Pineapples: Mean values of regression data	2,536,435	4.3	32.89	15,648	226	12.03	
Mean values x reg. coefficients % of net income/acre		13,257	-558,549 **-22.02%**	2,600,183	1,714,536	-180,347 **-7.11%**	-1,052,647

Note. Because of missing values, a different data set is used for the regression compared with the individual results of farmers' survey.

Overall the different analyses suggest that initial transport costs and crop losses account for reductions in the region of 30 to 40 % of net incomes of potatoes and pineapples in Tanzania. While for French beans in Kenya, the associated reduction in net incomes is around 10 to 15%.

5.3 Gender Findings

A range of gender related data were collected in the different surveys. Key data collected from the farmers' surveys is presented in Table 55. In total, 35% of farmers interviewed in both countries were female. In three of the four locations, the area farmed by men was significantly larger than that farmed by women. For Kithimani the crop areas were the same. Yields per acre were lower for women in three locations, however for Madeke pineapple farming women achieved 58% higher yields. Overall, in each location women's net incomes were substantially less than for men.

Women's farms tended to be closer to the collection point than for men (the exception was Madeke). However, despite this the cost of first transport was higher for women in Kithimani and Meru. Women owned substantially less means of transport than men did, although there was a significant variation between different locations. In particular, in Kithimani women owned a wide range of different transport modes, including 6 motorcycles, 7 donkeys/horses, 6 pushcarts or wheelbarrows and 4 animal carts. However very little transport was owned by women in Meru.

Table 55: A gender breakdown of key farmers' data

	Kithimani		Meru		Matola		Madeke	
	men	women	men	women	men	women	men	women
Number	76	52	79	47	96	43	89	43
Main crop, acres	1.2	1.2	0.43	0.36	2.2	1.2	5.2	2.7
Yield kg/acres	1,410	1,132	3,651	3,511	4,594	3,080	12,141	19,163
Net income US$	400	315	179	159	720	340	5,315	3,343
Distance to collection point, km	1.57	1.03	1.48	1.40	1.32	0.99	0.36	0.41
Ownership of mean of transport %	63%	48%	27%	6%	47%	23%	45%	19%
Cost of first transport US cents/kg	1.3	1.4	0.86	1.11	0.95	0.92	1.48	1.39

A gender breakdown of transporter survey data for Kenya is presented in Table 56. In this case it can be seen that a majority of head/backloading transporters interviewed were women. Women undertake this unskilled work in addition to performing general farming duties. Only one woman was interviewed in relation to operating an animal cart. In Tanzania no women transporters, or head/backloaders, were interviewed.

Table 56: Gender breakdown of Kenya transporters data

	Kithimani		Meru	
	men	women	men	women
Head/backloading	3	6	3	21
Motorcycle	19	0	9	0
Animal cart	6	1	0	0

6 Potential Areas for Change

This section identifies areas where there is potential to affect the livelihood of farmers through improvements in infrastructure and how it is constructed and maintained, as gleaned from the research results to date. These areas should be further explored at the country workshops in September 2018.

6.1 Development of Farmers' Associations

Farmers' associations exist in many places in different forms. The structure and role of these community-based organisations can be discussed with a view to how they can help with the provision and preservation of infrastructure. Some of the pertinent issues are:

- Identification of infrastructure improvements
- Negotiation with authorities
- Negotiation with transporters for more appropriate/efficient transportation
- Organisation of farmers to amalgamate loads
- Forming work gangs to carry out minor repairs to the road

6.2 Community Participation

Community participation in infrastructure provision and preservation has been experienced in many countries. When communities are motivated they can be strong advocates for change, this potential could be explored.

6.3 Gender Development

The role of women and how they can maximise their potential. Many of the farmers were female, but few of the transporters. What roles can women most effectively follow and how could this be implemented?

6.4 Local Government Infrastructure Specialists

How local government departments can help technically, i.e. funding, training, for small-scale community construction activities. The role of the department with responsibility for rural roads to farms could be explored with a view to identifying ways it can improve transport on the first mile.

6.5 Awareness Raising and Guidance

Farmers were found to be interested to learn more about rural road technology. The use of guidance manuals for village level infrastructure maintenance is a potential area for investigation. There are many resources already available for this task; these could be explored to determine whether appropriate ones exist or whether something needs to be developed.

6.6 Competition

Stimulation of competition amongst buyers. This is linked to farmers' associations, but may require some higher level input to encourage more than one buyer in an area. The ultimate goal is for farmers to receive a more competitive price for their produce, but first mile transport could play a role in this.

6.7 Stimulation of Transport Services by improved infrastructure

The analysis clearly shows that low capacity, high cost transport, is used, which is in part a reflection of the poor condition of infrastructure, preventing easy access for trucks. If infrastructure is improved, transport costs will decline, and it follows that farmers will be able to respond with higher yields and market more produce, thus contributing to poverty reduction and improvements in food security. There are however many more factors that will influence this decision, not least having confidence that roads will continue to be maintained in good condition into the future. Farmers will need confidence to invest more in order to enhance their livelihoods, as they will still see road condition as a risk.

6.8 Other

There are likely to be many other issues that arise from the workshops. All will be discussed and explored with equal weight.

7 Further Research

A number of potential areas for further research are noted here. These will be explored at the workshops and a more comprehensive list provided in the final report.

7.1 Secondary Transport Segment

This research has focused on the First Mile, which is considered as the primary movement from farm to first collection point or local market. The research has however, highlighted the importance of the secondary transport segment from collection point to storage facility or primary market. The quality of these secondary transport segments varied quite significantly between sites, and between countries. In Tanzania there were long sections of fair to poor gravel road from the collection centres to the nearest paved road or market, whereas in Kenya there were paved roads or short sections of good gravel road relatively close to the collection centres.

It was also noted in Kenya that many main roads have speed bumps or 'sleeping policemen', which are frequent and often quite steep. It was estimated that there could be more than one hundred speed bumps between Nairobi and Meru town, and possibly as many as two hundred. There is a significant possibility that such road features could affect the crop in a negative way through bruising and damage. Speed bumps seem to be the prevalent mode of traffic calming in Kenya, so this issue will be difficult to mitigate, unless alternative measures can be proven and applied, but that is beyond the scope of this study.

The secondary transport segment gravel roads in Tanzania are vulnerable to heavy rain. During the wet season, wet and boggy spots quickly appear and the surface becomes slippery and ruts easily. The particularly bad areas can cause large trucks to become stuck for long periods, and in the worst-case scenario the road could become blocked for some hours. In any case, the transport of crops becomes difficult and unreliable, leading to damaged crops and crops that become spoiled because they cannot be transported to the market on time.

To better understand the dynamics of how the secondary transport segment affects the quality and price of perishable crops it would be beneficial to carry out further research in this area, although arguably this is beyond the scope of Low Volume Road research.

7.2 Infrastructure Planning Investigation

A possible avenue for further research could be if a rural roads engineer and transport planner mapped out what physical infrastructure was required and where it would be most effectively located to meet the demands of smallholder farmers. This would include the location of collection/storage facilities, whether they would need cooling facilities, the nature of the onward journey from the collection point, etc. In terms of road provision, the whole life costs of the road should be taken into account and the likely levels of maintenance that would be applied, possibly with different scenarios, i.e. no maintenance, community maintenance, full maintenance.

In terms of transport services the most appropriate forms of transport could be compared, how loads could be amalgamated in the most efficient way and what level of maintenance would be required for the planned transport modes. More sophisticated research could be funded doing simulations using different modes, quantities and load amalgamation strategies to provide a range of costed solutions to see what is likely to work best.

7.3 Competition

On the Meru site, limited buyers were a problem. Basically one buyer served all of the farms and the farmers received a significantly lower price for their crop than in Machakos in Kenya. Although this was not the only reason for the lower price, it was thought to be a significant factor. It would be possible to research this issue more and to define what the constraints are to getting more buyers to go to an area. For example, is it just monopolistic practices, or are there other factors that influence this, such as a very small supply? Is the secondary road a problem for the buyers? Although this is not a low volume roads or

transport issue, it does have a bearing on farmer's incomes and needs to be factored in when considering First Mile issues.

8 Next Steps

8.1 Planning for Country Workshops

8.1.1 Timing

The country workshops were held on 18th September 2018 in Kenya, and on 20th September 2018 in Tanzania. Feedback has been fed into the draft of the Phase 3 report so that it can be used as a basis for discussion at the final workshop. This allowed sufficient time from the completion of Phase 3 report before the regional workshop, planned for 14th November 2018.

