

ASIAN DEVELOPMENT BANK

IES: NEP 2000-18

IMPACT EVALUATION STUDY

OF THE

ASIAN DEVELOPMENT BANK

ASSISTANCE TO THE ROADS SECTOR

IN

NEPAL

December 2000

CURRENCY EQUIVALENTS

Currency Unit – Nepalese Rupee/s (NRe/NRs)

NRe1.00	=	\$0.01373
\$1.00	=	NRs72.83

The Nepalese rupee is pegged to the Indian rupee (Re) at NRe1.00 to Re1.00, and is fully convertible on all current account transactions.

ABBREVIATIONS

ADB	–	Asian Development Bank
AOTA	–	advisory and operational technical assistance
DFID	–	Department for International Development
DOR	–	Department of Roads
EIRR	–	economic internal rate of return
EWB	–	East-West Highway
IES	–	impact evaluation study
km	–	kilometer
LCB	–	local competitive bidding
PCR	–	project completion report
PPAR	–	project performance audit report
PPTA	–	project preparatory technical assistance
PRC	–	People's Republic of China
TA	–	technical assistance
VOC	–	vehicle operating cost
vpd	–	vehicle per day

NOTES

- (i) The fiscal year (FY) of the Government ends on 15 July.
- (ii) In this report, "\$" refers to US dollars.

CONTENTS

	Page
EXECUTIVE SUMMARY	ii
MAPS	vi
I. BACKGROUND	1
A. Study Rationale and Objective	1
B. Road Sector of Nepal	1
C. ADB Assistance	2
D. Study Focus, Scope, and Methodology	4
II. HILL ROAD UPGRADING AND NEW CONSTRUCTION	5
A. Hill Roads in the East and Far Western Region	5
B. Hill Agriculture Development Project Roads	12
III. EAST-WEST HIGHWAY UPGRADING	13
A. ADB Involvement and Current Status	13
B. Development Context	14
C. Transport and Traffic	15
D. Reestimated Economic Internal Rates of Return	15
E. Assessment	16
IV. PERIODIC MAINTENANCE	16
A. ADB-Supported Projects	16
B. Evaluation	17
C. Assessment	18
V. INSTITUTIONAL, POLICY, AND OTHER ASPECTS	18
A. Institutional Support	18
B. Road Maintenance	19
C. Road Safety	20
D. Environmental Impact	21
E. Project Planning and Preparation	21
F. Road Contractors and Consultants	22
VI. CONCLUSIONS	23
A. Overall Assessment	23
B. Lessons and Implications for the Future	25
APPENDIXES	28

EXECUTIVE SUMMARY

Since 1976, the Asian Development Bank (ADB) has provided the Government of Nepal with \$173 million for five road projects and road components in nine other projects, mainly on agriculture and urban development with significant road components. Three advisory and operational technical assistance (AOTA) grants for \$1.6 million, aimed at institutional strengthening within the road sector, and project preparatory technical assistance amounting to \$1.4 million, have also been provided. Overall, ADB's involvement in the road sector has been significant, addressing a large proportion of the road upgrading and periodic maintenance needs of the nationally important East-West Highway (EWH) as well as two access routes into the hills. In addition, rural roads have been improved. About one quarter of the road development expenditure in Nepal since the 1980s has been financed under ADB projects.

The strategic network is the key part of Nepal's road system and comprises the EWH running the length of the country in the southern Terai, and feeder roads running off the EWH to connect to district centers and border crossings. Rural roads, typically earth and gravel tracks, link small rural population centers to the strategic network. The remainder of the road system comprises urban roads. The Department of Roads is responsible for the strategic network; responsibility for rural and urban roads has been devolved to local government units. Nepal has fewer than 50,000 operating trucks, buses, and small vehicles, other than motorcycles, and traffic volumes are generally small. Bus and truck movements dominate traffic outside Kathmandu Valley. There is a general excess of trucks and buses relative to needs, and most operate on a rotation basis with substantial nonoperating periods while waiting for their turn. It is also noteworthy that most hill and mountain areas do not produce large volumes of surplus outputs, and the majority of freight movements in these areas are for transporting food and consumer goods into the hills, and many trucks leave the hills empty.

Most of ADB's road projects have been multicomponent, addressing different road development needs in several places at the same time. The majority of the components are of three main types, namely (i) hill roads, comprising the upgrading of existing roads and some new road development in hill areas, particularly involving the strategic network roads in the eastern hills around Ilam and Far Western Region districts of Dadelhdhura and Doti; (ii) EWH upgrading, comprising the upgrading with some reconstruction of the eastern portion of the EWH from Narayangarh to Belbari, plus the Hetauda-Birganj road; and (iii) periodic maintenance, comprising the resurfacing and some upgrading of other parts of the EWH, Kathmandu Valley roads, and feeder roads in the Terai.

This impact evaluation study aims to review and assess the main types of ADB assistance to the road sector and provide guidance for the future. It comes at a time when a major objective for road development in Nepal, namely the upgrading of the constructed part of the strategic network, has been completed and development efforts are being refocused elsewhere. One project not included in the study was the Rural Infrastructure Development Project, which involves communities and uses labor-intensive means in road construction in rural areas. This Project was ongoing at the time of evaluation and not ready for review, but it is likely to have particular relevance to future development efforts.

About half of ADB's loan assistance has been for hill roads, and most of this assistance has been to upgrade to sealed, all-weather roads what were primarily earth tracks of the strategic network centered on Ilam in the eastern hills and on Dadelhdhura in Far Western

Region hills. The work was funded under three road projects and one agriculture project. Delays and cost increases affected implementation. Overall, less road was upgraded and completed later than expected, but the quality of the completed works was satisfactory.

As a result of the hill road project components, transport costs were reduced and national integration has been improved. Bus fares and freight rates are lower for sealed roads than for earth and gravel roads, and traffic on the sealed roads has grown faster than the normal rate for Nepal. The movement of people by bus and taxi has grown particularly strongly. The road upgrading also stimulated a noticeable increase in the movement of food and consumer goods into the project areas by encouraging the growth of market centers at strategic points along the roads. In the east, an expansion in cash cropping and dairy production also has paralleled road development, but there is insufficient evidence to quantify the link between road upgrading and the agricultural change. In Far Western Region, the roads had no effect on agriculture. Employment opportunities have increased in both the east and Far Western Region. The greater availability of consumer goods, greater mobility through faster and more frequent bus services, and enhanced employment have improved living conditions. Some positive impacts on disadvantaged groups, particularly women and those of lower caste, have also been noted. The improvement in employment and living conditions was greater in the east than Far Western Region due to the changes in agriculture.

Economic internal rates of return (EIRRs) were recomputed for the hill roads on the basis of conventional road user cost and maintenance savings. Such benefits are insufficient by themselves to justify road upgrading, producing EIRRs of 5 percent or less. Primarily, this is because of the low traffic volumes. The results point to the need for lower cost mechanisms for upgrading and/or the need to ensure that other benefits in the form of increased agricultural output or social improvement occur. One of the roads in Far Western Region was new. Even though the surface was only gravel, maintenance poor, and traffic volumes lower than on the sealed roads, the recalculated EIRR was 16 percent. The better result highlights the value of providing the initial access that allows motorized transport to replace relatively high cost porter and pack animal transport.

ADB's assistance to the EWH upgrading was completed to a generally adequate standard, although significant delays were experienced during implementation. As a result of the upgrading, traffic speeds have increased leading to reduced and more reliable journey times (see below for a discussion on road safety). As bus and freight charges reflect road conditions, transport efficiency—the main objective of these components—is considered to have been improved and part of the benefit has been passed on to the general population. Over the past 15 years, traffic has grown faster than predicted by the various appraisal projections, but similar to normal rates of traffic growth in Nepal. The EIRR for the EWH upgrading components, based on conventional user cost and maintenance savings, was reestimated to be 17 percent.

All the periodic maintenance works were completed to a satisfactory standard. World Bank analyses indicate that conventional road user cost savings alone produce high EIRRs when traffic exceeds 300 vehicles per day. Since most of the roads were important transport links carrying greater traffic volumes than this, the ADB-supported periodic maintenance works are deemed to have successfully improved transport efficiencies, which was their main objective.

No major negative impacts are associated with the road assistance. Road safety is an issue, however, particularly on the Kathmandu Valley roads and the EWH where significant populations exist close to the roads, but lack of data prevents an assessment of the safety

impact of the ADB-supported roads. The ADB-funded road works included measures to improve safety, but vehicle speeds which can influence accident rates have increased as a result of upgrading. Environmental problems such as deforestation and the silting of streams have not been major, as the vast majority of the works were done on existing road alignments. On the positive side, the hill roads have facilitated forest rangers in their work of monitoring forests and supporting community forestry efforts.

Local contractors were extensively involved in the road works, in some cases after the failure of an initially selected international contractor. They performed well, and the projects have contributed to the growth of this local industry. Nevertheless, local contractors still suffer from “lumpiness” of work, i.e., work is not received in a smooth flow. Local consultants also performed satisfactorily.

ADB's institutional strengthening efforts through technical assistance (TA) have been relatively minor, but this is partly because of low absorptive capacity within the sector and the large effort supported by other external agencies. Two of the ADB AOTAs were useful, but the third was small in relation to needs and the output was not sustained. Although ADB contributed in an ad hoc manner to road sector planning, it missed opportunities to address road sector planning on a more comprehensive basis.

Overall, ADB's assistance has been successful, although within this overall assessment there is variability—the EWH upgrading and periodic maintenance components were highly successful while the hill roads and institutional strengthening assistance have been less than successful. ADB's project assistance scores well for relevance to both national goals and ADB objectives. The objectives of improved national integration and improved transport efficiency were well achieved, but the hill roads did not have the full impact on agriculture expected of them. The efficiency of ADB assistance also was mixed due to the implementation delays, reductions in scope, and the low EIRRs for the hill roads. The sustainability of what was created under loan assistance is likely, however. No major negative impacts are associated with the roads and the unintended social impacts of the hill roads have been small but positive.

The experience with upgrading the EWH and periodic maintenance shows that keeping roads with high traffic volumes, such as the EWH and the key roads in Kathmandu Valley and the Terai, in good condition is economically justifiable on the basis of road user cost savings alone. It is also highly probable that the transport benefits are passed on to the general population, which can have an impact throughout the economy. The appropriate management approach for these roads, therefore, is to keep road user costs low by maintaining the roads in good condition with progressive upgrading in accordance with growth in traffic volumes.

