SDC

Swiss Agency for Development and Cooperation

External Review of Local Roads Motorable Bridge Programme (LRBP) – Phase 1

FINAL REPORT

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1 Introduction

It is recognised that, in rural areas of Nepal, there is a strong correlation between a lack of motorable access and observed levels of poverty. The provision of all-weather motorable access leads to reductions in poverty levels and to improved overall social and economic conditions.

In consultation with the Government of Nepal (GoN), SDC embarked in 2011 on a programme of bridge construction on local roads in order to enhance the extent of all-weather road access into remote areas – as well as to strengthen the institutional capacity of local agencies engaged in the sector. The programme also seeks to target Disadvantaged Groups (DAGs) living in the vicinity of the bridges through skill development and the creation of job opportunities in bridge construction.

This Review is being undertaken at the end of the first of four phases of the project, covering the period from March 2011 to July 2015. The overall programme is anticipated to have a total duration of 12 to 15 years. The first phase focuses on the overall programme design, bridge planning, selection and prioritisation, together with capacity building in both the public and private sectors.

It is calculated that, as of June 2015, over 1400 km of local roads have been brought up to all-weather standards through the construction, in the past 4 years, of 85 bridges in over 40 Districts across the country. Based on the Outcome Monitoring Summaries (OMS) conducted to date, it is estimated that over 300,000 people have benefitted from these improvements in accessibility. Increased numbers of trucks, buses, jeeps and motor-cycles are now operating, new shops and services have been established and significant increases in the use of services recorded. Over 600,000 person-days of employment have been created in 48 Districts, with almost 200 people (over 50% women) receiving skill enhancement training.

This Review has been undertaken to assess the impact of the first phase of the project and to identify any aspects of the programme that could or should be modified for the remaining phases. Much of the analysis has been based on a series of surveys undertaken at a sample of 11 completed bridges, selected to represent typical conditions throughout the country.

The timing of the Review has been delayed as a result of the April 25th and May 12th earthquakes, which seriously disrupted the fieldwork and subsequent analysis of the data.

2 Objectives and Structure of the Review

2.1 Terms of Reference

The Terms of Reference (ToR) provided to the Review Mission clearly define the scope of work and outputs required. The overall objectives of the Review are to examine the major achievements of the programme, particularly in regard to the institutional aspects, and assess the extent of tangible benefits obtained. The Review was also tasked with examining the validity of the existing Outcome Monitoring Summaries (OMS) and, based on the experience gained over the initial years, recommend changes in emphasis, content and procedures for the remaining phases of the programme.

The Review was required to examine the socio-economic impacts of the project and to quantify – where practical – the benefits that have accrued to users of the bridges and residents in the areas of influence. Other less quantifiable social and community benefits were also required to be assessed, including access to markets, jobs and social services, and, where appropriate, the effects on Disadvantaged Groups (DAGs), together with any particular gender-sensitive impacts.

The ToR required that the overall impact of the programme be measured, where possible, against the outcome indicators defined in the programme log-frame.

2.2 Objectives of Review

Four specific objectives for the Review were set down in the ToR:

i. Objective A: to assess the socio-economic impact of the bridges, especially on livelihoods and access to services;

ii. Objective B: to assess the degree of institutionalisation of the bridge building process and the extent of capacity strengthening amongst the stakeholders at both the local and central level – and the private sector;

iii. Objective C: to validate the results of the Outcome Monitoring Summaries; and

iv. Objective D: to produce conclusions and recommendations regarding progress achieved and proposals for the future development of the programme.

The ToR suggested a series of 'questions' to be researched in respect of each of these objectives. These questions have been used in establishing the proposed survey and data collection activities to determine the impact and effectiveness of the programme.

Objective A was addressed primarily by a series of field surveys and interviews which were conducted in the influence areas of 11 selected completed bridges. The surveys included sample household surveys, focus group discussions, key informant interviews and settlement inventories: traffic counts and origin-and-destination surveys were also conducted on completed bridges. Reference to – and comparisons with – Baseline Surveys and Outcome Monitoring Summaries, as available, have been included (Objective C).

Objective B was achieved through a series of internal discussions within DoLIDAR and with other concerned agencies, including those Donors active in the Local Roads & Bridges Sector (SDC, JICA, ADB, WB, and DFID).

Objective D represents the primary output of the Review Mission. It was originally planned that preliminary findings would be available in mid-May, to allow an input to the Mid-term Review of Swiss Cooperation Strategy starting on 19th May: however the schedule was disrupted by the earthquakes of 25th April and 12th May, and the outputs have consequently been delayed.

2.3 Outputs of Review

The primary output of the Review is contained in this Report, as described under Objective D above. The Study has assessed, based on the results of the field surveys, the extent to which the project investments have contributed to an increase in socio-economic activities and accessibility in the areas served by the bridges and, to the extent possible, the specific impact on disadvantaged groups in the community.

Institutional aspects associated with the planning, prioritisation, funding and construction of bridges on the local road network have been examined at both central and local government levels, in conjunction with potential development partners and the private sector.

2.4 Methodology Adopted

The primary data source for the impact evaluation of the LRBP has been a series of surveys conducted in relation to a sample of 11 bridges that have been completed in the first phase of the programme. These surveys were designed to assess the change in levels of socio-economic activity following the bridge construction by comparing the current (post-bridge) situation with the results of Baseline Surveys undertaken prior to construction. The surveys included a sample of households within the zone-of-influence (ZoI) of the bridge, 'focus group' and 'key informant' discussions within the ZoI, inventories of services and facilities provided in settlements close to the bridge, and daily counts (and OD surveys) of traffic using the bridge.

Additionally, Outcome Monitoring Summaries (OMS) were available for three of the selected bridge sites and the results have been compared with the survey results in order to verify the validity of the findings.

Visits were undertaken to a sample of the selected sites and meetings and interviews held with the local DDC and VDC Offices in order to identify the procedures adopted for the bridge selection and prioritisation process. Specifically in regard to the analysis in relation to the DTMP, the District Core Road Network (DCRN) and the extent of the all-weather road network in the District.

A series of interviews and meetings were also arranged with the primary donors active in the sector, to assess potential funding options, and with the relevant Government Departments to identify responsibilities and programme planning. Of particular relevance in the latter instance, was the recent decision that the responsibility for all roads and bridges that do not form part of the defined Strategic Road Network (SRN) should rest wholly with DoLIDAR (MoFALD) and NOT with the Department of Roads (DoR/MoPIT).

Changes in accessibility resulting from extensions to the all-weather road network have been assessed using GIS techniques to calculate the population within given time bands from an all-weather road. These will be based on the spatial distribution of population and the alignment of additional all-weather roads.

2.5 Timing of the Review

The Review commenced with a briefing from the Local Road Bridge Support Unit (LRBSU) on 17th March, following the contract signing on 13th March 2015. The agreed programme envisaged that the required fieldwork programme would be undertaken basically during the month of April, following the pilot field-testing of the survey procedures during the last week in March. Data entry and analysis was expected during April and early May, with preliminary findings available by mid-May and a Draft Final Report submitted in early-June. The Final Report was originally scheduled to be submitted by end-June.

The initial fieldwork, including the pilot surveys, was completed on time but the main survey programme was rescheduled to ensure improved staffing levels and supervision. As a result of this, only a limited number of the surveys had been completed by April 25th when the country experienced a massive earthquake. Following this and the subsequent after-shocks (including a major after-shock on May 12th), work on the Review was significantly disturbed as the LRBP and SDC Offices were damaged and deemed unsafe, and many staff returned to their villages to check on family. As a result the survey schedule was revised and extended.

Fortunately, no members of the team were physically injured in the earthquake, although some experienced damage to their homes and property[1]. It was also fortunate that survey work had been completed at the two sites that were within the severely affected Districts and thus survey work could be restarted in non-earthquake-affected Districts after a hiatus of about 4 weeks.

The earthquake did however severely affect the timing of the overall data assembly and analysis, leading to a delay in the production of findings and conclusions.

[1] The house of Consultant Social Scientist was destroyed by May 12th aftershock and she had to move in temporary houses, therefore delaying the process of data tabulation and analysis.

3 Project Status & Achievements

3.1 Overall Project Progress

Overall progress on the Project is documented in a series of Annual Progress Reports and is updated on the project website (efile.lrbpnepal.org): details of all Local Road Bridges are contained in the Bridge Information Management System (BIMS), also available on-line at bims.lrbpnepal.org.

The LRBP had – as of the end of FY2013/14 – completed 33 bridges[2], with a further 70 under-construction (including 5 directly funded by SDC): an additional 72 bridges (including 19 directly funded) had been identified and were added to the programme in the current year (FY2014/15), making a programme total of 175 bridges. Walk-over Surveys (preliminary investigations) have been completed for a total of 536 bridges and detailed design completed for 160 bridges. Additionally further assistance, including construction supervision and additional design support, has been provided for a further 252 bridges.

The BIMS website indicates, as of 15th July 2015, a total of 85 completed bridges, with a further 201 under-construction, 216 designed or under-design, and 602 for which a walk-over survey has been completed. A total demand has been identified for 1,198 bridges which form a 'long list' for potential consideration. These totals include bridges which form part of other parallel rural road and infrastructure projects. The locations of the 85 completed bridges are listed in Table 3.1 and illustrated on Figure 3.1 overleaf.

Table 3.1: Distribution of 85 Completed Bridges (2012-2015)

	FY 12-13	FY 13-14	FY 14-15	Total
Cluster 1: Biratnagar, Morang	1	1	3	5
Cluster 2: Birgunj, Parsa	2	2	7	11
Cluster 3: Lalitpur	1	4	3	8
Cluster 4: Bhairahawa, Rupandehi	3	5	8	16
Cluster 5: Pokhara, Kaski	1	5	4	10
Cluster 6: Birendranagar, Surkhet	0	2	3	5
Cluster 7: Nepalgunj, Banke	0	6	7	13
Cluster 8: Dadeldhura	0	0	2	2
SDC funded bridges	-	-	15	15
Total	**8**	**25**	**52**	**85**

3.2 Phase 1 (2011-2015)

The overall programme concept comprises of four phases, with a total duration of 12 to 15 years. The objectives of Phase 1 (2011-15) are related primarily to the establishment of the programme and setting up the associated procedures for the planning, selection and prioritisation of local road bridges, together with the strengthening of both public and private sector agencies involved in bridge design and construction.

[2] The 11 bridges identified for evaluation in this Review were selected from the 33 completed by April 2014

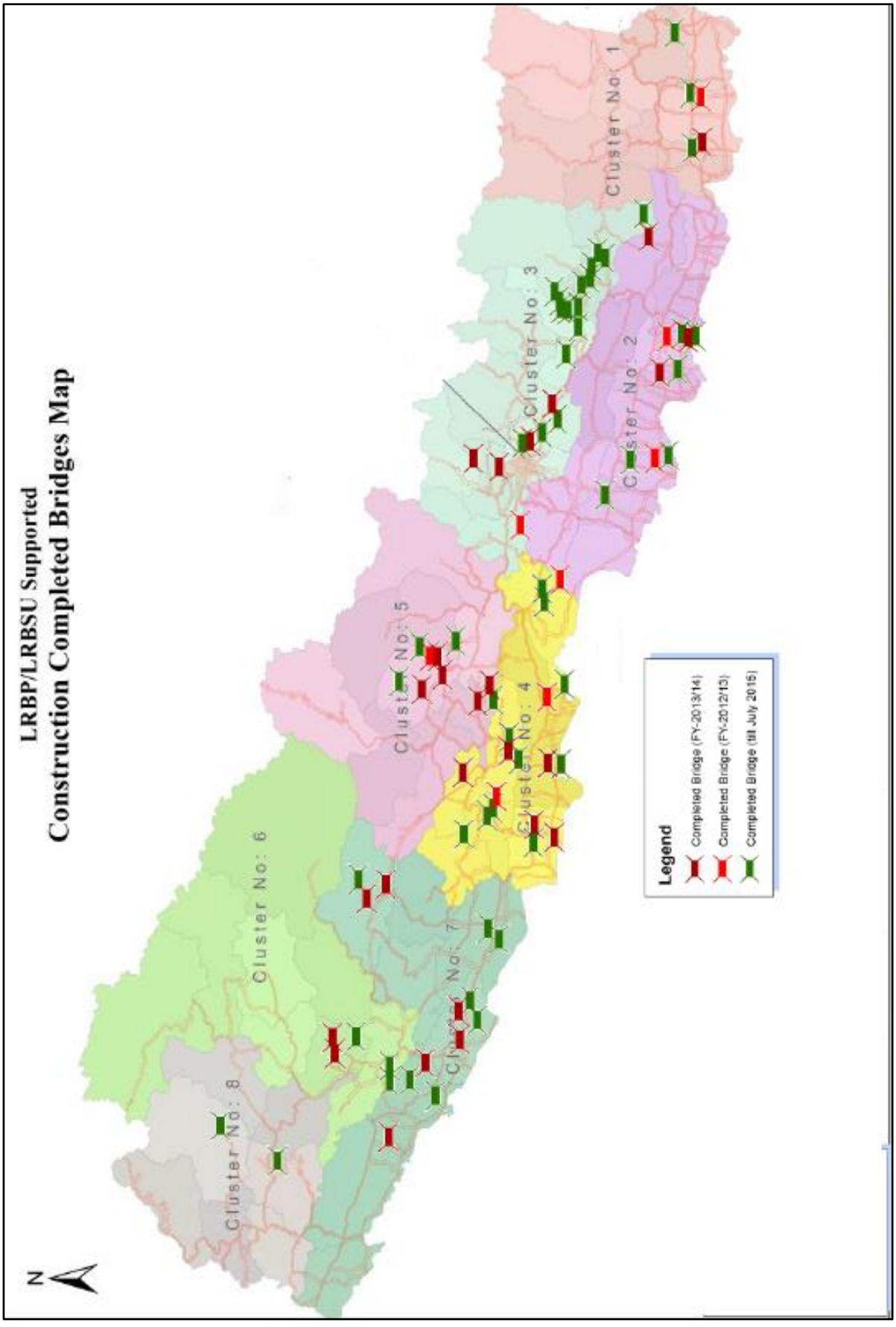

Figure 3.1: Location of 85 Completed Bridges (2012-2015)

This review therefore focuses on the systems that have been put in place as well as the physical achievements that have been made over the first 4-5 years.

3.3 Project Structure & Organisation

The Review Team has worked closely with staff of LRBSU to clarify procedures and to understand better the management and operation of the programme. Issues discussed included the methodology adopted for the selection and prioritisation of bridges and the use of GIS techniques to determine populations within the areas of influence and to calculate changes in accessibility. Further meetings and discussions have also been held with DoLIDAR staff and officials, including the DG, DDG and Head of the Local Roads Bridge Section, as well as with the key donors active in the sector and with relevant project staff.

Specific issues that were discussed included:

- Role & function of SDC-funded LRBP in the context of the overall demand for bridges on the Local Road Network;
- Other Donor's and programmes active in the Local Bridges Sector – e.g. ADB, WB, JICA, DfID, RTI-SWAp, RAIDP, RRRSDP, etc;
- Coordination between the expansion, development & improvement of the local ROAD network and the provision of bridges;
- Selection & prioritisation of bridges for inclusion in programme – criteria for inclusion, District-level evaluation, DTMP & DCRN – and how to select, prioritise and evaluate;
- Relationship between DoLIDAR and DoR in regard to bridges on the LRN (and SRN) and division of responsibilities;
- What opportunities are there for the expansion and/or redirection of the SDC-funded local bridge programme?

3.4 Local Bridge Status

A substantial number of bridges on the Local Road Network (LRN) have been completed in recent years under a number of different initiatives. In particular the Department of Roads (DoR) has been responsible for constructing a number of bridges, mostly under GoN funding and generally in response to local political pressure. Earlier editions of Statistics for the Strategic Road Network (SSRN 2006/7) contained a list of 184 completed bridges on the LRN, although many of these are on roads now included in the SRN.

An earlier review of the status of Local Road Bridges[3] provides an indication of the number of donor-funded local development and road projects that have included the construction of bridges on the LRN. In addition to the LRBP (which, at the time, had completed 46 bridges with a further 369 under construction or design) other projects included: RRRSDP - 11 complete and 4 under-construction; WB/RAIDP - 22 under-construction; Community Assistance Improvement Programme - 13 complete, 35 to be built; RTISWAp - 58 under-construction; and SNRTP, details yet to be defined. The total demand on the District Core Road Network (DCRN) was estimated at over 800 bridges.

[3] National Program for Rural Motorable Bridge Development, Concept Note, Kamal Pande, April 2014

3.5 Budget & Expenditure

The overall programme budget and expenditures for the period from FY2011/12 - FY2015/16 are shown in the following diagrams. The budget can be seen to have increased annually from around Rs 500 million in FY 11/12 to almost Rs 4,000 million in the current year. Annual expenditures, as would be expected, have lagged behind the budget and amounted to almost Rs 1,900 million in the last financial year (FY 114/15).

The lower pair of diagrams illustrate the division between the Capital Works and TA budgets and expenditures. The significant increase in the TA expenditure during FY 14/15 can be attributed to the inclusion of the construction costs of SDC directly-funded bridges.

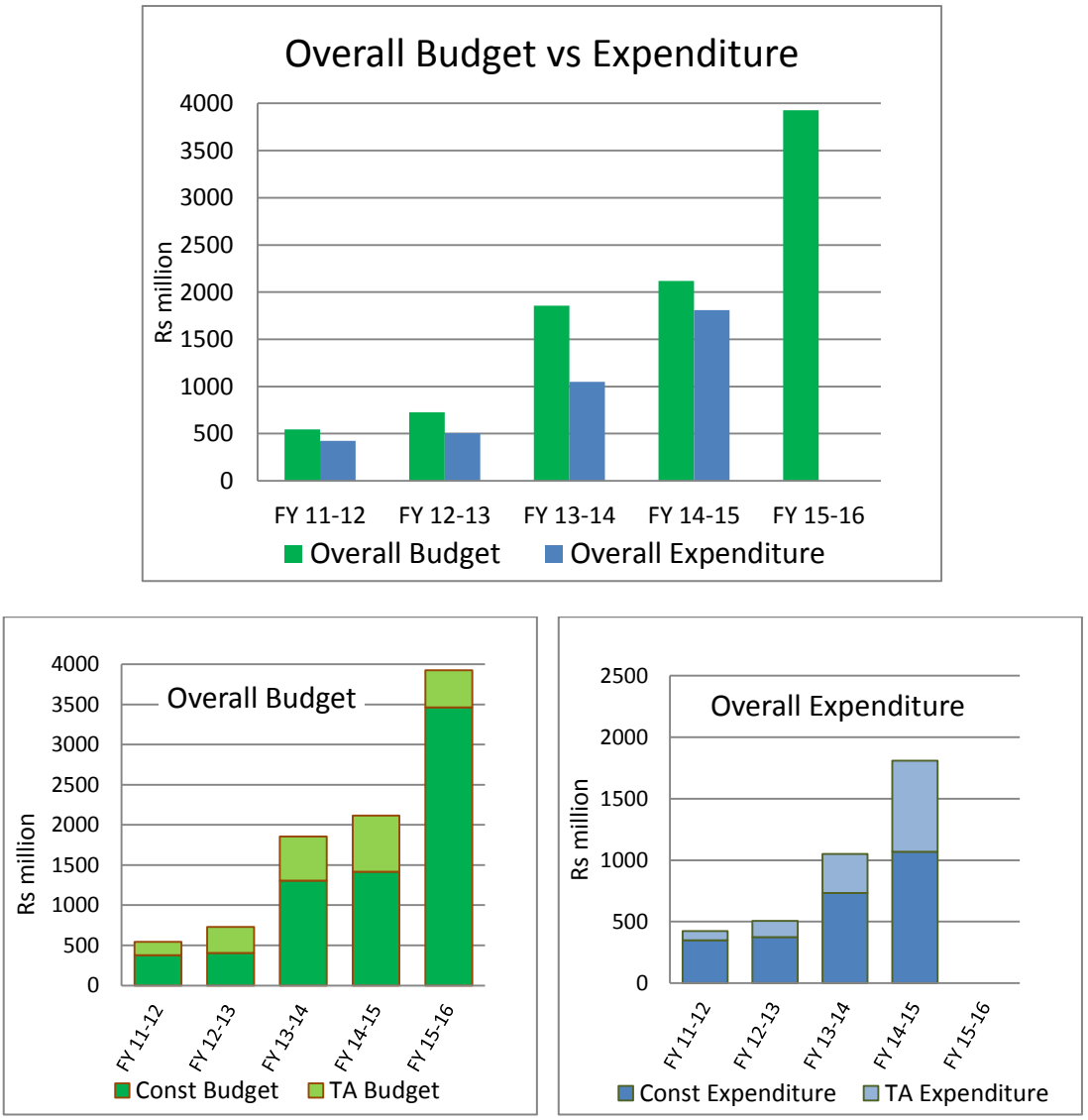

Figure 3.2: Overall Programme Budgets & Expenditure (FY 2011/12-FY 2015/16)

4 Impact Survey at Completed Bridges

4.1 Objectives of Survey Programme

The Terms of Reference require that the Review identifies and measures the impact of the LRBP through a series of surveys undertaken at selected bridges constructed under the programme. The objectives of the surveys are: to identify any changes in the socio-economic characteristics of the populations in the area of influence of the bridge; to measure the increase in traffic volumes using the bridge; and to quantify the economic benefits of the bridge.

The surveys were undertaken at a representative sample of bridges throughout the country that had been completed and had an established traffic demand – including at least one public bus per day.

4.2 Survey Approach & Methodology

Data provided by LRBP at the outset of the Review indicated that a total of 33 bridges in 25 Districts had been completed – or substantially completed – during the initial 3½ year phase of the project (2011-2015): these are listed in Table 1 in Annex A. These form the basis for the survey and overall evaluation of the project. The 33 sites include a number where – although construction is recorded as being 'substantially complete' – traffic is not operating due to problems with the approach roads or other 'off-site' issues. These were excluded from the sample, together with a number of very small or short bridges and those located in (or close to) urban areas where the impact of the bridge would be difficult to isolate and assess.

The 33 bridges are estimated to increase the length of all-weather road by around 660km and to improve levels of accessibility to over 300,000 people.

From this list of 33 bridges, 10 sites were selected for full survey, in addition to the pilot survey site at Roda Khola, Kailali. A second pilot site (Kahare Khola, Dhading) was also identified but the household survey sample numbers were subsequently increased so as to provide equivalent survey data to the other sites selected. The full list of the 11 survey sites[4] – and the basis for the selection – is given in Annex A Table 2.

The selected bridges represent a geographic spread from the East (Morang) to the West (Kailali), and include six locations in the hills and five in the Terai. Locations close to urban areas were avoided, together with short bridges and those where regular traffic movements (including bus services) had not become established due to incomplete bridge works or approach roads.

The total number of bridge sites surveyed was reduced to 11 (from the initially suggested 15) due to constraints on both the time and resources.

The six locations in the Hills and five in the Terai (including the first pilot) are representative of the proportions of all the completed bridges. There is one site in Cluster 1 (and the Eastern Region), one in Cluster 6, two in each of Clusters 3, 4 & 5, and three sites (including the Pilot) in Cluster 7. This distribution is considered representative of all the 33 completed bridges. Local

[4] Including the Pilot Survey Site at Roda Khola

staff were engaged for the surveys, but with supervision and coordination by Cluster Team members and members of the Review Mission.

4.3 Develop Survey Plan & Programme

4.3.1 Scope of Surveys

The overall survey programme at the 11 selected bridge sites included Household Surveys taken at a sample of households throughout the Zone of Influence of each bridge, Settlement Surveys at key settlements served by the bridge, and Traffic Surveys of vehicles using the bridge. A pilot survey was undertaken at two sites prior to the design of the full survey programme.

