

ReCAP Impact Case Study on Bangladesh

Final Impact Study Report



Ernst & Young

ReCAP Reference number: GEN2160B

September 2020



Preferred citation: Ernst & Young (2020). ReCAP Impact Case Study on Bangladesh, Final Case Study Report, GEN2160B. London: ReCAP for DFID.

ReCAP Project Management Unit
 Cardno Emerging Market (UK) Ltd
 Level 5, Clarendon Business Centre
 42 Upper Berkeley Street, Marylebone
 London W1H 5PW United Kingdom



The views in this document are those of the authors and they do not necessarily reflect the views of the Research for Community Access Partnership (ReCAP) or Cardno Emerging Markets (UK) Ltd for whom the document was prepared

Cover photo: Ernst & Young

Quality assurance and review table

Version	Author(s)	Reviewer(s)	Date
Draft	Sainath Sunil, Sangeeta Singh, Ankush Saxena	Joseph Haule, ReCAP	31 May 2020
	Sainath Sunil, Sangeeta Singh, Ankush Saxena	Joseph Haule, ReCAP	20 July 2020
		Phil Paige-Green, ReCAP TP Subhmay Gangopadhyay, ReCAP TP	12 June 2020 17 August 2020
Final	Sainath Sunil, Sangeeta Singh, Ankush Saxena	Joseph Haule, ReCAP	2 September 2020
		Phil Paige-Green and Subhmay Gangopadhyay	25 September 2020

ReCAP Database Details: ReCAP Impact Case Study on Bangladesh

Reference No:	GEN2160B	Location	Bangladesh
Source of Proposal	ReCAP Procurement	Procurement Method	Open Tender
Theme	Rural Roads and Infrastructure Research	Sub-Theme	Impact Assessment
Lead Implementation Organisation	Ernst & Young LLP	Partner Organisation	Local Government Engineering Department (LGED)
Total Approved Budget	GBP 47,500.00	Total Used Budget	
Start Date	22.1.2020	End Date	31.5.2020
Report Due Date		Date Received	

Contents

Abstract.....	4
Key words	4
Acknowledgements	4
Acronyms, Units and Currencies	5
Executive summary.....	7
1. Introduction.....	10
1.1. Current status of rural road infrastructure & transport research	10
1.1.1 Bangladesh over the years.....	10
1.1.2 Scope for Course Correction and emerging plan priorities	11
1.1.3 Understanding learnings from the past and charting a new course	12
1.1.4 The Perspective Plan and the country’s plan ahead	12
2. Approach and methodology.....	14
2.1. Project plan and deliverables.....	16
3. Indicator Evaluation.....	17
3.1. Impact indicator 1: Improved Rural Access Index (RAI).....	17
3.2. Impact indicator 2: Rural Transport Premium (RTP).....	18
3.3. Outcome indicator 1: Sustainability- Partner Government and other financiers cofunding research with ReCAP	21
3.4. Outcome indicator 2: Concrete Examples of Change	24
3.5. Outcome indicator 3: Number of citations in academic articles of ReCAP articles.....	27
3.6. Output Indicator 1: Cost Benefit Analysis	28
3.7. Output 2: Capacity building	32
3.8. Impact indicator 1: Access to Educational Institution	33
3.9. Impact indicator 2: Employment generated and Indirect Employment Generated	36
3.10. Impact indicator 3: Health- access to hospitals.....	36
4. Conclusion	39
5. Recommendations for ReCAP	40
Annex 1 - Follow on Discussions (BUET) 19 May 2020.....	41
Annex 2 – Follow on Discussions LGED 20 May 2020	45
Annex 3 – Follow On Discussions TRL 29 May 2020.....	47
Annex 4 – Perception Case Studies (General Public)	48
Annex 5 – Stakeholder Consultation	51
Annex 6 – Photos taken during the site visit	52

Abstract

The Local Government Engineering Department (LGED) is responsible for the rural roads and transportation infrastructure in Bangladesh, with about 353,000 km of rural roads spanning across the country. Further, around 100,000 Km roads are unpaved. ReCAP interventions - Rural Road Planning and Prioritisation Model, Climate Resilient Concrete Structures in the Marine Environment of Bangladesh, Ground Improvement of the Khulna Region Soils, Review of the Road Design and Pavement Standards Manual in Bangladesh and Scoping Study for Establishment of an Effective Pothole and Patch Repair Programme for the Rural Road Network of LGED in Bangladesh aim at improving the rural road and transport infrastructure by carrying out targeted research and building research capacity to bring and sustain change.

With an aim to gauge the impact of this research conducted, Cardno Emerging Markets (UK) Ltd has engaged EY to deliver ‘ReCAP Impact Case Study for Bangladesh’ to capture the value created by ReCAP research projects and how much has it improved the rural road and transport infrastructure through its targeted research and capacity building activities to sustain the change. This Final Report consolidates the relevance, credibility, applicability of the research projects conducted in Bangladesh and further validates that combining quantitative and qualitative methods is a useful strategy to increase confidence in impact evaluation findings.

Key words

Impact Assessment, Inception Report, Impact Indicators, Outcome Indicators, Rural Road, Bangladesh, Rural Access Index, Rural Transport Premium, Sustainability, Cost Benefit Analysis, Cost Savings, Planning and Prioritisation Model, Low Volume Rural Roads

Acknowledgements

We are grateful to the LGED, RHD and other government officials for providing access to their data and relevant literatures. The project team is indebted to the Department of Urban and Regional Planning (DURP) of Bangladesh University of Engineering and Technology (BUET) for providing necessary support. We also acknowledge ReCAP for their constant support and assistance.

Research for Community Access Partnership (ReCAP)

Safe and sustainable transport for rural communities

ReCAP is a research programme, funded by UK Aid, with the aim of promoting safe and sustainable transport for rural communities in Africa and Asia. ReCAP comprises the Africa Community Access Partnership (AfCAP) and the Asia Community Access Partnership (AsCAP). These partnerships support knowledge sharing between participating countries in order to enhance the uptake of low cost, proven solutions for rural access that maximise the use of local resources. The ReCAP programme is managed by Cardno Emerging Markets (UK) Ltd.

www.research4cap.org

Acronyms, Units and Currencies

AfCAP	Africa Community Access Partnership
AHP	Analytic Hierarchy Process
AsCAP	Asia Community Access Partnership
ASDR	Age Specific Death Rates
ATTC	Average Travel Time Cost
BC	Bituminous Concrete
BDT	Bangladesh Taka
BUET	Bangladesh University of Engineering and Technology
CBA	Cost-Benefit Analysis
CBR	California Bearing Ratio
CPF	Country Partnership Framework
CPR	Contraception Prevalence Rate
DCP	Dynamic Core Penetrometre
DFID	Department for International Development (UK)
DGHS	Directorate General of Health Services
DURP	Department of Urban and Regional Planning
EIRR	Economic Internal Rate of Return
EY	Ernst & Young
FY	Financial Year
GBP/£	British Pound
GDP	Gross Domestic Product
GIS	Geographic Information System
HBB	Herring Bone Bond
HDI	Human Development Index
HQ	Headquarters
ICT	Information and Communications Technology
IMR	Infant Mortality Rate
IRI	International Roughness Index
KM/km	Kilometre
Kg/m ³	Kilogram per cubed metre
LDCs	Least Developed Countries

LGED	Local Government Engineering Department
LVERR	Low Volume Rural Road
LVSR	Low Volume Sealed Roads
MCA	Multi Criteria Analysis
PMU	Programme Management Unit
RAI	Rural Access Index
RCC	Reinforced Cement Concrete
ReCAP	Research for Community Access Partnership
RHD	Roads and Highways Department
RPPM	Rural Road Planning and Prioritisation Model
RTP	Rural Transport Premium
SDGs	Sustainable Development Goals
SP	Service Provider
ToR	Terms of Reference
ToT	Training of the Trainers
TRL	Transport Research Laboratory
U5MR	Under 5 Mortality Rate
UK	United Kingdom (of Great Britain and Northern Ireland)
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USD/US\$	United States dollar
VOC	Vehicle Operating Cost
WEC	World Economic Forum
WG	Working Group

Executive summary

The Local Government Engineering Department (LGED), an arm of Bangladesh government, is responsible for development of rural roads and transport infrastructure in Bangladesh, which is the eight-most populous country in the world with about 353,000 km of rural roads and 100,000 km of unpaved roads. ReCAP interventions -for the Rural Road Network in Bangladesh aims at improving rural road and transport infrastructure in the country by carrying out targeted research and by building research capacity to bring and sustain change.

With an aim to gauge the impact of the conducted research, Cardno Emerging Markets (UK) Ltd engaged EY (hereinafter referred as “Service Provider or SP) to deliver ‘ReCAP Impact Case Study for Bangladesh’. The study captures the value created by ReCAP research projects and echoes the extent of improvement done in the rural road and transport infrastructure through its targeted research and capacity building activities. This impact case study will also help to understand the relevance, credibility and applicability of the research projects conducted in Bangladesh.

As a part of this impact study, EY delivered:

- an Inception Report which details the scope and methodology undertaken for the study; and
- a Status Review Report which details the status of the rural road infrastructure and transport research in Bangladesh.

Both these documents helped in shaping the draft version of the Impact Study Report. The findings and recommendations of the draft report were discussed in detail with the stakeholders from ReCAP, LGED and BUET. The discussions and feedback received from the stakeholders were collated and incorporated into the report which helped in strengthening the facets of the final report being presented in this document. The stakeholder’s consultation further formed the part of Stakeholder Workshop Report.

The key findings of the study are based on secondary research, stakeholders’ inputs and on ground evaluation of the current situation. It also highlights the overall impact of ReCAP research in meeting certain objectives.

The following table provides an overview of the findings which are put into three categories of indicators - Impact, Outcome, and Output. The description and ReCAP achievements are captured alongside for each indicator.

Table 1 Findings summary table

Indicator	Description	Achievement
Impact indicator	Rural Access Index (RAI): The percentage of the rural population in Bangladesh that lives within 2 kilometres of an all-season road	<p>Bangladesh attained highest improvement in RAI amongst all ReCAP countries, improving from 37 in 2006 to 86.7 in 2016. Although the methodologies for arriving at RAI are different in the two years (2006 and 2016), wide stakeholder consultation suggested new methodology of 2016 was more or less acceptable and reflected the ground reality.</p> <p>Stakeholders also apprised that extensive construction and maintenance work on Bangladesh’s rural roads took place in the 10 years spanning 2006-16 and beyond. 2016. More specifically, the new methodology was based on geo-spatial mapping and census surveys across Bangladesh.</p> <p>Local Government Engineering Department (LGED) computed a RAI at 84 which is closer to that arrived at by the World Bank and others (86.7). Further, LGED has acknowledged RAI as an important development indicator.</p>
Impact indicator	Rural Transportation Premium - fares per passenger-km on	Rural Transport Premium (RTP) was not developed for Bangladesh. Therefore, the project team conducted an analysis

ReCAP Impact Case Study Bangladesh

Indicator	Description	Achievement
	<p>Low Volume Rural Roads (LVRR) relative to fares on long-distance bus services</p>	<p>of the status and evolution of transportation costs in Bangladesh which include the following:</p> <p>Dependence on autorickshaws has reduced dramatically mainly because of the increase in the number of private motorized vehicles.</p> <p>Bangladesh has seen its motorcycle sales increase by 36% in three years between 2015 and 2018, implying that the mobility of people and their reliance on their own vehicles have increased.</p> <p>All types of vehicles (other than auto rickshaws) are being utilized more extensively; and possibly for longer distances as well. This may suggest that a person can now travel to areas that were previously costlier to visit or were not easily accessible.</p> <p>The cost of running vehicles seems to have increased slightly between 2008 and 2018, this is likely because of the increase in retail market values of vehicles.</p> <p>Though the people of Bangladesh are utilizing vehicles more than they did a decade ago, the Travel Time Cost (TTC) has increased across all vehicle types, suggesting that roads are increasingly getting more congested and that traffic is becoming a concern.</p>
<p>Outcome Indicator</p>	<p>Concrete examples of change (applied or formally adopted), influenced by ReCAP research that will be applied to kilometres of road in focus countries</p>	<p>The Rural Road Planning and Prioritisation Model (RPPM) tool was tested for Tangail District and is expected to directly influence the planning and prioritisations for upgrading and maintenance of all 256,000 km of unpaved roads nationally.</p> <p>As a result of this intervention, an R&D Unit of LGED has been created. LGED has introduced mobile maintenance unit; and is also using this framework in their National Policy formulation.</p>
<p>Outcome Indicator</p>	<p>Number of citations in academic articles of ReCAP articles and/or working paper, conference papers etc.</p>	<p>Srinivasan and Gibb's paper (0.5 points) Srinivasan's second paper titled: "Climate resilient reinforced concrete structures in coastal environment - Bangladesh Case Study", June 2018 (0.25 points).</p> <p>Bangladesh Specification for Concrete mix for coastal areas of Bangladesh was incorporated into the World Bank supported "Program for Supporting Rural Bridges" (USD625m).</p>
<p>Output Indicator</p>	<p>Cost Benefit Analysis conducted to determine cost effectiveness of the proposed solutions based on ReCAP research, conducted on a whole of life road cost basis</p>	<p>BAN2072A: Planning and Prioritization of Rural Roads in Bangladesh- The methodology was integrated into the planning and prioritisation model and is currently being used by LGED for their rural road network.</p> <p>Planning and Prioritization Tool, LGED, Bangladesh, has been formally adopted by Government of Bangladesh and is being rolled out nationally through the ADB assisted Rural Connectivity Improvement Project.</p> <p>Planning and Prioritization Tool developed for LGED in Bangladesh will directly influence the planning and prioritisations for upgradation and maintenance of all 256,000 km of unpaved roads nationally.</p> <p>BAN2077A: The project has helped examine the major factors that contribute towards premature deterioration of concrete</p>

ReCAP Impact Case Study Bangladesh

Indicator	Description	Achievement
		<p>structures. It suggests a cost-effective concrete mix design to enhance the durability of structures constructed in the future, while also making recommendations on improving construction practice and workmanship, thereby improving service life.</p> <p>LGED has instructed its district engineers to follow the recommendations of the project.</p>
Output Indicator	LVRR and TS information generated for dissemination, and disseminated, that is not peer reviewed.	<p>Seven mentions of the ReCAP reports by Department of Urban and Regional Planning (DURP/BUET) (2072A)</p> <p>Eight mentions of the ReCAP reports by Mott MacDonald (2077A)</p> <p>Three mentions of the ReCAP reports by Mott MacDonald (2082A)</p>
Output Indicator	Capacity Building Proportion of research projects undertaken by Bangladesh experts or institutions taking lead roles.	<p>BAN2072A - Planning and prioritization of rural roads in Bangladesh, is contracted to DURP, Bangladesh University of Engineering and Technology (BUET) (Output Expenditure 143,500 GBP)</p> <p>BAN2077A - Md. Abdul Bashir (Deputy Team Leader), Khan Amanat (Peer Review), Yasmin Dil Khan (Structural Engineer), are all Bangladeshi (Output Expenditure - 90,655 GBP)</p> <p>BAN2143A - Hydrologist is from Bangladesh (Output Expenditure - 5,793 GBP)</p>
Output Indicator	Number of research projects with female researcher inputs at senior technical level	<p>BAN2077A - Tina Dil Yasmin Khan (Expenditure - 222,258.99 GBP)</p> <p>BAN2077A (Uptake and Embedment Activities) - Tina Dil Yasmin Khan (Expenditure - 90,655 GBP)</p> <p>BAN2083A - Tina Dil Yasmin Khan (Expenditure - 189,588 GBP)</p>
Other Impact Indicator	Access to Educational Institution	Tangail district's capacity for providing primary education, tertiary education, fuel for vehicles, relief and other emergency services has increased between 2012 and 2018. This can largely be attributed to improvements in LVRRs. The findings were validated through stakeholders' consultation.
Other Impact Indicator	Health- access to hospitals	<p>Patient attendances at district/general hospital, for Cox's Bazar the influx of patients from rural region has increased.</p> <p>Age-specific death rate (ASDR) per 1000 population for Khulna Region for the year 2014 and 2018 has seen a significant improvement in ASDR across almost all age groups. In fact, the life span also increased over a span of 2014 to 2018.</p> <p>For indicators such as CPR: Contraceptive Prevalence Rate; IMR: Infant Mortality Rate; U5MR: Under 5 Mortality Rate by district there is a significant improvement. All these suggest improvement in rural roads has led to shorter travel time and ease of travelling</p>

1. Introduction

1.1. Current status of rural road infrastructure & transport research

The history of modern road development in Bangladesh is not very old. During the British period, water transport and railways served as the two major transport modes. At that time, road development was considered as a subject of local interest and therefore, the responsibility was given to the provincial governments. The colonial British Government prepared a master plan for road development in 1938 for India, which included the then Bengal Province. However, road development never got the attention it required either during the British rule or till the time it was part of Pakistan (as East Pakistan).