Nepal's requirement for continued ADB support for maintaining the EWH and other key roads is likely to diminish since these roads have largely been upgraded, and future maintenance is to be provided by the Road Fund and Roads Board proposed by the Government with World Bank support. Interim assistance may be required until the Road Fund and Roads Board are operational; however, in general, the focus of future support to the road sector in Nepal is likely to be for hill and rural roads, and for specific large projects such as improvements on the Kathmandu ring road or the Kathmandu-India border link. ADB is participating in this refocus through projects such as the Rural Infrastructure Development Project.

In the hill areas, traffic volumes are inadequate to generate sufficient quantifiable economic benefits from road user cost savings to justify the expenditures needed to upgrade

gravel or earth roads to sealed all-weather status, even in combination with savings in road maintenance expenditure. Other benefits, such as those from increased agricultural output, social improvements, or enhanced national integration, must be assured, or lower-cost approaches devised, to justify expenditure on road sealing in these areas. The experience in the eastern hills shows that agricultural development may result from road development without much additional assistance. However, the results in Far Western Region Province indicate that agricultural development may not necessarily follow road development, and specific interventions to ensure that the expected development occurs may be required. The experience from ADB assistance in this sector also shows that hill road upgrading can generate significant nonquantifiable benefits, and that the formulation and evaluation of such roads requires a broader focus than one which revolves around the estimation of EIRRs.

The low traffic volumes and consequent small road user cost savings from road improvements in the hill areas indicate that the appropriate management approach for such roads would be to focus on asset preservation and the least cost way of ensuring a minimum level of serviceability. High standards, which implies substantial expenditure, are not rewarded commensurately by large user cost savings such as occur in the EWH (with its greater volume of traffic).

Domestic road construction contractors performed adequately. Except for a limited number of tasks, such as the laying of asphalt concrete surfaces, the use of domestic contractors on future road works would be appropriate. Domestic contractors would benefit from actions, such as the letting of maintenance contracts to expand the volume of work and smooth out the "lumpiness." Domestic consultants also performed adequately. However, as occurs in many countries, domestic consultants are subject to various social and political pressures, and combinations of international and domestic consultants would appear to be the most appropriate option for contract supervision.

Government attention is drawn to the possibility of errors in traffic counts for the northern roads in Far Western Region, and the need to investigate the causes of premature deterioration in the hill road south of Ilam and along the northbound lane of the Hetauda-Birganj road. Improved road safety is also an area that warrants added attention in the future, and may require TA from external agencies such as ADB.

The proposed Fourth Road Improvement Project has a component for further sealing of hill roads in Far Western Region. The findings of this impact evaluation study in relation to hill road upgrading suggest that such a component is unlikely to be economically viable by itself. At the time of finalization of this study, ADB's infrastructure department was investigating ways of integrating the hill road component with other rural development projects. This investigation should continue and result in a broader integrated design for the proposed hill road.

I. BACKGROUND

A. Study Rationale and Objective

1. The Asian Development Bank (ADB) first became involved in road development in Nepal in 1976. At that time, Nepal's road system was relatively undeveloped, comprising roads linking Kathmandu and Pokhara to India and the People's Republic of China (PRC), lengths of low capacity road in the Terai,¹ including those forming the eastern portion of the important East-West Highway (EWH), and roads within Kathmandu Valley. Elsewhere were rudimentary tracks. Over the succeeding 25 years, ADB, along with the World Bank and bilateral aid agencies, assisted the Government of Nepal to expand and upgrade the road system, and maintain it. The physical accomplishments over this 25-year period have been significant and the immediate objective of establishing a basic road network has largely been achieved, leading to a need to refine the focus of future assistance. Given such a need, this impact evaluation study (IES) provides a timely review of ADB's assistance to the road sector so far.

2. The purpose of the IES is to assess the impact of ADB's assistance to the road sector of Nepal, and derive lessons and recommendations from the experience. It is expected that this knowledge will help in guiding the selection, design, and implementation of future ADB assistance.

B. Road Sector of Nepal

3. A key part of Nepal's road system is the 4,740-kilometer (km) strategic network² linking major towns, district headquarters, and other key commercial and economic centers. The strategic network is formed by the EWH, which acts as a backbone running the length of the country in the Terai, and north-south highways and feeder roads³ running from the EWH to Kathmandu and Pokhara, into the hills, and to border points. While the strategic network is mostly all-weather, only about two thirds is sealed. Other roads comprise rural roads that feed off the strategic network and urban roads. The rural roads total about 6,610 km and are mostly earthen roads and tracks. The urban roads, about 1,870 km in total length, are also a mixture of sealed and nonsealed roads. About a third of all urban roads are within Kathmandu Valley.⁴ As part of a general devolution of power in Nepal, the responsibility for rural and urban roads has been passed to local government units, namely village committees, district committees, and municipal authorities. The Department of Roads (DOR) retains responsibility for the strategic network.⁵

¹ The east-west lowland area on Nepal's southern border with India, generally 30-40 kilometer (km) wide.

² An additional 660 km of the strategic network has been identified but not yet constructed.

³ In Nepal, the term "feeder road" refers to an important group of roads mostly linking district centers to the EWH. These roads carry higher traffic volumes (generally more than 50 vehicles per day) than rural roads and are at a higher level in the road hierarchy than the "feeder road" designation used in Southeast Asia.

⁴ The Department of Roads (DOR) estimates the total length of the constructed road network to be 13,220 km.

⁵ In practice, DOR also retains an interest and involvement in some important rural and urban roads.

4. An important feature of road transport within Nepal is the relatively low traffic volumes. Outside Kathmandu Valley, the highest volumes are 2,500-3,000 vehicles per day (vpd) on the main route to the Indian border. On key links in the Terai, volumes are 300-1,000 vpd, with flows of 100-200 vpd on the main hill roads. Earth roads at the extremities of the network may have traffic volumes of less than 25 vpd. Except around Kathmandu where cars are common, traffic is dominated by buses and trucks.⁶ Motorcycles, bicycles, and pedestrians are also common on the roads.

5. Since the 1970s, the Government's main objective within the road sector has been the completion of the strategic network. As well as integrating the country, the improved access and reduced transport costs arising from such development are expected to stimulate economic development, particularly in agriculture, and help remove regional disparities. Under the Eighth Five-Year Plan (1992-97), poverty reduction was introduced as a specific additional road development objective, and gender equality was introduced as an objective under the Ninth Five-Year Plan.

6. The development of Nepal's main roads has depended upon substantial foreign assistance. Typically, 50-70 percent of the road budget has come from foreign loans and grants. ADB's assistance, along with that from the World Bank and Japan,⁷ is highly significant, each comprising about 25-30 percent of the total foreign assistance to the road sector. PRC, India, Switzerland, former Union of Soviet Socialist Republics, United Kingdom, and United States of America also have provided significant assistance.

7. Most of the main roads, particularly those made with foreign assistance, are built to a high standard. In contrast, the rural roads are typically built by village and district local government units, and construction methods can be crude. Instances of poor alignment and environmental degradation from such construction occur. However, with the assistance of the Department of Local Infrastructure and Agricultural Roads, the design and construction of rural roads is improving.

C. ADB Assistance

8. Since 1976, ADB has funded five projects⁸ classified as road projects, and a further nine nonroad projects^{9,10} that have included a significant amount of public roads within their scope.¹¹

⁶ Based on data from the Second Draft Report of the Nepal Transport Sector Strategy Review, dated March-April 2000, there are an estimated 159,000 vehicles operating in Nepal. Of these, about 101,000 are motorcycles. Buses and trucks account for about 8,900 and 14,100 vehicles, respectively, and while this number is less than the 35,300 cars, most of the cars are in the Kathmandu area.

⁷ Japan's assistance in recent years has been dominated by the construction of the Sindhuli road.

⁸ Loan 117-NEP(SF): *Hetauda-Narayangarh Road Project*, for \$10.1 million, approved on 19 December 1972; and supplementary Loan 274-NEP(SF), for \$4.8 million, approved on 23 September 1976; Loan 651-NEP(SF): *Feeder Roads Project*, for \$17.5 million, approved on 10 November 1983; Loan 806-NEP(SF): *Road Improvement Project*, for \$30 million, approved on 2 December 1986; Loan 982-NEP(SF): *Second Road Improvement Project*, for \$50 million, approved on 9 November 1989; and Loan 1377-NEP(SF): *Third Road Improvement Project*, for \$40 million, approved on 21 September 1995.

⁹ Loan 721-NEP(SF): *Hill Agriculture Development Project*, for \$17.8 million, approved on 13 December 1984; Loan 748-NEP(SF): *Seti Zone Rural Development Project*, for \$20 million, approved on 31 October 1985; Loan 867-NEP(SF): *East Rapti Irrigation Project*, for \$30.4 million, approved on 26 November 1987; Loan 1113-NEP(SF): *Rajapur Irrigation Rehabilitation Project*, for \$16.6 million, approved on 31 October 1991; Loan 1114-NEP(SF): *Upper Sagarmatha Agricultural Development Project*, for \$13.3 million, approved on 31 October 1991; Loan 1156-NEP(SF): *Tourism Infrastructure Development Project*, for \$10.4 million, approved on 16 January 1992; Loan 1240-

Apart from these loan projects, ADB provided three advisory and operational technical assistance (AOTA) grants aimed at institutional strengthening within the road sector. Four of the five road sector¹² and each of the nine nonroad-sector loan projects were preceded by a feasibility study under an ADB-funded PPTA. A further PPTA for a possible sixth road project has been completed.¹³ The total appraised cost of the road developments involved in ADB's five road and nine nonroad-sector projects amounts to about \$219 million, against which ADB has approved loans totaling \$173 million (Appendix 1). Technical assistance (TA) approved for the road sector amounts to about \$3 million (Appendix 2).

9. Four of the road projects and four of the other nonroad projects with road components have been completed and project completion reports (PCRs) have been prepared. Two of the completed road projects¹⁴ have been postevaluated. Overall, the conclusions of the PCRs and postevaluation reports have been generally favorable. Delays and reductions in length of road works were reported for some projects, but the completed works were generally found to be of a satisfactory standard, and the estimated economic benefits from road user cost savings, road maintenance savings, and assumed agricultural benefits produced a satisfactory economic internal rate of return (EIRR) in most cases (Appendix 3).

