Rural Mobility and Socio-Economic Baseline Pilot Study in Liberia

Inception Report

The University of Birmingham

LIB2135A

July 2018

Cite as: Bopoto, C. and Burrow, M. (2018). Rural Mobility and Socio-Economic Baseline Pilot Study in Liberia, Inception Report, LIB2135A. London: ReCAP for DFID.

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Cover photo: DFIT / Name

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ReCAP Database Details: Rural Mobility and Socio-Economic Baseline Pilot Study in Liberia

Reference No:	LIB2135A	Location	Liberia
Source of Proposal	RECAP Website	Procurement Method	Competitive Tender
Theme	Research for Community Access	Sub-Theme	Monitoring and Evaluation of Socio-economic Impacts
Lead Implementation Organisation	University of Birmingham	Partner Organisation	None
Total Approved Budget	GBP155, 028 plus UK VAT	Total Used Budget	GBP 50,000
Start Date	01 June 2018	End Date	13 December 2018
Report Due Date	29 June 2018	Date Received	13 July 2018

Contents

Tables and Figures

Abstract

Safe, reliable and affordable rural access facilitates the movement of goods and services which affects the livelihoods of low income households, especially in developing economies such as Liberia. Evidence shows there is a strong correlation between poverty and connectivity. Currently, various donor funded rural access programmes and projects are being implemented in Liberia, whilst other such projects are in the pipeline.

There is a growing need to measure the impact of these rural access investments on livelihood opportunities and poverty reduction, and to measure the socio-economic benefits accruing to project beneficiaries.

To this end, the Liberian Ministry of Public Works (MPW) is to establish a Monitoring and Evaluation (M&E) system for assessing the socio-economic impacts of rural road improvement projects. The system is being established with the assistance of the Liberian Swedish Feeder Roads Project (LSFRP) funded by the Swedish Government and the ReCAP programme through a pilot study to be undertaken with the guidance of the University of Birmingham.

This Inception Report presents activities undertaken to date as part of the pilot study, and those still to be undertaken, by the University of Birmingham and outlines the study methodology and programme of activities. The report also indicates the planned outlay of resources to achieve the study objectives, confirms the project management structure as well as updates the current risk profile of the study.

Key words

Rural Access, Monitoring, Evaluation, Socio-economic, Livelihoods

Acknowledgements

The project team should wish to thank Mr Sumoiwuo Zizi Harris, Dr Paul Starkey and the Liberian Ministry of Public Works for their valuable assistance.

Acronyms, Units and Currencies

ADB	African Development Bank
ADF	African Development Fund
AFCAP	Africa Community Access Partnership
ASCAP	Asia Community Access Partnership
CBO	Community Based Organisation
CBA	Cost Benefit Analysis
CC	Climate Change
DFR	Department of Feeder Roads
EMA	Environmental Management Agency
EIA	Environmental Impact Assessment
HDM	Highway Design and Management, software
IT	Information Technology
FRAMP	Feeder Road Alternatives and Maintenance Program
IPSS	Infrastructure Planning and Support System
LIC	Low Income Countries
LIS-GIS	Liberia Institute of Statistics and Geo-Information Services
LRA	Liberia Revenue Authority
LSFRP	Liberian Swedish Feeder Roads Project
LVRR	Low Volume Rural Road
M&E	Monitoring and Evaluation
MPW	Ministry of Public Works
PMC	Project Management Committee
QA	Quality Assurance
RR	Rural Roads
SSA	Sub Saharan Africa
ToR	Terms of Reference
TRL	Transport Research Laboratory
TS	Transport Services
UoB	University of Birmingham
UKAID	United Kingdom Agency for International Development
USAID	United States Agency for International Development
WB	World Bank

1 Background

1.1 Background to Study

Safe, reliable and affordable rural access facilitates the movement of goods and services which affects the livelihoods of low income households, especially in developing economies such as Liberia. Evidence shows there is a strong correlation between poverty and connectivity. Road access in rural areas can improve social welfare by increasing the proximity and quality of basic services, and broadening livelihood opportunities.

In order to monitor and evaluate the impact of investments in rural access projects on livelihood opportunities and poverty reduction, and to measure the socio-economic benefits of improved accessibility on project beneficiaries, it is important to identify whether the project outcomes have been achieved through ex-ante and ex-post impact studies.

Currently, various donor funded rural access programmes and projects are being implemented in Liberia, whilst other such projects are in the pipeline. There is a growing need to measure the impact of these projects on rural livelihoods and economic growth.

The Liberian Ministry of Public Works (MPW) therefore sought to establish a Monitoring and Evaluation (M&E) Framework for assessing the socio-economic impacts of rural road improvement projects, using the Liberian Swedish Feeder Roads Project (LSFRP) funded by the Swedish Government as a case study. MPW obtained assistance from the ReCAP programme to undertake a pilot study on two roads. The University of Birmingham was awarded the contract to provide consultancy services towards establishment of an M&E Framework.

1.2 Purpose of this Report

The purpose of this report is to present activities undertaken to date, and those still to be undertaken, by the University of Birmingham, and outline the updated study methodology and programme of activities. The report also indicates the planned outlay of resources to achieve the study objectives, confirms the project management structure as well as updating the risk profile of the study.

1.3 Study Aim

As described in the study Terms of Reference (ToR), the aim of the project is to establish a systematic and functional monitoring and evaluation system for low volume feeder roads, including a robust data collection approach and an associated on-line database.

1.4 Study Objectives

Considering commonly accepted definitions of terminologies pertaining to monitoring and evaluation of projects, the objectives to meet the study aims are to:

- Define indicators of measurement and specifications that can be used to measure potential direct and indirect impacts of the rehabilitation of LVRs under LSFRP.
- Establish an appropriate study approach and procedure for socio-economic baseline data collection on LVRs in Liberia.
- Develop a database management system that can be used to compare and contrast ‘before’ and ‘after’ impact data for the LSFRP and other feeder road projects in Liberia.
- Populate the database using existing socio-economic data obtained from local communities impacted by two recent or ongoing projects.

- Build capacity and transfer knowledge to the MPW's Department of Feeder Roads (DFR) and M&E staff to carry out baseline, output, outcomes and impact surveys.
- Achieve uptake and embedment of the approach through conducting two country workshops to validate the proposed methodology for study and review the outcomes of the study.

1.5 Study Approach

There are several, albeit disjointed, efforts to monitor mainly the outputs of several of the current rural road rehabilitation projects in Liberia. Many of the projects are donor funded. At the same time, several studies have been undertaken on rural transport services in Sub-Saharan Africa. Of late, the studies have attempted to determine the relevance of socio-economic baseline studies in determining the impact of investment in rural road infrastructure. To that end, several indicators of the impact of such investments have been researched and documented.

The approach to be adopted in this study takes cognisance of existing studies and focuses on taking advantage of the existing body of knowledge to quickly deliver an M&E framework and online system that is appropriate, simple and practical. The aim is to develop a M&E system taking into account full consideration of stakeholder needs and expectations to ensure understanding, ownership and use of resultant M&E information.

2 Review of the Study Methodology

2.1 Overview

Our study methodology presented at bid stage remains largely unchanged, although there have been some necessary modifications. These are outlined in the following sub-sections.

2.2 Stage 1: M&E Design and Baseline Establishment

2.2.1 Project kick-off consultations

The study kick-off consultation meetings, as planned, were to identify and engage meaningfully with the key stakeholders for the study to be successful.

These stakeholders are:

Representative members from the various bureaus within Liberian Ministry of Public Works

Representatives of various rural road programmes taking place in Liberia including:

- Feeder Road Alternatives and Maintenance Program (FRAMP)
- Liberian Swedish Feeder Roads Project (LSFRP)
- Smallholder Agricultural Productivity Enhancement and Commercialisation Project (SAPEC)
- Fishtown to Harper ADB Funded Road Upgrading Project
- Team members associated with MPW institutional reforms: There are ongoing institutional reform studies being undertaken by MPW with the assistance of donor partners and it was therefore important to consider as stakeholders team members undertaking these studies.
- The Road Fund Manager: A Road Fund has just been established in Liberia and a Manager has been appointed. It is anticipated that the Road Fund will play a major role in assuring provision of funds for feeder road maintenance, hence the views of the Manager on monitoring the use of such funds will need to be considered.

2.2.2 Literature review

The literature review exercise commenced well before contract signing with the view to expediting the timely completion of the study. Results of the review are summarised in Section 4 following on and linked

to the relevant components of the study.

As part of the exercise, it had been anticipated that a comprehensive data gathering exercise from secondary sources would be available for obtaining the following existing information:

- Traffic data relevant to the potential roads to be studied.
- Population density and settlement data.
- Economic activity /agriculture production data.

The search for the above information has not yielded positive results to date. The team will continue to search for the same as well as other secondary data as this will help in the identification of data gaps and development of strategies and plans for collecting required data.

2.2.3 Review purpose and scope of the M&E under the project

The stated intention of the study is to set up a de facto M&E system for all projects delivering feeder roads improvement within the MPW. This implies a high-level M&E system that captures data from a diverse range of projects, some undertaken in-house and others through donor funded projects, or even by counties. At the same time, the study shall assist the LSFRP in defining a project level M&E system. We have taken cognisance of the two levels and will work towards achieving both taking into account the Project's contractual requirements. The study will work closely with the LSFRP M&E Expert in defining the project level system.

2.2.4 Review, design and refinement of indicators

The review and selection of indicators will from the onset recognise the different levels at which monitoring and evaluation will apply, these being: goals, outcomes, outputs and inputs. The study will undertake surveys and establish a database populated with data relating to improved livelihoods, employment creation, rural transport modes, road condition, road safety, works progress, gender mainstreaming, use of alternative materials and technologies, development of contractors and consultants and preservation of the environment, amongst others. Indicator tracking sheets will be developed to suit the MPW's requirements and a clear system of reviewing and updating the same shall be incorporated.

2.2.5 Develop project level monitoring and evaluation plan

Following completion of the review of the scope and objectives of the M&E exercise as well as the revision and refinement of indicators a project specific M&E plan will be defined that will be adopted by the LSFRP. The M&E plan shall be designed such that it can be adapted and used on future rural roads projects by the MPW or its cooperation partners.

2.2.6 Design and develop the MPW-DFR M&E framework

Following initial consultations with the MPW it was agreed that the system to be developed will be operated and maintained by the MPW's M&E Bureau and not the MPW's DFR as initially expected. We have established contact with the relevant staff within the division and agreed in principle on the best strategy for delivering an output that will be 'owned' by all potential users.

2.2.7 Design and commission M&E Database and Website

The relational database will enable easy extraction of information to measure the outcomes and impacts, analysing the impact of the projects on the socio-economic development of the project influence area. It will be built using a computational platform which is easy to maintain, use and is robust. To this end we will take note of the databases being built for the ReCAP Back Analysis (RAF2101A) and the Materials

(RAF2069A) projects so that if appropriate a similar architecture and platform can be utilised. Our systems developer has established early and intensive contact with specific MPW divisions that will be crucial in sustaining the system, i.e. the M&E Bureau, IT and Communications divisions.

2.2.8 Development of the Survey Plan

It is important that the baseline survey be carried out before the rains which are expected at the end of June. As the final selection of the LSFRP 2018/2019 roads to be rehabilitated had not yet been made the LSFRP project team guided that the baseline surveys be undertaken on two selected roads in Zwedru County in the south east region, one of which had already been pre-selected for upgrading from Phase 2 of the LSFRP (based on surveys in 2016).

The surveys will consist of technical, household, institutional and business surveys as informed by the literature review and from consultations with stakeholders. Technical surveys will include road user surveys and traffic counts (12-hour classified counts, inclusive of motorised and non-motorised traffic) to be undertaken at three representative locations on the roads over three days including a market day. It is anticipated that at least 150 households shall be interviewed on each road.

2.2.9 M&E methodology and system validation workshop

The method validation workshop will be held at MPW offices in Monrovia as this is seen as a convenient venue for all key stakeholders. A total of 50-100 participants had been anticipated, this has been revised to not more than 50 participants. The participants will be carefully selected to maximise participatory engagement.

2.3 Stage 2: Baseline Surveys and Data Analysis

2.3.1 Training of MPW-DFR staff

The M&E division has agreed to propose a list of employees to participate in the various stages of the study and to be trained in how to use the M&E framework to be developed. For the field work, half of the team members shall be drawn from MPW staff.

2.3.2 Baseline surveys

Our team of experts will assume overall responsibility for undertaking of all surveys. To assist our team of experts we shall engage and train teams of data collectors and interviewers. Three teams of two members each shall be trained to undertake traffic counts whilst two teams of three members shall focus on household surveys. The surveys of business activity will be undertaken by one team with two members. The teams shall be trained for two days in Monrovia and a further day in the field before commencement of the surveys.

Data shall be collected using mobile devices such as tablets, backed up by a paper-based system where necessary. The choice of suitable devices will be informed by a review of approaches of similar studies.

Data collation and analysis

All data collected shall be stored on a high-powered desk-top computer to be housed in the MPW M&E division's offices. The desk-top computer, along with a lap-top computer, data collection tablets, data storage external hard disk drives, battery packs and ancillaries shall be provided by the study team through the reimbursable £30,000 budget provided for by the project. Adequate back-up facilities shall be set up within MPW, LSFRP and an external service provider.

2.3.3 Data and Results Validation

A workshop for stakeholders will be held to present the M&E results from the selected two projects. The workshop will be structured to allow maximum participation by stakeholders, the result of which it is

anticipated will be improvements in the M&E process as well as ownership of the process by representatives of beneficiaries to the projects.

3 Study Activities to Date

3.1 Study Team Mobilisation

The University of Birmingham's study team remained as at bid stage. The team mobilised well before the commencement date indicated above and undertook some of the preliminary study activities. The effective mobilisation dates for the team members are as given in Table 1.

Table 1: Study Team Mobilisation Status

Name	Designation
Charles T. Bopoto	Team Leader
Alice Owiaba Addai-Yeboah	Sociologist
Maxwell S. Amuzu	Systems Analyst
Boakai Kollie	National/Local Researcher
Dr Michael Burrow	Project Director/QA
Dr Edward Fekpe	Mentor
Kingstone Gongera	Investment Appraisal Expert
Richard Shumbusho	Research Student

3.2 Consultative Meetings

Following mobilisation of the team, the Team Leader proceeded to Monrovia, Liberia and was in-country from 16-28 April 2018. During this period several consultation meetings were held with parties relevant to the study and their details are given in **Annex A**. Information gathered during the consultative meeting was used to undertake the situational analysis which is summarised in the following sections. A detailed situational analysis will be included in the Final Report.

Study Kick-off Meeting

The study kick-off meeting was held at MPW Offices in Liberia on 27 April 2018. The minutes of the meeting and a copy of the presentation given by the Team Leader are included in this report as Annex A. The objectives of the meeting were to obtain buy-in from stakeholders, discuss any specific concerns and expectations of the stakeholders, decide and agree with the client on selection criteria for road segments to be included in this study and present the technical approach to be adopted for the study. To a large extent the objectives had been achieved through consultative meetings that had been held with the participants prior to the meeting. Through discussion, the major issue that arose was that of sustainability of the system when donor support ends. The meeting agreed that it was important for MPW and the Road Fund to ensure funds are set aside to sustain the M&E system.

3.3 Situational Analysis

3.3.1 Approach

Following the consultative meetings and study kick-off meeting mentioned above a situational analysis was undertaken. The situational analysis examined MPW's organisational set up, donor and stakeholder profiles and the likely impact of ongoing reform activities.

The status of M&E activities within MPW and partner organisations was reviewed, including an evaluation of impact assessment methods used under the LSFRP Phases 1 and 2 and methods proposed for Phase 3. The analysis involved reviewing LSFRP Phase 1 and 2 documents including the Project Appraisal Report, Project Feasibility reports and Annual Reports. The Inception Report for LSFRP Phase 3 was also studied with attention to M&E aspects.

The following sub-sections provide summarised perspectives of the prevailing situation in the roads sector in Liberia, with focus on feeder roads and M&E activities.

3.3.2 MPW Organisational Structure

The MPW was established in 1972 following amalgamation of several government departments. The MPW's current organisational structure is given in Figure 1. The structure of the ministry is commonly encountered in post-colonial Africa except for the inclusion of the position of a politically appointed Assistant Minister to head the various divisions. The following is a commentary on some of the divisions or departments relevant to M&E.

Feeder Roads Division

The division reports to the Assistant Minister for Feeder Roads under the Rural Development arm.

Monitoring and Evaluation Bureau

The bureau is headed by a Director and is currently staffed with five personnel. The main activity of the division is monitoring of project outputs although the staff have been involved in collecting socio-economic data on some specific projects on behalf of other divisions. Some rudimentary guidelines for undertaking M&E are in use although the focus is mainly on performance monitoring of ongoing activities. The division suffers from a lack of equipment and software, amongst other things. At the time of consultation, it was found that the bureau had one working computer. The main outputs of the bureau are monthly progress reports and annual reports. The reports do not provide any detailed socio- economic issues.

Planning and Research

The department was established in 2016 and is staffed by only four personnel, namely: Director, Assistant Director, planning officer and research officer. None of the staff are engineers. The mandate of the division and reporting structure are not clearly defined. The division is not undertaking project planning or research. Any reports that the division prepares are submitted via the M&E division. Currently the division has no computer facilities.

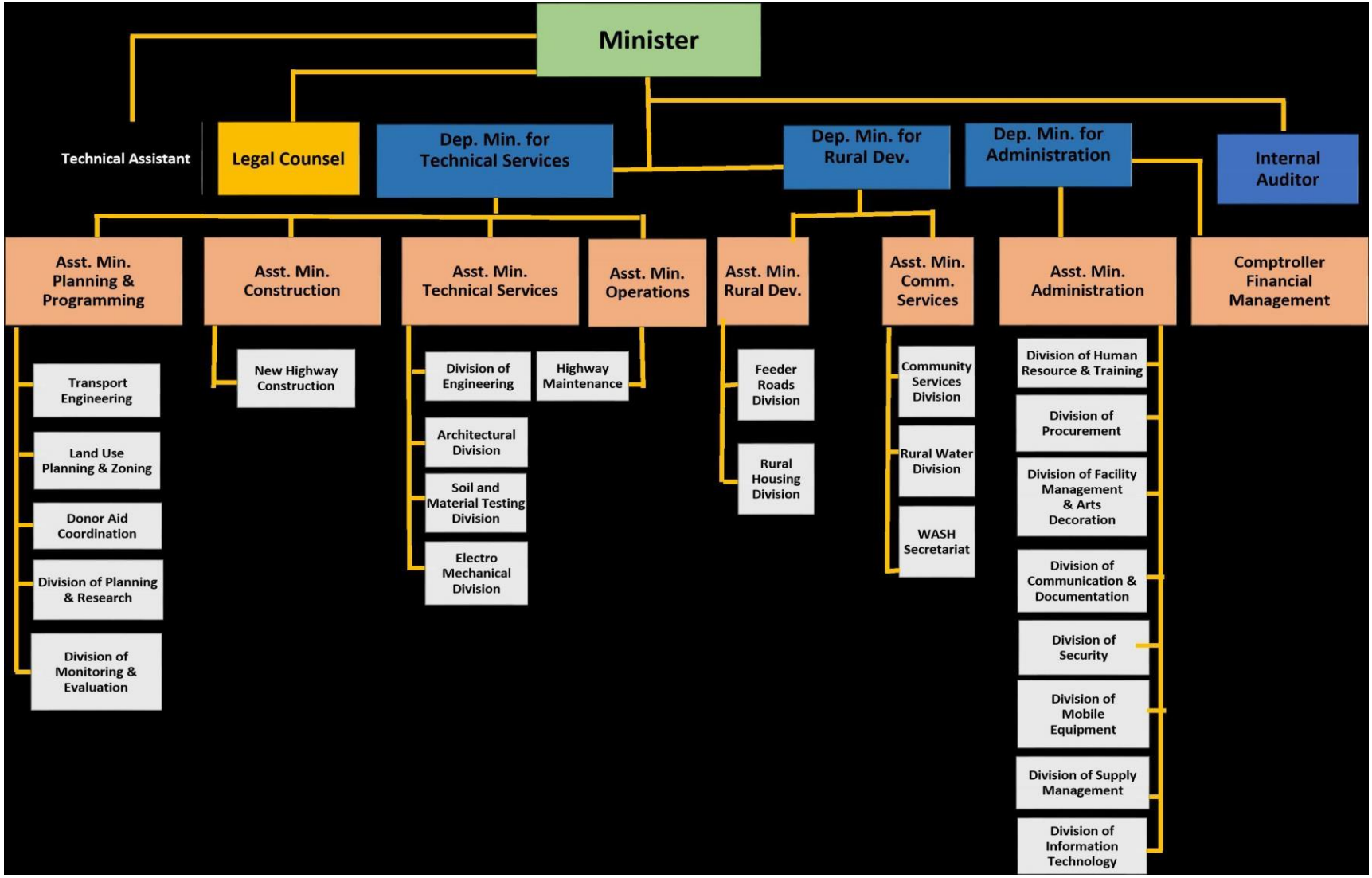

Figure 1: MPW Organisational Structure

Transport Engineering

The department is part of the Planning and Programming Division and has the mandate to undertake traffic surveys, manage traffic safety equipment, participate in feasibility studies and keep traffic statistics. Currently the department is mainly involved in the erection and maintenance of road signs and traffic signals. The staff is occasionally called upon by other departments or donor funded projects to assist with traffic surveys. Although mandated to carry out traffic surveys on the entire network, to date such surveys do not appear to have been undertaken.