8.1.2 Locations

The country stakeholder workshops were held in similar locations to the workshops in Phase 2. Nairobi was the obvious location for the workshop in Kenya, and Dar es Salaam was preferred for Tanzania. The joint workshop in November is likely to be held in Arusha so that it can be linked with the IMPARTS project and form part of a Transport Services event, and to coincide with the PIARC Transport in the Fourth Revolution conference.

8.2 Capacity Building and Knowledge Exchange

8.2.1 Liaison with stakeholders

The consultant has supported capacity building throughout the project, specifically at the stakeholder workshops where awareness was raised of the issues being researched and participants were provided with information on the project and the main principles of the research. In addition the participants were actively involved in the selection of the study areas, which allowed them to become familiar with the requirements and principles of the research.

The project team have continued to liaise with the key stakeholders on the project, which includes the technical road practitioners from the partner organisations in Kenya and Tanzania, who visited the data collection teams on site when they were able to do so. The data collection teams have also liaised closely with stakeholders at the village and community level throughout the data collection process and at regular intervals since.

8.2.2 Presentations at international conferences

There is a requirement in the project to make paper presentations at two international conferences. The team are planning to write papers and make presentations on key aspects of the project at the following conferences:

- SARF/IRF/PIARC regional conference, Roads to Social and Economic Growth
  Durban, South Africa, 9-11 October 2018
- PIARC/Govt. of Tanzania, Transport in the Fourth Revolution: The Dynamical Low-Income World
  Arusha, Tanzania, 14-16 November 2018

The abstracts for these conferences can be seen in Annex 2.

8.2.3 Scientific paper

There is also a requirement to write a scientific paper for publication in a relevant journal. This will be based on the research and results analysis, so is under preparation at present and is unlikely to be complete until the end of the project.

8.3 Uptake and Embedment

The team recognise that uptake and embedment of the outcomes of the project are key ReCAP targets and an important aspect of successful research.

8.3.1 Country options

There are various options for uptake and embedment at country level, from local planning to national policy. These options will depend on the results and conclusions of the research, so they will be identified and implemented during Phase 4, and proposals will be made for further uptake into the future.

8.4 Activities for Phase 4

The activities for Phase 4 will include an inter-country workshop where the final outcomes and proposed way forward will be presented, and feedback will be sought. The final report will include this feedback. Knowledge dissemination exercises will be discussed, including those most suited to output uptake at the farm and village level.

9 Feedback from country workshops

The country workshops were held in Kenya and Tanzania, as noted above, and attendees and results of the workshop assessments can be seen in Annex 3.

Discussions on clarity and technical queries were undertaken throughout the informative presentations at the workshops. The workshop sessions are summarised next.

9.1 Kenya

The following headings were discussed with the participants and it was agreed that the main discussions of the workshop session would concentrate on the potential for change sections of the report and the outline recommendations.

9.1.1 Community participation

Farmers can form associations for specific crops, and cooperatives for groups of different crops. Public engagement is important and stakeholders must be involved throughout. Bye-laws may be needed to facilitate this. It was suggested that it would be beneficial to present the research findings to local County committees. For example, one farmer had to persistently badger a politician to get a road repaired, could this be done more efficiently by committees?

Education and sensitisation are necessary at all levels of the issues raised in this research. Local communities need to demand accountability. The community are not aware of the resources available for road maintenance, so they need to liaise with County administration. Local communities / committees need to prioritise the construction and maintenance of roads for the Counties. These plans need to be made at sub-County or Ward level. The Ward administrators are responsible for basic access roads.

A local committee of 9 people was suggested. At Ward level this committee could include the Ward Administrator and an Infrastructure Representative (for all services, roads, water, sanitation, etc.).

9.1.2 Form farmer's associations

The first step is to agree on common crops, then prioritise these crops at Ward level, to give farmers more power. Capacity building of farmers is necessary, to help them to increase their livelihoods and add value to their crops. Farmers need to be taught how to stand up to the buyers and get a better deal. Associations can help them to do this. At present the buyers take advantage of the farmer's ignorance and are actively discouraging them to form associations.

9.1.3 Increased competition amongst buyers

Having a Farmers' Association can also lead to increased competition amongst buyers. There is a ministry for Cooperatives in Kenya. The local committee could also be useful in lobbying for more competition.

9.1.4 Local technical advisors

Each County has an engineer or a technician. Participants thought that they should lobby for a technician at Ward level who can advise on First Mile roads. A technician / engineer could be present in local committee meetings, and even be part of the committee. If not available to attend s/he could send a representative. This is similar to the IRAT example from Tanzania.

9.1.5 Awareness raising

It is important to raise awareness of the issues raised by this research. This needs to be done at all levels, and a community level committee could facilitate this.

9.1.6 Developing women's potential

The participants fed back that women tend to downplay their role in the farm and the community, whilst men tend to overplay theirs. Women farmers as interviewed tend to be alone, whereas men farmers tend to have women behind them helping out, which could have distorted the results. The participants were posed the question: How can we get women a fairer deal?

Feedback included sharing the burden of cost, by providing funding options for women. Funding needs to be effective and affordable for women. At present credit can be available from Government. NGOs, etc. but this needs to be made affordable to women. Women and youths could be considered together. i.e. vulnerable groups, which could also include men. Women have less bargaining power and get less income for their crops. This needs more research. Men get better financial deals generally.

Some women are not allowed to talk in front of men, for cultural reasons. For some decisions women still have to consult men. Cultural issues were discussed; the example was used whereby Masai cows are owned by the men, but the milk is owned by the women.

We need to empower women by educating men. Women tend to spend money on the family, not themselves, whereas men tend to be the opposite. In the context of First Mile it was noted that the buyer must pay the farmer, whoever they are, not the husband or head of household. This already happens in Meru and Machakos.

From the whole study only one female transporter was found. There is certainly potential for women to work in this area as cultural attitudes and norms change.

9.1.7 Other

There was a suggestion to increase awareness of various options to add value at the farm, rather than just selling raw materials. The market prices are significantly higher than the price paid to the farmer, for example in Tanzania the farmer sells a pineapple for TSh 100, but it sells in the market for TSh 2,000. One option is to make juice from rejected fruit, rather than leaving the rejected fruit with the buyer.

Mr. Ojepat, a steering group member, noted that it is important to involve all stakeholders from the beginning, to bring them along, i.e. women and men. Inclusivity from Day 1 is important and to have a mix of people is essential. Even if a group is predominantly comprised of women, it is advisable to include some men.

He also asked how we can take the programme forward, without relying on donors.

9.2 Tanzania

As with Kenya, there was lively discussion during the informative presentations of the background, data collection and analysis of results. Some of the more interesting subjects included:

- Recognised that engineers do not consider transportation when planning roads. This is a key issue for the First Mile project. Under SUMATRA policy was considered, and a National Transport Logistics Strategy for Tanzania was developed.
- The negotiating power of farmers can be reduced by intentional delays by transporters.
- How can the results and analysis be linked with DROMAS 2, the TARURA asset management database? The data should be compatible and useful for TARURA.
- Very few low-income countries subsidise their rural transport, unlike medium and high income countries.
- The key to successful change is to convince politicians to take on board the recommendations. The best way to do this is to link the results to the economic situation of the country.
- Other technologies such as animal carts and tractor based maintenance can be appropriate and is being used elsewhere, also under ReCAP (Tractor-based maintenance in Zambia, Motorcycles in Tanzania). Communities need to be made aware of this and guided in its use.
- Value can be added to produce at the farm.
- Overloading can damage rural roads, as can animals.
- This is a very large dataset. Analysis has been carried out to satisfy the ToR, but further data mining could be carried out to further extract other information.

Some examples of existing farmers' organisations were relayed:

- There is a relevant policy from 2003, which allows routine maintenance to be contracted to local communities. They can also report overweight vehicles to the police. Introduced in the districts, the group are registered and have a continuous dialogue. The focus is on routine maintenance to provide income for communities.
- They also need a system to accelerate capital investment. There was a situation where labour-based contractors were hiring graders, which defeated the object of community contractors! |Communities need to be trained in labour-based practices.
- The particular initiative was undertaken under IRAT, and a new phase of project is due to start in January 2019. They now want TARURA to engage with local communities and to integrate this into policy.
- 30% of funding can go to special groups; women, youths, etc. There is potential to adjust this to be available to the community as a whole. The community is able to register as a CBO and perform as a contractor.