Road building received impetus after the emergence of Bangladesh as an independent nation in 1971. Very soon road transportation became the most popular mode of transportation. Its share of both passenger and freight traffic became higher than the combined share of rail and water transport¹. Currently, road transportation is the dominant mode of transportation in Bangladesh, carrying more than 70% of passenger and 60% of freight traffic². The country adopted its First Five Year Plan in 1973 which focused on starting post-war reconstruction of its infrastructure, farms and industrial production growth, poverty eradication and the creation of employment opportunities. But there were budgetary constraints to support the Five-Year Plan. The Government then built a strategy that would create employment for the agricultural workers who were unemployed and starving.

1.1.1 Bangladesh over the years

Bangladesh has made remarkable progress towards reducing poverty, supported by its sustained economic growth. Based on the international poverty line of \$1.90 (using purchasing power parity exchange rate) a day, the country has seen poverty percentage drop from 44.2% to 14.8% between 1991 and 2017. Bangladesh's progress was supported by a steady growth in GDP. Its economy grew at 6.1% in 2014 and at 8.2% in 2019, according to IMF³. Rapid growth enabled Bangladesh to reach the lower middle-income country status in 2015. In 2018, it fulfilled all three eligibility criteria for graduating from the UN's Least Developed Countries (LDC) list for the first time. Post this, the United Nations declared Bangladesh eligible to graduate to a developing country by 2024⁴.

The government's Seventh Five Year Plan, FY2016- FY2020 has been designed to sustain the economic growth momentum, aiming to achieve a growth rate of at least 7% on an average over the plan period. Sustained economic growth has rapidly increased the demand for energy, transport and urbanization.

The below graph shows steady improvement in leading socio-economic parameters in Bangladesh as also in five key districts that ReCAP reports have mentioned, namely; Tangail, Cox's Bazar, Bagerhat, Gopalganj and Noakhali between 2014-18. Since 63% of Bangladesh's population lives in rural areas, the rural economy largely driven by agriculture (which alone contributes around 15% to the GDP and is the mainstay of over 87% rural households), assumes significant importance.

Improvement in rural infrastructure, therefore, has a big role in the overall growth of Bangladesh.

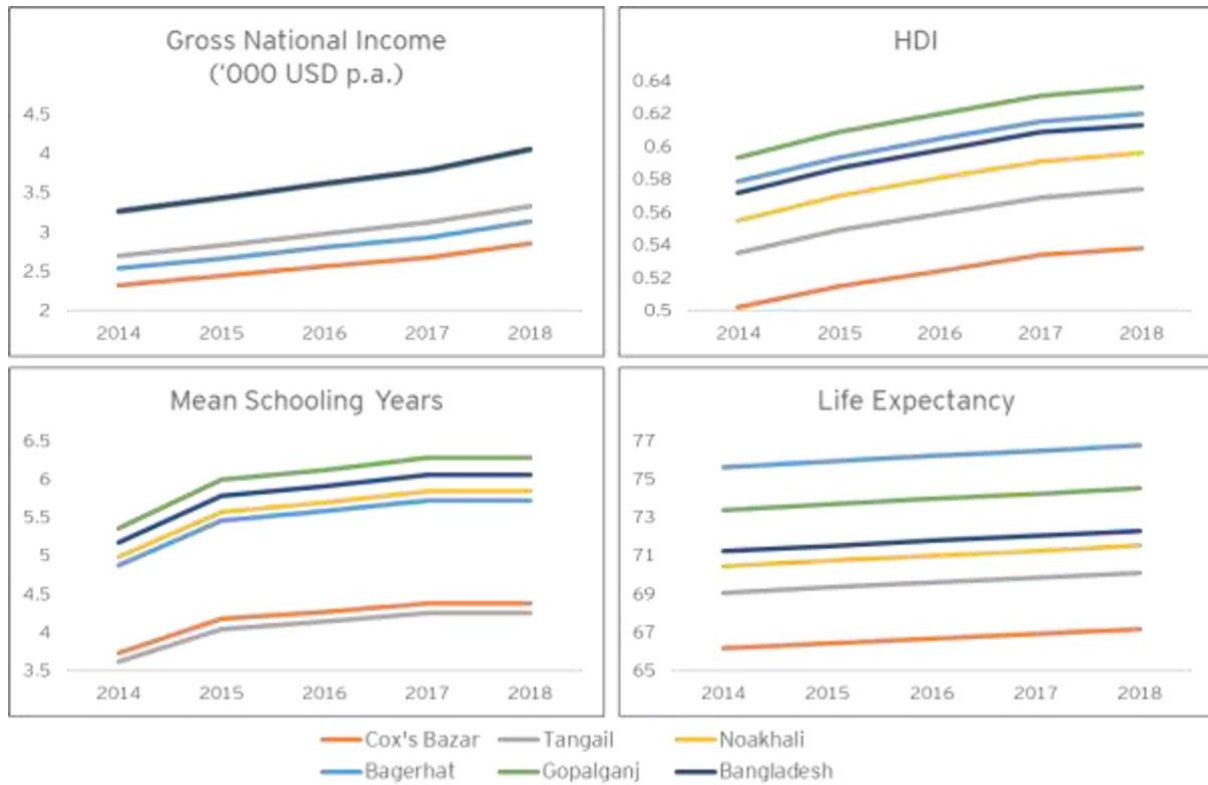
¹ Abdul Quium A S M, Aminul Hoque S A M, The completeness and vulnerability of road network in Bangladesh. Engineering Concerns of Flood, BUET, retrieved 20 March 2020 < <https://salekseraj.com/Page59-Abdul-Quium.pdf>>

² Rural Connectivity Improvement Project (RRP BAN 47243), Sector Assessment (Summary): Agriculture, Natural Resources And Rural Development, Asian Development Bank, Retrieved 23 March 2020 <<https://www.adb.org/sites/default/files/linked-documents/47243-004-ssa.pdf>>

³ GDP, Bangladesh, International Monetary Fund, Retrieved on 24 March 2020, <https://www.imf.org/external/pubs/ft/weo/2020/01/weodata/weorept.aspx?sy=2014&ey=2021&scsm=1&ssd=1&sort=country&ds=.&br=1&pr1.x=36&pr1.y=14&c=513&s=NGDP_RPCH&grp=0&a=>>

⁴ Rural Connectivity Improvement Project (RRP BAN 47243), Sector Assessment (Summary): Agriculture, Natural Resources And Rural Development, Asian Development Bank, Retrieved 23 March 2020 <<https://www.adb.org/sites/default/files/linked-documents/47243-004-ssa.pdf>>

Figure 1 Key development indicators for Bangladesh 2014-2018



Source: Global Data Lab⁵

1.1.2 Scope for Course Correction and emerging plan priorities

Bangladesh has meanwhile registered a drop in the World Economic Forum's (WEF) global competitiveness index (2019) due to slippages in 10 out of the 12 indicators, where significant deterioration in ranks was observed in macroeconomic stability, labour market, ICT, adoption and infrastructure^{5,6}. Specifically, on the infrastructure front, the country has slipped by 5 points when compared against 2018. The index tracks 141 countries across the globe.

The rural economy, through the farm and non-farm sectors, substantially contributes to the national economy. The Seventh Five Year Plan, from FY 2016 - FY 2020 takes cognisance of this and therefore, focuses on increasing rural incomes and agriculture's contribution to economic development. Seen within this specific sectoral and broader macro-economic sense, rural connectivity emerges as a pivot to drive sustained and incremental growth. Rural roads contribute significantly to generating increased agricultural incomes and employment opportunities while providing access to valuable economic and social services to the entire rural population.

However, rural connectivity in Bangladesh remains a challenge with only about 40% of the rural population having access to all-weather roads. These roads make up only 28% of the total length of rural roads in the country. Despite the growing demand for better transport conditions in rural areas, the issue of road construction has been at the centre of considerable debate in Bangladesh since the late 1980s. Further, road projects have had a long and patchy history in the country's foreign-assisted development⁷.

5 Institute for Management Research, Radboud University, Global Data Lab, Retrieved on 24 March 2020 < https://globaldatalab.org/areadata/shdi/BGD/?levels=1%2B2%2B3%2B5%2B4&interpolation=1&extrapolation=1&extrapolation_years=3&nearest_real=0 >

6 Global Competitiveness Report, 2019, World Economic Forum, Retrieved on 24 March 2020 < http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf >

7 Coelho, Karen, 2009, Infrastructure investment as "sustainable development": A Bangladesh case study, UNESCO-EOLSS, Retrieved

1.1.3 Understanding learnings from the past and charting a new course

Continuous interaction with the international development assistance agencies has helped in Bangladesh's gradual change in priorities. The LGED has emerged as a nodal agency and has a well-established maintenance planning and budget allocation system. However, only about 20% of the estimated requirement for rehabilitation and maintenance of all roads is allocated in LGED's budget each year. Most rural roads were constructed during 1990-2010 and because of shortage of funds, there is a significant backlog in the maintenance works for rural roads.

Thus, in 2013 the Government of Bangladesh adopted "The Rural Roads and Bridges Maintenance Policy". The objective of the policy was to develop a sustainable rural transport system through an appropriate maintenance management system to provide safe operation of vehicles and to ensure necessary and consistent funding for their maintenance. The need for this specific policy emerged because maintenance of roads constructed did not receive the kind of budget or the specific institutional support that was necessary. The policy commits the government to fund road maintenance on an incremental basis. The government has also recently introduced a Medium-Term Expenditure Framework Statement and the concept of three-year rolling targets for expenditure indicators to provide greater certainty for multiyear budgeting and the predictability of resources for prioritized schemes.

The guidance therefore focused on:

- i. Routine maintenance to get priority over periodic maintenance;
- ii. Maintenance of bridges and culverts on Upazila and Union roads to get urgent attention; and
- iii. Upazila and Union roads to get priority over village roads.

The policy also emphasized the importance of road safety, citizen participation and implementation management linked to the maintenance of rural roads and bridges.

1.1.4 The Perspective Plan and the country's plan ahead

The Perspective Plan (2010-2021) provides the road map for accelerated growth and lays down broad approaches for eradication of poverty, inequality, and human deprivation. It is important to continue to give attention to ways that the rural transport infrastructure, particularly the physical infrastructure, can support rural economies.

In essence, the international donor communities' presence in Bangladesh and their areas of support have evolved over the years. The areas of funding identified by them have been driven progressively by the LGED and the project designs are influenced domestically as well. This signifies greater process and project level ownership within the country's organizational structure. LGED is recognized as a competent and professional agency which continues to receive quality and capacity augmentation led support from the wider donor community. The five-year plans and the perspective planning document have provided important traction to the larger donor community in areas they would want to focus on. For instance, the World Bank Group Country Partnership Framework (CPF) for 2016-2020 supports Bangladesh to achieve its vision of reaching middle-income status by 2021, something which is indicated very clearly in the Seventh Five-Year Plan.

Bangladesh is a signatory to the 2017 Vientiane Declaration on Sustainable Rural Transport⁸ to promote inclusive, affordable, accessible, and sustainable rural transport infrastructure and services. Although a voluntary and non-binding declaration, its components link back with the Sustainable Development Goals (SDG) framework and their fulfilment will be critical for the country to make the transition to a middle-income economy by 2021.

on 17th March 2020 < <https://www.eolss.net/Sample-Chapters/C14/E1-18-06-03.pdf>>

⁸ Vientiane Declaration, March 2017, Sustainable Rural Transport towards Achieving the 2030 Agenda for Sustainable Development, UNCRD, Retrieved on 24 March 2020, <[https://www.uncrd.or.jp/content/documents/5099Final%20Adopted%20Vientiane%20Declaration-16March2017-\(Unedited\).pdf](https://www.uncrd.or.jp/content/documents/5099Final%20Adopted%20Vientiane%20Declaration-16March2017-(Unedited).pdf)>

A commitment of this nature acknowledges that rural transport is a key enabler for social equity, human resource development, local economic growth and employment generation, efficiency and productivity in rural areas, and improvement of the quality of life of the rural poor, farmers, girls and women, youth, the elderly and other vulnerable populations.

2. Approach and methodology

The approach and methodology for the implementation of the project involved following main tasks:

Inception and methodology phase, comprising:

- a. Definition and operationalization of the impact aspects to be measured and included, including selection of qualitative and/or quantitative approach for each of the aspects;
- b. Comprehensive literature review of available impact information and distillation of relevant information on the impact aspects for the case study;
- c. Work plan for additional research/data collection to be carried out in order to obtain a complete set of relevant data and a description of the methodology for monetisation where possible and appropriate.

Draft Impact study phase, comprising:

- a. Overview of the current status of rural road infrastructure and transport research in Bangladesh;
- b. Collection of additional research/data defined during the inception phase;
- c. Drafting of the impact study report.

Stakeholder consultation phase, comprising:

- a. Organising stakeholder meetings to discuss the draft Impact study;
- b. Finalising the impact study based on the outcomes of the stakeholder meetings.