10. With the exception of the first project, each of ADB's road projects funded several types of road works, such as upgrading, reconstruction, and periodic maintenance, in different parts of the country. While at first glance this approach seems to be scattered and unfocused, over time and in combination, the majority of the assistance has been concentrated on three large parts of the strategic road network and the Government's periodic maintenance program (Map 1). Some road components under the nonroad projects also contributed to this focused assistance, but most of these components involved specific, separate rural roads in hill areas. Taken together, the road components under ADB's loan projects can be grouped into four main types, namely (i) hill roads involving improvement and new road construction in hill areas, with particular focus on the strategic network in the eastern district of Ilam, and Far Western Region around Dadeldhura, Doti, and Sanfegagar, as well as agricultural development areas; (ii) reconstruction, improvement, and periodic maintenance over a generally contiguous length of the eastern portion of the EWH to bring it to an adequately functioning and maintainable condition; (iii) time slices of the Government's periodic maintenance and upgrading program involving various sections of the EWH and feeder roads in the Terai and roads in Kathmandu Valley; and (iv) road construction under the ongoing Rural Infrastructure Development Project characterized by a high degree of community involvement and labor-intensive methods.¹⁵

NEP(SF): *Kathmandu Urban Development Project*, for \$12 million, approved on 29 June 1993; Loan 1450-NEP(SF): *Rural Infrastructure Development Project*, for \$12.2 million, approved on 27 June 1996; and Loan 1604-NEP(SF): *Second Agriculture Program*, for \$50 million, approved on 22 January 1998.

¹⁰ The road component of the Kathmandu Urban Development Project was reduced to about 8.2 km after the start of implementation with the deletion of the Bishnumati Link Road subcomponent.

¹¹ Other ADB-financed projects, such as in irrigation and forestry, have included roads, but the roads are either minor or nonpublic roads, such as forest plantation roads.

¹² ADB did not fund a project preparatory technical assistance (PPTA) for its first road investment, the Hetauda-Narayagarh Road Project. This Project was formulated under a Government-funded feasibility study.

¹³ Fourth Road Improvement Project.

¹⁴ The Hetauda-Narayagarh Road Project and the Road Improvement Project.

¹⁵ Several other agencies are also working at the district and village levels in the development of rural road networks, for example, Germany (GTZ), United Nations World Food Program through its Food for Work-Rural Community Infrastructure Works Program, Switzerland (Swiss Agency for Development Corporation [SDC]) through its District Roads Support Programme, United Kingdom (Department for International Development [DFID]) under its Rural Access Program, and the World Bank through its Rural Infrastructure Program.

11. Based on the present values¹⁶ of completed contracts, around half of ADB's total expenditure on road projects has been on the hill road improvements in the east and Far Western Region, with a further quarter on the rehabilitation of the EWH. The balance has mostly been spent on periodic maintenance and various agricultural development roads.

D. Study Focus, Scope, and Methodology

12. The IES focuses on the three main types of ADB loan assistance, i.e., improvement of hill roads, upgrading the eastern portion of the EWH, and periodic maintenance. The IES also reviews the institutional strengthening under the AOTAs and the contribution to the development process of ADB's PPTAs. The works under the Rural Infrastructure Development Project have not been reviewed, although the approach under this Project differs significantly from that of other projects and is likely to be relevant to future road development. The Rural Infrastructure Development Project was ongoing at the time of the field studies for the IES, and it was considered unlikely that any results could be measured.

13. The three types of project component selected for study differ in the type of impact expected and, consequently, different study approaches were adopted for each. The hill roads are developmental in nature, aiming to open up areas either by changing road access from fair-weather to all-weather or by building motorized access for areas otherwise accessible only by nonmotorized means. In addition to generating benefits from savings in road user costs and avoided future maintenance or rehabilitation expenditure, the roads were expected to generate increases in economic activity, particularly agriculture, as well as social benefits related to improved access. Therefore, the study conducted extensive field surveys of road-served, poorly road-served, and nonroad-served areas in the hill areas in order to determine the extent of economic and social change attributable to road upgrading. In addition, for the hill areas, the field studies investigated the impact of the road upgrading on traffic and gathered data to complete economic reevaluations (Appendixes 4, 5, and 8). The project interventions in the eastern portion of the EWH were not expected to have such a clearly identifiable development impact, but rather were expected to generate benefits in a more general way through avoided transport cost increases and improved transport efficiencies. The EWH investments were only a few of many public and private investments in the area, and one, as shown by preliminary study, that local people and transport operators find difficult to identify benefits from because such benefits are in the form of hypothetical, avoided higher costs. As a result, for this group of components, the study focused on identifying changes in key transport and traffic parameters and recalculation of the economic returns to the overall investment in upgrading and maintaining the eastern portion of the EWH. Such a limited approach is also warranted given the national importance of the EWH and the lack of any alternative to establishing and maintaining this all-weather road link. In a similar manner, the impacts from periodic maintenance beyond savings in avoided road user and road maintenance costs are not readily identifiable. The ADB assistance financed time slices of the Government's periodic maintenance program for specific road links, and the study focused on reestimation of the economic returns for these components and assessment of the likelihood of benefits being passed on to the general populace. For all road investments, particularly the EWH and periodic maintenance components, the study also reviewed the degree of competition within the transport sector and assessed the extent to which the direct benefits of road improvements, namely savings in road user costs, are passed on to the general public in the form of lower transport charges. The passing on of road user cost

¹⁶ Actual costs were adjusted to constant 2000 values and expressed in Nepalese rupees.

savings for vehicle owners is particularly important since significant numbers of vehicles in some areas, such as trucks plying the Birganj-Kathmandu route and taxis in the eastern hills, are owned by Indian nationals. Unless the primary benefits are passed on, they are lost to Nepal.

14. The majority of the data gathering and analyses for the study were completed under part of an ADB TA, and the study was constrained by the availability of resources for the TA.¹⁷ For the hill roads, surveys were conducted to collect information on changes in traffic, road conditions, the facilities available in villages, prices of indicator goods, bus and freight rates, and socioeconomic parameters. The socioeconomic parameters focused on poverty and gender issues, and included information on agricultural production, employment, housing conditions and availability of services, education and contact with outside areas, feudalism, caste, and women's empowerment. The main sources of information were physical counts and observations by a team of interviewers; interviews with key informants such as the district development committee persons and other district officials and staff of the agriculture, forestry, education, health and industry services; and structured group discussions with both villagers in general, and groups restricted to the poor and women. In an attempt to isolate the effects of upgrading road conditions from the provision of road access, surveyed settlements included settlements near to roads, settlements several hours' walk from a road, and settlements in nonroad-served areas. For the EWH and periodically maintained roads, surveys were undertaken to collect information on traffic volumes and types, road conditions, bus fares and freight rates, and to assess the extent of competition within the transport sector.

II. HILL ROAD UPGRADING AND NEW CONSTRUCTION

A. Hill Roads in the East and Far Western Region

1. General Features

15. In the east of Nepal, components of the Feeder Roads Project and the Third Road Improvement Project upgraded the existing earth road from the Terai to Ilam and onward toward Phidim. A spur from Fikkal (located just south of Ilam) to the Indian border at Pashupatinagar was also upgraded (Map 2). The upgrading was to all-weather two-lane bitumen standard. In Far Western Region, components of the Feeder Roads Project, the Road Improvement Project, and the Third Road Improvement Project upgraded the existing earth road from the Terai to just north of Dadeldhura and from Dadeldhura eastward to Silgadhi to the same all-weather two-lane bitumen standard (Map 3). In addition, in Far Western Region, a component of the Seti Zone Rural Development Project constructed a new all-weather gravel road from Silgadhi to Sanfebagar. In both the east and Far Western Region, the road sections improved under the ADB projects are contiguous and provide the main access link for each area to the EWH in the Terai.

¹⁷ RETA 5832: *Evaluation Studies in the Bank's Developing Member Countries*, for \$1 million, approved on 12 February 1999. Approximately \$145,000 was available for the study of the impact of ADB assistance on the road sector of Nepal.

16. Apart from Silgadhi-Sanfegagar, the roads had existed as earth tracks since the 1970s. Small portions in the eastern area had been sealed by the Government before ADB's involvement. Prior to the 1970s, both these hill areas had been accessed through earth tracks from India where all-weather roads existed, and by porter from the Terai. Although by the time ADB became involved with these roads they were traversed only with difficulty by trucks and buses in the wet period and subject to closure by landslides, the motorized transport of goods and people was possible. ADB projects primarily upgraded the roads to an all-weather state with better riding qualities suitable to all types of vehicles. In Far Western Region, the Silgadhi-Sanfegagar road included under the Seti Zone Rural Development Project was a new road and nonmotorized transport prior to ADB's involvement was impossible. Prior access to the areas served by this new road was by porter and donkey from other parts of Nepal.

17. Although the road works that were completed were of an adequate standard, implementation problems affected the outcomes. Delays and a need to retender the Feeder Roads Project meant that the length of road upgrading in both the eastern hills and Far Western Region was reduced and, importantly, the works, which started in 1987, were completed only in 1994. In Far Western Region, this meant that an important section south of Dadeldhura was not completed until early 1999, which limited the usefulness, until then, of road works further along the route under other projects. The main cause of the problem was the closure of the border as a result of a disagreement between the governments of India and Nepal over the Trade and Transit Treaty. The closure of the border caused logistical difficulties for the international contractor who failed to remobilize after the dispute was resolved. Construction costs under the Third Road Improvement Project proved to be much higher than expected and the second stage contracts for the road north of Ilam in the east and north of Dadeldhura in Far Western Region could not be let in full. Only 42 km out of 67 km in the east and 12 km out of 49 km in Far Western Region under the second stage could be accommodated within the available budget. Both roads terminate at an arbitrary point rather than at a settlement.

18. In August 2000, the time of the study, the condition of the majority of the upgraded roads was satisfactory. The improvements under the Third Road Improvement Project had been completed only recently and sections were still in the defects liability period. In the east, premature pavement deterioration had occurred on a section of the road near to Ilam, while in Far Western Region, inadequate maintenance has resulted in frequent closures during the rainy season of the gravel road from Silgadhi to Sanfegagar, which is now only usable by trucks and buses during the wet season.

2. Impact on the Local Economy

19. A significant movement of food and consumption goods into the project hill areas from supply centers in the Terai and India had existed prior to ADB involvement. Upgrading the roads to all-weather bitumen standard under the ADB projects expanded this trade by encouraging the growth of market centers at strategic points along the roads. These market centers have extended the availability of outside goods a considerable distance from the roads as porters and pack animals move the goods from the market centers to more remote areas. Based on changes in traffic, the quantity of goods imported into the eastern hill districts is estimated to have increased by around 10-12 percent per year over the past decade. A similar growth in imports has been seen in Far Western Region, but the effect in the area around the Silgadhi-Sanfegagar road has been more significant because that road provided the first motorized

access route. Other studies have shown that the first motorized access generates a substantial increase in the inward movement of consumer goods.¹⁸ Not all the new shops and trade within the east and Far Western Region hill areas are incremental in the national or even regional context, however. A continuing shift has occurred in the location and structure of market outlets, including from the Terai towns, with the main locus of activity moving further into the hills as the road upgrading proceeded.

