LINKING SMALLHOLDER FARMERS TO MARKET

MANAGEMENT OF FEEDER ROADS IN SIERRA LEONE FOR ENHANCED SUSTAINABILITY

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Acronyms and Abbreviations

AADT	Average Annual Daily Traffic
ADT	Average Daily Traffic
AfCAP	Africa Community Access Programme
CAADP	Comprehensive Africa Development Programme
CBO’s	Community Based Organizations
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer
EU	European Union
LFM	Linking Smallholder Farmers to Market
MAFFS	Ministry of Agriculture, Forestry and Food Security
MoTA	Ministry of Transport and Aviation
MoWHI	Ministry of Works, Housing and Infrastructure
NRS	National Road System
NSADP	National Sustainable Development Plan
OPRC	Output – And – Performance – Based Road Contract
ReCAP	Research for Community Access Partnership
RMFA	Road Maintenance Fund Administration
RRMP	Road Rehabilitation and Maintenance Project
RFR	Rwanda Feeder Roads
RTDA	The Roads and Transport Development Agency
SLRA	Sierra Leone Roads Authority
SLRDM	Sierra Leone Roads Design Manual
SCP	Smallholder Commercialization Programme

EXECUTIVE SUMMARY

E1. Introduction

Feeder roads are crucial to agricultural development and by implication, to National development in Sierra Leone. Their relevance to market access of agricultural products underlies every sphere in the Agriculture sector.

The Feeder road network in Sierra Leone comprises of 4,277 km of gravel/earth roads in rural areas connecting towns and villages to secondary and primary road systems and chiefdom headquarter towns; such roads therefore need sustainable maintenance. However, these roads are often neglected either under budget pressure or poor maintenance and management structures. The roads therefore deteriorate rapidly and become either totally inaccessible by vehicular traffic or passable with great difficulty and risk in terms of safety, especially during the rainy season. Most of these roads can now be correctly described as " Motor Bike (Okada) Highways" because these bikes are the main mode of transportation used by farmers to take produce to markets and for communities to access other service such as health facilities.

E1.1 Study Objectives

This study is a component of an overall study to achieve the objectives of the National Sustainable Development Plan 2010 – 2030 (NSADP) developed by the Ministry of Agriculture , Forestry and Food Security (MAFFS) , under the umbrella of the Comprehensive Africa Agriculture Development Programme (CAADP).

The objective of the LFM project is to increase smallholders' income and reduce household food insecurity by improving farmers' production and marketing capacity.

The specific objectives of this component of the study therefore are:

- To assess the management and maintenance of Feeder roads in Sierra Leone and present the lessons learned.
- To review systems of management and maintenance of feeder roads from regional and international experiences and recommend a sustainable system that will ensure the provision of all - weather access to link farmers to markets.

E2 Key Findings

A review of available data, information from SLRA, the Sierra Leone Road design standards for feeder roads, interview of senior engineers at the Feeder Roads Department at SLRA, was undertaken by the sub consultant, Alhaji Ing. A. B. Savage.

Three feeder roads each in the Districts of Bo, Bombali, Tonkolili and Koya Rural in the Western Area, were also selected for field data collection including road condition surveys and travel time surveys. Farmers using these selected roads were interviewed at their villages/farms using a specifically designed survey questionnaire, to assess their current situation, their coping mechanisms and their perception on the impact of the road conditions on their productive capacity.

The following are key findings from the study, captured under specific sub - heads:

E2.1 Design Standard

There was no standard design for feeder roads until in 2002 when a Road Design Standard was recommended by consultants under the Road Rehabilitation and Maintenance Project (RRMP) of 2002. In 2012 under a Technical Assistance programme to SLRA funded by the EU , a new Sierra Leone Road Design Manual was produced. In this manual, Feeder roads are classed according to average Daily Traffic (ADT) of 100 – 500 vehicles/day on the roads. Design standards are recommended for two classes of feeder roads – Class IV and V, in Flat to Gentle Terrain (F), and in Heavily Rolling and Mountainous Terrain (H); because of the expected low level of traffic, the recommended road surface for feeder roads in the SLRDM is engineered gravel or earth.

From the road condition survey , it was observed that no feeder road currently fully satisfies either the 2002 RRMP Standard , or the 2012 Sierra Leone Road Design Manual standards for feeder roads: With the exception of one road in the Tonkolili District, no feeder road examined meets the minimum required 5.0m road width; only one lane operation is possible in most cases; most roads are without engineered gravel with the correct gradation; in many cases the gravel wearing course has been eroded away because of heavy rains ; road gradients are steeper than 10% in some cases making it challenging for vehicles to climb; road cross sections are virtually flat with no crossfall to drain water quickly off the road surface, which is an absolute requirement for unsealed roads; there are virtually no operational side drains ; travel speed on roads is much lower than recommended design speeds because of poor road conditions; curves are very sharp and unsafe with inadequate sight distances in many cases.

E2.2 Road Condition

The condition of the feeder roads in Sierra Leone in terms of road surface condition, accessibility to markets and other services, travel speed, safety, Geometric design standard and drainage condition, can be rated as “ poor” to “very poor”. Over 80% of the roads are either not used by vehicular traffic at all, or passable with great difficulty and risk in terms of safety, especially during the rainy season. Most of these roads can now be correctly described as “Motor Bike (Okada) Highways” because these bikes are the main mode of transportation used by farmers to take produce to markets and for communities to access other service such as health facilities. Some areas of the roads require culverts which are either washed out or not installed at all; the roads are therefore impassable especially during the rainy season. Side drains are also non – existent on the roads. Gully erosion due to steep gradients is common. Roads are very unsafe for vehicles to use.

Preparation of road condition surveys to inform proper engineering design, material specifications and costing is inadequate or absent during feeder road rehabilitation. There is no proper geometric design for these roads; only line diagrams are produced mostly using the existing track alignments and topography. Virtually no geometric improvement for safety and ease of access is made during implementation of the road construction/rehabilitation programmes; evidences indicated that there are serious lapses in supervision of the rehabilitation works.

In short, management and maintenance of feeder roads have not been robust enough and given the attention they truly deserve; there has been a mismatch in terms of the technical emphasis placed on feeder roads compared to primary and secondary roads

The failures observed on the roads are two types:

- Structural defects - due to the failure of the sub- grade and/or pavement layers; these are related to the road material used, pavement depth (especially base course), and geometry as well as drainage deficiencies. These defects are manifested as soft spots, large depressions, or loss of road pavement.
- Surface defects – mainly affect ride quality and appear as roughness, corrugations, potholes and gully erosion, loss of surface material, dustiness and slippery surface.

E2.3 Existing Situation and Perception by Farmers

The results of the perception survey of farmers confirmed the results of the road condition and travel time surveys on the feeder roads in terms of the general poor conditions.

The roads are difficult to pass all year round by motor vehicles and are impassable at least in one month of the year in the rainy season. Farmers use Motor bikes to transport produce to markets and sometimes use “Head loads” (Walk). Only one of the roads studied in Tonkolili District (Rowallah – Mathora road) is being used normally by vehicular traffic in this dry season. All farmers interviewed were concerned about safety of the roads because of poor surface conditions, drainage and road geometric features.

E2.4 Management and Maintenance of Feeder Roads

The overall management of feeder roads and rehabilitation is done by the Feeder Roads Department of the SLRA; however, following the Local Government Act of 2004 and decentralization policy, rehabilitated feeder roads are handed over to the District/Local Councils for maintenance. SLRA District Engineers provide technical support and backstopping to the Councils.

The Road Management Fund Administration (RMFA) provides funding to the Local Council which should ideally go towards routine maintenance (grass cutting and vegetation control, cleaning/re – shaping of side drains, de – silting culverts, repairing pot holes, uprooting vegetation from roadway and clearing flood debris). The funds from RMFA are obtained from a levy on fuel and are disbursed directly to the Councils.

Feeder roads are constructed/rehabilitated by using labour – based methods supported by light equipment such as rollers, tractors and tipping trailers, loaders and dump trucks (when available). The method of contracting feeder roads rehabilitation projects is by National Competitive Bidding (NCB) using the "Bill of Quantities" measurement type of contract. The contracts are usually awarded to small - medium contractors; most of these companies however have limited equipment and technical capacity for roadworks. Supervision contracts are awarded to consultants; however, it was evident that there has been inadequate attention paid by these consultants to engineering design standard and specification in order to ensure that the rehabilitated roads are handed over to local councils, in conditions fit for purpose. One factor responsible for this is insufficient funding for fundamental engineering surveys and design for the rehabilitation of feeder roads. Due to this lapse, the roads are initially not constructed/rehabilitated to any specifications and standards; the conditions are unsafe and challenging and defects are therefore manifested at a very early stage after being handed over to the Councils.

E2.5 General

Additional general observations made during the studies are:

- Farmers have no incentive to increase production due to the challenges of transportation of goods to markets as a result of inaccessible and poor road conditions.
- Some of the major secondary roads to which feeder roads connect are unpaved and in poor condition; this also contributes to the challenges faced by farmers to transport produce to markets.
- In addition to funding constraints, there is a lack of adequate technical capacity at Local Councils to manage and supervise maintenance of feeder roads.
- The poor condition of the roads which are impassable for significant periods of the year and preventing farmers to access markets with their produce, is resulting to unwanted and uncontrolled cutting down of trees for firewood, charcoal and bush sticks for sale by the roadside, with the consequent negative environmental impact.

E3 Lessons Learned

The lessons learned from this study should be used to inform decisions and policies in order to provide sustainable feeder roads to link farmers to markets. They include:

- Maintenance of feeder roads which provide access to rural communities and for farmers to access markets easily and safely, have been largely neglected; it is a major reason for the poor condition and inaccessibility of many of these roads.
- The deficiency in effective maintenance of the feeder roads which are the responsibility of local councils, are caused by inadequate funding, poor institutional structures to monitor and supervise maintenance activities and lack of adequate technical capacity at the local district level.
- Regional and international experiences have indicated that a form of "Output and Performance Based" contract method involving and training of local communities to undertake routine maintenance activities has proven to be very effective.
- A major factor in the road surface deterioration is caused by lack of quality control – appropriate gravel material with the necessary characteristics such as appropriate grading distribution is not used; there are either too much fines causing excessive dust during the dry season, or clayey material causing slippery surfaces in the rainy season.
- Rehabilitation of feeder roads is mostly by using labour – intensive methods by small scale contractors; use of equipment is very minimal. Road works such as grading to achieve crossfalls, excavation in cuts to achieve required gradients, compaction to required densities with rollers, are key activities that are not effectively undertaken.
- Implementation of rehabilitation of feeder roads is very poor both in terms of engineering design, construction, and supervision. The poor implementation of the rehabilitation works was observed at one of the recently rehabilitated LFM roads in the Tonkolili District. The unsafe conditions and rapid deterioration and inaccessibility of most of these roads are the manifestations of poor initial rehabilitation works which are not undertaken to required standards and quality.
- Considering sustainability of all - weather linkage for farmers to markets and using "Whole Life Cost" analysis, it has been recognized in countries like Ghana and the USA, that the use of gravel as a wearing course is more expensive in the medium to long term compared to a low cost alternative sealing such as thin film of bitumen and chippings (chip seal) or Otta Seal, which is an asphalt surface treatment constructed by placing a graded aggregate on top of a thick application of a soft bituminous binder (emulsified asphalt, or cutback asphalt).
- A study to recommend alternative road surfacing to maximize the use of local resources in feeder road rehabilitation and maintenance with reduced whole life costs for road assets is ongoing in Sierra Leone. SLRA engineers have been trained by ReCAP to train other engineers in the use of Dynamic Cone Penetrometer (DCP) method for rural road pavement design.
- Of the 8,700 km of functionally classified roads in the NRS, 4,277 km are feeder roads which are all unsealed (with gravel or earth surfacing). About 900 km of the remaining 4,423km of primary and secondary roads are also unpaved. As the economy develops and traffic volumes increase, the demand arises to seal previously unsealed roads. The transition point between unsealed and sealed roads depends on many conditions that

should be evaluated. Guidance has been provided by The World Bank Transport Note TRN- 33 [4].