The Project Team reviewed over 35 documents pertaining to the socio-economic advantages of rural road development, and also evaluated various economic and social research techniques used in gauging the impact and development of prioritisation tools. In addition, documents pertaining to the ReCAP Projects conducted in Bangladesh were also reviewed, whose impact has been summarised in Table 2 below:

Table 2 Impacts of ReCAP projects

Project	Impact
Ground improvement for Khulna Soft Clay Soil (BAN2083A)	<p>The Khulna region in Bangladesh faces major concerns for resilience of its rural road embankments as they are exposed to an aggressive coastal environment, high flood risks, and embankments that are often constructed on soft soil deposits, and sometimes with high compressible organic content. It was important to understand the effectiveness and limitations of existing ground improvement techniques implemented in Khulna region to come up with remedial measures. It involved analysing relevant findings from existing research, field observations and on-ground investigations to overcome the typical construction challenges, costs for road embankments and structures in Khulna region.</p> <p>To this effect, Mott MacDonald was contracted by Cardno, who using the results gained through the research, developed observational ground models which help inform authorities:</p> <ul style="list-style-type: none"> - <i>Understand better the deformation mechanisms and assess the likely contributory causes;</i> - <i>Present potential ground improvement techniques that are either (a) technically feasible and (b) within the likely budget for rural road construction together with guidance for implementation which will help counter specific construction issues;</i> - <i>Topics for further research that will improve the ability to apply ground improvement techniques in Khulna Region.</i>

ReCAP Impact Case Study Bangladesh

Project	Impact
<p>Planning and Prioritisation of Rural Roads in Bangladesh (BAN2072A)</p>	<p>As of September 2017, about 97,000 km of Bangladesh's rural roads were paved; the rest were undeveloped earth roads. However, many Upazila and Union roads or parts of them are still unpaved. The Government has a policy to improve such Upazila and Union roads. Moreover, given the quantum of roads to be developed, the increasing traffic thereby affecting durability of roads, growing population and need for continuous upgradation and maintenance of roads, there was a need to develop a planning and prioritisation methodology for the development and maintenance of rural roads on a sustainable basis. To this effect, ReCAP commissioned BUET to provide its research support to develop:</p> <ul style="list-style-type: none"> a. Methodology on planning and prioritisation of rural roads - developed for three types of road development - improvement, further improvement/upgrading and maintenance b. An application tool (software) to implement the methodology; and c. User manual and training of 15 professionals to use the application tool <p>The RPPM will directly influence the planning and prioritisations for upgrading and maintenance of all 2,56,000 km of unpaved roads nationally and help connect over 87,000 villages.</p> <p>It is being rolled out nationally through the ADB assisted Rural Connectivity Improvement Project.</p> <p>It will also help in informing government of Bangladesh's development agenda focussing on agriculture and rural development to improve rural income and food security.</p>
<p>Climate Resilient Concrete Structures in Marine Environment of Bangladesh (BAN2077A)</p>	<p>Bangladesh has a vast coastal infrastructure which seriously faces the brunt of climate change and associated environmental conditions. The durability of the existing reinforced concrete structures in this region is under threat when exposed to such a detrimental environment. Apart from the exposure to the marine environment, this deterioration is accelerated due to issues related to poor workmanship, limited availability of good quality materials and lack of awareness on good construction practices.</p> <p>In order to inform construction of durable concrete structures to withstand this aggressive coastal environment for the intended design life, there was a need to study the local factors that influence the durability of reinforced concrete structures. Mott MacDonald, engaged by Cardno, examined the major factors that contribute to premature deterioration of concrete structures, developed cost effective concrete mix design to enhance the durability of future structures and provided recommendations on improvements in construction practice and workmanship considered necessary to improve service life.</p> <p>This has apprised LGED's current construction and maintenance models and practices. LGED possess the sole responsibility for maintenance of around 380,000 linear metres of concrete bridges/culverts in the rural coastal areas and the construction of more than 200,000 linear metres during the next ten years.</p>
<p>Review of the Road Design and Pavement Standards Manual in Bangladesh (BAN2143A)</p>	<p>In a previous engagement with LGED, the Bangladesh University of Engineering and Technology (BUET) and the Bureau of Research and Testing (BRTC) were commissioned to update the existing road design manual used by the department. Following the submission of BUET and BRTC's report, concerns were raised as the report did not cover the full scope required. LGED, therefore, requested an independent review which highlighted missing topics and the editing issues and provided recommendations for its improvement. Working on the recommendations, BUET and BRTC submitted the second draft which did not adequately address many of the issues identified in the review.</p> <p>LGED, therefore, initiated this project which will attempt to correct the deficiencies identified in the review and finalise the Road Design and Pavement Standards and Manual for Bangladesh, which can then be applied to LGED operations.</p>

Project	Impact
Scoping Study for Establishment of an Effective Pothole and Patch Repair Programme for the Rural Road Network of LGED in Bangladesh (BAN2169A)	<p>The LGED requested support from the AsCAP to undertake a scoping study for the establishment of an effective pothole-and-patch-repair programme for the rural road network in Bangladesh. The research conducted by Council for Scientific and Industrial Research (CSIR), reviewed and analysed relevant documents and mapped best practices in pothole-and-patch repairs informed LGED the options for a suitably revised methodology and made recommendations for the adoption of a countrywide pothole-and-patch-repair programme.</p> <p>It analysed and provided recommendations on:</p> <p>It analysed and provided recommendations on:</p> <ol style="list-style-type: none"> Mobile Maintenance Team (MMT) staffing; Pothole-repair vehicles and equipment; Pothole-repair materials/options; Pothole-repair management and reporting systems; Outsourcing pothole-repair; MMT budget requirements; The need for updating LGED guidelines for rural roads maintenance <p>Cost-Benefit Analysis (CBA), in terms of the evaluation of the life cycle costs associated with selected pothole-repair methods, was also conducted. Recommendations for future research were also provided.</p> <p>These findings were shared by CSIR through a knowledge-sharing and dissemination strategy, which consolidated stakeholder views to inform and validated the findings effectively.</p>

The Project team had an e-workshop with (i) Mr. Abdullah Al Mamun (Additional Chief Engineer, RHD); (ii) Prof. Musleh Uddin Hasan (Professor at the DURP, BUET); (iii) Mr. Delwar Hossain Mazumder (Project Director, LGED and ex-Executive Engineer of Tangail); (iv) Mr. Monzur Sadeque (National Coordinator, ReCAP, Bangladesh); (v) Mr. Joseph Haule (Team Leader, ReCAP); and (vi) Mr. Dave Runganaikaloo (Programme Director, ReCAP) (as part of stakeholders consultation on 2 June, 2020). Further, to better understand certain issues discussed in the e-workshop, the project team reached out to some critical stakeholders individually.

The project team conducted some stakeholder interactions as well. For instance, the project team met Mr Monzur at LGED in Dhaka.

Further, Service Provider (SP) designated field researchers in Bangladesh visited the Tangail district headquarters and spoke with officials in Bangladesh Bureau of Statistics to have a ground level understanding. Relevant datasets were obtained after thorough discussion with district officials. The researchers also went and had discussion with officials in the Directorate of Secondary and Higher Education, Directorate of Primary Education, Local Government Engineering Department, Directorate of Technical Education, Directorate of Madrasa Education, Bangladesh Police, Bangladesh Fire Services and Civil Defence, and Bangladesh Computer Council.

The researchers also visited some Upazilas to obtain more data. The information was obtained through discussion with officials at the Upazilas.

Service Provider triangulated data obtained through field visits, stakeholder consultations and e- workshop with information publicly available and ReCAP research reports. On the basis of all these, the project team analysed the developments in various impact and outcome indicators over time.

2.1. Project plan and deliverables

The milestone deliverables of the project were the Inception Report, the Rural Road Research Status Review Report, the Draft Impact Assessment Report, the Stakeholder Workshop Report and this Final Report.

3. Indicator Evaluation

3.1. Impact indicator 1: Improved Rural Access Index (RAI)

RAI measures the proportion of rural population that lives less than 2 kilometres away from an all-season road. It is a development indicator that gauges infrastructure levels, mobility and connectivity. The UN has included RAI in the Sustainability Development Goals (SDGs) as indicator 9.1.1.9

Table 3 – Comparison of RAI data 2006/2008 with most recent RAI calculation

Country	Original RAI	New RAI	Year	% change	Improvement
Bangladesh	37	86.7	2015	134%	49.7
Nepal	17	54.2	2015	218%	37.2
Ethiopia	32	21.6	2015	-32.5%	-10.4
Kenya	44	56	2009	27%	12
Mozambique	27	20.4	2010	-24%	-6.6
Tanzania	38	24.6	2008/2014	-35%	-13.4
Uganda	27	53.1	2015	97%	26.1
Zambia	64	17	2011	-73%	-47

Source: World Bank, 2016

The above table compares the latest RAI data for a group of ReCAP countries with the RAI calculated in 2006 (or 2008 in Tanzania’s case). It must be noted that the methodologies of calculating the original and new RAIs differ, the latter being more robust and has wider expanse. The updated methodology considers more extensive and updated data on roads including local road networks, and spatial data analyses.¹⁰ A comparison was made between the rate at which Bangladesh’s RAI increased with that of other ReCAP countries using previous and new methodologies.

ReCAP assessment of the new methodology of RAI, wherein an investigation into more than doubling of RAI from 2006 to 2016 was made, providing clarity on the interpretation of the new index. ReCAP along with World Bank applied a combination of household surveys, and GIS mapping using Census data. Rich local level data with the LGED and Bangladesh Bureau of Statistics (BBS) helped in the calculation of the new index.

Service Provider analysis highlight the following:

- RAI was first introduced in 2006. This index was calculated using a household survey that was not spatially representative. The updated methodology to calculate RAI was first introduced in a World Bank report titled “Measuring Rural Access: Using New Technologies” in 2016¹¹. However, depending on the latest data available in various countries, data from different years was taken to calculate the “new RAI” in 2016.
- The “new RAI” introduced in 2016 uses high-resolution population distribution data that has been developed by the international research community. This data is more accurate and allows one to compare the RAI of different countries more accurately.
- Though the two methodologies cannot not be compared, the RAIs of countries and their improvement over the time period 2006-2016 can be compared with each other.
- The 2-kilometre distance criteria exist for consistency reasons. Since the definition of RAI needs to be uniform across all countries, 2-kilometres has been decided as the distance criterion. To avoid any discrepancies between rural areas in the plains and rural areas in the hilly and mountainous regions, the distance criterion has been given an alternative interpretation. In such cases RAI has been interpreted as the percentage of people for whom an all-season road is less than a 20-30-minute walk

⁹ World Bank, Rural Access Index (RAI), Data Catalog, World Bank Group, Retrieved 16 March 2020, <<https://datacatalog.worldbank.org/dataset/rural-access-index-rai>>

¹⁰ International Labour Organization, October 2017, Technical Paper: Rural Access Index (RAI) - the case of Timor-Leste

¹¹ World Bank, 2016, Measuring rural access : using new technologies (English). Washington, D.C., World Bank Group, retrieved 17 March 2020, <<http://documents.worldbank.org/curated/en/367391472117815229/Measuring-rural-access-using-new-technologies>>

away¹².

- Bangladesh attained the highest improvement in RAI with it improving from 37 in 2006 to 86.7 (according to new methodology) in 2016.
- RAIs did not improve to that extent for other countries. In fact, for Ethiopia, Mozambique, Tanzania, and Zambia RAI reduced on the basis of new methodology.
- Bangladesh's RAI was discussed at length at the stakeholders e-workshop as also individually with LGED officials. LGED official Mr Monzur Sadeque (National Coordinator of Bangladesh, ReCAP) confirmed that an internal study conducted by the LGED in 2018 computed RAI at about 84. This model used a different database that has technical and road data. According to LGED, both studies (World Bank and internal study) may be deemed to be accurate.
- According to representatives of TRL, an independent research organization, ReCAP's role has been significant in defining Bangladesh's RAI. Further TRL study, too worked to improve the methodology. The 2016 methodology relies on road condition as opposed to the 2006 methodology that relied on household surveys with poor questions. TRL, therefore, confirmed that 2016 methodology is more accurate and depictive of the accessibility.

3.2. Impact indicator 2: Rural Transport Premium (RTP)

Rural Transport Premium (RTP) is defined as the fares per passenger-kilometre on LVRR relative to fares on long-distance bus services. For this study, the impact indicator helps in gauging how costly or feasible it is for residents of rural Bangladesh to travel using modes of transport other than long-distance bus services.

A reduction in the cost of traveling using other modes of transport is likely to result in an increase in mobility of residents of rural Bangladesh. It also suggests rural roads being more accessible to a large number of rural people.

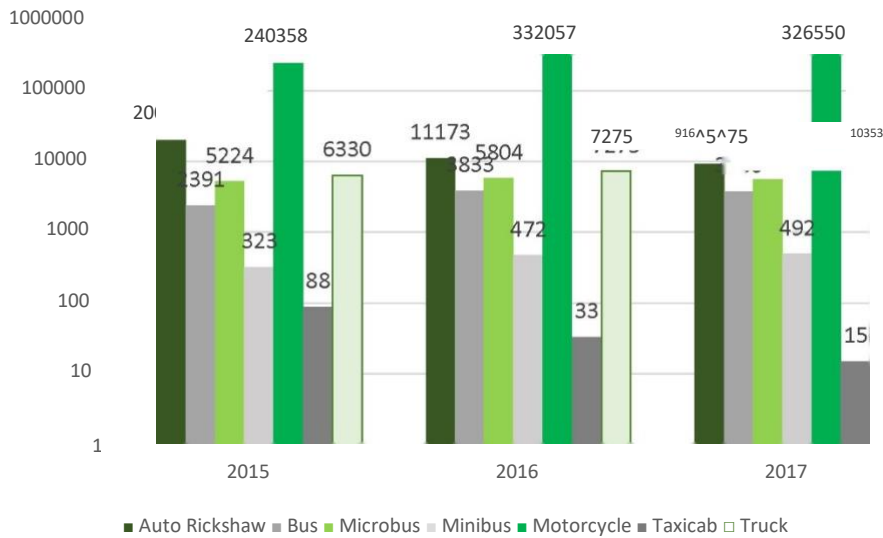
Discussions with representatives of TRL (Annexure 3) suggest that though the RTP is an indicator with significant potential, it is not yet a well-developed concept. Trials of measuring RTP were conducted in Nepal and Tanzania alone.

Baseline data related to RTP for Impact Indicator 2, Tanzania, Myanmar, and Nepal for the year 2014 is available. Baseline data for Bangladesh in the ReCAP logframe for impact indicator 2, however, is not available.

Rural Transport Premium (RTP) was not developed for Bangladesh in the absence of which, Service Provider (SP) conducted an analysis of the status and evolution of transportation costs in Bangladesh over the last few years. Therefore, as a proxy, Vehicle Operation Cost (VOC) as an indicator has been used to arrive at something closer to RTP.

¹² International Labour Organization, October 2017, Technical Paper: Rural Access Index (RAI) - the case of Timor-Leste

Figure 2 Registered Motorized Vehicles (Numbers)

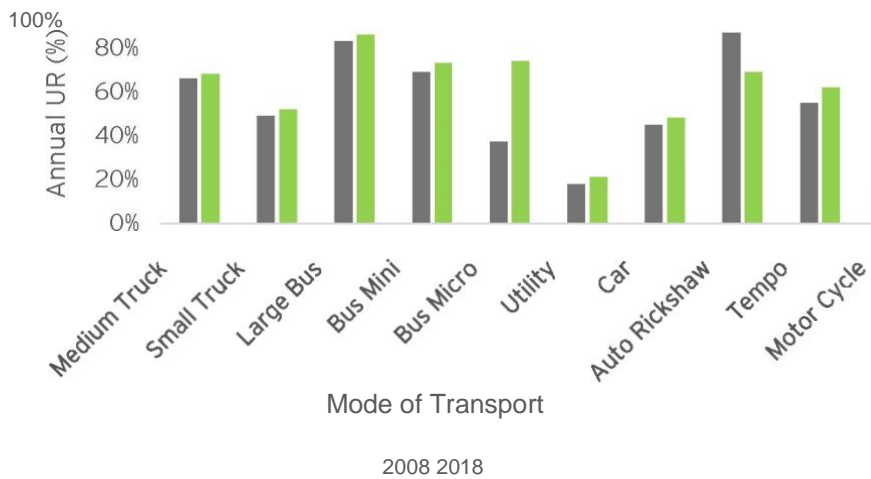


Source: Road User Cost Study for Year 2018-19, Final Report, Ministry of Local Government, Rural Development and Cooperatives, Local Government Engineering Department (LGED), June 2018

The above figure reflects the number of new registered motorized vehicles in Bangladesh added annually between 2015-2017. The graph exhibits a steep fall in the number of new registered motorized auto rickshaws but increase in the number of new registered buses, cars, and trucks at different rates. It was also noted, the number of registered motorcycles increased by 36% between 2015 and 2018 from 2,40,358 to 3,26,550. The reduced dependence on autorickshaws, thus, can be attributed to better accessibility to roads.