4.3.2 Pilot Surveys

Prior to the main survey, Pilot Surveys were undertaken at two sites to 'test' the survey procedures, the design of the questionnaires and to determine the staffing levels required. The two sites selected were considered typical, one in the Terai and one in the hills. Roda Khola (Kailali) in the Western Terai was adopted as the initial site to test the surveys forms, procedures and to estimate the staffing requirements: a second site in the hills (Khahare Khola, Dhading) was also identified, to enable the initial findings to be refined and checked against a set of different physical and locational criteria. The survey at Khahare Khola was expanded to collect data for a full sample, rather than the lower sampling rates initially adopted for the pilot.

The two 'pilot' Surveys were completed between 26th-29th March at Roda Khola (Kailali) and between 2nd-5th April at Kahare Khola (Dhading). The findings from the Pilot Surveys were reported in the Inception Report.

4.3.3 Survey Questionnaires

The questionnaires used in the Baseline Surveys for household and settlement surveys were reviewed and a number of modifications and additions made to capture information on 'change' resulting from the bridge construction: it was however considered important to retain much of the original structure of the Baseline Surveys, so that comparisons of key indicators could be made between the 'before' and 'after' situations.

Copies of the Household and Settlement Survey Questionnaires used are included in Annex A. As mentioned, these were based on the forms adopted in the Baseline Surveys, modified as necessary to collect information on change resulting from the bridge construction. Separate forms were developed for the traffic count and survey: these are also included in the Annex. Separate checklists were prepared for the focus group discussions and 'key informant' interviews.

Following the completion of the Pilot Surveys some minor revisions were made to the survey forms and procedures: these involved clarifications of the questions and minor changes to the training and briefing of local staff. The sampling procedure and the target number of interviews were revised following discussions with SDC, to ensure an acceptable degree of accuracy was attained.

4.3.4 Findings of Pilot Survey

No particular difficulties or problems were experienced with the conduct and output from the Pilot Surveys. The Pilot Surveys enabled estimates to be made of the number of forms it was practical for each individual enumerator to complete during a day – and thus the number of

person-days required to complete the desired sample. It was recognised that it would take longer to complete the HH surveys in the hills due to the increased walk time between interviews: it was estimated that the HH surveys would take 5 days in the Terai and 7 days in the hills.

The findings from the Pilot Surveys were fundamental in the planning and design of the full survey programme – in terms of the design of the individual questionnaires and the scheduling and staffing of the programme. It was concluded that it was better to focus on a limited number of sites and that a member of the Review Team should visit ALL the sites and hold discussions also with the appropriate DDC and VDC officials.

4.3.5 Main Survey Design

It was determined that a total of 1,730 HH interviews should be undertaken across the 10 sites, with individual numbers determined by the population and number of households in the ZoI of each bridge. The total population in the 10 ZoIs is just over 90,000 people in 17,236 households. Details of the sampling methodology and size of the sample at each bridge site are given in Annex B.

Based on the household population of the ZoI wards, the sample size was determined for survey, using a random sampling technique, sample size for the different bridge sites were determined, see Annex B.

Teams of 4 or 6 surveyors were deployed at each location – 2-4 for the household surveys and 2 for the traffic counts. It was anticipated that the HH surveyors would complete (on average) 7 or 8 surveys each per day in the Terai and 5 or 6 in the hills, due to the additional walk times involved. In order to achieve the required number of completed surveys at each location, 5 days would be required at each Terai site and 7 days in the hills.

At the same time, 1 or 2 enumerators (depending on anticipated traffic volumes) were be engaged on the traffic survey for a minimum of 5 days at each location, to include a Friday & Saturday and, where appropriate, the nearest local Market Day. Where possible, interviews were taken with truck and bus drivers (and transport entrepreneurs) to determine the effects and impact of the expansion of the local road network on both the services provided and the costs of transportation.

The survey programme commenced in mid-April and was scheduled to be completed by the end of the month. The programme was however significantly disrupted following the earthquakes of 25th April and 12th May, although surveys at the only two sites in the severely affected Districts (Dhading and Nuwakot) had already been completed. The remaining bridge sites were in areas not significantly affected by the earthquakes and thus the results should remain valid. The schedule was however delayed due to the availability of staff and the disruption caused by the damage to the SDC and DoLIDAR buildings in Kathmandu. The survey programme was eventually completed by the end of May, although there was a subsequent severe delay in the completion of the analysis by the consultant (social scientist) as a result of damage incurred during the two major earthquakes.

4.4 Survey Procedure & Results

Surveys were conducted at all 11 selected sample bridge sites, over a period of 7 days at each site in the hills and 5 days in the Terai. Household Surveys were undertaken within the ZoI at all sites, on the basis of the sample rates described above. Settlement Surveys were completed in

villages adjacent to the bridge site and in the immediate vicinity. Traffic counts and driver interviews were conducted for 12 hours (0600-1800) daily at each site.

Due to time limitations and loss of data in the disruption following the earthquakes, not all of the collected data have been analysed. The status of the analysis as used to prepare this Review Report is presented in the following tables. Table 4.1 summarises the available data from the household surveys at 9 of the 11 sites.

In total, almost 1800 household questionnaires were completed at the eleven bridge sites: around 10% of the households surveyed were female-headed and around 40% (on average) were Dalit or Janjati. The ethnic composition however varied significantly between sites. The average household size was 5.4. With the exception of Duduwa Nala (Banke) and Sankh Khola (Rukum), almost 100% of those interviewed used the new bridge: at the two sites with lower usage, some of the interviews were remote from the bridge and, in Rukum, the bridge serves a large and poorly developed hinterland where regular travel away from the home village is less prevalent.

The Settlement Surveys, at 17 locations associated with eight of the bridge sites, have been separately analysed, see Section 4.5 below.

Table 4.1: Details of Household Surveys Undertaken

	Bridge Site	No of interviews completed	VDCs covered	No of settlement surveys	Percentage Female HH Head	Family Size	Ethnicity of HH head		Percentage using Bridge
							Dalit & Janjati	Brahmin, Chhetri & Thaakuri	
1	Daas Khola, Morang	354	3	2	13%	4.72	36%	55%	99%
2	Khahare, Dhading	(60)							
3	Belkot, Nuwakot	(165)							
4	Mathura Arghakhanchi	85	3	3	9%	5.65	20%	80%	99%
5	Gudrung, Kapilvastu	118	2	1	7%	5.91	57%	42%	99%
6	Harpan, Kaski	91	2	2	14%	5.85	55%	45%	98%
7	Ringdi, Syanja	305		2	13%	5.35	41%	57%	95%
8	Tiperi, Dailekh	127	2	2	28%	5.63	48%	52%	98%
9	Dudhwa, Banke	256	3	3	9%	5.68	50%	31%	80%
10	Roda Khola, Kailali	28			11%	6.61	86%	7%	100%
11	Sankha, Rukum	174	2	2	9%	5.89	40%	60%	60%
	Total	1763				5.40			

Initial findings are presented in Table 4.2, illustrating change over the past 2 years since the completion of the bridges. Increases in 'out-migration' are observed at most sites and this probably replicates trends throughout the country and cannot be attributable to any specific local change. Similarly an increase in Motor Vehicle ownership is observed in all locations, again presumably replicating national trends. Increases in in motor-cycle ownership were particularly pronounced.

Most respondents indicated that public transport access had improved, reflecting an enhanced provision of bus services which hopefully had been prompted by the upgrading of the local road network and provision of all-weather access. Significantly also, transport costs were perceived to have reduced, again reflecting improved levels of access which permitted the operation of buses, mini-trucks and pick-ups in place of tractors and tractor-trailers.

Similarly, both the availability of goods and the ease of access to market show marked improvements over the period since the completion of the bridges.

A large number of other parameters and indicators were examined in the survey but, in general, these showed little or no significant change over the previous 2-3 year period. The questions covered: ease of access and time taken for trips to Primary School, Secondary School and College; frequency, ease and cost of trips to Health Facilities (pharmacy, clinic and hospital); access to veterinary services; and the time and cost to access the nearest local market, main market and District Headquarters.

Similarly questions relating to land holdings (size and amount irrigated), food sufficiency, food production, farming activities and sources of income produced no conclusive evidence of change over the past 2-3 years – and certainly nothing that could be attributed to the bridge construction.

Table 4.2: Summary Findings from Household Surveys

	Bridge Site	Percentage out migration		MV Ownership		Enhanced PT access	Transport Cost Reduced	Availability of Goods	Ease of access to Market
		Before	After	Before	After				
1	Daas Khola, Morang	31%	23%	33%	42%	75%	50%	69%	87%
2	Khahare, Dhading					30%	2%	95%	-
3	Belkot, Nuwakot					43%	22%	48%	-
4	Mathura Arghakhanchi	8%	53%	1%	33%	88%	16%	66%	78%
5	Gudrung, Kapilvastu	1%	41%	15%	22%	97%	58%	80%	97%
6	Harpan, Kaski	1%	43%	10%	16%	92%	21%	100%	100%
7	Ringdi, Syanja	1%	63%	0%	12%	82%	28%	95%	52%
8	Tiperi, Dailekh	12%	61%	0%	0%	66%	88%	54%	52%
9	Dudhwa, Banke	27%	50%	6%	8%	98%	31%	97%	97%
10	Roda Khola, Kailali	39%	32%	32%	36%	-	-	-	-
11	Sankha, Rukum	13%	19%	0%	1%	97%	24%	71%	52%

Overall it is evident that the bridge construction has had a positive impact on households in the vicinity with high proportions of bridge use and significant improvements in public transport services, reduced transport costs, enhanced availability of goods and improved market access. The majority of the other indicators assessed appeared to show little or no correlation with the changes in the local road accessibility, suggesting that, in future, impact monitoring can be undertaken with substantially fewer indicators focussed more directly on the transport and access aspects. This issue is addressed in the Overall Findings and Recommendations.

4.5 Settlement Surveys

A series of surveys were undertaken in a total of 17 settlements in the vicinity of eight of the bridges. The objectives of the surveys were to collect basic socio-economic data relating to the situation both before-and-after the bridge construction and to hold discussions with key informants (eg traders, transport operators, etc) regarding the impact of the new bridge. Data were collected regarding commodity prices, transport costs, provision of services and numbers of businesses operating.

Information was collected on the market price within each settlement of basic items (eg petrol, diesel, rods, food grains and fertilizer) as well as transport costs to the nearest main market by various available modes for the situation both before and after bridge construction. No clear pattern of price change could be discerned: fuel prices were clearly influenced by national pricing issues and other factors determined the prices of various commodities. There was however some evidence of transport costs reducing.

There was some indication of an increase in the numbers of businesses, shops and public institutions established in the settlements but, in many cases, the 'before' data were either missing or appeared unreliable. Similarly volumes of goods, both imported and exported, wage rates and the values of land were inconsistently reported and it was not possible to identify a trend or evidence of change.

The surveys also enquired about traffic volumes and frequencies of bus, truck and other vehicle movements. Without specific and consistent instructions or guidance regarding data collection – in both the 'before' and 'after' situations – this information is unlikely to be reliable enough to allow any clear conclusions to be reached.

Detailed information was gathered during the Settlement Surveys regarding the frequency and length of road closures during the rainy season for individual vehicle types: these data have been used in the economic analyses, together with information on the availability of alternative diversionary routes.

Due to inconsistencies in the Settlement Survey data, it has not been possible to conduct a comprehensive comparison between the current data and that collected in the Baseline Studies.

4.6 Traffic Surveys

The traffic surveys were substantially expanded beyond the surveys undertaken for the Baseline, with the inclusion of OD information and interviews with truck and bus drivers. Only limited information is available for the 'pre-project' situation, often in the form of estimates provided by the local population.

A summary of the daily traffic counts undertaken at the 11 completed bridge sites is given in Table 4.3 below: the volumes are the average daily flow recorded over 5 days in the Terai and 7 days in the hills, from 0600 to 1800 hrs. The volumes of 4-wheeled traffic recorded ranged from 5 to 90 vpd, with the lowest volumes being observed at the hill sites in Rukum, Nuwakot, Kaski and Dhading. The highest volumes were recorded in the Terai at Daas Khola, Duduwa Nala and Roda Khola: these latter three sites also experienced very substantial flows of motor-cycles and pedal-cycles.

A 5-day Traffic Count (7-days in the hills) was undertaken at each bridge site to record all vehicular movements, by vehicle type: additionally, where practical, the origins and destinations of all commercial vehicles (buses & trucks) were recorded – and interviews conducted with bus and truck drivers to determine patterns of movement and how this had changed (or could change) as a result of the bridge.

A substantial volume of data was also collected in regard to origin-and-destination, vehicle type, occupancy, journey purpose, and type and volume of goods carried. Only limited analysis of these data has been undertaken, including a plot of the origins and destinations of traffic using four of the bridges – two in the Terai and two in the hills, see Annex D. It can be seen that the Terai bridges are used by some long-distance traffic, whereas the bridges in the hills have a more limited area of influence.

Table 4.3: Summary of Traffic Counts (vehicles per day) April/May 2015

	Bridge Site	Truck Tractor	Bus	Jeep	**Total 4Wheel**	M/c	**Total MV**	Cycle	Ped
1	Daas Khola, Morang	64	1	27	**91**	379	**470**	583	1537
2	Khahare Dhading	10	3	2	**15**	29	**44**	8	585
3	Belkot Nuwakot	9	0	1	**10**	10	**20**	9	161
4	Mathura Arghakhanchi	10	5	24	**39**	82	**121**	1	
5	Gudrung Kapilvastu	11	2	7	**20**	92	**112**	179	45
6	Harpan Kaski	6	1	6	**13**	46	**60**	4	350
7	Ringdi Syangja	5	8	6	**18**	35	**54**	2	124
8	Tiperi Khola Dailekh	14	0	5	**20**	5	**25**	0	53
9	Dudhwa Banke	46	6	7	**59**	280	**339**	777	311
10	Roda Khola	33	3	3	**38**	261	**298**	455	201
11	Sankha Rukum	4	0	1	**5**	6	**11**	0	300

A summary of the traffic data available for each bridge site ('before' and 'after' construction) and comments on the traffic impact and changes in travel patterns resulting from the bridge construction are provided in Annex D together with detailed descriptions and maps of the bridge locations.

4.7 Survey Findings

4.7.1 Household Surveys

The Household Surveys were designed to collect socio-economic data and to identify change that had occurred in the period since the completion of the bridge. The surveys recorded a positive response to the bridges, with almost all households using the bridge and reporting improved public transport services and better access to markets.

The surveys monitored a number of basic economic indicators (eg vehicle ownership, levels of migration, income, land values, etc) and identified some limited change. However these changes could not necessarily be directly attributed to the bridge construction and more probably were a reflection of national trends. Other social indicators – school attendance, use of health facilities, frequency of trips to markets, etc – did not demonstrate any significant change.

Thus, whilst the Household Survey recorded an overall positive response to the bridge construction, it was not possible to identify any significant change in the majority of the social indicators that was a direct result of the bridges. Rural Nepal is in a period of considerable change – in regard to parameters such as migration and the expansion of local road networks – and it is not realistic to attempt to isolate the effects of a single isolated investment.

It is thus concluded that extensive household surveys of the type undertaken are not effective in identifying significant change resulting from the bridge construction. Other – more direct – methods are likely to be more effective.

4.7.2 Settlement Surveys

The Settlement Surveys provided much of the relevant data on commodity prices, changes in local services and facilities, road condition (including closures) and transport costs that were used in the analysis and evaluation. However the value of the data collected was limited due to inconsistencies in the format and scope of questionnaires used in the baseline and subsequent surveys.

Potentially, settlement surveys and/or interviews with Key Informants can provide a rapid and reliable source of local information. For example, commodity costs, transport costs and levels of service provision (transport, health, schools, etc) can be more effectively – and probably more reliably – assembled from group discussions than through individual household survey: In addition, valuable anecdotal evidence in regard to change and use of the new facility can be obtained

4.7.3 Traffic Surveys

Traffic volumes recorded were in general low, except some Terai locations where traffic diverted from other routes. In most locations some vehicles had been able to use the crossing for much of the year prior to the bridge being constructed. Substantial volumes of motor-cycles (and pedal-cycles) used the Terai bridges.

Bridge construction provided improved and more reliable accessibility (for a broader mix of vehicle types) and enhanced the degree of all-weather access to remote areas. The bridges alone did not necessarily guarantee all-weather access – complementary improvements were required to the remainder of the road (eg: cross-drainage, retaining structures, improved surface, etc). It is difficult to isolate the effect of the bridge in relation to overall changes and network expansion in the area.

5 Outcome Monitoring Summaries

The ToR require that the Review 'validates' the results of the Outcome Monitoring Summaries (OMS) that have been undertaken. Of the eleven 'sample' bridges examined by the Review only THREE have been subject to an OMS: this validation exercise is therefore limited to these three sites only. The sites are:

- Khahare Khola, Dhading
- Mathura River Bridge, Arghakanchi
- Dudwa Nala Bridge, Banke

5.1 Methodology

The OMS surveys examined the access to all weather roads, accessibility to health services and physical facilities, and changes in freight cost, traffic and freight volume as compared to the baseline data. These issues relate to Outcome 1 and data are measured against Indicators 1.2 to 1.6 as follows:

- **Outcome 1:** People in the programme districts will have improved access to services and opportunities:
  - **Indicator 1.2** Increase in the number of people having access to all weather road within 2 – 4 hrs walk;
  - **Indicator 1.3** Utilization of health services in local health facilities increased by 20%;
  - **Indicator 1.4** Average freight cost decreased by 25% as compared to the baseline data;
  - **Indicator 1.5** Traffic and freight volumes (Import & Export) increased by 50% as compared to baseline data;
  - **Indicator 1.6** Increase in number of public utilities.

The three bridge sites for which OMS have been conducted are considered below.

5.2 Khahare Khola

The Abstract of the OMS includes the following:

> *The result (of the survey) shows that 100% respondents use the bridge indicating increase in the number of people having access to all weather roads (Indicator 1.2). The access in health services increased to 518 people from 140 people monthly after the bridge construction. This shows substantial increase in the utilization of health service in local facilities (Indicator 1.3). The result also shows that there has been decrease in the average freight cost as compared to the baseline data (Indicator 1.4). Additionally, the traffic and freight volumes (import and Export) have increased by more than 50% compared to the baseline data (Indicator 1.5). The construction of bridge has also aided in the increase in the number of public utilities (Indicator 1.6). Hence, it is evident that the requirements of the indicators are met and the local people are highly benefited after the construction of Khahare Khola Bridge in Dhading District.*

The results are general confirmed by survey conducted for this Review, although it is considered unlikely that the observed increase in the use of health services (up from 140 to 518 per month) can be attributed solely to the bridge and it is noted that the calculation of reduced freight costs was based solely on the increase fuel prices. This reduction is claimed as actual freight rate (per kg) remained constant despite the increase in fuel prices: the subsequent drop in fuel prices over the past year would negate this claim.

In practice, the volume of traffic has increased from 10 vehicles per day quoted in the Baseline Report (or 20 vpd in the Executive Summary) to 44 motor-vehicles in the current survey. This is a clear and positive indicator of the impact of the bridge.

5.3 Mathura Bridge

The Abstract of the OMS includes the following:

> *The result (of the survey) showed that there has been increase in the number of people having access to all weather roads and that 3282 (90%) of them used the bridge (Indicator 1.2). Before construction of the Mathura Bridge, access in health services was 225 people per month which increased to 385 people per month after the completion of the bridge. This shows that there is a 58% increase in the utilization of health service in local facilities (Indicator 1.3). The result also shows that has been a decrease in the average freight cost as compared to the baseline data (Indicator 1.4). Again, the traffic and freight volumes (import and Export) increased by more than 50% compared to the baseline data (Indicator 1.5). Finally, the construction of the bridge also aided in the increase in the number of public utilities (Indicator 1.6). Hence, it is evident that the requirements of the indicators are met and the local people are highly benefitted after the construction of the Mathura Bridge in Arghakhanchi District.*

The increases recorded are generally in line with the findings of this Review. As with Khahare Khola above, it is doubtful whether the increase in health centre attendance is wholly attributable to the bridge construction and the apparent reduction in the freight rate may not have been sustained with falling fuel prices. However the growth in traffic and freight volumes has been verified by the counts undertaken during this Review, with the traffic volume increasing from 15 vpd to in excess of 120 vpd (80 motor-cycles).

5.4 Duduwa Nala Bridge

The Abstract of the OMS includes the following:

> *The result (of the survey) shows that there has been Increase in the number of people having access to all weather roads and that 100% respondents use the bridge (Indicator 1.2). Before the construction of Duduwa Nala Bridge, access in health services was 461 people per month which increased to 972 people per month after the completion of the bridge, which is 47.48% increase in the utilization of health service in local facilities (Indicator 1.3). The result also shows that there has been decrease in the average freight cost as compared to the baseline data (Indicator 1.4). Again, the traffic and freight volumes (import and Export) increased by more than 50% compared to the baseline data (Indicator 1.5). Finally, the construction of bridge also aided in the increase in the number of public utilities (Indicator 1.6). Hence, it is evident that the requirements of the indicators are met*

and the local people are highly benefited after construction of Duduwa Nala Bridge in Banke district.

The OMS records a massive increase in traffic volume from 4 to 181 vpd – quoted as a 45-fold or 98% increase – which is misleading as the 'before' figure (taken from the Baseline Study) refers to public vehicles (buses) only whilst the observed flow likely includes all vehicles. The traffic count undertaken for this Review recorded 339 vpd (incl 280 motor-cycles). It is probable that the major impact at this site relates to the availability of all-season access which was apparently unavailable for up to three months annually during the monsoon: this was not recorded in the OMS.

5.5 Conclusions

The three OMS examined have each concluded that the bridges concerned have had a positive impact in line with expectations and as measured by the five Indicators defined to assess Outcome 1: "that people in the programme districts will have improved access to services and opportunities".

Unsurprisingly, a large percentage of those interviewed expressed a positive reaction to the bridges, with high levels of usage reported. Similarly significant increases in access to local health facilities are reported, although it is doubtful whether the full extent of these increases can be attributed to the bridge. Reductions in freight costs are reported in each case, based primarily on the fact that the freight rates remained unchanged during a period of rising fuel costs: assuming that the rates may not have reduced along with lower fuel costs, this benefit is forfeit.

Overall the positive results and responses to bridge construction as reported in the OMS are borne out in the surveys conducted in this Review.

Surprisingly the OMS does not include a direct measure of the traffic using the bridges, although Indicator 1.5 refers to traffic and freight volumes. The volume of traffic using the bridge on completion is probably the single most readily identifiable and quantifiable indicator of the overall impact and should be explicitly included in the outcome assessment. The project is concerned with the construction of local motorable bridges and the enhancement of all-weather access: thus a measure of the increase in motorised traffic – throughout the year – is a key parameter.

6 Institutional Assessment

6.1 Current Status

Responsibility for the design, construction and maintenance of Local Road Bridges has – in the past – been unclear, with conflicting involvements of both local and central agencies and funding from various sources. The Department of Roads (DoR) had, de facto, assumed the primary role, based on their historic involvement and capacity (relative to DoLIDAR & the DDCs) to undertake the work. However the expansion of the Local Road Network (LRN) over recent years has led to the demand for – and construction of – a large number of local road bridges and the consequent involvement of other agencies, including specifically the local Districts and various rural access and transport development projects.

A decision was however taken, at a joint meeting on 20th February 2015 at Secretary level between MoFALD and MoPIT, that the responsibility for ALL local roads and bridges would be transferred to DoLIDAR and the respective DDC. In this context 'local roads' include all roads (except municipal roads) that do NOT form part of the designated and approved Strategic Road Network (SRN). Those bridges presently under construction, or for which contracts have been signed, would remain with the DoR and would be transferred to the respective DDC on completion. The Review welcomes this policy decision.