E4 Conclusions

Based on the outcome of the studies, interviews with stakeholders and field investigation the following can be concluded:

A. General

- One major reason for the poor condition of feeder roads in Sierra Leone is that the initial construction/rehabilitation prior to being handed over to local councils for management and maintenance is not undertaken efficiently. Rehabilitation works are supposed to bring the roads up to specific design standards to meet requirements of safety and durability. This has not been the case; roads with poor geometrics, drainage and surface conditions are often handed over to Councils which lack the capacity and funding to remedy such anomalies; Councils are only supposed to manage the roads and undertake routine and periodic maintenance activities with support from SLRA.
- Significant investments in feeder roads construction and rehabilitation by a number of development partners are not yielding the expected results to provide access for farmers and the rural communities because the road assets are not effectively maintained. A paradigm shift in the way feeder roads are implemented and maintained is required.
- The general condition of feeder roads in Sierra Leone can be rated as “Poor” to “Very Poor”. Most of the roads are not used by vehicular traffic at all; roads are impassable by motor vehicles for at least one month in the rainy season because of soft depressions on road surface, washed out culverts or lack of adequate cross drainage.
- The main mode of transportation for farmers to markets on all the feeder roads is by motor bikes, which is very unsafe especially when loaded with goods and passengers; transport cost by these bikes are also expensive. Less than 20% of feeder roads are accessible by 4 - wheel drive vehicles with difficulty only in the dry season. Feeder roads are currently operating as *“ Motor bike highways”.*
- The inaccessibility of the roads is the reason for the low level of vehicular traffic; paradoxically, this has been the argument put forward by road authorities for not justifying the use of appropriate low cost sealing material on feeder roads instead of gravel.
- Lack of sustainable rural/feeder roads for farmers to access markets is the main factor preventing the realization of the desired impact of government’s commercialization policy of agriculture. It is consequently therefore a major factor contributing to poverty especially in the rural areas.
- There is an indirect negative impact on the environment caused by lack of sustainable access for farmers to markets; this is caused by uncontrolled cutting down of trees by farmers to produce wood, charcoal and bush sticks which they sell along the roadside to sustain their families.

B. Management and Maintenance

- The policy of devolution of rehabilitated feeder roads to District/Local Councils for routine maintenance is a good system which is adopted in nearly all Sub Saharan countries; however, the system is not working efficiently and should be reviewed. The reasons for this in Sierra Leone are:
  - There is lack of adequate technical capacity at the District Council level to undertake condition survey, plan and budget properly for maintenance activities;
  - Periodic maintenance/spot improvement which is a more equipment intensive process should be contracted to contractors with the required technical and financial capacity;
  - There is lack of adequate design, costing, and supervision of rehabilitation works on feeder roads. Rehabilitated roads are therefore handed over to local councils with design and durability deficiencies;
  - Local Community participation in routine maintenance of feeder roads is minimal because all works are contracted out by the NCB process and this limits the participation of local communities because they cannot meet the technical requirements as well as the equipment and financial criteria to bid. There is therefore no local ownership to keep roads maintained and passable all year round.
- Similar to many countries in Sub Saharan Africa, sustainability of feeder road maintenance is a challenge in Sierra Leone; many feeder roads are unpaved and need to be maintained frequently, but are often neglected under budget pressure and poor monitoring and supervision of maintenance activities.
- Gravel surface for feeder roads in Sierra Leone is not a sustainable material to use; considering the heavy rainfall and whole life cost based on the maintenance requirements including the need for re- gravelling when the gravel surface washes off. Obtaining lateritic gravel with the required gradation and characteristics at close proximity can be very challenging in some areas of the country; gravel is not an easily renewable resource. Research and road tests in Ghana and U.S.A. have revealed that a low cost alternative seal such as Otta Seal or Chip seal is more durable with lower whole life cost over the design life of feeder roads.
- The Measurement type of contracting for maintenance activities is not effective in Sierra Leone; Lessons learned on the use of OPRC for maintenance of feeder roads revealed that it is more sustainable.
- Lessons learned from Rwanda and Zambia indicated that community participation for routine maintenance is very effective and cost less; about $675/km/year compared to Sierra Leone where routine maintenance costs vary from $1,000/km in the first year after rehabilitation to $2,000/km by the third year after rehabilitation. Periodic maintenance and spot improvement cost $5,000/km four years after rehabilitation in Sierra Leone.

C. Perception by Farmers and Road Users

It can be concluded from the survey results that providing sustainable feeder roads to provide all - weather links to markets, will increase production from farmers, will attract more traffic on the roads, will reduce transportation costs, and consequently, alleviate poverty by reducing food insecurity for the whole of Sierra Leone. Fertile agricultural lands are left untouched because the enabling environment to increase production does not exist; the main element of this, is sustainable feeder roads.

E5 Recommendations

The following are specific recommendations based on the study results and review of international and Sub Saharan experiences, noting the lessons and challenges faced and the successes achieved:

Management, Maintenance and Design of Feeder Roads

- The AfCAP project scoping studies done for Sierra Leone and Liberia in 2016 [3] has identified relevant projects on feeder roads; some of these projects which are already ongoing include:
  - Use of DCP Pavement Design Method and Developing DCP Manuals for Feeder Roads Design and Appropriate Specifications for Construction/Specifications.
  - Whole – Life Costing and Sustainability of Sealed versus Unsealed Roads, and Gravel versus Earth Roads.

These projects should provide relevant guidance for the design and construction/rehabilitation of feeder roads to ensure sustainability.

- For sustainability and economic development, the use of a low cost sealing such as Otta seal is strongly recommended as an alternative road surface to gravel.
- Should gravel surface continued to be used for feeder roads in the short term, good surface performance can be obtained by undertaking, the following activities:
  - Maintain the drainage system – this is the most important maintenance function and should be performed as a routine activity to minimize deterioration of the road surface/structure. The drainage system needs to be regularly cleaned of silt, material accumulations and debris.
  - Selecting quality material – this includes the appropriate material type and other characteristics of the gravel, such as grading.
  - Grading/Reshaping - routine and periodic grading should be performed to ensure adequate ride quality and safety.

- Re - gravelling – this activity replenishes the lost gravel and restores both the service level and the load bearing capacity of the road. This is the principal periodic maintenance operation for gravel roads.
- Controlling vegetation – this considers control of grass, shrubs, bushes and trees as routine maintenance.

- Management of feeder roads should continue to be devolved to local District Councils for maintenance; however, local communities should be more involved in routine maintenance activities to ensure ownership; structures must also be put in place at the District level to ensure robust monitoring and supervision of these activities.
- Gravel roads should be designed and built/rehabilitated according to stipulated Geometric design standards and specifications for safety and durability before being handed over to Local Councils; The SLRDM should be used and the section on Pavement Design Manual for Gravel Road Pavement[7] should be complied with. Proper side drains should be provided.
- Include Rural Feeder roads maintenance in the Districts' yearly performance assessments.
- Ensure that robust oversight is carried out by SLRA and MoWHI during rehabilitation of feeder roads before devolution to local Councils.
- What is currently termed a "Rehabilitation" contract for feeder roads should now be called a "Rehabilitation and Improvement" contract to emphasize the need for engineering design to ensure that the completed road meets minimum design standards before being handed over to District Councils.

Procurement Method, Funding and Monitoring

- To ensure effective maintenance of feeder roads to provide all - weather access for farmers and local communities, the method of procuring works must be re - visited. The Zambian model is a good model to adapt to the circumstances in Sierra Leone as follows:
  1. All work on feeder roads must be split into three elements:
     - Initial Rehabilitation and Improvement works
     - Maintenance works
     - Emergency works
  2. Initial Rehabilitation and improvement works should be contracted out to contractors with the necessary capacity for design and implementation of the works which would have been designed and specified in detail by contracted Consultant or by the SLRA itself.
  3. Maintenance works should then be contracted out, preferably to the same contractors involved in the Initial rehabilitation/improvement works, so that responsibilities will not be separated; this contract will be based on a lump sum price per kilometer to be paid on a monthly basis according to the contractors' ability to meet specific performance criteria such as : ensuring road is always passable (road always open), comfortable riding surface (user comfort), average running speed to be attained in order to reduce travel time and vehicle operation

costs. The use of this OPRC method of contracting as appropriate is hereby recommended.

iv. The contractors to be awarded these contracts must include in their Bid submission, local community engagement and training to undertake the routine maintenance activities.

- From the lessons learned from countries that have been using OPRC for feeder road maintenance, safeguards must be ensured in order to guarantee effectiveness:
    - Adequate structures must be put in place to monitor compliance with the set service criteria;
    - If the contractor fails to comply with any of the service criteria in any one month, its fees is reduced. If it fails repeatedly to comply, its contract can be terminated.
    - Private operators may need training and capacity building to bid for and implement output – based contracts especially because most will not be accustomed to the requirements of pre – financing outputs before being reimbursed.
    - Clear vehicle weight regulations must be put in place, along with strong enforcement protocols to overcome the challenge of vehicle overloading (axle load control) which is a major cause of road pavement deterioration.
- To address issues of funding constraints, the Initial rehabilitation/improvement works which are to be contracted through the traditional method, should be funded by government and donor partners; funds from RMFA should be ring - fenced only for the maintenance activities. Other funding sources such as from donor partners, private sector and local taxes collected by the Districts should be considered.

1. Introduction

This study is a component of an overall study to achieve the objectives of the National Sustainable Development Plan 2010 – 2030 (NSADP) developed by the Ministry of Agriculture , Forestry and Food Security (MAFFS) , under the umbrella of the Comprehensive Africa Agriculture Development Programme (CAADP). At the core of the NSADP is the Smallholder Commercialization Programme (SCP). The objectives of the NSADP are:

i. To increase the agricultural sector growth from its current 4 percent to 7.7 percent per annum.
ii. To increase incomes of farming households by 10% and increase household food security by 25 percent.

This study component is related to linking farmers to markets by rehabilitating feeder roads for better access to markets.

1.1. Background

From an agro – ecological point of view, Sierra Leone has significant potential for agricultural production. Apart from mining, the main sector of the economy is agriculture which contributed about 41% to GDP in 2013. The Government's commercialization policy of agriculture (tractorization, processing and marketing) is expected to further stimulate growth of this sector significantly. However, limited accessibility by farmers to markets will hamper such expected growth. Maintenance of feeder roads where traffic level is low at less than 100 vehicles per day , tends to either be neglected under fiscal pressure, or poorly implemented because of institutional arrangements and procurement methods.

This study component is related to improved connectivity of production areas to markets in order to reduce post – harvest losses and reduce travel time spent by farmers to access the markets and agricultural inputs. Lack of reliable roads because they are impassable due to seasonal heavy rains prevents farmers and rural communities from accessing markets to sell crops and goods and to access essential products and services such as education and healthcare.

Feeder roads are crucial to agricultural development and by implication, to National development. Their relevance to market access of agricultural products underlies every sphere in the Agriculture sector. Whatever investments are made in the Agriculture sector, if there are no sustainable all weather roads for the farmers to access the relevant markets with the produce, the very success of such investment will be undermined.

Feeder roads are usually gravel/earth roads in rural areas connecting towns and villages to secondary and primary road systems and chiefdom headquarter towns. Physical infrastructure suffered heavily from the war, especially in the rural areas.

For the past 20 years, only 1,460 km of the 4,277km of classified feeder roads were rehabilitated. In addition, only about 50 percent of the country's feeder roads have received some road maintenance over the past 10 years. Culverts are also frequently washed out during the heavy rains, rendering most feeder roads inaccessible during the rainy season.

There is increased awareness of the critical importance of road transport to a productive agricultural sector. Increasing funding for the country's feeder road system will not only bring immediate and direct benefits to the farming population, but will generate increased private investment in the sector and consequent National development.

1.2 Study Objectives

The main objectives of the study are:

- To assess the management and maintenance of Feeder roads in Sierra Leone and present the lessons learned.
- To review systems of management and maintenance of feeder roads from regional and international experiences and recommend a sustainable system that will ensure the provision of all - weather access to link farmers to markets.

1.3 Sierra Leone Road Sector Brief

Road transport is the most dominant mode of transport in Sierra Leone and 95% of inland transport of passengers and goods is carried out on roads. Sierra Leone has a public roads network of about 11,700 kilometers, of which 8,700 km are functionally classified in the National Road System of which 4,277km are feeder roads. The remaining 3,000km consists of local roads and unclassified roads and tracks. The Sierra Leone Roads Authority (SLRA) manages the national roads. Ministry of Transport and Aviation (MoTA) provides the policy and regulatory framework for transport management in Sierra Leone; this Ministry is also responsible for policy formulation in the area of road safety. The Ministry of Works, Housing and Infrastructure (MOWHI) oversees the policy guidance and execution of the Road, Housing and Infrastructure sectors in the country.