Consultations with LGED officials and other stakeholders suggested that the number of new registered motorized vehicles, in fact, may not reflect the actual number of vehicles being used on roads. This is because a huge number of vehicles are being used without approval as they do not meet the new emission requirements.

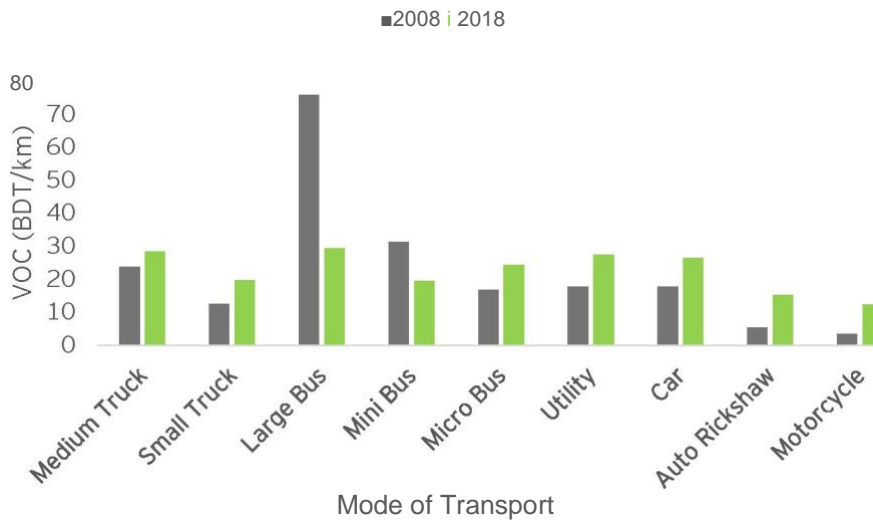
Figure 3 Annual Utilization Rates (%)



Source: Road User Cost Study for Year 2018-19, Final Report, Ministry of Local Government, Rural Development and Cooperatives, Local Government Engineering Department (LGED), June 2018

The above graph illustrates the annual utilization rates—indicator of how extensively and frequently a vehicle is used—of various vehicle types in Bangladesh. The most dramatic increase in utilization rate can be seen in micro-buses. This could be due to improvement/expansion or higher maintenance of LVRR enabling micro buses to ply more efficiently.

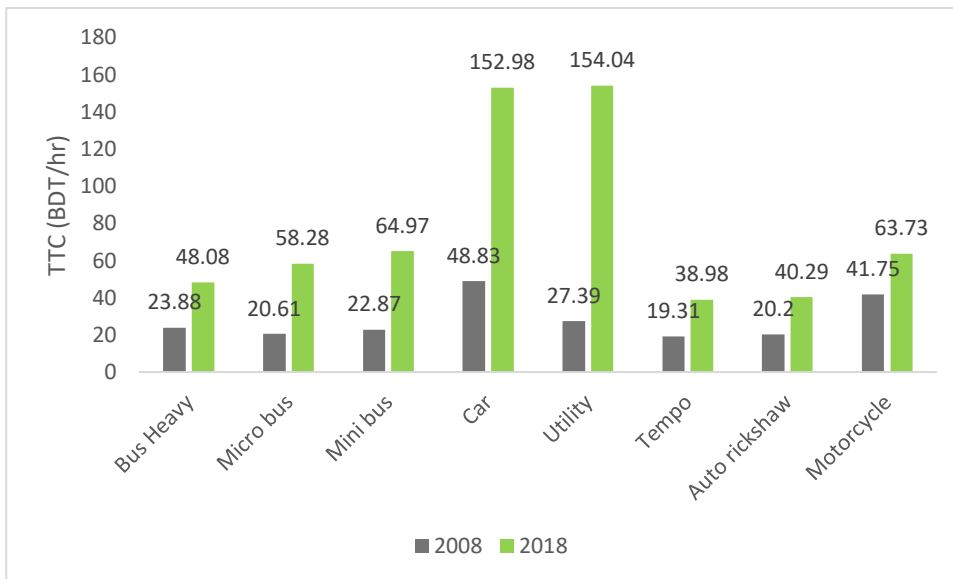
Figure 4 Vehicle Operating Cost (VOC) in Bangladesh (BDT/km)



Source: Road User Cost Study for Year 2018-19, Final Report, Ministry of Local Government, Rural Development and Cooperatives, Local Government Engineering Department (LGED), June 2018

The above graph exhibits financial VoCs,--the retail market value of the vehicle and its maintenance— which have reduced for large buses, and mini-buses between 2008 and 2018 but increased for all other vehicle types during the same period. According to the LGED, this most likely is because of: (i) a faulty and misleading methodology used by LGED to calculate the financial cost in 2008; and (ii) an increase in the retail market values of most motorized vehicles in Bangladesh between 2008 and 2018.

Figure 5 Travel Time Cost (TTC) per passenger (BDT/hr)



Source: Road User Cost Study for Year 2018-19, Final Report, Ministry of Local Government, Rural Development and Cooperatives, Local Government Engineering Department (LGED), June 2018

The above graph reflects TTC-- the opportunity cost of time spent travelling-- of passengers travelling in different types of vehicles. The most dramatic increase in TTC can be seen in cars and utility vehicles. This can be on account of two reasons: 1) lengthening of rural roads, and 2) higher vehicular traffic on existing roads.

Insights from a telephonic survey conducted in Tangail, suggest that better quality roads and a denser road network has helped improve connectivity to cities. The chairman of a union in Kalihati, Tangail mentioned that

the average travel time from a village in Tangail district to Tangail city reduced from approximately 1 hour five years ago, to approximately 12 minutes presently.

Different sub-segments of motor vehicles have been analysed in different graphs as SP had to depend on publicly available data sources and reports shared by some stakeholders. The idea of not clubbing sub-segments was to analyse as much granularity as possible.

3.3. Outcome indicator 1: Sustainability- Partner Government and other financiers co-funding research with ReCAP

BAN 2083 A - Ground improvement techniques for Khulna Soft Clay Soil by Mott Macdonald

Background

The resilience of rural road embankments exposed to an aggressive coastal environment, in areas of high flood risk and embankments constructed on soft soil deposits-- with high compressible organic content-- are a major concern for citizens and authorities of Bangladesh where they can experience settlement failures relatively early in their lifespan; and the scale of the problem spans over 4,500 km of village roads, 800 km of Upazila roads, and 475 km of Union roads.

State of available research

There is a large pool of existing research including geological and hydrological studies specific to the Khulna region. Additionally, international studies, research projects and innovative engineering projects have addressed the issues of durability, settlement and seismic behaviour for infrastructure founded on soft and compressible soils.

The Need

There was a need to organise the findings of this research based on their relevance and applicability in Bangladesh, besides to understand the effectiveness and limitations of existing ground improvement techniques implemented in Khulna region, and to help develop appropriate recommendations to overcome the typical construction challenges for road embankments and structures in Khulna region. To this effect, Mott MacDonald was contracted by Cardno, which is using the results gained through the research developed observational ground models, which will help improve the resilience of rural road embankments exposed to a coastal environment once uptake has been facilitated.

The research helped the authorities concerned understand the deformation mechanisms and assess the likely contributory causes. Mott Macdonald helped LGED identify potential ground improvement techniques that are (a) technically feasible and (b) within the likely budget for rural road construction together with guidance for implementation which will help counter specific construction issues, which once taken up will improve resilience of the structures constructed.

Mott Macdonald has also identified topics for further research that will improve the ability to apply ground improvement techniques in Khulna Region.

LGED has further instructed its district engineers to explore use of improvement techniques in their region, if applicable.

LGED support in implementation of this project

Given the complex nature of this project and the potentially positive results this research generated, LGED provided a full-fledged logistics support, which when calculated in monetary terms came up to GBP 1,400. LGED, while recognizing the need for such a research project is also planning to completely fund the extension of this project which will focus on the development of Design and Construction Guidelines.

RAS2145A - DCP DN Workshop LGED provided the trainees time (No. 7) for a total of 7 days (est. 49 days @ £50 per day)

Background

The Dynamic Cone Penetrometer (DCP) has been an established tool for in-situ estimation of sub-grade strength for more than 20 years and has been used extensively. An alternative method for DCP application has been developed for pavement structural design that avoids the use of direct correlation with the California Bearing Ratio (CBR) test by utilising the cone penetration rate (DN value) obtained directly from DCP measurements to quantify the in-situ strength of materials. This procedure is becoming popular because of its simplicity in the upgrading design of low volume sealed roads (LVSR).

RECAP's intervention and LGED contribution

Given how widely promoted as a simple yet appropriate low volume road design method in developing countries, a training was conducted by trainers with extensive experience in DCP- DN design method for low volume roads for seven LGED officials, individually for seven days.

The resultant impact and LGED's contribution

LGED contributed approximately GBP 2,450 to ensure the training mechanism and knowledge transfer of the highest quality in order to enable wider application of this innovative design methodology for cost-effective provision of LVSR.

The training has strengthened opportunities for uptake of national, regional and international best practices, particularly in relation to innovative and appropriate design methods for low volume roads.

BAN2077A - For the concrete in Concrete in Marine Environment project LGED provided significant laboratory support estimated at 240 man-days (@£50 per day)

Background

Bangladesh has a vast coastal infrastructure which is affected by climate change and associated extreme environmental conditions. The reinforced concrete structures in the coastal regions deteriorate rapidly due to exposure to aggressive marine environment, poor workmanship, limited availability of good quality materials and lack of awareness on good construction practices.

The need

While LGED plans building more than 200,000 linear metres of concrete bridges/culverts in the rural coastal areas over the next ten years, there is a need to construct durable concrete structures to withstand the aggressive coastal environment for the intended design life, there is also a need to study the local factors that influence the durability of reinforced concrete structures.

The research Intervention

This project has helped examine the major factors that contribute towards premature deterioration of concrete structures and has suggested a cost-effective concrete mix design, which once embedded and taken up by LGED will help enhance the durability of structures constructed in the future, while also improving the construction practices and workmanship thereby improving their service life. LGED has further instructed its district engineers to explore use of improvement techniques in their region.

LGED's contribution

The project was conducted across 4 stages - Inception, Condition Survey, Laboratory Testing and Stakeholder Workshops. LGED was particularly interested in the results of this project and provided significant laboratory support estimated at 240 man-days (at £50 per day), which works out to a contribution amount of GBP 12,000 along with an additional GBP 1,400 in logistics support.

BAN2143A - The Peer Review project involves the finalisation of an existing LGED funded project (LGED had originally commissioned BUET to develop the manual, reported contract price c.US\$450,000)

Background

The Bangladesh University of Engineering and Technology (BUET) and the Bureau of Research and Testing (BRTC) were contracted to review and update the existing road design manual used by the LGED, whose contract price was USD 450,000.

Need for a Peer Review

The report submitted by BUET triggered concerns as it did not cover the agreed upon scope. To fill the gap, LGED requested an independent review and invited recommendations for its improvement, which executed alterations in the original report, while also identifying missing topics as also topics that had not been dealt with satisfactorily.

Working on the recommendation, a further report was produced by BUET and BRTC in October 2018 titled "Final Report of Consultancy Services for Assessment of Road Design and Pavement Standards". However, this document also did not adequately address many of the issues identified in the Review. This compelled LGED to initiate a peer review project under John Rolt who through various stakeholder consultations and field investigations corrected the deficiencies identified in the review.

Expected Output

Post deliberations with its supervisory engineers, LGED will update their Road Design and Pavement Standards Manual and move towards implementation which will influence durability and quality of the structures constructed. Contribution amount from Bangladesh: approx. GBP 345,000.

RAS2117A - Development of National Business Plans for the Establishment of Road Research Units/Centres in AsCAP Member Countries, BMJA Verhaeghe, Council for Scientific and Industrial Research (CSIR), South Africa

Background

The Asia Community Access Partnership (AsCAP), funded by a grant from the UK Government through the Department for International Development (DFID), aims to promote safe and sustainable rural access in Asia through research and knowledge sharing between participating countries and the wider community. Based on the outcomes of project scoping exercises undertaken in Bangladesh, the need for the establishment of road research capacity within the partner government department, i.e. LGED was identified as a high priority in order to support and sustain research and knowledge management related to rural access.

To address the above need, AsCAP initiated a project to develop action/establishment plans supporting the needs of Bangladesh through the Council for Scientific and Industrial Research (CSIR), South Africa. This plan addresses issues pertaining to sustainable institutional arrangements, capacity building interventions and funding sources to support the road research centre or unit on an ongoing basis.

The Business Plan for First Five Years of Operation

CSIR, under RAS2117A proposed an indicative Business Plan for the first five years of operation of the Research and Development Unit (RDU) of the Local Government Engineering Department (LGED). The Business Plan is expected to evolve over time in line with the shifting views and expectations of LGED under the Local Government Division of the Ministry of Local Government, Rural Development and Cooperatives, and the realities associated with the physical establishment of the RDU. This Business Plan outlined the following:

- a. The vision, mission, goal and strategic objective of the RDU;
- b. The strategy to tackle governance issues, including the role of the Steering Committee that will maintain strategic oversight. The plan also provides preliminary recommendations on sources of funding, critical success factors and key performance indicators, as well as strategic relationships and

- linkages, both nationally and internationally;
- c. Potential research, development and implementation plan, in which the role of the Research and Development Advisory Committee (RDAC) is presented, as well as the process for developing a Rural Road Research Plan in the foundation phase of RDU, with the view to broaden the scope by including the research and development needs for all local infrastructure in subsequent phases. This chapter also outlines the importance of establishing working groups and technical committees to support and add value to the activities of the RDU, and the importance of including demonstration projects;
 - d. Capacitation of the RDU in terms of human resources - the critical operational issues that could impact the performance of the RDU, including both human resource and supporting infrastructure to sustain its operations in line with its mandate. It has also addressed issues such as recruitment of staff; the skills development plan, and supporting infrastructure;
 - e. Knowledge management, inclusive of information transfer and the importance of an information centre and of holding training courses, seminars and workshops for the uptake and embedment of new knowledge;
 - f. A tentative cost structure for the RDU, which may be used for preliminary planning and budgetary purposes. However, the cost structure will have to be reviewed and adjusted in line with the outcomes of the physical establishment of the RDU.

Current Status

Basis our discussion with LGED, we learnt that various government research institutes already exist, such as, National Institute of Local Government (NILG) and National Academy for Planning and Development (NAPD). However, their operations have not brought about the kind of impact they could have. They are being led by bureaucrats without any Engineers or Transport sector professionals on board.

Further, the Roads and Highways Department (RHD) has got a Road Research Laboratory which focusses on material testing.

LGED has recently established its R&D Unit, which is yet to operate seamlessly. The initiative which has been taken by LGED, has been influenced by the ReCAP Project.

3.4. Outcome indicator 2: Concrete Examples of Change

Bangladesh's vast rural road network of about 3,53,000 km is managed by the LGED in collaboration with Local Government Institutions (LGIs). The rural roads connect 87,000 villages with Zila, Upazila and Union HQs and other important market centres, as well as the National and Regional Highways and Zila roads are managed by the Roads and Highways Department (RHD).

Keeping in mind the vast rural road network in Bangladesh, it is important to understand the socioeconomic development opportunities a road brings on with its construction. The illustrative below depicts the viewpoints of individuals of different professions from Tangail, who have witnessed socioeconomic impact of the development of roads in their district.