20. In parallel with the improvement in roads in the east, agricultural activity has increased. The area has a tradition of cash cropping, has a much larger proportion of cultivatable land per person than in most other hill and mountain areas of Nepal, and has long been able to generate food surpluses. Over the past 10 years, agriculturally similar but nonroad-served areas to the west of Ilam have shown the same increases in cropping intensity of about 12-15 percent as in the Ilam area. However, around Ilam there has been a greater increase in the proportion of the cropped area used for cash crops as a result of a shift from cereal crops to cash crops. Dairy production and farmgate milk values have also increased around Ilam due to the installation of milk chillers and the operation of milk tankers that have allowed liquid milk sales from the area. A number of private and government-owned cheese factories and seven tea factories for the processing of smallholder tea have recently been established in the area.

21. Unfortunately, a lack of baseline data and limitations in the information collected under the study do not allow the effect of the road upgrading on the agricultural change in the eastern hills to be quantified. Direct effects of the road were evident only for dairy produce as the dairy facilities would not have been installed without a sealed all-weather road.¹⁹ It is likely that the road upgrading has had more general, indirect effects on crop production. Change has been occurring in the area for a long time, but the easier and more frequent movement of people, including technicians and nongovernment organization (NGO) staff, the enhanced availability of relatively lower priced food grains from the Terai, which enables land to be shifted from food to cash crop production, and the effects on prices of farm inputs and produce haulage rates, are likely to have enhanced the rate of change. The production of tea has been expanding in the area for many years, and the tea factories, along with the new cheese factories, are not dependent upon having a sealed road, although the existence of one may have favorably influenced the decision to invest and/or locate in the Ilam area.

22. Similar changes in agriculture have not occurred in Far Western Region.²⁰ This area has relatively low ratios of agricultural land per person and the soils are less fertile than in the east, and has traditionally relied upon seasonal and longer-term migration of family members for employment in the Terai, India, and further afield for cash needs. Although domestic food supply has increased over the past decade due to increased fertilizer use and irrigation development, a comparison among road-served and remote areas indicates that the roads have not had any major direct impact on agricultural production. Small-scale vegetable cropping has become established around Dadeldhura under an NGO program, and the road has facilitated a limited trade of fresh vegetables to neighboring settlements. However, as in the past, subsistence

¹⁸ Previous studies, e.g., the 1997 Priority Investment Plan, have indicated that when a road is opened in the immediate zone of influence, imports can double in a few years time and increase by around 20 percent over the same period in the broader areas served.

¹⁹ The increase in dairy production is considered to be at least NRs16 million per year, although it must be recognized that this is at best a rough approximation based on very limited information.

²⁰ The PCRs for both the Feeder Roads and Road Improvement projects attributed an increase in agricultural output to the road developments. However, the benefits were only anticipated and the reports did not provide any evidence of agricultural change. The postevaluation report for the Road Improvement Project, completed several years later than the PCR, did not find evidence of any significant road-related agricultural change in Far Western Region.

cereal cropping dominates and very little produce leaves the area. The area has long been a food deficit area and remains so, relying upon imports from elsewhere.

23. Associated with the increase in the number of trading outlets and other developments in the area, such as the installation of electricity and communication services, employment opportunities in general construction and related services have increased. However, apart from agriculture, and tea and dairy processing/handling in the eastern hill areas, significant industries have not established themselves in either area. The study reviewed the effect of the road upgrading on portering and other forms of traditional employment. There was no evidence of adverse impacts, although change had occurred. It appears that the increased volumes of freight imported by road and the construction and trading activities induced by the road have resulted in more job opportunities being created than lost. This is also suggested for Far Western Region by survey respondents in that area reporting a slight decline in the amount of seasonal migration for employment over the past decade. Most porters appear to be part-time porters, employed in agriculture or general laboring work at other times. Porters who previously made lengthy trips of several days from the Terai and India are now employed distributing goods from the newly established roadheads, and make more frequent but shorter trips. Some local craftsmen, such as tailors and shoemakers, reported a decline in demand for traditional skills, brought about by the import of cheaper manufactured goods.

3. Socioeconomic Impact

24. All respondents within the influence of the roads in the eastern hills reported an increase in overall living standards over the past 10 years, whereas those in nonroad or poorly served areas claimed there had been no change. The main reason for the change quoted by survey respondents was the income from the increased production of cash crops. The elimination of "middlemen" was seen as an additional benefit in the east, with individual farmers taking their produce directly to market. Both road- and nonroad-served areas in the east reported improved conditions for lower caste people and women—changes that appear to have occurred independently of the roads. However, the poor and lower castes in the road-influenced areas reported increased job opportunities over the last 10 years—including work in road construction, laboring, and portering of cash crops, milk, and other goods brought in for sale within the area. These changes were attributed by the people to both the improvement of road access and the expansion of cash cropping, and were not reported in the nonroad-served areas. In the east, women also considered that the road had improved market accessibility and led to higher incomes and better job opportunities for them.

25. In Far Western Region, the greatest change brought about by the roads has been in social aspects, rather than in income or material conditions. The roads have made the movement of people easier, which has led to more frequent trips, have resulted in savings in travel time, and have opened up the area to outside influences. Importantly, increased mobility and exposure to outside influences are making it possible for some people to ignore the more rigid aspects of caste. In addition, women reported that their conditions had improved compared with 10 years previously. Nevertheless, similar changes in caste and for women were reported in poorly road-served areas of Far Western Region, and the impact of road upgrading does not seem to be as great as predicted during the planning stages. The radio and workers returning from distant employment were indicated as important sources of information and influence in these remote areas.

26. Most respondents in Far Western Region survey areas reported an increase in overall living standards over the past 10 years, but these changes were similar to those of nonroad-served or poorly served areas. Additionally, there was no clearly identifiable link between increased living standards and the provision of an improved road or access to markets and the outside world. Road construction brought short-term employment and an increase in trade and NGO activity. Apart from these aspects, no specific increases in agriculture or substantial changes in patterns of employment or agricultural production were noted, with the exception of a small reduction in the relatively high proportion of people migrating seasonally to India for work.

27. The livelihood of the local population in Far Western Region continues to depend upon remittances from seasonal migrant workers. The road has facilitated such travel and has enabled more frequent return visits by reducing both the time and cost of travel. The money earned by such migrant workers may now be spent on both essentials (e.g., food imports) and on a greater variety of commodities available in the local market—all of which are now available at lower prices. The net effect is, therefore, an increase in the levels of locally disposable income and a greater consumption of imported goods.

28. The provision of electricity, water, and telephone services in both the eastern districts and Far Western Region is more pronounced where there are roads. This is to be expected because the roads aid the installation and servicing of these facilities. However, road upgrading as done under the ADB projects does not influence electrification and communication development. School construction and the availability of schools were also similar in road-served areas and areas poorly served by roads, as was house construction and housing. While schools in road-served areas achieved slightly better overall performance, attendance in schools in all areas was reported as high and increasing. The proportion of girls attending school continues to lag that of boys. Health services were better in the road-served areas than in poorly served areas, primarily because of the better access to hospitals and health centers, including through ambulance services.

4. Transport and Traffic

29. In the eastern hills, average annualized daily traffic volumes for 2000 ranged from 265 vpd near to the Terai²¹ to 170 vpd at Ilam and 75-85 vpd on the road leading north out of Ilam (Appendix 6). The spur to the Indian border at Pashupatinagar had 140 vpd, half of which were Indian registered taxis travelling as far as Fikkal only. These volumes represent an overall annual growth of around 12.5 percent from 1982 when the total daily traffic recorded was around 30-35 vehicles. Buses and light vehicles have grown at about 16 percent per year, with growth in truck traffic lower at around 9 percent per year.

30. Traffic in Far Western Region hills is less than in the east even though the population there within the influence area of the roads is almost double that in the east. Annualized average daily traffic in Far Western Region for 2000 ranged from about 130 vehicles over the main section out of the Terai and into the hills, to around 90 vpd on the Sanfebagar-Silgadhi road (also known as the Doti road) and dropping to between 20 and 50 vehicles at the ends of the network (Appendix 6). Traffic growth has been at a similar level as in the east, i.e., around

²¹ But excluding local traffic in the Terai.

12 percent per year overall, with truck traffic growing at less than 10 percent per year and bus traffic around 15 percent per year.

31. The traffic growth rates in both the east and Far Western Region are higher than the normal traffic growth for Nepal over the past decade, estimated to be 8 percent per year. The greatest growth has been in bus and taxi transport, indicating a particularly significant increase in personal mobility resulting from the road improvements. Most personal travel in Nepal is for social or family reasons, and the reduced travel times and better long-distance connections have facilitated such travel. On the Doti road, for example, travel times dropped from 8-10 hours²² to 2-3 hours following the road improvements and travel became more reliable throughout the year. Bus travel is not restricted to any social class, and improved personal travel has benefited all sections of society. Truck traffic has increased steadily, but at a slower pace than that of buses. The movement of food and consumer goods into the hills dominates freight traffic. Over half the trucks traveling out of the hills to the Terai are empty because of relatively low volumes of farm and other produce sent out of the area.

5. Bus Fares and Freight Charges

32. Historically, bus and truck operations have been controlled by operators' associations. Many more buses and trucks are available for hire than needed, and these associations provided a mechanism for rationing the available work among vehicles. The Government also established upper limits for bus fares. However, the operators' associations have not had complete control and free market services at lower prices exist, and not all bus fares conform with the government regulations, particularly in hilly areas and along earth roads (Appendix 7).

33. Bus fares show a clear relationship with road condition (and whether the road is in the hills or the Terai): if roads are allowed to deteriorate, it is likely that bus fares will increase, and conversely, if roads are maintained, fare increases are likely to be avoided. However, while this general relationship exists, in practice it seems that neither official nor actual fares are adjusted automatically when roads are improved.²³ Changes in fares may occur only over the longer term or where strong competition exists. The competition to buses from taxis in the eastern hills appears to have had a major impact in lowering fares in that area. As the taxi services only started after the completion of a sealed road to Ilam, such competition and its effect on fares can be taken as a direct benefit of the road upgrading.

34. Analysis of freight charges in the eastern hill areas of Nepal indicates that freight rates also reflect the condition of the road and imply rates on the unpaved sections of NRs20-25 per ton km, compared with around NRs10-12 per ton km on the paved sections.²⁴ In Far Western Region, rates are generally lower and show a more marked difference between paved and unpaved sections. The lower rates in Far Western Region are despite a lower volume of back-haul freight and are believed to result from stronger control over freight by truck owners' associations in the east. However, the general link between road condition and freight rates in

²² With some journeys taking up to three days in the worst of the monsoon.