2. Study Approach

The assessment of the condition of feeder roads as a result of current management and maintenance mechanisms was undertaken based on field surveys of selected feeder roads across Sierra Leone in different agro – ecological and agricultural zones, particularly in the districts where the feeder roads development project are targeted. The roads studied are a combination of the selected project roads for rehabilitation and some non – project roads, all in the selected districts of Bo, Bombali, Tonkolili and Western Area.

The roads selected for the study are as listed in Table 1.0 below:

Table 1.0: Roads Assessed

District	Chiefdom	Roads
Bo	Bumpe	Darssamu – Semabu – Folubu–Vulahun (P)*
Bo	Tikonko	Tikonko – Gbanahun – Niagorahun–Balie (P)
Bo	Selenga	Dambala – Kpetema–Gbangba (NP)*
Bombali	Safroko Limba	Magbonkani – Kabonka (P)
Bombali	Gbanti Kamaranka	Mangay – Makari (P)
Bombali	Bombali Sebora	Makambo – Mamoro (NP)
Tonkolili	Kholifa Rowalla	Rowalla – Mathora – Maraka (P)
Tonkolili	Kunike Barina	Makumbu Junction – Farama (P)
Tonkolili	Tane	Makrugbeh – Mamontor (P)
Koya Rural	Western Area	Makoray Road (P)
Koya Rural	Wester Area	Joe Town Road (P)
Koya Rural	Western Area	Magbanpoh Road (P)

*P – Project Road

*NP – Non Project Road

The following approach was adopted to undertake the studies:

i. Literature Review/Desk Study/Interviews with Chief Engineer of feeder Roads, SLRA – This included obtaining information on:
   - Nominal Design Standards
   - Road Classification as a function of Average Annual Daily Traffic (AADT)
   - Engineered Gravel Roads and Improved Earth/Gravel Road Design Standards
   - Construction methods – Labour- based, equipment based
   - Contracting methods for construction and maintenance
   - Average construction cost of roads per kilometer
   - Maintenance policy of SLRA
   - Actual maintenance costs including grading frequency per year
   - Institutional Structure for service provision for farm to market feeder roads; role of SLRA, MAFFS, District Councils in management of feeder roads
   - Research on sustainable road surfacing options for unsealed roads
   - Research on Output and Performance Based Road Contracts for maintenance of feeder roads (OPRC)

ii. Selection of the Feeder roads for field studies – Due to limited time constraint for the study, the roads selected for the study was based on accessibility and existence of Smallholder farms in the vicinity of the roads.

iii. Field Studies undertaken on the selected roads included:
   - One – on – one Interview conducted with farmers affected by the roads; the purpose was amongst others, to get their views on issues such as: Accessibility,

Key constraints, effects of problems of inaccessibility, coping mechanisms, accident experience, effect on agriculture production etc. A Survey Questionnaires was prepared for this purpose(See Annex 1). At least three farmers connected with each road studied, were interviewed at the vicinity of their farms or surrounding villages.

- Road Condition Survey – basic inventory and condition of the roads were undertaken to establish issues such as: existing condition, road Geometric features, drainage conditions, pavement condition.
- Travel time survey to establish average travel speed on the existing roads, to indicate roughness IRI values.

3. Findings

3.1 Road Classification and Design Standards in Sierra Leone

The classification of roads adopted in Sierra Leone is given below in Table 3.1.

Table 3.1: Road Classification

Classification	Description	Network Length (km)
Class A	Primary roads connect the capital with the principal provincial cities and with district centres and trunk roads of neighboring countries.	2,332 (925 km paved)
Class B	Secondary roads are the principal collector/distributor roads for the Primary network; services major district centres as well as other important population centers and tourist and agricultural areas.	2,091 (46 km paved)
Feeder Roads (Tertiary Roads)	Providing service to chiefdom centers	4,277 (0 km paved)
	Urban Roads	3,000

There was no standard design for feeder roads until in 2002 when a Road Design Standard was recommended by consultants under the Road Rehabilitation and Maintenance Project (RRMP - 3) of 2002. This standard recommended a road width of 5.0 – 6.0m, no road shoulders, Design Speed of 40 km/hr, limiting gradient of 15% and a 15cm thick lateritic gravel surface on variable thickness of subbase (15cm minimum) as determined by CBR tests.

In 2012 under a Technical Assistance programme to SLRA funded by the EU , a new Sierra Leone Road Design Manual was produced. In this manual, Feeder roads are classed according to average Daily Traffic (ADT) on the roads. Design standards are recommended for the two classes of feeder roads – Class IV and V, in Flat to Gentle Terrain (F) and in Heavily Rolling and Mountainous Terrain (H).

These two standards are given in Tables 3.2 and 3.3.

Table 3.2: Road Design Standard from RRMP-3

Description	Primary Roads	Secondary Roads	Feeder Roads
Surface width	7.0m	6.0m	5.0m – 6.0m
Shoulders	2 x 1.38m	2 x 0.6m	None
Design Speed	80kph	65kph	40kph
Minimum radius	300m	180m	90m
Absolute minimum	255m	153m	76m
Limiting gradient	6%	6%	15%
Pavement crown	2.5%	3%	5%
Stopping sight distance	Min. 110m	Min. 85m	Min. 85m
Pavement design	DBST over crushed aggregate base (sealed MC X -30 Prime) over variable subbase (min. 15cm) determined by CBR tests	DBST over variable crushed roack (sealed MC -30 prime) or laterite base over variable subbase (min. 15cm)	15cm thick laterite gravel and variable thickness of subbase (15cm min.), as determined by CBR tests.
Drainage	10 years for pipe culverts; 25years for box culverts; 50 years for bridges. Minimum pipe diameter is 610mm		

The assessment of the roads studied revealed that the current state of the roads is such that none of them currently fully meets the Sierra Leone Road Design Manual standards for feeder roads: The required road width of 5.5 – 6m is not available. Most roads are without any gravel wearing course because it has been washed off by the rains; roads have deteriorated down to the subbase layers and in most cases are operating as earth roads. The terrain and topography along these roads result to steep gradients in many cases, leading to severe gully erosion after the very first rains after rehabilitation.

The design standard for feeder roads is such that there are no shoulders and side drains when the Design class is Class V for ADT less than 100 vehicles per day; due to the poor method of construction and supervision the required pavement crossfall of 4 - 5% to drain off water into the side bushes is non – existent; most road pavements are flat or with gullies and potholes.

Feeder roads are supposed to be engineered roads with engineering designs in accordance with the SLRDM design standard; this however does not seem to be the case as most roads have very steep gradients greater than 7 % and sharp horizontal curves with less than the minimum required radius and sight distances.

Table 3.3: SLRDM for Feeder Roads - 2012

	Design Class			
	IV: ADT 100 -500 veh/day		V: < 100 veh/day	
	F: Flat to Gentle Terrain	H: Heavily Rolling to Mountainous Terrain	F: Flat to Gentle Terrain	H: Heavily Rolling to Mountainous Terrain
Design Speed (Km/hr)	90	80	80	60
Carriageway Width (m)	6.0	6.0	6.0	5.5
Minimum Effective Shoulder Width (m)	0.75	0.50	0	0
Formation Width (m)	8.0	7.5	6.5	6.0
Recommended Surface and Crossfall	Engineered Gravel. 4%		Engineered Earth/Gravel. 4 – 5%	
Maximum Gradient %	5.0	6.0	5.0	7.0
Bridge Width between Kerbs(m)	7.5	7.5	6.7	6.1

With the terrain and topography around feeder roads and the poor quality of construction, small pipe culverts are easily washed out, rendering roads impassable in most cases. In other cases, poor hydrological studies have resulted to inadequate sizing of culverts and sometimes no culverts at all; the community and local councils resort to using logs to facilitate crossing of streams.

The running speed on the roads is less than the minimum design speed of 60 km/hr for Class V feeder roads in heavily rolling /mountainous terrain; the poor road surface condition as a result of gullies, potholes, sharp curves, challenging gradients contribute to unsafe driving conditions and low travel speeds.

3.2 Inventory and Condition of Study Roads

The conditions of the roads studied were assessed by conducting visual inspection and noting critical elements which influence the effectiveness of these feeder roads to provide the service for which they were constructed.

For each road studied, a Table is provided that summarizes the existing condition and apparent standards of the roads.

Darssamu–Semabu -Vulahun; Bumpe Chiefdom; Bo District

Figure 3.1: Vegetation on road; road reduced to a track

Figure 3.2: Road virtually Impassable ; Log palms for Crossing

Figure 3.3: Gullies and Steep Gradient

Table 3.4: Condition and Standard of Existing Darssamu – Vulahun Road

Existing Carriageway Width	≤ 4.0 m
Type/Likely Original Design Class	Non Engineered road ; No apparent Design Class
Surface Type	Earth with residual gravel in some places;
Surface Condition	Vegetation in carriageway; gully erosion in some places; flat surface with no apparent crossfall.
Lateral drainage	No side drain evident
Transverse drainage	Few existing under – sized pipe culverts; wide streams are impassable by vehicles; logs are provided for pedestrian crossing
Horizontal alignment	Appears as if this has never been rigorously designed
Vertical alignment	Appears as if this has never been rigorously designed. Locations exist where gradients are steep, approaching 10%.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	Definitely less than 100 veh/day (No vehicles observed on road)
Average Travel Speed based on Travel Time runs on passable sections	15.0 km/hr

Tikonko –Gbanahun -Balie Road; Tikonko Chiefdom; Bo District

Figure 3.4 Road with Newly Constructed Culvert

Figure 3.5: Evidence of Previous Surface Treatment Wearing Course on Road

Figure 3.6: Road Becomes Impassable at Wide Stream; Steep Gradient Evident.

Table 3.5: Condition and Standard of Existing Tikonko – Balie Road

Existing Carriageway Width	≤ 4.0 m. Reduced to tracks in some locations 2.0m wide
Type/Likely Original Design Class	Engineered road ; Design Class not adhered to.
Surface Type	Evidence that road was once paved up to some point with Single Surface Treatment of bitumen and chippings; residual gravel surface evident in some places;
Surface Condition	Vegetation narrowed carriageway in some places; flat surface with no apparent crossfall.
Lateral drainage	No side drain evident
Transverse drainage	Evidence of recent intervention to construct some culverts; Some wide streams are however still impassable by vehicles; logs are provided for pedestrian crossing. Need for box culverts across wide streams.
Horizontal alignment	Appears as if this has never been rigorously designed
Vertical alignment	Appears as if this has never been rigorously designed. Locations exist where gradients are steeper than 10%.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	less than 100 veh/day (No vehicles on road)
Average Travel Speed based on Travel Time runs on passable sections	18.0 km/hr

Dambala – Kpetema – Gbangba Road; Selenga Chiefdom; Bo District

Figure 3.7: Apparent Engineered Road; Evidence of Side Drains Recently Constructed

Figure 3.8: On- going Unsupervised Works to Construct Culvert

The condition of the feeder roads in Bo district in terms of: road surface condition, accessibility to markets and other services, travel speed, safety, Geometric design standard and drainage condition, can be rated as " Very poor".

There does not appear to have been any engineering standards complied with during rehabilitation of the roads; this is responsible for the typical observation of poor road surface with no crossfall, dangerous horizontal curves and challenging vertical curves; no side drainage exacerbated by lack of crossfall causes water to pond on the roads resulting to pavement deterioration and consequent impassability.

Table 3.6: Condition and Standard of Existing Dambala – Gbangba Road

Existing Carriageway Width	≤ 4.0 m. Reduced to tracks in some locations 2.0m wide
Type/Likely Original Design Class	Apparent Engineered gravel road ; Design Class not adhered to.
Surface Type	Residual gravel surface evident in some places; gravel surfacing has all been washed off .
Surface Condition	Vegetation narrowed carriageway in some places; flat surface with no apparent crossfall.
Lateral drainage	On – going works shows recently constructed side drains.
Transverse drainage	Evidence of on -going intervention to construct culvert; although work has stopped at the time of visit; contractor seem to have abandoned works. Road now impassable at excavated culvert location.
Horizontal alignment	Appears as if this was never rigorously designed;
Vertical alignment	Appears as if this was never rigorously designed. Locations exist where gradients are steeper than 10%.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	less than 100 veh/day (No vehicles on road)
Average Travel Speed based on Travel Time runs on passable sections	20.0 km/hr

Magbonkani – Kabonka road; SafrokoLimba Chiefdom, Bombali District.