In the workshop part of the meeting, the previous change potential issues were discussed from Kenya. There was general agreement in all of the areas, although situations differed slightly between the two countries.

The meeting was then split into two groups, who tackled two questions each and fed back to the meeting in plenary:

9.2.1 Group 1

Question 1: What elements of the transport system that can be improved in order to unlock economic growth?

Group 1 identified four different elements:

- Organisation
- Infrastructure
- Transport services
- Origin-Destination

Organisation: The community should participate in improving infrastructure and operations. TARURA need to participate with the community.

Infrastructure: Roads should be passable all year round and be regularly maintained. Improvement should focus on the main First Mile type sections, before any other sections, to unlock economic growth.

Transport Services: Improvement is vital in several areas:, transportation, sorting, packaging, scheduling, etc. All aspects need to be more efficient.

Question 2 What advice would you give to planners on the best location for access improvements?

The suggestion was to emphasise the Rural Land Use Plan. Focus on First Mile type roads that will directly influence the livelihoods of farmers. Aim to develop the recommendations from First Mile, and plan land use, markets, add values of area, community centres.

TARURA should adopt and guide in the use of low cost technologies. Participation of TARURA is necessary in the location and development of structures. DROMAS should be able to include First Mile data.

9.2.2 Group 2

Question 3 How can the provision-preservation-services continuum work more effectively?

Farmers need to be in registered groups. They need to be educated in various subjects, including how to harvest, market and negotiate price. Marketing skills and communication skills are needed. Also how to check quality and organise storage places in the community. Advocacy could be the key to development. After some time it may be possible to reach out to other development partners to support the implementation of First Mile recommendations. There is also a possibility for the village to set rules to monitor road quality.

Question 4 How can we disseminate the results to community level and to Ministry level?

Feedback can be given at farmer's meetings in the village. It would be appropriate to produce a simple leaflet, one page, that is easy for the farmers to read and understand.

For the Ministry it may be necessary to provide more detail, but the materials produced should not be long. Possibly one page with key messages that politicians can identify with and use. Ministries have forums at the Ministry level where such information could be disseminated. International marketing facilities are available and there is a government website for marketing.

Other:

Some other useful insights that were discussed included:

- Farmers have a lack of knowledge of the market and current prices. Their understanding of their situation and how marketing works needs to be enhanced so they are not taken advantage of. Competition needs to improve in order to increase the prices farmers can charge.
- Trucks should be facilitated to drive closer to the farms. The modes of transport such as headloading and animal cart are many times more expensive than motorised transport, but are still prevalent in Tanzania. This is probably the most potentially transforming activity in terms of reducing farmers' costs. Facilitating communities to maintain tracks can assist in increased truck access.
- How can we get away from headloading? This question was first asked in the 1980's in Tanzania, but the practice is still widespread, indicating that access has improved little in rural areas. Headloading tends to be more prevalent in difficult terrain. Intermediate Means of Transport have largely failed, such as donkey carts (slow to breed, so limited response), although motorcycles are increasing rapidly in Tanzanian rural areas.
- Consolidation of loads could also save farmers money. Most have relatively small loads on a daily basis, so in order to minimise transport costs the farmers should work together to consolidate loads. Mobile phones can help in this respect, although apparently coverage is still poor in many rural areas.
- Mobile phones can also help farmers to find out the going price at market for their produce, which gives them more power in the negotiation process.
- First Mile should present evidence to the Road Fund Board of Tanzania, to convince them of the need for funding of rural roads. Flag up at national level the need for maintenance of rural roads.
- Community contractors should be possible under current regulations. They will however need funding for materials, as well as technical advice.
- The analysis has the potential to give perspectives of women and men of all ages and abilities with regard to land holding, ownership of means of transport and income from farming. More gender and age disaggregated analysis could have given information on who is exploited by farm gate prices, who experiences wastage of farm produce for lack of transport and subsequently who benefits more from improved rural access. Head/body loading is a common means of transport and often carried out by women, but what is the magnitude and how much of this is by older women.

9.3 Further Research

Potential further research was identified from both workshops in the following areas:

- Institutional mechanisms and funding. How can they be revised to facilitate some of the recommendations from this project?
- How can community maintenance be effectively arranged and managed? It appears to be illegal for strategic network roads, but is practised on rural roads.
- How to add value at the farm, and not just sell raw materials. Maximise the value added of a product, i.e. produce juice as well as the raw fruit. It should be noted that on the field trip to Madeke an old pineapple drying factory was noticed. It was set up by the government but was never fully commissioned so is now used solely as a storage shed.
- Investigate successful funding to maintain or upgrade First Mile roads, where has it worked and why?

10 References

Jarimopas. B, Singh, S.P. and Saengnil, W. “Measurement and Analysis of Truck Transport Vibration Levels and Damage to Packaged Tangerines during Transit,” Packag. Technol. Sci. 2005; 18: 179–188.

Ngereza, A.J. & Pawelzik, E. Constraints and opportunities of organic fruit production in Tanzania, 2016, International Journal of Agricultural Policy and Research Vol.4 (4), pp. 67-78, April 2016.

Njenga,P. G. Wahome and J. Hine (2014) Pilot Study on First Mile Transport Challenges In The Onion Small Holder Sector. AFCAP Report No. AFCAP/GEN/147

Njenga P, Wililo S and J. Hine (2015) First Mile Transport Challenges for smallholder Tomato Farmers along Ihimbo-itimbo Road, Kilolo District Tanzania. AFCAP/ASCAP Report SC14061/TAN2015C

PIARC, International Road Maintenance Handbook, Volume 1: Maintenance of roadside areas and drainage, 2006. In partnership with DFID, TRL and GTKP, published by TRL.

PIARC, International Road Maintenance Handbook, Volume 2: Maintenance of unpaved roads, 2006. In partnership with DFID, TRL and GTKP, published by TRL.

PIARC, International Road Maintenance Handbook, Volume 3: Maintenance of paved roads, 1994. In partnership with DFID, TRL and GTKP, published by TRL.

PIARC, International Road Maintenance Handbook, Volume 4: Maintenance of structures and traffic control devices, 1994. In partnership with DFID, TRL and GTKP, published by TRL.

Pretorius, C.J. and Steyn, W.JvdM. “Influence of road roughness on the transportation of fresh produce,” Abstracts of the 31st Southern African Transport Conference (SATC 2012) 9-12 July 2012, Proceedings ISBN Number: 978-1-920017-51-4 Pretoria, South Africa.

Sayers, M.W. Gillespie, T.D. and Paterson, W.D.O. (1986) “Guidelines for conducting and calibrating road roughness measurements,” World Bank Technical Paper No. 46, World Bank, Washington, D.C., U.S.A.

SMEC & Ambicon Engineering Ltd. Defect identification and data collection manual: Local government road inventory and condition survey project, 2005, Published by: The united republic of Tanzania president’s office regional administration and local government.

Wang, W. and Feng, G. “RoadLab: Revamping Road Condition and Road Safety Monitoring by Crowdsourcing with Smartphone App,” Transportation Research Board 95th Annual Meeting, Washington D.C., U.S.A., 2016, 15p.

Annex 1 Questionnaires and Checklists

FARMER'S QUESTIONNAIRE

Village Name_____ District_____ Region_____

GPS Coordinates_____ Nearest road name_____

Enumerator's Name _____Date _____

SECTION 1: FARMER'S DETAILS	
1. Name of Farmer 2. Gender 3. Age	4. Farmer's Education Level: a) No Formal Education b) Primary Education c) Secondary Education d) Tertiary
5. Is farming the main occupation? Yes / No.	6. If not what is the main occupation?
7. Total Area Under Cultivation for all crop. _____ Acres/ Hectare (specify) 8. Is the land in one plot location? Yes/No 9. If no what is the maximum distance between plots? _____ km	10. Farmer's relationship to land. • Owned outright • Customary rights • Leasehold • Rented • Other -Specify

11. Main Crops Grown over last year on your farm (include target crop):

	Crop	Area(specify units)	Yield (specify units)	Gross Income
a)	_____	_____(Acre/Hect)	_____ kg/tonnes	_____ Sh.
b)	_____	_____(Acre/Hect.)	_____ kg/tonnes	_____Sh.
c)	_____	_____(Acre/Hect.)	_____ kg/tonnes	_____ Sh.