M&E Donor Coordination Section

The section's primary role is to link with the different partners to MPW and act as the National Coordinator for all donor funded projects in the country. Three key personnel are employed in the section. The section convenes a meeting every last Thursday of the month wherein representatives of various donors and donor-funded projects present progress reports. The purpose of such meetings is to share experiences and avoid duplication of efforts. The section also holds "Town Hall" meetings in counties to interact with beneficiaries of the various donor funded initiatives and obtain feedback on the impact on livelihoods.

Information Technology Department

The department is responsible for providing and maintaining the information and technology equipment and software for the entire MPW. The department also scans and archives all official MPW documents. A total of nine personnel are employed. The department maintains the LAN and WAN networks driven by a 9Meg fibre connection provided by Leteko, a local ISP company. The network malfunctions regularly and assistance has been requested from donors to improve the system and introduce full sharing of facilities. The IT department manages the MPW website using in-house resources and the content is provided by the Communications Department. All MPW data is backed up to a cloud storage facility managed by Albright, a private company.

Human Resources

The department, which falls under the Administration Division, is headed by a Director, who is assisted by four Assistant Directors. A total of 16 staff are employed and the role of the department is to ensure staff are engaged in all approved positions, undertake skills assessment, coordinate training of staff and monitor performance. Currently the department is involved in the restructuring of the ministry and is giving particular attention to the merging of the PCU and the M&E Bureau.

3.3.3 MPW Feeder Roads Partners

Swedish Embassy

The Swedish Embassy oversees the implementation of the LSFRP and the desk officer for the project is actively involved in MPW coordination activities. The Embassy is keen to see the strengthening of MPW's M&E function, especially linking with other ministries and agencies responsible for the environment, health, education, gender and children. In addition, the Road Fund is seen as key to the sustainable maintenance of roads that have been rehabilitated to date and those that will be attended to under Phase 3 of the LSFRP.

Liberian Swedish Funded Feeder Roads Program (LSFRP)

The Government of Sweden, through the LSFRP, supported Liberia in the rehabilitation of selected feeder roads and capacity building, providing approximately US$35 million that was spent on roads in Lofa, Bong and Nimba counties. Three phases were defined. Phases 1 and 2 were completed in 2016. Phase 3 commenced in January 2018 with a four-year implementation period. The M&E aspects of the two phases are given in the sub-sections below.

USAID – Feeder Road Alternatives and Maintenance Program (**FRAMP)**

The USAID funded FRAMP program supports the Government of Liberia's Poverty Reduction Plan. The four year program is managed by Cardno and commenced in March 2016. The areas covered are: training and capacity building for the MPW Feeder Roads Unit, Regional Engineers, County Resident Engineers, District Maintenance Engineers; Local County Governments; Community Based Organisations (CBOs) and Local Engineering Firms; construction of 450 km of farm to market roads; periodic/recurrent maintenance on a total of 120 km of roads in four counties as well as routine maintenance on an accumulated total of 1,300 km-years of roads; construction of Alternative Low Volume Road Seals (ALVRS) on a total of 200,000 m^2 of roads in four counties. FRAMP has a well-defined M&E system that collects data for a total of 19 indicators and these are shown in **Annex B**.

Ministry of Agriculture Smallholder Agricultural Enhancement and Commercialisation Program (SAPEC)

The ADB/ADF funded SAPEC program is currently being implemented by the Ministry of Agriculture and involves rehabilitation of 270 km of feeder roads in six counties. The timeframe for the project is from 2013 to 2019. A consultant was engaged to supervise rehabilitation works which are being undertaken by contractors. The programme goal is to improve agricultural yields of disadvantaged farmers and aims to improve the livelihoods of women, children and people living with disabilities. The anticipated outcomes are reduced input costs for farmers, higher farm gate prices, travel time reduction and increased traffic volumes and modes on the roads serving the benefiting communities.

3.3.4 M&E Activities under LSFRP Phases 1 & 2

Under the completed phases of the LSFRP, the achievement of the project purpose was monitored through collection of data based on three indicators of livelihoods improvements, as a result of the rehabilitation works:

- Farm and non-farm incomes of beneficiaries,
- Access to health and other social services,
- Employment creation and employment of women.

There was no structured M&E plan, however, an interim impact study was carried out in 2013, two years after commencement of the programme. The impact study focused on assessing the farm and non-farm incomes of beneficiaries and access to health and other social services. Employment creation and employment of women was subsequently assessed in 2016, and the results included in the *Semi-Annual Report* for 2016. The results indicated that 20% of the road works budget was apportioned to community maintenance workers by the civil works contractors with 10% of the work days being allocated to women.

3.3.5 Planned M&E Activities for LSFRP Phase 3

It was acknowledged at completion stage that the previous phases of LSFRP lacked baseline data that would enable proper evaluation of socio-economic impacts of the rehabilitation interventions. The monitoring and evaluation had largely been focused on inputs and outputs.

The monitoring of outcomes and impacts was not timely or structured. In addition, it was observed that the participation of MPW's M&E Division was minimal. As reported by the implementation team, the next phase of LSFRP will aim to remedy this by developing a results-based monitoring system in close conjunction with MPW's M&E division and relevant stakeholders to ensure that a robust M&E system is

established, with SMART[1] indicators and appropriate baseline data that will provide the basis for measuring and accurately assessing the impact of project/programme interventions.

Example of possible indicators identified by the LSFRP team from the review of the literature (Section 4) include:

- Time, including walking and waiting, to travel from village to a large market on market day.
- Cost per passenger-km to travel to nearest large market on market day.
- Time, including walking/waiting, to travel from village to County City on a non-market day.
- Cost per passenger-km to travel to County City on non-market day.
- Freight cost per tonne/km for plantain/banana bunch to County City or large weekly market.
- Frequency of family members attending major markets.
- Frequency of family members using motorised transport per month.
- Traffic counts disaggregated by gender and by numbers/types of passenger, volume/types of loads and vehicle mode.
- Estimated annual passenger and freight volumes for different modes.
- Indicators relating to modal shift in transport types as the road and transport demand improves.
- Cost per tonne/km of transporting bag of cement from County Capital.
- Number of road-side enterprises.
- Stallholders at local markets.
- School attendance.
- Percentage of children with specified vaccines.
- Percentage of women attending perinatal clinics.
- Number of people working as motorcycle taxi drivers.
- Disaggregated local worker days for rehabilitation.
- Disaggregated local worker days for maintenance.
- Number of people working as motorcycle taxi drivers.
- Disaggregated local worker days for feeder road rehabilitation.
- Disaggregated local worker days for feeder road maintenance.
- Reported safety incidents (crashes) along road relative to traffic volumes.
- Reported transport-related security incidents (crimes) along road relative to traffic volumes.
- Reported emergency journeys to medical facilities (disaggregated by personal circumstances and transport type).

[1] SMART indicators for the purposes of this report are those which are Specific, Measureable, Attainable, Relevant and Time-based.

4 Literature Review

4.1 Systematic Review

A systematic review formed the basis of the literature review. Often used to inform policy and practice, a systematic review is a critical appraisal and synthesis of research findings carried out using explicit, systematic and transparent methods (Gough et al., 2013). This systematic review has been guided by the terms of reference and needs of the project, namely to address the following:

1. The relevance of socio-economic baseline studies for identifying the relationship between investments in low volume roads and poverty reduction in developing economies like Liberia.
2. To identify similar studies in Africa and elsewhere, for lessons on best practice that can be applied to shape the development of the database and improve the study outcomes.

The conceptual framework and questions posed in the review have informed all aspects of the review methodology, including the search strategy, the inclusion and exclusion criteria, data extraction and the approach to synthesis. The review has been conducted in two stages. The aim of the first stage was to provide a brief, descriptive overview of the type and scope of studies being conducted in this area. The aim of the second stage was to appraise and synthesise evidence on the relevance of socio-economic baseline studies for identifying the relationship between investments in low volume roads and poverty reduction in developing economies. Accordingly, the review was undertaken to answer the following research question:

"Based on baseline studies conducted in Africa or elsewhere, what are the methodologies and lessons on best practices that can be applied for impact evaluation of rural roads projects in Liberia?".

The following sections present a summary of the systematic review.

4.2 Study approaches

The impact evaluation techniques described in the literature can be divided into quantitative and qualitative approaches. The former usually form the major part of an evaluation study, and they are composed of Experimental (or Randomized Control Designs) and Non-experimental (or Quasi-Experimental Designs).

4.2.1 Quantitative approaches

Experimental design

Experimental designs, also known as randomization control designs, are usually deemed to be the most robust of all the evaluation methodologies. By randomly assigning the intervention among eligible recipients, the allocation process itself produces comparable treatment and control groups that are statistically equivalent to one another, in a case of appropriate sample sizes. This is a very reliable outcome; theoretically the control groups created through random assignment serve as a perfect counterfactual, free from selection bias issues that exist in other impact evaluation methodologies (Baker, 2000).

Quasi-Experimental Designs

Quasi-experimental (non-random) techniques can be used to conduct an impact evaluation when it is not feasible to construct treatment and control groups through experimental design (randomization). These methods produce control (comparison) groups that resemble the treatment group, at least in observed characteristics, through various impact evaluation methodologies such as reflexive comparisons, matching methods, double difference methods and regression methods (Baker, 2000).

Before and after or reflexive approach

The reflexive approach consists of carrying out a survey before and after the road investment project and the impact is determined as the difference between metrics common to both surveys. Since there are no controls and there is no way of knowing what happened to the local economy in general, say whether there were changes in agriculture due to variations in climatic conditions or crop diseases throughout the intervening period between the different surveys, this approach can be unreliable (Hine et al., 2015). Reflexive approaches can be considered as a special form of quasi-experimental design where a counterfactual is constructed based on the situation of programme participants before the intervention. This type of design is specifically useful in evaluating full-coverage interventions such as countrywide policies and other programs in which the totality of population participates and there is no possibility to construct controls (World Bank, 2016).

Cross-sectional (with and without) approach

The cross-section approach concerns determining the difference between the reported welfare level from a project implementation and the estimated welfare level in a non-intervention scenario (control). It is important to highlight that since one individual cannot be at the same time in both intervention and non-intervention scenarios.

Matching methods or constructed controls

Matching is a method of sampling from a large stock of potential controls to select the right control group in which the distribution of covariates is comparable to the one of the group subject to the intervention (i.e. treatment group) (Rosenbaum and Rubin, 1983). Typically, as far as the impact evaluation is concerned, an ideal comparison group (control group) with characteristics resembling the treatment group is chosen from data of a larger survey. The most commonly used type of matching is propensity score matching (developed by Rosenbaum and Rubin, 1983; 1985), in which the control group is matched to the treatment group based on a set of observed characteristics or by using the "propensity score" (predicted probability of selection on the basis of observed characteristics). Thus, the closer the propensity score, the better the match. Typically, a good control group is taken from the same economic setting and is given a similar questionnaire by similarly trained interviewers as the treatment group. The propensity score matching technique is well-liked by evaluators with time constraints and working without the availability of baseline data because of its flexibility to be used with a single cross-sectional dataset. It can be possible to limit bias through statistical methods such as matching and instrumental variables, but it can be problematic to fully remove them which remains a great challenge for researchers in the domain of impact analysis (Baker, 2000). As it is often pessimistic to carry out a meaningful impact evaluation without baseline data (Van de Walle and Cratty, 2002), it is a good idea to enhance reliability of the results by combining matching techniques and other methodologies that make use of baseline (pre-intervention) data. The most robust, reliable and rigorous design is to combine "with & without" and "before & after" scenarios; such evaluation is done where data are collected before and after project implementation both for the beneficiaries (treatment group) and for a comparison group (Blöndal, 2007).

Double Difference Approach

This approach combines the two methods presented earlier: with & without and before & after. This approach is perceived as reliable since it makes use of control data that allows the historic trends to be easily identified and excluded. The essence of this method is to compare a treatment and a control group (first difference) before and after a programme (second difference). However, identifying control groups can be challenging because of the likelihood of bias during the selection process. To mitigate this, some researchers choose to combine the double difference approach and propensity score matching. The latter helps in selecting households, roads or communities on a scientific basis that allows control observations to be more judiciously matched with intervention observations (Grootaert and Calvo, 2002; Hine,2014).

Regression

Supposing that outcome (O) is a function of the treatment (T), observed effects (S) and unobserved effects (U), a typical regression equation gives (Blöndal, 2007);

$$O_i = a + b_i T_i + c_i S_i + d_i U_i + \varepsilon_i \quad \text{(Eq. 1)}$$

Where a designates the constant and ε_i the error term. Considering the changes over time t, the difference gives:

$$(O_{i,t} - O_{i,0}) = a + b_i(T_{i,t} - T_{i,0}) + c_i(S_{i,t} - S_{i,0}) + d_i(U_{i,t} - U_{i,0}) + \varepsilon_i \quad \text{(Eq. 2)}$$

When unobserved variables do not change over time, $U_{i,t} = U_{i,0}$, thus $U_{i,t} - U_{i,0} = 0$. The effect of the treatment can be isolated, and thus it is equal to

$$(O_{i,t} - O_{i,0}) - c_i(S_{i,t} - S_{i,0}) - \varepsilon_i \quad \text{(Eq. 3)}$$

Interestingly Eq. 3 resembles the double difference equation (see Eq. 1). This shows that the double difference approach can be considered to be another form of regression equation under the assumption that the unobservable characteristics are time invariant. A variety of econometric regression equations are proposed in the literature to address differing needs and contexts. These include instrumental variables and fixed effects regression models.

4.2.2 Qualitative approaches

When used, these techniques provide critical insights into the beneficiaries' viewpoint, the value of an intervention to beneficiaries, processes that may have influenced outcomes and a deeper interpretation of the results obtained in quantitative analysis. The essence of such approaches is to help in understanding processes, behaviours, and circumstances as they are perceived by the individuals or groups being studied (Baker, 2000). Qualitative approaches are therefore considered useful in helping to address technical issues associated with sample size and data. Resources permitting, it is advisable to combine both quantitative and qualitative methods to construct a holistic assessment approach.

4.3 Documents Reviewed

The comprehensive literature search was undertaken using a number of key search terms (see Table 2) and search databases shown in Figure 2. In total, 294 research documents were identified and screened (See Figure 2) based on the inclusion and exclusion criteria presented in Section 4.3.1 and the weight of evidence presented in Section 4.3.2.

4.3.1 Key Search Terms

- Methods used to assess benefits of rural roads
- Socio economic benefits of rural roads
- Socio economic impacts of rural roads
- Rural roads benefits in Liberia
- Economic evaluation of rural roads transport project
- Socio economic impact assessment of rural roads
- Estimation of social benefits of rural roads
- Estimation of socio economic impact of rural road investments on socio-economic development
- Socio economic appraisal of rural roads projects for development

- Econometric analysis of rural roads projects
- Rural roads and poverty reduction
- Cost benefit analysis of rural roads
- Consumer surplus for rural roads benefits estimation
- Producer surplus for rural roads benefits estimation
- Multi-analysis socio economic benefits estimation of rural roads
- Ranking analysis of rural roads projects
- Valuation of travel time

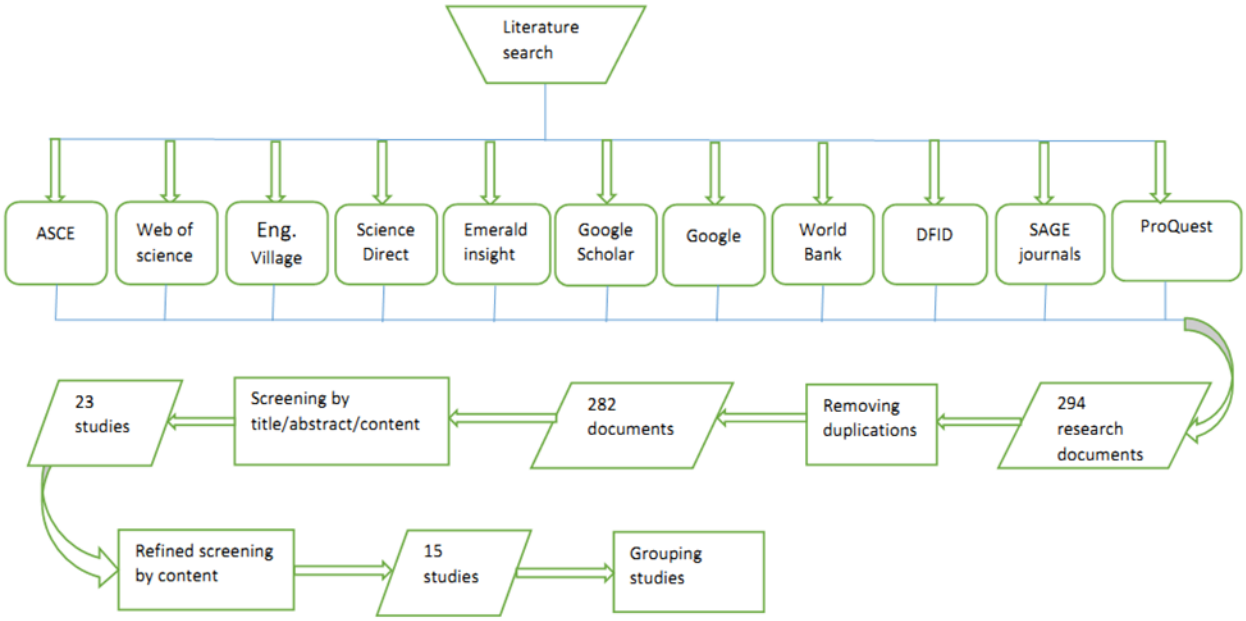

Figure 2: The Process of Identifying Relevant Studies

4.3.2 Screening

Since the Project calls for the study of impacts associated with improvement of existing rural roads rather than new ones, this research work focuses more on the impacts generated from rehabilitating/improving/upgrading existing rural roads.