` **Figure 3.9: No gravel surface layer; Dangerous S - Curve**

Figure 3.10: Tight Dangerous Curves, Steep gradients, Gulley Erosion

Figure 3.11: Typical Challenges Taking Produce To Markets

Table 3.7: Condition and Standard of Existing Magbonkani – Kabonka Road

Existing Carriageway Width	3.5m. average carriageway; cannot accommodate two vehicles at most locations
Type/Likely Original Design Class	No engineering design standard complied with; Earth riding surface with no gravel covering.
Surface Type	Earth
Surface Condition	Vegetation narrowed carriageway in most places; flat surface with no crossfall. Dusty road; will be slippery and difficult to ride on in the rainy season.
Lateral drainage	None
Transverse drainage	Culverts exist but silted and not flowing; potential to overtop in rainy season.
Horizontal alignment	No Design standard complied with; appears as if it was never designed;tight , dangerous curves with very little sight distance.
Vertical alignment	Appears as if this was never rigorously designed. Locations exist where gradients are steeper than 10%, causing gulley erosion.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	Definitely less than 100 veh/day. (No vehicle observed on road)
Average Travel Speed based on Travel Time runs on passable sections	14.0 km/hr

Mangay – Makari Road; GbantiKamaranka Chiefdom, Bombali District

Figure 3.12: Steep Slope; Tight Curves with Gulley Erosion

Table 3.8: Condition and Standard of Existing Mangay – Makari Road

Existing Carriageway Width	3.5m. average carriageway; cannot accommodate two vehicles at most locations
Type/Likely Original Design Class	No engineering design standard complied with; Earth riding surface with no gravel covering.
Surface Type	Earth
Surface Condition	Vegetation narrowed carriageway in most places; flat surface with no crossfall. Dusty road; will be slippery and difficult to ride on in the rainy season.
Lateral drainage	None
Transverse drainage	Culverts exist but silted and not flowing; potential to overtop in rainy season.
Horizontal alignment	Design standard not complied with; No apparent engineering design; tight , dangerous curves with very little sight distance.
Vertical alignment	Appears as if this was never rigorously designed. Locations exist where gradients are steeper than 10%, causing gulley erosion.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	Definitely less than 100 veh/day. No Vehicle observed on road)
Average Travel Speed based on Travel Time runs on passable sections	20.0 km/hr

Figure 3.13: Virtually no gravel on surface; washed out.

Makambo – Mamoro Road; BombaliSebora Chiefdom, Bombali District

Figure 3.14: Poor Road Geometry; Gulley Erosion; Overgrown Vegetation

Table 3.9: Condition and Standard of Existing Makambo - MamoroRoad

Existing Carriageway Width	3.0m. average carriageway; cannot accommodate two vehicles at most locations
Type/Likely Original Design Class	Apparent engineered road but no engineering design standard complied with
Surface Type	Residual gravel; most washed off.
Surface Condition	Overgrown vegetation narrows road width; flat surface with no crossfall. Surface rideable with difficulty.
Lateral drainage	None; overgrown by vegetation
Transverse drainage	Culverts are in good condition
Horizontal alignment	Design standard not complied with; tight , dangerous curves exist.
Vertical alignment	Appears as if this was never rigorously designed.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	Definitely less than 100 veh/day. (No vehicle on road)
Average Travel Speed based on Travel Time runs on passable sections	22.0 km/hr

Figure 3.15: Dangerous Tight Curve; Vegetation Restricting Width of Carriageway

The condition of the feeder roads in Bombali district in terms of: road surface condition, accessibility to markets and other services, travel speed, safety, Geometric design standard and drainage condition, can be rated as " poor". Condition is better for accessibility by motor bikes which is the main means of transport for the local population and farmers to market and other social services.

There does not appear to have been any engineering standards complied with during rehabilitation of the roads; this is responsible for the typical observation of poor road surface with no crossfall, dangerous horizontal curves and challenging vertical curves with gulley erosion; no side drainage and crossfall has caused rapid deterioration of road surfaces.

Rowalla – Mathora – Maraka Road; KholifaRowalla Chiefdom, Tonkolili District

Figure 3.16: Relatively good gravel road; Overgrown Vegetation at Edge of Road

Table 3.10: Condition and Standard of Existing Rowalla – Mathora - MarakaRoad

Existing Carriageway Width	5.0m. average carriageway
Type/Likely Original Design Class	Engineered road .
Surface Type	Gravel
Surface Condition	Reasonably good, although bumpy when driving because of corrugations; dusty road conditions
Lateral drainage	No definite side drains; overgrown vegetation at edge of road; this can cause water to be trapped on roadway.
Transverse drainage	Culverts are in good condition
Horizontal alignment	PParent engineering design followed
Vertical alignment	Appears this was properly designed.
Terrain type	Flat to gentle (Type F)
Traffic level (ADT)	More than 100 veh/day.
Average Travel Speed based on Travel Time runs on passable sections	33.0 km/hr

Makumbu Junction – Farama Road, KunikeBarina Chiefdom, Tonkolili District

Figure 3.17: Recently Rehabilitated LFM Road - Sign Board

Figure3.18: Extremely Steep slope

Figure3.19: Poorly Designed Section; Seem Untouched

Figure 3.20: Poorly Engineered Tight Curves

Figure 3.21: No Surface Gravel

Table 3.11: Condition and Standard of Existing MakumbuJnct – Farama Road

Existing Carriageway Width	3.0m average carriageway; below required design standard; overgrown vegetation on side of road.
Type/Likely Original Design Class	Poorly engineered road
Surface Type	Residual gravel; some areas without gravel surface material
Surface Condition	Very poor for a road that is supposed to have been recently rehabilitated; dusty conditions
Lateral drainage	No side drains evident. Overgrown vegetation; no routine Maintenance apparent since rehabilitation.
Transverse drainage	Culverts are in good condition
Horizontal alignment	Very poor engineering design ; curves very tight and dangerous.
Vertical alignment	Poorly designed, or no design at all; very steep challenging gradients.
Terrain type	Rolling to Mountainous (Type H)
Traffic level (ADT)	Less than 100veh/day.
Average Travel Speed based on Travel Time runs on passable sections	14.0 km/hr

Makrugbeh – Mamontor Road, Tane Chiefdom, Tonkolili District

Figure 3.22: Tight Curve; Earth Surface

Table 3.12: Condition and Standard of Existing Makrugbe – Mamontor Road

Existing Carriageway Width	3.0m average carriageway; below required design standard;
Type/Likely Original Design Class	No apparent engineering design;
Surface Type	Earth
Surface Condition	Very poor; earth surface which has the potential of becoming very slippery during the rainy season.
Lateral drainage	No side drains evident.
Transverse drainage	Culverts unfinished
Horizontal alignment	Very poor engineering design ; curves very tight and dangerous.
Vertical alignment	No apparent engineering design
Terrain type	Flat to gentle rolling (Type F)
Traffic level (ADT)	Definitely less than 100 VPD; none using road
Average Travel Speed based on Travel Time runs on passable sections	20.0 km/hr

Figure 3.23: Abandoned Work at Culvert Location

The condition of the feeder roads in Tonkolili district in terms of: road surface condition, accessibility to markets and other services, travel speed, safety, Geometric design standard and drainage condition, can be rated as “ poor”. Condition is better for accessibility by motor bikes which is the main means of transport for the local population and farmers to market and other social services.

Except for the Rowalla to Mathora road, there does not appear to have been any engineering standards complied with during rehabilitation of the roads; this is responsible for the typical observation of poor road surface with no crossfall, dangerous horizontal curves and challenging vertical curves with gulley erosion; no side drainage and crossfall has caused rapid deterioration of road surfaces.

A classical case of poor implementation of rehabilitation works is seen at the Makumbu junction – Farama road, which is a recently rehabilitated LFM road (see Figs ….to …..). The evidence indicated that no proper engineering design was done, supervision was poor or non – existent and part of the road even appeared untouched.

Joe Town Road, Koya Rural, Western Area

Figure 3.24: Reasonably Rideable Earth Surface

Figure 3.25: Digging Side Drains

Table 3.13: Condition and Standard of Existing Joe Town Road

Existing Carriageway Width	4.0m average carriageway
Type/Likely Original Design Class	Un - engineered road
Surface Type	Earth
Surface Condition	Uneven Earth surface with depressions ; passable in dry season, but clayey sand material would be slippery during the rainy season.
Lateral drainage	Efforts being made to dig side drains
Transverse drainage	None
Horizontal alignment	Poor; No Geometric standards followed.
Vertical alignment	No apparent engineering design
Terrain type	Flat to gentle rolling (Type F)
Traffic level (ADT)	Definitely less than 100 VPD (No vehicle on road)
Average Travel Speed based on Travel Time runs on passable sections	15.0 km/hr

Makoray Site Road, Koya Rural, Western Area

Figure 1.26: A Track With Vegetation on Road

Table 3.14: Condition and Standard of Existing Makoray Road

Existing Carriageway Width	4.0m average carriageway
Type/Likely Original Design Class	Un - engineered road
Surface Type	Earth
Surface Condition	Virtually a motor track with vegetation on roadway
Lateral drainage	None
Transverse drainage	None
Horizontal alignment	Not engineered.
Vertical alignment	No engineering design
Terrain type	Flat to gentle rolling (Type F)
Traffic level (ADT)	Definitely less than 100 VPD; no vehicle using road
Average Travel Speed based on Travel Time runs on passable sections	15.0 km/hr

Magbanpoy Road, Koya rural, Western Area

Figure 3.27: Effort Digging Side Drain

Table 3.15: Condition and Standard of Existing MagbanpoRoad

Existing Carriageway Width	4.0m average carriageway
Type/Likely Original Design Class	Un - engineered road
Surface Type	Earth
Surface Condition	Eart surface accessible during dry season; would be slippery in the rainy season
Lateral drainage	None
Transverse drainage	None
Horizontal alignment	Not engineered.
Vertical alignment	No engineering design
Terrain type	Flat to gentle rolling (Type F)
Traffic level (ADT)	Definitely less than 100 VPD; no vehicle using road
Average Travel Speed based on Travel Time runs on passable sections	20.0 km/hr

The roads in the Koya Rural, Western Area district are all earth surfaced roads which have never been designed. Roads are reasonably accessible by 4 – wheel drive vehicle during the dry season, but would be slippery during the rainy season because of slippery conditions; surface is sandy clay. There appears to be efforts at constructing side drains and brushing.

3.3 Situation and Perception of Farmers

A questionnaire (see Annex 1) was used to assess the way smallholder commercial farmers perceive the effect of the feeder roads on their production and transportation of produce to nearest market centers for sale, as well as accessibility to nearest health clinic. The situation, perception and coping mechanisms vary by district; it seems to depend on the distance of the markets from the farms, the condition/ accessibility of the roads and the cost of transport. Analysis of aggregated data for each district is presented separately.

Bo District

A total of 10 smallholder commercial farmers associated with the three selected feeder roads for the study in Bo were interviewed. Table 3.4 present the results of the assessment:

Table 3.16: Situational Analysis in Bo District

Parameter	Current Situation/Perception of Farmers
Main Commodities produced for Markets	Rice – 60% Cassava, Potatoes – 20% Groundnut – 10% Palm oil production – 10%
Average area cultivated per farm	4.1 acres
Mode of transport to nearest market with produce	Motor bike (Okada) – 100%
Average distance to nearest market (miles)	6.6 miles
Average travel time to nearest market (hours)	1.60 hours
Average transport cost per one way trip to nearest market with produce (Le.)	Le. 9,000
Whether transport costs will reduce if road is improved	100% - said "Yes"
Mode of transport to nearest clinic	50% walking; 50% Motor bike
Average distance to nearest clinic (miles)	4.1 miles
Percent of harvested produce taken to nearest market for sale (%)	30%
Percentage of sales from produce spent on transportation of produce to nearest market	21.7%
Perception of road width, road surface condition	100% - road width very inadequate 70% - Road surface very poor 30% - Road surface poor
Accessibility/passability of roads	Average no. of months road difficult to pass in year- all year round Average no. of months roads impassable in year – 1.5 months
Safety of roads	100% - very unsafe
Satisfaction with the durability/maintenance of road	100% - Highly dissatisfied
Most important factor considered while commuting on the road	60% - Safety; poor condition of road and concern for accidents. 40% - time taken to reach nearest market

Bombali District

A total of 10 smallholder commercial farmers associated with the three selected feeder roads for the study in Bombali District were interviewed. Table 3.5 summarizes the key results of the analysis:

`**Table 3.17: Situational Analysis in Bombali District**

Parameter	Current Situation/Perception of Farmers
Main Commodities produced for Markets	Rice – 40% Cassava, Pineapples – 30% Groundnut – 10% Palm oil production – 10%
Average area cultivated per farm	6.6 acres
Mode of transport to nearest market with produce	Motor bike (Okada) /sometimes walking – 70% Only walking – 20% Motor bike only – 10%
Average distance to nearest market (miles)	5.3 miles
Average travel time to nearest market (hours)	30 minutes – by motor bike 2 hours - walking
Average transport cost per one way trip to nearest market with produce (Le.)	Le. 11,100
Whether transport costs will reduce if road is improved	100% - said “Yes”
Mode of transport to nearest clinic	80% walking; 20% Motor bike
Average distance to nearest clinic (miles)	1.9 miles
Percent of harvested produce taken to nearest market for sale (%)	60.9%
Percentage of sales from produce spent on transportation of produce to nearest market	11.9.%
Perception of road width, road surface condition	80% - road width inadequate to very inadequate 50% - Road surface very poor 50% - Road surface poor
Accessibility/passability of roads	Average number of months road difficult to pass in year – 3.2 months Average no. of Months impassable per year – 1.5
Safety of roads	60% - very unsafe 20 % somewhat unsafe 20% neither safe nor unsafe
Satisfaction with the durability/maintenance of road	70% - Highly dissatisfied 20% - Somewhat dissatisfied 10% - neither satisfied nor dissatisfied
Most important factor considered while commuting on the road	100% - Safety; poor condition of road and concern for accidents.