Based on research and field visits conducted during this review, it is evident that a significant number of local road bridges remain with the DoR and that considerable confusion – and lack of coordination – exists at the local level. For example, the DoR are constructing a new bridge over the Ankhu Khola (very close to the Khahare Khola Bridge in Dhading) which will create a new direct route to Dhading Besi and effectively reduce the importance of the Khahare Khola bridge[5]. In addition to the numerous DoR bridges on the LRN, there are other examples where DoLIDAR (through LRBP) is constructing bridges on the SRN – eg Mathura River (Arghankhanchi) and others on the Postal Road.

6.2 Review of Government Agencies – DoLIDAR, DoR & DDCs

The Review held a number of meetings with the relevant government agencies, including MoFALD, DoLIDAR, DoR and selected DDCs (eg Kaski & Dhading) – to identify their role and involvement in regard to local road bridges, as well as assessing the respective capabilities of each agency.

The key issue to be resolved relates to division and allocation of responsibilities for Local Bridges between the various government agencies and, in particular, to the division between DoLIDAR and the Districts. It is accepted that the DoR should relinquish their involvement with local bridges, although it will be a number of years, in practice, before all the present commitments are completed and a clear demarcation can be established.

[5] The DoR Ankhu Khola Bridge is in fact part of the proposed alignment of the Mid Hills Highway which follows the existing Local Road to Salyantar and will also cross the Khahare Khola bridge

It is evident that the responsibility for the identification, selection and prioritisation of local road bridges should rest with DDC. It is a strong recommendation of this Review that this selection and prioritisation should be based on DTMP and the DCRN. Bridges should not be identified or prioritised alone but should be considered as a component of the road (and the network) on which they are located.

All 75 Districts have prepared a DTMP and this identifies the 'main road' network within each District linking all major settlements, key locations (eg tourist sites, industrial or commercial activities, hydro plants, etc) and each VDC centre. This main road network has recently been re-designated as the District Core Road Network (DCRN). [It is noted that in most instances that the DCRN comprises a series of radial routes connecting the District HQ to each VDC independently: more desirably the DRCN should be formed of a network of roads linking the major centres in the District, complementing the SRN, and serving the major traffic demands within the District and to neighbouring Districts.]

A priority within each District will be the upgrading of the DCRN to all-weather standards: this will require a programme for the construction of bridges, within which individual priorities may be readily determined based – for example – on populations served.

In addition to the selection and prioritisation of bridges, the Districts should also take on responsibility for the design and construction supervision of their bridges, with construction contracts let to local (or national) contractors.

Concern has been expressed over the capacity and capability of the Districts to deliver the necessary number of bridges and it is evident that continuing technical support and assistance will be required. It is suggested that this is best provided through a Bridge Directorate within DoLIDAR (headed by a Deputy DG) with the continuing support from SDC through the LRBSU.

The current central and 'cluster' units would appear to offer the most appropriate form of support: the centre would continue to provide overall guidance and control, with the clusters providing 'hands on' support to the Districts in regard to design and supervision of construction.

It is probable – given the significant demand for local bridges over the next 5-6 years – that the existing levels of support from SDC may need to be enhanced but the longer-term objective should be to build up the capacity and capability within DoLIDAR and the Districts and thus enable the eventual withdrawal of any external support.

The Ministry (MoFALD) should remain responsible for policy reform, sector oversight and monitoring, together with overall coordination and funding issues.

Within DoLIDAR, the Bridge Directorate, supported by the LRBSU, should provide the necessary planning and coordination of the overall programme. Ideally this unit, together with the TBSU, should be accommodated within the main DoLIDAR building but this may not be possible in the short term due to the damage sustained in the April/May earthquakes. The DDCs and DTOs would be responsible for the implementation of individual district level programmes.

6.3 Appraisal of donor involvement – ADB, DFID, JICA & WB

The Review Mission held meetings and discussions with the key donors active in the local roads and infrastructure sectors – ADB, DFID, JICA & WB – to ascertain their existing and future

proposals for involvement in the local motorable bridges sub-sector and willingness to join in a coordinated programme for action.

All of the donors contacted expressed a desire to continue and/or expand their involvement in the local bridge sector – and agreed with the principle of donor harmonisation.

The ADB will, in the future, be looking at a portfolio with fewer larger projects, although these will continue to include the transport and rural development sectors. Their focus will remain with overall development issues, improved rural access and poverty alleviation – rather than employment generation. In the local roads sector, it is possible that ADB might look at a larger project involving inter-District roads – ie those that might not otherwise be a DDC priority.

DFID expressed an interest in coordination or collaboration with an SDC-lead initiative in the local bridge sector. However they were concerned over a lack of Fiduciary Risk Assessment and Disaster Proofing in local bridge design. They identified a need to improve the capacity and capability of local contractors and would be willing to support an initiative in this area.

JICA have only recently become involved in the local road and bridge sector. Their initial programme is designed to extend impact and footprint of the Dhulikhel-Sindhuli Road through the upgrading of associated local roads to all-weather standards. This was JICA's first experience of working with local contractors and they expressed surprise at their poor performance, even given their use of expatriate supervision consultants. JICA's future involvement will likely focus in the environs of Kathmandu or the Terai (or near Japanese projects) for domestic 'visibility'.

The World Bank are – and wish to remain – heavily involved with both SRN and LRN bridges, and have been piloting the use of the P4R (Payment for Results) programme approach. They would support the creation of a comprehensive inventory of ALL bridges. A major project involving investment in LRN bridges is under consideration, involving 'parallel' financing with SDC TA support.

It is noted also that SDC are providing (through LRBSU) independent third-party monitoring of the World Bank P4R Bridge Programme for the NPC. This evaluation of key indicators provides the basis for payments from the WB to the MoF for the Bridge Improvement and Management Programme (BIMP).

7 Capacity Enhancement

7.1 Capacity Strengthening

It is evident from the substantial increase in the numbers of bridges to be designed and built on the Local Road Network (LRN) that there will be a significant shortfall in the numbers of trained personnel at all levels at the District level. Historically most bridges in Nepal have fallen under the jurisdiction of the Department of Roads (DoR) and the DoR has developed a significant skill-set in regard to bridge management, although the majority of existing bridges on the SRN were designed and built under foreign aided projects.

The project has included a significant element of local capacity building within DoLIDAR, the DDCs & DTOs in the project Districts, and amongst the local communities. The objectives of this has been to enhance the capability and capacity of the local bodies in regard to bridge planning, designing and construction management and supervision.

There are three additional areas where the LRBP has assisted with the enhancement of skill levels within the bridge sector by engaging through local Engineering Institutes and local Consultant's and Contractor's Associations. These aspects are described in Sections 7.6 to 7.8 below.

7.2 Capacity Building at District Level

In addition to the assistance offered centrally to DoLIDAR through the LRBSU, the project has provided orientation and awareness programmes to the Local Development Officers (LDOs) and Chief District Technical Officers (DTOs) in all 75 districts, combined with Training Courses for both professional and operational staff. The establishment of eight regional Clusters has strengthened the construction capabilities and quality control in all Districts, through the provision of hands-on and day-to-day training opportunities.

The project has introduced a number of technical improvements in regard to the design and construction of local road bridges. These have included training in the application and use of Micro-Pile construction equipment and the preparation of typical designs of RCC and Composite Steel Plate Girder Bridges for both single and double lane configurations.

Additionally, a series of guidelines have been produced – and training provided – for Hydrological Investigations, Analysis & Reporting, and Geotechnical Investigations.

7.3 Training Courses

A total of 46 Training Courses have been arranged during the First Phase of the Programme, involving an overall attendance of 939 professional and operational staff. Of these courses, 21 were conducted in Districts outside of Kathmandu Valley.

The target groups for these training courses included:

- DoLIDAR, DDC/DTO engineers
- DTLs of LRBSU
- LRBSU & DRILP Staff
- University Staff
- Private Consultancies
- Contractors Staff

7.4 New Bridge Types

A number of examples of new bridge types and construction technologies have been explored for application where appropriate and pilot projects implemented. These have included the use of composite steel plate girder bridges, new pile foundation techniques, fixed frame bridges and an RCC Bridge with inclined support girders.

7.5 Gender Balance & Disadvantaged Groups

A specific focus of the programme has been to raise awareness and to increase the participation levels of women in both the design and construction of local bridges: this has involved both the training and recruiting of female engineering staff as well as the inclusion of local women in the construction workforce. Additionally, positive action was taken to ensure the inclusion of disadvantaged group members (DAGs) in the workforce: almost 80% of the workers were recruited from the DAGs, with 16% of the total being women. The inclusion of women and DAGs in the workforce, together with the provision of certified skills development, will provide the potential to ensure long term and sustainable livelihoods and enhanced local capacity.

7.6 Engineering Institutes

LRBP has been partnering with three engineering colleges offering 'real-world' examples of local bridge design and construction experience to final year students who opt for a specialisation in structures, and potentially also in geotechnical or hydrological studies. Students have been given access to the available survey and ground condition data, and have visited the site, prior to embarking on a design exercise. Additionally, the programme promoted the selection of female graduates for specific on-the-job training in bridge construction management.

Depending on the level of course being offered, the potential exists for students to engage in field work and to gain practical experience in post-graduate Construction Management or Contract Administration qualifications.

The major difficulty encountered in working with the colleges related to the timing of the availability of the students, which was restricted to limited fixed 'windows' in the academic year and did not necessarily coincide suitable stages in the construction activity.

7.7 Consultants

At a meeting with the Society of Consulting Architectural and Engineering Firms (SCAEF), the association members expressed the view that many projects (including LRBP) no longer engaged

consulting firms for construction supervision, preferring to engage individual consultants. They claimed the effect of this was to weaken the consulting industry through the removal of a major component of their potential work, whilst also challenging the impartiality of the client-contractor relationship by excluding the 'independent' consultant.

7.8 Contactors

It is generally recognised that the overall capability and capacity of the local (Class C & D) Contractors is below acceptable standards, with poor performance in regard to timely completion and quality control. Much of the problem is attributed to the procurement process with contract award to the lowest bidder, who may be ill-equipped and over-committed.

LRBP have arranged training workshops and seminars for both DDC and Contractors (as parties to the contract process) with the intent of improving contract management and administration, in order to improve on-site performance. Such measures are welcomed by the Contractors Association.

7.9 Conclusions

LRBP have, in the first phase of the project, identified key areas where the existing institutional and technical/professional capacity is deficient. Significant strengthening has been undertaken within the technical capacity of DoLIDAR are the Districts (DDCs& DTOs), with training programmes and technical support, specifically through the eight Regional Clusters. The project has also established contacts with the key academic institutes and contracting and consulting organisations with a view to further strengthening the sector during the remaining phases.

The academic institutes welcomed the opportunity for interaction with the programme, through the provision of 'real world' experience and exposure for their students; this can be expanded, although timing and schedule constraints limit the availability of the students.

The Consultants Association were positive in looking for opportunities to strengthen the overall capacity of their membership and were keen for a greater involvement in the design and supervision of future bridge programmes. The Contractors Federation was similarly keen to encourage their members' participation in training sessions and seminars to enhance their skills and capability

8 Economic Evaluation

8.1 Introduction

The objective of this evaluation is to assess the economic impact of the transport cost and value of travel time savings, based on a comparison of the costs and benefits in the 'without project situation' (before construction) with the 'with project situation' (after construction). This Chapter summarises the methodology and results of the evaluation: further details are provided in Annex E.

The costs include the construction and maintenance costs and the benefits are the savings to road users – ie savings in vehicle operating costs (VOCs) and value of travel time saved. The Roads Economic Decision model (RED) was used to estimate Vehicle Operating Costs (VOCs) and travel time of vehicles: RED is a derivative of the Highway Design and Maintenance Model (HDM4) and was developed for use on lower volume roads. It has been calibrated to Nepali conditions.

The economic analyses were carried out with a twenty year timeframe. Annual costs and benefit streams were converted to represent 2015 values using a social discount rate of 12% per annum. Three indicators of economic viability have been calculated and used to test the viability of the bridge construction, namely: Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR).

8.2 Project Costs

The construction costs of the selected bridges are presented in Annex E. To account for the residual value of the bridges, a negative cost was included at the end of the 20-year evaluation period. A life of 50 years has been used for the project as a whole, with an allowance for annual maintenance.

The vehicle operating costs (VOCs) were calculated using the RED model, which is based on HDM-4 and calibrated to Nepali conditions. The RED model calculates VOCs based on input data comprising the price of vehicles, tyres, fuel and oil, costs of crew members and maintenance labour, and characteristics of the project road.

Additional benefits were calculated based on time savings to road users and the associated value of travel time (VoT). Details are provided in the Annex.

8.3 Project Benefits

Benefits from construction of the project bridges are realised from the savings in users' costs. These savings are either in the form of reductions in VOCs and travel time through the diversion of traffic from previously longer routes or savings in waiting times for crossing the river during periods of high flow which are eliminated after construction of the bridge. To calculate the user costs savings, the Annual Average Daily Traffic (AADTs) before and after the project were estimated from vehicle counts undertaken for this Review.

The comparisons show a clear picture of the impact of bridge construction on traffic levels. In general, significant increases in traffic volumes have been observed: these comprise both diverted and generated traffic as a result of the bridge construction. In the case of three Terai bridges – Daas Khola, Duduwa Nala and Roda Khola – traffic generally diverted from other alternative routes, with few vehicles having previously used the bridge approach roads. In the case of the Mathura and Gudrung River Bridges, which were closed during periods of high flow in the rainy season, vehicles were assumed to have diverted to nearby alternative crossings. In the remaining six locations, traffic was assumed to wait during periods of high water levels until the river became passable – which could have been a matter of hours or days. As a result, the differences in traffic levels between the 'before' and 'after' situations were assumed to have resulted from either diverted traffic (in the case of three bridges) or generated traffic in respect of the other bridges.

8.4 Economic Evaluation

The economic evaluations are based on a comparison of the situation before the intervention ('without project') and after the investment ('with project') with costs and benefits projected into future years. The bridges have been considered together with the full length of the associated access road for the purposes of the economic evaluation.

In many cases, the rivers or streams crossed by the bridges used to become impassable for vehicles due to rise in water levels during the rainy season. The waiting time until the water levels reduced to enable vehicles to cross varied from hours to days. The total days of such closures in a year for individual rivers were obtained from the Settlement Surveys and ranged between 25 and 90 days. For economic evaluations, the vehicle waiting time in all cases of closure were assumed to be an average of 8 hours per day.

For Daas Khola, Duduwa Nala and Roda Khola, the economic benefits from the bridge construction were derived from the values of savings of VOCs and travel times of vehicles diverting from longer routes to shorter routes using the new bridges. Other benefits were derived from the value of waiting time savings of traffic using the approach roads during closures before the project, which were eliminated after construction of the bridges.

Economic benefits from constructions of Mathura and Gudrung river bridges were derived from the VOC and travel time savings obtained by not having to use the alternative diversions during periods of closure. Other benefits from the construction were derived from the generated traffic benefits.

In remaining six bridges, benefits were derived from the savings in waiting time of the traffic on the approach roads during closures, which were eliminated after the construction of the bridges. Other benefits from the bridge construction were derived from generated traffic.

The results of economic evaluation are set out in Table 8.1 and show that the economic internal rates of return (EIRR) of construction of six of the bridges are above the 12 percent threshold rate that is often used by development banks to justify investments. The net present values (NPV) obtained using the 12 percent discount rate are positive and the Benefit Cost Ratios (BCR) are also above 1. The rates of return of the remaining 5 bridges are below the 12 percent threshold rate: their NPVs are negative and the BCRs are below 1. These results indicate that implementation of the project bridges is highly sensitive to traffic levels and to the extent of generated traffic.

Table 8.1: Results of Economic Evaluation

	Bridge	NPV NRs million	BCR	EIRR (%)
1	Daas Khola Bridge	69.49	2.71	26.6
2	Kahare Khola Bridge	-3.22	0.61	6.6
3	Belkot Khola Bridge	-9.19	0.23	0.8
4	Mathura River	7.24	1.60	17.5
5	Gudrung Khola	-2.14	0.95	10.8
6	Harpan Khola	0.13	1.07	12.2
7	Ringdi Khola	14.09	1.92	20.5
8	Tiperi Khola Bridge	-3.50	0.70	7.8
9	Duduwa Nala	28.81	2.31	23.4
10	Roda Khola Bridge	29.45	2.96	28.6
11	Sankh Khola Bridge	-0.84	0.94	10.8

8.5 Conclusion

The economic evaluation was based on the procedures used by development banks and donors to evaluate roads investments. The evaluations have shown mixed returns on the investments. It is evident that the outcome of these evaluations depends on a wide range of variables – each with a large degree of uncertainty. This problem is typical of all evaluations of low-volume roads and bridges.

The economic analyses were difficult due to the lack of adequate and reliable baseline traffic data. However in conjunction with the many additional development benefits available, the quantifiable traffic benefits contribute to the overall picture of positive economic returns of the investments.

The generally low traffic volumes and limited changes in travel patterns and demand following the bridge construction result in limited quantifiable economic benefits: however credible and acceptable benefits are identifiable on at least six of the bridges examined, suggesting that significant time and VOC savings are available. Economic appraisal should be regarded as part of overall assessment of upgrading the local road network to all-weather standards bringing socio-economic benefits to whole community.

Rather than undertake extensive and complex economic assessments of individual bridges, it is suggested that traffic volume – and estimates of increases in traffic demand – can act as an effective proxy for economic benefits, assuming modest construction costs and a location on a key element of the local road network (DCRN).

9 GIS & Accessibility

9.1 Approach

An assessment has been made of the changes in accessibility brought about by the construction of the project bridges – in terms of the numbers of people within a given walk-time from an all-weather road. Initially this required the identification of the changes in the all-weather road network brought about by each bridge: this was based on the Local Road Network (LRN) alignment data as available from DoLIDAR or the DDC. The population within each time-band could then been computed using GIS techniques that calculate the walk-time across the terrain between each household and the LRN.

This enabled plots and calculations of populations within the 1 hour, 2 hour and 4 hour walk times of the roads in the areas of influence, both 'with' and 'without' the bridge. However, it became evident that the 'traditional' approach to accessibility analysis was NOT directly applicable in regard to many of the selected bridge sites. The accessibility analysis methodology had been developed primarily in relation to the expansion of the rural road network into previously non-road-served areas – ie into areas where there had previously been no road access and where significant changes in accessibility were proposed.

This is NOT the situation in respect of many of the bridges that are proposed under this programme. In the Terai, for example, most of the local road bridges proposed are in areas that already have a degree of access to the motorable road network: the justification for the bridge is based on improved 'connectivity' or better local linkage that will result in shorter and more convenient travel. Similarly, in the hills, many of the bridges are accessing only a relatively small catchment due to the presence of other existing roads. In only a few locations are the bridges providing access into previously unserved areas.

The approach adopted in this Review has therefore been to examine each location individually and then to assess the changes in all-weather accessibility that can be attributed to the bridge construction. A detailed analysis of each of the 11 sample bridges is included in Annex F where the associated 'accessibility' issues are discussed and the impact demonstrated graphically. A single approach to all sites is not appropriate as the issues involved are different, especially in regard to the treatment of other (existing) roads.

9.2 Findings

It is evident, based on the sample of 11 selected bridges, that the construction of local motorable bridges has a significant impact on the level of accessibility to the all-weather road network. Substantial additional areas are brought within a 1 hour walk of a motorable road with all-season access.

It should be noted however that each bridge needs to be considered in conjunction with the overall road network – and specifically with the extent of the additional lengths of all-weather road created.

The calculations need to be undertaken with care – especially in regard to defining the extent of the ZoI as this may be constrained or restricted by the presence of existing alternative roads.

Specifically, in the Terai, the bridges will improve local connectivity – rather than accessibility: most areas of the Terai are already within 1 or, at the most, 2 hours of an all-weather road.

Analysis of the OD data at each site (see Annex D) can also assist in identifying the extent of the area of influence of individual bridges and the associated changes in accessibility.

In only a few cases – of roads into previously unserved areas – will the bridge substantially increase the extent of the area served: however, in other locations, accessibility will be improved with increased numbers of people in the 1 hour (or 2 hour) time bands from an all-weather road – coupled with a reduction in numbers of people in the higher time bands.

Typically, the number of people within 1 hour of an all-weather road is increased by a factor of between 2 and 5 times, with a few sites showing a much greater change. On average, within the ZoI of each bridge, the population within a 1 hour walk of an all-weather road increases from around 2,000 to 9,000 – a factor of 4.5.

Improvements to accessibility are clearly an important factor to be considered in the development of the Local Roads Bridges Programme. However there is no single method of calculating the impact on accessibility and each location will need to be treated on its merits – some locations (for example in the Terai) offer no significant improvement in accessibility (as measured in terms of 1 or 2 hours from an all-weather road), whereas others offer substantial improvements. Many people can benefit from the bridge improvements without necessarily enhancing accessibility.

10 Findings & Recommendations

This section summarises the key findings of this External Review of Phase 1 (2011-2015) of the SDC Local Road Motorable Bridges Programme (LRBP).

10.1 Main Goal and Outcomes

The Main Goal of the LRBP is that 'People in the districts have improved livelihoods'. It was proposed that this goal be achieved through Two Outcomes:

- Outcome 1: People have improved access to services & opportunities; and
- Outcome2: National & local institutions adopt appropriate local road bridge strategy

Outcome 1 requires that rural populations (including specifically DAGs) will have better access to resources and opportunities through the provision of all-weather motorable roads and bridges. The six targets identified to measure this outcome were:

(i) an additional 1400 kms of all-weather road – ACHIEVED, an additional 1,436 km of all-weather road established;

(ii) more people have access within 2/4 hours walk – YES, each bridge brings, on average, an additional 2,000 to 9,000 people within a 1 hour walk of an all-weather motorable road;

(iii) increased utilization of health services – YES, increase observed, but not necessarily attributable directly to the bridge construction;

(iv) increased number of public utilities in ZoI – PROBABLY, there has been a general increase in public services provision due, in part, to investment in infrastructure;

(v) decreased cost of freight – POSSIBLY, it would appear that freight rates have remained constant despite overall levels of inflation and variations in fuel prices;

(vi) increase in traffic & freight volumes – TRAFFIC VOLUME UP – significant increases recorded in traffic volumes using the bridges and approach roads.

Outcome 2 implies that both GoN and the private sector are able to regulate, facilitate and build/maintain local motorable bridges. Four indicators were defined to assess the Outcome:

(i) National Strategy on Motorable Bridges endorsed – YES, IN PART – strategy partially endorsed and adopted by relevant agencies;

(ii) Strategy adopted & followed by relevant agencies – YES, IN PART – strategy partially endorsed and adopted by relevant agencies;

(iii) Separate institutions (Roads & Bridge Section at DTO) capable of facilitating and regulating motorable bridge building works – IN PROGRESS – capacity strengthening on-going in both DoLIDAR and the Districts (DDC & DTOs);

(iv) Regular budget allocated to implement motorable bridges at local level – YES separate budget established and increased by 250%.

Additionally, Five Outputs have been defined to achieve these outcomes:

- Output 1: DAGs within Zone of Influence of bridge benefit from Bridge Construction – YES: almost 80% of the local jobs in construction went to DAGs;
- Output 2: DDCs build rural local road bridges using Appropriate Technology – IN PROGRESS – capacity strengthening on-going at a local level;
- Output 3: LBS/DoLIDAR pilot new type of bridges and approaches – IN PROGRESS – capacity strengthening on-going at a national level;
- Output 4: LBS/DoLIDAR have capacity to develop Standard, Norms & Procedures – IN PROGRESS – capacity strengthening on-going at a national level;
- Output 5: Private sector has capacity for construction of local road bridges – IN PROGRESS – capacity strengthening on-going.

From this analysis of the Goal, Outcomes and Outputs, it is evident that the programme has had some specific successes and that – equally importantly – progress is being made on all components, including specifically the capacity building and institutional strengthening activities.

10.2 Main Findings

It is evident that the implementation of the SDC assistance programme has been effective in establishing the basic procedures, within DoLIDAR and eight regional clusters. The programme has provided technical assistance and support, with funding from GoN budget and resources.