With an effort to understand the importance of rural roads in Bangladesh, our team interacted with opinion leaders, professionals in various fields to understand the need for rural connectivity and how it has helped in overall socio-economic growth. This will help in validating the need for prioritisation for rural accessibility - given the fact there is still more than 2,56,000KM of unpaved roads yet to be developed

Improved access to medical facilities

"As a medical practitioner. I saw Tangail grow from having almost no formal medical facilities to 9 established community clinics in every Union Parishad stationed with MBBS graduates, all of which was possible due to the rural connectivity. Moreover, it has reduced travel time to hospitals from 1 hour to 15 minutes while also enabling the availability of specialist doctors to remote villages."

-A member of the Bangladesh Medical Association, Tangail

Better enrolment and attendance rates

"As a teacher for 20 years. I realised how merely the construction of roads has helped improve access to schools, thereby improving the enrolment rates especially among girls. While earlier all transport was through boats, the development of roads has helped teachers and students save both travel time and money, improving attendance rates even during bad weather."

-School Head Master in Kalihati Upazila, Tangail

Better value realisation for agricultural commodities and diversification of economic activities

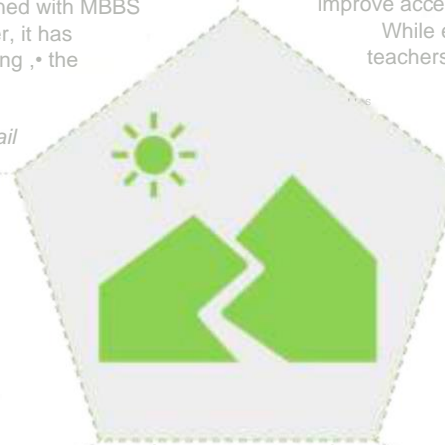
"Coming from a farming background. I am aware of the economic losses farmers face in the absence of roads. However, I have witnessed the changes road construction has brought to the lives of us farmers. The time and cost of transporting produce has reduced significantly, helping us realise appropriate value for our commodities and has also helped us diversify to allied agricultural activities. Moreover, educated people have started coming back to our village and have started their own business, thereby improving rural economy."

~ Owner of a Saw Mill. Kalihati. Tangail

Enhanced trading and improved standard of living

"Prior to the construction of roads by LGED, there was limited mobility which brought about extensive disruptions in the supply chain. Traders would carry goods in boats and sometimes on their head in order to transport them. The construction of roads saw not only improvement in supply chains, but also saw diversification of products amongst traders, better value realisation, thus improving the standard of living among rural masses."

-Proprietor in Chamuria Bazar, Kalihati, Tangail



Impetus to rural development

"As a Chairman of the Bangra Union Parishad for the past 7 years, I seen how improvements in rural access has benefitted Bangra. From the diversification of economic activity, development of MSMEs, financial independence among women to improved access to information, all of this has been possible only after LGED developed the road infrastructure."

-Chairman of a Union Parishad, tangail

BAN2072A - Rural Road Planning and Prioritisation Model (RPPM)

Background

As of September 2017, about 97,000 km of rural roads were paved; the rest being undeveloped earth roads. Many Upazila and Union roads or parts of them are still unpaved. The Government has a policy to improve such Upazila and Union roads. Also, many villages are yet to be connected by all-weather roads. With majority of the population of Bangladesh living in rural areas, there is a need to develop the rural road infrastructure in Bangladesh.

With more than 2,00,000 km roads to be developed, there is a need to develop a planning and prioritisation methodology for the development and maintenance of rural roads on a sustainable basis due to increasing traffic (that affect durability of roads), growing population and need for continuous upgradation and maintenance of roads. The current computer-based priority ranking model for road maintenance is used for the prioritisation of road maintenance work and is based on parameters such as road type, surface type, traffic volume, markets, hospitals, social centres, educational institutions which have assigned, and unjustified weights. Apart from this, the development of roads is based on its hierarchy and level of connectivity. There is no simple method in place for prioritisation among Upazila-to-Upazila roads, Union-to-Union roads and Village-to- Village roads. Moreover, analysing and prioritising the development from a macro perspective has not been done previously. RHD, too had developed a methodology for their road network but considered indicators which are used for high-volume roads and are not applicable to low-volume rural roads. To this effect, ReCAP commissioned BUET to provide its research support to develop:

- A. Methodology on planning and prioritisation of rural roads - developed for three types of road development:
 1. Improvement - Converting an earth road to a paved road i.e., from earth to Bituminous Concrete (BC)/ Reinforced Cement Concrete (RCC) in an existing alignment; converting a partly paved road to a fully paved road; and converting a Herring Bone Bond (HBB) road to a fully paved road
 2. Further improvement/Upgrading - Improvement of road geometric standards, raising of embankment and widening of pavement and/or road crest and raising of road embankments of an existing road
 3. Maintenance - Maintenance of an already paved or partly paved road (BC, RCC or HBB).
- B. An application tool (software) to implement the methodology; and
- C. User manual and training of 15 professionals to use the application tool

Intervention

The development of the RPPM saw a seamless synergy between BUET, LGED and ReCAP. The RPPM tool was tested for Tangail District and is expected to directly influence planning and prioritisation for upgrading and maintenance of all 2,56,000 km of unpaved roads nationally.

During the inception phase, BUET proposed a methodology for prioritisation which was dependent on extensive data to be sourced from LGED. However, the accuracy and granularity of data required as per the proposed methodology was not available with LGED. This compelled BUET to review and revise the methodology for prioritization of rural roads. Revision and review of the methodology incorporated viewpoints from both LGED as well as ReCAP. Professor Musleh from BUET states, "ReCAP expertise in helping us revise the methodology is highly appreciated by our team. ReCAP, as the funder never imposed any suggestions or solutions, instead encouraged us to find homegrown solutions. They shared their experiences in Africa and other Asian countries to help us plan and execute our work for Bangladesh."

Initially a set of criteria, reflecting policy and social objectives of rural road development, was identified considering LGED's current practice. A survey was conducted among the stakeholders (including LGED officials) to identify the potential criteria. Local context was also taken into consideration which was enabled by conducting a local-level workshop. The workshop was attended by LGED Officials, BUET and local stakeholders such as the Upazila chairmen, Union Chairmen as also women representatives. This workshop enabled for the first time, participatory planning which incorporated local viewpoints while developing the

RPPM.

BUET then shortlisted the criteria for the appraisal of prioritisation using a Multi- Criteria Analysis (MCA) or a Cost Benefit Analysis (CBA), approaches propagated by LGED and ReCAP. The selected criteria included variables such as access to markets and services, connectivity, traffic volume, social and economic factors, etc. which were selected from among a list of potential criteria by conducting an Analytic Hierarchy Process (AHP) survey amongst the stakeholders including experts and LGED officials. That was then reviewed and agreed by the Working Group (WG).

Basis the Model, ReCAP has also developed a web-based application tool which provides reports based on priority score and ranking of a road. Outputs are available in both a tabular and graphical form. The information being captured by the RPPM tool may be effectively used to draft relevant policies.

ReCAP has further developed a *User Guide*, while also providing training to LGED officials to ease uptake and embedment. The LGED has validated and accepted this Planning and Prioritisation Tool as it now will make the selection process for development of a certain road, out of many roads, optimal and rational. The development of roads will further lead to socio- economic development of the rural people and transform the rural economy of Bangladesh.

Output

The Planning and Prioritisation tool developed for LGED in Bangladesh (BAN2072A) will directly influence planning and prioritisation for upgrading and maintenance of all 2,56,000 km of unpaved roads nationally and help connect over 87,000 villages. The Bangladesh Government, in its development agenda is focussing on agriculture and rural development to improve rural income and ensure food security. RPPM could play an important role in operationalising these priorities.

Mr. Delwar Hossain Mazumder, the Project Director and ex-Executive Engineer for Tangail with LGED stated that RPPM will be executed across Bangladesh to help implement the Government's manifesto "My Village, My Town". Additionally, an R&D Unit of LGED has been created; LGED has introduced mobile maintenance unit; and has also started using this framework in their National Policy formulation.

Further enhancements to the RPPM Tool

While RPPM identifies roads that need to be developed, there is a gap in terms of identifying the villages that require socio-economic development. This will require incorporation of appropriate data such as indicators pertaining to poverty and other relevant indicators. However, there is a lack of accuracy and granularity in the existing data and in order to capture this information in the RPPM tool, the combined data can be used to complement the overall development in Bangladesh. The RPPM tool can be effectively used to inform Bangladesh's development agenda with incorporation of indicators pertaining to poverty and other factors. However, this is only possible with improved data necessitating considerable amount of data collection at granular levels.

The government too, has expressed a need for the enhancement of the RPPM tool by recognising priority villages that require development and the necessary road construction/ maintenance to ensure the same. For this, RPPM cannot be looked at in isolation and combining RAI data to identify priority villages will help.

3.5. Outcome indicator 3: Number of citations in academic articles of ReCAP articles

Peer reviewed papers - agreed international conferences

Srinivasan, S. and Gibb, I. (2018). Climate Resilient Concrete Structures in Marine Environment of Bangladesh. In: Basheer, P. (2018). Proceedings of 6th International Conference on Durability of Concrete Structures (ICDCS2018), 18-20 July 2018, University of Leeds, pp. 321-336. Dunbeath: Whittles Publishing

Peer reviewed papers - agreed national or regional conference

Srinivasan, S. (2018). Climate resilient reinforced concrete structures in coastal environment - Bangladesh Case Study. In: Proceedings of 2nd iTRARR conference, Mombasa, June 2018.

Apart from the above, the Bangladesh Specification for Concrete mix for coastal areas of Bangladesh was incorporated into the World Bank supported “Program for Supporting Rural Bridges (USD625m).

Additionally, the Mott MacDonald on Climate Resilient Concrete Structures in Marine Environment of Bangladesh (project reference BAN2077A) research paper, presented at the 6th International Conference on Durability of Concrete Structures (ICDCS2018), 18-20 July 2018, organised by the University of Leeds, was awarded the second-placed prize for best conference paper.

Journal Articles- international journal

Zafri, N. M., Sameen, I., Jahangir, A., Tabassum, N., and Hasan, M. M. U. (2020). A multi-criteria decision-making approach for quantification of accessibility to market facilities in rural areas: an application in Bangladesh. *Geo-Journal*. <https://doi.org/10.1007/s10708-020-10161-z>. The study seeks to propose a flexible and practical approach for quantifying and ranking the accessibility to market facilities in rural areas.

Reference: ReCAP. (2016). The contribution of rural transport to the sustainable development goals. Retrieved April 23, 2019, from https://slocat.net/wpcontent/uploads/2020/02/SLOCAT_2017_rural-transport-fact-sheet-key-messages-en.pdf

Newsletter- national

LGED Newsletter: A quarterly publication of LGED, January-March 2018. Issue No.128, Regd. No. 24/87. *With the help of UK Aid, LGED is conducting a research on fixing priority for rural road planning and development under ReCAP. The software developed by LGED will help take decision in the selection of roads. LGED is conducting three research programmes with the help of RECAP and one of them is planning and fixing priority of the rural roads. The newly developed software will ease decision making process as well as identifying core rural network of LGED and keep those usable.*

LGED Newsletter: A quarterly publication of LGED, October-December 2016. Issue No., Regd. No. 24/87. *LGED and DFID signed agreement on research on sustainable rural road planning, construction, maintenance and management. Under the agreement, Research for Community Access to Partnership (ReCAP) will jointly conduct research with LGED. The project will continue up to December 2020.*

3.6. Output Indicator 1: Cost Benefit Analysis

Conducted to determine cost effectiveness of the solutions proposed based on ReCAP research, conducted on a whole of life road cost basis

BAN2072A: Planning and Prioritisation of Rural Roads in Bangladesh

The Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology was contracted.

Multi- Criteria Analysis (MCA) and Cost Benefit Analysis (CBA) were used for the appraisal of prioritisation of rural roads. Initially a set of criteria, reflecting policy and social objectives of rural road development, was identified considering LGED’s current practice. A survey was conducted amongst the relevant stakeholders including local government representatives to identify the potential criteria, which included variables such as access to markets and services, connectivity, traffic volume, social and economic factors, etc. using Analytic Hierarchy Process (AHP) survey. After selection of the MCA criteria, their relative weights were established, which were as follows:

Table 4 – Relative weights of the MCA criteria

	Types of facilities	Weight of the Facility
Educational facilities	Primary School	1
	Secondary School	3
	High Madrasa	6
	College	9
Health Facilities	Community clinic/ FWC	1
	Union Health centre	6
	Upazila health centre	9
	Non-govt hospital	9
	Private Clinic	9
Other Facilities	Small Industry	1
	Medium Industry	3
	Large Industry	6
	Cyclone shelter	1
	Cyclone shelter cum school	1
	Other Public Centre	3
Growth Centres/ Market Centres	Growth Centre	6
	Rural market	1

As health and educational indicators have been assigned higher weightage, suggests the methodology used was appropriate, given both economic and social parameters have been taken into consideration.

The results of CBA are an important consideration for the policy makers including the Planning Commission for making an investment decision. The CBA, propagated by LGED and ReCAP to be a part of the prioritisation methodology, is based on calculation of economic internal rate of return (EIRR). Vehicle operating speeds and costs by road roughness condition, value of time of passengers etc. were some important elements of economic benefits considered for computing EIRR. However, more economic benefits such as lower road accidents, higher transportation of agricultural products, higher mobility of labour force could also have been considered subject to data availability.

The MCA procedure developed to consider the access and connectivity benefits of rural roads are not well reflected in CBA, especially for very low-volume roads. For instance, the criterion considered for MCA included, amongst others, traffic volume, number and types of socio-economic facilities, growth centre and rural markets served, connectivity and local priority.

The MCA results, therefore, can complement the CBA results (EIRR values), especially for low volume roads. A high MCA score of a road reflecting its significant access benefits may also justify its priority for development even if the EIRR value is low.

Achievements of this research study BAN2072A Planning and Prioritization of Rural Roads in Bangladesh- The methodology was integrated into the planning and prioritisation model and is currently being used by LGED for their rural road network.

Planning and prioritization Tool, LGED, Bangladesh, has been formally adopted by Government of Bangladesh and is being rolled out nationally through the ADB assisted Rural Connectivity Improvement Project.

The outcome is that the Planning and Prioritization tool developed for LGED in Bangladesh will directly influence the planning and prioritisation for upgrading and maintenance of all 2,56,000 KM of unpaved roads nationally.

BAN2077A: Climate Resilient Concrete Structures in Marine Environments of Bangladesh

A cost benefit analysis was conducted to analyse the benefits of the proposed concrete specifications of the research. The report detailed the proposed concrete mix versus the current concrete mix that LGED utilises to highlight the durability of the proposed concrete mix. The proposed concrete mix is backed by an extensive literature review, condition survey of concrete structures, intensive field and laboratory testing and detailed discussions with relevant stakeholders, thus improving its acceptability. Further, a cost comparison between the Nominal concrete mix and the recommended durable concrete mix has been presented below:

Table 5 Cost comparison Nominal Concrete Mix and Durable Concrete Mix

Materials	Nominal mix 1:1.5:3 (Stone aggregates)		Nominal mix 1:1.5:3 (Brick aggregates)		Durable Concrete Mix (Stone aggregate)	
	Quantity (kg per m ³)	Cost (BDT)	Quantity (kg per m ³)	Cost (BDT)	Quantity (kg per m ³)	Cost (BDT)
Cement	400	3360	400	3360	350	2940
Fly Ash	0	0	0	0	150	420
Water	164	Free	164	Free	200	Free
Coarse Aggregate	1268	5200	981	2889	990	3933
Sand	614	1156	614	1156	660	1165
HRWR	4	600	4	600	5	750
Total Cost	10,316 BDT/m ³		8,005 BDT/m ³		9208 BDT/m ³	
Present Value of Lifecycle cost (BDT)	16,29,762		16,91,466		791,982	

Achievement of this study

This project has helped examine the major factors that contribute towards premature deterioration of concrete structures and suggests a cost-effective concrete mix design to enhance the durability of structures constructed in the future, while also making recommendations towards improving construction practice and workmanship, thereby improving service life.