Tonkolili District

A total of 9 smallholder commercial farmers associated with the three selected feeder roads for the study in Tonkolili District were interviewed. Table 3.6 summarizes the key results of the analysis:

`Table 3.18: Situational Analysis in Tonkolili District

Parameter	Current Situation/Perception of Farmers
Main Commodities produced for Markets	Rice – 77% Cassava, Pineapples, groundnut – 20% Palm oil – 3%
Average area cultivated per farm	5.8 acres
Mode of transport to nearest market with produce	Motor bike (Okada) /sometimes walking – 33% Only walking – 34% Motor bike only – 33%
Average distance to nearest market (miles)	7.1 miles
Average travel time to nearest market (hours)	30 minutes – by motor bike 2- 3 hours - walking
Average transport cost per one way trip to nearest market with produce (Le.)	Le. 16,500
Whether transport costs will reduce if road is improved	100% - said "Yes"
Mode of transport to nearest clinic	78% - Motor bike/walking; 22% - Motor bike
Average distance to nearest clinic (miles)	6.1 miles
Percent of harvested produce taken to nearest market for sale (%)	35.5%
Percentage of sales from produce spent on transportation of produce to nearest market	19.2 %
Perception of road width, road surface condition	100% - road width inadequate to very inadequate 56% - Road surface very poor 44% - Road surface poor
Accessibility/passability of roads	Average number of months road difficult to pass in year – 2.7 months Average no. of Months impassable per year – 1 month
Safety of roads	77% - very unsafe 23 % somewhat unsafe
Satisfaction with the durability/maintenance of road	56% - Highly dissatisfied 46% - Somewhat dissatisfied

Most important factor considered while commuting on the road	100% - Safety; poor condition of road and concern for accidents.

Koya Rural District

A total of 9 smallholder commercial farmers associated with the three selected feeder roads for the study in Koya Rural District were interviewed. Table 3.7 summarizes the key results of the analysis:

`Table 3.19: Situational Analysis in Koya Rural District

Parameter	Current Situation/Perception of Farmers
Main Commodities produced for Markets	Rice – 75% Cassava, groundnuts - 25%
Average area cultivated per farm	3.0 acres
Mode of transport to nearest market with produce	Motor bike (Okada) /sometimes walking – 75% Motor bike only – 25%
Average distance to nearest market (miles)	4.0 miles
Average travel time to nearest market (hours)	30 minutes – by motor bike 1- 2 hours - walking
Average transport cost per one way trip to nearest market with produce (Le.)	Le. 5,000
Whether transport costs will reduce if road is improved	100% - said "Yes"
Mode of transport to nearest clinic	50% - Motor bike/walking; 50% - Walk
Average distance to nearest clinic (miles)	3.3miles
Percent of harvested produce taken to nearest market for sale (%)	37.5%
Percentage of sales from produce spent on transportation of produce to nearest market	5 %
Perception of road width, road surface condition	100% - Very inadequate 100% - Road surface very poor
Accessibility/passability of roads	Average number of months road difficult to pass in year – 3.8 months Average no. of Months impassable per year – 1 month
Safety of roads	100% - very unsafe

Satisfaction with the durability/maintenance of road	100% - Highly dissatisfied
Most important factor considered while commuting on the road	50% - Safety; poor condition of road and concern for accidents. 50% - Riding comfort/convenience

3.3.1 Summary of Situation as Perceived Farmers

The purpose of the survey was to provide an indication of the general perception of farmers in the districts surveyed, with respect to the condition of the roads and their coping mechanisms.

The survey sample was random; however, the scope and limitations of the study grossly limited the sample size; therefore, emphasis is placed on general trends rather than individual statistics of different factors in this report. The following summarizes the general findings of the survey:

1. The predominant crop produced by farmers is rice; other crops such as cassava, potatoes, pineapples and palm to produce palm oil are produced to a smaller scale, mostly together with rice.
2. The average area of cultivated farms varies from as low as 3.0 acres in Koya Rural District, Western Area, to 6.6 acres in Bombali district.
3. The trend of the results indicates a general correlation between the average area cultivated and the general condition of the roads in the districts. In Koya Rural, the roads are all un -engineered roads; some are barely road tracks, with earth surface of clayey sand material which could be difficult even for motor bikes in the rainy season to traverse. All respondents interviewed in Koya replied that road width and surface condition are very inadequate and very poor respectively. In Bombali District, the roads are in relatively better condition, with 50% of respondents replying that road surface is poor and 50% replying they are very poor.
4. The trend also indicates that the percentage of produce cultivated and taken to markets for sale is reflective of the road conditions; the highest percentage taken to markets was in Bombali district, where about 61% of produce cultivated are taken to markets; this could be because the roads are relatively better (although in “poor” condition). The lowest percentage of 30% was in Bo district, where the roads are in “very poor” condition.
5. With respect to expenditure on transportation as a percentage of earnings from sale of produce, farmers in Bombali spend about 12% of their earnings on transport, whilst those in Tonkolili and Bo spend about 19% and 22% respectively; again, indicative of the relative road conditions. Expenditure in Koya is low because the farmers do a lot of walking because of the proximity to the main Waterloo road.
6. In general, as perceived by farmers, the road conditions in Bo district and Koya can be classified as “very poor”; in Bombali and Tonkolili they can be classified as “poor”. These perceptions are confirmed by the road condition and travel time surveys.

7. Feeder roads in all districts are inaccessible for at least one month in the rainy season; respondents all agree that the roads are difficult in terms of accessibility all year round because of the conditions of the roads.
8. The major concern of farmers using the roads is safety in terms of accidents because of the poor geometrics and condition of the roads.
9. With the exception of a road in Tonkolili district, no traffic was observed using these feeder roads during the study; goods are transported by motor bikes (Okada) and sometimes by headload - walking). The feeder roads can be termed “Okada Highways”.
10. The coping mechanism of farmers with regard the poor condition of the feeder roads are:
    - More trips to markets by farmers and their families to the markets with load portions that can be accommodated by Motor Bikes (albeit at very high risk because the motor bikes are overloaded most times to maximize profit);
    - Farmers use “Head Loads” and walk, especially when the distance is less than 2 miles to markets; some people walk up to 5 miles with great difficulty and take up to 2 hours on the roads.
    - Most trips to access clinics/hospitals are done by walking.

3.4 Management and Maintenance of Feeder Roads

The overall management of feeder roads and rehabilitation is done by the Feeder Roads Department of the SLRA; however, following the Local Government Act of 2004 and decentralization policy, rehabilitated feeder roads are handed over to the Local Councils for maintenance. SLRA District Engineers provide technical support and backstopping to the District Councils at District Levels.

The rural/feeder roads policy of 2010 requires that 20% of the road fund from fuel levy collected by the Road Management Fund Administration (RMFA) should go towards maintenance of feeder roads; these funds are sent directly to the various District Councils. The funding is provided annually and is based on budget submitted by the District Councils basically for routine maintenance only (grass cutting and vegetation control, cleaning/re – shaping of side drains, de – silting culverts, repairing pot holes, uprooting vegetation from roadway and clearing flood debris). There is no formal policy for feeder road maintenance. In addition to routine maintenance, there should normally be periodic maintenance (a 3 to 5 year more comprehensive and costly set of activities such as: re – shaping or re - gravelling of the road surface, repair/reconstruction of cross drainage structures, spot improvement of short sections of 1 km or less to ensure reasonable passability). Routine maintenance activities are undertaken by cycle with associated costs: Year 1 after rehabilitation (routine) cost is $1,000/km; year 2 after rehabilitation (routine) cost is $1,500; year 3 after rehabilitation (routine) cost is $2,000/km; year 4 after rehabilitation (spot improvement) cost is $5,000/km; year 5 after rehabilitation, must be rehabilitated again.

No road condition surveys are done to inform budgeting for specific maintenance activities; currently however, the SLRA in partnership with the Africa Community Access Programme (AfCAP) is doing a feeder roads asset management project in the Tonkolili District. Under this project, road condition survey and inventory surveys will be done twice a year for a road network of about 252km. At the end of this project, it is expected that procedures for road condition surveys, asset inventory, socio economic data and other asset management surveys and issues will be established and rolled out.

It was also discovered that funding provided by RMFA to District Councils are not received regularly. There is also no monitoring mechanism to ensure that the funds are used for the intended purpose. It was found out that funds sent for routine maintenance of the feeder roads are mostly used to do new roads that are of interest to the Councilors. The consequence of this is that rehabilitated feeder roads handed over to the Councils are left to deteriorate rapidly, sometimes becoming impassable. The deficiency in effective maintenance means that significant investments in these road assets are being lost due to failure of the responsible Councils to maintain the roads.

Feeder roads are constructed by using labour – based methods supported by light equipment such as rollers, tractors and tipping trailers, loaders and dump trucks (when available). The average cost per kilometer for a gravel surfaced feeder road is $25,000/km. The method of contracting feeder roads projects is by National Competitive Bidding (NCB) using the normal Measurement Bill of Quantities type contract. The contracts are usually awarded to small - medium contractors; most of these companies however have limited equipment and technical capacity for roadworks. Supervision contracts are awarded to consultants; however, it was evident that there has been inadequate attention paid by these consultants to engineering design standard and specification in order to ensure that the rehabilitated roads are handed over to local councils, in conditions fit for purpose. One factor responsible for this is insufficient funding for fundamental engineering surveys and design for the rehabilitation of feeder roads. Due to this lapse, the roads are initially not constructed/rehabilitated to any specifications and standards; the conditions are unsafe and challenging and defects are therefore manifested at a very early stage after being handed over to the Councils.

3.5 General Observations

In addition to the specific findings, general observations made during the studies and interviews revealed the following:

i. Farmers have no incentive to increase production due to the challenges of transportation of goods to markets as a result of inaccessible and poor road conditions.

ii. Feeder roads connect with secondary roads; however, some of these secondary roads which eventually link to major town markets are also unpaved and in deplorable condition; example of such roads that are important for impacting agricultural production and in need of urgent intervention, are: Bo – Yele road, Bo – Mattru Road.

The impact of rehabilitating feeder roads cannot be realized if the secondary roads to which they connect are not well designed and paved.

iii. In spite of the numerous interventions on rural and feeder roads development in Sierra Leone by funding agencies, the full desired impact on the agriculture sector has not been realized; significant number of feeder roads have been neglected for over 10 years and are now impassable because of lack of efficient management and maintenance for these roads.

iv. In addition to funding constraints, there is a serious lack of technical capacity at District Councils to manage and supervise maintenance of feeder roads. Design of the roads is substandard and supervision of construction and maintenance activities is virtually non – existent because of the remoteness of some of these roads.

Figure 3.28: Poor Condition of a Secondary Road: Bo - Mattru Road

v. The poor condition of the roads which are impassable for significant periods of the year and preventing farmers to access markets with their produce, is resulting to unwanted and uncontrolled cutting down of trees for firewood, charcoal and bush sticks which they can readily sell to truck drivers that manage to access the roads, because they have to feed their families. These activities have significant negative impact on the environment in terms of Global warming and drought, erosion and landslides.