12. Does the farmer own any means of transport? Yes/No If Yes Please indicate:
    a) Bicycle b) donkey/horse c) Animal cart d) push cart/wheelbarrow e) Motorcycle f) saloon car g) 4 wheel drive utility h) pickup truck i) truck j) Other – Specify _____

13. Can trucks easily get to your farm? Yes/ No. If not, identify the problems, circle all that apply:
    a) Path/track too narrow b) gradient too steep, c) slippery surface, d) vegetation too dense
    e) Thick mud when wet f) difficult water crossing g) road surface too rough or uneven
    f) Other –specify _____

14. Can you easily organise transporters or buyers to take your produce? Yes/No. If No what are the problems? Circle all that apply: a) farm too remote b) quantity too small d) difficult to amalgamate loads with other farmers e) route too difficult f) transporters & buyers do not stick their promise to come g) difficult to make agreements because prices fluctuate, h) market prices are too low to make trip worthwhile i) not enough buyers j) not enough transporters) buyers complain about quality of produce l) produce is spoilt on journey m) credit arrangements are unsatisfactory n) poor mobile phone connections o) Other specify:_____

Enumerator and farmer must now select one or two major crops, for detailed investigation, that have been identified as having significant problems in getting to market in the area.

SECTION 2: CROP 1 DETAILS (Target Crop)

15. Crop Name _____

16. Harvest yield per year _____kg/tonnes

17. How many harvests per year?

18. Main harvest periods:
From _____ To _____
From _____ To _____

19. What are the yearly total costs of production of this crop?
a) Seed_____Sh.
b) Fertiliser _____Sh.
c) Insecticide/weedicide _____Sh.
d) Labour_____Sh.
e) Machinery/Animal Hire _____Sh.
f) Land Rent_____Sh.
g) interest or loan charges _____Sh.
h) Other costs _____Sh.
(Total _____ Sh.)

20. Gross Income for crop: _____Sh.

21. How soon after harvest is the crop transported from the farm to market?
Same Day_____ Yes / No/Sometimes

If No: _____ days later

22. f the harvested target crop, on average, what proportion is:

a) spoiled	
b) consumed domestically	
c) kept for next year (for planting)	
d) sold	
Total	100%

23. Is the crop stored on the farm, locally, or at the house before being transported to collection point/market/ factory?

Yes / No.

23a. If Yes:

Where is it stored?	How?
Farm	
Locally	
House	

24. What type container is used for the crop when it is transported? (Examples include bag, wooden crate, plastic crate, cardboard box, or is it loose?)

Section	Container: Explain
Farm to Collection Point	
Collection Point to Market	

25. Is extra packaging used to stop bruising, like leaves, paper, plastic foam? Yes/No

25a. If Yes what sort ? _____

26. How much does the container or box cost ?
_____Sh
How many kilos does it hold? _____kg

27. How much does the extra packaging cost, per kilo if used _____per kilo of crop

28. When do you usually transfer ownership to the buyer? Is it:
    a) at the farm, before harvest,
    b) at the farm, after harvest,
    c) as it is loaded onto first transport
    d) at collection point,
    e) at the market
    f) Or elsewhere? _____
    Please circle or write in answer.

29. Do you usually :
    a) sell to a buyer at the farm
    b) pay for transport from the farm to collection point or market
    Please indicate.

30. Do you usually get paid a) an advance by the buyer before transfer of ownership b) when the buyer takes possession or c) after buyer takes possession ? Please indicate.

31. If credit is involved explain how this works _____

32. Usually what does the buyer pay for:
    a) Harvesting
    b) Packaging
    c) Loading (at farm)
    d) Transport from the farm
    e) Unloading at collection point
    f) Onward transport to market/factory
    Please indicate all that apply.

33. If the crop is found to be damaged after first transport will you (the farmer) be penalised? I.e. is it at your cost? Yes/ No/Sometimes

    If yes explain. _____

34. Do you usually travel to the collection point or local market to sell the produce?

    Yes/No/Sometimes
    Please indicate

35. Where and when does most crop spoilage take place during different stages of the marketing and transport process?
    Please Indicate for each:
    a) After harvest at store on farm or at house _____
    b) Waiting for first transport _____
    c) Loading and Unloading _____
    d) During first transport from farm _____
    e) Waiting for a buyer at collection point _____
    f) Further transport onto major market or factory _____

    High Spoilage : High
    Medium Spoilage: Med.
    Low Spoilage: Low
    No Spoilage: None

36. Can you estimate, on average, percentage lost:

    a) Before loading on first transport _____%
    b) During first transport _____%
    c) At first collection point _____%

37. What are the main factors that will spoil the crop after harvest? Select one score for each factor.
    (1 : major factor, 2: moderate factor, 3: minor factor, 4: not an issue)

Factors	1	2	3	4
a. A lack of adequate storage at the farm				
b. Pests (rodents, insects)				
c. Diseases and mould				
d. Getting wet				
e. High Temperature				
f. Left unprotected				
g. Lengthy delays before first transport is found				
h. A lack of (or poor) packaging materials on first transport				
i. Bruising caused by loading and first transport				
j. Poor facilities and storage at collection point				
k. Lengthy delays before second transport is found at collection point				
l. Bruising caused by loading and for second transport				

38. Is the crop mostly identified as "First Grade Quality" by the buyer, when a sale is made? Yes/ No

39. What proportion of the crop is sold as second quality (or worse)? _____ %

40. If there is a problem with the crop. What is it ? _____

41. Usually what is the first means of transport used to take the crop from farm to collection point/market?

_____

42. Is there a break (to first collection point) in transport where different modes of transport are used? Yes/No

43. If Yes, what is the second means of transport used? _____

44. What was the destination?_____

45. What was the distance, from farm? _____km

46. Usually who pays for the first movement from farm?
    a) Farmer hires transport
    b) Farmer uses own transport
    c) Buyer pays for transport
    Please indicate.

47. For first transport what weight of produce was moved on each trip? _____ Kg

48. What was the costs of transport for trip? _____Sh.

49. Price of transport per kg _____Sh/kg

50. Price farmer gets at farmgate _____Sh/kg

51. Price farmer would get at first collection point/market (less any additional marketing or storage costs) _____Sh/kg

52. Were loads amalgamated with other farmers for first transport from farm. Yes/No

53. For the second stage of movement from collection point/local market what is usual means of transport? _____

54. What is the standard consignment* size? _____ Tonnes

*A consignment is the load (of one crop)for transport that is organised and accounted for at one time. It can be the total load of the truck, but sometimes the truck may take several consignments, for example, of different commodities, or organised by different people.

55. For 2nd Movement what is the usual destination and distance?

	Destination	Distance KM
a		
b		
c		
d		

56. In order of priority what would be the best measures to help farmers overcome the difficulties of transporting produce, getting better prices, and reducing crop losses for the first stages of transport from the farm?

	Measures	Priority
a	Improving the paths and tracks on 'first mile' to collection point/ local markets	
b	Improving the roads from the collection points and local markets to major towns and markets	
c	Assisting with better storage in local vicinity of the farms	
d	Providing better facilities at local collection points and local markets	
e	Organising farmers to cooperate in amalgamating loads	
f	Providing loans and assistance so farmers can buy their own transport	
g	Providing help to groups of farmers so they can work together to market their own produce to urban supermarkets and international companies	
h	Providing advice and help on better containers and packing materials for crop transport	
i	Providing better mobile phone communications	
j	Other?	
k	Other?	

For highest priority write "1" next to the proposed measure, For next highest priority write "2" next to the measure and so on.

Questionnaire No: …….

TRANSPORT OPERATOR PERSPECTIVE QUESTIONNAIRE

Objective: This survey instrument aims at documenting the dynamics of transporting crop "……..." in the area by covering all the existing modes of "……..." transportation aspects existing in the area. This is important in analyzing the cost of transporting a Kilogram of "……."/Km for different modes of transport, which helps in understanding the transportation burden farmers undergo in the First Mile Phase of Transportation.

Interview Point Name:_____ Date of Interview:_____

Interviewer :_____ Tel. No. _____

Farm Origin Administrative Location Name: _____

Geo. Coordinates: _____

Average Trip Distance in KM (From the Farm to Collection Point): _____

Day of the Interview: 1. Normal day 2. Market Day 3. Weekend 4. Rainy day*(circle all that apply)*

Name of Transporter:_____Tel. No._____

Gender: Female Male *(circle one)***Age: _____**

Education level: _____*(Primary / Secondary / Tertiary[college/university])*

TRANSPORT MODE: _____(use one form for each transport mode discussed)

Options are: *Lorry / Pickup, Saloon, station wagon / Tractor / Motor tricycle / Motorcycle /Matatus / Bicycle / Animal cart / Head/Back Loading / Other (specify)*

Are you the:

Transport Service (TS) owner	
TS operator	
TS owner-operator	
Self (Farmer)	

Where did you collect the crop from? *(Farm, collection point)*_____

For the last trip, who paid for the transport?