The following inclusion and exclusion criteria were used:

Include:

- Empirical studies only
- Improvement of existing rural roads
- Socio-economic impacts evaluation studies

Exclude:

- Studies without baseline ex-ante data were not considered.
- Studies outside of developed countries
- Studies that deal with multi-sectoral development projects in rural areas where impacts attributed solely to rural roads project are not isolated from other rural development projects.

4.3.3 Weight of Evidence

A weight of evidence (WoE) framework was employed to assess the quality and relevance of the included studies in three categories, (i) soundness of the study, (ii) appropriateness of study design for answering the review question and, (iii) relevance of the study emphasis to the review (see Table 2). The studies considered were required to achieve at least a medium rating in each of the three categories.

4.3.4 Synthesis of information

The data were synthesized, using narrative methods to indicate the key impact evaluation indicators and the applicability of the methodologies used in their evaluation. The former include agriculture, gender, poverty reduction, household welfare, health and education, employment, markets, transport, and impact distribution. The methodologies used include reflexive approaches, double difference approaches and other regression models.

Table 2: Weight of Evidence (Adapted from Gough et al., 2013)

Weight of evidence	Rating
A. Soundness of studies	*High*: Clear and detailed methodology for data collection and analysis; explicit presentation of results and comprehensive interpretation based on findings; critical comparison with similar studies; availability of both baseline and control data. *Medium:* Satisfactory methodology and results; interpretation partially aligned with findings; availability of baseline data. Low: Both methodology and results are not satisfactory; no interpretation of findings or interpretation not supported by findings. Unavailability of baseline data.
B. Appropriateness of study design to the Review	*High:* Empirical evaluation study conducted after 8 years from road project completion; two follow-up surveys after project completion. *Medium:* Empirical study conducted after 3 to 5 years after road project completion. *Low:* Any theoretical impact evaluation study.
C. Relevance of the study emphasis to the Review	*High:* Improvement of low-volume rural road in low income country *Medium:* Improvement of any rural road in low middle income or upper middle income country *Low*: New rural road construction in any country

4.4 Overview of the type, scope and location of included studies

Fourteen high quality studies were identified through the evidence based rigorous literature search and screening processes presented in the previous section. The type of studies, in terms of the impact evaluation methods employed are summarised in **Error! Reference source not found.**. Two of the studies used a before and after approach, eight were econometric analyses, two adopted a double difference (DD) approach and ten combined the double difference approach with Propensity Score Matching (PSM).

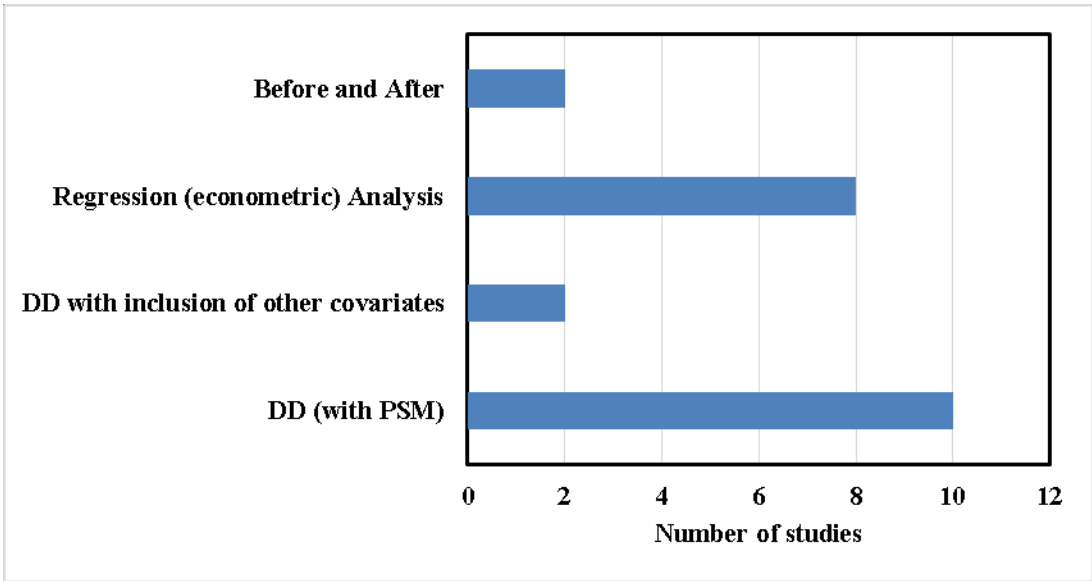

Figure 3: Impact Evaluation Approaches in Identified Studies

The impacts of rural roads on agriculture (n=9), education (n=11) and transport (n=10) were the most addressed in the studies considered (see Figure 4). The spatial distribution of the studies considered was found to be across the globe (Asia, Centre America, South America and Africa), and the countries with the biggest number of studies are Bangladesh (n=3) and Nicaragua (n=3) as shown in Figure 5. Three quality studies were identified in Sub-Saharan Africa (Ghana, Mozambique and Zambia). The level of a project's impacts is a function of the lapsed period of time after its completion. Accordingly, Figure 6 depicts the impact period of each study identified. All fourteen studies considered were financed by international organisations and most of the road projects were of a large scale (Figure 6). The World Bank funded seven of the studies considered, DANIDA three and amongst the others, one is an AFCAP funded project (in Mozambique) (Figure 7). Among others, the study by Limi et al., (2015) evaluated a large rural roads improvement project of approximately 4,400 km funded by the World Bank in Brazil, and the study conducted by Thompson and Pedro (2012) evaluated the impacts of 900 km of feeder roads funded by AFCAP in Mozambique.

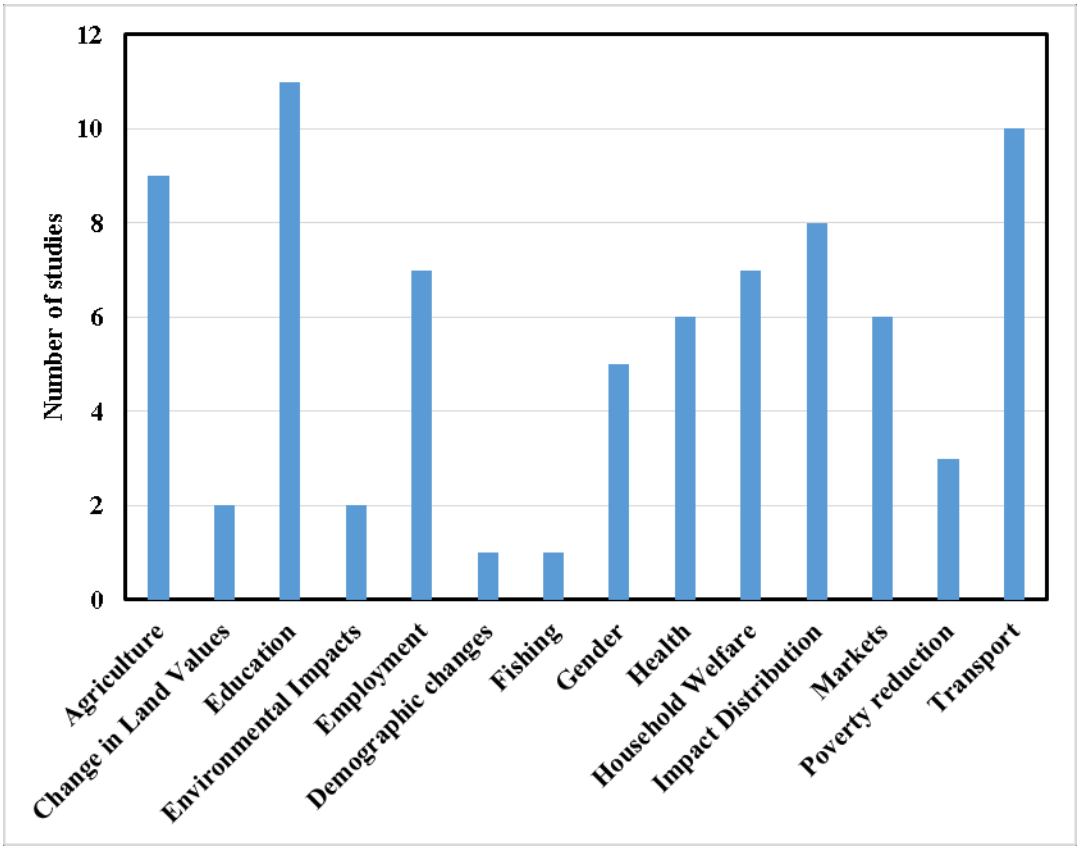

Figure 4: Socio-Economic Indicators Evaluated in Reviewed Studies

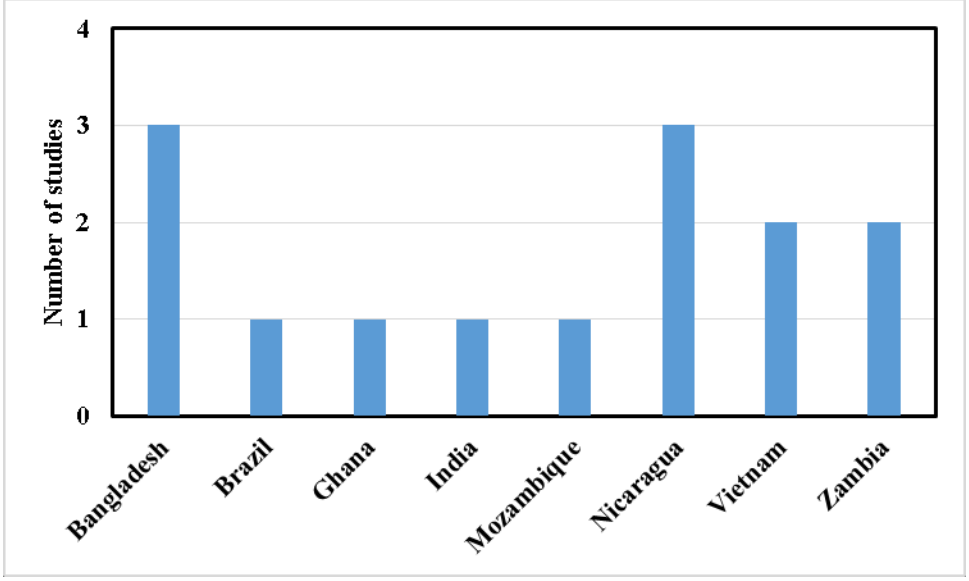

Figure 5: The Spatial Distribution of Reviewed Studies

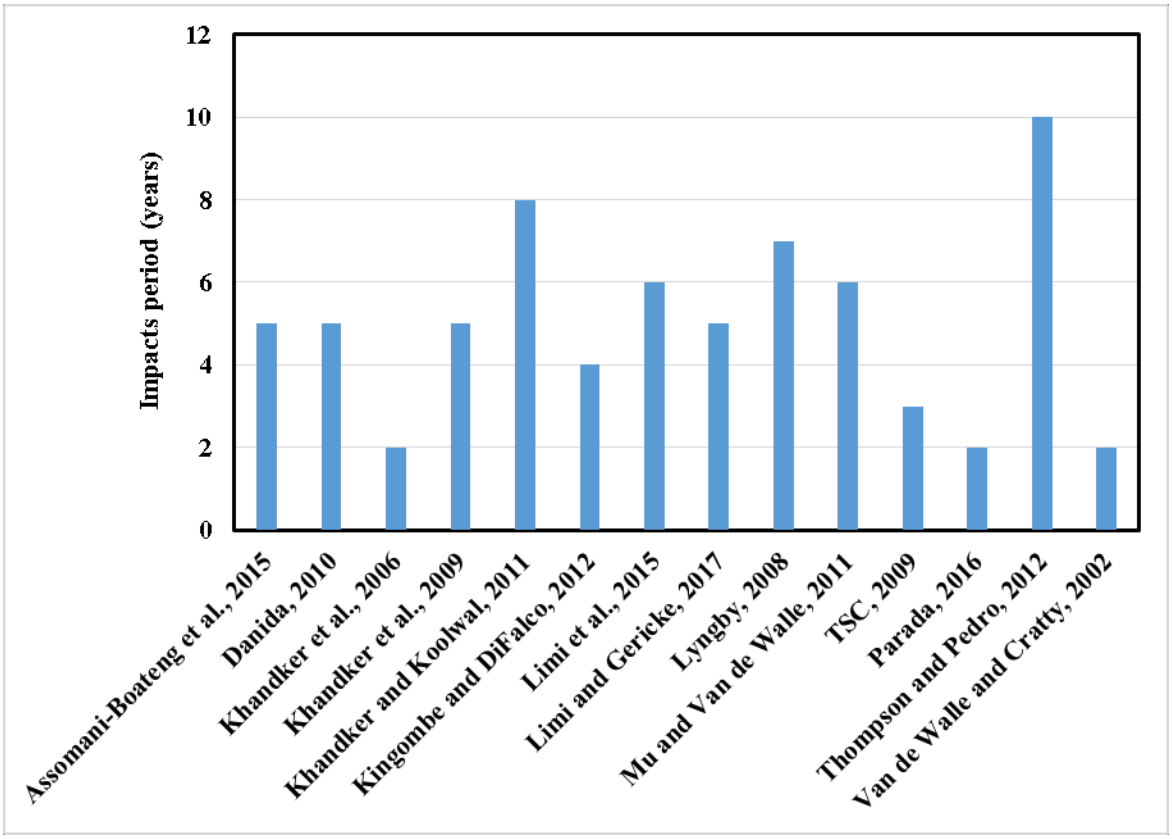

Figure 6: Period of Analyses

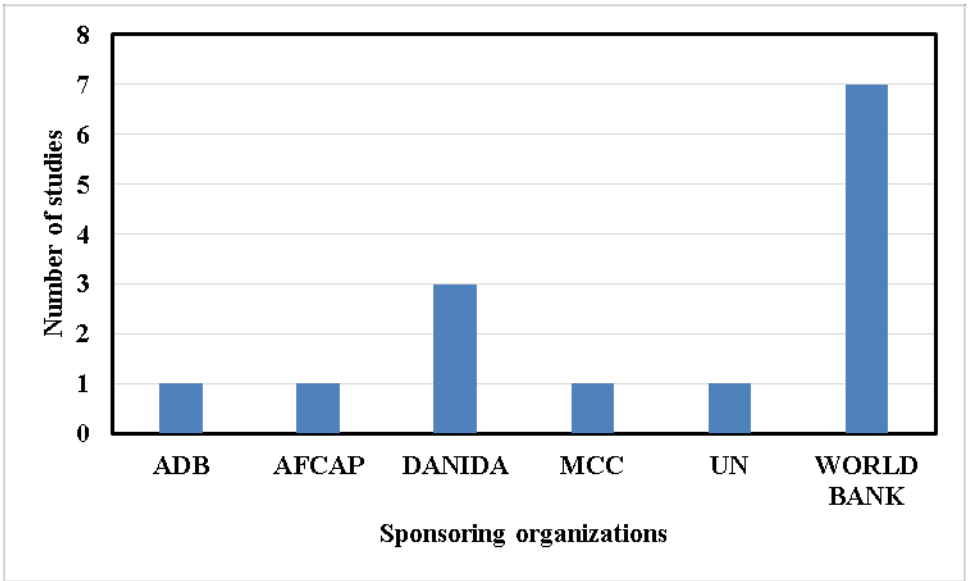

Figure 7: Organizations Financing Rural Roads Projects

4.5 Methodological Approaches of the Included Studies

4.5.1 Rationale of impact estimation methodology

The selection of appropriate methodologies ensures that the evaluation is as accurate as possible. Some methodologies can be very simple to carry out but their results can be less reliable. Some of the fast but unreliable methodologies include reflexive techniques (before and after) and cross-sectional (with and without) approaches. However, due to a number of reasons such as budget and time constraints, lack of skills, and the rationale of the study, such methods can be adopted with care taking into account their shortcomings.

There are instances when a rigorous study is needed. For a study to be rigorous time, skills and resources are needed from planning to the final stage of report writing. In general a rigorous study should have (1) proper baseline and follow-up data taken at pre-defined intervals designed to allow for the targeted impacts to emerge (for instance direct impacts such as reduction in travel time and cost may appear immediately after project implementation, whereas long-term effects such as household income and expenditure may take longer to accrue); (2) the type and size of the selected samples should be representative of the entire population, and the data collection exercise should be designed in a way that ensures data reliability; (3) the study should have appropriate controls i.e. the socio-economic characteristics of the control groups should resemble the ones of the treatment groups. The last requirement is perhaps the most challenging and generally having addressed the first two requirements, the degree of the study rigorousness can be judged on the level of similarity (comparability) between control groups and treatment groups. In other words, the last requirement implies that the most rigorous study should address the counterfactual scenario with the highest level of accurateness. Practically, the counterfactual scenario cannot be observed (unless there is no intervention and without intervention, there would not be any need of impact evaluation), and that is why there are several impact evaluation models that try to reflect imaginary counterfactual scenarios using available field realities. Econometrics are often used to address these issues. Arguably the most challenging part of an impact evaluation would be the attribution of impacts to the intervention (since many other factors can influence the outcomes). In an ideal case where the control fully resembles the treatment group, such other possible factors would also be present in a control group, and thus be isolated during impact evaluation provided there is no exogenous effect (i.e. spill-over effect) that arises over time.

Considering the above-mentioned requirements, it is evident that a method that combines before/after and with/without scenarios is most reliable. Such a method calls for the conventional double difference estimation approach. However, the study's rigorousness will vary depending on its ability to reflect the counterfactual scenario with a minimum level of bias. This is why the double difference method is often combined with the propensity score matching technique to ensure the similarity (comparability) of control and treatment groups. The use of regression models making use of treatment and control data to allow for before and after differences so that the impacts which emerge over a given period of time can also be considered. The standard double difference approach can also be considered as a regression model but with limited complexity i.e. it has an inability to control for time-varying unobserved heterogeneity between control and treatment groups.

As long as the evaluation approach addresses both before/after and with/without scenarios properly, it can be a reliable approach. However, this is not sufficient; given the nature of the impact evaluation, hence the choice of the estimation approach also needs careful consideration.

According to Limi et al (2015), the logic behind the use of different methods is that the impact evaluation is often sensitive to the estimation techniques used, and different identification assumptions are required for different approaches. Furthermore, each approach has advantages and disadvantages. For example, some methods such as double difference and matching are comparatively simple to perform, while others such as instrumental variables necessitate a careful construction of the empirical model. Given

the need for the reliability of results, it is often good practice to compare and contrast different regression models to verify the statistical robustness of the estimated results.

4.5.2 Sampling

Most of the included studies used a surveying methodology that allows for the collection of data at both household and community level, and thus enabling impact evaluation at both levels. In the Viet Nam study (Van de Walle and Cratty, 2002), the double matching methodology is essential. Even though the project and non-project communities may be well matched using PSM, the households which are included in those communities are not necessarily comparable.