Figure 3.29: Indiscriminate Cutting of Trees for Wood and Bush Sticks

4. Lessons Learned

The lessons learned from research, one to one interviews of farmers and other stakeholders as well as inspection of the sample of feeder roads in the various districts, are based on the findings and observations. They should be used to inform decisions and policies in order to provide sustainable feeder roads to link farmers to markets.

The following are worthy to be noted:

- Sierra Leone like a lot of other Sub Saharan African countries have experienced significant increase in road construction and maintenance of main primary and secondary roads; however, less progress has been made with maintenance of rural/feeder roads which provide access to rural communities and for farmers to access markets easily and safely.
- The deficiency in effective maintenance of the feeder roads which are the responsibility of local councils, is caused by inadequate funding, poor institutional structures to monitor and supervise maintenance activities and lack of technical capacity at the local district level.
- Feeder roads are rehabilitated by SLRA and handed over to District Councils to manage and maintain; however, only routine maintenance activities are funded; the funds given to the District Councils for maintenance are sometimes used to develop other roads that are of interest to them, neglecting the rehabilitated roads which consequently deteriorate rapidly and sometimes become impassable.
- Feeder road maintenance activities are not planned; monitoring and supervision of maintenance activities are virtually non – existent; contractors are many times paid for work not actually done; some contractors simply abandon the maintenance works contracted to them and still manage to collect their payments. Large investments in feeder roads by a number of development partners are not yielding sustainable results

to provide access for farmers and the rural communities because the road assets are not effectively maintained.

- The method of construction of feeder roads is mostly by using labour – intensive methods. Use of equipment is very minimal because the works are contracted out mainly to small to medium scale contractors without the necessary basic road construction equipment. Due to the unit rates quoted for executing these works, they find it difficult to meet the rental cost of equipment. They therefore resort to using manual labour for works which should otherwise be done more effectively and efficiently only by using equipment. As a result of this, pavement layers are not adequately compacted, pavement cross – slopes are not achieved, required earthworks to bring gradients to required design standards are not met and gravel surface are not watered and properly compacted during construction; this worrying lapse in quality of construction is exacerbated by inadequate supervision.
- During rehabilitation of the roads, it was observed that there is total disregard for the required engineering design standards to be complied with; supervision and quality control is almost non - existent. Consequently, the supposed rehabilitated roads passed on to the local councils for maintenance are sub - standard and deteriorate soon after rehabilitation. The local councils do not have the level of funding and capacity to correct the lapses during rehabilitation. The poor implementation of the rehabilitation works was observed at one of the recently rehabilitated LFM roads in the Tonkolili District. The unsafe conditions and rapid deterioration and inaccessibility of most of these roads are the manifestations of poor initial rehabilitation works which are not undertaken to required standards and quality.
- In Liberia, low cost alternative seals instead of gravel surfacing is now being used to provide more sustainable all weather feeder roads in the on – going $24m Feeder Roads Alternative and Maintenance Program (FRAMP).
- Considering the "Whole Life Cost" (initial construction cost and required maintenance including re – gravelling over a 10 year design life of the road for example) of feeder roads , the use of gravel as a wearing course is more expensive in the medium to long term compared to a low cost alternative sealing such as thin film of bitumen and chippings (chip seal); This has been proven by *Whole Life Cost* analysis in published Transport Note No. TRN 33 [4] . Another low cost sealing is the use of Otta Seal which is an asphalt surface treatment constructed by placing a graded aggregate on top of a thick application of a soft bituminous binder (emulsified asphalt, or cutback asphalt. Otta seals are constructed over an aggregate base course; no prime coat is necessary; Local aggregates or natural gravels can be used for Otta seals[6.]
- `Sierra Leone is currently benefiting from engagement in the Research For Community Access Partnership (ReCAP) – funded Economic Growth Through Effective Road Asset Management project. A study on the development of a robust design manual for feeder roads suited to the specific needs of each country is ongoing in Sierra Leone and Liberia. A study to recommend alternative road surfacing to maximize the use of local resources in feeder road rehabilitation and maintenance with reduced whole life costs for road

assets is ongoing. SLRA engineers have been trained by ReCAP to train other engineers in the use of Dynamic Cone Penetrometer (DCP) method for rural road pavement design.

- As a result of poor quality in construction, the roads deteriorate faster, most times after the very first rains. Huge maintenance interventions are then required and because of lack of adequate funding, the feeder roads are neglected and abandoned to deteriorate further to the point of being inaccessible in some cases.
- Of the 8,700 km of functionally classified roads in the NRS, 4,277 km are feeder roads which are all unsealed (with gravel or earth surfacing). About 900 km of the remaining 4,423km of primary and secondary roads are also unpaved. As the economy develops and traffic volumes increase, the demand arises to seal previously unsealed roads. The transition point between unsealed and sealed roads depends on many conditions that should be evaluated. Guidance has been provided by The World Bank Transport Note TRN- 33 [4].

5. Output - And - Performance – Based Road Maintenance Contracts

One of the main factors responsible for the poor condition of feeder roads in Sierra Leone is the lack of effective maintenance; the situation is exacerbated by the fact that feeder roads are unpaved with lateritic gravel as the wearing surface course. This state of affairs is caused by the continued use of the traditional measurement type of contract method used to award maintenance contracts. This method is not suitable for maintenance contracts because measurements of the work activities can be difficult to ascertain and contractors can easily be paid for work not actually done. The current trend now is to use Output – And – Performance – Based Road Maintenance Contract (OPRC) method. This is now being used in most Sub Saharan African countries and supported by the World Bank and other funding agencies.

In the OPRC method, the contractor is paid on an output basis (maintaining the road at a specified service standard) rather than on an input basis as occurs under traditional maintenance contracts. Under traditional input – based contract the private contractor gets paid for each repaired pothole, whereas under an output – based contract the contractor gets paid for each length of road it maintains at the required condition. In return for achieving this standard, the contractor is paid periodically a fixed amount.

Output – based maintenance contracts have several benefits over traditional input – based contracts. By paying contractors based on the level of service they deliver, output – based contracts provide a clear financial incentive for contractors to meet performance standards. Private contractors are also incentivized to improve their efficiency and minimize waste because they are paid at a set level for performance, not based on the value of the inputs used.

Output – based maintenance contracts are usually longer than traditional maintenance contracts, which incentivize private contractors to take measures that improve the road conditions for the duration of the contract, rather than ad hoc repairs. Longer maintenance contracts also commit governments to fund maintenance for several years, reducing the risk of delaying maintenance for budget reasons. This encourages predictable and regular maintenance works, resulting in improved asset quality and reduced long – term costs from lower rehabilitation and reconstruction costs.

This method has been successfully used in Brazil, Australia, Vietnam ,Chad and Zambia .The World Bank Group has learned considerable lessons from implementation of these types of contracts and has developed World Bank OPRC contract templates for use by countries.

6. Review of Regional Maintenance Systems for Rural/Feeder Roads

The purpose of this section is to identify any common themes including “what works” and “what is less successful” in rural/feeder road maintenance arrangements to reduce Whole Life Costs of these roads and preserve the assets; It also presents ongoing works and research that can provide answers for more sustainable access for rural communities and farmers to markets.

Liberia

According to a recent publication*“ USAID Provides US$24m Grant For Feeder Roads In Liberia”* in May 2016 published by *Cardno USA Inc.* an international consulting company working in Liberia, in 2016 USAID provided US24m Grant for Feeder roads in Liberia; Cardno is currently implementing this project and the roads are expected to improve livelihoods and increase access to essential markets by farmers. The project is using a new alternative seal that prevents rain water from permeating the roads for years. The project is called the “Feeder Roads Alternative and Maintenance Program (FRAMP) and involves rehabilitation of 450km of rural roads, using low volume seals instead of gravel surfacing. They are also developing community – based maintenance systems and building capacity of Liberian construction firms, public sector engineers and planners, and community – based organizations (CBO’s) to manage the road network.

The lesson here is that it is now being recognized that in countries such as Liberia with similar heavy rainfall like Sierra Leone, gravel surfacing for rural/feeder roads is not sustainable in the long term because rain will easily permeate the surface, wash off the gravel, create gullies and potholes and make the road inaccessible especially during the rainy season.

With some 3,000 to 5,000mm of rainfall per annum, road maintenance becomes a significant technical and financial challenge. This impacts vehicle operation costs. Bridges and culverts are frequently washed out and rendered roads impassable during the wet season. The high road maintenance costs are difficult to fund due to limited government resources. In support of addressing some of these issues, AfCAP has recently funded the scoping of research options in rural accessibility, mobility and safety.

Zambia

Zambia was the first country in the region to adopt a Road Fund in 1993 , and since 2002 has an agency structure with separate agencies responsible for funding, road management and road safety each reporting to different ministries. The Road Fund is collected from road user charges and a levy on fuel for maintenance (as in Sierra Leone). However, one of the main challenges faced by the agency was disbursing maintenance funds efficiently and effectively over the network - a situation that is also currently typical in Sierra Leone.

The Road Fund Board recognized that they were not getting value for money using the traditional ways of contracting out maintenance using measured contracts; they were not getting the required results and they thought it fit to introduce a new system. They introduced the Performance – Based Road Maintenance system of contracting out maintenance works. The contractor in a performance – based road maintenance contract is paid on an output basis (maintaining the road at a specified service standard) rather than on an input basis as occurs under traditional maintenance contracts.

In 2006 performance contracts were introduced on over 3,000km of unpaved District Roads with funding assistance from the European Union. The World Bank sample bidding document; “The Output and Performance – Based Road Contract, OPRC” was used to award 10 contracts. The works were split into four components: Initial Rehabilitation, Improvement Works, Maintenance Works and Emergency Works. Only Maintenance was paid for on a performance basis. Under the contract, bidders were required to make their own estimate of the initial work needed to bring roads up to maintenance condition (the design) which was paid for on a measured basis under the “Output” part of the contract, during the first year. Maintenance services were priced as a lump sum which was paid in monthly installments according to the length of network under maintenance and the Contractors’ ability to respect performance criteria. Some contractors partnered with consulting firms to bring in road management expertise.

There were initial problems in agreeing on scope of the Initial works; however, after overcoming these initial challenges including robust monitoring and supervision, the impact on the ground was remarkable with most of the roads becoming all – weather routes for the first time after many years. Traffic levels and vehicle speeds increased quite dramatically. Local consultants were engaged to supervise the large OPRC contracts.

In a Policy Research Working Paper 8201[5], the following were concluded from the research done in Zambia:

- Rural access is among the most important infrastructure elements to stimulate economic growth in rural and remote areas;
- The sustainability of feeder road maintenance is a challenge; many feeder roads are unpaved and need to be maintained frequently, but are often neglected under budget pressure.
- Output – and performance – based road contracts are an instrument to ensure the sustainability of road maintenance. Contractors are required not only to improve roads , but to maintain them.
- The output – and –performance – based contracts had a significant impact on crop production, especially maize and groundnuts, two major crops grown in the study area.

Tanzania

In Tanzania, the district road network comprising about 108,000 km , is the responsibility of the District Councils. The Councils are required to adhere to strict uniform procedures for planning their maintenance programmes and doing funding applications. One key lesson to be learnt here is that the district engineers are required to carry out a condition survey of the roads using a Road Inventory and Condition Survey software. The data from the software is used to prepare the annual work plan and budget for submission to the appropriate Office for funding.

Zimbabwe

In Zimbabwe, the construction of rural roads after independence was carried out using plant hired from the private sector and government equipment through force account. The project included the establishment of a Road Engineering Division to carry out the construction works and the development of a road maintenance system.

The road maintenance system divided the road network into small manageable units. These units were provided with a dedicated allocation of funds from the state budget based on the roads to be maintained. Each unit received a full complement of equipment comprising a tractor, towed grader, trailer and a water bowser. The units were allocated personnel specific to the network under its geographic boundary and a road supervisor. A total of 204 units were formed and the programme recorded significant success during the 15 years of implementation due to the following reasons:

- Rural roads were managed by a separate entity from the one responsible for the national trunk roads; this organization was a semi – autonomous government department which enjoyed relative independence.
- The road construction was funded by donor partners but the condition was that the government pre – financed 100% of the cost and then upon producing proof of expenditure and related progress, the donor refunded 80% of the funds. The up –

front funding and 20% government net contribution encouraged the government to take ownership of the programme.

- The use of low cost intermediate equipment made road maintenance affordable and efficient.
- A comprehensive staff development exercise was conducted during the inception phase to “qualify” personnel for their roles.