A large number of local road bridges have been (and are being) constructed by many different agencies and programmes. This Review supports the establishment of a detailed and comprehensive inventory of all bridges on the local road network, to track the status of each and to establish priorities for new construction.

There has been a massive expansion of LRN over the past 10-15 years, much of which has been built to low standards – basic earth construction with no structures – resulting in a substantial demand for upgrading to all-weather standards, including the provision of local road bridges. It is anticipated that there will be a significant peak in the demand for new bridges over the next 5-8 years, with the demand for new bridges subsequently dropping to more moderate levels.

The current processes for the identification, selection and prioritisation of local bridges need to be reviewed and formalised. Investment decisions should be made at a local (District) level and be based on a technical and rational basis, so as to minimise the extent of political influence and interference.

Within each District, priorities for local bridge construction should be established by the DDC, based on the objective of establishing a network of all-weather roads linking all VDCs. This network – the District Core Road Network (DCRN) – should be defined within the District Transport Master Plan (DTMP). Only bridges that contribute towards the creation or expansion of the all-weather DCRN should be entertained.

The current practice of selecting bridges based on local village (community) pressure is NOT considered appropriate and leads to a distortion of priorities and poor investment decisions.

The DoR has had a historic involvement in the construction of bridges on the LRN: it has however been agreed that ALL local road bridges shall be transferred to DoLIDAR, including (when completed) those presently under construction by DoR.

The DoR are proposing a major Bridge Project, with World Bank funding, to replace or upgrade bridges on the SRN. The World Bank are also interested in funding Local Road bridges – raising the possibility of parallel funding under the SDC TA.

This Review recommends that the prime responsibility for local bridges belongs – along with the Local Road Network – with the individual Districts. The Districts should be responsible for the identification and prioritisation of the bridges and for the subsequent design, supervision and construction. Technical Support should be provided to the Districts through a continuation of the Local Road Bridge Support Unit (LRBSU) from both the central level and, more critically, through a series of regional clusters who will be able to provide site-specific technical support and back-up.

A common theme of this Review has been that the bridges should be viewed not in isolation but in conjunction with the development of the Local Road Network. Specifically this applies to both the selection of bridges and their subsequent evaluation: it is not practical or realistic to isolate a bridge from the associated road links. As a corollary to this, it is not meaningful to expect individual local bridges to lead to significant or measurable impacts on the local economy or socio-economic characteristics.

The Review recommends that evaluation and monitoring exercises are focussed more directly on measurable impacts – and specifically on levels of traffic generation and use of the facility. Any vehicle or trip that uses a bridge is doing so because the existence of the bridge provides a benefit: the volume of traffic attracted to (or generated by) the bridge is a direct indication of its worth to society.

Many factors contribute to changes in the socio-economic parameters in the areas of influence of the proposed bridges. It is rarely practical to isolate the cause and effect of such changes. Factors such as rural-to-urban migration, overseas employment, expansion of the local road networks, increased motor-cycle ownership, higher standards of education among the youth and countless other issues all contribute to the dynamics of change: given these factors, the effects or impact of an individual bridge cannot readily be isolated.

Economic assessment of Local Road Bridges should be undertaken in conjunction with the overall Local Road Network and not in isolation: the objective should be the creation of an all-weather road network providing year-round accessibility to all areas within each District.

The current SDC TA is providing valuable support and assistance to LRBP in DoLIDAR at both the central and regional (cluster) level. Over time the Government capacity (at both central and local levels) should be progressively increased and the SDC support reduced – although further strengthening of the support in the initial years may be required to cater for an anticipated peak in demand for new bridges.

10.3 Overall Conclusions

The first phase of LRBP has been generally successful and has addressed a growing need for the improvement and upgrading of District Core Road Networks to all-weather standards. Overall

the programme has had a positive impact – contributing to improved accessibility together through the expansion of the all-weather local road network.

Critical to the success of the project is the selection of the bridges: this should be undertaken at the District (DDC) level, based on a strategy to develop the DCRN to all-weather standards – rather than at the local village level as at present.

Rather than conducting extensive socio-economic household surveys to establish the impact of bridge construction, it may be simpler and more cost effective to measure traffic levels and conduct limited interviews with key informants and hold focus group discussions in the affected communities.

Efforts to strengthen the institutional capacity and capability have been successful – but this is only the start: it will be necessary during the second and subsequent phases to continue with the programmes to provide training to ensure that the local agencies are strengthened and the necessary skills are developed.

10.4 Summary of Recommendations for Phase II

The key recommendations for the next phase of the LRBB can be summarised as:

- Phase II of LRBP should build on the successes of the first phase
- The selection and prioritisation of bridges by DDCs should be undertaken on a strict technical assessment related to the creation of an all-weather DCRN
- Evaluation and monitoring should be based primarily on observed levels of traffic and person movements
- Further strengthening of the LRBU in DoLIDAR and the 8 regional/cluster offices should be undertaken, with SDC TA support
- DDCs should have prime responsibility for the implementation of LRBP, with back-up support and Technical Assistance from SDC

SDC

Swiss Agency for Development and Cooperation

External Review of Local Roads Motorable Bridge Programme (LRBP) – Phase 1

FINAL REPORT

Annexes

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Consultant
December 2015

ANNEXES

ANNEX A: Schedule of Bridge Sites, Plans & Descriptions

ANNEX B: Survey Forms Used

ANNEX C: Sampling Methodology for Household Surveys

ANNEX D: Traffic Data for 11 Sample Bridges

ANNEX E: Economic Evaluation of the 11 Sample Bridges

ANNEX F: GIS & Accessibility

ANNEX A

Schedule of Bridge Sites, Plans & Descriptions

Table 1: Full List of 33 Completed Bridges (April 2015)

	District	Bridge name	Bridge Span (m)	Road Length km	Population in ZoI	Baseline (Yes/No)	Remarks
A	**1 – Cluster, Biratnagar-Morang**						
1	Morang	Daas Khola Bridge	74.3	8	23,016	Yes	Completed
2	Sunsari	Sera Khola Bridge	25	6.5	13,650	Yes	Substantially Complete
B	**2 – Cluster, Birganj-Parsa**						
3	Dhanusa	Baluwa River	20	15	6,899	Yes	Completed
4	Mahottari	Kantawa Khola Bridge	25.7	26	5,474	Yes	Substantially Complete
5	Udayapur	Chaudiya Khola Br	40.64	23	8,099	Yes	Substantially Complete
6	Rautahat	Jhanj Khola Bridge	50	10	1,691	Yes	Completed
H	**3 – Cluster-Lalitpur**						
7	Dhading	Kahare Khola Bridge	18.7	25	3,515	Yes	Completed
8	Kavre	Basdol Khola Bridge	5.4	15	3182	No	Completed
9	Rasuwa	Dhobi Khola Bridge	18.6	10	3,182	Yes	Damaged
10	Kathmandu	Bishnumati Bridge	20.9	5	0	No	Completed
11	Nuwakot	Belkot Khola Bridge	20.6	10	8,293	Yes	Completed
H	**4 – Cluster, Bhairahawa-Rupandehi**						
12	Arghakhanchi	Mathura River Bridge	21.7	28.3	3,647	Yes	Completed
13	Chitwan	Kerunga Khola Bridge	66	24	12,497	Yes	Completed
14	Gulmi	Satmure Khola Bridge	25.25	30	16,916	Yes	Completed
15	Nawalparasi	Arnaiya Khola Bridge	32.6	8	21,518	Yes	Completed
16	Rupandehi	Mahau River Bridge	25	8	6,251	Yes	Completed
17	Kapilvastu	Bel River Bridge	40	25	4,789	Yes	Completed
18	Kapilvastu	Gudrung Khola Bridge	69.7	8	4,936	Yes	Completed
19	Palpa	Dumre Khola Bridge	24.7	91	5,558	Yes	Completed
H	**5 – Cluster, Pokhara-Kaski**						
20	Kaski	Taal Khola Bridge	20.7	40	9,557	Yes	Completed
21	Kaski	Kali Khola Bridge	37	10	13,850	Yes	Completed
22	Kaski	Harpan Khola Bridge	24.7	35	3,592	Yes	Completed
23	Kaski	Seti Nadi Bridge	56	45	16,938	Yes	Substantially Complete
24	Syangja	Ringdi Khola	24.4	14	14,418	Yes	Completed
25	Syangja	Jyagdi Khola	50.4	32	9,287	Yes	Completed
H	**6 – Cluster, Birendra Nager-Surkhet**						
26	Dailekh	Thado Khola Bridge	21.5	5	8251	Yes	Substantially Complete
27	Dailekh	Tiperi Khola Bridge	16	25	3734	Yes	Completed
H	**7 – Cluster, Nepalganj-Banke**						
28	Banke	Duduwanala Bridge	60	11	16,687	Yes	Completed
29	Banke	Jethi Nala, Bridge	20	13	15,736	Yes	Completed
30	Baridya	Bhadali Nala Bridge	24	10	8,918	Yes	Approach Rd damaged
31	Kailali	Roda Khola Bridge	37.2	16	30,088	Yes	Completed
32	Rukum	Deuta Khola Bridge	22.5	12	10,754	Yes	Completed
33	Rukum	Sankh Khola Bridge	15	15	8,463	Yes	Completed
		Total	**1054.19**	**659**	**323,386**		

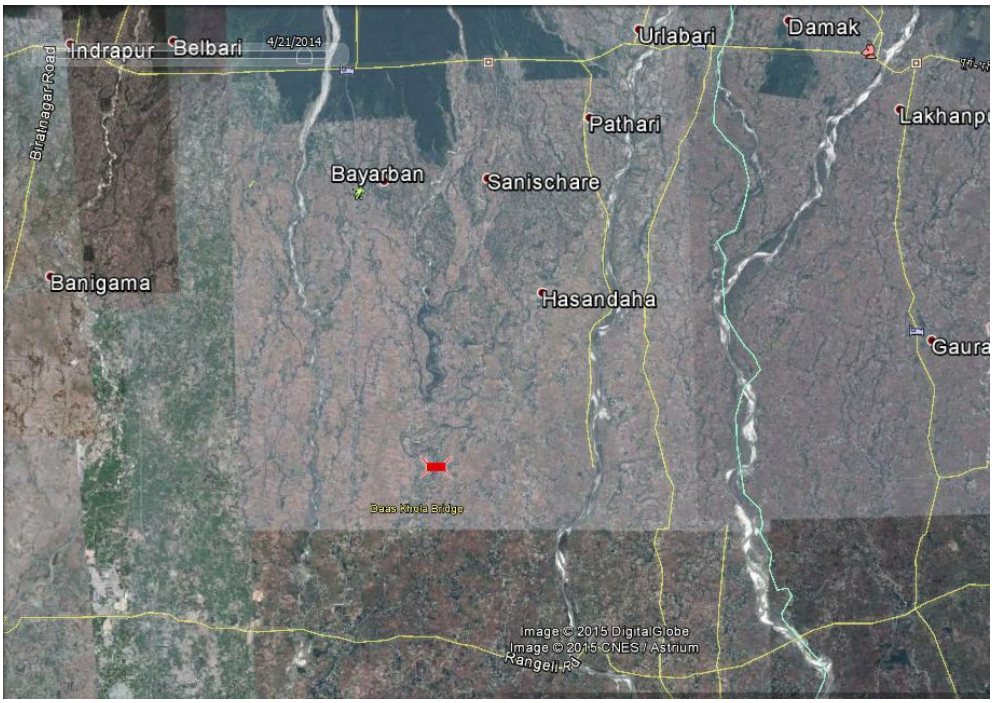
Table 2: List of 11 Selected Sample Bridges

	District	Bridge name	Bridge Span (m)	Roads Length (km)	ZoI population	Comments/Observations
A	**1 – Cluster, Biratnagar-Morang**					
1	Morang	Daas Khola Bridge	74.3	8	23,016	Terai - significant bridge over substantial nala - populated area: Eastern Region/Terai
C	**3 – Cluster-Lalitpur**					
2	Dhading	Kahare Khola Bridge PILOT SITE	18.7	25	3,515	In village on long local road: 6km E of SRN (+25km N of Prithvi Hway) - Central Region Hills
3	Nuwakot	Belkot Khola Bridge	20.6	10	8,293	Near start of hill road - accessible from Kathmandu - Central Region Hills
D	**4 – Cluster, Bhairahawa-Rupandehi**					
4	Arghakhanchi	Mathura River Bridge	21.7	28.3	3,647	West of Sandikharka on long local road - previous bridge (2001) - strategic link: low local population
5	Kapilvastu	Gudrung Khola Bridge	69.7	8	4,936	Local road 5km north of EWH: small catchment - Access to small pocket of agric development -WR Terai
E	**5 – Cluster, Pokhara-Kaski**					
6	Kaski	Harpan Khola Bridge	24.7	35	3,592	Access road to Panchase behind Phewa Lake - In village, long road - Western Region Hills
7	Syangja	Ringdi Khola	24.4	14	14,418	Location close to H10, near Waling - Near start of hill road from NH10 - Western Region Hills
F	**6 – Cluster, Birendra Nager-Surkhet**					
8	Dailekh	Tiperi Khola Bridge	16	25	3734	Remote - NE of Dailekh .. Maybe other bridges required of same road? - low local popln - Mid-Western Hills
G	**7 – Cluster, Nepalganj-Banke**					
9	Banke	Duduwanala Bridge	60	11	16,687	Terai Bridge across nala at eastern end of Nepalgunj Airport - access to Dist HQ
10	Kailali	Roda Khola Bridge PILOT SITE	37.2	16	30,088	Terai Bridge on local road network 5km south of EWH - local road linking network of Terai villages
11	Rukum	Sankh Khola Bridge	15	15	8,463	Remote site - 5km from Musikot Khalanga local road to Chungwang - Feeds network of road from Dist HQ - MidWestern Hills
		Total	**382.3**	**195**	**120,389**	

Details of the Selected Eleven Sample Bridges

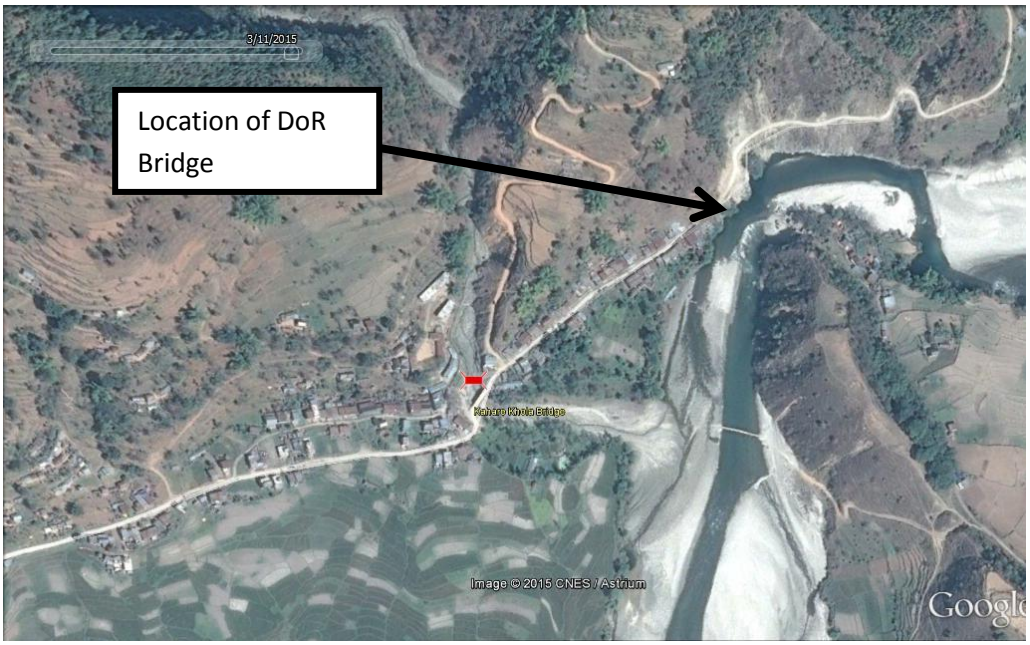
1. Daas Khola Bridge Morang

Located adjacent to Terai village; no immediate evidence of previous vehicular crossing – 2011 Google image shows temporary foot bridge (70m long). Forms part of network of Terai roads – no other vehicular crossing of Daas Khola between EWH & Postal Rd (see lower image). Nearest crossing 6.5km to south



2. Kahare Khola Bridge Dhading

Improves all-weather access on route from Salyantar on the SRN (F152) which runs north from Dhading Besi to Aarughat linking towards the remote VDCs in the NE quadrant of the District (incl Salyankot, Marpak, Satyadevi, Darkha, Jharlang, Sertung & Tipling). Potentially all VDCs in the NE will have improved accessibility – although there are alternative routes. The bridge is located across a side stream on road following the right bank (north) of the Ankhu Khola. The situation is complicated by the construction of major bridge by DoR across the Ankhu Kh approx 200m east of the Kahare Kh, which connects more directly to Dhading Besi. This latter route to Dhading Besi forms part of the DTMP/DCRN, whereas the LRBP bridge is technically NOT on the DCRN.



3. Belkot Khola Bridge Nuwakot

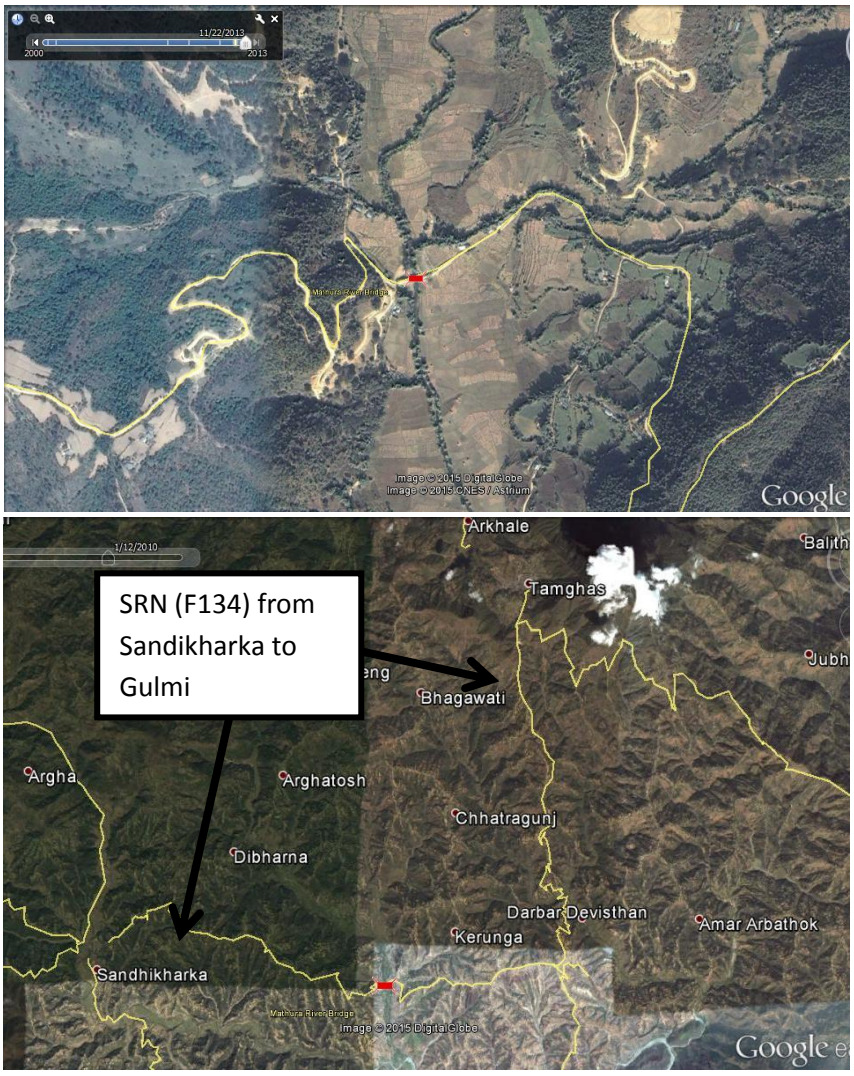
Accesses a small network of hill & valley roads to the east (& south of the Tadi Khola), from the Trishuli Highway F021. Poor quality fordable crossing previously available (see attached images) – or alternatively a suspended (foot) bridge to the north across the Tadi Khola.

Belkot Khola 2010:

Belkot Khola 2015:

4. Mathura River Bridge Arghakhanchi

Bridge located on newly designated inter-District Strategic Link (FR134) from Sandikharka (Arghankhanchi) to Tamghas (Gulmi). A previous bridge existed (2008) but no road to east (see images). Use of bridge dependent on the associated road construction: possible long-term development of Inter-District traffic.

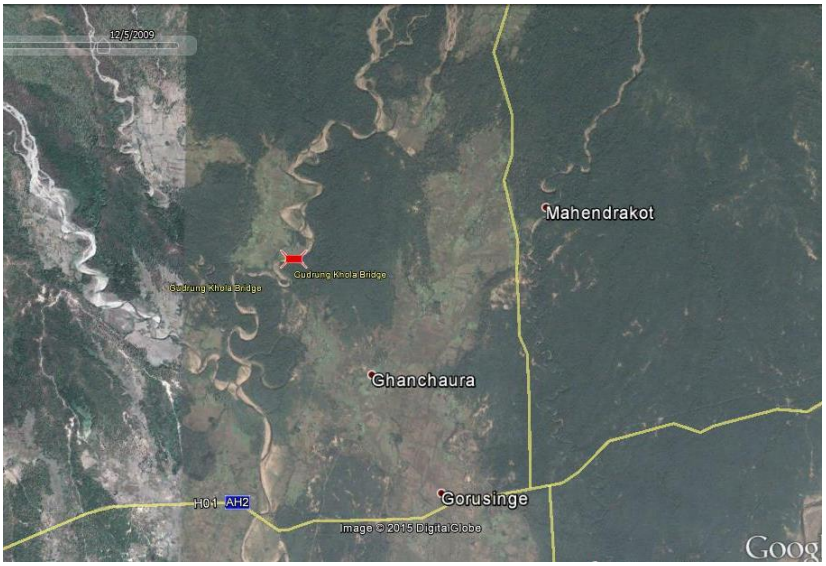


Mathura Bridge 2008:

Mathura Bridge 2013:

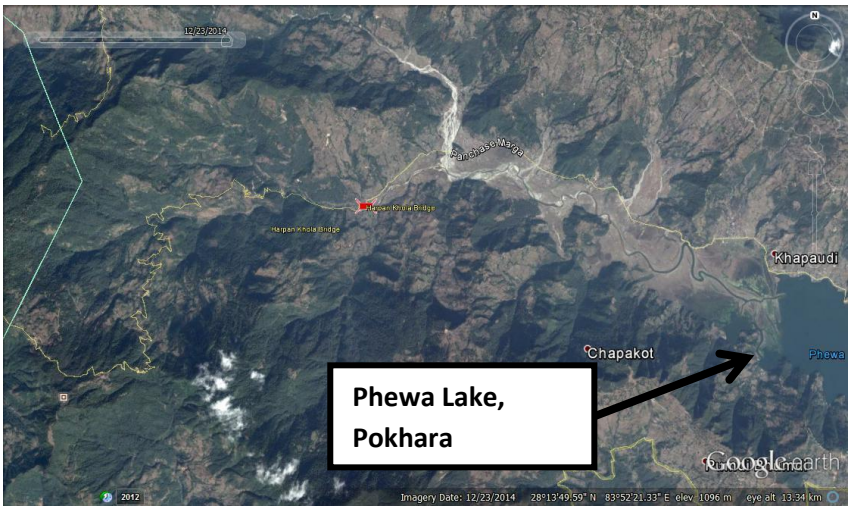
5. Gudrung Khola Bridge Kapilvastu

Located approximately 5km north of EWH and serving an agricultural pocket stretching for about 5km to the north & NW. No previous bridge – but river would appear easily fordable for most of the year. It is unclear whether there is an alternative access to the area north of the bridge from the EWH.