Thus, a second matching of households may be required. In case of experimental design (randomization), the selected household samples would be deemed to be statistically equivalent given appropriate sample size. However, no randomization approach was used in any of the 14 studies under consideration. Therefore, a number of factors were used to select samples from a control group to ensure similar socio-economic characteristics. For example, taking the case study of Nicaragua (Danida, 2010), the control households were matched with treatment households based on a number of parameters. These include crowding (area of house with respect to the number of household members), quality of housing (level of quality of construction materials of the house), level of basic services (adequacy of water supply and sewerage disposal), education (schooling of children in the household), and economic dependency (education level of the household head and employment of household members). The households matching criteria may differ to some extent among studies but a considerable number of key parameters may remain the same. For instance, this can be clarified as in Zambia (Iimi and Gericke, 2017) where the matching criteria included household size, male household head, household head age, household head educational attainment, area of concrete floor of the house, borehole use as a main source of water supply, tap water as a main source of water supply, toilet type (pit latrine, ventilated, or flush), electricity or gas use as a main source of lighting a household, and household assets (mobile phone, solar panels, bicycle, motorcycle and vehicle). Though the Zambia case study (Iimi and Gericke, 2017) presents a relatively more inclusive matching criteria compared to the one of Nicaragua (Danida, 2010), both of them complete each other and they can be combined for better results.

As already highlighted, one of the key requirements of carrying out a rigorous impact evaluation is to select samples that are representative of the entire population. Given the population size (which can be very big), budget and time limitations, and sample selection bias concerns it can be challenging to select a sample that is representative of the entire population. In order to mitigate these problems, stratified sampling can be used. This refers to the sampling procedure where the researcher splits the entire population into various subgroups and randomly samples each of them independently. The studies in Viet Nam (Van de Walle, 2009; Van de Walle and Cratty, 2002), Bangladesh (Khandker et al., 2009) and Ghana (Asomani-Boateng et al., 2015) have employed this approach. Referring to the Viet Nam case, the stratified sampling was used in a number of ways. First, the study provinces were randomly selected to be representative of Viet Nam's geographical regions (North, Centre and South); out of 18 Viet Nam's provinces, only six were randomly selected where North, Centre and South has two provinces each. Secondly, the stratified sampling was used at household level. Given the fact that the pre-defined household sample size was too small (only 15 out of 1300 households), there were concerns that a random sampling wouldn't be representative of the main socio-economic groups in the commune. Therefore, a system of stratified sampling was used whereby five households were selected from each of three administrative lists, containing the poorest, middle and richest of all households in the commune. Though these rankings presented a certain level of subjectivity, such a stratified sampling provided at least samples that were fairly representative of the socio- economic groups of each commune studied. In the case of a robustness check, both random and stratified sampling can be conducted at the same time. Such an exercise would provide insight into the probability of the error between the two sampling methods.

Maintaining the same survey samples over time helps in constructing panel (longitudinal) data. Establishing panel data can be extremely important in impact evaluation especially in measuring long-term impacts. The studies associated with Viet Nam (Mu and Van de Walle, 2011), Bangladesh (Khandker and Koolwal, 2011) and Nicaragua (Kongens, 2008) provide good examples. One of the disadvantages of panel data is that some samples may drop out over time and a careful consideration is necessary in order to replace them (Kongens, 2008). Another lesson learnt from the Nicaragua study (Kongens, 2008) is that panel data is to design the survey questions carefully and keep them unchanged over time. This avoids reinterpreting data due to changes in survey questions over time.

4.5.3 Exploiting existing data sources

Exploiting existing sources of data held by the Ministry can be helpful during impact evaluation. A number of studies have used data from external sources in assessing the impacts of rural road projects. The Viet Nam studies (Mu and Van de Walle, 2011; Van de Walle and Cratty, 2002) used data sets that were specifically created for evaluating the impact on living standards of the rural roads rehabilitated under The Viet Nam Rural Transport Project I (RTPI). In order to incorporate the study area within the national framework analysis, the study also made use of the Viet Nam Living Standards Measurement Survey (VNLSS) and the Survey of Impacts of Rural Roads in Viet Nam (SIRRV). Using both data from the and data from the national survey (VNLSS) helped to rank the socio-economic characteristics of the project area in comparison with the national socio-economic standing. It was found that the incidence of poverty in SIRRV population is higher at 48% in comparison with 40% for the total rural population in Viet Nam and 33% for the total population as a whole. This suggests that the project was pro-poor i.e. it targeted poorer populations of the country.

The Zambia case study (Kingombe and Di Falco, 2012) assessed the dynamic impacts of rural road improvements on cotton productivity in the Eastern Province of the country. It used both national postharvest surveys (taking place annually) and agricultural census (taking place once in 10 years). This study shows the country's good practice of keeping records of agricultural produce (through postharvest surveys), which can be later used for different purposes including impact evaluation of rural projects.

The Nicaragua case study (Danida, 2010) evaluated the impacts of rural transport infrastructure. The study used baseline data collected throughout the National Household Living Standards Survey in 2001 and 2005 and the National Census of 2005, covering almost 800 households divided between treatment and control communities. The lesson from this study would be the appreciation of retrospective consideration of existing data to establish the baseline of an already running project.

Though using data from other sources can be helpful in carrying out an impact evaluation, relying solely on external sources without conducting a survey specific to the project in question can cause data validity issues. Another case study of Nicaragua (Kongens, 2008) relied exclusively on panel household survey data. These data are considered to be of high quality and reliability. However, restricting the number of variables to those available in the National Households Living Standards Survey (EMNV) has validity concerns. For example, the impact analysis of road projects may require data such as rural road networks, road condition, road directions to key places (such as markets, services and schools), accessibility type (all-weather or seasonal roads), etc. which are not necessarily covered by EMNV, and the analysis either employs proxy indicators or simply makes assumptions. If there had been another survey that took into account such other factors (specific to roads), its combination with EMNV would have allowed a more comprehensive analysis (as was the case for Viet Nam where project data was combined with national survey data).

4.5.4 Qualitative approaches

A qualitative analysis is an essential methodology that helps to interact with programme beneficiaries to have critical insight on their perception of the project, various processes that may have influenced the results, and a deeper interpretation of the results obtained in quantitative analysis (Baker, 2000). As mentioned previously, qualitative methodologies can also help to address sampling and data collection issues. A number of studies employed this methodology in their impact evaluation exercise.

Due to sample size issues, in the Nicaragua study by Danida (2010) the resurvey and double difference analysis could not be conducted with reasonable confidence in some areas. Qualitative evaluation methods were employed in the analysis to address these issues. To this end a Participatory Qualitative Evaluation of Impacts at Community Level was carried out which relied on community members to identify, discuss, map and clarify the effects and impacts of the programme using a set of participatory evaluation methodologies. In both treatment and control communities, community members identified economic and social developments comprising access to transport and traffic volumes; production, employment and economic development; access to education and health facilities; basic services such as water and electricity; and environmental changes.

In the Mozambique case study (Thompson and Pedro, 2012), qualitative methods prioritising participative group discussions were adopted to capture the most important points in the shortest time. In all study communities qualitative tools were utilised to characterise the community and as a means of taking into account the opinions of households in general and women in particular. Along each of the roads studied, there were group discussions with heads of households, leaders, women and community leaders. The study utilised field observation during the course of the work, and this formed an important basis for comparative assessment of situations found on each one of the roads.

In the Ghana study (Asomani-Boateng et al., 2015) both quantitative and qualitative approaches were combined. This ensured that generalisation of the data would be based on a sound and reliable means of analysing data from the field. The use of qualitative approaches was proven to be relevant in many ways. For instance based on the case study of Nicaragua (Danida, 2010), the quantitative approach did not provide any specific effect of the road project to women as far as participation in income generating activities is concerned. However, the use of qualitative techniques has provided interesting findings; in four out of seven project communities.

4.5.5 Impact estimation techniques

As discussed previously, randomisation has a greater statistical significance and thus provides more reliable results compared to other impact evaluation methodologies. However, due to a number of concerns, a randomisation approach remains more theoretical than practical. For example in this research, among the 14 studies considered, no study was identified where an intervention was randomly assigned without any possible external factors governing the selection of project area (endogeneity).

Among the studies considered, of the ones in Ghana (Asomani-Boateng et al., 2015) and the one of Mozambique (Thompson and Pedro, 2012) would be considered to be the least rigorous. These have employed a before/after impact evaluation approach. Interestingly, these two studies have both used a qualitative approach in their analysis. Given the weakness of before/after methodology, especially in controlling for the historical trend of observable characteristics, it is likely that these studies used qualitative analysis to help in reducing methodology limitation caused by absence of controls. Nevertheless, the Mozambique study had control areas but because of the fact that they were actually within areas influenced by other road projects (contamination), it was not feasible to identify aspects that could be used for comparison. The Viet Nam study (Van de Walle and Cratty, 2002) used double difference analysis with propensity score matching. The study assumed that unobserved characteristics are time invariant. A standard double difference approach gives unbiased results under the assumption that the unobserved heterogeneity is time invariant (see Section 3.1.2.4). If there are time- varying factors that have an

influence on programme placement, the programme is correlated with an error term in the differenced equation. Though this study did not take into account time-varying unobserved heterogeneity, the follow-up study by Mu and Van de Walle (2011) did. They adopted a more rigorous methodology that allows for the possibility of time variant selection bias and used the predicted probability of participation in the intervention programme (propensity score) to match control communes in the double difference estimate. The propensity score was estimated using a logit that comprises initial conditions that may affect outcome variables. Such a methodology has also been used in the Nicaragua study (Danida, 2010). Mu and Van de Walle (2011) used different approaches to check the robustness of empirical results: double difference estimates of the mean impacts using the PS-based kernel matching, PS-weighted double difference and conventional double difference estimates.

The Bangladesh studies (Khandker et al. 2006) used a regression model which assumes unobserved heterogeneity to be time invariant (as it was the case for Viet Nam case study). The regression model has a structure that allows application of a double difference approach in the way that it considers both before/after scenarios for treatment and non-treatment areas. The follow-up study that took place three years later (Khandker et al. 2009), and it has adopted a much more rigorous methodology in controlling for unobserved heterogeneity. In addition to controlling for unobserved characteristics of households (and thus villages), the study also controls for potential observed factors affecting changes in household outcomes over time (comprising district-level rainfall and a number of other time-varying village characteristics). Time-varying community-level characteristics that the study has controlled for include village electrification, number of grocery and fertilizer shops, irrigated land, rainfall, and distance to facilities such as the nearest village market. For robustness, the estimation of the results of road impact were verified using both a fixed-effects and OLS-difference models. Eight years after the baseline (three years after the first follow-up study), a second follow-up study took place (Khandker and Koolwal, 2011). The availability of the data from a third survey round allowed the use of a dynamic panel estimation approach which employs the lagged variables.

The Brazil study (Iimi et al., 2015) used two estimation approaches: simple double difference matching and double difference regression. To verify the statistical robustness of the estimated results, the instrumental variable estimation was also partly employed. The Zambia study (Iimi and Gericke, 2017) also employed an estimation based on the double difference analysis with inclusion of other covariates to allow for various time-varying household characteristics.

The study of Nicaragua by Kongens (2008) used a pooled linear regression model and a fixed effects model. The pooled regression analysis allows control for both “within each household” and “between households” variation but only allows for controlling for factors to the extent that they are included in the data set. On the other hand, the fixed effects model allows for controlling for all time-invariant effects. The disadvantage of these two models is the failure to control for the unobserved heterogeneity which varies over time. As a lesson from this study, the combination of regression models can help in studying more complex scenarios including a wide range of unobserved bias. Other than robustness checking, regression models can also be combined whereby the strength of a model backs the weakness of another one.

As a key note, controlling for unobserved heterogeneity marks the limitation of double difference analysis and some other (but not all) regression models. Some studies simply make assumption that the unobserved heterogeneity is time-invariant or just admit the limitation (Khandker et al. 2006; Kongens, 2008; Van de Walle and Cratty, 2002). The need to control for time invariant unobserved heterogeneity raises the need to use more rigorous methodologies. Some studies may use regression equations with covariates included (Iimi and Gericke, 2017; Iimi et al., 2015). Other studies may use double difference methodology with matching techniques that allow for consideration of initial conditions that may affect the subsequent outcomes (Danida, 2010; Mu and Van de Walle, 2011) or dynamic panel estimation when there is availability of panel data (Khandker and Koolwal, 2011).

4.6 Approaches to Measuring Key Indicators

The systematic review synthesised findings by fourteen key indicators of road investment benefit (see Figure 4). Those of most relevance to this study i.e. agriculture, gender, poverty reduction, household welfare, health, education, employment, accessibility and market development, are discussed next.

4.6.1 Agriculture

It is widely accepted that rural road improvement has wider impacts on the local agrarian economy. The rural road impacts on agriculture include increase in farm-gate prices, reduction in agricultural input prices and increase in agricultural productivity, access to markets and reduction in perishability risk of agricultural produce, increase in value of agricultural land, shift from low-value subsistence agriculture to high value market-oriented agriculture, use of agricultural extension services, etc. A number of previous studies have endeavoured to evaluate the impacts of rural road improvements on agriculture by measuring the changes in any or several of the aforementioned.

Given the fact that households can benefit in terms of agricultural gains through higher prices of agricultural production, lower fertilizer prices, higher agricultural wages, and higher value of agricultural production, the outcomes of study on agriculture used in the Bangladesh study (Khandker et al., 2009) include changes in fertilizer price, male agricultural wage, agricultural output and price indices and transportation costs of agricultural produce. The agricultural commodities used in the analysis were potato, wheat, and high-yielding variety (HYV) Boro paddy, HYV Aman, and local HYV Aus. This shows that evaluation of road projects on agriculture should be carried out in a holistic way that considers not only the amount of agricultural production but also other integrated aspects such as change in fertilizer price, agricultural wages and transportation costs of agricultural produce in order to capture the maximum (if not all) impacts on the whole agriculture sector.

The Nicaragua study (Kongens, 2008) used regression models to estimate the impact of rural project on agriculture. The impact on agriculture was estimated through consideration of change in agricultural input and output prices, effect of agricultural extension effects on the outcomes, poor access in rainy season and consideration of agricultural effects distinctly on poor and better-off farmers (impact distribution among poor and better-off farmers). Additionally, the study has used a number of agricultural proxies in the regression models. These include:

- Proxy of technical assistance. Equal to one if the household has been offered agricultural technical assistance during the past 12 months
- Proxy of agricultural input: Equal to one if the household has purchased agricultural inputs (pesticides, seed, fertilizer, etc.) over the past 12 months
- Proxy of agricultural sale: A proxy for the value of the farms produce, measured as the total sale of cultivation adjusted to the regional price. The logarithmic transformation has been applied to lessen the sensitivity to outliers
- Proxy of agricultural problems: Equal to one if the household reports to have faced exogenous agricultural problems such as flooding, drought and pests, etc.

Using a double-difference approach, the Danida Nicaragua study (Danida, 2010) estimated the impacts of rural transport infrastructure through consideration of change of employment opportunities in the agricultural sector, the change in value of agricultural land, changes in price of agricultural inputs and outputs, and changes in crops produced and how they are marketed (subsistence grains and other agricultural products grown for market sale).

Iimi and Gericke (2017) evaluated the impacts of Output and Performance Based Road Contracts (OPRC) on agricultural production in Zambia. The estimation methodology used is based on the double difference analysis with the inclusion of other covariates to study the impacts of road project on production of seven major crops grown in the study areas. The regression equation used was specifically designed for

evaluating impacts on agriculture; it estimates the total value of crops at household level, and it takes into account different aspects involved in agricultural processes. These include improved seeds, fertilizer, pesticides, labour, land, transportation expenses of agricultural output, quantity and prices of agricultural produce, observable household characteristics (households assets, access to utility services, etc.), soil, agro-ecological conditions and rainfall.

Another Zambia study (Kingombe and Di Falco, 2012) assessed the dynamic impacts of rural road improvements on cotton farm productivity in the Eastern Province of Zambia. Drawing data from both national postharvest surveys (carried out annually) and agriculture census, the study used the regression model combined with the double difference approach. Consideration of postharvest surveys carried out annually can increase data reliability and avoid possible recalling errors associated with conventional questionnaire style especially when the recalling period gets longer (five years or more). The agricultural model used appears to be robust given the fact that it covers a wide range of aspects involved in agricultural process. The output is measured per hectare produced by a household. Household determinants for cotton yields include the age (i.e. experience) and sex of household head, the size of household, household demographics, (i.e. share of male household members), input use (i.e. fertilizers), assets (i.e. livestock), the size of the land allocated to cotton, farm size (i.e. stratum) and a measure of the district effect. The district effects comprise local infrastructure (road density), market access, local knowledge and access to credit. The household level effects used include farm effects and cotton-specific effects. The farm effects capture all specific factors influencing general agricultural output that are not perceived by the econometrician such as quality of soil, de jure (i.e., titles) and de facto land rights, know-how, and some other factors that can affect crop output. The cotton-specific effects are a combination of unobserved factors that affect cotton output such as capability and know-how in cotton husbandry and suitability of the land for growing cotton.

Using the double difference analysis, the Indian study (TSC, 2009) evaluated the impacts of rural road project based on the changes of following features: average number of farmers in the village, percentage of farmers who have accepted crop diversification, quantity of agricultural produce in the village, change in number of traders that are accessible for marketing forest products, percentage of agricultural produce being spoiled/wasted or damaged in transit, percentage of agricultural produce not being able to be transported to market due poor road conditions.

The studies considered above looked at impacts of rural road projects on agriculture. Considering the structure of regression models used and their scope especially in addressing impacts on agriculture, it can be suggested that both Zambia studies (Iimi and Gericke, 2017; Kingombe and Di Falco, 2012) are most robust among others. It would also be important to highlight the contribution of India case study (TSC, 2009) in raising some aspects that can allow a direct attribution of agricultural impacts to an intervention. These include for example the changes in agricultural produce spoiled/wasted or damaged in transit, and changes in agricultural produce not being able to be transported to market due to poor road conditions. It makes sense that the change in these two aspects may be attributed to an intervention. In addition, the study also considered the change in number of traders that are accessible for marketing forest products. Commonly, forests may be located in remote areas so that their inaccessibility may hinder marketing of their products. It is in this regard that rural road intervention may allow their accessibility, and thus enable marketing of their products such as wood and planks. Though this is considered as a positive impact, elsewhere it has led to environmental concerns. For example through a qualitative assessment of rural road projects the Nicaragua study found that improved access to a forested area by medium sized trucks may have encouraged deforestation of community forest resources by those from outside of the community area (Danida, 2010). Another agricultural aspect of interest that was only studied by (Danida, 2010) is the impact of rural roads on changes in crops types (subsistence crops and market oriented crops) grown in the study area. This can be an important consideration in evaluating impacts on agricultural sector; the diversification of agricultural crops, especially the switch from subsistence to the

market oriented agricultural products following road intervention can be a good indication of the growth of local economy.

As far as regression models are concerned, it is important to appreciate the possibility of including dummies and proxies in the model in order to consider a number of factors that can affect the model outcome (say agricultural output). For example the Nicaragua study by Kongens (2008) employed a number of model dummies in order to control for the effect of technical assistance, occurrence of natural disasters affecting agriculture, use of agricultural inputs, etc. on agricultural output. Caution is needed in considering the parameters of a given agricultural regression model. In the Zambia case study (Iimi and Gericke, 2017), one of the empirical challenges is that several input variables are likely to be zero, when analysing data from developing countries. In Sub-Saharan Africa in particular, not all farmers use fertilizers, relatively few use pesticides and transport services and only a small number of the farmers may be taking their produce to market. Some mathematical adjustment may be needed to avoid taking the logarithm of zeros when some variables are found to be zero.

As far as impact evaluation of rural roads on agriculture is concerned, it is recommended to use an all-inclusive methodology that takes account of all aspects involved in agricultural processes as well as other factors that can affect the agricultural outcomes of study interest. The studies reported herein can be considered to complement each other, and thus it would be prudent to draw lessons on each of them in order to conduct a worthwhile impact evaluation of rural road projects on agriculture.