Rwanda

In Rwanda a Rural Feeder Road (RFR) Maintenance Implementation Framework was developed for the Rwanda Ministry of Agriculture and Animal Resources in order to provide for the planning, budgeting, implementation and monitoring of rural feeder road maintenance. The responsibility of maintaining rural feeder roads in Rwanda falls primarily to the Districts. A common framework for the maintenance of these roads provides a common approach to maintaining the roads.

The implementation institutions for the routine maintenance works on feeder roads in their jurisdictions using community associations under The Roads and Transport Development Agency (RTDA) management , is funded by the Road Maintenance Fund (RMF). The routine maintenance of these roads were carried out based on yearly renewable performance based contracts between the community association and the District. The field inspection and verification of the completed maintenance tasks are done by the Sector Agronomist under the supervision of the District Engineer. Periodic and emergency maintenance are however carried out by road construction contractors under direct supervision of RTDA, funded by the RMF.

Routine Maintenance activities are carried out on a regular basis once or more frequently per year on a section of a road, particularly before and after the rainy season. The tasks include: Grass cutting and vegetation control, Removing small landslips, Cleaning/re-shaping of side drains, De – silting of culverts and channels, repairing potholes, clearing of flood debris etc.

Periodic maintenance is scheduled every 3 years and involves more comprehensive and costly activities such as: Re –shaping or re- gravelling of the road surface, Repair of culverts, Re – surfacing and major repair or reconstruction of cross – drainage structures, may require additional design; specific form of periodic maintenance is spot maintenance works on short sections (typically I km or less) of roads in order to ensure a reasonable level of passability. This activity normally requires specialist equipment and skilled resources.

There is also an Emergency/Urgent Maintenance programme which is only mandatory in response to a particular unforeseeable event, e.g. floods, landslips or other emergencies. The work required varies in accordance with the event but is usually required immediately to re – open immediately the road, which would have become impassable to normal traffic.

An important lesson learned from the Rwanda projects is that the devolution of responsibility for routine maintenance to community participation associations has the following advantages:

- Creation of job opportunities to local community people, thus supporting poverty alleviation;
- Imparts a sense of community ownership for road infrastructure;
- Builds the skills and knowledge of local people regarding road works through training.

Malawi

Another example of successful use of private sector participation in rural road maintenance is in Malawi. The European Union – funded *Income Generating Public Works Program (IGPWP)* used a village- based system modeled around a road maintenance club where one person is responsible for the annual routine maintenance of one kilometer of a road. The clubs were formed at the village level where District officials, District Councils and Village Development Committees helped establish the clubs. The club members were drawn from villages next to the road, with preference given to those living next to the road and having participated in the rehabilitation. Each kilometer of the road was assigned one person. Local government instructed the club members on routine maintenance techniques before they start work, and provided them with subsidized tools. The road maintenance program paid half the cost of the tools, and the members pay the other half in installments. Every year the club entered into a contract that details all the activities each member is expected to do on a monthly basis, as well as the conditions and requirements for performance – based payment. A Community Road Foreman (CRF) helped the local government supervise the club members' activities on a daily basis. In addition, the District Roads Supervisor visited each maintenance club at least twice every month.

7. Conclusions

Based on the outcome of the research, interviews with stakeholders, field investigation/studies, the following can be concluded:

A. General

1. One major reason for the poor condition of feeder roads in Sierra Leone is that the initial construction/rehabilitation prior to being handed over to local councils for management and maintenance is not undertaken efficiently. Rehabilitation works are supposed to bring the roads up to specific design standards to meet requirements of safety and durability. This has not been the case; roads with poor geometrics, drainage and surface conditions are often handed over to Councils which lack the capacity and funding to remedy such anomalies; Councils are only supposed to manage the roads and undertake routine and periodic maintenance activities with support from SLRA.
2. Significant investments in feeder roads construction and rehabilitation by a number of development partners are not yielding the sustainable results to provide access for farmers and the rural communities because the road assets are not effectively maintained.

3. The general condition of all feeder roads in Sierra Leone can be rated as "Poor" to "Very Poor". Most of the roads are not used by vehicular traffic at all; roads are impassable for at least one month in the rainy season because of soft depressions on road surface, washed out culverts or lack of adequate cross drainage.
4. The main mode of transportation for farmers to markets on all feeder roads is by motor bikes, which is very unsafe especially when loaded with goods and passengers; transport cost by these bikes are also expensive. Less than 20% of feeder roads are accessible by 4 – wheel drive vehicles with difficulty only in the dry season. Feeder roads are currently operating as "*Motor bike highways".*
5. The inaccessibility of the roads is the reason for the low level of vehicular traffic; paradoxically, this is has been the argument put forward by road authorities for not justifying the use of appropriate low cost sealing material on feeder roads instead of gravel.
6. Lack of sustainable rural/feeder roads for farmers to access markets is the main factor preventing the realization of the desired impact of government's commercialization policy of agriculture. It is consequently therefore a major element contributing to poverty in the rural areas.
7. There is an indirect negative impact on the environment caused by lack of sustainable access for farmers to markets; this is caused by uncontrolled cutting down of trees by farmers to produce wood, charcoal and bush sticks which they display along the roads near their farms, for sale to trucks that once in a while manage to get access to these villages; they do this in order to make money to take care of their families since they cannot transport their produce to markets.

B. Management and Maintenance

The policy of devolution of rehabilitated feeder roads to District Councils for routine maintenance is a good system which is adopted in nearly all Sub Saharan countries; however, the system is not working efficiently in Sierra Leone because of the following reasons:

- There is lack of adequate technical capacity at the District Council level to undertake condition survey, plan and budget properly for maintenance activities;
- Periodic maintenance/spot improvement which is a more equipment intensive process should be contracted to contractors with the required technical and financial capacity; it is not clear who is responsible for this – the SLRA or the District Councils. Consequently, meager funds provided for routine maintenance are sometimes used for activities which should actually be periodic maintenance activities; sometimes the funds are even used on new rehabilitation activities that the District Councils are interested in;
- There is lack of adequate monitoring and supervision of maintenance activities and use of funds both at the District/local level and by the SLRA/RMFA.

- Local Community participation in routine maintenance of feeder roads is minimal because all works are contracted out by the National Competitive Bidding (NCB) process and this limits the participation of local community because they cannot meet the technical requirements as well as the equipment and financial criteria to bid. There is therefore no local ownership to keep roads maintained and passable all year round.

Similar to many countries in Sub Saharan Africa, sustainability of feeder road maintenance is a challenge in Sierra Leone; many feeder roads are unpaved and need to be maintained frequently, but are often neglected under budget pressure and poor monitoring and supervision of maintenance activities.

Gravel surface for feeder roads in Sierra Leone is not a sustainable material to use; considering the heavy rainfall and whole life cost based on the maintenance requirements including the need for re – gravelling when the gravel surface washes off. Obtaining lateritic gravel with the required gradation and characteristics at close proximity can be very challenging in some areas of the country; gravel is not an easily renewable resource. Research and road tests in Ghana and U.S.A. have revealed that a low cost alternative seal such as Otta seal or Chip seal is more durable with lower whole life cost over the design life of feeder roads.

The measurement type of contracting for maintenance activities is not effective in Sierra Leone; Lessons learned on the use of OPRC for maintenance of feeder roads revealed that it is more sustainable.

Lessons learned from Rwanda and Zambia indicated that community participation for routine maintenance is very effective and cost less; about $675/km/year compared to Sierra Leone where routine maintenance costs vary from $1,000/km in the first year after rehabilitation to $2,000/km by the third year after rehabilitation. Periodic maintenance and spot improvement cost $,5000/km four years after rehabilitation.

C. Perception by Farmers and Road Users

The trend of the result of the perception survey indicates that the area of the land cultivated , the percentage of produce taken to markets for sale, the percentage of income from sales used on transportation of produce to markets are all influenced by the condition of the roads in terms of road width, surface condition, accessibility and safety.

It can be concluded that providing sustainable feeder roads to provide all - weather links to markets, will increase production from farmers, will attract more traffic on the roads, will reduce transportation costs, and consequently, alleviate poverty by reducing food insecurity for the whole of Sierra Leone. Fertile agricultural lands are left untouched because farmers do not have the enabling environment to increase production; the main element of this is sustainable feeder roads.

8. Recommendation

General

Currently there is no approved maintenance policy for feeder roads. In order to ensure value for money and all weather access on feeder roads, a sustainable Feeder Roads Maintenance Strategy and Implementation Framework that is practical, efficient and measurable is required. Such a framework should be focused on short, medium and long term solutions in three key areas:

- ➢ Building Capacity of the road maintainers;
- ➢ Improving the ability of government institutions and District Councils to plan, budget and implement, and monitor the required rehabilitation and maintenance;
- ➢ Source of funding – RMFA, Grants from donor partners, Local taxes collected by Districts as well as Private sector support (e.g. mining companies, as their Corporate Social Responsibility in their Districts of operation).

The following are more specific recommendations based on the study results and review of international and Sub Saharan experiences, noting the lessons and challenges faced and the successes achieved:

Management, Maintenance and Design of Feeder Roads

- In Sierra Leone, there is a Draft Pavement Design Manual for Gravel Road Pavement[7], under which feeder roads fall. A review of this manual is recommended to provide guidance for decision making on selecting the timing and conditions, for the use of appropriate alternative surface material for these gravel roads. World Bank studies and Research with Whole Life Costing Analysis have shown that under certain climatic, environmental, safety and durability considerations the benefits of sealing gravel roads with low cost sealing alternative such as a thin bitumen surface with chippings (chip seal) or Otta Seal, far outweigh the cost of gravel surface and the required maintenance and re – gravelling costs over the design life of the road [4] .
- The AfCAP project scoping studies done for Sierra Leone and Liberia in 2016 [3]has identified relevant projects on feeder roads; some of these projects which are already ongoing include:
    - ➢ Use of DCP Pavement Design Method and Developing DCP Manuals for Feeder Roads Design and Appropriate Specifications for Construction/Specifications.
    - ➢ Whole – Life Costing and Sustainability of Sealed versus Unsealed Roads, and Gravel versus Earth Roads.

These projects should provide relevant guidance for the design and construction of feeder roads in the near future, to ensure sustainability.

- For sustainability and economic development, the use of a low cost sealing such as Otta seal is recommended as an alternative road surface to gravel in the short to medium term.

  The Otta Seal can be constructed over an aggregate base course. The base and subbase courses must be designed to support the anticipated traffic loading. Subgrade and base materials should be compacted and graded to provide a stable working surface prior to placement of Otta seal. A prime coat is need above the aggregate base prior to Otta Seal application. The Otta seal is constructed of a graded aggregate on top of a thick application of emulsified (soft) asphalt. The rate of application of the asphalt binder will depend on the aggregate gradation and type. The same graded gravel used for gravel surfacing can be used for constructing the Otta seal. Trial sections are recommended to determine the appropriate materials and applications.
- To ensure good surface performance of gravel feeder roads, the following activities must be carried out:
  - Maintain the drainage system – this is the most important maintenance function and should be performed as a routine activity to minimize deterioration of the road surface/structure. The drainage system needs to be regularly cleaned of silt, material accumulations and debris.
  - Selecting quality material – this includes the appropriate material type and other characteristics such as grading. Some gravel material contains too much fines and clay, causing dust and slippery surface conditions.
  - Grading/Reshaping - routine and periodic grading should be performed to ensure adequate ride quality and safety.
  - Re - gravelling – this activity replenishes the lost gravel and restores both the service level and the load bearing capacity of the road. This is the principal periodic maintenance operation for gravel roads.
  - Controlling vegetation – this considers control of grass, shrubs, bushes and trees as routine maintenance.
- Management of feeder roads should continue to be devolved to local District Councils; however, local communities should be more involved in routine maintenance activities to ensure ownership, and structures must be put in place at the District level to ensure robust monitoring and supervision of these activities.
- Should gravel surface continued to be used for feeder roads, they should be designed and built/rehabilitated in accordance with an established and approved design standard (the SLRDM) in terms of design speed as well as horizontal and vertical alignment; this should include provision of definite side drains. Adequate transverse drains based on proper hydrological investigation of streams in order to determine correct sizing of culverts, should be provided.

- Develop and ensure the existence of yearly maintenance plans and dedicated budget at district level for submission to RMFA through SLRA.
- Include Rural Feeder roads maintenance in the Districts' yearly performance assessments.
- Address the issue of monitoring and evaluation, involving RMFA and the District Councils.
- Ensure that oversight is carried out by SLRA and MoWHI.
- What is currently being termed " Rehabilitation " contract for feeder roads should now be called a "Rehabilitation and Improvement" contract to emphasize the need for engineering design to ensure that the completed road meets minimum design standards before being handed over to District Councils.