Farmer	
Marketing Wholesaler	
Warehouse or Factory processor	
Other: Who……	

*Explain*_____

_____

Did you purchase the crop, on your own account, for selling later on? Yes / No. *(circle one)*

If Yes how much did you pay for the crop per kilo? _____Shs.

Or _____Shs. per _____ …… give units (eg. bag, box, tonne, etc.)

Other information: _____

_____

_____

T1-1: How do you charge for the transport of "……..." ? (i.e. per bag, per kg, per tonne/km)

T1-2: What is the distance you normally transport "……" in KMs _____per trip

T1-3:How many "……..."transportation trip(s) do you make on this section of the road on normal days, rainy days and market days using your mode of transport?

Transport Mode (same as Page 1)	Origin: Farm or Collection Point	Destination: CP, market, factory, etc.	Normal day	Rainy day	Market day	Number of Market days a year *(eg, weekly = 52)*

T1-4a: How many days do you normally transport "……..." per week in harvest season? _____

T1-4b: Which days do you normally transport "……..." per week in harvest season? _____

T1-5: How much "……."do you carry per trip in Kilograms on this section of the road on normal days, rainy days,market days and disrupted days?

Transport Mode (same as Page 1)	Origin: Farm or Collection point	Destination: CP, market, factory, etc.	Amount of **"….."**Carried per trip (Kgs) Normal day	Amount of **"….."**Carried per trip (Kgs) Rainy day	Amount of **"….."**Carried per trip (Kgs) Market day	Amount of **"….."**Carried per trip (Kgs) disrupted day

T1-6. How much do you charge in_Shs per trip on this section of the road on normal days, market days and disrupted days?*(school open/close, demonstrations, functions, road works, etc.)*

Reference number					**O1-3a**	**O1-3b**	**O1-3c**	**O1-3d**
Transport Mode (same as Page 1)	Origin: Farm or Collection point	Destination: Collection point/market /Factory/ Warehouse etc.	Travel time minutes	Dist KM	Amount Charged per trip Normal day Shs	Amount Charged per trip Rainy day Shs	Amount Charged per trip Market day Shs	Amount Charged per trip Disrupted day Shs
*	*	*	*	*	*			
			*			*		
			*				*	
			*					*

Travel considered:

Farm › Collection Point › Local Market › Main Market/Town/City

Farm ➤ Collection Point ➤ Factory, Warehouse, Shop or Institution

T1-7: What is the Reliability of Transport Services, for this Transport Mode (See Page 1), for the route sections mentioned above?

Transport Mode (same as Page 1)	Estimate Number of Days where no service is available (because of weather and road/track condition) per year	Number of Days with disrupted service (because of weather and road track condition) per year	Number of Days with good Transport Services per year	Total
Main Harvest Season (Give number of days Of Harvest season)_____Days				= Total Harvest Season Days
Non-Harvest Season (Give number of days outside of Harvest season) _____Days				= Total Non-Harvest Season days

Note: we are trying to capture the number of actually disrupted days and not the length of the rainy season(s).

T1-8: During the past year, for your mode of transport, has the number of vehicles operating each day along the road changed?

Big decrease	Small decrease	No change	Small increase	Big increase

T1-9: During the past year, has the number of trips per day for your mode of transport for"….."along your regular route changed?

Big decrease	Small decrease	No change	Small increase	Big increase

T1-10: What is the overall condition of the path/ track/ road in relation to your mode of transport?

Dry Season*(circle one)*	Impassable	Poor	Fair	Good
What is the problem? i.e. Roughness, muddy, slippery, steep, water crossing, other?				
Wet Season*(circle one)*	Impassable	Poor	Fair	Good
What is the problem? i.e. Roughness, muddy, slippery, steep, water crossing, other?				

Note: Impassable = no access, Poor = restricted access….

T1-11a: Has the condition of the path/track/road ever negatively affected the condition or value of the produce? Yes / No *(circle one)*

T1-11b.

If Yes, Explain:

T1-12: Has the way the produce is loaded, unloaded, packaged transported or the delays involved,negatively affected the condition or value of the produce? Yes / No *(circle one)*

Action	**How it affected the condition of produce?**
Loaded	
Unloaded	
Packaged	
Transported	
Delayed	
Other: ……..……..	
Other: ……..……..	

T1-13: Are there any active associations (formal/informal) of operators for your mode of transport on this road?

No association	Association with member welfare	Association concerned with welfare + fares control	Association concerned with welfare + fares control, queuing and terminals	Association with welfare + fare control, queuing, terminals + route allocation

T1-14: How many vehicles/modes of transport are sharing the "……..”transport market leading to this Collection Point?

	Number of vehicles	Number of owners / franchise	Number of associations	Number of vehicles operating outside association context
Lorry				
Pick-up				
Saloon / station wagon				
Tractor				
Motor Tri-Cycle				
Motorcycle				
Mini Bus				
Bicycle				
Animal cart				
Head/Back Loading				
Other (Specify)				

T1-15a. Most often does the farmer, or buyer, accompany the produce up to the collection point?

Yes *usually someone accompanies the produce* / **No** *usually it is transported alone(circle one)*

T1-15b. Does the farmer accompany the produce from collection point to market?

Yes *usually someone accompanies the produce* / **No** *usually it is transported alone(circle one)*

T1-15c: If someone travels with the crop, will they have to pay extra for their personal transport?

Yes /No *(circle one)*

T1-15d: What extra will they have to pay for a typical journey? _____Sh.

T1-15e. Explain _____

T1-15f. For what distance does that price refer? _____km

T1-15g. Type of vehicle this information refers to _____

T1-16: Who carries out loading and unloading if the load is accompanied?

Explain _____

T1-17: If the produce is unaccompanied, explain how delivery and unloading are arranged.

_____

T1-!7a: Who pays for unloading ? _____

T1-17a. What are the typical costs for unloading for typical load ? _____ Sh

COLLECTION POINT & LOCAL MARKET SURVEY

AGRICULTURAL PRODUCE SELLER OR FARMER QUESTIONNAIRE

Interviewer…… Location District……..……village/town…..……

Name of market/collection point…….…….…… Date……

Are you:

A farmer (or family member) who has grown the produce now on sale	
A trader/stallholder who bought the produce from a farmer at this location	
A trader who previously brought the produce to the market from a farmer elsewhere	
A trader who previously bought the produce from another wholesaler or trader	
Other: Explain	

Are You:

Principally selling retail (i.e. to people for their own consumption)	
Principally selling wholesale (i.e. to people who will sell it again)	

Over the last four weeks how many days did you attend this collection point or market? ……..

For Key Crops on sale what are today's prices?

Crop	Typical unit of sale (bag, box, bunch, crate or by weight - Kg)	For Typical Unit No of Kgs	Price per unit

Do you know the means of transport that was mostly used to bring produce to this market? Yes/No

Head/back load	Bicycle	donkey	Motor-cycle	Push cart	Pick-up truck	Mini bus	Large bus	Truck

Can you give an example of produce transport charges, bringing goods to market?

Crop	Load type and amount (eg. 10 bags, 20 crates)	Total weight kg	Distance Km.	Transport charge	Means of transport
				Sh.	
				Sh.	
				Sh.	
				Sh.	

When you first bought the produce, or arrived at the market, what was its general quality?

Please try to give Percentage (%) in each category (ie. 80% + 10% + 5% +5% = 100%)

'Grade 1' Will fetch best price	'Grade 2' Will fetch lower price	Quality not so good- May be difficult to sell	Produce is damaged or rotten and will have to be thrown away	Add to 100 %
%	%	%	%	= 100%

Do you expect to sell all your produce today? Yes/No

If No what will happen to most of the remaining produce?

I will take it away.	I will store it at the market	I will throw it away

Do you expect to throw any produce away today? Yes/No

If yes what percentage or proportion of what you started with will be thrown away?

…….. %

What additional facilities or measures could be taken to help improve the market/collection point?

……

……..

……

……..