²³ In particular, the recent completion of the upgrading of the road to Dadeldhura and the upgrading of the Lamahi-Tulsipur road has not yet led to lower fares.

²⁴ The overall rates to the more northern areas are in the range NRs15-17 per ton km but these include substantial lengths on paved roads.

both areas shows that improved road conditions result in a reduction in freight rates, which has underpinned the increase in trade volumes seen in both areas.²⁵

35. Further analysis in Appendix 7 compares bus fares and freight rates with computed vehicle operating costs (VOCs). The results indicate that bus fares are above levels based on the study's estimates of bus operating costs, offering scope for further reductions in fares with improved competition. In Far Western Region, freight rates appear in line with VOCs, and the cost savings benefit from road improvement has been adequately passed on to consumers. The higher freight rates in the east indicate that further price reductions are possible with increased competition.

6. Reevaluation of Economic Internal Rates of Return

36. EIRRs were reevaluated for the two packages of hill road improvements in the east and Far Western Region. The benefits were quantified in terms of conventional transport savings, namely, savings in VOCs, passenger time, and road maintenance costs (Appendix 8). No benefits from stimulated agricultural production, which may have occurred in the east, were included. Appraisal of the hill roads also included benefits from road user cost and maintenance savings, but in addition included benefits from the increased agricultural output expected to be stimulated by the road upgrading.²⁶ Typically, the appraisal estimates of the benefits from agriculture accounted for less than 11 percent of total benefits, and predominantly the ex ante economic justification was on the same basis as used in this reevaluation.

37. In the east, the overall rate of return has been recalculated at 3 percent, which is much lower than the 12-13 percent expected at appraisal. The relatively poor rate of return can be attributed primarily to (i) the protracted construction period of 15 years to complete the upgrading from the Terai to just north of Ilam; (ii) higher than expected construction costs, partly due to the delays; (iii) reduced length of road upgraded because of the increased costs and fixed upper budget limit for the projects, and resultant reduced benefits which are distance-based; (iv) reduced benefits for the road north of Ilam because it does not end at a settlement;²⁷ (v) use of lower and more pragmatic assumptions for the "without-project" cost of road maintenance in the IES reevaluation; and (vi) noninclusion of agricultural benefits since these could not be quantified. The assumption about road maintenance cost savings is justified because while gravel roads are not adequately maintained but deteriorate and make travel during the wet season impossible for light vehicles, trucks and buses still traverse the roads, albeit with difficulty. The traffic forecasts made at the time of appraisal are slightly lower than

²⁵ The effect on prices can be illustrated by a comparison of prices in areas directly served by road and those away from the road—prices increase with distance away from the road. For example, in Dadeldhura, away from the road, the price of basic staples (rice, salt, cooking oil) are in general 10 percent higher than in the main road-served markets, with kerosene up to 25 percent more expensive. In the remote areas of Doti, prices are generally 15-20 percent higher, with kerosene and cooking oil up to 40 percent more expensive. Similar increases were reported along the Sanfebagar Road and in Achham, compared with the main markets in Dipayal. Without the roads, prices everywhere would have been higher and some items would not have been available.

²⁶ At appraisal, no road user cost benefits were included for the Silgadhi-Sanfebagar road component under the Seti Zone Rural Development Project. The subsequent PCR (December 1997) determined that effectively there were no agricultural benefits in the hill areas but that transport benefits should have been included. The postevaluation report for the Road Improvement Project also concluded that the expected increases in agricultural output for the Doti road did not materialize.

²⁷ More traffic would be expected if the road had ended at a settlement. As it is now, traffic to settlements north of Ilam must be capable of travel on earthen roads.

actual levels, although the appraisal estimates assumed a faster rate of growth in the years immediately following completion of the projects. It must be noted that the reevaluation analysis underestimates the EIRR for the roads in the eastern hills by the amount of any increase in agriculture that could be realistically attributed to the road works.

38. The road sections from Charali to Ilam, which were mainly completed under the Feeder Roads Project with a contribution from the Third Road Improvement Project in the Mai Khola to Ilam section, yield an EIRR of 5 percent. The sections from Maikhola through Ilam to Phidim yield an EIRR of -1 percent. The difference in results is due to substantially higher costs per kilometer of upgrading under the Third Road Improvement Project relative to the Feeder Roads Project, and the lower traffic volumes on the more northerly sections of road around Ilam and Phidim.

39. The package of roads in Far Western Region, which included 187 km of upgrading and 67 km of new gravel construction, has a reevaluated EIRR of 5 percent. Most of the benefits in the Far Western Region are attributable to the Silgadhi-Sanfepagar road, which, if considered alone, produces an EIRR of 16 percent. The remainder of the package, without the Sanfepagar Road, yields an EIRR of -1 percent and the Dadeldhura-Silgadhi road (Doti road) alone has an EIRR of -4 percent. The good results for the Silgadhi-Sanfepagar road are because it is a new road that replaced nonmotorized transport with motorized transport. Overall, the results for the upgrading components are clearly disappointing and are substantially lower than the estimates of 12-15 percent made at appraisal. The causes of the poor results are the same as those for the roads in the east, except that Far Western Region does not have any nonquantified agricultural benefits. Traffic forecasts were similar to actual levels, except for the Third Road Improvement Project, which appears to have used abnormally high base traffic levels in the northern sections. The effect of the delays and higher costs can be seen from the fact that the first project, the Feeder Roads Project, expected 160 km of road to be upgraded over two years, 1987-1988. All the project funds for the component were used to complete only 41 km, which took until 1994. A further 81 km were subsequently completed by 2000 at a significant additional cost under the Third Road Improvement Project. Thus, after 14 years, more funds have been expended than originally expected and the full length of road has not been completed.

40. It is evident from the reevaluation analyses that conventional transport benefits, i.e., reductions in road user costs, and savings in road maintenance costs, are insufficient to justify the expenditures in upgrading the roads from earth or gravel to all-weather two-lane bitumen standards. The economic returns from upgrading are better in the east—due primarily to the higher traffic volumes, but overall traffic volumes are insufficient to generate large transport benefits. Several of the appraisal analyses included significant benefits from road maintenance cost savings. However, such large savings do not occur as actual maintenance expenditure on earth and gravel roads has historically been low. Unsealed roads are left to deteriorate, and while causing difficulty in the wet season, most vehicles in the area, namely trucks and buses, still manage to operate. An important consequence is that either development costs must be reduced, or other benefits, such as increased agricultural or other economic output and social and political improvements, must underlie the justification for the upgrading and sealing of hill roads.

B. Hill Agriculture Development Project Roads

41. ADB financed the improvement of two rural roads in the Central Region of Nepal between 1987 and 1993 under the Hill Agriculture Development Project, namely (i) Panchkhal-Melamchi, a 12 km extension at all-weather gravel standards of an existing 11 km gravel rural road serving an agricultural area and substantial further upland areas to the north of the Arniko Highway, approximately 40 km east of Kathmandu; and (ii) Chaugadha-Thingaun, the upgrading over 33 km of an existing earth track to truckable standards east of Hetauda. Of the total length of the Chaugadha-Thingaun road, 13 km was upgraded to gravel, and 20 km was earth standard. Shortly after Chaugadha, the road climbs then follows a ridge along an alignment originally proposed as a direct link to Kathmandu and does not directly pass through any substantial agricultural area.

42. Traffic levels of around 70-80 vpd are observed on the Melamchi road, with 20 buses per day to Kathmandu. Fresh milk production has developed in the area with the establishment of two chilling centers and up to 18,000 liters of milk (three tankers) are shipped to Kathmandu daily. The road provides access into the Helambu area to the north, with Melamchi as the main roadhead. Helambu is an important trekking area with trails leading into the Langtang tourism area. At the time of the study, the road was being extended to the north to provide access to the main intake being constructed under the Melamchi Water Supply Project to supply domestic water for Kathmandu.

43. The Chaugadha-Thingaun road carries few vehicles—only two buses per day operate on a regular basis during the dry months and in the wet season only one bus operates as far as Jitpur where the road changes from gravel to earth. One or two mini-trucks also operate along the road, according to demand, in the dry season. Most goods, apart from construction materials, are carried by bus.

44. It is evident that the Melamchi road serves as an access spine into a sizable agricultural area, with milk and other products being brought to collection centers along the road from distances of up to four hours in the case of milk. The road also serves an extended catchment beyond the current roadhead at Melamchi. Although the study survey data were not sufficient to quantify any direct link between agricultural output and the road, ADB's 1997 postevaluation²⁸ of the Hill Agriculture Development Project determined that the Project in total generated a significant increase in aggregate agricultural output. In view of the traffic volumes, the pattern of goods movement, and the large areas of agriculture in the influence area, it is likely that the road played its part in overall development. The importance of the road is reflected in it being maintained to a reasonable standard.

45. In comparison, the Thingaun road, which was supposed to facilitate the movement of goods to markets in Hetauda, serves a relatively sparse population with little agricultural area. The main crop production areas are in the valley bottoms to either side of the road, which have their own independent access. There is no catchment beyond the road-end in the north as that area can also be reached by local roads from the Kathmandu Valley, which is a more attractive market destination than Hetauda in the south. Traffic levels are very low, there is no evidence of any impact on agriculture or other productive activities, and the road is not well maintained, as might be expected for a road of such low importance. Although this road was also included in the postevaluation estimates made for the Hill Agricultural Development Project, it must be noted that only one out of 52 irrigation development sites are within the catchment area of the

²⁸ Project Performance Audit Report on Loan 721-NEP(SF): *Hill Agriculture Development Project*, report PE-486, August 1997. The postevaluation did not separately assess the roads.

Thingaun road, and little of the increase in agriculture determined by the postevaluation can be attributed to this road.

III. EAST-WEST HIGHWAY UPGRADING

A. ADB Involvement and Current Status

46. ADB has been involved in the upgrading and maintenance of substantial sections of the EWH in the Central and Eastern regions through three projects. These three projects have effectively reconstructed and restored to a maintainable condition all of the EWH from Narayangarh, which lies southwest of Kathmandu, to a point 78 km from the eastern border with India.²⁹ The projects and works are (i) Hetauda-Narayangarh Road Project, the upgrading of 78 km from gravel to two-lane bitumen standards, including the construction of four major bridges. The works, which comprised ADB's first road project in Nepal, were completed between 1978 and 1983; (ii) Road Improvement Project, reconstruction and widening from 3.8 meter (m) to 5.5 m of 134 km from Belbari (km 78) to Chuharwa (km 218)³⁰ in the Eastern Region, completed in 1994; and (iii) Second Road Improvement Project, reconstruction of the EWH from km 218 to km 267 and Hetauda-Birganj (56 km),³¹ plus periodic maintenance of EWH (km 267-366).³² The works were completed in 1997.