The cost analysis study for a sample structural element (deck slab of bridge/culvert) concludes that the recommended durable concrete mix fulfils the 75-year design life with no major repair costs. On the other hand, the current LGED specified concrete mixes incur repair costs, which is therefore not a cost-effective design for concrete structures in coastal regions of Bangladesh.

From the table above, the unit cost of durable concrete mix is observed to be lower than the nominal concrete mix when stone aggregates are used in the mix, but higher than the nominal concrete mix when brick aggregates are used. However, the strength and durability of designed concrete mix will be far better than the brick aggregate nominal concrete mix. The economic life cycle cost of adopting the ReCAP recommended concrete mixes are approximately 50% lower than the existing standard mixes applied. The Present value of life-cycle costs (discounted at 6% of the three concrete mix options for 300 square metre deck slab). Life cycle costs will reduce from BDT 1.63 billion to BDT 0.79 billion, if the research findings and

recommendations are adopted (durable mix 30% fly ash and stone aggregate).

It should be noted that, in the case of durable concrete mix, additional capital costs to perform trial mixes and durability tests in the laboratory will be incurred when utilised.

BAN2169A: Scoping Study for Establishment of an Effective Pothole and Patch Repair Programme for the Rural Road Network of LGED in Bangladesh

The current LGED's road asset management programme is comprehensive, covering approximately 110,000 km of paved rural roads. At present, LGED has a district-based patch repairing programme - Mobile Maintenance Teams (MMTs). The district offices of LGED deliver this programme with a set of vehicles, equipment and manual labour. Due to limited staff and resources, it is difficult for the district offices to manage this large road network effectively, and LGED therefore intends to implement a revised systematic approach for the pothole-and-patch- repair programme for Bangladesh's Rural Road Network. Given the need for efficiency, LGED requested this scoping study for the establishment of an effective pothole-and-patch-repair programme for the rural road network of LGED in Bangladesh be conducted to research and investigate best practices in patch-and-pothole-repair processes. This study was conducted by Council for Scientific and Industrial Research (CSIR), who provided recommendations on the following:

- a. Mobile Maintenance Team (MMT) staffing;
- b. Pothole-repair vehicles and equipment;
- c. Pothole-repair materials/options;
- d. Pothole-repair management and reporting systems;
- e. Outsourcing pothole-repair;
- f. MMT budget requirements;
- g. The need for updating LGED guidelines for rural roads maintenance

A Cost-Benefit Analysis (CBA), in terms of the evaluation of the life cycle costs associated with selected pothole-repair methods, was also conducted. This CBA was approached by the team through a method proposed by Thomas and Anderson (1986). This allowed the team to establish the costs of pothole-repair using each of the five methods. The costs of different pothole-repair methods are best compared in terms of the unit cost for placing the repair material, (usually expressed in terms of cost/ton). The pothole-repair costs depend on the labour, equipment and material costs - deriving the unit cost for repair, which is based on the equation below:

$$\text{Cost/ton} = \{[(\text{Daily labour cost} + \text{Daily equipment cost})/(\text{Tons/day})] + \text{Material cost/ton}\}$$

Basis the above equation, CSIR derived five methods to understand the most cost-effective method for pothole repairs. The results indicate that in terms of cost per ton, method 2 is the cheapest, followed by methods 1,4, 3 and 5. A summary of the same has been presented below:

Table 6 Cost-effectiveness of methods for pothole repair

Method	Repair cost per ton (TK/ton)	Repair cost per ton (USD/ton)
	<i>Considers daily labour cost, daily equipment cost and daily material cost</i>	<i>Considers daily labour cost, daily equipment cost and daily material cost</i>
1	12,182	143
2	11,440	135
3	13,945	164
4	12,440	146
5	15,027	177

However, CSIR went on to understand the expected benefits related to the longevity or life expectancy of the repaired pothole to compare the cost of each of the pothole repair methods through the Life Cycle Cost Analysis (LCCA). LCCA accounts for all costs of an investment over the entire life. Costs occurring at different times are placed on a comparable basis by reducing the future amounts using the present worth of cost (PWOC) method. In this study, PWOC was used to compare the cost-effectiveness of different pothole repair methods, assuming 15 years analysis period, discount rate at 6 percent, salvage value at the end of three years was assumed zero and all the repairs are located at the same area and will be subjected to similar traffic and environmental conditions. The option with the lowest PWOC is preferred.

Table 7 PWOC values for different methods

Method	Life Expectance (years)	Analysis period (years)	PWOC per ton (TK/ton)	PWOC per ton (USD/ton)
1	1	15	125,415	1,475
2	1		117,778	1,386
3	3		50,669	596
4	3		45,198	532
5	5		54,602	642

Overall, the results indicate that in terms PWOC per ton, method 4 is the most preferred, followed by methods 3, 5, 2 and 1.

3.7. Output 2: Capacity building

Output 2.1: Summary of research projects undertaken by Bangladesh experts or institutions taking lead roles

BAN2072A: Planning and prioritisation of rural roads in Bangladesh

The Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology was contracted (GBP 143,500) to lead and execute the development of the Rural Road Planning and Prioritisation Model and its tool for implementation. The assignment deployed more than one-third senior technical researchers.

This project which witnessed its application towards the planning and prioritisation for the improvement, construction and maintenance of the rural road network in Bangladesh held multiple workshops with LGED to build capacity in order to ensure smooth uptake and implementation. The team at ReCAP along with BUET held workshops since the inception of the project which helped concerned stakeholders at LGED to consider and discuss the planning and prioritisation methodology during its ideation and preparatory stages and receive suggestions and recommendations before the BUET team could finalise the methodology. The workshops so held, therefore, helped the LGED, BUET and ReCAP stay on the same page during the course of the project, thus improving the acceptability of the final tool.

Moreover, to aid uptake, the Department of Urban and Regional Planning (DURP) of Bangladesh University of Engineering and Technology (BUET) in collaboration with LGED organised a two-day Training of the Trainers (ToT) programme to train LGED professionals as trainers to facilitate future uptake of the Rural Road Planning and Prioritisation Model (RPPM). It is expected that the RPPM tool can be implemented in other districts of Bangladesh with the help of the trained officials. The training programme was attended by 18 LGED officials, including two women participants, from the Head Quarters and field-level offices in Tangail. The deliberations and active participation of the trainees at the training programme provided valuable insights. Discussion between the trainees and trainers were found effective to identify the issues critical to the application of RPPM in other districts of Bangladesh.

Impact of engagement with ReCAP on the research and academia space in Bangladesh

According to Prof. Musleh Uddin Hasan, Professor with the Department of Urban and Regional Planning, Bangladesh University of Engineering & Technology and team lead of the RPPM development project, the research and academic space pertaining to rural infrastructure development in Bangladesh has gained an impetus post BUET's engagement with ReCAP. The engagement also saw collaboration between various departments such as Civil Engineering and the computer science department (for the development of the RPPM software) within the University.

BUET has been providing rural planning education at a master's as well as an undergraduate level. However, limited focus has been placed on rural road planning. Collaborating with LGED and ReCAP has given both the students as well as the faculty an exposure in this space and has sparked an interest in rural roads research. The project required the faculty to conduct field visits while developing the RPPM Tool, insights from which have been incorporated in its rural planning fieldwork conducted with students.

However, in order to sustain and enhance this momentum, funding and strategic partnerships are key. A mid-term level commitment should be established between BUET and the established LGED R&D unit to improve the quality of research capacity. Academia can inform planning-related aspects to LGED as well as the Government of Bangladesh.

BAN2077A: Climate Resilient Reinforced Concrete Structures in the Marine Environment of Bangladesh

To aid the uptake and embedment activities, this project witnessed Bangladeshi experts in their fields taking lead roles:

1. Md. Abdul Bashir (Deputy Team Leader)
2. Khan Amanat (Peer Review)
3. Yasmin Dil Khan (Structural Engineer)

ReCAP saw an output expenditure of GBP 90,655 for this project which includes the cost of onboarding these experts to materialise uptake and embedment.

Further, even for the Road Design and Pavement Standards Manual Project (BAN2143A) in Bangladesh, a highly experienced Hydrologist was onboarded to provide expertise and guidance to project specifics.

Output 2.2: Number of research projects with female researcher inputs at senior technical level

BAN2077A: Climate Resilient Reinforced Concrete Structures in the Marine Environment of Bangladesh Project

BAN2083A: Study on Ground Improvement Technique for soft Clayey soil of Khulna Region of Bangladesh

Both the above-mentioned projects had inputs from Tina Dil Yasmin Khan, a structural engineer informing various project specifics and uptake activities to be conducted.

3.8. Impact indicator 1: Access to Educational Institution

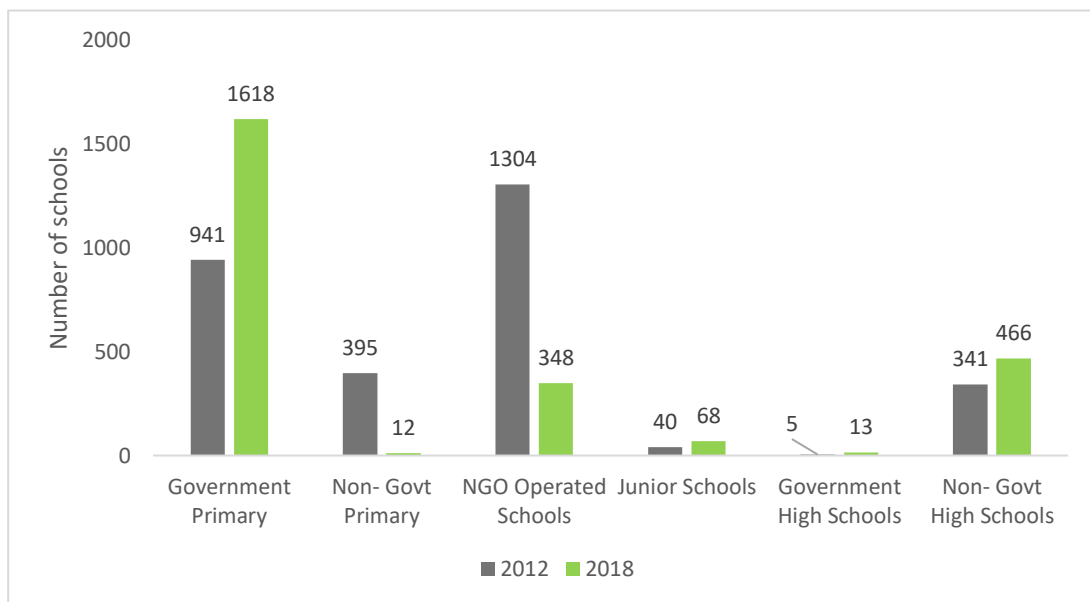
Indicators such as education, health, and infrastructure facilitate and catalyse development. This section explores possible outcomes of improvements in education and various other infrastructure and disaster

management facilities in Tangail district specifically between 2012 and 2018. Tangail district was chosen as several case studies and pilot projects took place in the district and lessons learnt from Tangail could be extended to other districts.

The below figure illustrates the increase in number of primary and secondary educational institutions in Tangail district between 2012 and 2018. It has been observed that the number of primary schools run by the government increased (677 new government primary schools were established between 2012 and 2018).

During the same period the number of non-government primary schools reduced drastically from 395 to 12. This phenomenon has largely occurred due to a government decision to nationalise nongovernment schools in 2013.¹³

Figure 6-Primary and Secondary Educational Institutions (Numbers)



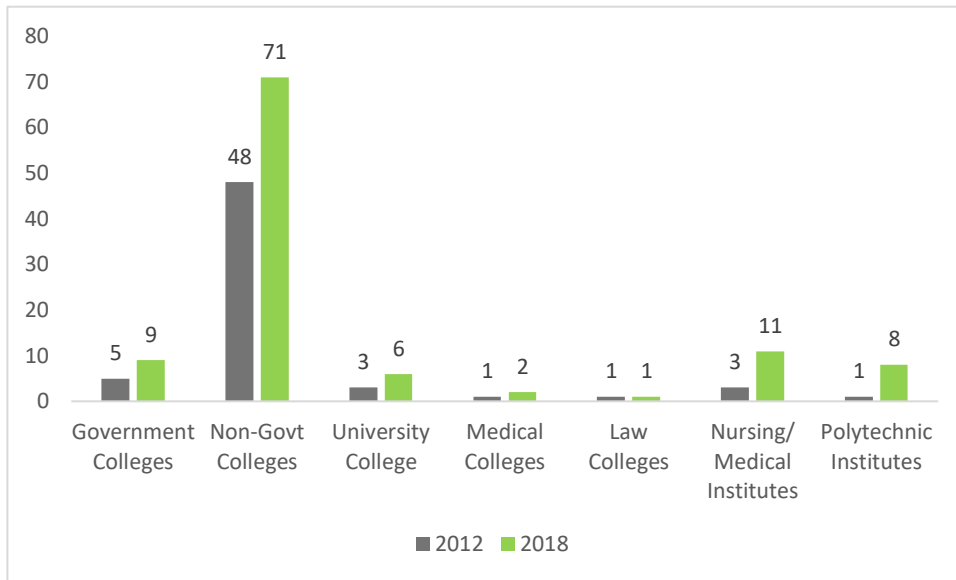
Source: Bangladesh Bureau of Statistics, Directorate of Primary Education, and Directorate of Secondary and Higher Education

Below figure illustrates the increase in number of colleges and universities in Tangail district between 2012 and 2018. As one can observe, the number of colleges have increased in number between 2012 and 2018. The most notable increase has however, been seen in non-government colleges (number of non-government colleges increased from 48 in 2012 to 71 in 2018).

A substantial increase in specialized training such as nursing, and technical education such as polytechnic colleges, suggests that Tangail district’s tertiary education system is producing more employable and trained workforce.

¹³ Mamun, Shamsul Arifin Khan, 2019, Nationalising educational institutions: Opportunity or threat?, The Daily Star, retrieved 27 March 2020, <<https://www.thedailystar.net/opinion/education/news/nationalising-educational-institutions-opportunity-or-threat-1780294>>

Figure 7 College and Universities (Numbers)



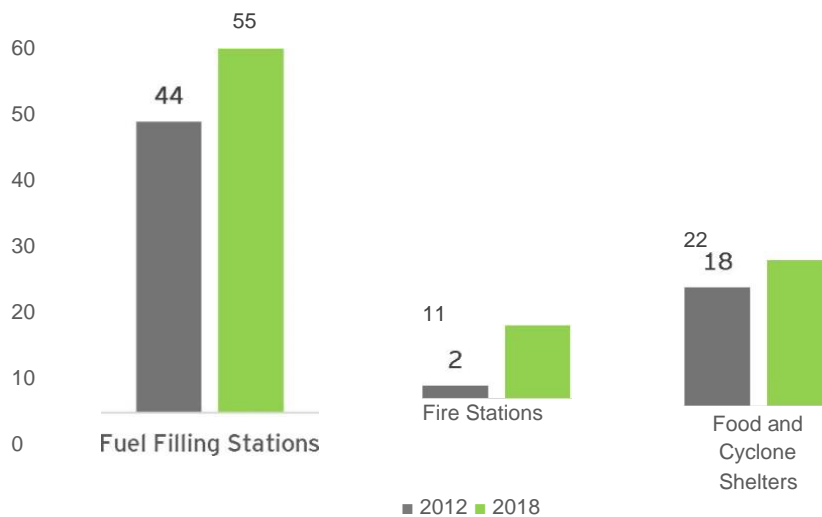
Source:

Bangladesh Bureau of Statistics, Directorate of Technical Education

While it is difficult to ascertain the extent of contribution of rural roads on educational facilities, it can be said with certainty that Tangail district has seen improvement in educational facilities—more so at primary, college and specialized courses levels.