4.6.2 Gender

The impact of rural road projects on gender has been a subject of discussion among several impact evaluation studies. These were mainly limited to education and employment opportunities among girls and boys, women and men respectively (Khandker et al. 2006; Khandker and Koolwal 2011; Iimi et al., 2015). Using various estimation methodologies (such as double difference analysis), these studies have evaluated changes in wages/work opportunities among women and men distinctly, and school enrolment/attendance/dropout rates among boys and girls separately. The Nicaragua study (Kongens, 2008) adopted a methodology that allows for gender to be analysed directly from the structure of the equation used. The effect on gender was studied by considering the households with female head vs households with male head. Though this can be an indication of project effects on gender, especially in evaluating the impact distribution among households headed by men and women, it is likely that this approach will not cover all gender related effects. This is due to the fact that a higher emphasis is given to female household heads (possibly widows) who may naturally form a smaller number of the sample and exclude the effects of the remaining women (such as those living with their husbands). In addition, the model does not distinguish between widowers and the male household heads living with their wives. Given that there may be dissimilarity between widowers and couples in obtaining impacts from the project, the failure to address it may be taken as another form of bias in the study.

The Mozambique study (Thompson and Pedro, 2012) adopted a qualitative analysis in evaluating the impacts of road projects on gender. In all study communities, qualitative techniques were used to provide the means of listening to the opinions of households in general and women in particular. This methodology of forming distinct groups of men and women can provide better outcomes especially in gathering gender-specific information. For example, Vargas (2007) highlighted an example where explicit inclusion of women in data collection provided further awareness that led to the improvement of non-motorised tracks (used by women in their daily activities), which were often ignored by other road upgrading programmes. Putting more emphasis on gender, has also extended the study to estimate the female household members who can read and write, and the female household members who are employed (Thompson and Pedro, 2012).

4.6.3 Poverty

It is prudent to establish the guidelines for poverty measurement and to evaluate them overtime in order to assess road impacts on poverty alleviation. For example, the studies undertaken in Bangladesh (Khandker

et al.2006; Khandker et al. 2009; Khandker and Koolwal, 2011) categorised people in different poverty groups according to Food and Agriculture Organization (FAO) guidelines. In these studies, poverty is measured as the daily consumption expenditure necessary for an individual to be above the poverty line; such per capita consumption expenditure is a function of food calorie and other nutritional requirements set by FAO standards. Moderate poverty is defined as per capita consumption expenditure needed to meet the FAO guidelines of a daily dietary requirement of 2,112 calories, and non-food expenditure that is about 30% of this food expenditure. Correspondingly, an extreme poverty line is established using consumption expenditure necessary to meet a lower calorie requirement of 1,739 calories, with non-food expenditure equal to approximately 30% of that for food. Accordingly, it was possible to work out the impacts of road project on poverty alleviation over time. The analysis of data from follow-up surveys were used to evaluate the percentage of people moving above or below set poverty lines, and thereby providing a measure of the rate of poverty reduction.

The World Bank uses a measure of poverty known as the National poverty headcount ratio, which is the percentage of the population living below the national poverty line. The national poverty line is related to the cost of a basket of food considered to provide adequate nutrition for good health and normal daily activity, plus an allowance for nonfood spending. In Liberia the poverty headcount ratio was 50.5 % in 2018 (World Bank, 2018b).

Measures of poverty based on the percentage of the population living on less than $1.90/day (modified by purchasing power parity) and less than $5.50/day (modified by purchasing power parity). When determining the percentages for any given year the figures are discounted to 2011 USD are also widely given. In Liberia the corresponding percentages for 2014 provided by the World Bank were 38.6% and 93% respectively (World Bank, 2018c).

4.6.4 Household Welfare

Seven studies considered have addressed the impact of rural road improvement on household welfare. Though a wide range of factors were taken into account (such as change in household assets), studies have put more emphasis on evaluating the changes in household income and consumption.

Making use of different estimation methodologies, income and expenditure were studied in different ways, including changes in monthly household income (Iimi et al., 2015); changes in household income and expenditure (Asomani-Boateng et al., 2015); changes in per capita income and expenditure per annum (TSC, 2009) and household per capita food expenditure and household per capita non-food expenditure (Khandker and Koolwal, 2011). In the study of Iimi et al (2015), the change in monthly household income was estimated based on the data collected using the survey question which was designed to capture the household income of the past month. Though recalling can be easier (using such a question in a survey) given a short period of time elapsed, it is also important to make sure that the month considered provides the average monthly income in the year. The questionnaire used in the Viet Nam studies (Mu and Van de Walle, 2011; Van de Walle and Cratty, 2002) did not measure directly income or consumption. However, using all-encompassing information on household characteristics common to the SIRRV and the VLSS, the regression techniques were used to predict consumption expenditures for SIRRV households.

A number of studies have estimated household welfare taking into account the changes in household assets. The Nicaragua study (Danida, 2010) considered TV, Internet, Computer, Air Condition, Sewing Machine, Kitchen and Washing Machines, Electric Iron and Telephone. The India study (TSC, 2009) used Movable assets (TV, furniture, agriculture implements, cattle stock, motor cycles and bicycles) and immovable assets (agricultural land, house site and tube wells). The Viet Nam considered assets including radio cassette player, bicycles, telephones (per capita), threshers, boats and sprayers.Two studies (Van de Walle and Cratty, 2002; Danida, 2010) considered the proportion of households that built new homes or extended/renovated existing ones. In order to capture such impacts Danida, (2010) used a qualitative evaluation at community level. This provided further insights on observed outcomes such as the reduction

of transportation costs of construction materials due to improved access. An increase in financial resources from project employment could have also been the reason.

In the evaluation of road impacts, Danida (2010) focused on examining a set of parameters that are indicators and proxies for household income and welfare instead of endeavouring to estimate specific values for possible production and income increases/decreases that could be attributed to an intervention. One reason for this was that, due to budget limitations, it was not feasible for the assessment to fully repeat the EMNV 2005 (baseline) questionnaire interview. Another reason that can be of interest to most surveys especially the ones being undertaken in developing countries is the common tendency of the households to under report income to avoid possible tax penalties, albeit to address this it is now common practice to match income information with expenditure. In addition to that, some households may even under report their income expecting possibly to benefit from national support to the poor.

In the study conducted by Kongens (2008) consumption counted as value of consumption of agricultural outputs and rent, was considered as the main welfare indicator in the evaluation. Parada (2016) used a quite different approach in measuring the household welfare. The welfare analysis was carried out using a typical monthly basket of goods of a family of six (four adults and two children), which comprises 53 goods in three categories: food, household goods and clothing. The basket of goods was designed according to the Nicaraguan National Information and Development Institute's (INIDE) to calculate the value of this basket at national level, nationally-representative average prices of those goods are available from INIDE. The welfare effect of the improved road was obtained by measuring the change in value of a typical monthly basket of goods (using double difference analysis).

4.6.5 Education

Rural road interventions can provide positive impacts on education. Several studies have evaluated road impacts on education through a number of ways including change in school attendance.

The Bangladesh study (Khandker and Koolwal, 2011) evaluated the impacts of rural roads on education, and their evaluation approach was based on the change in enrolment rates of school- aged boys and girls of 5-17 years of age. Kongens (2008) used literacy levels for individuals between 15 and 64 years of age to measure road project impact on education. The dummy variable was utilised within a regression equation to study the education of the household. The dummy variable was set to be equal to one if at least one of the household's members between

15 and 64 years of age was not able to both read and write. Given the fact that individuals between 15 and 64 years who are illiterate are not likely to join school as an impact of road investment, it can be suggested that this methodology may be subjective.

It is likely that if Kongens (2008) used the literacy levels of children of age between 5 and 17 at household level, the study outcome would be somewhat similar to considering their school attendance, given that the fact of attending school would justify development of literacy skills. Measuring road effects on any socio-economic indicator can be a complex assignment. There can also be instances where road investment can also negatively affect schooling; for example opportunities brought by roads may cause 16 year-old children to drop out in order to seek paid work, such as operating a motorcycle taxi or 'boda boda'. Assuming that these 16 year-old children would already be literate, measuring road impacts on education based solely on literacy can be misleading. However, basing the study on school attendance, such effects can be more easily captured.

Iimi et al (2015) used a methodology that can capture education effects attributed to the road project. The evaluation was done based on the change of number of households with children who could not attend school due to poor road conditions. The study also measured change in the number of children who attended school (elementary/primary/secondary school and university). Given these two considerations of the study, one can argue that the first one indicates the direct effect of the road project since children who couldn't attend school before the intervention were able to do so after the intervention. The second

one indicates the derived effects of the project since children who couldn't attend school (say because of poverty) before the project were able to do so after intervention because of various benefits brought by the project, such as increased household income.

Using a qualitative approach, Danida (2010) was able to identify some key impacts on education that could have been difficult to recognise using quantitative approaches alone. These include for instance increased supervision of schools by the Ministry of Education, regular teacher attendance and provision of more school materials and rehabilitated/new schools. Using a double difference approach, TSC (2009) evaluated the road impacts on education through a number of aspects including the changes in percentage of un-enrolled school age children, post-primary school dropout, attendance of teachers and primary school inspection.

4.6.6 Health

Improved rural access also generates health related benefits including better access to health centres, relatively better health conditions resulting from improved welfare, accessibility to health facilities (such as immunization, visit of health workers, etc.) and, improved health awareness and thus a reduction in sickness incidence. Indeed, reductions in maternal mortality and morbidity are key indicators of improved health and wellbeing of women in rural areas. Several studies have tried to evaluate health benefits resulting from rural road interventions using various approaches as described below.

In a Ghana study (Asomani-Boateng et al., 2015), respondents were asked about the health facilities they had access to both before and after the road project. Each health facility was ranked by the level of health care provided, which varied from small health posts to health centres and hospitals. Using a qualitative approach, Danida (2010) evaluated the effects of road investments on health. The qualitative instruments helped in capturing key information on emergency healthcare services (such as transport of pregnant women with delivery complications and for the very ill). TSC (2009) employed a well-structured questionnaire that included a number of relevant questions which isolated the health effects that may be attributed to improved rural access. These included, among other things: reasons for avoiding the visit to clinic/hospital (cannot afford, cannot find time, bad road, and transport cost), the mode used to reach the hospital (tractor, bullock cart, jeep, bus), and the number of times in failing to reach hospital on time in the last 3 months due to non-availability of transport. Iimi et al (2015) evaluated the road impacts on health based on the change in number of households having difficulty in reaching hospital due to poor road conditions. Kongens (2008) used a regression model to evaluate the road impact on health in Nicaragua. A dummy variable was utilised within a regression equation to study the variation of health conditions at household level. The dummy variable was set as equal to one if one or more of the household's members have been affected by any disease throughout the past month. The dummy variable for the household health based on the past month can make sense in a way that recalling can be made easier. However, caution is needed to avoid some months of disease prevalence that may bias the study (for example, in some countries 'flu prevalence can be higher in cold seasons or in others bronchitis prevalence can rise in dry season because of a lot of dust'). Such a methodology has been also used by Iimi et al (2015) where respondents were asked about those who were sick in the last two months.

TSC (2009) employed a well-structured questionnaire that included a number of relevant questions in isolating the health effects that may be attributed to improved access. These included among others: reasons for avoiding the visit to clinic/hospital, mode used to reach the hospital; the frequency of failing to reach the hospital on time due to the non-availability of transport and the accessibility of health facilities such as immunization and visit of health works. Iimi et al (2015) have also evaluated the road impacts on health based on the change in number of households having difficulty to reach hospital due to road conditions. The Mozambique study (Thompson and Pedro, 2012) evaluated the HIV/AIDS awareness at household level in two ways: (i) the percentage of those who have heard of HIV/AIDS and, (ii) the percentage of those who know how to avoid it. The study did not however look at the road impacts on HIV/AIDS incidence.

4.6.7 Employment

Rural road projects are often associated with the increases in local employment. The employment can result from the direct employment in road project works or other job opportunities created by the improved access of the local area. A number of studies showed that the improvement of rural roads is often followed by a movement of agricultural to non- agricultural employment, and thus indicating another source of rural income other than subsistence agriculture.

Mu and Van de Walle (2011) and Van de Walle and Cratty (2002) estimated the impacts of rural roads on employment by measuring the change in local employment opportunities reflected by: change in farm and non-farm activities, number of households that move from agriculture to non-agricultural livelihood activities, migration of workers coming to or out of the project area as a result of intervention, and consideration of short-term direct employment in road project works. Kongens (2008) looked at the change in income generated by non-agricultural activities. Non-farm employment outcomes were estimated by measuring the household's total earnings from non-farm employment. As it is argued that non-farm employment is benefited by individuals living in the direct vicinity of a road, the study also sought to determine the relationship between non-farm employment and distance to the road.

Khandker and Koolwal, (2011) measured rural effects on local employment based on the rate of change from agricultural to higher-paying non-agricultural wage work. The study made use of data collected on the total number of wage labour days worked in the last month by men and women in agricultural and non-agricultural sectors. This approach looks promising in capturing changes in number of hours worked i.e. change in work opportunities. However, such an approach needs to ensure the avoidance of bias associated with the period when the survey is conducted. For example, in seasonal employment when there are peak months when there are more jobs or quiet months of the year when there are less jobs. The busy months can include sowing and harvesting periods and quiet months can include periods when agricultural activities are not in activity. Iimi et al. (2015) evaluated the change in employment opportunities both in agricultural and non-agricultural sector. This was done through consideration of change in the number of households working full-time in agriculture, industry, commerce, services and public sector.

The Nicaragua case study (Danida, 2010) looked at the change in employment opportunities for heads of households in agriculture and non-agriculture activities. Such approach can be helpful in capturing the road effect on employment at household level. However, given the fact that the household head may not be the only one to work in a family, it may be a good idea to consider the number of all individuals with working age.

A wider outlook is essential to evaluate a maximum number of possible effects of an intervention to the rural population. For example in Nicaragura (Danida, 2010), there were concerns whether all observed project impacts were a result of an intervention alone (improved roads, bridges, etc.) or integrated outcomes from other aspects linked to the programme such as training of the community members, institutional capacity development, short-term income from project wages, experience acquired through project employment and the use of labour- intensive methods. The use of both qualitative and quantitative methodologies has helped inform an improved evaluation. For example, it was found that the experience gained through direct project employment have enabled some of the community members to seek construction employment in municipal centre. The studies by Van de Walle and Cratty (2002) and Kongens (2008) also took into account the effects brought by employment in road project works.

4.6.8 Accessibility

The effects of rural road projects on the transport sector are widely considered as the direct impacts brought by an intervention. These can be identified immediately or short time after project completion. The road improvement leads to a reduction in travel time and costs, which in turn can promote shift from non-motorized to motorized traffic, change in transport modal choice, emergence of public transport,

increase in vehicle ownership, change in transport demand and a change in transportation fares. The evaluation of road impacts on transport can be done by assessing any or more of these afore-mentioned direct effects following road improvement.

Four studies considered evaluated the effects of road improvement on travel time by measuring the change in travel time to certain key destinations such as the nearest health centre, school, market and work place (Danida, 2010; Iimi et al., 2015; Asomani-Boateng et al., 2015; Kongens, 2008). Van de Walle and Cratty (2002) stressed caution would be needed in evaluating the effects of road improvement based on changes in travel time. This approach can be more applicable to the services and facilities that are not likely to relocate as a result of a road improvement. Those include health centres, schools, provincial hospitals, natural resources such as forests (to collect firewood). However, other facilities such as shops, post-office and local banks may relocate to the community centre as a way of attracting more customers after road intervention. This will of course lead to the reduction in travel time (to get to those facilities) for people living in the community centre, whereas the individuals living a bit further from the centre may experience increase in travel time to get to those facilities which were located in their close proximity prior to their relocation following road project.

Three studies evaluated impacts of road improvement on changes in transport charges (Asomani-Boateng et al., 2015; Khandker and Koolwal, 2011; Kongens, 2008; TSC, 2009). Asomani-Boateng et al. (2015) evaluated the change in transport charges to the local primary school facility. The study has also shown that it is essential to take into account the changes in fuel prices in evaluating the impacts of road projects on transport charges. This can help to interpret unreasonable fluctuation in transport charges over time especially when the methodology of "before and after" without any control is used (without a control, it would be difficult to understand what is going on elsewhere, say if there is an increase in fuel price which can in turn affect transport fares). TSC (2009) evaluated the change in transport fares using data collected through field discussions with the transport operators as well as the transport users. Three studies took into account the effect of rainy season on transport costs through consideration of aspects such as weeks per year when a road is impassable or has limited accessibility due to harsh seasonal conditions (Asomani-Boateng et al., 2015; Khandker and Koolwal, 2011; Kongens, 2008).

Four studies evaluated changes in traffic by type and volume (Asomani-Boateng et al., 2015; Danida, 2010; Iimi et al. 2015; Kongens, 2008; Thompson and Pedro, 2012 and TSC, 2009). The changes in a wide range of motorized traffic (jeeps, bus, taxis, trucks, cars, motorbikes) and non- motorized traffic including beasts, pedestrians and bicycles were evaluated. Categorization of traffic can be a good practice since it can provide a picture of the local economy. For example, increase in trucks may reflect increases in local production. In addition to that, the NGO's cars and other cars were considered differently in the study conducted by (Danida, 2010). Such an approach can be an indication of other development programmes (run by NGOs) available in the area. The traffic count reported by (Danida, 2010) has been taken twice a year, once week in summer and the other week in winter, from Monday to Sunday, 6am to 6pm. Iimi et al. (2015) evaluated the change in transport demand; the frequency of trips with the following five basic purposes was studied: purchasing food, purchasing other goods, going to work, doing business, and visiting friends and relatives.

Kongens (2008) used a regression model to study the effect of rural road projects on transportation. The emergence of transport services such as buses and trucks as well as household expenses on transport were considered in the model. In addition, the regression equations used make use of variables such as travel time to health facilities and schools using public transportation.

The distinction between passenger and freight transport and the consideration of all possible modes of transport in one framework in impact evaluation is of important. For example, Van de Walle and Cratty (2002) reported a 9% increase in freight service but there was no appreciable project impact on passenger transport. Furthermore, the daily availability of motorcycle services experienced a significant decrease in some of project areas relative to the comparison group. However, because of integrated consideration of the whole transport sector, it was suggested that the reason behind such unexpected outcomes may have

been a change to cheaper alternatives that were not previously possible because of the poor road condition. Additionally, it was also suggested that there might have been a switch to freight transport services that allow the transport of individuals together with their produce or possessions. This demonstrates that the integrated consideration of all modes of transportation is essential in assessing the impacts of road improvement on the whole transport sector. It is possible that benefits of an intervention can be more concentrated in some available transportation modes and not in others. The failure to address this possibility may leave some impacts unnoticed.

4.6.9 Markets

Rural road improvements have numerous effects on market development. The farmers who often form a significant part of rural workforce can use improved roads to take agricultural produce to market quicker, at lower vehicle operating cost and less damaged at therefore better prices and, as a result are able to spend more on other commodities essential to their daily lives. In addition, the opportunities offered by rural road projects can increase local income, which can in turn be invested in other market-related activities such as production and local manufacturing. Rural road improvements can also help in connecting rural areas to other markets such as in nearest towns or cities, and thereby fostering market related interactions. Mu and Van de Walle (2011) evaluated the effects of rural roads on market development in Viet Nam. The study showed how the initial presence of a commune market was related to both the commune's distance to the nearest central market (in the town), and its average living standards expressed in baseline household per capita consumption. Though such a model was not used in impact evaluation during the course of Viet Nam study, one can argue its potential applicability.