47. All the works were completed to a generally adequate standard, although significant delays were experienced during implementation. These delays resulted from problems with one of the contractors on the Hetauda-Narayangarh section and more general difficulties associated with disagreements between Nepal and India over the Trade and Transit Treaty which impeded the performance of contractors on the remaining sections.³³ The Hetauda-Narayangarh section was subsequently resealed under the Road Improvement Project in 1991 and again under the World Bank-funded Road Maintenance and Rehabilitation Project in 1998. The resealing was part of the normal periodic maintenance program and does not reflect upon the quality of the original works. The section between km 78 and km 218 is showing normal signs of wear and was due for periodic maintenance in 2000.³⁴ On the Hetauda-Birganj section, parts of the northbound lane of the road south of Hetauda have failed. Research will be required to determine the cause.

48. In general, the overall condition of the EWH is excellent and appropriate for the volumes of traffic experienced. The road is well aligned and constructed to two-lane sealed standards

²⁹ The section east of km 78 (Kakarbitta-Belbari) was reconstructed in the mid-1990s with aid from DFID (United Kingdom).

³⁰ Kilometers quoted from zero at Kakarbitta, the eastern border with India. Upgrading excluded 6 km across the Koshi Barrage.

³¹ The northern portion (Hetauda-Pathlaiya, 29 km) forms part of the EWH. The remainder links to the Indian border near Birganj.

³² This section was originally built under Russian aid, had a stronger sub-base and did not require reconstruction.

³³ This caused difficulty as the poor condition of roads in Nepal at the time meant that access from India was required to facilitate the construction works.

³⁴ This was planned as part of the Fourth Road Improvement Project proposed for ADB funding. If approved, this Project will be delayed and the Government should undertake the work earlier under alternative funding arrangements to avoid further road deterioration.

throughout, permitting the uninterrupted movement of traffic at reasonable speeds. The nature of the terrain allows a generally straight alignment and gradients are an issue in only a few areas where the highway crosses the foothills of the Chure Range, as in the section south of Hetauda. The major obstructions to the free flow of traffic are the few major towns and numerous villages located along the road, plus the substantial amounts of local and agricultural activity that take place on and adjacent to the road—animals, slow-moving vehicles, pedestrians, and cycles all compete for space with high speed trucks and buses.

B. Development Context

49. The EWH, totaling 1,024 km in length, is a fundamental component of the road network in Nepal, forming the backbone of the strategic network linking the eastern, central, and western parts of the country and Kathmandu. In addition to being part of the EWH, the Narayangarh-Hetauda-Birganj section also forms part of the main route between Kathmandu and the major Indian border crossing at Birganj/Rexaul, and from there to the port of Calcutta from where most of Nepal's non-Indian imports are landed. The commercial importance of the EWH, and of the link between Kathmandu and Birganj to the overall economy and operation of the country, cannot be overemphasized. At present, there are no practical alternatives to the use of these roads other than to use the road network in India, which was done before the EWH was constructed. The use of the Indian network is time consuming and renders travel subject to possible border closure.

C. Transport and Traffic

50. Current traffic levels on the EWH range from around 1,000 vpd in the eastern and western sections to 2,000 vpd on the Hetauda-Birganj stretch, and 2,500 vpd between Hetauda and Narayangarh.³⁵ Trucks constitute about half the total traffic on the central sections around Hetauda and buses a further 30 percent. In the eastern sections, the proportion of trucks is slightly lower and buses higher. Light vehicles, such as cars and utility vehicles, generally make up less than 20 percent of traffic. Motorcycles, cycles, three-wheelers, and animal-drawn vehicles are not included in any of these counts. They are common on the roads, but are typically used only for short distance trips close to settlements.

Table 1: Typical Traffic on the Central and Eastern Sections of the EWH

³⁵ In the eastern portions, traffic levels reach 1,500 vpd east of the Koshi Barrage as a result of local traffic movements.

Section	Length (km)	1986 AADT	2000 AADT			Annual Growth (%)	
			Total	Light	Bus		Truck
			% of Total				
Hetauda-Narayangarh	78	600	2,500	19	30	51	10.7
Hetauda-Pathlaiya	26	750	2,060	14	30	56	7.5
Pathlaiya-Birganj	33	800	2,070	14	15	71	7.0
Pathlaiya-Dhalkebar	99	350	1,080	18	35	46	8.4
Dhalkebar-Chuharwa	49	300	970	23	36	41	8.7
Chuharwa-Koshi Barrage	85	350	1,000	20	37	43	7.8
Koshi Barrage-Belbari	55	600	1,440	18	38	44	6.5

AAADT = average annual daily traffic, EWH = East-West Highway, km = kilometer, TA = technical assistance.
Source: TA consultants' reports and Department of Roads counts.

51. Traffic growth over the past 15 years has averaged around 8 percent per annum, representing an approximate tripling of traffic volumes over this period. Current traffic volumes are higher than those forecast in the studies on which the various road improvements were designed and justified. The highest rates of growth are on the Hetauda-Narayangarh section where traffic has grown at over 10 percent per annum since the initial upgrading in the late 1970s.³⁶

52. The general relationships between road condition and both bus fares and freight charges found for the hill areas also apply for the EWH (paras. 32-35). These relationships indicate that improvements in road conditions lead to lower bus fares and freight rates.

D. Reestimated Economic Internal Rates of Return

53. An economic reevaluation was undertaken on the improvements to the EWH and the link to Birganj which were funded by ADB (Appendix 8). The combined EIRR of these improvements has been recalculated as 17 percent, with all the improved sections individually returning rates above 15 percent. The main benefits were road user savings in VOCs and time savings, which resulted from the improved road surface and higher vehicle operating speeds. The benefits also included maintenance savings. The results are similar to those expected at appraisal (Table 2). The similarity in results is despite a greater actual increase in traffic than forecast at appraisal, which can be explained by differences in maintenance and VOC assumptions between the two sets of analyses.

Table 2: Economic Evaluations for the East-West Highway

Road Section	Appraisal	PCR	PPAR	IES
Hetauda-Narayangarh	14.4-15.0 ^a	6.9-14 ^b	10.6	15
Belbari-Chuharwa: km 78-218	15.0	25.7	31.8	21
Chuharwa-Pathlaiya: km 218-366	26.8	22.1		21

³⁶ This growth includes traffic to Kathmandu diverted from the Rajpath, following completion of the Narayangarh-Mugling road.

Hetauda-Birganj	30.4	20.1	28
-----------------	------	------	----

IES = impact evaluation study, km = kilometer, PCR = project completion report, PPAR = project performance audit report.

^a The figures refer to the initial and supplementary loans, respectively.

^b The higher figure includes diverted traffic from the Rajpath, the original access road to Kathmandu from the south: the lower figure is comparable with the appraisal estimate. The difference in results can be attributed to the delays and cost overruns.

54. The Hetauda-Narayangarh section produced the lowest return on reevaluation (15 percent). This is contrary to expectations because of the strong traffic growth over this section of road. In part, it may be because of the length of time since the improvement was implemented and the effect of inflating the construction costs over a period of up to 25 years to constant 2000 prices for the analysis. Excluding Hetauda-Narayangarh, the improvements to the remainder of the EWH produce an EIRR of 23 percent, confirming the substantial benefits achievable through the timely improvement and maintenance of this heavily used road.

E. Assessment

55. It is evident that the upgrading and rehabilitation of the EWH has created considerable traffic-related benefits in terms of avoided increases in VOCs because of the high traffic volumes and strong traffic growth rates. This is confirmed by the favorable economic analyses. Driving conditions have improved and vehicle speeds have increased, leading to reduced and more predictable journey times. The transport industry is partly controlled by transport operator groups, but freight rates and bus fares reflect road conditions to the extent that charges for transport on better roads are lower than on deteriorated or rough roads. Consequently, it is likely that maintaining roads in good condition will result in a real avoidance of increases in transport charges, and project benefits will be passed on to the public. Failure to undertake the projects would have seriously impacted on the overall economy due to the effect of increased transport costs on key sections of the strategic network.

IV. PERIODIC MAINTENANCE

A. ADB-Supported Projects

56. ADB's road projects funded slices of DOR's periodic maintenance program. DOR had identified the works as a priority. Similar time-slices of the periodic maintenance program have been funded by the World Bank and bilateral agencies. ADB's involvement comprised the following: (i) Road Improvement Project, 242 km of the periodic resealing program for the strategic network and other key transport links,³⁷ cofinanced by the Organization of Petroleum Exporting Countries; (ii) Second Road Improvement Project, 263 km of periodic maintenance on

³⁷ Including Dhangadhi-Godawari, Butwal-Pokhara, Nepalganj-Kohalpur, Bhaktapur-Nagarkot, Hetauda-Narayangarh, and Narayangarh-Mugling.

the strategic network and Kathmandu Valley roads, including 100 km of the EWH in the west,³⁸ 108 km of roads in Kathmandu Valley, and 55 km of other strategic roads; and (iii) Third Road Improvement Project, upgrading to bitumen standard of 62 km and periodic resealing or rehabilitation of 63 km of feeder roads in the Terai and Kathmandu Valley.

B. Evaluation

57. All works were identified by DOR and the feasibility of the individual works was evaluated during the project preparatory phase of each project. ADB's PCRs and project performance audit reports (PPARs) provide ex post reassessments of the works. All project components for periodic maintenance show good economic returns both ex ante and ex post (Table 3). Primarily, the good returns are due to high traffic volumes and low costs per unit length of road works. It is also noteworthy that many main roads, particularly those in the Terai, serve significant local traffic movements, including nonmotorized traffic which use road shoulders, and these road users also receive benefits (due to the improved road surface and shoulders) which are not captured in the formal benefit calculations.

Table 3: Economic Returns for Periodic Maintenance

Project	Length (km)	Economic Internal Rate of Return (%)		
		Appraisal	PCR	PPAR
First Road Improvement Project	242	19.1		48.4 ^a
Second Road Improvement Project:	263			
Kathmandu Valley Roads		32.3	36.0	
Other Strategic Roads		19.5	16.1	
Third Road Improvement Project	125	14.6 ^b		

km = kilometer, PCR = project completion report, PPAR = project performance audit report.

^a Based on Kohalpur-Nepalganj and Bhaktapur-Nagarkot only.

^b For Lamahi-Tulsipur (47 km) only; other sections not identified.