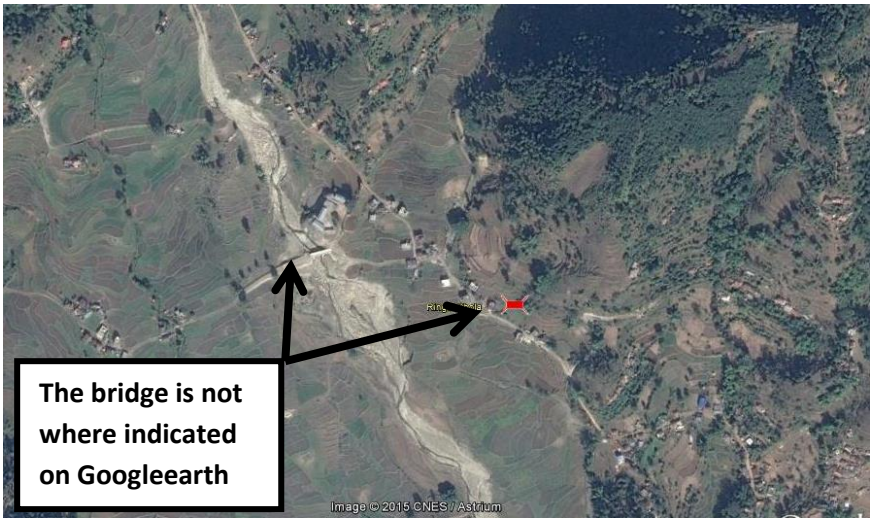
6. Harpan Khola Bridge Kaski

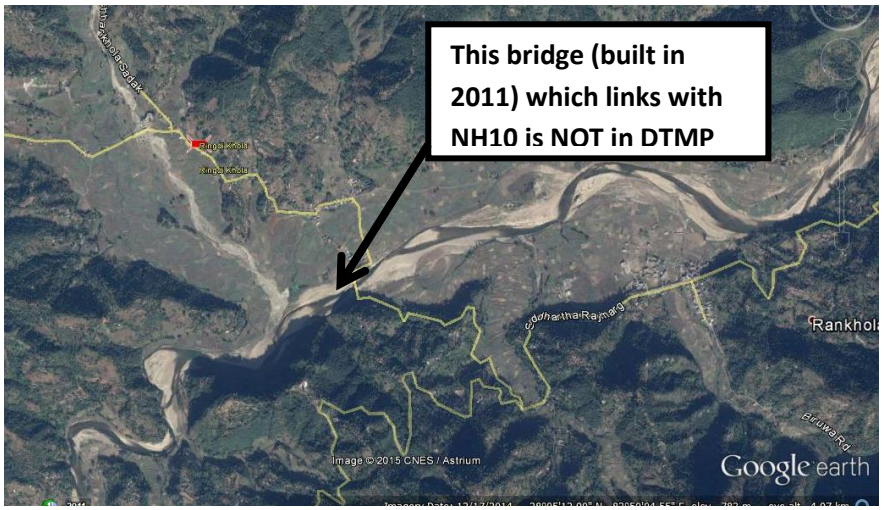
Located at km 14 on Panchase Marga (approximately 10km west of Pokhara) and providing access to a number of VDCs in the west of the District, plus an inter-District link to Parbat & Syangja. A 'difficult' ford and footbridge existed previously. The first 14km from Pokhara is relatively developed, with tourist traffic, but beyond the bridge the road climbs steadily through forest with little development activity. Two further bridges are under-construction beyond Harpan Khola – one by LRBP and one by DoR.



7. Ringdi Khola Syangja

This bridge provides access to Arjunchaupari and other VDCs in the west of Kaski District from Putalibazar on the Siddartha Highway (NH10). The current network differs from that in the DTMP – the connection to NH10 is via a new bridge (2011) that is NOT in the DTMP or DCRN. The road (including the connection to NH10) appears to be of recent construction (post-2010). There appears to have been a fordable crossing previously – but poor standard road.





8. Tiperi Khola Bridge Dailekh

Located 6km (crow-fly distance) to the NW of Dailekh District HQ on what appears to be a newly under-construction minor road serving a remote and sparsely populated upland area. No evidence of any previous crossing: it is unclear whether there are other bridges required to provide access from Dailekh.

9. Duduwanala Bridge Banke

Bridge across a major nala immediately east of Nepalgunj Airport and accessing an agricultural area: it is the only crossing between the EWH (east of Kohalpur) and the Postal Highway (east of Nepalgunj), 5km to the south. Previous crossing available during periods of low flow. Provides shorter route to Nepalgunj for an agricultural area of approx 12-15 sqkm.

Duduwanala 2011:

Duduwanala 2014:

10. Roda Khola Bridge Kailali

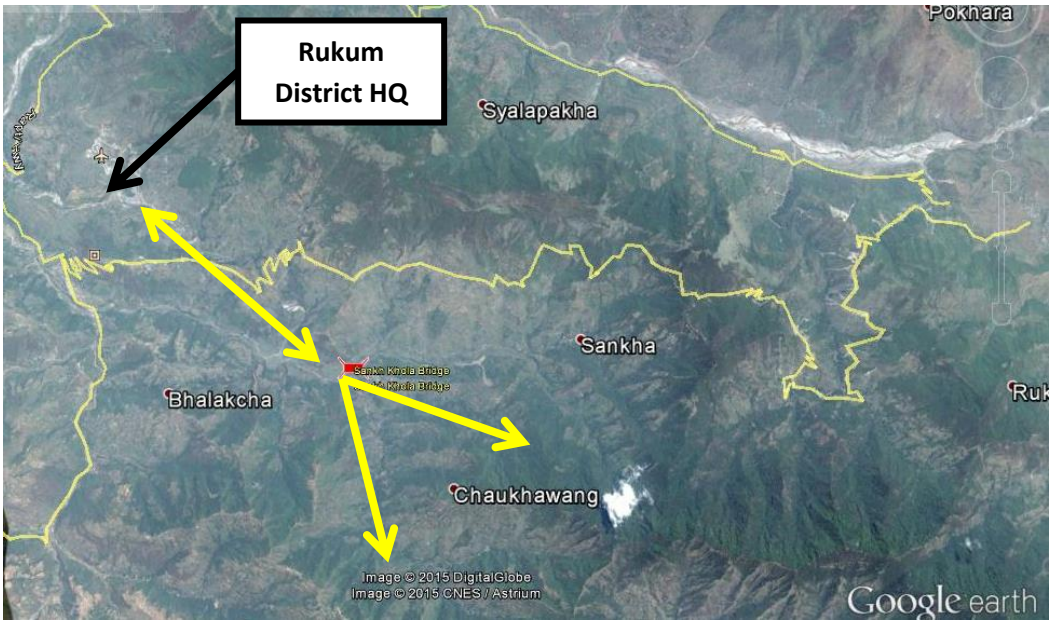
Bridge crossing a sizeable N-S khola in agricultural area and close to major village, 7km south of EWH – nearest crossings are 7km to north & south. Previous bridges have existed at the site and khola may have been crossable through much of the year. Issues relate to the 'network effects' of the bridge and whether travel patterns are/were affected by road closures. Where are the main market centres and bus routes? Used for initial PILOT surveys.

Roda Kh 2011 (previous bridge)**:**

Roda Kh 2012 (bridge destroyed, new u/c)**:**

11. Sankh Khola Bridge Rukum

Provides access from District HQ to a sizeable part of the SE of the District: are other bridges required to achieve all-weather access? Road appears to be recently constructed. Suspended bridge only (& no road in 2008). Road to SE still under extension/upgrading. Check status in DTMP/DCRN.



ANNEX B
Survey Forms Used

ANNEX B1: Survey Forms Used- Household Survey

Government of Nepal
Ministry of Local Development
Department of Local Infrastructure Development and Agricultural Road
Office of District Development Committee
District Technical Office (DTO)

……

Local Road Bridge Program (LRBP)

Household Survey

Name of Bridge: ……..
Road Alignment: ……..

Household No.: ……..

Name of Interviewer: …… Date: ……

1. General Information

1.1 Name of Respondent: ……

1.2 District: …… 1.3 VDC: …… 1.4 Municipality: ……

1.5 Ward No.: …… 1.6 Name of settlement (village): ……

1.7 Name of HH head ……

1.8 Gender of the household head

1. Male 2. Female

If women:

1.8a. Are land registration in your name?

1. Yes 2. No

1.8b. Who makes decisions regarding buying and selling of land (property) in your family?

1.9 Caste/ethnicity: 1. Dalit 2. Janajati 3. B/C/T (please specify)……

1.10 Do you need to use this proposed bridge?

1. Yes 2. No

1.11 At present how do you cross the river?

1. Temporary bridge 2. Artificial ford 3. Trail Bridge 4. Others (specify)

2. Household Information:

How many members are there in your household? ……

SN	Name	Relation to HHH	Sex	Age	Literacy status	Education	Occupation
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Code:
Relation to head *1 = Household Head, 2 = Wife/Husband, 3 = Son/Daughter, 4 =Daughter in law 5= Brother/ Sister, 6 = Grandchild, 7= Parents, 8= others (specify)*
Sex *1 = Male and 2= Female*
Literacy Status *1 = Literate and 2 = Illiterate*
Education *1-10 passed class 1from 10 similarly, 11=Intermediate, 12=Bachelor, 13=Master Degree, 14 PhD and above*
Occupation *1=Agriculture/ livestock raising, 2=Business/commerce, 3= Service, 4=Wage labour, 5= Foreign employment 6=Student, 7= Housewife*
Education *Upto 10 classes =Number of classes completed, 11=Intermediate, 12=Bachelor, 13=Masters & 14 =Ph.D. and above*

3. Access to utilities and services:

SN	Services	Location	Frequency of Visit (Annual)	Means of Transport/Time Taken (Min.)				One way Expense (Rs.)		Use of Bridge	
				Walk		Vehicle					
				Before	After	Before	After	Before	After	Before	After
1	Primary School										
2	Secondary School (+2)										
3	Colleges										
4	Health /Sub Health post										
5	Pharmacies/ Clinic										
6	District Hospital										
7	Veterinary / Agriculture service center										
8	Local market										
9	Main Market										
10	District Headquarters										
11	Nearest Fair weather road head										

Code
Where *1= In Village, 2=In VDC, 3=In District, 4=Out of District*
Use of Proposed Bridge *1= Yes and 2= No*

4. Does your household own land? 1. Yes 2. No

If yes, please provide the following information.

Type of land	Unit	Irrigated		Non-irrigated		Total	
		Before	After	Before	After	Before	After
Khet							
Bari							
Pakho							
Total							
Code: *1= Ropani, 2= Kattha, 3= Bigha, 4=Hectare*							

5. Details of Income and Expenditure of Family.

5.1 Income Source of family?

S.N.	Particular	Before	After
1	Agriculture		
2	Agriculture wage labour		
3	Services		
4	Business		
5	Pension/ remittance		
6	Rent/ interest		
7	Seasonal Business		
8	Wage labour		
9	Other		
	Total		

5.2. Description of family income?

S.N.	Particular	Annual Production		Annual Income (Rs.)	
		Before	After	Before	After
1	Cereal crops				
2	Cash crops				
3	Livestock				
4	Milk products				
5	Vegetables and fruit				
6	Agriculture wage labour				
7	Services				
8	Business				
9	Pension/ remittance				
10	Rent/ interest				
11	Seasonal Business				
12	Wage labour				
13	Other				
	Total				

5.3. What were your Expenditures during the last year?

S.N.	Particular	Annual Expenditure (Rs.)	
		Before	After
1	Food items		
2	Clothing		
3	Education/Reading material		
4	Medicine/Doctor/Hospital charges		
5	Fuel Energy (Bio-Gas, Kerosene, Fuel Wood)		
6	Fertilizers		
7	Transportation/ Communication		
8	Social, Religious & cultural function		
9	Donation for social action		
10	Bangles/Cigarettes/Alcohol		
11	Loan and interest payment/Taxes/Fines/Loans etc.		
12	Transport cost for household goods & farm inputs		
13	Transport cost for taking farm products to the market		
14	Investment in IG Activity (Micro-enterprise/Cottage industry/Small shops)		
15	Ornaments		
16	Livestock		
17	Other		
Total			

What are you doing with saving money?

_____

6. **For how many months is your agriculture production sufficient?**

S.N.	Particular	Agriculture production sufficient	
		Before	After
1	Less than 3 months		
2	3 – 6 months		
3	6 – 9 months		
4	4. 9 – 12 months		
5	Surplus		

7a. Do you sell your agricultural products in the market? 1. Yes 2. No

S.N.	Particular	Before	After
1	Sale		
2	Not sale		

7b. Do you sell your agricultural products in the market?

Agriculture Product	Unit	Description Before	Amount	Description After	Amount

7c. How do you transport the products to the market?

Transport	Before	After
Porter		
Mule /Horse/Cart/Donkey		
Tractor/Bus/Jeep		

8. How do you cope with the food deficit? (Multiple Responses)

Food Deficit	Before	Place	After	Place
Business/Trade				
Take loan				
Services				
Wage labor				
Remittance/pension				
Sale of livestock product				
Others (Specify)…				

9a. Has any household member migrated for work?

Migration	Before		After	
	In Country	Overseas	In Country	Overseas
Yes				
No				

9b. If yes, where are they and what do they do?

S. N.	Name	Sex	Where	Type of Work	Since when	Remarks

Code:
Sex Male = 1 and Female = 2
Where Inside country = 1 Outside Country = 2

9c. Are the person permanently returned from in country/overseas works?

1. Yes 2. No

If yes, what he is doing?

---

10. Do anyone family member had attained in construction (Road Meson/Gabon Meson/Bar Bender) related training program?

1. Yes 2. No

S. N.	Name	Sex	Name of Training	Duration (Hrs.)

Code: 1= Male, 2=Female

If yes, what he is doing?

11. Where do you go during illness?

Illness	Before	After
Health post		
District Hospital		
Medical/Clinic		
Traditional Healer		

12. You have vehicle in your home?

Vehicle	Before		After	
	Yes	No	Yes	No
Cycle				
Motor				
Tractor				
Other				

13a. Benefit after bridge construction?

Easy Travel	Very Good	Good	Satisfactory	Bad
Saving in travel (Compare to 2 years)				
Access in vehicle (Compare to 2 years)				

13b. Economic Benefit

	Economic Benefit	Increased	Few increased
a	Material availability in market		
b	Easy market for the sale of goods		
c	Easy travel to market		

Annex B2: Settlement Survey Form

Government of Nepal

Ministry of Local Development

Department of Local Infrastructure Development and Agricultural Road

Office of District Development Committee

District Technical Office (DTO)

……

Local Road Bridge Program (LRBP)

Settlement Survey

Name of Bridge…… Road Alignment ……..

Name of Interviewer: …… Date: ……

Name of Settlement:…… VDC: ……

1. What is the current price of these items in the settlement?

S.N.	Items	Unit	Rate (Average)	
			Before	After
1	Rice			
2	Wheat			
3	Maize			
4	Millet			
5	Sugar			
6	Edible Oil			
7	Pulses			
8	Salt			
9	Petrol			
10	Diesel			
11	Cement (in Sack)			
12	Rod/Chhad (in quintal)			
13	Fertilizer			

2. What is the transportation cost of goods from nearest market?

S.N.	Means of Transportation	Name of Market		Cost of Transportation	
		Before	After	Before	After
1	Truck				
2	Tractor				
3	Porter				
4	Buffalo cart				
5	Bus				
6	Jeep				
7	Ambulance				
8	Others				

3. What is the Quantity of goods from nearest market?

S.N.	Items	Name of Market		Quantity			
				Import		Export	
		Before	After	Before	After	Before	After
1	Food grains (in Kg/Ltr.) ***(Rice, wheat, maize, sugar, edible oil, Pulses/beans)***						
2	Vegetables (in Kg.) ***(Potato, Onion, cabbage, cauliflower)***						
3	Cement (in Sack)						
4	Rod/Chhad (in quintal)						
5.	Other (specify)						

4. What is the current land value?

Quality of Land	Unit	Market rate	
		Before	After
Khet			
Bari			
Pakho			
Residential land			

5. What is the daily wage rate in construction work?

Type of labor	Current market rate		District rate	
	Before	After	Before	After
Skilled				
Unskilled				

6. List of Public Properties in the settlement:

S.N.	Public Utilities	Number	
1	Hospital/Health-post/Sub health-post	Before	After
2	Schools (+)/ College		
3	Pharmacies/Clinic		
4	Shops/Grocery/Provision /Tea Shops		
5	Local Market		

7. How many vehicle s are plying (Daily)?

Vehicle	Total		No./Day	
	Before	After	Before	After
Motorcycle				
Bus				
Jeep				
Truck				
Tractor				
Other				

8. How many patients are visited in health service centre (Monthly)?

(Date ……to…….)

S.N.	Name of Health Service Center	Total		Refer Case	
		OPD	Emergency	No.	Refer case
1					
2					
3					

9. River crossing – Information

S.N.	River Crossing Name	Total no. of days (No river crossing before Bridge construction)	Time taken for river crossing (in minute)	
			Before	After
1				
2				
3				

Annex B3: Traffic Count Form

Name of road: **Road number:** **Direction from:** **Direction to:**
Station Name: **Station Reference:** **Date:**
Name of Enumerator: **Name of supervisor**

Hours Counted	1	2	3	4	5	6	7	8	9	10	11	12
	Heavy Truck	Medium Truck	Small truck	Large Bus	Mini Bus	Micro Bus	Tractor	Jeep	Motor Cycle	Cycle	Carts (Manual & animal driven)	Pedestrian
6-7 AM												
7-8 AM												
8-9 AM												
9-10 AM												
10-11 AM												
11-12 AM												
12-1 PM												
1-2 PM												
2-3 PM												
3-4 PM												
4-5 PM												
5-6 PM												

Origin and Destination Survey

Name of road: **Road number:** **Direction from:**

Station Name: **Station Reference:**

Name of Enumerator: Name of Interviewer:

Time	Vehicle Type (Code)	Passenger Vehicles		Freight Vehicles		Origin	Destination	Passenger Trip Purpose			
		Seating Capacity	No. of Pass	Freight Type (Code)	Load (F, H, E, O)	Place	Place	1	2	3	4

Code

Vehicle Types	**Type of Freight**	**Load**	**Trip Purpose**
Heavy Truck 1 Medium Truck 2 Small truck 3 Large Bus4 Mini Bus5 Micro Bus6 Tractor7 Jeep Includes Sumo) 8 Motor Cycle 9 Cycle 10 Carts 9Manual and animal driven) 11 Pedestrian 12	Agricultural/Food 1 Timber 2 Building Materials 3 Raw Materials 4 Industrial Products 5 Fuel/Chemicals 6 Fertiiser 7	Full F Half Load H Empty E Over Load O	Business 1 To/from work 2 Social/private 3 School 4 Holiday/Tourism 5 Other 0

ANNEX C

Sampling Methodology for Household Surveys

Annex C: Sampling Methodology for Household Surveys

The sample frame of households has been constructed following Arkin and Colton (1963), the sample size (based on a total of households enumerated) was computed from the following formula:

$$\mathrm{n} = \frac{NZ^2p(1-p)}{Nd^2 + Zp(1-p)}$$

Where,
n= Sample size
N= Total number of households
Z= Confidence level (at 95% level Z = 1.96)
p= Estimated population proportion (0.5, this maximizes the sample size)
d= Estimated population proportion (0.5, this maximizes the sample size)

N= Sum of the ZoI population in all the bridge sites
The sample size "n" thus computed was then proportionately distributed in all the sites based on the proportion of the population in the "total population"

Source Arkin, H. and Colton, R. 1963, Table for statistics, New York, Barnes and Noble.

ANNEX D

Traffic Data for 11 Sample Bridges

Daas Khola Bridge Morang

The Daas Khola Bridge provides the ONLY east-west crossing of the Daas Khola between the East-West Highway (15km to the north) and the Postal Road (6km to the south). It is located immediately west of the village centre of Amardaha and provides improved "connectivity" within the already developed Terai area. Both sides of the bridge were previously accessible by motorised traffic although there is no evidence of an earlier vehicular crossing at this location: a temporary bamboo bridge was erected in the dry-season for foot passengers.

The bridge will have provided a new (and shorter) route for traffic which will have diverted from alternative routes – as evidenced by the growth in traffic levels recorded (see Table below). The 'before' traffic data is supplied by the local community and is assumed to have used nearby temporary (dry-weather) crossings.

Before-and-After Traffic Data – Daas Khola, Morang

Baseline Report	*As per the consultation with local communities, at least average twenty (20) vehicles are plying per day on the nearest roads of bridge site*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	8	2		10	10	20		
Review Survey April/May 2015	64	1	27	91	379	470	583	1537

Kahare Khola Bridge Dhading

Khahare Khola Bridge provides all-weather access across a relatively small side-stream to the main Ankhu Khola and connects to a network of local roads serving the North-East of the District. Prior to the bridge construction, all traffic accessing the NE of the District would have been delayed during periods of closure due to high water levels. Benefits from the bridge will result from reduced delays during the rainy season and generated traffic resulting from improved all-weather accessibility.

The potential role and function of the bridge will be affected by the completion of the DoR bridge across the Ankhu Khola (approx 250m to the east) which will provide a more direct route to the District HQ at Dhading Besi.

Before-and-After Traffic Data – Khahare Khola, Dhading

Baseline Report	*There is low intensity of heavy and light vehicles that ply along the road. Daily 10 nos. of vehicle flow along the road on fair weather. These areas obtain goods in trucks/Tractor only in the dry season. Apart from trucks, tractors mule/porters are also used for transporting goods during monsoon season*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	5	2		7	3	10		
Review Survey April/May 2015	10	3	2	15	29	44	8	585

Belkot Khola Bridge Nuwakot

The Bridge provides all-weather access to 'pocket' of population otherwise not served by an all-weather road. The ZoI is constrained by the presence of alternative roads in the vicinity. Improved all-weather accessibility will be available for all trips resulting in savings from reduced closures during the monsoon season. The potential for generated traffic is limited.

Before-and-After Traffic Data – Belkot Khola, Nuwakot

Baseline Report	*As per the consultation with local people and from traffic survey, altogether 10 different types of vehicles are plying daily up to the Belkot Khola Bridge site on Belkot-Ghodgade-Kalighumti–Dhodphedi Road but at present public transport is not plying*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	5	3		8	16	24		
Review Survey April/May 2015	9	0	1	10	10	20	9	161

Mathura River Bridge Arghakhanchi

The bridge located on the newly designated inter-District Strategic Road (FR134) between Sandikharka (Arghankhanchi) and Tamghas (Gulmi). A previous bridge existed (2008) but the road to east has only recently been completed (see Annex). There is significant potential for traffic growth (as demonstrated by the traffic counts) from both improved access to VDCs in the north and east of the District and – more significantly – from the improved connectivity provided by the inter-District linkage.

Before-and-After Traffic Data – Mathura River, Arghankhanchi

Baseline Report	*As per the consultation with local people, average 15 vehicles are plying through the Mathura River (Ridi-Kharjyang-balkot-Sandhikhark) road*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	10	5		15	0	15		
Review Survey April/May 2015	10	5	24	39	82	121	1	66

Gudrung Khola Bridge Kapilvastu

The bridge is located approximately 5km north of EWH and serves a pocket of agricultural development. There was no previous bridge – but river would appear to have been easily fordable for most of the year. There is little opportunity for generated traffic and benefits will accrue due to the elimination of closures during the rainy season.

The total observed traffic volumes from the Review Surveys were in fact lower than the Baseline data.