COLLECTION POINT & LOCAL MARKET: GENERAL DATA

Interviewer…… Location District……..……village/town…..……

Name of market/collection point…….…… Date…… Time……

1. **Is this market/collection point open every day? Yes /No**
   If no give frequency ……
2. **At time of survey how many people or stallholders are selling agricultural produce? ……..**
3. **Is this location?**

Covered or protected from weather		Not covered and Unprotected	

4. **How is agricultural produce mainly stored prior to sale?**

On the ground	On a hard surface, like concrete	On wooden stalls	In kiosks or buildings	In vehicles, waiting for sale	A complete mixture

5. **What best describes the collection point/market?**

It is principally to collect local produce together for the onward movement	
It is principally a local market where people can buy produce for their own consumption	
It is principally a wholesale market where produce comes some distance before sale to traders/wholesalers	
The market has mixed functions	

6. **What facilities are available at the location (within 200 m)?**

electricity	**water**	**toilets**	**General storage**	**Cold storage for produce**

7. **Describe the main road connection to the location.**

A good quality main road	**A poor quality main road**	**A good quality minor road**	**A minor road with some access issues**	**A minor road or track with major access problems**

8. **Numbers of different types of vehicles observed at location at time of survey**

motorcycles	**pushcarts**	**Cars/ 4- wheel drive**	**minibuses**	**Large buses**	**Pickups**	**Trucks**

KEY INFORMANT GUIDE-AGRICULTURE INFORMANT

Questions	Questionnaire No.
SECTION 1: RESPONDENT'S BACKGROUND	
Name of Enumerator	**Tel. No.** **Email:**
1a. Name of the respondent	**Tel. No.** **Email:**
1b. Sub-county/ district name.	
1c. Location where informant is stationed.	
2. Ministry/Institution	
3. Department/Section	
4. Designation of the Respondent	
5. Gender	**1. Male 2. Female**
6. Respondent Contacts	
7. Respondents Education Level	Primary / Secondary / Tertiary [College/University]
8. Age in Years	
SECTION 2: AGRICULTURAL ACTIVITIES	
9. What is the role of your institution/organisation?	
10a. Do you work with small scale farmers?	
10b. How do you work with small scale farmers?	
11. How has small scale farming changed in this area over the last ten years?	

12. Identify the main crops (up to three) in this location that suffer the most problems of post harvest deterioration and 'first mile' transport issues from the farm. (*It is most important to get a good answer to this question as the following questions will relate to these crops*) How important are these crops in terms of economic activity in this area? (i.e. is it the main crop, secondary crop, etc?)	Crop a) _____ Crop b) _____ Crop c) _____
13. Do you have any records or statistics on production the above crops in the area? Is it possible to get these for the last three years?	Yes / No
14. What are the main growing areas of these crops in this district/sublocation.	Crop a) _____ Crop b) _____ Crop c) _____
15. How many farmers are involved in farming these crops in this district or sublocation?	There are xxx_____farmers for crop a) _____ farmers for crop b) _____farmers for crop c) In this district /sublocation. (Identify)
16. How many tonnes of the key crops in question are produced in the area per year,? *Note: Enumerator can use average acreage and productivity to work this out*	Crop a) _____ Crop b) _____ Crop c) _____
17a. Do small scale farmers of have formal 'farmers groups' for sharing information and being involved in cooperative activities?	Yes / No
17b. If Yes, how many farmers groups are there?	
17c. How many of these would you consider active?	

17d. Why are the remaining farmers groups not active?		
18. Why do you think farmers have mobilised small scale farmers to form farmers groups?		
19a. Are there storage facilities for the different crops identified above in the area?		
19b. What type of storage facilities are there?		
19c. Describe where the storage facilities are? (eg, on farms, at collection points, near markets etc)		
19d. Describe how far the storage facilities are from your collection point? *Note: Possibly draw a sketch map.*		
20a. Do farmers deliberately attempt to coordinate and consolidate their loads together before arranging transport in order to reduce costs?		
20b. What percentage of farmers arrange the marketing and transport of their produce independently of farmers groups?		
21. Which locations would you consider as most challenging in terms of transporting farm produce by the small scale farmer?	Why are they challenging?	How are they challenging?
i. location a) _____		
ii. location b) _____		
iii. location c) _____		

iv. location d) _____		
SECTION 3: TRANSPORTATION AND MARKETING		
22a. Where do farmers, of the crops identified above, in this area take their produce to, directly from their farms?		
22b.Why?		
23a. In this area are smallholders' farms mostly accessible by conventional trucks through the year? Explain.		
23b. What is the infrastructure (road, track) like?		
23c. What is the quality of the different transport links? (i.e. farm to collection point, collection point to market)		
24. What market information do small scale farmers in this area require?		
25What are the main issues involved by farmers in accessing and using the current collection points or first markets? Explain.		
26a. What is the most popular mode of transport used?		
26b. Why is this mode most popular?		
26c. Is it usually arranged individually or as a group?		

27a. Do you have any record(s) on the cost of the transportation in the area:	Yes / No Specify below
• From farm to Collection Point?	
• From Collection Point to market or processing centre?	
27b If No records, do you have knowledge of costs on the transportation chain?	Yes / No Specify below
• From farm to Collection Point?	
• From Collection Point to market or processing centre?	

28. How important are the following issues for crop deterioration before and during first transport? a) Excessive delay between harvesting and first transport? b) Inadequate storage before first transport? c) Crop exposed to pests/disease before first transport? d) Crop gets wet before first transport and deteriorates? e) Crop gets wet during first transport and deteriorates? f) Bruising due to loading/unloading and first transport? g) Poor temperature control in first stages of transport? h) Poor packaging before first transport? i) A lack of suitable packaging materials before first transport? j) Unloading at collection point?	Very=4, Moderate=3, Minor=2, None=1

29. How important are the following issues for crop deterioration, at collection point and for the second transport leg? a) Inadequate storage at collection point? b) Excessive waiting time for transport at collection point? c) Crop exposed to pests/disease at collection point? d) Crop gets wet at collection point and deteriorates? e) Crop gets wet during second transport leg and deteriorates? f) Poor temperature control before and during 2nd transport leg? g) Bruising due to loading/unloading and for 2nd transport leg? h) Poor packaging at collection point? i) A lack of suitable packaging materials at second transport leg? j) Unloading at final destination?	Very=4, Moderate=3, Minor=2, None=1	
30. What are the main types of crop deterioration in this area and the causes?	Type of Deterioration	Cause of Deterioration
	i.	
	ii.	
	iii.	
	iv.	
31. Where do the highest crop losses occur?	Place	Percentage of crop lost
	i. At Farm	
	ii. Farm to collection point	
	iii. At collection point	
	iv. Collection point to market	
32a. Do farmers in the area get the best prices (net of any transport costs) for their crop?	Yes / No	
32b. If not, why not?		

33. What would you consider as most challenging to the small scale "……..." farmers?	
34a. What kind of solution is needed to address these challenges?	
34b. Who should be the key actors to drive these solutions?	
34c. Why?	
35a. How can transportation costs be minimized?	
35b. What needs to be done to enable them adopt such a strategy?	
SECTION4: REGULATORY FRAMEWORK	
36. Would you say that all necessary regulations are in place to facilitate small scale farmers' requirements? Discuss	Yes / No
37a. What regulations need to be put in place to support small scale farmers to transport their produce economically?	

37b. Who should play a role in this?	
37c. Why?	
38a. Are there any recent changes in regulations targeting small scale farmers? (Eg since the introduction of devolved government in the area?)	Yes / No
38b. If Yes, which ones?	
38c. How have they changed the way small scale "……" farmers operate?	

39. Please provide "……..…" crop prices over the year in Shs per Kg.

Crop	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Farm Gate												
Collection Point												
Market												

Close: Thank you very much for your time. Your knowledge and insights will be very helpful to our study in understanding the complexity of transportation burden shouldered by small scale farmers in the region.

KEY INFORMANT GUIDE-INFRASTRUCTURE EXPERT

Note to the Expert we are particularly interested in the transport of certain key Identified Crops (Specify……/…… …/ ……) that suffer particular "first-mile" transport problems.