Such a market model can help in evaluating the impacts of project intervention on the local market. Based on the fact that road project can improve the welfare of the local population (per capita consumption), it can be anticipated that there will be an increase over time in local markets after intervention (given the validity of the model). In addition, the model has shown that the presence of a commune market is also related to the distance (implying travel time) from commune to the nearest town market; this may suggest that the reduction in travel time between commune and town market (following intervention) may also have a certain effect (concealed in the model) on the commune market. This may also suggest that if the model was constructed based on travel time (which can change after road improvement) rather than travel distance (which remains constant even after road improvement), one could have been able to predict the potential effects on the local market development given model validity. However, these questions can be only answered through experiment. Using such a model and combining it with other impact evaluation methodology can help to check the robustness of empirical results.

Two studies evaluated the impacts of road projects on changes in prices of commodities which are representative of the study area (Danida, 2010; Parada, 2016). A number of commodity prices were recorded during the baseline and follow-up surveys in treatment and control areas, and the impacts were evaluated using double difference analysis. For example in Nicaragua (Parada, 2016), a survey was conducted to collect data on prices of goods based on the requirements of basic basket which consists of 53 different goods. These goods include 23 food items, 15 household items and 15 clothing items. The surveyed establishments include small grocery stores, supermarkets and distributors. (Asomani-Boateng et al., 2015) have also evaluated impacts of road project on changes in price but they used "before and after" methodology without any control.

Using a dynamic panel estimation approach and fixed effects model, (Khandker and Koolwal, 2011) evaluated the change in prices of certain commodities (rice, pulses, fish and fertilizer) over time and with respect to the distance away from the road. They showed that controlling prices over time and in relation to road location can provide an indication of market status as an effect from road intervention. For instance increase in prices (close to road location) may show market demand in project areas such as that related to increase in labour attracted by the project or demographic effects resulting from changes in settlement patterns with people moving from further away to the roadside areas.

4.6.10 Impact distribution

Given the fact that some of the rural roads projects target the poor (pro-poor), and that depending on the circumstances the poor may even get poorer as a consequence of project implementation (see section 4.2.8), it is essential to study the distribution of road impacts among the poor and the better off of the rural community. The effects may also vary in community across genders and distance away from the road. In addition, the impacts of a road project on commodity prices can be distributed either fairly or unfairly across regions and local occupations.

The approach used by (Van de Walle and Cratty, 2002) in incorporating the poverty status of the study area within the national framework looks promising. The baseline SIRRV (project commune) households weighted by household size and ranked by their estimated per capita expenditures were compared to the Viet Nam's rural population based on the data from VNLSS (see section 8.3), and it was found that the rural road project was targeting the poorer population (pro-poor) of the country. In their follow-up study, Mu and Van de Walle (2011) divided communes into poorer and better-off categories in order to study the impacts of the road project on market development in poor and better-off communes distinctly. Other than consideration of VNLSS data, some other parameters were also taken into account to define distinctly two categories. These include for example: literacy rate, access to transportation and credit, distances to the nearest city, market presence, ethnic minority population, road densities, population densities, availability of commercial businesses, access to services, income sources, market availability and frequency, shops, percent of farm households and percent of people practicing agriculture. Such an approach aided in evaluating how fast rural road impacts can emerge depending upon the baseline economics of the area. It should be noted that literacy rate is not necessarily a good time related measure for the distribution of impacts (Hine et al., 2015).

Khandker et al. (2006) evaluated the spatial distribution of impacts of rural road projects on roadside and remote villages in Bangladesh separately in order to evaluate how road project effects degenerate with distance. Using calorie and other dietary requirements set by FAO standards, the moderate and extreme poverty lines were defined (see section 9.3). It was then possible to study the impacts distribution of road project across people of different poverty status. Kongens (2008) assessed the spatial distribution of rural road impact in rural Nicaragua and used regression equations to link household consumption with respect to the distance from the road.

Four studies looked at the distribution of impacts according to gender. This was done by considering distinctly women's and men's wages and work opportunities, and road project impacts on girls' and boys' schooling separately (Khandker et al., 2006; Khandker and Koolwal,2011; TSC, 2009; Iimi et al., 2015).

The spatial model of prices suggests that the difference in prices of any commodity in the two areas would be dictated by the transportation costs of moving it from one place to another. Given the fact that improvement of a rural road connecting rural and urban areas would lead to reduction in transportation costs, it would be expected that the costs of local produce that are sold in the city reduces the price. Equally, the rural population would expect the reduction in city manufactured products that are sold in rural areas. Based on these premises, it should be possible to verify whether the impacts of rural road project are fairly distributed in rural areas. For example if the price of manufactured products that are sold in rural areas remained unchanged after road improvement, it would be likely that the local traders are enjoying the road benefits alone.

A second example is the case when the price of local produce increases because of competition from urban consumers who enjoy the product at a relatively lower price than before. In this case, based only on the price indicator of local produce, the urban consumers (who enjoy a reduction in price) and the local producers (such as farmers or fishermen who enjoy the increase in price) benefit from the project, and the remainder of the rural population especially those unemployed would not (Parada, 2016).

Based on the spatial model of prices, it is possible to measure the ideal or fair price of a commodity based on the change in transportation costs that follows road improvement between two regions. Such a price would be a reference line so that anything above or below it would justify a natural unfair distribution of road impacts in any of those areas. To this end, it is possible to identify losers and gainers based on the prices of commodities in the local market. The evaluation would also take into account various professions since some may gain or lose depending on their occupations and their role in the transaction framework i.e. whether they are potential buyers, sellers, producers or transporters. However, this outlook is based solely on commodities' prices and it does not reflect the general situation.

4.6.11 Data Collection tools, Analysis Methods, Instruments and Reporting

This section outlines for the included studies, the data collection tools, methods of storing, managing and analysing the resulting data. A summary of the information is given in Table 3: Summary of Data Collection and Analysis Methodologies.

1. Data collection tools: Nine of the 15 studies reported that structured interview techniques were adopted. These included house and commune level questionnaires, focus group discussions and targeted key informant interviews. None of the included studies reported the use of electronic recording such as the use of apps on tablets or smartphones. However, the Mozambique study (Thompson and Pedro, 2012) funded by RECAP also made use of video recordings of road condition

2. Data storage and management: Eight of the 15 studies mentioned that data were stored in electronic databases. The remaining seven studies did not report how the data were stored. , others did not mention anything

3. Two studies provided information on the software used for data analysis. The Mozambique study (Thompson and Pedro, 2012) used the statistical package SPSS™, whereas the Ghana study (Assomani-Boateng et al., 2015) used Microsoft Excel™.

Table 3: Summary of Data Collection and Analysis Methodologies

Authors	Country	DD with PSM	DD regression with time covariate	Econometric approach	Regression analysis	Before and after	Household welfare	M&E systems	Data collection tools	Data storage and management	Data analysis	Lessons learned
Van de Walle and Cratty (2002)	Vietnam	X			X		X		interviews conducted to answer household and commune level questionnaires	Database	Computer based	Selecting the control groups non-randomly because of practical and logistic reasons to limit the field work to certain areas.
Khandker et al. (2006)	Bangladesh	X		X								
Lyngby (2008)	Nicaragua				X		X		Living Standard Measurement Survey (LSMS) questionnaires	Database	Computer based	Panel households were biased as they are concentrated in more accessible areas. Questions were altered, removed or added over time restricting the evaluation approach. Respondents dropped out over time, and new respondents were added.
Khandker et al. (2009)	Bangladesh	X		X			X					
DANIDA (2010)	Nicaragua	X		X					Questionnaires (quantitate approach), key informant interviews and focus group discussion (qualitative approach)	Database	Computer based	Field survey took place during the period of heavy rainfall, and this hindered smooth execution of the exercise
Khandker and Koolwal (2011)	Bangladesh			X			X					
Mu and Van de Walle (2011)	Vietnam	X			X				household and commune level questionnaires	Database	Computer based	Selecting control groups in a no-random way because of practical and logistic reasons to limit the field work to certain areas.

Kingombe and DiFalco (2012)	Zambia	X			X				questionnaires, structured forms for recording direct observations, interviews, consultation of stakeholders planned through formal visits, and official reports	Database	Computer based	Questionnaire has had frequent major revisions including changes in questions asked.
Thompson and Pedro (2012)	Mozam bique					X			focus group discussions (household leaders, groups of women, groups of community leaders) , key informant interviews (district administrators, representative of institutions, community leaders, etc.), questionnaires, and video recordings of road condition.	Data were coded and put into a database	Statistical package for social sciences (SPSS) analysis.	Unavailability of GPS coordinates of the interviewed households and informants in the previous survey (conducted 10 years earlier) made it difficulty to locate them in follow-up survey. Some of the previous survey respondents were not local and were in study area only because of project works. They had left the area when follow-up survey took place ruling out the possibility of interviewing them. Other issues included contamination of control groups by other projects, and the biased recalls of some respondents. Rainy period hindered surveying exercise as well
Assomani-Boateng et al. (2015)	Ghana					X	X		questionnaires, structured forms for recording observations, interviews, consultation of stakeholders planned through formal visits, and official reports	Database	MS Excel	
Iimi et al. (2015)	Brazil	X	X				X		questionnaires (used for interviews)	Database	Computer based	It was not possible to build panel data since geo-references of previous interviewees were not documented. Questions about relevance of the questionnaire (wording of questions) in view of adequately addressing benefits.

Parada, J. (2016)	Nicaragua	X					X					
Limi & Gericke (2017)	Zambia	X	X									
ORG (2018)	India	X							key informant interviews and Focus Group discussions	Database	Computer based	

4.7 Conclusions and Recommendations from the Review

It is important to collect baseline data from treatment and well-selected control areas before project implementation. It is also recommended that follow-up surveys need to be scheduled at pre-defined time intervals (e.g. every two years after project completion, depending upon the available budget). For any initial follow-up survey, it is recommended that it is carried out shortly after project completion (say a year or less) to be able to capture project direct benefits (some of which may attenuate over time). The follow-up survey can help in constructing a panel (longitudinal) data set that can allow a robust impact evaluation study. A sufficiently large set of panel data which includes both treatment and control data, will enable rigorous impact evaluations to be conducted that make use of a number of impact evaluation methodologies. For instance double difference analysis with propensity score matching can be used, and in addition, regression equations such as fixed effects, instrumental variables and dynamic panel estimation approach can be constructed for robustness check. However, proper planning and flexibility in collecting data is essential at the outset in order to allow a use of a wide range of methodologies. This is due to the fact that each methodology may require some data peculiarities that should be considered throughout planning and data collection processes.

One of the common issues which undermine data collection exercises (and thus impact evaluation) is collecting too much data. A limited number of impact indicators which reflect the most indispensable impacts of the project are usually sufficient and recommended, and this should be given a higher consideration in the Liberia study. In addition to quantitative evaluation methodologies, the participatory qualitative techniques are also recommended. These can help in amending technical issues associated with samples and data, and in providing deep interpretation of quantitative results. A number of other recommendations for Liberia are presented below:

1. The field survey teams should be given intensive training
2. A lesson from Viet Nam (Mu and D. Van de Walle, 2011) regarding collecting information at the local level (commune) is pertinent to Liberia. Ordinarily, Viet Nam has a practice of data collection at local level whereby each commune engages one or more ‘statisticians’ whose assignment is to collect and preserve certain types of information related to various aspects such as demographics, land use, distribution and production activities. Adopting such a methodology in a country like Liberia can help in ensuring data availability, consistency and reliability. For example the timely collection of data on agricultural production (postharvest surveys) carried out after each season can reduce possible recalling errors associated with conventional questionnaire style approaches especially as the recalling period increases (say 5 years or longer).
3. Exploiting existing data sources such as a national census or any other reliable sources of information can be helpful for comparison with both the with / without project and the before / after evaluation to determine impact changes.
4. Consideration should be given to following the approach advocated by the World Bank's Living Standard Measurement Survey (LSMS) questionnaires (World Bank, 2018). These are high quality, multi-topic questionnaires intended to study multiple aspects of household welfare and behaviour. Constructing a database detailing (quantitatively and qualitatively) the information on what the project did, when and how should be constructed for each survey project area
5. It is important to control for, address and avoid, the likely concerns faced else where such as the tendency to compile statistical information that conforms to the pre- determined plans, tendency to avoid a part of the sample (such as the poorest) for the sake of better results and the tendency of the respondents to underestimate their income (fearing tax penalty or expecting government benefits).
6. Drawing from the Bangladesh study (Khandker et al., 2009), studying the decay effects of the road project can be important. Selecting both roadside and remote villages with respect to the location of

improved road can give a true picture of how road effects attenuate with a distance. Having a panel data, it can even be possible to study the impacts of roads in time and space.

7. Stratified sampling can be helpful especially when there are concerns that other practical sampling techniques may not be representative of the entire population. This can make sense especially in case of a large population where random samples can be unlikely to represent the whole population. In addition, stratified sampling can also be carried out along with random sampling to check the robustness of the sampling exercise.
8. The evaluation of the impacts of rural road investment on agriculture should be evaluated in a holistic way that not only includes the amount of change in agricultural production but also other integrated aspects such as changes in fertilizer price, agricultural wages, transportation costs (of agricultural produce), climate effects, soil type and other agro-ecological aspects in order to capture the maximum (if not all) impacts to the whole agriculture sector.
9. For the purpose of carrying out a rigorous impact evaluation, it is prudent to construct regression models that can control for unobserved temporal heterogeneity. It is also recommended to control observed factors affecting changes in household outcomes over time (such as precipitation and draught for instance) and a number of other time- varying characteristics at community level such as village electrification, growth of local market, local irrigation, etc. Controlling for all of these aspects helps in minimising bias and isolates impacts which are uniquely attributed to road investment. Caution is needed to avoid the use of an inappropriate regression model. A robustness check (of results) making use of a number of different methodologies is therefore recommended.
10. In addition to evaluating the impacts resulting from infrastructures themselves (improved access, bridges, etc.), it is also important to identify and evaluate some other aspects that can be linked to the project in one way or another. For example training of the community members, institutional capacity development, short-term incomes from project wages, experience acquired through project employment and the use of labour- intensive methods can provided added impacts to the overall local economy. Conducting both careful quantitative and qualitative analysis can help in identifying and evaluating such effects on the local economy.
11. The inflow of other development projects from various programmes and organisations can follow road intervention. These can include for example electrification and other investments projects in the project area. Though these may be the direct effect attributed to an intervention (since such my not happen in control areas), the careful consideration in impact evaluation in order to isolate road impacts from impacts of other development programmes is needed
12. The timing of the follow-up survey(s) is a critical concern; though direct outcomes such as travel time to the nearest school or hospital, can be observed immediately after project completion, it may take longer to observe some other derived outcomes such as job creation or improvement in household welfare. Therefore, it is essential to conduct multiple follow-up surveys and establish a panel data set to capture long term project effects. This can also help in studying how effects of a road project changes over time and some inconsistencies in data that can affect results may be easily removed. However, a careful analysis is required in impact evaluation exercise in order to deal with various shortcomings such as the risk of losing part of the sample (which may necessitate a careful replacement), and possible spill-over effects either from intervention itself or other local development projects.
13. Drawing from the case study from Tocantins, Brazil (Iimi et al., 2015), the questionnaires to be used for the interviews must be extremely well conceived and customised to the project's specific design, needs and context. For instance in this case study, although questions about the transport distance or travel time from a particular place looked pertinent (during data collection), with hindsight the questionnaire should have rather focused on various impediments to travel due to harsh weather conditions over the past 6 to 12 months (to cover all seasonal periods). Such questions would have been more effective in

view of addressing the road improvement outcomes especially in allowing for year-round transport. Moreover, other questions, such as those connected with illness, seem to have little correlation with the project. Instead, a question about the frequency of foregone medical care owing to transport problems would have been more relevant.

14. Since many of the aspects to be evaluated are seasonal in nature, it is recommended to carry out baseline and follow-up surveys at the same time of the year, and to avoid busy periods of economic activity, such as seeding or harvest time to encourage the participation of local people.

4.8 Selection of Pilot Study Roads

The final selection of the 2018/2019 roads to be rehabilitated under the LSFRP has not yet been made. It has been decided that the initial 'pilot' baseline will be undertaken on a road that was pre-selected for upgrading (based on surveys in 2016). The 24.5 km road between Zwedru and Bawaydee in Grand Gedeh will provide the with-intervention scenario whilst the Zwedru to Boduo road will be taken as the without-intervention scenario. Figure 2 shows the general location of the pilot study roads.

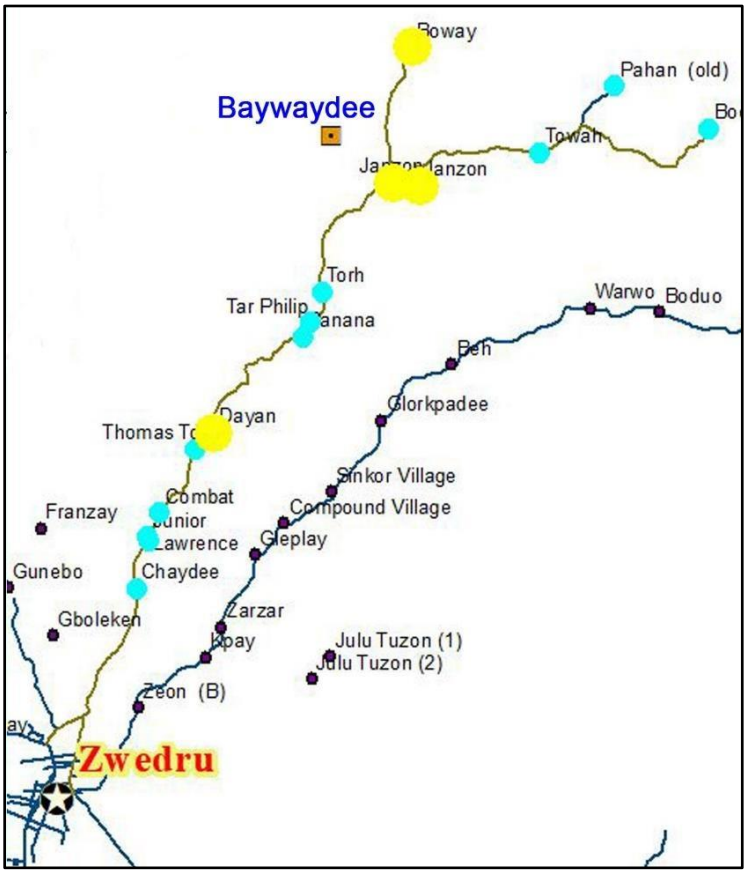

Figure 8: Location of Pilot Project Roads

4.9 Preliminary Review of Potential Indicators

A preliminary review of potential indicators for the MPW M&E system was undertaken as part of the situational analysis and via the literature review (see below). The preliminary review process involved

tallying of indicators currently in use by MPW and its partners involved in provision of feeder roads. This was further informed via the literature review.

The systematic review found two empirical studies of the socio-economic impacts of rural road interventions in Liberia. However, the studies were deemed not to meet the weight of evidence criteria of the systematic review. Nevertheless, a brief review of the identified studies is presented as it is felt that these could help to identify relevant study approaches for our work.