Before-and-After Traffic Data – Gudrung Khola, Kapilvastu

Baseline Report	*During the focus group discussion it is learnt that, at least in average one hundred and sixty-three (163) numbers of different vehicles (tractor, bus, truck, jeep and motorcycles) are plying daily in the Buddi-Rangai-Baktapur road alignment of bridge site (Source FGD).*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	10	3		13	150	163		
Review Survey April/May 2015	11	2	7	20	92	112	179	45

Harpan Khola Bridge Kaski

The Baseline data refers only to the section of road up to the bridge site, suggesting that no traffic crossed the khola previously: *"At present the road serving the area terminates at the proposed bridge site"*. It is however understood that some tractors and buses were able to cross the river during the dry season.

Significant growth in (generated) traffic appears evident, with benefits also accruing due to the removal of closures during periods of high water flow

Before-and-After Traffic Data – Harpan Khola, Kaski

Baseline Report	*Information was obtained from two different sites, namely Ghatchhina and Damdama. At present the road serving the area terminates at the proposed bridge site. Apart from tractors, buses are also used to transport goods. Nearly 15 to 20 vehicles are plying daily up to this bridge*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	5	3		8	12	20		
Review Survey April/May 2015	6	1	6	13	46	60	4	350

Ringdi Khola Syangja

The Baseline data suggest that no traffic used the bridge and that 10-15 vehicles were plying up to the bridge site, although it would appear that a fordable crossing existed previously. Significant growth in generated traffic can be expected, with benefits also available for any traffic that previously used the crossing due to reduced periods of closure.

Before-and-After Traffic Data – Ringdi Khola, Syangja

Baseline Report	*Information was obtained from two different sites, namely Putalibazar and Panchamul. At present the road serving the area terminate at the proposed bridge site. Nearly 10 to 15 vehicles are plying daily up to this bridge site.*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	2	3		5	10	15		
Review Survey April/May 2015	5	8	6	18	35	54	2	124

Tiperi Khola Bridge Dailekh

The Bridge is located on a newly built minor road serving a remote and sparsely populated upland area in the north of the District. The Baseline data appears to indicate that traffic was only operating up to the bridge. Considerable growth in generated traffic can therefore be expected following the completion of the bridge AND the road. The resultant benefits are thus attributable to both road and bridge.

Before-and-After Traffic Data – Tiperi Khola, Dailekh

Baseline Report	*As per the consultation with local people and traffic survey 10 vehicles are plying up to the Tiperi Khola Bridge through Kholi Bazzar-Badakhola-Bansi-Kashikandh road*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	2	4		6	4	10		
Review Survey April/May 2015	14	0	5	20	5	25	0	53

Duduwanala Bridge Banke

The bridge is located within Terai and provides improved linkage between the agricultural area to the east of the nala and Nepalgunj. It is the only permanent crossing of the nala between the EWH and Postal Road. Benefits will accrue to substantial volumes of traffic that will divert from longer alternative routes and to local traffic that will benefit from reduced periods of closure during the rainy season.

Before-and-After Traffic Data – Duduwa Nala, Banke

Baseline Report	*There are 3 public transport are plying in Manikapur-Kamdi road daily. But in rainy season (from Ashad to Bhadra), no vehicles are plying*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	2	1		3	0	3		
Review Survey April/May 2015	46	6	7	59	280	339	777	311

Roda Khola Bridge Kailali

The bridge provides improved local access and connectivity: the alternative crossings are 7km to north or south. Previous bridges have existed on this site and the khola may have been fordable for much of the year. Substantial increases in traffic volume are recorded following construction, suggesting a significant amount of suppressed or diverted traffic

Before-and-After Traffic Data – Roda Khola, Kailali

Baseline Report	*There are 8 vehicles plying in this Gulara-Narayanpur road per day in average. But in rainy season (from Ashad to Bhadra), there will be no transport available due to road condition*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	6	3		9	0	9		
Review Survey April/May 2015	33	3	3	38	261	298	455	201

Sankh Khola Bridge Rukum

The bridge provides access from District HQ to a sizeable part of the SE of the District and forms part of an expanding local road network. Traffic volumes appear to remain low, possibly due to the remote nature of the area and the low level of development.

Before-and-After Traffic Data – Sankh Khola, Rukum

Baseline Report	*Public transport is not plying to this road*							
	Truck Tractor	Bus	Jeep	Total 4Wheel	M/c	Total MV	Cycle	Ped
Before Project	4	0		4	10	14		
Review Survey April/May 2015	4	0	1	5	6	11	0	300

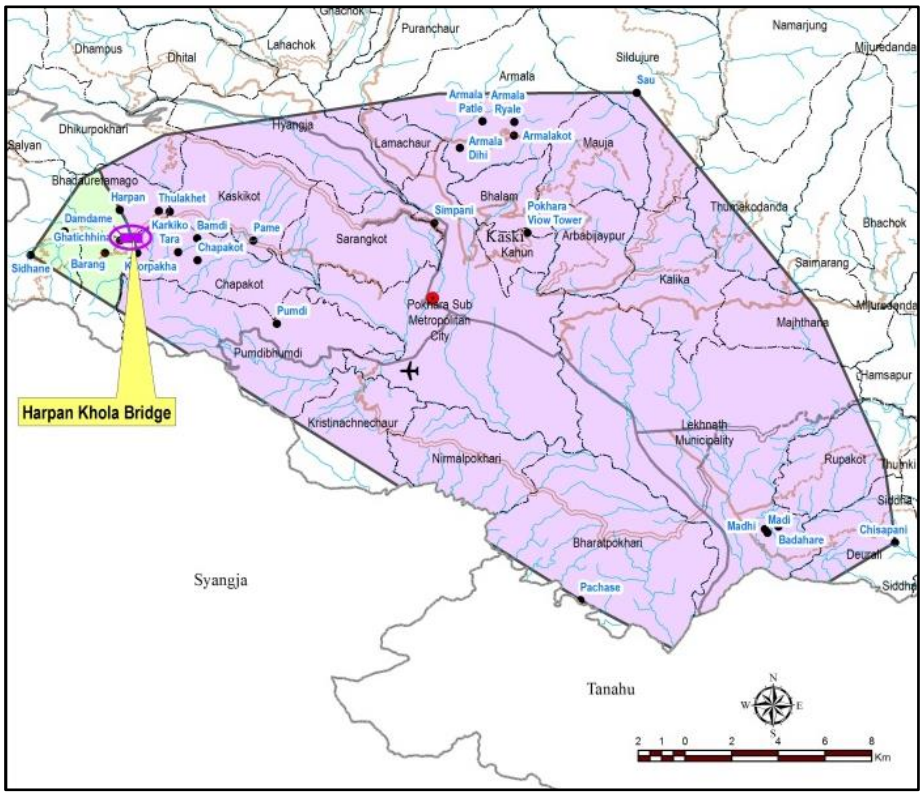
Influence Area of Bridges

An analysis has been undertaken of the origins and destinations of traffic crossing the 11 sample bridges. This can be used to define the broader 'influence area' of the bridges: in the hills this area is generally restricted on the 'remote' (or newly accessible) side of the bridge, whereas in the Terai areas (and the 'accessible' side of hill bridges) the area is much larger.

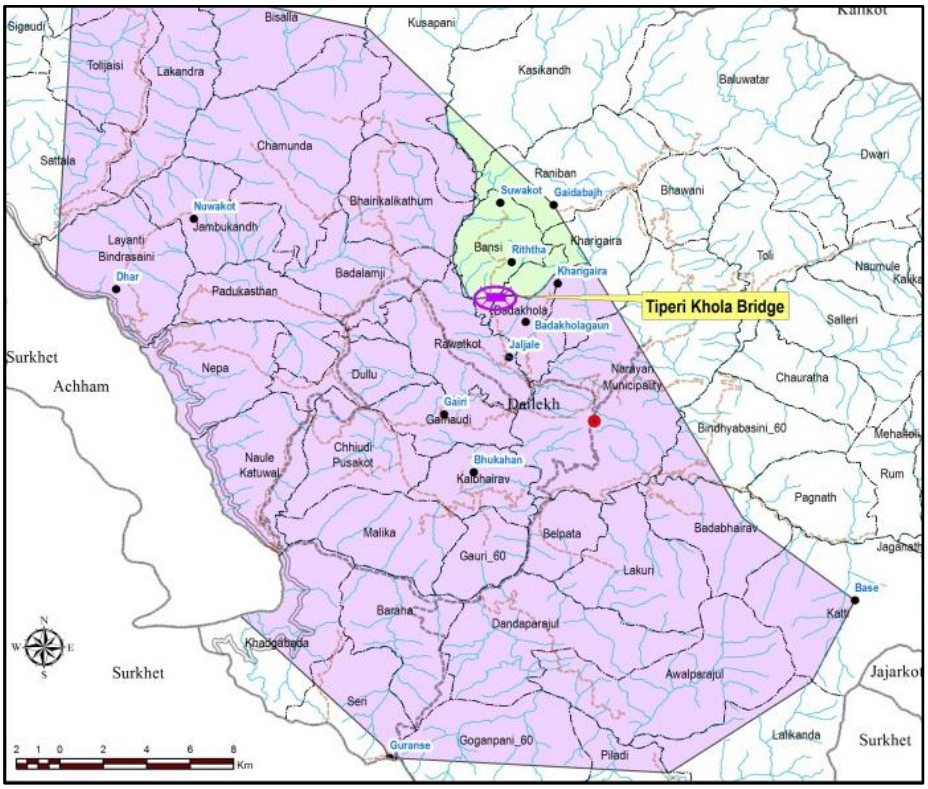
The areas of influence of four sample bridges – two in the hills and two in the Terai – are shown in the diagrams below. Harpan Khola and Tiperi Khola are hill locations and Dass Khola and Mathura Khola are more typical Terai locations. The light blue areas represent the 'remote' area served and the dark blue the area from which trips to the area originate: the black dots indicate the trip origins & destinations.

In the Terai, it can be seen that the areas are of a similar size each side of the bridge, with much smaller areas served on the remote side in the hills.

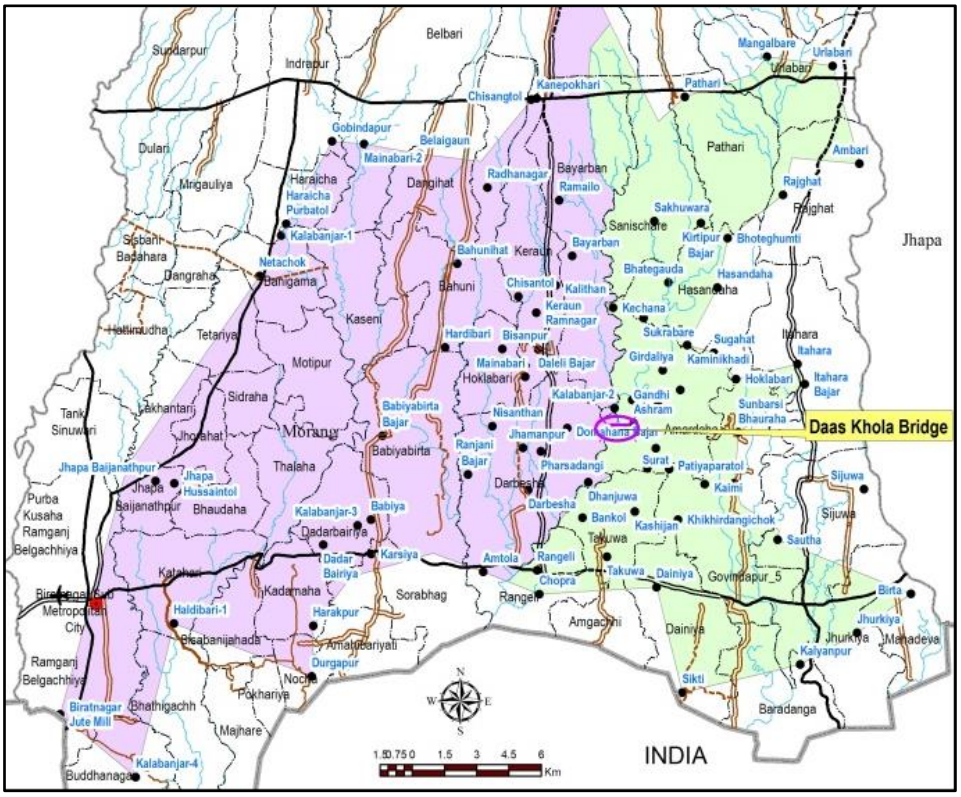
Harpan Khola:



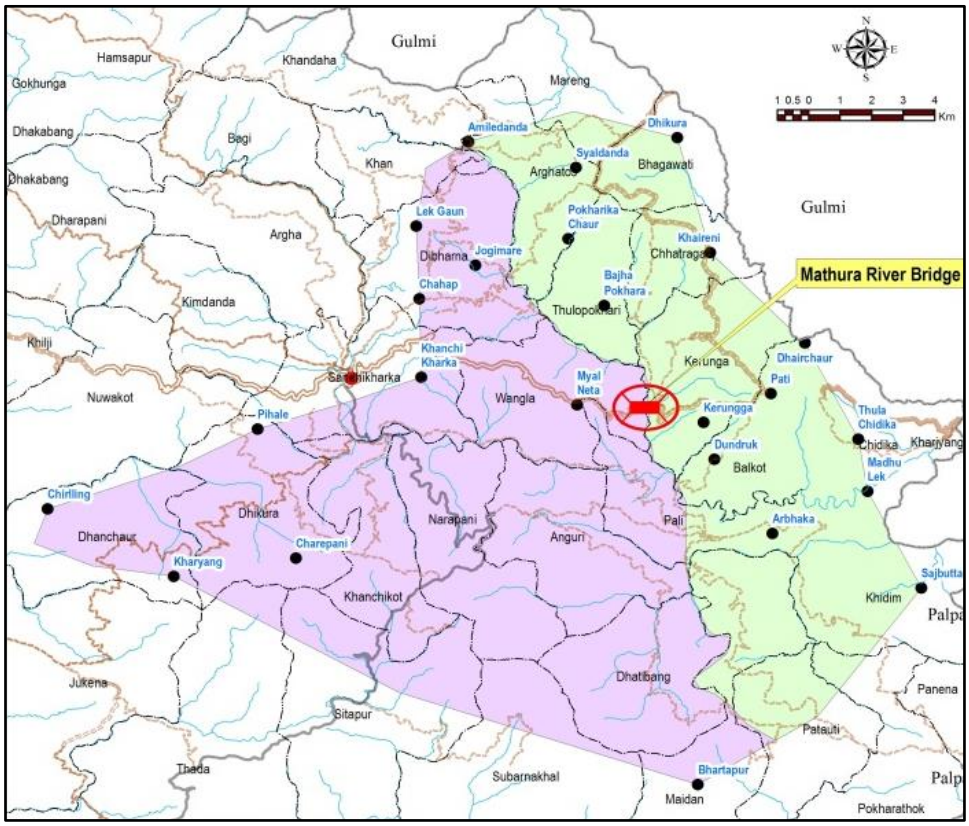
Tiperi Khola:



Dass Khola:



Mathura Khola:



ANNEX E

Economic Evaluation of the 11 Sample Bridges

Economic Evaluation

Introduction

The Local Roads Bridge Programme (LRBP) funded by Swiss Development Co-operation (SDC) has been engaged in the construction of bridges in different districts of Nepal through the Local Roads Bridge Support Unit (LRBSU) since March 2011. This External Review has been commissioned to measure the outcomes of the programme and to assess the socio-economic impacts. This economic evaluation forms part of this review.

The objective is to assess the economic impact of 11 selected bridges in terms of transport cost savings and value of travel time savings. In accordance with the Term of Reference, the economic analysis requires an evaluation of the impact of the bridges by means of a comparison of the situations 'before' and 'after' the construction.

The methodology used was a conventional appraisal methodology as used for estimating impacts of construction of roads and bridges. The methodology compares the 'without project situation' (before construction) with the 'with project situation' (after construction).

The costs considered are the construction and maintenance costs and the benefits are the savings to road users – ie savings in vehicle operating costs (VOCs) and value of travel time savings. Other benefits, such as reduction in the financial prices of consumer goods, were not included to prevent double counting: such benefits are considered to be a consequence of reduced VOCs which are included as part of the economic benefit.

The Roads Economic Decision model (RED) was used to estimate Vehicle Operating Costs (VOCs) and travel time of vehicles. RED is a derivative of the Highway Design and Maintenance Model version 4 (HDM4) that is widely used by development banks. RED was developed for use on lower volume roads and has been calibrated to Nepali conditions.

Costs and benefits were estimated in economic prices. The economic prices were obtained by excluding all duty, tax or subsidy included in the financial prices. A Standard Conversion Factor (SCF) of 0.9 was used to calculate the economic construction and maintenance costs of the project from the financial costs: this value is used in almost all DoR and DoLIDAR road projects.

The economic analyses of the projects were carried out with a twenty year timeframe. Annual costs and benefit streams were converted to represent 2015 values using a social discount rate of 12% per annum.

Three indicators of economic viability have been calculated and used to test the viability of the bridge construction, namely: Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR).

Details of the bridges that were selected in consultation with SDC and LRBP for evaluation are given in Table 8.1, which indicates also the bridge length (span) and the length of associated local road. Further details of these roads, together with maps, are provided elsewhere in this Review.

Table 8.1: Details of Selected Bridges for Economic Analysis

	District	Bridge Name	Name of Access Roads	Bridge Span (m)	Road Length (km)
A	**1 – Cluster, Biratnagar-Morang**				
1	Morang	Daas Khola Bridge	Babiya- Dohmana-Gandhi Aasharam	74.3	8
C	**3 – Cluster-Lalitpur**				
2	Dhading	Kahare Khola Bridge	Taribesi - Khahare - Baguwa - Gumdi	19.7	25
3	Nuwakot	Belkot Khola Bridge	Belkot-Ghodgade-Kalighumti-Dhodphedi	20.6	10
D	**4 – Cluster, Bhairahawa-Rupandehi**				
4	Arghakhanchi	Mathura River Bridge	Ridi-Kharjyang-Balkot-Sandikharka	21.7	28.3
5	Kapilvastu	Gudrung Khola Bridge	Buddi-Rangai-Tanku-Bakatapur	69.7	8
E	**5 – Cluster, Pokhara-Kaski**				
6	Kaski	Harpan Khola Bridge	Baidama Pame-Ghatechhina-Damdame-Sidane	24.7	35
7	Syangja	Ringdi Khola	Putalibazaar-Arjunchaupari-Daraun-Panchamul	24.4	14
F	**6 – Cluster, Birendra Nager-Surkhet**				
8	Dailekh	Tiperi Khola Bridge	Kholi Bazar-Badakhola-Bansi-Kashikandh	16	25
G	**7 – Cluster, Nepalganj-Banke**				
9	Banke	Duduwanala Bridge	Ratna Raj Marga-Manikapur-Kamdi	60	11
10	Kailali	Roda Khola Bridge (Pilot)	Gulara-Narayanpur	37.2	16
11	Rukum	Sankh Khola Bridge	Musikot-Julkhet-Chungwang	15	15

Project Costs

Construction Cost

Table 8.2 shows calculated economic construction costs of the selected bridges. To account for the value of the project remaining at the end of the evaluation period, a negative cost was included equivalent to the remaining unused portion of the project's life (ie its residual value). A weighted life of 50 years has been used for the project as a whole.

Maintenance Cost

The approach roads were receiving some maintenance before the bridge constructions. It was assumed that the maintenance activities will control the deterioration of the roads even after the project. The level of expenditure on the maintenance activities is defined as 'holding maintenance' cost. The holding maintenance activities are assumed adequate to keep the condition of the road surface in average to IRI 6 over the project life. The economic holding maintenance cost per kilometre is estimated at NRs 30,000 per kilometre for all approach roads before and after the project.

Standard maintenance measures for the bridges have been assumed for "With Project" scenario. The proposed activities are assumed adequate to maintain the condition of the bridge over the project life. The deterioration of the bridges over time under the traffic loadings and environment degradation is not explicitly considered in the economic evaluation. The economic maintenance cost is estimated at NRs 500 per meter for all the project bridges.

Table 8.2: Financial and Economic Costs of Sample Bridges

	District	Bridge name	Financial Cost (NRs million)	Economic Cost (NRs million)
A	**1 – Cluster, Biratnagar-Morang**			
1	Morang	Daas Khola Bridge	53.43	48.09
C	**3 – Cluster-Lalitpur**			
2	Dhading	Kahare Khola Bridge	9.18	8.26
3	Nuwakot	Belkot Khola Bridge	13.85	12.46
D	**4 – Cluster, Bhairahawa-Rupandehi**			
4	Arghakhanchi	Mathura River Bridge	16.91	15.22
5	Kapilvastu	Gudrung Khola Bridge	25.75	23.17
E	**5 – Cluster, Pokhara-Kaski**			
6	Kaski	Harpan Khola Bridge	10.30	9.27
7	Syangja	Ringdi Khola	20.23	18.20
F	**6 – Cluster, Birendra Nager-Surkhet**			
8	Dailekh	Tiperi Khola Bridge	12.29	11.06
G	**7 – Cluster, Nepalganj-Banke**			
9	Banke	Duduwanala Bridge	29.24	26.32
10	Kailali	Roda Khola Bridge (Pilot)	19.50	17.55
11	Rukum	Sankh Khola Bridge	9.75	8.78

Road User Costs

Vehicle Operating Cost (VOC)

The vehicle operating costs (VOCs) are calculated using the RED model (the HDM-4 module calibrated to Nepali conditions). The RED model requires various input data for predicting VOCs. The input data comprise prices of vehicles, tyres, fuel and oil, costs of crew members and maintenance labour and characteristics of project road. The prices were obtained from dealers and Nepal Oil Corporation in Kathmandu in early 2015. All the duties and taxes were excluded from the financial prices to estimate economic prices. The costs of crew members such as drivers, helpers and maintenance labour are also as prevailing in early 2015 and have been obtained from drivers and local workshops. On the basis of the above input data, the RED model calculated following VOCs (Table 8.3).

Table 8.3: VOCs in the Access Roads (NRs/km)

Vehicle Types	Terai	Hill
Motorcycle	4.37	4.52
Car	16.53	18.37
Commercial Jeep	20.80	24.75
Minibus	34.13	52.28
Bus	53.49	83.35
Truck	42.63	88.74
Minitruck	40.21	62.12
Tractor	33.90	44.25

Value of Travel Time (VoT)

One of the economic benefits ascribed to the roads and bridges relates to time saved on journeys by passengers in public transport vehicles, people travelling on private or official business and pedestrians. Assumptions have to be made relating to the time saved and the value of this time. This information may be obtained by survey, but is more generally estimated by making assumptions about income levels of various travellers. The value of time for work or business trips was assumed to be related to average regional incomes. In this analysis, the local convention was followed of giving no value for non-work trips. The value of travellers' time is higher for people considered to have higher incomes. The values used are shown in Table 8.4.

Table 8.4: Assumptions on Value of Time (Hills & Terai)

Passenger Vehicle	Value of Time (Hills)		Value of Time (Terai)	
	NRs/hour	NRs/km	NRs/hour	NRs/km
Motorcycle	15.00	0.40	15.00	0.37
Car	259.00	6.90	259.00	6.22
Bus	753.00	24.75	753.00	19.24
Mini Bus/Commercial Jeeps	304.00	8.94	304.00	7.85
Pedestrian	14.00	4.67	14.00	4.67

The speeds of vehicles for the 'with project' situation were predicted by the RED model.

Project Benefits

Benefits from construction of the project bridges are realised from the savings in users' costs. The users' costs savings are either from the reductions of VOCs and time through the diversions of traffic from previously longer routes to the shorter route provided by the bridge or savings in waiting times for crossing the river during periods of high flow which are eliminated after constructions of the bridge. To calculate the savings of users' costs Annual Average Daily Traffic (AADTs) before and after the project were estimated from vehicle counts undertaken for this Review.