Questions	Questionnaire No.
SECTION 1:RESPONDENT'S BACKGROUND	
Name of Interviewer	**Tel. No.** **Email:**
1a. Name of the respondent	**Tel. No.** **Email:**
1b. District / County Name	
2. Ministry/Institution	
3. Department/Section	
4. Designation of the Respondent	
5. Gender	**1. Male 2. Female**
6. Respondent Contact Details	
7. Respondents Education Level	Primary / Secondary / Tertiary [College/University]
8. Age in Years	
SECTION 2: INFRASTRUCTURE RELATED ACTIVITIES	
9. What is the role of your institution/organisation in so far as roads in the area are concerned?	
10. What type of rural roads are you principally concerned with? (i.e. secondary roads, classified feeder/ minor rural roads, unclassified roads and tracks?) *Please state which apply*	

11. What type of infrastructure activities do you get involved with? (i.e. construction/rehabilitation/ periodic maintenance and regravelling/ spot improvements/ routine and emergency maintenance)	
12a. Do you, or immediate colleagues, ever get involved with helping rural communities with their access problems to their farms on the unclassified road or track network? 12b. If Yes explain:	Yes / No
13a. Do you, or any of your colleagues, have a specific role(like a Village Travel & Transport Coordinator, (VTTP)) to help with these rural access problems? 13b. If Yes, explain:	Yes/No
14a. In your district/area is there a specific Government budget set aside to help with village/ farm access problems? 14b. If Yes what is the approximate annual budget?	Yes / No
15a. Have you been involved working with initiatives or donor programmes covering roads as part of agricultural, CDD, Social Development, Safety Net (or similar) schemes ? 15b. If Yes explain what was involved.	Yes /No
16. How would you describe how the current condition of roads that link farms (growing the crops identified above) to the first collection points?	i. Farm to Collection Point
	ii. Collection Point to Market
Probe for Feeder Roads also?	iii. Feeder Roads

<table>
<tr><td>17a. In your area what are the main access problems for farm to First Collection Point? (e.g. water crossings, mud, slippery soils, heavy vegetation, steep gradients, high road roughness)

17b. How can these issues be addressed?</td><td></td></tr>
<tr><td>18a. For rural feeder roads what are the main access problems?

18b How can these issues be addressed?</td><td></td></tr>
<tr><td rowspan="2">19.What challenges do you face in the provision of roads serving small scale farms?</td><td>i. Administrative/ Financial?</td></tr>
<tr><td>ii. Technical?</td></tr>
<tr><td colspan="2">SECTION 3: TRANSPORTATION AND MARKETING</td></tr>
<tr><td>21. In very rough terms do you have an idea of the proportion of smallholders' farms that are accessible by trucks during the main harvest period?</td><td>The proportion of small holder farms directly accessible by trucks during harvest period are:
<table><tr><td>Extent</td><td>Tick</td></tr><tr><td>a) Vast majority</td><td></td></tr><tr><td>b) Majority</td><td></td></tr><tr><td>c) About half</td><td></td></tr><tr><td>d) Minority</td><td></td></tr><tr><td>e) Small minority</td><td></td></tr></table>(Please indicate)</td></tr>
<tr><td>21. What are the range of typical distances from a farm to a maintained road?</td><td></td></tr>
</table>

22. What is the most popular modes of transport used to transport their produce from the farm?		
23. Why do they use these modes of transport?		
24. Which aspects would you consider as most challenging in terms of transporting farm produce by small scale farmers?	Why are they challenging?	How can the situation be improved?
Location a)		
Location b)		
Location c)		
25. Are there any institutional changes, or changes in transport regulations, that might improve the transport of small holder produce to market?		

SECTION 4: ROAD DATA

26a. Give details of the roads/links having the worst problems in the area

Road Name/Location	Problem	Length in KMs	Which months are these roads difficult, but possible, to travel on?	Which months are these roads effectively closed to motorised traffic, such as trucks?
Road a).				
Road b)				
Road c)				
Road d)				

26b. How many days in the months mentioned are the roads most difficult but possible to travel on?

Months	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
No. of days												

26c. How many days in the months mentioned are the roads most effectively closed to motorised traffic, such as trucks?

Months	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
No. of days												

Close: Thank you very much for your time. Your knowledge and insights will be very helpful to our study in understanding the complexity of transportation burden shouldered by small scale farmers in the region.

NB: I would appreciate if you have any reports to hand, particularly if available electronically, or any specific data on examples of road improvements, structures, and maintenance costs over the last three years, to enable us appreciate the effort made by your organisation/institution in reducing transportation burden borne by the small scale farmers.

(It would help for the interviewer to carry a USB memory stick in case a useful report is available from the Respondent.)

FARMERS GROUP FOCUS GROUP DISCUSSION (FGD) GUIDE

For each participant of the FGD, please take down the following information in a register/Note book

1. Name 2. Age 3. How long have you been farming?

Instructions:

This FGD will be conducted with 7 to 12 participants who are members of …….. targeted for the First Mile Transport Challenges Study.

Select FGD participants carefully, considering background, gender, age, etc. Aim for specific focused groups, as well as general groups. Refer to Phase 2 report for combination of groups.

Introduction:

Suggested introduction: Thank you for the opportunity to speak with you. We are a research team interested in learning more about agriculture in this area. We assure you that all the information that you provide to us will be used exclusively for our research and analysis. We will record the session but all responses will appear anonymously. This is not a test, and there are no right or wrong answers. The most important thing is that you should feel comfortable and contribute. You can express opinions and discuss issues freely but respecting other members' opinions.

Objective:

This session brings together members of farmers group in the area to talk about their ideas, perspectives and opinions about ….. (Crop 1) transportation from the farm to collection point. This is well suited to assessing experience farmers have with ….. (Crop 1) transportation by allowing the research team better understand ……. (Crop 1) transportation practices, while also learning the important role the farming groups play in addressing framers transportation needs, including ideas for future improvements.

Checklist

a) Land size and ownership

b) Production

c) Harvesting

d) Transport

e) Marketing and payment

f) Challenges

g) Recommendations

Discussion Questions

1. What is the objective of this group? Probe whether farm products transportation and more so crop transportation has been factored in
2. Among the farmers, why did you decided to farm this crop?
3. Percentage of cash income from other crops grown in the area?
4. Are there people in your farmers group who have stopped farming this crop? If yes, why did they stop growing? Ccheck for the profitability and popularity of this crop as compared to other crops and probe for transportation cost on the first mile as a possible hindrance.
5. What is the percentage of cash income from this crop?
6. Is this crop transported together with other crops?
7. How do members transport their crop from first mile to collection point? Probe for modes used and their suitability?
8. Do they go to the same destination(s)?
9. Do men or women use particular modes which are different?
10. Is the group facilitating members in transportation of this crop at the first mile? If Yes, how and if no, why?
11. From your experience, do farmers make their decision about continuing to grow this crop based on what other members of the farmers group do, or do they make their decision independent of others? [Probe to find out why].
12. How and where do you market this crop? What means of transport do you use to reach your target market? At what cost? Who bear the cost of transportation?
13. Which other institution/agency do you partner with in ensuring that farmers of this crop benefit from the products?
14. What role is the group planning to play in ensuring efficient transportation of this crop in the area?
15. How has the transportation of this crop in the area improved? Who should play a leading role in this?

Annex 2 Abstracts for Regional Conferences

IRF Durban

The presentation at the IRF Durban conference will be regarding the measurement of road condition and is entitled 'Measuring Road Condition of the First Mile' and the abstract is shown below:

Abstract:

The efficiency of rural transport is important for improving financial and time costs in the delivery of produce and for reducing post-harvest losses. Many crops lose value as they are transported over rough roads and suffer time delays in getting to the market. The pattern of transport varies between seasons with many roads becoming impassable, which results in slower transport and increased costs. There is growing recognition that rural infrastructure needs to be planned together with transport services to minimise transport costs, reduce crop wastage and gain the maximum advantage for farmers.

TRL is undertaking research in Tanzania and Kenya on moving harvest along the primary transport segment, or 'First Mile', from farm to established road access. This project is concerned with the cost-beneficial improvement of access, by assessing the condition of these primary road segments to determine the effect on crop damage and wastage. The condition assessment is being carried out using a variety of high-tech means, in addition to traditional visual surveys being assessed from DashCam videos of the road. A quantitative assessment of road roughness will be measured using two methods, maximum comfortable achievable vehicle speed and the use of accelerometers and smartphone apps. Accelerometers are placed in both passenger and goods vehicles; in amongst the produce when vehicles are loaded. Using a spreadsheet, the accelerometer data will be analysed and expressed in units similar to that of roughness. This will lead to a greater understanding of First Mile access problems and result in recommendations for improvement.