A study by Peters et al. (2018) sought to determine the obstacles and faced by women becoming commercial motorcycle taxi (MCT) operators in rural Sierra Leone and Liberia. Whilst the study did not explore socio-economic impacts directly lessons learnt from the data collection methodology in the Liberian rural road context may be pertinent to our study. Peters et al. (2018) used a variety of methods to gather data including the use of female and male only focus groups, a 12 hour traffic census taken on both a market and non-market data and questionnaires. The latter were designed to assess the impact of the motorcycle taxi on women's activities and included questions designed to determine: patterns and frequency of recent trips, frequency of attendance at periodic markets, travel in different seasons, the impact of motorcycle taxi transportation on family and public roles, and livelihood activities. The majority of questions required yes / no answers. A Likert scale was originally tested but respondents were found to prefer a simple yes or no answer rather than a rating scale. Randomisation by household was attempted, but difficulties were reported associated with a variety of factors (primarily seasonal in nature) which affected the availability of women to respond to survey questions. Passenger and operator questionnaires were carried out at the traffic count points. In total 221 passengers (of whom 151 were women) and 166 MCT operators (whom were all male) were interviewed.

The Agency for International Development (AID) carried out an empirical study to assess the socio-economic impacts of rural roads built in Liberia in the 1970s. The findings are reported by Cobb et al., 1980. However, the overall approach to impact assessment and the data gathering methods were less developed than would be the case now and the team was also hindered by the prevailing political climate which is much changed. As a result there is little that could be learned from this study.

The literature review also identified an article by Starkey et al. (2013) which reports an AFCAP research study which sought to identify pertinent indicators that can be used to assess how good rural transport services are at providing access for rural people in developing countries. It was the intention to identify indicators that were consistent, replicable and sensitive to changes in the transport services and allow comparison over time and space. The indicators were also required to be based on data that are easy to collect and should measure parameters that are relevant to the predominant stakeholders (i.e. passengers, operators, regulators) and which could be improved by appropriate interventions. The indicators were developed from a review of the literature and expert elicitation. A methodology to acquire the indictors was developed and trialled on six roads in Kenya and Tanzania. Thereafter a refined approach was trialled in Cameroon, Kenya and Tanzania.

The following aspects were considered when developing the indicators:

- Fares and travel costs
- Freight costs
- Transport frequency and travel opportunities
- Journey times and waiting times
- Safety and security
- Disruption and reliability
- Vehicle operating costs (VOCs)
- User perspectives
- Operator perspective
- Regulator perspective

The report recommended the following six headline indicators (to be measured for each travel mode):

- Fare price per passenger kilometre
- Transport frequency on normal days
- The costs per tonne-kilometre of accompanied small freight (50 kg loads)
- The costs per tonne-kilometre of consigned medium freight (200 kg loads)
- A reliability and predictability index for return trips to the market/services hub
- A transport services disruption index (to assess weather associated issues including seasonal road impassability, operational failures and increased waiting and journey times due to disrupted services).

Four more complex sets of indicators relating to the key stakeholders were conceived:

- User satisfaction
- Regulator perspective
- Operator perspective
- Development perspective

The indicators suggested by Starkey et al. (2013) are relevant to the Liberia context as is the methodology proposed for data collection and it is therefore intended that the most pertinent proposed indicators and the methodology will inform our study. **Annex B** lists the indicators under consideration. The process is ongoing and a final list will be circulated amongst all stakeholders for comments before the method validation workshop. A detailed review of the indicators will be included in the Workshop Report.

4.10 Monitoring and Evaluation Data Management Systems

Very little specific information was found from the literature review regarding the design (architecture), computer language or the database platform used for the studies reviewed. Table 4 summarises some of the available information. Nine of the studies reported that the data were stored in a computerised database of some sort, without giving further details. Two of these studies mentioned that the collected data was analysed using respectively, Microsoft Excel™ and the statistical software package SPSS™ (Statistical Package for the Social Sciences).

RECAP has commissioned two regional projects, the Back Analysis Project (RAF2069A) and the Materials Database Project (RAF2101A) which are developing databases. The former is available for the general public to use and requires a simple registration process achieved via the following web interface http://lvroadsdata.com/ (Otto and Buckland, 2018). Whilst Otto and Buckland (2018) do not provide technical details of the database, the developed live user interface at provides a useful example for the development of the interface for the database proposed in this project.

The latter has provided recommendations and specifications for a database which will act as an inventory of materials and aggregates which can be used for improved material management for various road types (Bilj and Corea, 2017). The proposed specification builds on stakeholder engagement, workshops were held in Ghana Mozambique and Tanzania, and from a review of similar systems in the following countries:

- Botswana, the Materials Database and Inventory System;
- Cambodia, the Pilot Road Materials Database;
- Indonesia, the Indonesian Construction Materials Information System;
- Namibia, the Materials Information Management;
- South Africa, Western Cape Province, the Borrow Pit Information Module;
- Zimbabwe, the Materials Inventory.

Bilj and Corea (2017) propose a web-enabled system which uses server side scripts to communicate with a database platform built such as MySQL (free open source) or MS-SQLServer™ (Microsoft proprietary). This

is similar to the approach advocated in our Tender. Bilj and Corea (2017) also provide a useful suggested architecture which could be adopted for this project.

5 Revised Work Plan

5.1 Schedule of Activities

The revised schedule of project activities is given as Annex C. According to the terms of reference the study was supposed to commence in February 2018. The commencement was delayed by a total of approximately three months due to delays in the procurement process and signing of the contract. An extension of time has been granted by AfCAP and the program of activities has been adjusted such that the study will now be completed in early December, 2018.

5.2 Milestones and Deliverables

The timing of key milestones and deliverables for the study will be as indicated in Table 4 and Table 5 below.

Table 4: Key Milestones

Name	Date
Study Commencement	16 Apr 2018
Method Validation Workshop	31 May 2018
Training of Survey Teams	29-30 May 2018
Field Surveys	04-20 June 2018
Results Validation Workshop	05-06 Sept 2018
Project Completion	13 Dec 2018

Table 5: Timing of Deliverables

Name	Date
Inception Report	06 July 2018 2018
Method Validation Workshop Report	27 July 2018
Progress Report	10 Aug 2018
Database and Manuals/Guidelines	14 Aug 2018
Results Validation Workshop Report	24 Sept 2018
Draft Final Report + System + Manuals	25 Oct 2018
Final Report + System + Manuals	13 Dec 2018

5.3 Resource Scheduling

The main resources are associated with the professional services provided by the team members. The anticipated timing of the input is as in Table 6.

Table 6: Timing of Experts' Input

			Experts' Input										Total Time Input		
No.	Name	Position		Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	H	F	Tot al
K1	Charles T Bopoto	Team Leader	H	1	4		6	5	2	1		1	20		60
			F	10	4	18		3	2	2		1		40	
K2	Alice Yaddai-Yeboah	Sociologist	H		5		8	3	2	2			18		40
			F		4	15		3						22	
K3	Maxwell Amuzu	Systems Analyst	H		5		11	3	3	2			24		40
			F		9	1		3	1	1		1		16	
K4	Boakai Kollie	National Researcher	H	8	5	1	3	3				1	21		35
			F			14								14	
NK1	Dr Michael Burrow	Project Director	H		2	1	1	2	1	1			8		12
			F		2			2						4	
NK2	Kingstone Gongera	Appraisal Expert	H		2		2	2	1	1			8		10
			F					2						4	
NK3	Dr Edward Fekpe	Mentor	H		2		2	2	1				7		10
			F		1			2						3	
NK4	Richard Shumbusho	UoB Researcher	H	10	10										20

6 Project Management, Quality Control, Monitoring and Evaluation

6.1 Project Management

Our project management team remains as was indicated in our proposal. Charles Bopoto, the Team Leader, will be responsible for delivering the study outputs. He will co-ordinate the tasks and the inputs of all the experts and is the main point of contact for the ReCAP Project Manager for West Africa, Dr Paulina Agyekum. Dr Michael Burrow acts as the University of Birmingham's academic Principal Investigator (PI) on the project and so will be ultimately responsible for delivering the project to ReCAP's satisfaction.

6.2 Quality Control, Monitoring, Evaluation and Ethics

6.2.1 Project Management Committee

A PMC will be established, chaired by the Team Leader and consisting of the three other team members and representatives from the ReCAP Steering Group. The PMC will monitor the project progress on a

monthly basis, manage programme risks and take strategic decisions at milestones during the project. This will be facilitated by monthly Skype meetings.

6.2.2 Quality Control

The quality of the delivery of the output will be the responsibility of Dr Michael Burrow with the support of Dr Gurmel Ghataora. They will engage with the Team leader on a weekly basis, at least, to discuss progress and will review all project reports and documentation.

6.2.3 Financial Control

Every project undertaken at the University of Birmingham is assigned a financial manager who is responsible, together with the Principal Investigator (Michael Burrow), for ensuring that the finances of any research project are managed appropriately. This includes budgeting and the appropriate expenditure of resource within budget headings. Formal monthly accounts are sent by the financial manager to the Principal Investigator to aid budget management. The financial manager assigned to this study is Ms. Sumandeep Matharou.

6.2.4 Ethical Requirements

Every research project undertaken by the University of Birmingham is subjected to a process that is underpinned by the University's Ethics Review policy and requires submission of documentation by the project team at project inception, demonstrating how the project will adhere to the University's ethics requirements. These documents are reviewed formally by the University's Executive Board. Dr Michael Burrow has submitted the required documentation and is liaising with the UoB to ensure that the submission meets UoB policy.

6.2.5 Risk Assessment

Dr Michael Burrow and Mr Charles Bopoto have developed and submitted a risk assessment to cover in country visits. This is formally required for all UoB research activities. The risk assessment has been approved by the School of Engineering's risk assessment committee, chaired by the Head of the School of Engineering.

7 Risks and Mitigation Measures

The risk profile of the study largely remains as was identified at proposal stage and is given in

Table 7 with minor updates. An additional risk of disruption and delay due to rains has been identified. The rainy season in the pilot study area is expected to commence in the May/June period and intensify as from July. The risk of delay has partially been mitigated by the University of Birmingham commencing the study before the contract was finalised.

Table 7: Project Risks and Mitigation Measures

Risk	Likelihood	Impact	Mitigating Actions
Data collection strategies too onerous	Medium	Sustainability of project beyond funded period threatened	Through literature of what is sustainable in other LICs; engage with stakeholders at an early stage to assess resources and training needs. Devise suitable training programmes
Data analysis too onerous	Medium	Sustainability of project beyond funded period threatened	Through literature of what is sustainable in other LICs; engage with stakeholders at an early stage to assess resources and training needs. Devise suitable training programmes
Database too difficult maintain over time	Medium	Sustainability of project beyond funded period threatened	Choice of a resilient development platform which can be easily supported. Devise suitable training programmes for IT staff
Lack of sufficient buy-in from road authority	Medium	Sustainability of project beyond funded period threatened	Engage with all stakeholders at an early stage. Identify and engage at an early stage RECAP AfCAP country representatives; Engage experienced Liberian as project's Researcher – who is also well known to MPW.
Insufficient capacity in road agency	Medium	Sustainability of project beyond funded period threatened	Develop appropriate training & capacity building programmes. Identify key road agency staff to be trained at early stage of project
Change or loss of project personnel	Low	Project implementation	The wider project team is sufficiently diverse and strong to withstand changes in personnel.
Electoral period prevents progress	Low	Threat of loss or change to funding	Build strong relationships with stakeholders
Heavy rains impede collection of	High	Delay in study completion	Commence the study early and target to complete field work by mid-June.

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Annex A: Project Kick-off Meeting Minutes and Interviewees

Minutes of Study Kick-off/Commencement Meeting

Date & Time: April 27, 2017 @ 10:00

Venue: Conference Room, Bureau of Rural Development, Ministry of Public Works (MPW) of the Republic of Liberia, South Lynch Street, Liberia

Participants:

1. Dr. Frederick M. Were-Higenyi – Chief of Party FRAMP Project/USAID funded
2. Mr. Charles T. Bopoto – Team Leader AFCAP Project
3. Mr. Boakai Kollie Local Researcher AFCAP Project
4. Mr. I. Richmond Harding – Project Coordinator MPW
5. Mr. Sumoiwuo Z. Harris – MPW Consultant
6. Mr. Johnny W. Jackson - Monitoring and Evaluation Director MPW/LSFRP 3
7. Mr. Paul Starkey – Monitoring and Evaluation Consultant/Specialist with LSFRP 3/FCG GOPA
8. Mr. Weweekema Siaplay – Technical Assistant/M-4/RDCS
9. Mr. Frederick D. Hinder – Engineer – IIU/MPW
10. Hon. T. Oliver Zomonway – Project Director LSFRP/MPW

Proceedings:

The meeting was chaired by Mr. Johnny W. Jackson, Director for the Division of Monitoring and Evaluation of the Ministry of Public Works and he called the meeting to order.

Mr. Bopoto, Team Leader for the Liberia Rural Mobility and Socio-Economic Baseline Pilot Study Project, presented and discussed the purpose of the meeting, the study administrative details, the team composition, the study approach, reviewed the definition of the monitoring and evaluation (M & E), the indicators, aim of the study, study and project objectives, project implementation calendar with key dates, the project deliverables and MPW role and responsibilities.

The project study administrative details include the project beneficiary (MPW Liberia), the funding agency (UKAID), client (RECAP/AFCAP), Service Provider (University of Birmingham), Program Manager (CARDNO, Pretoria), Project Manager (Ms. Paulina Agyekum) AfCAP Coordinator (Mr. Samoiwuo Harris).

The kick-off meeting marked the official commencement of the study and the objective of kick-off meeting was to create an understanding of the study purpose, objective, methods, outputs and the review of the program and draft indicators of the project.

The Team Composition was presented as follow:

- Director – Dr. Michael Burrow
- Team Leader – Mr. Charles T. Bopoto
- Sociologist – Ms. Alice Yaddai – Yeboah
- System Developer – Maxwell Amuzu
- Local Researcher – Boakai Kollie
- Mentor 1 – Kingstone Gongera
- Mentor 2 – Dr Edward Fekpe

The Approach to Study includes the following:

- Macro studies to establish the link between poverty and other indicators and provision of roads;
- Sector studies establish the relationship between poverty and expenditure in the road sector using time series data;
- Cross-sectional study using with-without ex-post data;
- Longitudinal studies: with and with-out and before and after roadside data;
- Household survey of the before and after and the with and without data.

The parties to the project that the team met during the project kick-off and literature review were mentioned along with the Project's activities and the project's implementation calendar with key dates for project milestone achievement.

There were concerns raised about the sustainability of the project once it was completed. According to Mr. Harding, similar projects have been under taken before but, the Ministry of Public Works did not make the effort(s) to pay for the needed software and hardware subscription fees to maintain the system.

Mr. Paul Starkey, the M/E Specialist with the Phase Three (3) of the Liberia Swedish Feeder Road Project (LSFRP Phase 3/FCG GOPA) indicated that there is the possibility for the LSFRP Phase 3 to provide the funding for the proper operation of the online M/E database the AFCAP Liberia project will be developing for the MPW M/E Division for the full duration (4 years) of the project but at the end the project, the Government of Liberia through MPW must take it over.

Engineer, Frederick D. Hinder from MPW IIU encouraged the involvement of all the stakeholders especially the Senior Management of MPW to help sustain the online database that the AFCAP Project is currently developing. He solicited ideas and mentioned the potential and benefit of the database for the Ministry of Public Works. He shared that this would be an asset and resource for the Ministry.

Hon. T. Oliver Zomonway – Project Director LSFRP Phase 3/MPW also supported the idea of the online web database. According to him, the system will be a vital instrument for the Ministry to help track project activities and progress.

Dr. Frederick M. Were-Higenyi – Chief of Party FRAMP Project inquired about how other projects will be incorporated with the M/E online database currently being developed. Mr. Paul Starkey and AFCAP Project Local Researcher, clarified that the system is being develop for the use of the entire MPW and other GoL institutions but, the LSFRP Phase 3 was being use as the pilot for the project.

Mr. Charles T. Bopoto indicated that the online M/E web database with improve the coordination of projects and project related information with the donors and GoL and partners. Mr. Bopoto also indicated that it was a pilot project tested on the feeder roads but could be applied to all projects.

Dr. Frederick M. Were-Higenyi – Chief of Party FRAMP Project, indicated that the Road Reform which will establish the Liberia Road Authority, all Feeder Roads will be carried over to the counties authority for maintenance and should be considered during the development of the online database.

Mr. Paul Starkey mentioned the roads for piloting the project in the southeast have not been identified but, four (4) roads under the LSFRP Phase 2 in Bong County have been chosen for maintenance and hope that the roads for the pilot project will be identified soon.

The meeting was adjourned at about 11: 45 A.M. with Hon. T. Oliver Zomonway – Project Director LSFRP/MPW thanking all the participants and welcoming them to the project.

Table B1: List of Interviewees

#	Contact Person	Position/Designation	Organisation
1	Samuwoiwo Harris	AfCAP Coordinator	MPW
2	Jackie A. Bernard	Ass Minister Rural Roads	MPW
3	Alibaba K. Kpakolo	Director Feeder Roads	MPW
4	Oliver Zomonway	Project Director	LSFRP/MPW
5	Paul Starkey	M&E Expert	LSFP
6	Mr Johnny Jackson	M&E Director	MPW
7	A. Blamoh Tugbeh	Director Engineering Transportation	MPW
8	Ms. Bynor G. Young	Director, Planning and Research	MPW
9	Ms. Fregina Bloh Trinity - Bettie	Director, HR & Training	MPW
10	Mr. Jerome Beh	Director, Information, Communication and Technology	MPW
11	H. Athelstan F.K. Tambah	Inf. Project Engineer	MoA/SAPEC
12	Emmanuel K. Baker	Program Manager	IIU/MPW
13	Dr. Frederick M. Were-Higenyi	Chief of Party	FRAMP Project/USAID
14	I. Richmond Harding	Project Coordinator	IIU/MPW
15	Hon. Mabuto Nyepan	Minister	MPW