The demand for transport is related to the output of the economy that produces it. Traffic is almost invariably positively correlated with GDP and traffic growth with GDP growth. The relationship is as follows:

$$Q = k\ (\text{real GDP})^{e}$$

where, Q is some measure of demand for transport, k is a constant and exponent 'e' is the elasticity of demand for transport with respect to GDP. Elasticity is the proportional change in demand per unit change in real GDP, so an elasticity of 0.2 implies a 2 percent growth in transport demand in response to a 10 percent growth in real GDP. Elasticities for demand for passenger traffic and goods transport are assumed to be higher as in other parts of Nepal. The estimated elasticities for all types of transport are shown in Table 8.5.

Table 8.5: Elasticity of Demand for Transport

Vehicle Type	Price Elasticity
Goods Traffic	1.35
Passenger traffic	1.70

Source: Consultants' estimates. 2015

Annual GDP growth of Nepal is forecasted to be 5 percent during 2015 to 2020 and 4 percent after 2021. The GDP growth rates and above elasticities are used to obtain traffic growth rates. Following traffic growth rates (Table 8.6) are used to project future traffic.

Table 8.6: Estimated Traffic Growth Rate (%)

Period	Growth Rate (%)	
	Pedestrian/ Motorcycle/Car/Jeep/Bus	Truck/ Tractors
2015-20	8.5	6.8
2021+	6.8	5.4

Source: Consultants' estimates, 2015

Traffic levels recorded before and after the project in the project road sections were compared in order to allow meaningful comparisons and to estimate generated and diverted traffic on the bridges. The traffic levels are assessed in terms of a common year which is taken as 2015: in order to convert the base year traffic (assumed to be 2012) to 2015 level, the above traffic growth rates were applied.

The comparisons show a clear picture of the impact of bridge construction on traffic levels. In general, significant increases in traffic volumes have been observed: these comprise both diverted and generated traffic as a result of the bridge construction. In the case of three Terai bridges – Daas Khola, Duduwa Nala and Roda Khola – traffic generally diverted from other alternative routes, with few vehicles having previously used the bridge approach roads. In the case of the Mathura and Gudrung River Bridges, which were closed during periods of high flow in the rainy season, vehicles were assumed to have diverted to nearby alternative crossings. In the remaining six locations, traffic was assumed to wait during periods of high water levels until the river became passable – which could have been a matter of hours or days. As a result, the differences in traffic levels between the 'before' and 'after' situations were assumed to have resulted from either diverted traffic (in the case of three bridges) or generated traffic in respect of the other bridges. Table 8.7 shows the extent of diverted and generated traffic assumed.

Table 8.7: Base, Diverted and Generated Traffic at all Bridge Sites (2015)

	Bridge Location	Type of Traffic	AADT							
			Motorcycle	Truck	Mini-truck	Jeep	Bus	Mini-bus	Tractor	Total All Vehicles
1	Daas Khola	Base	11	0	0	0	1	0	12	24
		Diverted	368	3	6	27	0	0	44	448
2	Kahare Khola	Base	11	0	0	0	0	0	1	12
		Generated	18	1	7	3	1	3	2	35
3	Belkot Khola	Base	28	0	0	1	0	0	1	30
		Generated	0	1	6	0	0	0	3	10
4	Mathura River	Base	15	0	0	0	0	0	4	19
		Generated	68	3	1	25	4	2	4	107
5	Gudrung Khola	Base	115	0	0	0	6	4	16	141
		Generated	0	1	0	7	0	0	0	8
6	Harpan Khola	Base	18	0	0	1	0	2	4	25
		Generated	29	2	3	6	0	0	0	40
7	Ringdi Khola	Base	15	0	0	1	0	0	2	18
		Generated	21	1	1	5	8	0	3	39
8	Tiperi Khola	Base	10	0	0	1	0	0	1	12
		Generated	0	0	1	4	0	1	3	9
9	Duduwanala	Base	0	0	0	0	0	0	4	4
		Diverted	280	3	1	8	0	6	39	337
10	Roda Khola (Pilot)	Base	6	0	0	0	0	0	5	11
		Diverted	255	0	2	3	3	0	26	289
11	Sankh Khola	Base	15	0	0	1	0	0	2	18
		Generated	0	0	0	1	0	0	2	3

Economic Evaluation

Assumptions Made

Economic evaluations are based on a comparison of the situation before the intervention ('without project') and after the investment ('with project') with projected costs and benefits into future years. The baseline ('without project') is crucial as all incremental benefits are derived from this situation.

The project bridges have been considered together with the full length of the associated access road for the purposes of the economic evaluation.

In many cases, the rivers or streams crossed by the bridges used to become impassable for vehicles due to rise in water levels during the rainy season. The waiting time until the water levels reduced to enable vehicles to cross varied from hours to days. The total days of such closures in a year for individual rivers were obtained from the Settlement Surveys and ranged between 25 and 90 days. For economic evaluations, the vehicle waiting time in all cases of closure were assumed to be an average of 8 hours per day.

For Daas Khola, Duduwa Nala and Roda Khola, the economic benefits from the bridge construction were derived from the values of savings of VOCs and travel times of vehicles diverting from longer routes to shorter routes using the new bridges. Other benefits were derived from the value of waiting time savings of traffic using the approach roads during closures before the project, which were eliminated after construction of the bridges.

Economic benefits from constructions of Mathura and Gudrung river bridges were derived from the VOC and travel time savings obtained by not having to use the alternative diversions during periods of closure. Other benefits from the construction were derived from the generated traffic benefits.

In remaining six bridges, benefits were derived from the savings in waiting time of the traffic on the approach roads during closures, which were eliminated after the construction of the bridges. Other benefits from the bridge construction were derived from generated traffic.

Table 8.8 shows proportions of benefit obtained from savings in VOCs, reductions of travel time and elimination of waiting times, plus generated traffic benefits after the bridge construction.

Table 8.8: Proportions of Benefits after the Project Implementation

	Road Section	Proportions of Benefits (%)			
		VOC	Value of Time	Generated /Diverted Traffic	Total
1	Daas Khola Bridge	-	8.0%	92.0%	100.0%
2	Kahare Khola	-	11.0%	89.0%	100.0%
3	Belkot Khola	-	100.0%	-	100.0%
4	Mathura River	79.5%	1.1%	19.4%	100.0%
5	Gudrung Khola	95.7%	2.1%	2.2%	100.0%
6	Harpan Khola	-	46.1%	53.9%	100.0%
7	Ringdi Khola	-	3.4%	96.6%	100.0%
8	Tiperi Khola	-	43.8%	56.2%	100.0%
9	Duduwanala	-	-	100.0%	100.0%
10	Roda Khola Bridge	-	1.7%	98.3%	100.0%
11	Sankh Khola	-	64.7%	35.3%	100.0%

Results of Economic Evaluation

The results of economic evaluation are set out in Table 8.9 and show that the economic internal rates of return (EIRR) of construction of six of the bridges are above the 12 percent threshold rate that is often used by development banks to justify investments. The net present values (NPV) obtained using the 12 percent discount rate are positive and the Benefit Cost Ratios (BCR) are also above 1. The rates of return of the remaining 5 bridges are below the 12 percent threshold rate: their NPVs are negative and the BCRs are below 1. These results indicate that implementation of the project bridges is highly sensitive to traffic levels and to the extent of generated traffic.

Table 8.9: Results of Economic Evaluation

	Bridge	NPV NRs million	BCR	EIRR (%)
1	Daas Khola Bridge	69.49	2.71	26.6
2	Kahare Khola Bridge	-3.22	0.61	6.6
3	Belkot Khola Bridge	-9.19	0.23	0.8
4	Mathura River	7.24	1.60	17.5
5	Gudrung Khola	-2.14	0.95	10.8
6	Harpan Khola	0.13	1.07	12.2
7	Ringdi Khola	14.09	1.92	20.5
8	Tiperi Khola Bridge	-3.50	0.70	7.8
9	Duduwa Nala	28.81	2.31	23.4
10	Roda Khola Bridge	29.45	2.96	28.6
11	Sankh Khola Bridge	-0.84	0.94	10.8

Conclusion

The economic evaluations followed closely the procedures used by development banks and donors in their evaluation of roads investments. The evaluations have shown mixed returns on the investments. However, rather than just tick the 'good' or 'poor' economic impact boxes, the reviewers would like to suggest that the outcome of these economic evaluations depended on a wide range of variables – each with a large degree of uncertainty. This problem is not specific to these analyses, but appears likely to be the case for all evaluations of low-volume roads and bridges.

The economic analyses were difficult due to the lack of adequate and reliable baseline traffic data. However the analyses should be considered in conjunction with the many additional development benefits available: the quantifiable traffic benefits contribute to the overall picture of positive economic returns of the investments.

The generally low traffic volumes and limited changes in travel patterns and demand following the bridge construction result in limited quantifiable economic benefits: however credible and acceptable benefits are identifiable on at least six of the bridges examined, suggesting that significant time and VOC savings are available. Economic appraisal should be regarded as part of overall assessment of upgrading the local road network to all-weather standards to bring socio-economic benefits to whole community.

Rather than undertake extensive and complex economic assessments of individual bridges, it is suggested that traffic volume – and estimates of increases in traffic demand – can act as an effective proxy for economic benefits, assuming modest construction costs and a location on a key element of the local road network (DCRN).

ANNEX F

GIS & Accessibility

GIS & Accessibility

Approach

An assessment has been made of the changes in accessibility brought about by the construction of the project bridges – in terms of the numbers of people within a given walk-time from an all-weather road. Initially this required the identification of the changes in the all-weather road network brought about by each bridge: this was based on the Local Road Network (LRN) alignment data as available from DoLIDAR or the DDC. The population within each time-band could then been computed using GIS techniques that calculate the walk-time across the terrain between each household and the LRN.

This enabled plots and calculations of populations within the 1 hour, 2 hour and 4 hour walk times of the roads in the areas of influence, both 'with' and 'without' the bridge. However, it became evident that the 'traditional' approach to accessibility analysis was NOT directly applicable in regard to many of the selected bridge sites. The accessibility analysis methodology had been developed primarily in relation to the expansion of the rural road network into previously non-road-served areas – ie into areas where there had previously been no road access and where significant changes in accessibility were proposed.

This is NOT the situation in respect of many of the bridges that are proposed under this programme. In the Terai, for example, most of the local road bridges proposed are in areas that already have a degree of access to the motorable road network: the justification for the bridge is based on improved 'connectivity' or better local linkage that will result in shorter and more convenient travel. Similarly, in the hills, many of the bridges are accessing only a relatively small catchment due to the presence of other existing roads. In only a few locations are the bridges providing access into previously unserved areas.

The approach adopted in this Review has therefore been to examine each location individually and then to assess the changes in all-weather accessibility that can be attributed to the bridge construction.

The Sample Bridges

Each of the 11 Sample Bridges are examined below and the associated 'accessibility' issues are discussed and the impact demonstrated graphically. A single approach to all sites is not appropriate as the issues involved are different, especially in regard to the treatment of other (existing) roads.

(i) Daas Khola

This is a Terai bridge and its function is more to do with 'connectivity' rather than 'accessibility': both sides of the bridge were previously accessible by all-weather roads. Construction of the bridge eases and improves movement between areas on both sides of the bridge – as well as allowing a reduction in travel distance and time for trips that would otherwise have had to use the EWH or Postal Road. The bridge is the ONLY motorable crossing of Daas Khola between the EWH and Postal Road.

In regard to the 'accessibility' analysis, the key indicator is the population within 1hr and 2hrs on either side of the bridge, as these are the potential beneficiaries. All trips made

across the bridge will contribute some benefit, as these are either newly generated trips or trips that are diverting from longer alternative routes.

The population within 1 hour of the bridge is calculated at 47,900 as illustrated in yellow on Figure 9.1. It can be expected that most of this population will benefit from the improved connectivity provided by the bridge.

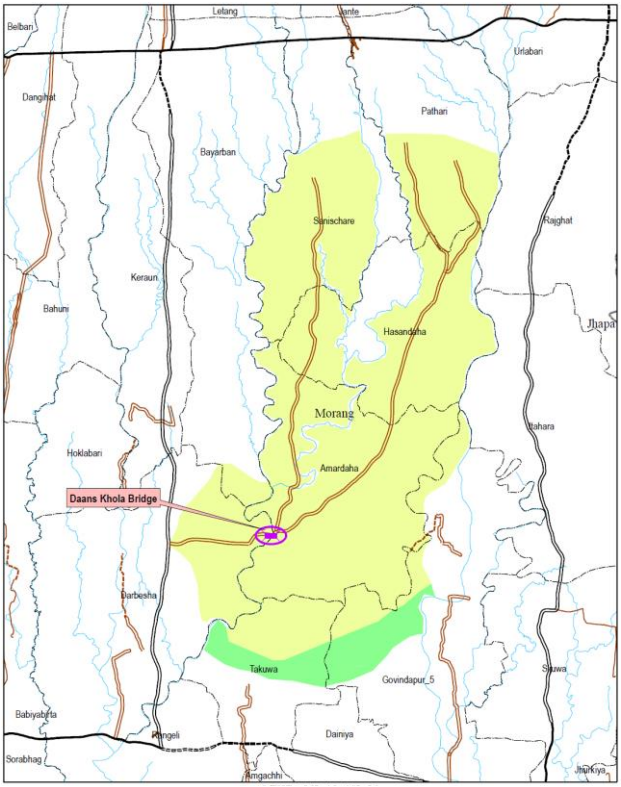


Figure 9.1: Accessibility – Daas Khola Bridge, Morang

(ii) Khahare Khola

This is a situation where the bridge allows all-weather access to an existing network of roads to the east and NE of the bridge. The accessibility analysis calculates the difference in the number of people in the 1, 2, 3 & 4 hour bands in the area beyond the bridge which is presently not served by an all-weather road – and which will benefit from a reduction in access time to an all-weather road with the bridge.

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	162	5528	42	1279
1-2 hours	1712	2349	409	522
2-3 hours	2100	1348	473	309
Within 4 hours	1315	843	294	186
Total within 4 hrs	5289	10068	1218	2296

It can be seen that there is a significant increase in the population living within a 1 hour walk of an all-weather road and that the total population living with 4 hours of an all-weather road doubles from 5,000 to 10,000.

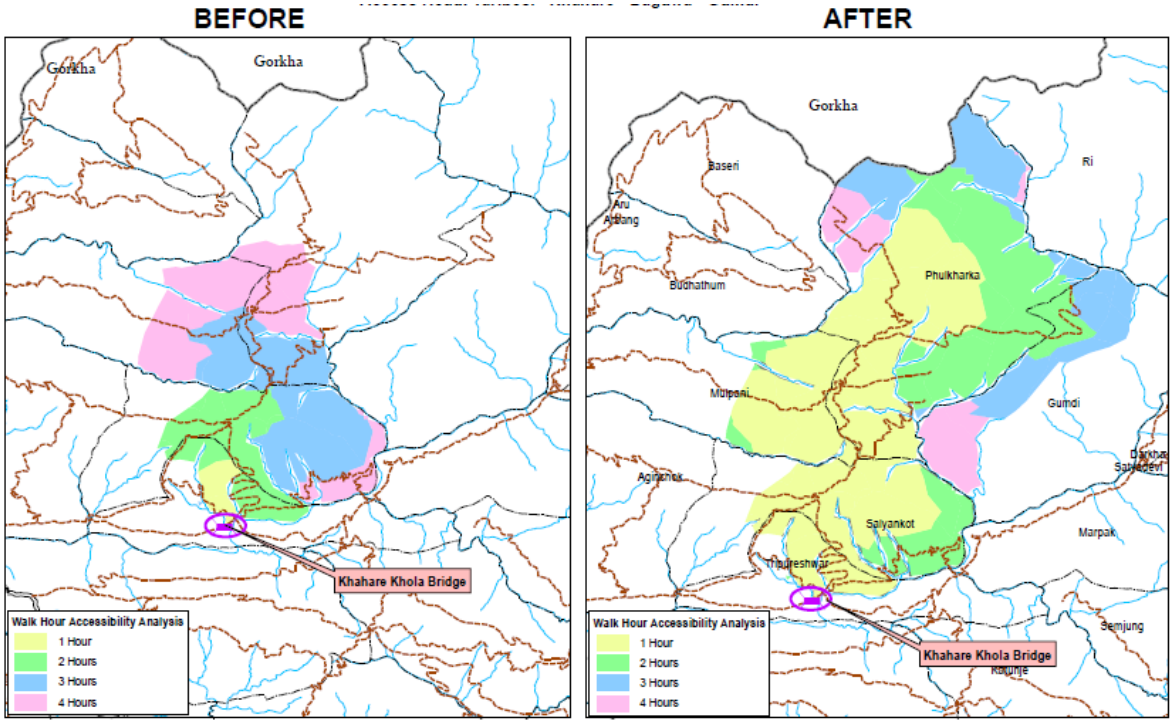


Figure 9.2: Accessibility – Khahare Khola Bridge, Dhading

(iii) Belkot Khola.

This bridge accesses a small but clearly defined catchment area, surrounded by a network of other roads. The analysis is restricted to this area and demonstrates that the bridge construction brings the whole area within the 1hr time band. The total population served is almost 14,000, of which over 10,000 were previously more than 1 hour from an all-weather road.

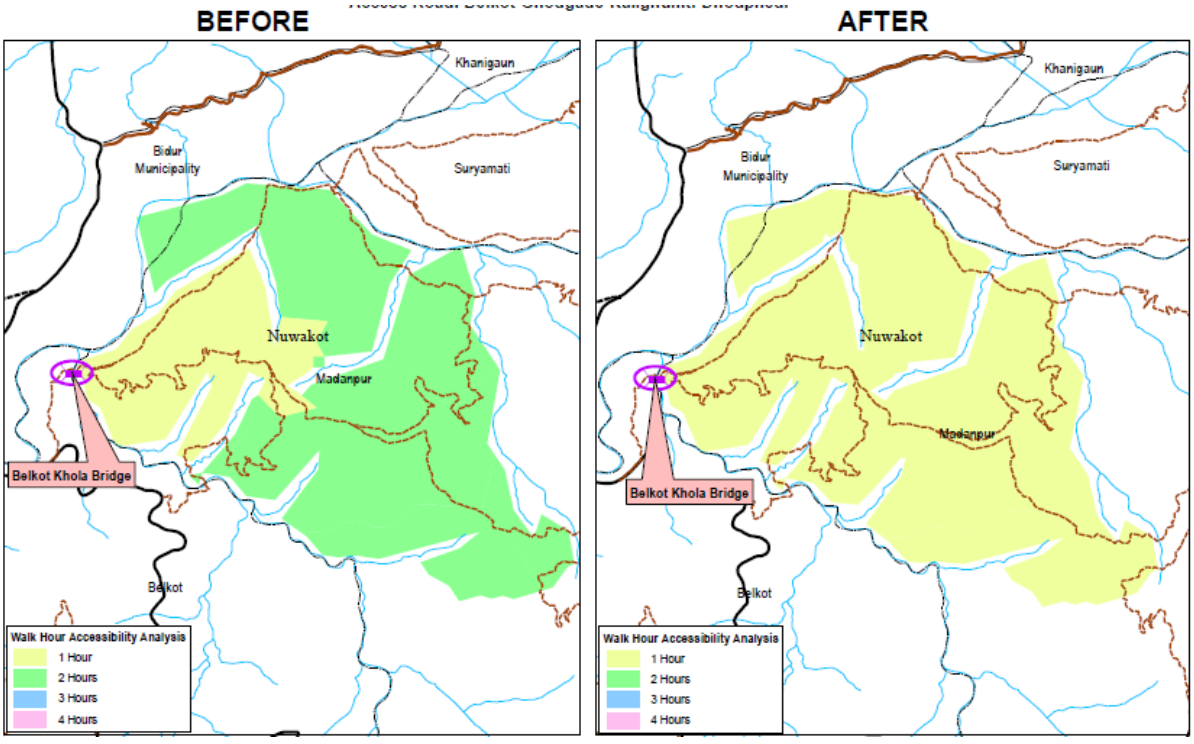


Figure 9.3: Accessibility – Belkot Khola Bridge, Nuwakot

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	3120	13636	610	2739
1-2 hours	10516	-	2129	-
Total	13636	13636	2739	2739

(iv) Mathura River

The Mathura River Bridge is located on a newly designated Strategic Inter-District Road between Sandikharka (Argakhanchi) and Ridi (Gulmi). The accessibility analysis is based on improved access within Argakhanchi District to the east of the bridge: the total population within the area of influence of the road is approaching 45,000 and it is all brought within a 1 hr time-band of an all-weather road, following completion of the bridge.

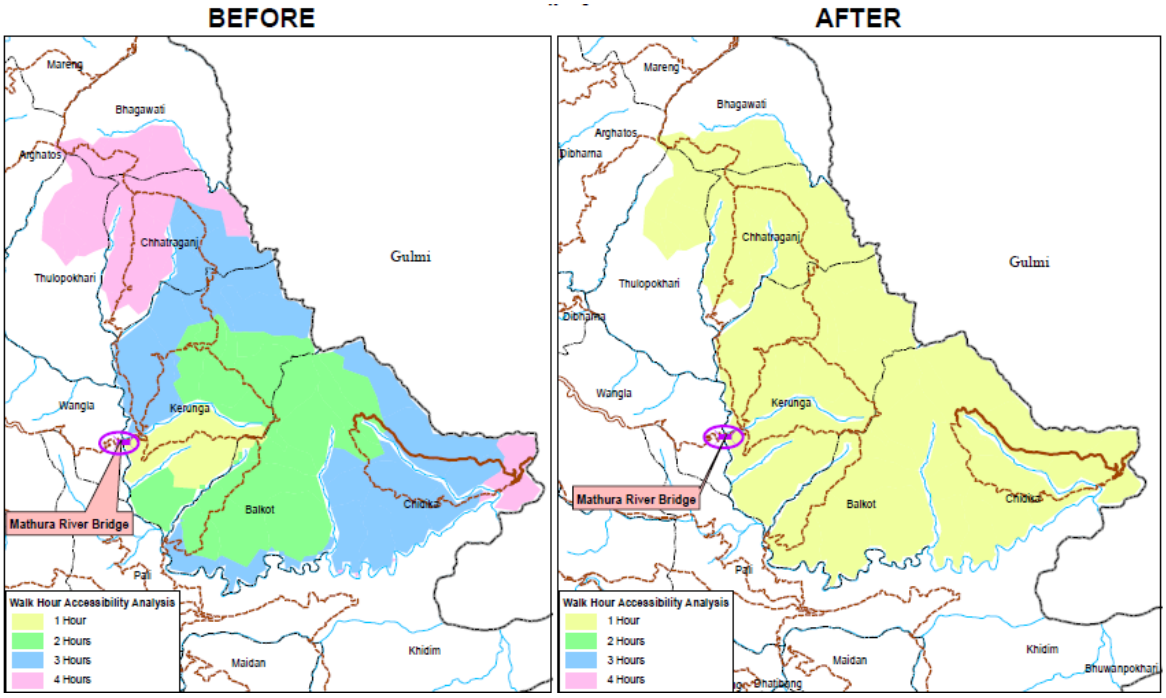


Figure 9.4: Accessibility – Mathura River Bridge, Argakhanchi

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	2977	44679	780	1116
1-2 hours	12497	-	3141	-
2-3 hours	19445	-	4743	-
Over 4 hours	9760	-	2452	-
Total within 4 hrs	44679	44679	11116	11116

This demonstrates a significant catchment area (ZoI) that is brought within a 1 hr walk time from an all-weather road, resulting from the provision of the bridge across the Mathura River. It must however be remembered that this calculation is only valid if the road is maintained to all-weather standards throughout.

(v) Gudrung Khola

This is one of the few 'classic' road-into-a-previously-unserved-area locations, where construction of the bridge will allow an expansion of the 1hr, 2hr, 3hr & 4hr time bands, accompanied by increased populations in the 1 & 2 hour time bands.