58. The World Bank found similar results for its Road Maintenance and Rehabilitation Project, which completed 504 km of similar periodic maintenance works. In its implementation completion report, the World Bank reported the EIRR at project completion in 1999 to be 27.6 percent, almost identical to the appraisal estimate of 27.3 percent. The World Bank's report concluded that returns to periodic maintenance expenditure of over 20 percent were obtained where traffic levels exceeded 300 vpd, but with lower traffic volumes, even where the initial roughness was high, the returns were marginal. Moreover, with higher traffic volumes, periodic maintenance was generally justified even when the initial roughness was relatively low.

59. The road sections included under the ADB Road Improvement Project were important parts of the strategic network, including the Hetauda-Narayangarh-Mugling road, and other key transport links. Traffic volumes in the early 1990s, when the works were undertaken, were

³⁸ An additional 99 km of EWH was resealed in the east (km 267-366) under the rehabilitation contract for km 218-267. It has been evaluated together with the other EWH improvements in the Central and Eastern regions.

generally around 300-800 vpd and all the roads were in a very rough, deteriorated condition. Based on the World Bank's findings, it is not surprising that the periodic maintenance component of the Road Improvement Project generated high returns. The roads receiving periodic maintenance under the Second Road Improvement Project included sections of the Kathmandu ring road and radial routes in Kathmandu. These roads also had traffic volumes in excess of 500 vpd at the time of project initiation and showed high rates of return.

60. The recently completed, but not yet evaluated periodic maintenance components under the Third Road Improvement Project should also produce acceptable results since the construction costs are comparable with other evaluated projects and traffic volumes were above 300 vpd.³⁹ Traffic volumes on the Terai roads under this Project were generally in the range of 300-600 vpd (excluding motorcycles and nonmotorized vehicles) and were higher in Kathmandu Valley. One section, improved under the Third Road Improvement Project, is showing signs of premature wear due to the overlay thickness being reduced in response to increased project costs. It is likely that resealing for a second time will cost more than if the initially designed thickness had been applied.

C. Assessment

61. ADB's support for periodic maintenance has produced satisfactory results, based on the sustainability of the works and estimated economic returns of other studies. Most of the roads selected for periodic maintenance had relatively high traffic volumes, which appears to be a key factor underlying the viability of this type of expenditure. In the few cases with traffic levels below 300 vpd, the scale of expenditure was correspondingly lower and a positive result still occurred. Analyses of bus fares and freight rates indicate that VOC reductions from road surface improvements are passed on to passengers and freight owners in the form of lower charges (Appendix 7).

62. While most of the roads were important transport links, it must be recognized that they were identified by DOR, which does not yet have a comprehensive and objective system for planning pavement management for its roads. It was not possible to establish whether the priority implied by the roads' inclusion for foreign funding matched the real needs of the country.

V. INSTITUTIONAL, POLICY, AND OTHER ASPECTS

A. Institutional Support

63. ADB has provided institutional strengthening directly to the road sector through three AOTAs, namely:

³⁹ The upgrading of Lamahi-Tulsipur (47 km) and the rehabilitation of two radial roads in Kathmandu Valley were completed for around NRs7 million per km, and the periodic maintenance of four Terai roads was undertaken for between NRs2-4 million per km.

- (i) Transport Sector Profile Project (TA 764-NEP). The TA provided for an overall study of the transport sector in Nepal and was completed in 1988. The objective of the study was to set the framework for investment and development of the transport sector. The only previous study of this type had been an International Bank for Reconstruction and Development-assisted transport study conducted in 1965. The study included a Transport Investment and Maintenance Strategy Study, a Road Maintenance Study, a Domestic Airports Study, and an Environmental Study.
- (ii) Institutional Strengthening of the Department of Roads (TA 824-NEP). This TA, implemented in 1988/89, provided inputs from a road maintenance engineer and a traffic engineer, with the objective of establishing an effective road maintenance management system to implement the recommendations of the Transport Sector Profile Study, and to initiate a regular traffic count program.
- (iii) Road and Road Transport Institutional Development (TA 1216-NEP). The TA, undertaken in 1991, aimed to assist (a) the Ministry of Works and Transport and DOR in establishing improved administrative and accounting procedures, and (b) the Department of Transport Management⁴⁰ to implement revised vehicle and driver licensing arrangements.

64. The first AOTA provided a basis for subsequent development of the institutional framework, part of which was attempted under the other two AOTAs. The outcome of the TA for institutional strengthening of DOR was less than expected. DOR has a regular traffic counting capability, but this has taken several independent initiatives funded from various sources and the system and equipment established under the ADB TA operated for only a short time. The road maintenance improvements, such as the planning and monitoring cell within the Chief Engineers' Office of DOR, which was set up under TA 824-NEP, led to (and have been subsumed within) the much larger World Bank, Overseas Development Administration, and Department for International Development (United Kingdom) efforts toward improving road maintenance by DOR in Nepal. Nevertheless, it cannot be said that Nepal has an effective road maintenance management system and further improvement in this area is warranted. Several of the recommendations of TA 1216-NEP were implemented, such as the establishment of the office of chief technical examiner within the Ministry of Works and Transport, the general reorganization of the Department of Transport Management, and amendments in the Financial Administration Regulations.

65. In general, ADB's assistance has been relatively small. However, this is because of limited absorptive capacity of DOR, the main road institution, in the early years and, in more recent years, the availability of major assistance from other agencies, notably the World Bank and DFID (United Kingdom). The first of the three AOTAs correctly identified real needs for institutional strengthening, but underestimated the efforts required, particularly in relation to the road maintenance and traffic counting aims of TA 824-NEP. Partly, this was due to the small size and limited absorptive capacity of the institutions at the time. TA 824-NEP succeeded, however, in raising awareness of needs and created initial capabilities that were built upon under assistance from other sources. TA 1216-NEP was useful.

⁴⁰ Formerly the Department of Transport.

B. Road Maintenance

66. While most of the ADB-supported roads do not suffer from weak maintenance, due to a combination of low traffic volumes for some roads, and the recent completion of some works, road maintenance requires improvement in planning and financing. Nepal is in the process of introducing fundamental reforms in both these areas. Central to this endeavor will be the formation of a Roads Board and a Road Fund. The proposed Roads Board will be responsible for the planning and administration of road maintenance. The Road Fund, to be financed from road user charges, will be independent of the vagaries of the annual budget process. The Road Fund is expected to be established with an initial budget of NRs1 billion. Expenditure from the Road Fund will be divided between the strategic network (55 percent), district and village roads (25 percent), and urban roads (20 percent), with a small amount of revenue retained for administration.

67. With the establishment of the Roads Board and Road Fund, it is expected that the requirement for continuing external assistance to fund road maintenance will decline. However, despite considerable political support, the parliamentary acts legislating the formation of the Roads Board and Road Fund have yet to be passed and the implementation of the proposals may be significantly delayed, requiring continuing support until the Road Fund is operational. The World Bank is assisting with the establishment of the Roads Board and is providing TA for the planning and management of the maintenance program.

C. Road Safety

68. Traffic accident data are not yet collected comprehensively or systematically in Nepal. A Traffic Engineering and Safety Unit was established in DOR with aid from DFID, but has collected traffic accident data and conducted safety audits for a very limited number of roads.⁴¹ Individual police stations have some data for their areas of responsibility, but the information varies in detail and typically covers only recent years.

69. Because of inadequate information, changes in road safety on the ADB-supported roads cannot be properly assessed. Nevertheless, the ADB-supported projects provided suitable road signs and road markings and aimed to improve lines of sight on roads, all of which would contribute to improved road safety. Improvements to the road alignment, surface, and riding quality would also have improved road safety, although such gains can be lost (and more than offset) through the effects of higher speeds and traffic volumes. Comments made by road users and police officers during the study suggest that traffic accidents on the ADB-supported roads have increased as a result of both increased traffic volumes and higher traffic speeds. Most of these people noted that increases in accidents occurred where upgraded roads passed through existing settlements, or where new settlements developed along the newly upgraded road. Pedestrians and slow-moving bicycles and other nonmotorized traffic use the roads along with high-speed vehicles. There were no indications that accident rates on the ADB-supported roads were any different from those on nonproject roads of similar standard and quality, however.

70. Road safety is only slowly being accorded importance; the establishment of the Traffic Engineering and Safety Unit is a step in the right direction. More systematic and comprehensive

⁴¹ Namely roads forming the Kathmandu ring road and the Naubise-Mugling road.

data collection is required, leading to safety audits and the identification of problem areas. Road designs could be further improved by (i) improved delineation and edge marking on hill roads, including use of reflecting marker posts; (ii) installation of deviation (chevron) boards in critical locations; (iii) widening of the pavement on sections of main road with high volumes of pedestrians, cycles, and animal-drawn vehicles; (iv) provision of off-road facilities for pedestrians through settlements, including facilities for buses and bus passengers; and (v) provision of adequate warning signs and imposition of realistic speed limits through settlements.

D. Environmental Impact

71. Most of ADB's project assistance has involved either the upgrading of existing earth tracks or the rehabilitation and/or resealing of existing bitumen roads. With few exceptions, existing road alignments have been used. The major exception is the Silgadhi-Sanfegagar road, which was a new road on a new alignment. There have been no involuntary resettlements, and damage to the natural environment from construction-related earthwork has been minor.⁴²

72. In the hill areas, improvements to roadside and crossroad drainage included as part of the road works has had a positive effect on managing stormwater flow and the stabilization of slopes disturbed by the initial construction. Some sections on the hill roads are unstable and prone to slides, and off-road works in general have assisted with the control of these areas. The Third Road Improvement Project included extensive off-road bioengineering works aimed at revegetating and stabilizing slopes disturbed by construction.

73. The hill areas are relatively unstable and, despite careful design and construction, landslides are common during the wet season. In view of this, a Geo-Engineering Unit has been established at DOR under the World Bank-assisted Road Maintenance and Rehabilitation Project. This Unit has developed a series of techniques appropriate to Nepal.

74. Instances of increased deforestation were not reported as a result of the road upgrading and new road construction in the hills. Most logging had occurred earlier. The Department of Forestry views the improved hill roads as beneficial by facilitating increased supervision and surveillance in the area. Substantial areas of the hill districts in both the east and Far Western Region remain under forest cover and the extent of forest cover is reported to be increasing through community forest initiatives.

75. The improvements to the EWH and the periodic maintenance components have had no discernible negative environmental impact. Localized reduction in dust levels in inhabited areas resulting from the upgrading of previously unsealed gravel roads is viewed as a positive impact.