PIARC Arusha

The presentation at the PIARC Arusha conference is entitled 'Improvement of 'First Mile' access', and the abstract is shown below:

Abstract:

A research project is under way in Kenya and Tanzania to investigate the issue of 'First Mile' (from farm to first market or collection point) access in depth. With study sites in Kenya and Tanzania, the research has the aim of extending the evidence base for the benefits associated with access improvements to small-scale farmers, and the potential impact that those benefits could have on food security and poverty reduction on a wider scale. This will be achieved by carrying out semi-structured interviews with farmers and local experts in agriculture and infrastructure, as well as using focus group discussions with key community groups. The condition and location of local access roads will also be assessed to define the relationship between accessibility and agricultural livelihoods. It is expected that the research will provide guidance on the cost-beneficial improvement of all-season access, from policy makers down to small-scale farmers, and is intended to be used to inform future planning and implementation of infrastructure.

This subject has previously been explored by IFRTD in two pilot studies in the same countries, but with limited effect on policy to date. There has been insufficient research to support stronger linkages between investments in agriculture and first mile infrastructure, and road authorities only tend to respond after traffic volumes have reached certain thresholds, and indeed this is often included in local criteria for road upgrading. Therefore, the results of this research have not been translated into a policy that will enhance agricultural marketing and ultimately meet the social demands of local communities. There is clearly scope for research results to be more influential in policy, which could enhance the agricultural supply chain at both local authority and small-scale farmer levels.

Annex 3 Workshop Feedback

Kenya – 18 September 2018:

Question 1 List 3 things that you have learned from this workshop:

- Gender issues, importance of women in agriculture
- Community participation and education
- Condition of roads and how it affects produce prices
- Challenges in transporting produce
- Economics of transporting produce
- Labour costs vs vehicle costs
- Dimensions of First Mile transport
- Limitations of community/government engagement
- Knowledge of data collection tools
- Communication with community needs to improve
- Road safety hazards

Questions 2 to 9 inclusive are shown in the table below:

Question	Very Good	Good	Fair	Poor	Very Poor	Total
2 Usefulness of workshop?	33.3%	66.7%				100.0%
3 Workshop met expectations?	50.0%	33.3%	16.7%			100.0%
4 Could you contribute?	41.7%	41.7%	8.3%	8.3%		100.0%
5 Schedule/timetable	33.3%	50.0%	16.7%			100.0%
6 Organisation of workshop?	16.7%	66.7%	16.7%			100.0%
7 Presentations at workshop?	50.0%	41.7%	8.3%			100.0%
8 Discussions and feedback?	58.3%	41.7%				100.0%
9 Rate summary of key points	41.7%	58.3%				100.0%
Total	**40.63%**	**50.00%**	**8.33%**	**1.04%**		

Question 10 What were the two best and most useful aspects of the workshop?

- Comparison between Meru and Machakos
- Government planning
- Challenges faced by farmers throughout the value chain
- Economics of transportation in agriculture
- Active participation by participants
- Integrating agriculture with engineering
- Differences in produce costs
- How community participation can influence society development

Question 11 How could the workshop have been improved?

- By encouraging people to keep to time
- A better video projector would have helped
- More engineers should have been involved
- By targeting more stakeholders in the agri-business space
- Addition of more sessions
- Wider range of invitees that directly impact the ReCAP project

Question 12 Do you have any other comments or suggestions?

- Good work
- Invite more stakeholders / actors
- Pity that engineers did not attend
- The presenters were thorough in their research and presented it well
- Can't wait for second mile, nicely done!

Tanzania – 20 September 2018:

Question 1 List 3 things that you have learned from this workshop:

- Link between poor roads and agriculture
- Importance of road construction on first mile for villages
- Damage to vehicles
- Challenges for smallholders and transporters with perishable crops
- Land ownership issues and its effect on agricultural production
- Lack of clear policy/strategy for transportation
- Effect of road condition on crops and the prices
- Necessary for government, private sector and community to improve roads
- Producers face a big transport challenge
- Explosion of bodaboda helps in reducing headloading
- The effect of lack of competition, farmers are exploited by buyers
- Road evaluation methods
- The crucial role First Mile roads have in the life of community farmers
- The burden of farmers in rural areas due to spoilage and transport capacity
- Cost of transport to collection point reduces farmer's incomes

Questions 2 to 9 inclusive are shown in the table below:

Question	Very Good	Good	Fair	Poor	Very Poor	Total
2 Usefulness of workshop?	47.4%	42.1%	10.5%			100.0%
3 Workshop met expectations?	21.1%	63.2%	15.8%			100.0%
4 Could you contribute?	47.4%	42.1%	10.5%			100.0%
5 Schedule/timetable	36.8%	42.1%	21.1%			100.0%
6 Organisation of workshop?	36.8%	52.6%	10.5%			100.0%
7 Presentations at workshop?	47.4%	47.4%	5.3%			100.0%
8 Discussions and feedback?	31.6%	63.2%	5.3%			100.0%
9 Rate summary of key points	21.1%	78.9%				100.0%
Total	**36.18%**	**53.95%**	**9.87%**			

Question 10 What were the two best and most useful aspects of the workshop?

- First mile access for small-scale growers
- Cost-beneficial improvement of perishable crops
- Analysis and data collection
- Findings of the project
- Discussions on recommendations
- Volume of spoiled farm produce is opportunity to start processing at farms
- Huge cost to the economy of inaccessible rural areas
- Group discussions
- Presentation and data analysis
- Identification of the way forward
- Integration of different sectors
- How to evaluate cost-beneficial improvements

Question 11 How could the workshop have been improved?

- By reviewing tools to collect data and analysis of data
- Should have been at least 1.5 days, more time for discussion necessary
- More participants to represent more stakeholders
- More participants of policy makers
- Better projector!
- Well organised
- Political interactions
- Government representation to get more involved and share plans for discussion
- More time for presentation of study results
- Different integration of different sectors, farmers and transporters
- Education/awareness should be provided

Question 12 Do you have any other comments or suggestions?

- Participants were enthusiastic and want to see recommendations implemented
- Needs more comprehensive study with cost-benefit analysis
- Technical information is necessary, research must be funded or information gap will sustain poverty

- Need more time for group discussion
- Should at least cover all areas and logistic issues, transport and road maintenance
- Clear purpose of the research
- Need to go back to farmers to organise themselves
- Good workshop, well attended
- Curious to hear what farmers say about road condition vs road safety and effects on livelihoods / economy
- Include participation for policy making level
- Final report should be shared with policy makers and other stakeholders
- Future proposals to community access should focus on funds allocated to infrastructure gap
- No buyers in the workshop to present their views
- Agriculture is key to the country, so government should provide loans for education to improve sector
- Should be 2 day workshop, more time for presentations and discussion

Annex 4 Workshop Participants

	Participant	Company/Organisation
Kenya		
1	Andrew Otto	TRL
2	Okisegere Ojepat	FPC Kenya
3	Grace Muhia	IFRTD
4	John Hine	TRL (independent)
5	Robin Workman	TRL
6	Agnes Ndungu	AWAN
7	Deborah Nakhauro	NISA
8	Njeri Kuna	NISA
9	Sabaya Doni	NISA
10	Arthur Oguta	Sparkling Images
11	Sylvia Karebe	AWAN
12	Fridah Mugo	IFRTD
13	Claudette Ofrilo	Glorious Agri-Consult
14	Mungai Migioi	NISA
15	Lydiah Gatere	AWAN
16	Julius Kemboi	IFRTD
Tanzania		
1	John Hine	TRL (independent)
2	Robin Workman	TRL
3	Shedrack Wililo	IFRTD
4	Amleset Tewodros	Helpage
5	Ronald Rwakatare	Roads Fund Board
6	Josephine Mwankusye	IFRTD
7	Nurdin Mushule	UDSM
8	Eli Mgonja	Transaid
9	Simon Lushakuzi	NIT
10	Neema Swai	Amend
11	Bruno Kinyaga	International Road Assement Programme
12	Thomas Majura	Madekle
13	Stanley Soiti	IRAT
14	Elikana Kagoma	Mbongwe DCC
15	Zainab Mshana	NIT
16	Hans Mhailila	Private
17	Anatory Mligo	Matola
18	Jasuga Lyambogo	Madeke
19	Omega Mgimba	Matola
20	Hans Mwaipopo	PO-RALG
21	Henry Kaywanga	PO-RALG
22	Frank Mwangoka	STET International
23	Ronald Mwajeka	PO-RALG
24	Ahmed Wamala	DART Agency