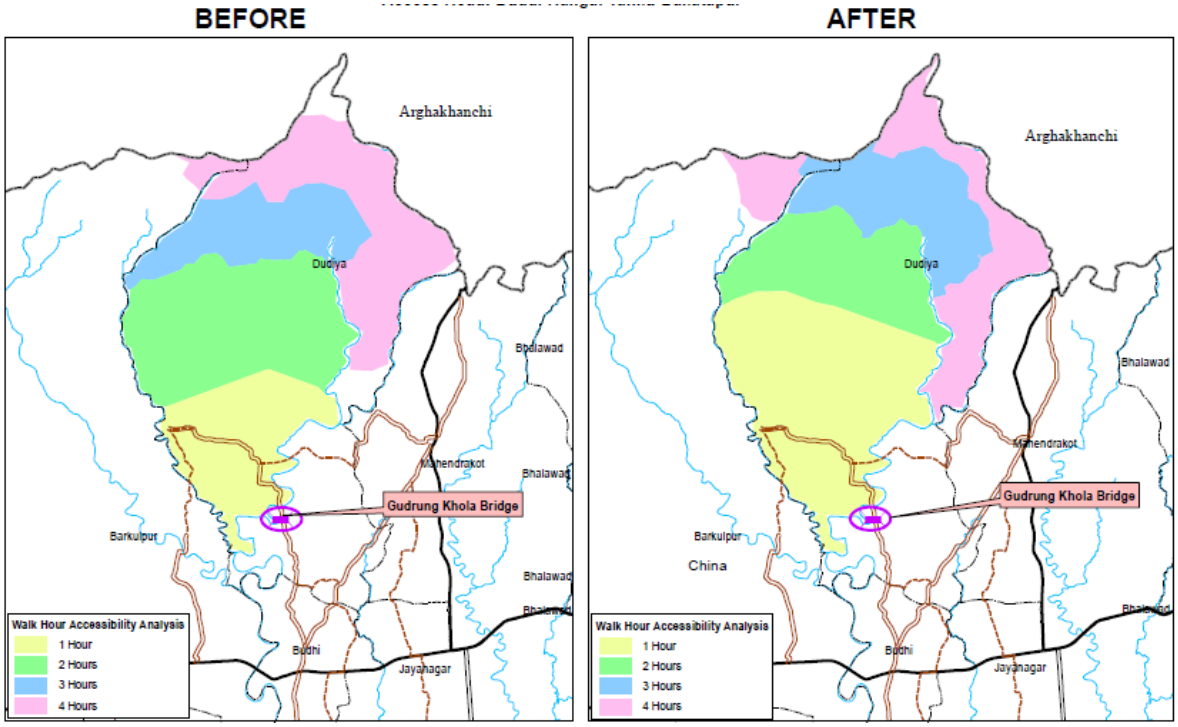


Figure 9.5: Accessibility – Gudrung Khola Bridge, Kapilbastu

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	776	1095	147	209
1-2 hours	538	354	106	71
2-3 hours	284	386	57	75
Over 4 hours	588	463	113	87
Total within 4 hrs	2186	2298	423	442

(vi) Harpan Khola

Harpan Khola Bridge is located approximately 10km from the western end of Phewa Lake in Pokhara. The approach is along the Lakeside and through a developed area but, beyond the bridge, the road enters a forested area and begins to climb steadily towards Panchase, on the borders with Syangja and Parbat.

The extent of the area served by the road is constrained by other roads existing in the surrounding areas. The improvements to accessibility are thus limited in area but include significant increases the up to 1 & 2 hour time-bands, although the absolute numbers are not large.

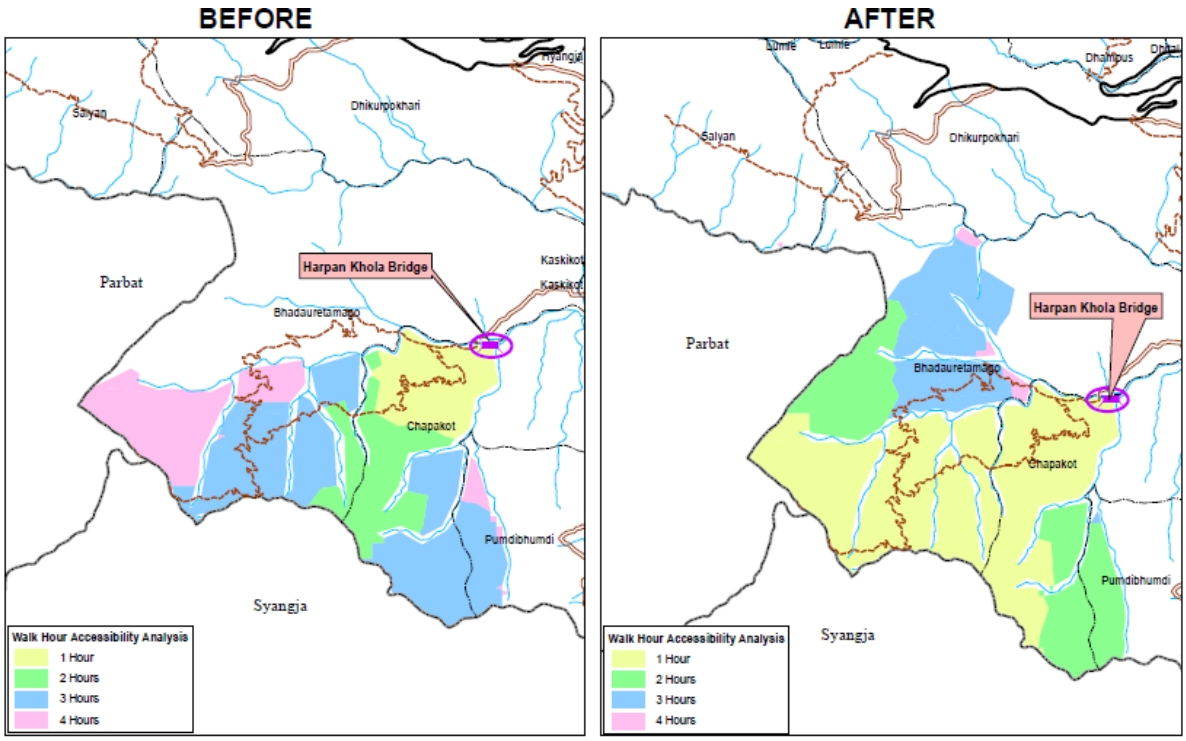


Figure 9.6: Accessibility – Harpan Khola Bridge, Kaski

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	304	594	75	163
1-2 hours	57	224	14	57
2-3 hours	222	168	62	46
Over 4 hours	127	12	39	3
Total within 4 hrs	710	998	190	269

(vii) Ringdi Khola

The Ringdi Khola Bridge similarly serves a developed section of the mid-hills and the extent of the ZoI is constrained and defined by other existing roads. The major impact of construction is that the bulk of the population served (84%) is brought within a 1 hour walk-distance.

It is noted that the main access route to the Ringdi Khola Bridge is from Chharikhola Sadak, a relatively newly developed road (including a major bridge over Aadhi Khola) which does NOT appear in the DTMP or DRCN. This emphasises the need to ensure that the DTMPs are regularly updated to reflect the completion of on-going works.

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	375	2028	97	526
1-2 hours	1685	387	435	98
2-3 hours	355	-	92	-
Total	2415	2415	624	624

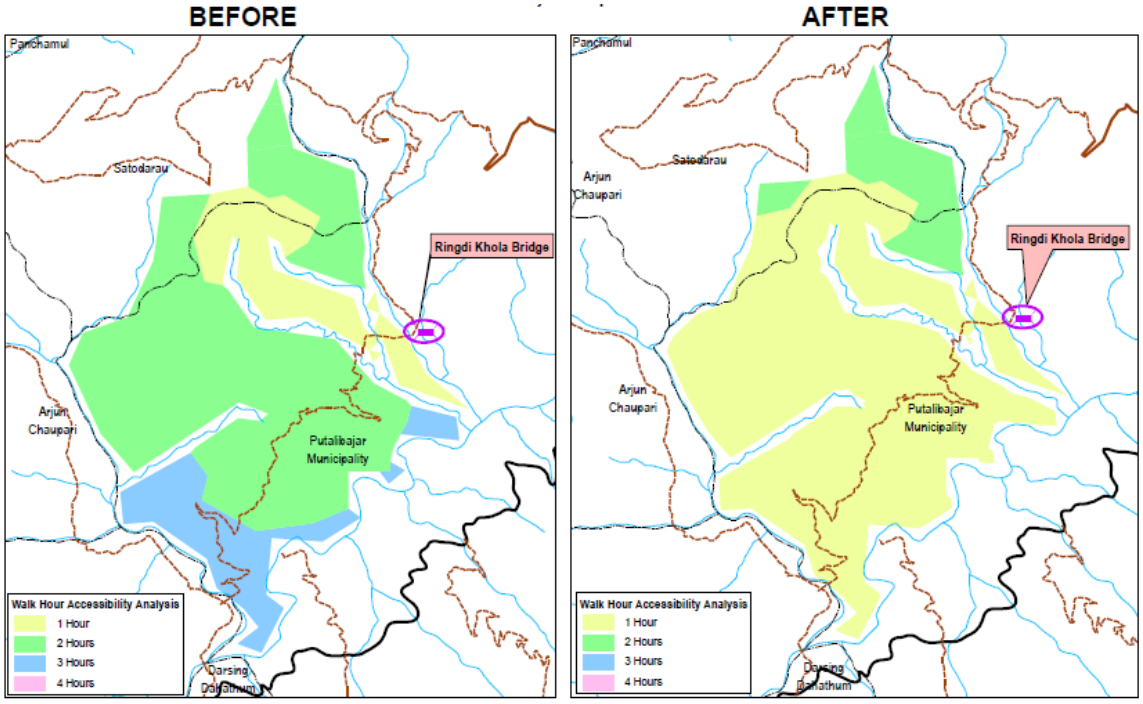


Figure 9.7: Accessibility – Ringdi Khola Bridge, Syangja

(viii) Tiperi Khola

Tiperi Khola Bridge is on a section of local road accessing a relatively remote area in the north of Dailekh District, most of which will be brought within a 1 hour walk-zone following construction. The main benefit is the 'transfer' of people from the 2hr & 3hr categories into the 1hr band.

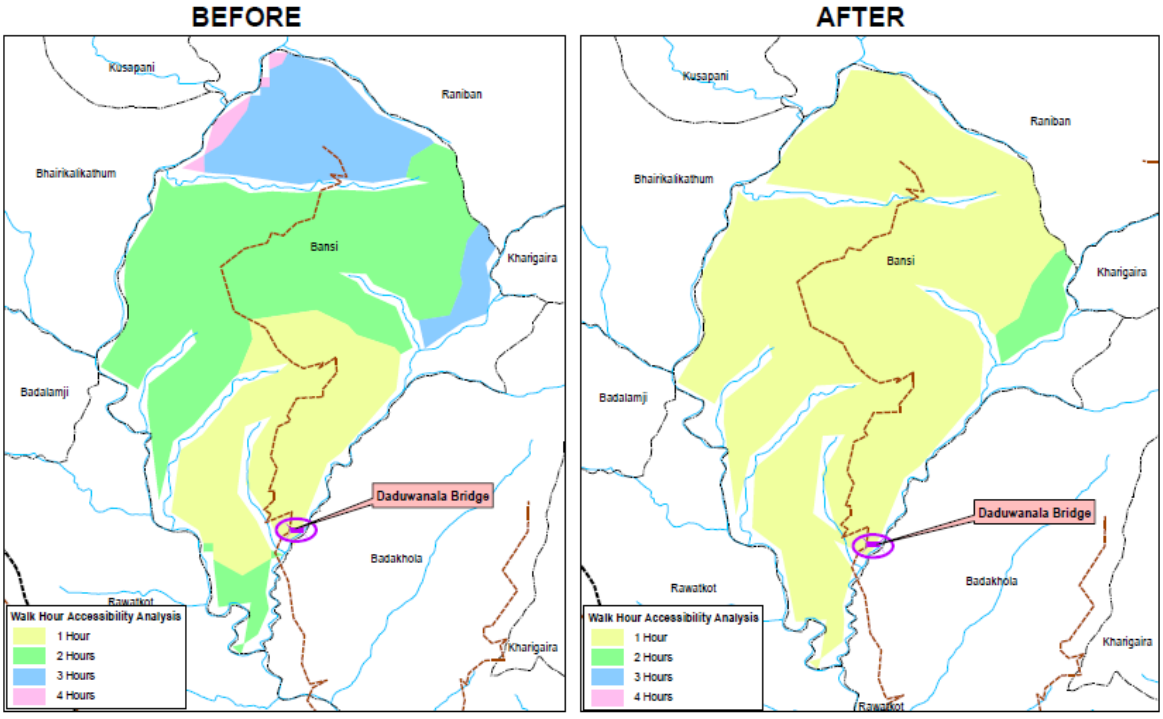


Figure 9.8: Accessibility – Tiperi Khola Bridge, Dailekh

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	811	3226	168	631
1-2 hours	1939	108	379	21
2-3 hours	547	-	98	-
Over 4 hours	37	-	7	-
Total within 4 hrs	3334	3334	652	652

(ix) Daduwa Nala

This is a Terai bridge located across a major drain, close to the eastern end of the runway at Nepalgunj Airport. It provides access to a relatively small ZoI allowing a substantial reduction in journey times to Nepalgunj. The extent of the ZoI is limited by other existing roads.

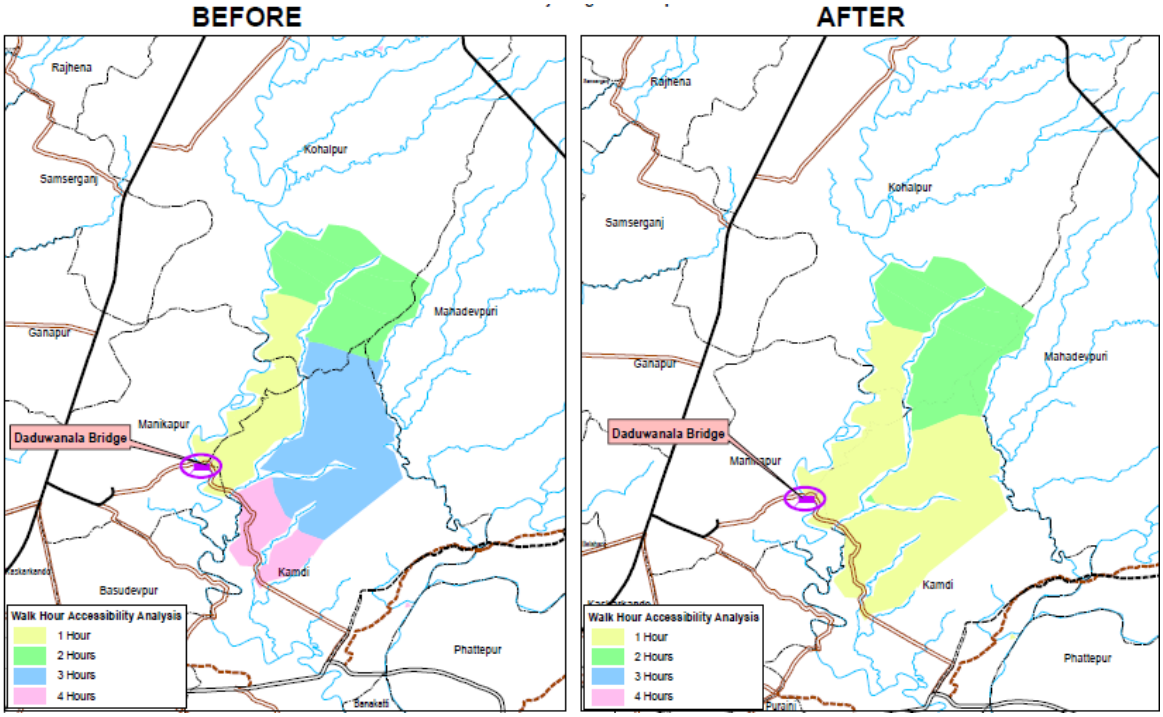


Figure 9.9: Accessibility – Daduwa Nala Bridge, Banke

The effect of the bridge is to expand the area west of the Nala that is within a 1 hour access time to an all-weather road.

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	1486	3376	300	717
1-2 hours	1192	1489	218	278
2-3 hours	1668	-	363	-
Over 4 hours	520	-	115	-
Total within 4 hrs	4866	4865	996	995

(x) Roda Khola

This was the location of the initial Pilot Survey. The bridge provides improved local connectivity and linkages, rather than enhanced accessibility, as both sides already have motorable access. The extent of areas affected is 'contained' by other existing roads. As a result of the bridge construction the whole of the ZoI falls into the within 1 hour zone.

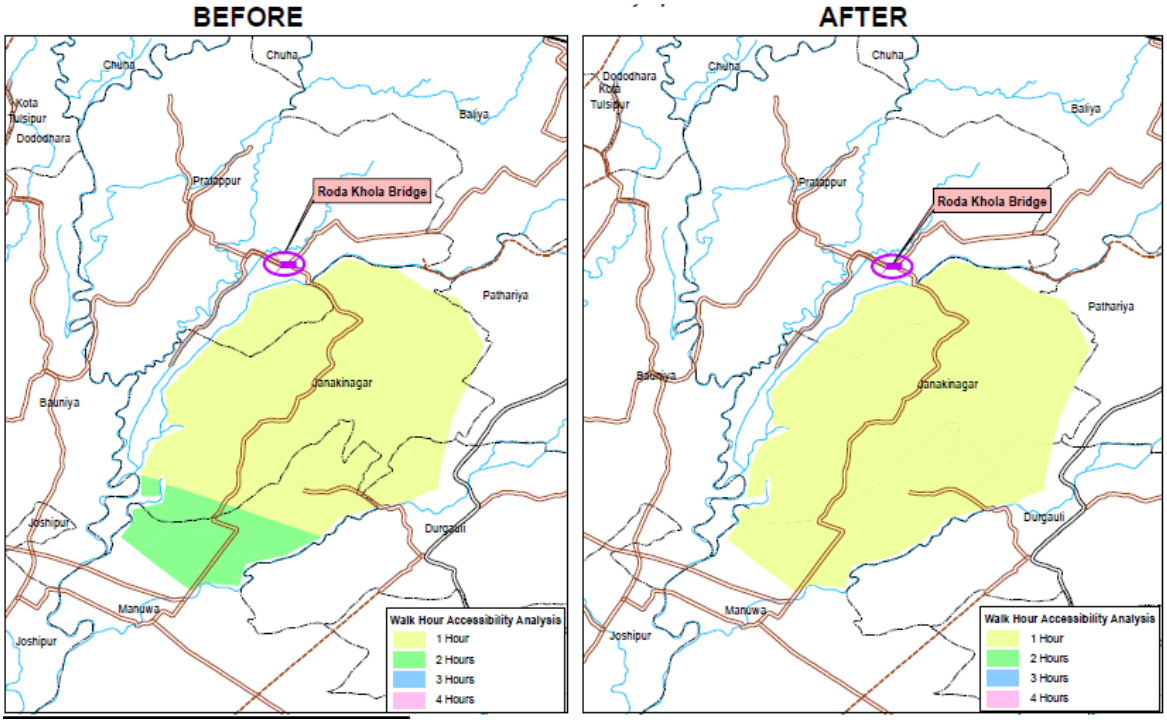


Figure 9.10: Accessibility – Roda Khola Bridge, Kailali

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	8118	10060	1417	1741
1-2 hours	1941	-	324	-
Total	10059	10060	1741	1741

(xi) Sankh Khola

Sankh Khola Bridge is located on the expanding network of local roads in south-east Rukum, providing access from the District HQ (Musikot) to parts of four VDCs. Significant parts of both Chokhabang and Chunbaang VDCs will be brought within 1 hour of an all-weather road and the overall area – and thus population – served will be substantially increased.

Time Band	Population		Households	
	Before	After	Before	After
Within 1 hour	606	2750	124	546
1-2 hours	726	1387	150	275
2-3 hours	847	1732	172	328
Over 4 hours	505	528	97	103
Total within 4 hrs	2684	6397	543	1252

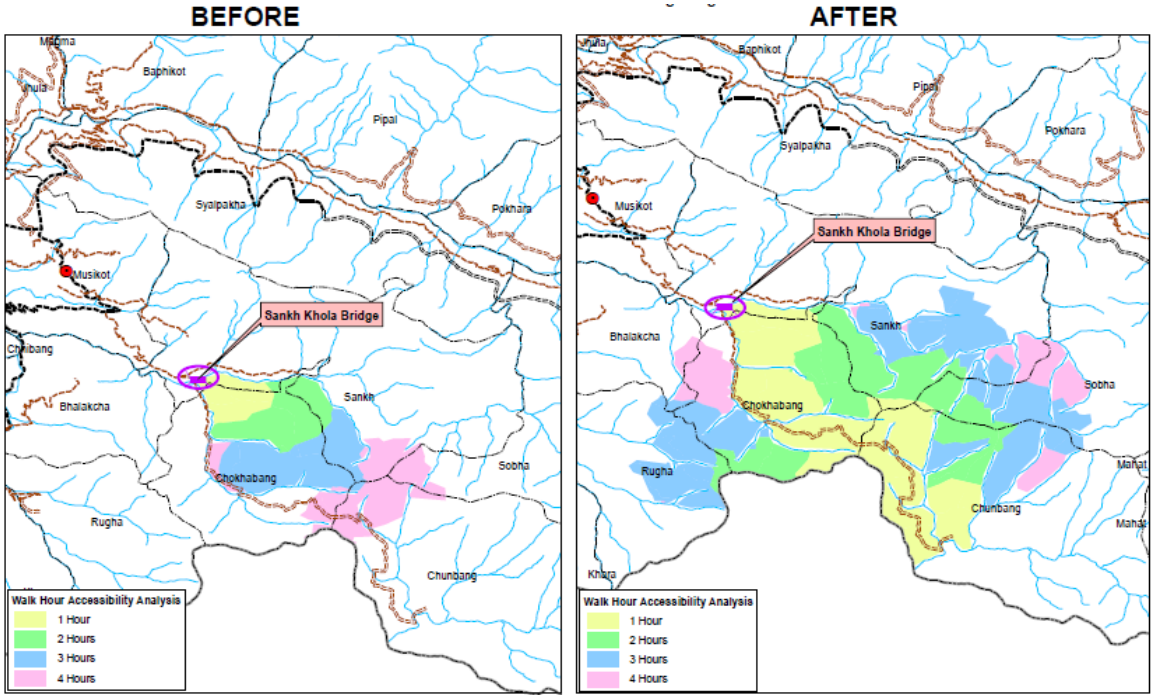


Figure 9.11: Accessibility – Sankh Khola Bridge, Rukum

Findings

It is evident, based on the sample of 11 selected bridges, that the construction of local motorable bridges has a significant impact on the level of accessibility to the all-weather road network. Substantial additional areas are brought within a 1 hour walk of a motorable road with all-season access.

It should be noted however that the bridge needs to be considered in conjunction with the overall road network – and specifically with the extent of the additional lengths of all-weather road created.

The calculations need to be undertaken with care – especially in regard to defining the extent of the ZoI as this may be constrained or restricted by the presence of existing alternative roads. Specifically, in the Terai, the bridges will improve local connectivity – rather than accessibility: most areas of the Terai are already within 1 or, at the most, 2 hours of an all-weather road.

In only a few cases – of roads into previously unserved areas – will the bridge substantially increase the extent of the area served: however, in other locations, accessibility will be improved with increased numbers of people in the 1 hour (or 2 hour) time bands from an all-weather road – coupled with a reduction in numbers of people in the higher time bands.

Typically, the number of people within 1 hour of an all-weather road is increased by a factor of between 2 and 5 times, with a few sites showing a much greater change. On average, within the ZoI of each bridge, the population within a 1 hour walk of an all-weather road increases from around 2,000 to 9,000 – a factor of 4.5.

Improvements to accessibility are clearly an important factor to be considered in the development of the Local Roads Bridges Programme. However there is no single method of calculating the impact on accessibility and each location will need to be treated on its merits.