Annex B: List of Potential Indicators

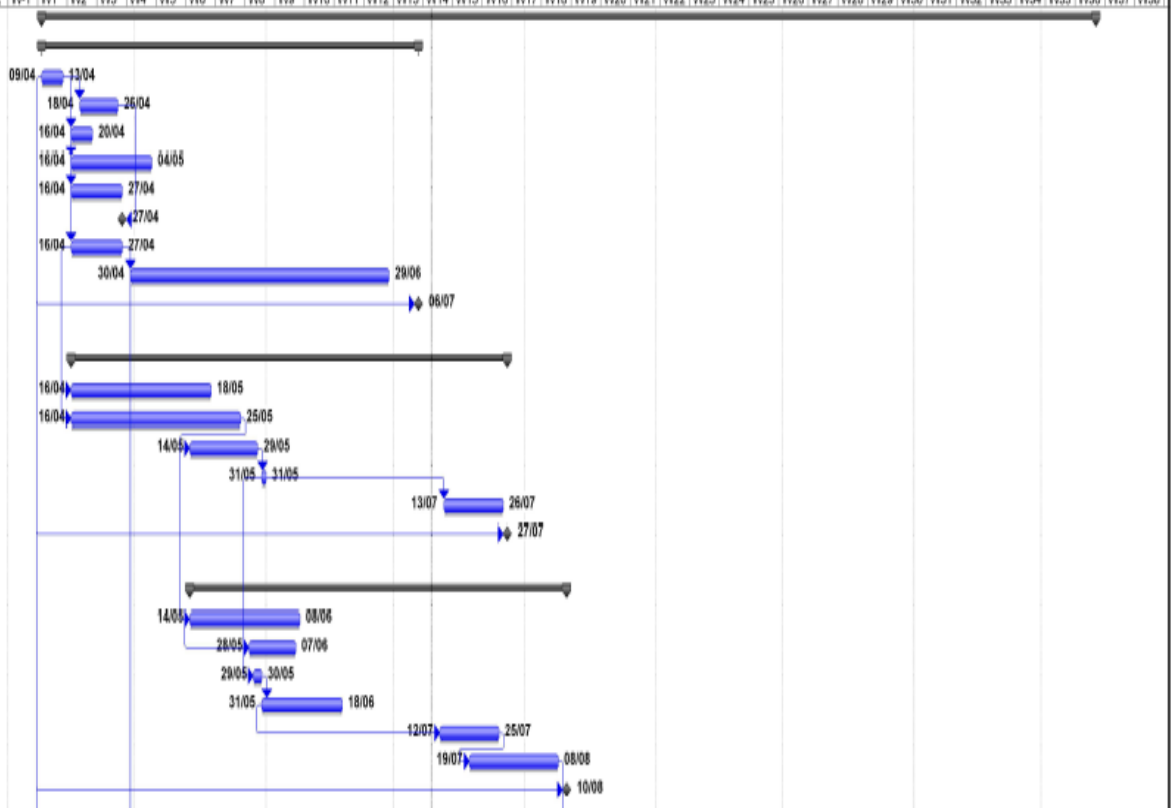
#	Level	Aspect	Indicator	Information Use/Audience	Disaggregation/Commentary/Notes	Data Collection Methods/Sources	Frequency
1	Impact	Access to Education	Percent school enrolment	Impact assessment and project evaluation	Gender. Primary, Middle, Secondary	Institutional Surveys Household Surveys	Baseline + Yearly
2	Impact	Access to Education	Percent school attendance	Impact assessment and project evaluation	Gender. Primary, Middle, Secondary	Institutional Surveys Household Surveys	Baseline + Yearly
3	Impact	Access to Education	Percent vacant teaching positions	Impact assessment and project evaluation	Primary, Middle, Secondary	Institutional Surveys Household Surveys	Baseline + Yearly
4	Impact	Access to Education	Percent number of teachers absent from school per year	Impact assessment and project evaluation	Gender, Primary, Middle, Secondary	Institutional Surveys Household Surveys	Baseline + Yearly
5	Impact	Socio-economic conditions	Population levels	Impact assessment and project evaluation	Gender	Key Informants Focus Group Discussions	Baseline + Yearly
6	Impact	Agricultural Production	Marketing of agricultural produce	Impact assessment and project evaluation		Household Surveys	Baseline + Yearly
7	Impact	Agricultural Production	Farming hactarage	Impact assessment and project evaluation		Key Informants	Baseline + Yearly
8	Outcome	Access to Health Facilities	No. of Emergency Visits to Referral Hospital	Outcome assessment and project evaluation		Institutional Surveys Household Surveys	Baseline + Yearly
9	Outcome	Access to Health Facilities	Percent of pregnant women ante-natal visits to clinic	Outcome assessment and project evaluation		Institutional Surveys Household Surveys	Baseline + Yearly
10	Outcome	Improved socio-economic conditions	Frequency of transport services	Outcome assessment and project evaluation	To Market, To County Capital	Transport Surveys Household Surveys	Baseline + Yearly
11	Outcome	Travel, Transport and Costs	Average Travel Time to the Market	Outcome assessment and project evaluation	Market day; Non-Market day	Household Surveys	Baseline + Yearly
12	Outcome	Travel, Transport and Costs	Average Travel Time to the County Capital	Outcome assessment and project evaluation	Mode	Household Surveys	Baseline + Yearly
13	Outcome	Travel, Transport and Costs	Average Travel Time the Referral Hospital	Outcome assessment and project evaluation	Mode	Household Surveys	Baseline + Yearly
14	Outcome	Travel, Transport and Costs	Average Travel Time to Nearest Clinic	Outcome assessment and project evaluation	Mode	Household Surveys	Baseline + Yearly
15	Outcome	Travel, Transport and Costs	Waiting Time for transport	Outcome assessment and project evaluation	Mode	Household Surveys	Baseline + Yearly
16	Outcome	Travel, Transport and Costs	Traffic Volumes (AADT)	Outcome assessment and project evaluation	Mode, incl NMT	Traffic Counts	Baseline + Yearly
17	Outcome	Travel, Transport and Costs	Vehicle occupancy	Outcome assessment and project evaluation	Mode, gender, child	Transport Surveys	Baseline + Yearly
18	Outcome	Travel, Transport and Costs	Passenger Travel Cost to Market per person.km	Outcome assessment and project evaluation	Mode, Market day, Non-market day	Transport Surveys	Baseline + Yearly
19	Outcome	Travel, Transport and Costs	Passenger Travel Cost to County Capital per person.km	Outcome assessment and project evaluation	Mode	Transport Surveys	Baseline + Yearly
20	Outcome	Travel, Transport and Costs	Freight Costs to Market per product.kg.km	Outcome assessment and project evaluation	Mode; Basket of produce, Palm oil, Cassava	Transport Surveys Household Surveys	Baseline + Yearly
21	Outcome	Travel, Transport and Costs	Freight Costs to County Capital per product.kg.km	Outcome assessment and project evaluation	Mode; Basket of produce, Palm oil, Cassava	Transport Surveys Household Surveys	Baseline + Yearly
22	Outcome	Travel, Transport and Costs	Freight Costs from County Capital per product.kg.km	Outcome assessment and project evaluation		Transport Surveys Household Surveys	Baseline + Yearly
23	Outcome	Travel, Transport and Costs	VOC: Service costs per year	Outcome assessment and project evaluation	Mode	VOC Surveys	Baseline + Yearly
24	Outcome	Travel, Transport and Costs	VOC: Tyre change cost per year	Outcome assessment and project evaluation	Mode	VOC Surveys	Baseline + Yearly
25	Outcome	Travel, Transport and Costs	VOC: Fuel cost per gallon	Outcome assessment and project evaluation	Location	VOC Surveys	Baseline + Yearly
26	Outcome	Travel, Transport and Costs	Frequency of Trips to County Administration centre per month	Outcome assessment and project evaluation	Mode, Gender	Household Surveys	Baseline + Yearly
27	Outcome	Safety	Accidents per year	Outcome assessment and project evaluation	Mode, Gender, Severity	Household Surveys	Baseline + Yearly
28	Outcome	Safety	No of Children using Motorcycles as percent of total	Outcome assessment and project evaluation		Household Surveys	Baseline + Yearly
29	Outcome	Safety	Percent use of helmet	Outcome assessment and project evaluation	Gender	Household Surveys	Baseline + Yearly
30	Outcome	Travel, Transport and Costs	Trips to Market per month	Outcome assessment and project evaluation	Mode, Gender	Household Surveys	Baseline + Yearly
31	Outcome	Employment Creation and Improved Conditions	Youth Employment	Outcome assessment and project evaluation	Occupation; level of skill, wages paid	Household Surveys Business Surveys	Baseline + Yearly
32	Outcome	Employment Creation and Improved Conditions	Women Employment	Outcome assessment and project evaluation	Occupation; level of skill, wages paid	Household Surveys Business Surveys	Baseline + Yearly
33	Outcome	Employment Creation and Improved Conditions	No of Roadside Vendors	Outcome assessment and project evaluation	Type of wares	Road side Surveys	Baseline + Yearly
34	Outcome	Employment Creation and Improved Conditions	No of Businesses	Outcome assessment and project evaluation	Agric, Non-agric, Mixed, Industrial	Road side Surveys	Baseline + Yearly
35	Outcome	Employment Creation and Improved Conditions	Household Income	Outcome assessment and project evaluation	Income source	Household Surveys	Baseline + Yearly
36	Outcome	Employment Creation and Improved Conditions	Household Income Utilisation	Outcome assessment and project evaluation	Expenditure type	Household Surveys	Baseline + Yearly
37	Outcome	Travel, Transport and Costs	Cost of Goods per unit	Outcome assessment and project evaluation	Imported Rice, Sugar, Salt, Soap, Cooking Oil; Beef, Chicken	Business Surveys Market Surveys	Baseline + Yearly
38	Outcome	Travel, Transport and Costs	Cost of Staple foods per unit	Outcome assessment and project evaluation	Cassava, Country Rice, Plantain, Edo	Business Surveys Market Surveys	Baseline + Yearly
39	Outcome	Travel, Transport and Costs	Walking Time	Outcome assessment and project evaluation	Clinic, School	Household Surveys	Baseline + Yearly

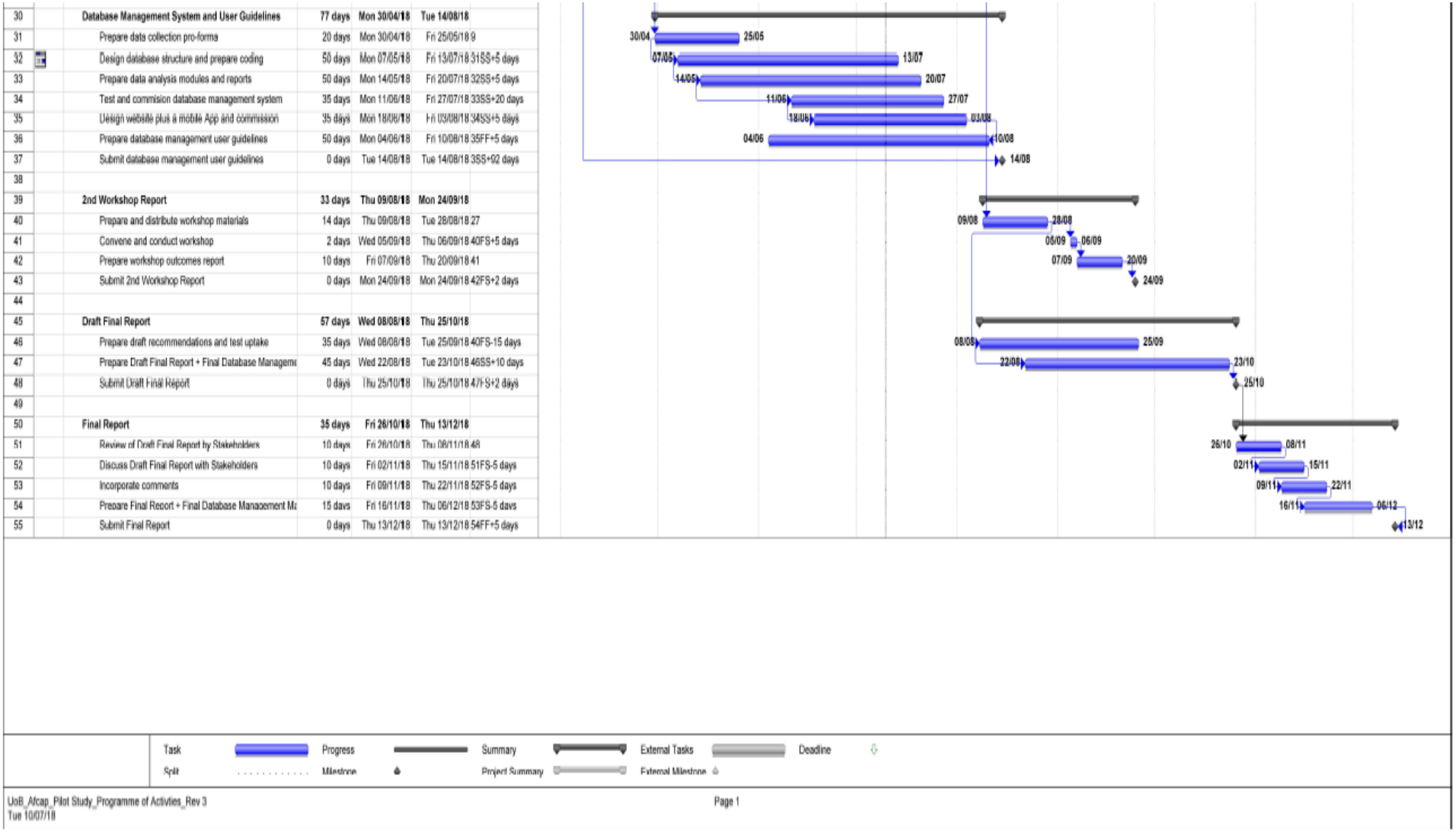
40	Outcome	Travel, Transport and Costs	Selling Price of Products	Outcome assessment and project evaluation	Cassava, Country Rice, Plantain, Edo	Market Surveys	Baseline + Yearly
41	Output	Civil Works	Feeder Roads Upgraded	Ouput monitoring	Physical length of upgraded (Kms); by class; per period	Reports	Quarterly
42	Output	Civil Works	Feeder Roads Reconstructed	Ouput monitoring	Physical length of road constructed (Kms) - by works element	Reports	Quarterly
43	Output	Civil Works	Feeder Roads Rehabilitated	Output monitoring	Physical length of road rehabilitated (Kms) - by works element	Reports	Quarterly
44	Output	Civil Works	Feeder Roads Maintained	Output monitoring	Physical length of road maintained (Kms), routine and periodice - by works element	Reports	Quarterly
45	Output	Civil Works	Milestones achieved	Output monitoring	Completed, delayed, pending	Reports	Monthly
46	Output	Civil Works	Tasks completion	Output monitoring	Completed, delayed, pending	Reports	Monthly
47	Output	Sensitisations	Sensitization: TB, HIV/AIDS, STI's, etc	Output monitoring	No of people sensitized	Reports	Quarterly
48	Output	Sensitisations	Sensitizations: Road Safety	Output monitoring	No of people sensitized	Reports	Quarterly
49	Output	Sensitisations	Sensitizations: Environmental Issues	Output monitoring	No of people sensitized	Reports	Quarterly
50	Output	Training	Training Programmes for Youth	Output monitoring	No of programmes	Reports	Quarterly
51	Output	Training	Training Programmes for Women	Output monitoring	No of programmes	Reports	Quarterly
52	Input	Resettlement and Compensation	No of persons compensated	Input monitoring	Gender	Reports	Quarterly
53	Input	Resettlement and Compensation	Value of compensation	Input monitoring	Type, Gender	Reports	Quarterly
54	Input	Expenditure	Funds Utilisation	Input monitoring	Budget item expenditure per period	Reports	Quarterly

Annex C: Revised Schedule of Activities

ReCAP/AfCAP
University of Birmingham
Liveria - Rural Mobility and Socio-economic Baseline Study
SCHEDULE OF ACTIVITIES

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Liberia Rural Mobility and Socio Economic Baseline Pilot Stu**	**179 days**	**Mon 09/04/18**	**Thu 13/12/18**	
2	**Inception Report**	**65 days**	**Mon 09/04/18**	**Fri 06/07/18**	
3	Mobilise team	5 days	Mon 09/04/18	Fri 13/04/18	
4	Conduct entry meetings with Client & Stakeholders	7 days	Wed 18/04/18	Thu 26/04/18	3
5	Review objectives and scope of services	5 days	Mon 16/04/18	Fri 20/04/18	3
6	Revise work plan	15 days	Mon 16/04/18	Fri 04/05/18	3
7	Establish linkages with other projects	10 days	Mon 16/04/18	Fri 27/04/18	3
8	Convene Project Kick-off Meeting	0 days	Fri 27/04/18	Fri 27/04/18	4FF+1 day
9	Literature search and collation and review	10 days	Mon 16/04/18	Fri 27/04/18	3
10	Prepare Inception Report	45 days	Mon 30/04/18	Fri 29/06/18	9
11	Submit Inception Report	0 days	Fri 06/07/18	Fri 06/07/18	3SS+65 days
12					
13	**1st Workshop Report**	**75 days**	**Mon 16/04/18**	**Fri 27/07/18**	
14	Prepare detailed review of indicators to be considered	25 days	Mon 16/04/18	Fri 18/05/18	9SS
15	Prepare draft M&E framework	30 days	Mon 16/04/18	Fri 25/05/18	14SS
16	Prepare and distribute workshop materials	12 days	Mon 14/05/18	Tue 29/05/18	15FS-10 days
17	Convene and conduct workshop	1 day	Thu 31/05/18	Thu 31/05/18	16
18	Prepare workshop outcomes report	10 days	Fri 13/07/18	Thu 26/07/18	17FS+30 days
19	Submit 1st Workshop Report	0 days	Fri 27/07/18	Fri 27/07/18	3SS+80 days
20					
21	**Progress Report**	**65 days**	**Mon 14/05/18**	**Fri 10/08/18**	
22	Prepare details of study methodology	20 days	Mon 14/05/18	Fri 08/06/18	15FS-10 days
23	Prepare survey plan	9 days	Mon 28/05/18	Thu 07/06/18	22SS+10 days
24	Undertake training of enumerators	2 days	Tue 29/05/18	Wed 30/05/18	17SS-2 days
25	Conduct fieldwork	13 days	Thu 31/05/18	Mon 18/06/18	24
26	Assess status of project implementation	10 days	Thu 12/07/18	Wed 25/07/18	25SS+30 days
27	Prepare Progress Report	15 days	Thu 19/07/18	Wed 08/08/18	26FS-5 days
28	Submit Progress Report	0 days	Fri 10/08/18	Fri 10/08/18	3SS+90 days





30	**Database Management System and User Guidelines**	**77 days**	**Mon 30/04/18**	**Tue 14/08/18**
31	Prepare data collection pro-forma	20 days	Mon 30/04/18	Fri 25/05/18 9
32	Design database structure and prepare coding	50 days	Mon 07/05/18	Fri 13/07/18 31SS+5 days
33	Prepare data analysis modules and reports	50 days	Mon 14/05/18	Fri 20/07/18 32SS+5 days
34	Test and commision database management system	35 days	Mon 11/06/18	Fri 27/07/18 33SS+20 days
35	Design website plus a mobile App and commission	35 days	Mon 18/06/18	Fri 03/08/18 34SS+5 days
36	Prepare database management user guidelines	50 days	Mon 04/06/18	Fri 10/08/18 35FF+5 days
37	Submit database management user guidelines	0 days	Tue 14/08/18	Tue 14/08/18 35S+92 days
38				
39	**2nd Workshop Report**	**33 days**	**Thu 09/08/18**	**Mon 24/09/18**
40	Prepare and distribute workshop materials	14 days	Thu 09/08/18	Tue 28/08/18 27
41	Convene and conduct workshop	2 days	Wed 05/09/18	Thu 06/09/18 40FS+5 days
42	Prepare workshop outcomes report	10 days	Fri 07/09/18	Thu 20/09/18 41
43	Submit 2nd Workshop Report	0 days	Mon 24/09/18	Mon 24/09/18 42FS+2 days
44				
45	**Draft Final Report**	**57 days**	**Wed 08/08/18**	**Thu 25/10/18**
46	Prepare draft recommendations and test uptake	35 days	Wed 08/08/18	Tue 25/09/18 40FS-15 days
47	Prepare Draft Final Report + Final Database Manageme	45 days	Wed 22/08/18	Tue 23/10/18 46SS+10 days
48	Submit Draft Final Report	0 days	Thu 25/10/18	Thu 25/10/18 47FS+2 days
49				
50	**Final Report**	**35 days**	**Fri 26/10/18**	**Thu 13/12/18**
51	Review of Draft Final Report by Stakeholders	10 days	Fri 26/10/18	Thu 08/11/18 48
52	Discuss Draft Final Report with Stakeholders	10 days	Fri 02/11/18	Thu 15/11/18 51FS-5 days
53	Incorporate comments	10 days	Fri 09/11/18	Thu 22/11/18 52FS-5 days
54	Prepare Final Report + Final Database Management Ma	15 days	Fri 16/11/18	Thu 06/12/18 53FS-5 days
55	Submit Final Report	0 days	Thu 13/12/18	Thu 13/12/18 54FF+5 days