Below Figure illustrates the increase in other infrastructural facilities - fuel filling stations, fire stations, and food and cyclone shelters, which suggest improvements in other infrastructure reflecting the preparedness of administration in mitigating, controlling, and providing relief. While it is difficult to ascertain the contribution of rural roads alone but the fact that better access to facilities are being provided for the citizens suggest rural roads have a role to play.

Figure 8 Other Infrastructure (Numbers)



Source: Bangladesh Bureau of Statistics, Directorate of Technical Education

A headmaster of Sahid Jamal High School, in Kalihati Upazila, Tangail confirmed that three new schools were constructed around his school and that improvement in connectivity to cities and mobility in rural areas has resulted in higher enrolment and attendance rates. He further mentioned that the attendance and even quality of teachers has improved due to better connectivity.

3.9. Impact indicator 2: Employment generated and Indirect Employment Generated

Lack of data on jobs created by various interventions in the construction sector in Bangladesh did not allow the project team to access the ripple effect of indirect employment created in the industry.

An existing framework used in the United States to reflect the employment multiplier, however, throws light on the potential of creating direct and indirect employment through investment in infrastructure sector. An employment multiplier measures the creation or destruction of employment or economic output due to employment generation in a particular industry or sector.¹⁴ The below mentioned multiplier effect worked for the US can be adapted to assess indirect employment generation in rural roads sector.

Table 8 Employment multiplier effects in construction sector

Sector	Direct Jobs	Supplier Jobs	Induced Jobs	Total Indirect Jobs
Construction	100	88	138.1	226.1

Source: Economic Policy Institute, 2019

The above employment-multiplier suggests that generating 100 jobs in the construction sector in the United States is likely to create 88 supplier jobs and 138.1 induced jobs, adding up to a total of 226.1 total indirect jobs.

A chairman of a union in Tangail district, conveyed through the telephonic survey that better roads and an expansive road network has resulted in diversification in occupations of local residents from agriculture to various services including automobile drivers and automobile mechanics. He stated that the region has seen a significant increase in women's earnings. Moreover, he pointed that better roads have created a favourable business climate in the region, thereby helping small and medium enterprises.

3.10. Impact indicator 3: Health- access to hospitals

Patient attendances at district/general hospital, for Cox's Bazar and Tangail are mentioned in the table below. On interactions with people in the region it was noted that the influx of patients from rural region has increased.

Table 9 Patient attendance at district/general hospitals

District	Outpatient attendances	Inpatient attendances	Emergency ward attendances
Tangail	292497	75,778	37,857
Cox's bazar	252567	61,301	75,578
Satkhira	170842	24,144	9,507

Source: Health bulletin 2018, DGHS

Similarly, age-specific death rate (ASDR) per 1000 population for Khulna Region for the year 2014 and 2018 are mentioned in the following table. There has been a significant improvement in ASDR across almost all age groups. In fact, the life span also increased over a span of 2014 to 2018.

¹⁴ Biven, Josh, 2019, Updated employment multipliers for the U.S. economy, Economic Policy Institute, retrieved 24th March 2020, <<https://www.epi.org/publication/updated-employment-multipliers-for-the-u-s-economy/>>

Table-10 Age-specific death rate (ASDR) per 1000 population for Khulna Region

Age	2014	2018
0	17.7	26.4
1	5.2	1
2	3	3.4
3	1.7	2.3
4	1.2	0.3
0-4	5.5	6.4
5-9	0.4	0.8
10-14	0.3	1
15-19	1.1	1
20-24	0.6	0.8
25-29	0.9	1.1
30-34	1	0.9
35-39	1.4	0.9
40-44	2.5	3.1
45-49	3.6	1.7
45-49	3.6	1.7
50-54	5.6	6
55-59	10	8.8
60-64	12.3	13.7
65-69	25	54.4
70-74	22	NA
75-79	92	NA
80+	128.1	NA

Source: Report on Bangladesh Sample Vital Statistics 2014 and 2018

For indicators such as CPR: Contraceptive Prevalence Rate; IMR: Infant Mortality Rate; U5MR: Under 5 Mortality Rate (per 1000 population) by district mentioned in Table-3, there have been a significant improvement.

Table 11 Changes in CPR, IMR, U5MR and Disability rate in selected regions

District	IMR	U5MR	CPR	Disability
2014				
Cox's Bazar	34.7	55.6	60.7	7.1
Tangail	28.0	10.5	63.0	9.0
2018				
Cox'a Bazar	22.8	35.5	52.7	7.2
Tangail	20.1	27.6	56.2	9.7

Source: Report on Bangladesh Sample Vital Statistics 2014 and 2018.

A retired civil surgeon and ex-deputy director of Sheikh Hasina Medical College in Tangail responded to the telephonic survey and elaborated on the impact better roads and road networks have on access to health. He mentioned that roads have partially helped in the setting up of new medical facilities in rural areas; currently, nine new community clinics with MBBS graduates are in place in every Union Parishad. With doctors able to travel to remote villages, and residents of such villages able to travel to major hospitals, the quality of life has seen an improvement.

4. Conclusion

This report relied on assessments of publicly available resources, ReCAP's Annual Reports, a field visit to Tangail (the pilot district for ReCAP's research on rural road infrastructure and transport), and stakeholder consultations.

With regards to the development of the impact indicators, the project team has been able to draw a conclusion that ReCAP's research has brought about a partially perceptible change in agenda setting and policy making. ReCAP's role in the development and computation of a more accurate impact indicator 1: RAI, for Bangladesh was successful.

However, ReCAP research's success with respect to the development and computation of impact indicator 2: RTP, could not be gauged as there is no RTP computed for Bangladesh. As a proxy, Service Provider (SP) has used the Vehicle Operating Cost (VOC) to understand the contribution of better rural roads in passenger movement.

ReCAP programmes have been able to foster research on rural roadways and transportation - research areas that were relatively unexplored prior to ReCAP's entry - through appropriate funding and coordination between relevant stakeholders within Bangladesh. In this process the programme has contributed towards a better research led policy making and in having a vision towards the sustainable rural road building including prioritization of roads, research and development by LGED in rural transportation, and design considerations for climate resilient structures.

For instance, its road prioritisation research has seen LGED adopt the ReCAP model in its National Policy formulation. Moreover, stakeholders from the government suggested that ReCAP's research and focus, on rural roads and transport is consistent with Bangladesh's new vision: "My Village - My Town" that focuses on rural planning and infrastructure.

In short, ReCAP's involvement in Bangladesh has been instrumental in (i) creating a research ecosystem where there is increased interaction between the government, academic researchers, and other research units both within and outside of Bangladesh; and (ii) initiating and developing research in the fields of rural road infrastructure and transport in Bangladesh.

5. Recommendations for ReCAP

A. Continuation of support for state of research in Bangladesh

Researchers in Bangladesh require more support financially as well as in terms of expert guidance, in order to ensure sustainable research in the abovementioned fields. ReCAP's research therefore be upscaled and continued to cover larger areas. Specific interventions in different district can be initiated through focused ReCAP research.

B. Support in data collection to improve the quality of data and enhance the credibility of the RPPM tool

The methodology for the development of the RPPM tool had to undergo significant revisions due to the unavailability of accurate and granular data with LGED. For example, the methodology could not consider poverty as an indicator for prioritisation but considered proxy variables instead. It is vital to update database in Bangladesh in order to capture the granularity and accuracy which will be possible only through large-scale data collection. ReCAP may facilitate these activities by mobilising local universities, research institutions and survey agencies to carry out this large-scale data collection, thereby creating a unified data repository for LGED. Data so obtained could be inducted with the current RPPM tool to make the tool more relevant and credible, thereby improving its ability to contribute in Bangladesh's development agenda.

C. Expansion of R&D Unit within the LGED

Research in Bangladesh, especially pertaining to rural accessibility and infrastructure is still at a nascent stage, which through ReCAP's intervention has gained some impetus. As a result of ReCAP research, LGED was compelled to establish its own R&D unit. ReCAP's support, credibility and expertise could be leveraged in future to improve the functioning of the R&D unit, by providing necessary knowledge base and international best practices in related areas.

D. Sustainable, low-carbon transport in Bangladesh

In the present COVID Scenario, mobility has reduced resulting in pollution levels going down. This throws an opportunity at Bangladesh to move towards sustainable, low-carbon transportation system. ReCAP can help in synthesising and translating knowledge, sharing good practices, identifying gaps in knowledge and assisting policy-makers and practitioner with tools and resources.

E. IT Enablement Platform for Rural Transport Stakeholders

Though mobile penetration rate and provision of WIFI services have increased in rural areas in Bangladesh, rural transport sector still needs to take leverage of the solutions available in urban areas. ReCAP can support research in enabling a common IT enabled platform. This will provide multiple benefits to stakeholders such as mobility sharing, route harmonization and also hygienic travel.

F. Development of RTP

While RAI focuses on accessibility to rural roads, RTP focuses on the utility that rural populations are enjoying with increased access to all-season roads. The development of RTP would help in determining the precise benefits of increasing access to rural roads. ReCAP can assist Bangladesh policy makers in computing RTP. More importantly, it could help in identifying geographical areas or issues that are not allowing increased access to all-season roads to lead to increased effective use of rural transport through an appropriate RTP.

Annex 1 - Follow on Discussions (BUET) 19 May 2020

Service Provider (SP): What role does BUET play in rural road research in Bangladesh? Could you start by telling us what kind of research happened previously before ReCAP? What makes ReCAP research special/important in Bangladesh's context?

BUET: People in academia used to know RPPM. Its practical implementation has never been done. Research on roads is being led by two organizations: LGED and RHD. RHD is concerned with regional and rural roads which comprises of less than 10% of the total road network in Bangladesh.

LGED on the other hand, is concerned with 300,000 kilometres of rural roads. They are concerned with stability and strength of concrete and roads. They are concerned with salinity resistant concrete too. Looking at rural roads from a macro and prioritisation perspective has not been done previously. RHD had once developed a methodology for their road network but they considered indicators used for high volume roads which are not applicable to rural roads. Bangladesh has enough number of roads. The challenge is to optimise the method of prioritisation. ReCAP research is the first research that has been taken up by LGED, which considers rural road prioritisation. LGED had a prioritisation method for Rural road maintenance but prioritising from a network perspective was never thought about before. Academicians are closely working with ReCAP and LGED too. This is the first time it is happening.

SP: So, this research is one of a kind and pioneering?

BUET: Yes.

SP: In terms of research itself, you may have been part of many researches funded by other international funding organizations. How is this different? What is it that is different in terms of research experience?

BUET: Let me add that RHD once developed a prioritization model for their road network. But they considered only few indicators of national roads, that are not applicable to most of the roads in Bangladesh. Moreover, it was only for their network. The LGED and ReCAP model is more bottom up.

The collaboration between academia and organizations is new. This is the first time we got cooperation from third parties like ReCAP. In the beginning, it was very academic. ReCAP was also guiding us in the initial stages. But the amount of data that was required was missing as LGED did not have much data, and during the inception phase itself we were asked to review the methodology proposed. Then we had to make a hard turn and were compelled to revise the methodology for prioritization. This can be applied in other countries as well. Here, ReCAP expertise helped. ReCAP never imposed any suggestions or solutions and instead encouraged BUET to find homegrown solutions. They shared their experiences in Africa and other Asian countries. Once the project was done, they even gave the opportunity to share the Bangladesh experience in Uganda.

SP: Can you provide a few examples.

BUET: In the inception meeting LGED reminded that they work with local representatives. During the inception meeting, while discussing the RPPM indicators, LGED was reminded how the local context was never taken into consideration. Stakeholders in rural roads often blamed LGED for not knowing local issues and for not consulting local stakeholders. However, this time LGED encouraged to collect the sentiment of locals. This was new as local views were not collected previously. Local level workshop was added as a new dimension. But due to lack of data we could not test.

The RPPM required rural roads to be included only after inspection. This helped in developing a core network identification.

Only 10% of the roads fall under core network. Upazila chairmen, union chairmen, and female representatives were encouraged to come to the workshop. They were given a list of rural roads and were asked to identify priority roads in their respective unions.

SP: Please elaborate on how the BUET team's approach changed with regards to learnings. Do you think it sparked any interest in other and upcoming academicians in this research area?

BUET: Yes, there is an immediate and short-term impact in interest. For a sustaining impact, some more steps need to be taken.

The team leader of the research is from UNESCO and not from Dhaka. He is an expert in transport research and professorship in Bangladesh. A group of 10 people have worked with him and had an enriching experience. The team comprised of people ranging from junior researchers to professors worked on this project.

Colleagues from Civil engineering and computer science departments (for the development of the software) also worked on this.

Colleagues were required to visit Upazilas on the field. Things were done professionally and practically. Local context and lack of data taught that new and customized solutions needed to be found.

Today many colleagues want to expand the idea academically in other Upazilas in other districts. As research projects, students are being asked to replicate this model for their home Upazilas. This idea was given by ReCAP.

With respect to sustaining this interest, research interest depends on funding. Research topics of students depends on professors and organizations' interests. Students cannot continue with their research for long unless and until funding and backing is provided. If ReCAP forms a system where this is taken care of, a sustainable change can be brought. If the programme is expanded, other relevant departments of other universities can join as well.

SP: In terms of other universities, what should the areas be where ReCAP should focus on? If ReCAP can continue their association with LGED, what should the project design be like?

BUET: When we work with LGED, BUET identified an extensive dataset for rural road infrastructure. This data has many shortcomings. LGED is aware of it too. Any model requires updated good quality ground level data. Updating the database is fundamentally important. While LGED is working towards this, the officials in local offices are busy with construction and administrative works and are unable to focus on planning and data-related issues. While updating GIS database, there were many difficulties with respect to. shortcomings in data and limited accuracy. ReCAP may engage with LGED to update and improve their data at the ground-level. Accuracy of data is also important.

If ReCAP and LGED are working, they can also work on improving data by engaging with other universities as data collection cannot be done through BUET alone. Local universities may be engaged for this purpose.

ReCAP may work with the government of Bangladesh to implement their vision. Bangladesh government using the RPPM is planning on changing the entire rural landscape of Bangladesh. ReCAP can help the government use the RPPM most effectively.

Updating or revising RAI: LGED and the government, both are saying that RAI is improving. RAI deems people residing near core network roads and other all-weather roads to be the same. Whereas, people living near core network roads are relatively more well off than other roads. This distinction should be made to precisely understand access to rural roads.

To conclude, there are three areas where ReCAP can provide additional support:

1. Data Collection to improve data quality
2. RPPM for RD
3. Updating/ Revising RAI from other perspectives

SP: In terms of setting up an R&D unit with LGED, do you think more such R&D units should be established? Maybe at a sub-national level? Form the funding standpoint, have you seen any increase in new research being funded by the national government on this particular subject? Do you think people involved in this research are now more involved in policy and execution?