Procurement Method, Funding and Monitoring

- To ensure effective maintenance of feeder roads to provide all weather access for farmers and local communities, the method of procuring works must be re - visited. The Zambian model is a good model to adapt to the circumstances in Sierra Leone as follows:

    i. All work on feeder roads must be split into three elements:
        - Initial Rehabilitation and Improvement works
        - Maintenance works
        - Emergency works

    ii. Initial Rehabilitation and improvement works should be contracted out to contractors with the necessary capacity for design and implementation of the works which would have been specified in detail by contracted consultants or the SLRA itself. Detailed condition surveys should be undertaken to ascertain the works required to be done to initially rehabilitate and improve the road to an approved standard. The contracting method will be the normal measurement *Bill of Quantities* priced contract with drawings and specifications (for durability and long term sustainability). It must be emphasized that the works involved in this part of the contract must be adequately defined before letting out.

    iii. Maintenance works should then be contracted out, preferably to the same contractors involved in the Initial rehabilitation/improvement works, so that responsibilities will not be separated; this contract will be based on a lump sum price per kilometer to be paid on a monthly basis according to the contractors' ability to meet specific performance criteria such as : ensuring road is always passable (road always open), comfortable riding surface (user comfort), average running speed to be attained in order to reduce travel time and vehicle operation costs. The use of this OPRC method of contracting as appropriate is hereby recommended.

    iv. Output – based maintenance contracts have several benefits over traditional input – based contracts. By paying contractors based on the level of service they deliver, output – based contracts provide a clear financial incentive for contractors to meet performance standards. Private contractors are also incentivized to improve their efficiency and minimize waste because they are paid at a set level for performance, not based on the value of the inputs used.

v. The contractors to be awarded these contracts must include in their Bid submission, local community engagement and training to undertake the routine maintenance activities.

The advantage of this recommendation is that the contractors will ensure that quality rehabilitation and improvement works are done in order to minimize their subsequent maintenance responsibilities; they stand to profit in the medium to long term because the routine maintenance activities can be subsequently carried out by the local community workers who would have been adequately trained; a win – win situation is guaranteed for all stakeholders and farmers will have all year round access to markets.

- From lessons learned from countries that have been using OPRC for feeder road maintenance, the following safeguards must be ensured in order to guarantee effectiveness:
  - Adequate structures must be put in place to monitor compliance with the set service criteria; the contractor can first perform self – monitoring and submit a report with each monthly invoice; then the SLRA or a consultant can verify the self – monitoring report through monthly inspections.
  - If the contractor fails to comply with any of the service criteria in any one month, its fees is reduced. If it fails repeatedly to comply, its contract can be terminated.
  - Private operators may need training and capacity building to bid for and implement output – based contracts especially because most will not be accustomed to the requirements of pre – financing outputs before being reimbursed. In order to mitigate this problem, it is recommended as stated above, to award this part of the contract to the same contractor involved in the initial rehabilitation and improvement works.
  - Clear vehicle weight regulations must be put in place, along with strong enforcement protocols to overcome the challenge of vehicle overloading (axle load control) which is a major cause of road pavement deterioration.
- To address issues of funding constraints, the Initial rehabilitation/improvement works which are to be contracted through the traditional method, should be funded by government and donor partners; funds from RMFA should be ring - fenced only for the routine maintenance activities; this will provide adequate funds for maintenance. Other funding sources such as from donor partners, private sector and local taxes collected by the Districts should be considered.

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ANNEXES

1. Feeder Roads Survey Questionnaire – SLRA Feeder Roads Department/District Council Engineers

Hello colleagues, I am currently conducting a study related to rehabilitation of feeder roads to facilitate better and more sustainable access to link farmers to markets and to reduce road user costs including vehicle operating costs. I would be very grateful if you could spare some time to answer the following questions:

1. Who is currently responsible for feeder roads management and maintenance in Sierra Leone?
2. How is funding obtained for feeder roads construction and maintenance?
3. What is current cost of construction of a typical gravel surface feeder road per Km?
4. What construction technology is commonly used for feeder roads construction? i) labour – based ii) Equipment based iii) a combination of both
5. Is there a maintenance policy for feeder roads? If so, what is the policy?
6. Are maintenance programs planned for feeder roads? If so, what are the plans based on?
7. Any yearly road condition survey done to plan and budget for maintenance programs?
8. How are maintenance activities implemented and which Agency is responsible for implementing maintenance activities?
9. What procurement method is used for contracting maintenance activities for feeder roads?
10. What is your opinion on use of Output and Performance - Based Road Contracts (OPRC) for feeder roads?
11. What is the current cost per km for routine maintenance of feeder roads? What constitute routine maintenance? How often by policy should this be done?
12. What is the current cost per km for periodic maintenance of feeder roads? What constitute periodic maintenance? How often should this be done by policy?
13. Is there a budget provided for maintenance of feeder roads by district? Who funds?
14. What is the role of District Councils in maintaining feeder roads?
15. What are the constraints from the perspective of district council engineers for the management of feeder roads maintenance at the district level?
16. What do you consider generally to be the key constraints for sustainable maintenance of feeder roads?
17. What are the coping mechanisms to overcome these constraints?

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2. Feeder Roads Survey Questionnaire – Farmers

Hello, we are currently conducting a study related to rehabilitation of feeder roads to facilitate better and more sustainable access to link farmers to markets and to reduce road user costs including vehicle operating costs. I would be grateful if you could spare some time to answer the following questions.

Name of Chiefdom/ District / Town/Village of the Farm……………………………………..

Type of Farming activity: Large Scale/ Smallholder………………………………….

Name of the feeder road used for access to nearest market/townlocation…………………………

Section A: Background Information

1. Name of the Head of Farm: …………………………………….
2. Address: …………………………………………
3. Phone Number: ……………………………………….
4. Sex of the Head of Farm: Male/Female

Section B: Travel Habits

5. Do you use this feeder roadto reach the nearest market/town to sell your produce?
   1) Yes
   2) No (if No, how do you sell your produce?...)
6. Do you use this feeder road to reach the nearest market /town to buy things?
   1) Yes
   2) No (If No, how do you buy things you need at the farm?...)
7. What mode of transport do you use to get to the market/ town?
   1) Walk
   2) Non-motorized
   3) Motor Bike
   4) Private Vehicle
   5) Bus
   6) Mini-van
   7) Any other, specify…….
8. What is the name of the town where the nearest market is……………………….
9. Average Distance Travelled each time to this market:
   1) Less than 1 mile
   2) 1 mile – 5 miles
   3) 5 miles – 10 miles
   4) 10 miles – 20 miles
   5) 20 mile – 30 miles
   6) Greater than 30 miles

10. How many trips made to market to buy things (i.e as a consumer):

    1) ……………a day
    2) …………….a week
    3) ……………..a month
    4) ………………a year

11. What products do you normally go to buy?..
12. How many trips made to market to sell things (i.e as a producer):

    1) ……………a day
    2) …………….a week
    3) ……………..a month
    4) ………………a year

13. What products do you normally go to sell?..
14. Average Travel-time taken per trip:

    1) Less than 30 min
    2) 30 min to 1 hour
    3) 1 – 2 hours
    4) 2 – 3 hours
    5) Greater than 3 hours

15. Travel-Cost per trip(if any):……………..

16. Howoften do you and other members of your family on the farm travelon this road togo to the market town to buy or sell goods**?** Number of household members' frequency of travel …….. Persons

No of trips --------Daily …….. Weekly ……..Monthly

Section C: Health Care

17. Do you use this Road to obtain medical care?

    1) Yes
    2) No

Howoften do you and other family members travelon this road to go **for medical help**? ..…Persons No of trips …. Daily …….. Weekly ……..Monthly………Yearly

18. How far do you travel for health care?

    1) Clinic (Miles)…………….
    2) Hospital (Miles)…………….

19. How long does it take to reach a maternal-child clinic (in time)?……………….

20. Howdoyou get to thehospital/clinic? [Predominant mode of transport]

    1) Walk
    2) Non-motorized

3) Motor Bike
4) Private Vehicle
5) Bus
6) Mini-van
7) Any other, specify…….

21. Howlong doesittake (hours/minutes)? …………

22. How much does a round-trip to the nearest hospital/clinic cost (SLL/trip)?…………..

Section D: Agriculture

23. Do you cultivatecrops?

1) Yes
2) No (if yes, go to next Section)

24. Types of crops cultivated (area in Ha. or Acres)
    1) Rice
    2) Cassava
    3) Coco
    4) Coffee
    5) Palm
    6) Pineapple
    7) Other (specify)
25. How much agriculturaloutput do you harvest (for each crop cultivated)?

1) Type of Crop: …………
2) Area size cultivated and harvested (ha/acres): …………
3) Quantity harvested (kg or bags, other): …………
4) % for sale in market (% and kg, other measure): …………
5) Unit sale price (SLL/kg): …………

26. Howmuch do you spend for all crops inSLL peryearon

1) Fertilizers:…………
2) Pesticides: …………
3) Seeds: …………
4) Transport: …………

27. Ofthefollowinganimals how manyofeachdo you rise up?

1) Poultry/Chicken: ……..
2) Sheep:………..
3) Goats:………..
4) Cows:…………
5) Donkeys:…………
6) Goats:…………
7) Any other specify…….

Section E: Access to Market

28. Do you orother members in yourhousehold produce othergoods orservices forsale?

    1) Yes
    2) No

29. Ifso, whatgoods orservices do you produce?

List: ____________________

____

30. Where do you or other household members sellyourgoods and services? ……. name of place ……. Miles from home

31. Do you sell

    1) To a middleman
    2) Directlyinthe market?

32. Do you usethis road to transportyourgoods forsale?

    1) Yes
    2) No

33. Howmuch (%) of thefinalsale valueis spentontransporting cost for your goods? ………..

34. Do you expect that the transport cost of goods will decrease after the road is improved?

    1) Yes
    2) No

Section F: Road Usage

35. Is there any time that this road is difficult to pass or not passable at all?

36. If "Yes" to question No.35, for how long in a year is this road difficult to pass?.............................

37. For how long in a year is this road not passable at all?..

38. Nowifwetalkaboutoverallsatisfaction,howsatisfiedareyouwiththis road section?

    (1)Highlysatisfied (2)Somewhatsatisfied (3)Neithersatisfiednordissatisfied
    (4)Somewhatdissatisfied (5)Highlydissatisfied

39. Whatdoyouthinkaboutthewidthofthisroad?Isitadequatefortrafficplyingontheroad?

    (1)Veryadequate (2)Adequate (3)NeitherAdequatenorinadequate
    (4)Inadequate (5)Veryinadequate

40. Whatdoyouthinkaboutqualityofroad-surface,smoothnessandsurfaceappearanceonthisroad?

    (1)Verygood (2) Good (3)Neithergoodnorpoor (4)Poor (5)Verypoor

41. Howsatisfiedareyouwiththedurability/maintenance doneonthe road?

(1)Highlysatisfied (2)Somewhatsatisfied
(3)Somewhatdissatisfied (4)Highlydissatisfied

42. Howsafedoyoufeelwhilecommutingonthisroad?

(1)Verysafe (2)Somewhatsafe (3)Neithersafenor unsafe
(4)Somewhatunsafe (5)Veryunsafe

43. ***(Ifresponsetoaboveis'4'or'5',*** ask)whydoyoufeelunsafeonthisroad? ***(RecordVerbatim)***

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POSTTHECODES: ***(Multipleresponsespossible)***
(1)Highspeedoftraffic (2)Highvolumeoftraffic (3)Heavyvehicles
(4)Poor/aggressivedriving (5)Badovertaking (6)Badroads/narrowroads
(7)Badweather–fog (8)Badweather-slipperyroadsinrainyseasons
(9)Sharpturns (10)Bad/ No road signs
(11)Others___

44. Pleasecouldyourankthefollowinginorderofimportancethatyouconsiderwhilecommutingonthis road? *Pleaserankthemfrom1 to 4, where1 beingthemostimportantreasonand2 beingthenextimportantreasonandsoon.*

	Factors	**Rank**
A	**Value for money** (Savings in fuel consumption, vehicleoperating cost Maintenancecost,tyres,etc)	
B	**Valuefortime**(Totaltimetakeninjourney,availingfacilities,etc)	
C	**Comfort&Convenience**(Conditionofroad,smooth riding surface etc)	
D	**Safetyontheroad**(Accidents, Safetyfromlandsliding,Poor road signsetc)	

Name of Interviewer:……………

Name of the Respondent:…………

Date:…………………