BUET: Yes, people who were working with ReCAP in the project are more involved in policy and panel

discussions. Engaging women especially has not been done before. Now LGED is also asking for their insights. LGED colleagues try to help academicians in conveying their insights to the government.

Bangladesh government provides scholarships to students in general. There is no special scholarship in the field of rural roads.

R&D expansion is person specific. If the right person is in-charge, the project might be a success. Success of the R&D project depends on interest and proactiveness of Chief Engineers. Therefore, there should be an institutional cooperation as opposed to personal cooperation. Industry, LGED, ReCAP and RHD must all be stakeholders in the R&D expansion along with academia. Unless there is such a mandate, success of R&D projects will depend solely on the people in-charge and how proactive they are. ReCAP should be conscious of this issue and must formulate and discuss with LGED how to incorporate stakeholders other than LGED in R&D.

SP: How CBA incorporated into the RPPM? How did RPPM get enriched by CPM coming into the picture?

BUET: CBA and MCA were both, LGED and ReCAP idea. CBA does not give meaningful results for small roads. But since Planning Commission looks at CBA for appraisal of projects, CBA had to be incorporated in the methodology. From now on LGED will be engaged with high and medium volume rural roads. Low volume roads have been given to local union councils. Although LGED pushed BUET to use CBA for all rural roads. CBA would work for roads within the purview of the LGED.

SP: Was BUET involved with the research facility set up by the LGED?

BUET: R&D unit set-up has not been officially been conveyed to BUET. Patrons, experts, and guides have not been identified for the lab. R&D unit may not be useful for people with other research areas.

SP: What is one area that the project did not look at and what it should have done? How can BUET benefit from insights?

BUET: Incorporate any indicator that says anything about poverty. There is a lack of space level poverty data. It exists only till district level, but not at union level. We need much more segregated level of poverty data. Some proxy variables have been identified though. Academic organisations should be given role. BUET is not able to go to international conferences by itself. Local institutions and researchers may be supported to participate in international conferences as well.

SP: With intensification of rural roads, was there any report on the kind of employment it generated directly or indirectly? Was this research done by ReCAP or not?

BUET. Dhaka University, Department of Development Studies have done some research. This research was probably done at a subnational level. They may have some data that is relevant but am not even sure if this was regarding rural road construction. Recently, there have not been any impact assessments. ReCAP work has only been done at a planning level. No physical work has been done yet.

SP: What is your opinion on the definition change of RAI? RAI really improved according to the ReCAP calculation as well as Bangladesh government. Can you comment on that?

BUET: Rural roads have significantly changed. Changing of rural economy and foreign remittances have contributed. With rural roads improving, services such as car rentals have also started. The problem with RAI is that it does not help in understanding access to quality roads as it focuses on all-weather roads only.

SP: Has rural road connectivity must have also led to better health indicators?

BUET: Yes, a greater number of people are going to hospitals for maternal care. Though it is known that greater number of people are going to hospitals, there is little research on how they are going to the hospital.

SP: Can progress in indicators on health, education, and employment be attributed to ReCAP research in any way?

ReCAP Impact Case Study Bangladesh

BUET: ReCAP research has been done for only 3-4 years. Research was primarily on planning and prioritization. Therefore, there is no direct impact of ReCAP research on the indicators. Other research on improving the quality of roads has not been implemented. Since construction of such roads has still not been done, there is no direct impact. Once transmitted, ReCAP research will have direct impact on those indicators.

Annex 2 – Follow on Discussions LGED 20 May 2020

SP: Can you elaborate on SDG indicators and RAI?

LGED: Most of the studies were completed in 2019 and LGED has just started applying it. This is not the stage to make an impact assessment. We are happy with this, but this is not the time to make an impact study.

RAI - according to World Bank is around 86. In our internal study, it is about 84. Therefore, both studies may be deemed to be accurate. The internal study was done in 2018. ReCAP has helped with the development of the RPPM. Through this, they have been able to identify priority roads very easily. The database that has technical and road data was used to develop a model. A score can be generated using a software. This is now part of our national policy. Previously the LGED would face political interference from MPs with respect to construction of roads. But due to the RPPM, they can now justify the construction of roads to anyone who objects. The RPPM will help in setting goals as well. By 2025 they are expecting a better RAI. In Bangladesh, it is not possible to connect all villages because of its topography. Alternative options need to be explored here. 100% RAI is therefore unrealistic. A more realistic RAI goal would be around 90-95.

SP: Did the government conduct a primary survey to come up with the RAI computed by the internal survey?

LGED: Simple poll was used and all Upazila offices were engaged in order to come up with the score. The database of roads was also used to come up with the score. Government is happy because of the data they have. Aerial survey or GIS data may be used as well. Government now knows the conditions of villages, the access these villages have, and the challenges involved in constructing roads to improve access. All the information is there in the database.

SP: Was ReCAP methodology used to a large extent to develop the RAI?

LGED: ReCAP did not explore this. The government developed it on its own.

SP: Can you shed some light on RTP? How was it developed and what was the contribution of the government in developing this?

LGED: It is true that private vehicles increased. But you should keep in mind that there are a huge number of unregistered vehicles because their engines that are not approved. Price of vehicles have increased. This is one of the main reasons for increase in RTP. There has also been an increase in the cost of oil. The government has done a study on RTP, but it has not been published. The initial findings are that the RTP has increased. They were reluctant to explain the increase in the number of unregistered vehicles in Bangladesh.

SP: We would like to hear from you how rural roads were developed in Khulna region? What was the output of the project?

LGED: Khulna region has a problem of soft land. We conducted a study on the soil of the region, and it was very insightful. The issue is that the output of the study was not easy for engineers to implement the findings. Therefore, we are currently developing a manual which should be ready in a month so that engineers can utilise the findings.

SP: Can you shed some light on health, education across districts especially in Tangail.

LGED: Accessibility to rural roads was one of the most important catalysis in MDG. Access to health, education, markets, and employment were found to be affected by roads. Work on this started in the 1980s. A methodical approach was used to connect villages to markets. Gradually, villages were connected to schools and hospitals. Now, most of the villages in Bangladesh (except those in wetlands and hills) are well connected.

SP: Yearly 6,500 km roads are constructed. Are these constructed in rural Bangladesh?

ReCAP Impact Case Study Bangladesh

LGED: Yes, these are all constructed by LGED in rural Bangladesh itself. Roads in urban areas are not expanding much.

SP: To what extent has ReCAP research ensured maintenance and construction of rural roads in Bangladesh?

LGED: We can maintain roads periodically (4-5 years). But the system was not up to the standard. We requested ReCAP to help us with a study. This study was immensely helpful to us as we got international best practices. In the case of maintenance, there was no literature or data. Moreover, there was no literature on planning and prioritization. Through this, the government was able to prioritize roads.

SP: Going ahead, how can ReCAP contribute?

LGED: Innovation is very important. With the help of ReCAP, we were able to work on our weaknesses and improve. Within LGED, we did not have a R&D unit before. Because of our association with ReCAP, we were compelled to open a R&D unit. If ReCAP extends their association, we shall be able to continue the R&D unit and expand it. It will be helpful as we can get more international exposure and best practices.

SP: Any specific outcomes in Tangail that can be duplicated in other districts?

LGED: We have been able to motivate stakeholders in Tangail. We have included it in our national policy. 'My village My town' is a national agenda that has been borrowed from ReCAP research.

SP: What should be the future of ReCAP research?

LGED: ReCAP has worked in many other countries. In all these countries, R&D is not in a good state. It is important to help them improve the state of R&D. ReCAP is important as it helps in structuring the research, augmenting focus and defining scope for R&D.

Annex 3 – Follow on Discussions TRL 29 May 2020

SP. In terms of consistency, could you elaborate on the RAI of Bangladesh? How authentic and consistent is the RAI?

TRL. There was not enough data or evidence to back the 2006 survey.

The 2016 methodology relied on the quality of the road (road condition) as well. Local engineers have a reasonably fair idea of the conditions of most of the roads.

The LGED results and the World Bank are close enough. LGED methodology seems to be similar to the World Bank methodology.

SP. LGED does a lot of household surveys using motorcycles. Reach to rural households in Bangladesh is high. Could the jump from 2006 RAI to 2016 RAI be justified?

TRL. Surveyors always map the government data with satellite data as well to verify if the government data is authentic. As mentioned above, for the 2006 survey there is not enough data or evidence.

SP. Can you elaborate on the role ReCAP played in coming up with the RAI methodology?

TRL. ReCAP role has been significant. Further to TRL study, they worked to improve the methodology. The 2016 methodology relies on road condition as opposed to the 2006 methodology that relied on household surveys with poor questions.

SP. Can we compare the RAIs of various countries?

TRL. The difference between Bangladesh and other countries cannot be considered for the 2006 RAI as the methodologies varied from country to country. The RAI of 2016 is more accurate as the methodologies are more uniform.

SP. Going forward, where do you see ReCAP conducting effective research?

TRL. There's a big focus on climate change. There's a lot of stress on development indicators. On the basis of this, the revised rural transport policy guidelines should be framed. Relevant research in this field is likely to have an impact.

Annex 4 – Perception Case Studies (General Public)

Stakeholder-1

- President, Bangladesh Medical Association, Tangail
- Practicing doctor since 1984
- Living in Tangail since birth (1959)

It was a long demand of the rural population to make road connectivity which has been fulfilled when LGED started making roads.

Development activities start with the creation of road network and mobility of rural people.

There were almost no formal medical facilities in the village level but now there is nine Community Clinics in every Union Parishad with MBBS graduates in place.

Now Doctors are available at remote villages due to more road construction and establishment of communication network.

Due to road construction, all development activities including trade and commerce, education facilities, marketing of agricultural produce, etc. have been created.

Earlier it took around one hour to reach Tangail from his village but now it takes only 15 minutes.

There was limited healthcare and education facilities at the doorstep of villagers but due to improved road network, people can easily access all those facilities.

Now motorized vehicles are available but earlier people needed to use boats for transportation, especially during the rainy season.

Patients can be easily carried to hospitals and clinics.

Specialist Doctors can travel to remote villages. o People's living standard has been improved.

Dr Said has commented that the rural roads and bridges constructed under LGED are of good quality, but he has recommended that these roads need to be wider.

Stakeholder 2

- Headmaster, High School, Tangail
- Serving as Teacher for last 20 years
- Living in Tangail since birth (1977)

Due to road construction, overall livelihood has improved. o Easy mobility to city and other parts of the country. o Increased access to schools as well as increased enrolment in the schools. o Setting-up of new schools. Three new schools have been established near his school in last 15 years.

Farmers get proper price for their agricultural produce. o Agricultural production has increased due to better marketing facilities. o Earlier, boat was the main mode of transportation which was slow. Now they have got roads which saves time and money. o Transportation cost has reduced.

Earlier it used to take 4 hours to go to Tangail but now, after road construction, it takes only 40 minutes.

Enrolment of girls in schools has increased and their result is better. o Quality of education has improved due to availability of better teachers. o Teachers and students can reach school in less time than before, and at less cost.

They now use motorized vehicles and bicycles. o Even in bad weather, usually the absentee is not high due to better transportation facilities.

Road construction quality seems to be good. But in many places, the drainage facilities should be

improved.

Stakeholder-3

- Chairman, Bangra Union Parishad, Kalihati, Tangail
- Residing in the locality since birth (1954)

Road development is the key to any development in rural community. ◦ Easy access to schools and health centres/hospitals/clinics. ◦ Growth in seasonal business. ◦ Small and medium businesses have developed. ◦ Women's earning has increased. ◦ Poultry and dairy have developed.

Diversification in profession has happened. Once a farmer, now an automobile driver or motor mechanic.

Labour wage has increased. People have the option to bargain and create better market for labour.

Access to information due to easy transportation.

Five years back, it took one hour to travel to Tangail city which now takes only 12 minutes.

There is a drainage problem in LGED roads. He has suggested that sufficient number of pipe or box culverts should be constructed for proper drainage. ◦ Loaded earth carrying trucks severely damage the road.

In many bazar/market area, concrete road has been built which is functioning well and very much durable.

Quality of LGED roads is fairly good.

Stakeholder 4

- Owner, Sawmill, Pouzan bazar, Kalihati, Tangail
- 8 years in this business.
- Living in Tangail district since born in 1979.
- Primarily a farmer and a sawmill owner.

As agriculture is the main economic base of Bangladesh, tremendous improvements have occurred in all sectors of agriculture (including fisheries and livestock).

Carrying cost of all commodities as well as time has reduced due to road construction.

There is improvement in education, healthcare, trade and overall the livelihood of the people.

Now people have the access to cable TV, internet and electricity and all facilities of towns and urban community.

Educated people have started coming back to villages and have started business activities.

Working labourers can now stay at their home and commute to work every day. ◦ 5 years back it took one hour to reach to Tangail which now takes only 15 minutes. ◦ LGED road quality is good.

Stakeholder-5

- Trader, Chamuria Bazar, Kalihati, Tangail
- 5 years in business
- Living in Tangail district since birth (1974)

Prior to construction of road by LGED, there was limited mobility with no supply chain. Traders used to carry goods in boat and sometimes carry it on their head. ◦ They had to spend a lot on carrying goods and often faced problems with perishable items.

There is improvement in the livelihood of the people. ◦ They can now use gas as cooking fuel.

ReCAP Impact Case Study Bangladesh

Children can go to school all year-round.

Traders can diversify their business and product.

Employment opportunity has been created.

Lifestyle has improved. o People's dream has been achieved.

Low cost of transportation and carrying goods.

Earlier, whole day was required to travel to Tangail district town (by walk and boat), which now takes only 30 minutes.

According to him, construction of roads is not always done properly, and, on many occasions, contractors take longer time to complete their work.

He mentioned that around 3-4 roads in his area need to be developed.

Annex 5 – Stakeholder Consultation

This stakeholder meeting as per Terms of Reference was held on 2nd May 2020. The purpose of the meeting was to provide a forum for the stakeholders to consider and discuss the draft impact assessment report and to receive their suggestions and recommendations before finalizing the impact study. The deliberations at the meeting provided valuable insights from all stakeholders.

Apart from gaining insights into various indicators of ReCAP contribution to the research and development of rural road infrastructure and transport policy in Bangladesh, ReCAP's scope of work and potential contributions to Bangladesh were also discussed.

In order to enhance the depth and understanding of insights collected during the stakeholder workshop, the steps have been highlighted in the Stakeholder Review Report.

List of Participants:

- Mr. Dave Ruganaikaloo-ReCAP Programme Manager
- Mr. Joseph Haule - ReCAP-Team Leader
- Mr. Monzur Sadeque- National Coordinator, ReCAP, Bangladesh
- Mr. Delwar Hossain Mazumder - Project Director, LGED and Ex-Executive Engineer, Tangail, LGED
- Mr. Abdullah Al Mamun- Addl. Chief Engineer, RHD
- Prof. Musleh Uddin Hasan- Professor, Department of Urban and Regional Planning, Bangladesh University of Engineering & Technology
- Sidharth Dutta -Monitoring and Evaluation Expert
- Sainath Sunil- Assessment and Evaluation Expert
- Sangeeta Singh -Economic Expert
- Sukhranjan Suter -Road and Transportation Expert
- Rajeev Saluja -Engagement Partner
- Ankush Saxena - Engagement Manager
- Research Officers- Shweta D Shirodkar, Vineet N Karlapalem, Jamil Ahmed

Annex 6 – Photos taken during the site visit

Bangra Union Parishad, Kalihati, Tangail



LGED road at Bangra Union Parishad, Kalihati, Tangail





LGED road at Bangra Union Parishad, Kalihati, Tangail