E. Project Planning and Preparation

76. ADB has financed five PPTAs to prepare the last four of the five road projects and the not yet approved Fourth Road Improvement Project. Each PPTA prepared feasibility studies for the proposed project components and, in most cases, conducted an initial screening of selected road options. Some PPTAs also prepared prefeasibility studies for additional roads not included under the Project and examined some alternative routes based on existing tracks. The Feeder Roads TA investigated networks of hill roads in nonroad-served areas of both the East and Midwestern regions, conducted detailed studies of the Road Transport Industry, and prepared initial proposals for the establishment of a National Traffic Database.

⁴² Allegations of environmentally damaging construction methods, as well as labor arrangements that contravene ADB's social and environmental guidelines on a road section north of Dadeldhura in Far Western Region under the Third Road Improvement Project, have been made. These were under investigation at the time of this study.

77. All the PPTAs appear comprehensive, and with the exception of the last PPTA, each was successful in leading to an approved loan and project. The quality of the PPTA documents was not reviewed, but the absence of major revisions in the projects suggests that the majority of the PPTAs were adequate. Exceptions are an overoptimistic time frame for hill road construction under the Feeder Roads Project, which required construction in 2 years whereas 4-5 years would have been more appropriate; and weak economic analysis in general which tended to use optimistic assumptions regarding agricultural responses and road maintenance savings leading to higher than warranted benefits from road upgrading.

78. Some of the PPTAs and loan projects included components concerned with road sector planning and the study of other roads. These include a study of the road transport industry, a materials study, and a transport database review as part of the TA for the second Feeder Roads (TA 549-NEP); the detailed design of the Sagarmatha and Rapti roads under the Second Road Improvement Project; and consultancy services for the screening of rehabilitation projects under the Third Road Improvement Project. All of these activities succeeded in achieving their specific aims.

79. Despite the review of options under various PPTAs, ADB's TAs have been related to the study of specific preselected road sections and have not contributed very much toward overall road network planning. Other foreign funding agencies have supported broader planning, but such planning lacks comprehensiveness and is not well integrated with planning in other sectors, particularly that for agricultural development. This has, for example, allowed the selection of roads for development based on an inappropriate area focus, such as under the Seti Zone Rural Development Project. If a broader national plan had been available in all areas, it is probable that (i) the access road to Sanfebagar in the Seti Zone would have come from the Midwestern Region rather than as an extension of the Doti road in Far Western Region, and (ii) the wasted investment in the Chaugada-Thingaun road may have been avoided.

80. The detailed designs for the Sagarmatha road were prepared using a sophisticated computer-aided design program. This proved to be unsuited to the conditions, and particularly the terrain, in Nepal. Hill road design practice in Nepal has evolved considerably over the past 10 years and the approach adopted today is for staged construction with an initial fair-weather earth track which may subsequently be upgraded in response to increasing traffic demands. The need and suitability of computer design packages must be questioned.⁴³

F. Road Contractors and Consultants

81. Both international and local contractors have been used in the ADB-funded projects. Overall, local road construction contractors have performed better than international contractors, which has led to greater use of local contractors and efforts to build local capabilities in later projects. The two international contractors under ADB's first road project, the Hetauda-Narayangarh Road Project and the single international contractor under the last project, the Third Road Improvement Project, performed satisfactorily. The performance of the international contractors under the other three road projects was not satisfactory, however, as they took longer than expected to complete the works. The international contract for the Feeder Roads Project was cancelled prematurely. Not all the delays were due to poor international contractor

⁴³ The alignments of the roads in the Sagarmatha have not been adopted by the Army which is constructing an alternative route to connect this area to the EWH.

performance, however, as the Nepal-India dispute over the Trade and Transit Treaty caused disruptions in two projects.

82. Following cancellation of the international contract for the Feeder Roads Project, the project scope was reduced and the works were re-let under small packages to local contractors, who generally completed the works satisfactorily despite some pavement failure (over a length of 15 km) on the Godawari-Sahajpur section in Far Western Region. The Second Road Improvement Project included 16 small local competitive bidding (LCB) contracts for the periodic resealing of roads outside Kathmandu, all of which were completed on schedule, while the international contracts under this Project required extensions. Contracts under the Third Road Improvement Project were, with the exception of the upgrading of the Lamahi-Tulsipur road, let as LCBs which were implemented satisfactorily. The road component of the Seti Zone Rural Development Project was built using labor-intensive methods under LCB. The first batch of four contracts was slow in being awarded, but once the contracts were awarded, the local contractors performed well and on schedule, despite the difficulties associated with the remote location. Following the success of these initial contracts, the overall period of the loan was extended and the road extended through to Sanfebagar under a further seven contracts to local contractors.

83. The greater focus on use of local contractors and the packaging of contracts into forms suitable for this in the later ADB-funded projects contributed to the availability of work to support growth of the local contracting industry, and parallels similar increasing use of domestic contractors by other foreign funding agencies in the road sector. Under the Third Road Improvement Project, ADB supported local contractors with advance funding for the importation of construction equipment. However, ADB has not taken any other specific steps to develop the local contracting industry. The good performance of the completed works suggests that the local contractors are capable of handling most of the types of road works and that special training and support programs may only be needed in special circumstances. One skill or capacity that is likely to be restricted within the local contracting industry is that of laying asphalt concrete. The quantity of such work in Nepal is relatively small and cannot support the purchase of paving machines by contractors and limits the number and location of asphalt plants. As a consequence, international contractor support may remain needed in this area. The most serious concern from the local contractor's perspective is the continuity of work to support investment in plant, equipment, staff, and training. In recent years, work under all funding sources does not appear well distributed over time but has been "lumpy" and has not contributed to sound development of local contractor capabilities.

84. The involvement of local consultants in the design and supervision of the maintenance and rehabilitation works was generally satisfactory. International consultants may still be required to supervise overall packages of projects and to provide specific technical advice and/or training activities; however, from a technical perspective, local consultants appear adequately capable for many tasks. It also may be desirable to use international consultants for nontechnical reasons, such as to ensure that undue pressures are not placed upon domestic consultants by either government or political sources.

VI. CONCLUSIONS

A. Overall Assessment

85. ADB's involvement in the road sector has been significant, addressing a large proportion of the road upgrading and periodic maintenance needs of the highly important EWH as well as two access routes into the hills. In addition, a number of agricultural access roads were improved. About one quarter of the road development expenditure in Nepal since the 1980s has been financed under ADB projects. Overall, ADB's road assistance has been rated as successful.⁴⁴ The hill road project components and TA are rated less than successful, but the EWH upgrading and periodic maintenance components are highly successful.

86. The overall assessment has been made using the same criteria as used for rating individual projects, namely, the relevance of the assistance to national goals and ADB development objectives, the efficacy of the assistance in meeting the expected purpose and goals of the various components, the efficiency by which the purpose and goals were attained, the sustainability of the achievements, and the extent of other unintended impacts, both good and bad.⁴⁵ The assessments do not apply to individual projects, but rather to the groups of component types, namely, hill roads, EWH upgrading, periodic maintenance, and TA. The assessments under each criterion are outlined below and summarized in Table 4.

1. Relevance

87. The relevance to both the national goals and ADB objectives of all components was, at least, good, giving an overall rating of relevant. Almost all components dealt with the all-important strategic network, and aimed to improve national integration and improve transport efficiency by reducing transport costs and improving transport reliability. By so doing, the various hill road components aimed to stimulate agricultural production, which is very relevant given the importance of agriculture to the majority of Nepal's people, although the design of the projects was not always adequate to achieve this objective. The hill road components in Far Western Region are in one of Nepal's least developed areas.

2. Efficacy

88. The efficacy of the various project components and TA was mixed, particularly in terms of the achievement of direct economic benefits, but overall was satisfactory (i.e., efficacious). The EWH upgrading and periodic maintenance components, which were limited in their purpose and main goal to improving transport efficiency and enhancing national integration, were highly efficacious. The growth in long distance bus traffic and the ability to move within the country without having to rely upon the Indian road network are key indicators of the achievement of national integration, while the lower freight rates and bus fares on improved roads compared with unimproved roads point to gains in transport efficiency. The hill road project components were less efficacious. These components contributed to improved national integration and transport efficiency, but the road upgrading in Far Western Region hills and one of the two Hill Agriculture Development Project roads did not achieve their expected agricultural impacts. Low

⁴⁴ The categories from lowest are unsuccessful, less than successful, successful, and highly successful.

⁴⁵ Refer to *Guidelines for the Preparation of Project Performance Audit Reports*, ADB, September 2000.

EIRRs for the hill roads indicate underachievement in other benefits. The TA efforts did not have an appreciable impact on improving DOR capabilities.

3. Efficiency

89. The efficiency of the ADB assistance was mixed and is rated less efficient, overall. Implementation delays in the Hetauda-Narayangarh and Feeder Roads projects, high road upgrading costs leading to reduced scope in the Third Road Improvement Project, and the low EIRRs for the hill roads in general contributed to the lowering of the efficiency rating. The hill roads account for about half of ADB's road investment, measured in constant 2000 Nepalese rupees.

4. Sustainability

90. The sustainability of what was created under loan assistance is likely. Several sections of upgraded road have deteriorated prematurely, and the gravel road from Silgadhi to Sanfebagar has not been adequately maintained. Nevertheless, access is still possible in all cases, and the length of road performing to expectations is large relative to the length not performing adequately.

5. Institutional Development and Other Impacts

91. Few negative impacts are associated with the road assistance, though an accurate assessment of road safety could not be made. Environmental problems such as deforestation and the silting of streams have not been major, as the vast majority of the works were done on existing road alignments. On the positive side, the roads have facilitated forest rangers in their work. Local contractors have done the majority of the road works and the projects have contributed to the growth of local industry. The social impact of the hill roads has been significant, such as the easing of caste and gender biases. The hill roads have also facilitated movement of migrant workers, important to poor families in Far Western Region. Agricultural development in the eastern hills has increased employment and incomes for the poorer groups and women. However, with all project components taken together, these impacts are rated little.

Table 4: Summary Details of Overall Rating

Criterion	Hill Roads	EWH Upgrading	Periodic Maintenance	Technical Assistance	Overall
Relevance	Relevant	Highly Relevant	Highly Relevant	Relevant	Relevant
Efficacy	Less Efficacious	Highly Efficacious	Highly Efficacious	Less Efficacious	Efficacious
Efficiency	Less Efficient	Efficient	Highly Efficient	Less Efficient	Less Efficient

Sustainability	Likely	Likely	Likely	Less Likely	Likely
Institutional Development	Moderate	Little	Little	Little	Little
Overall	Less than Successful	Highly Successful	Highly Successful	Less than Successful	Successful

EWB = East-West Highway.

B. Lessons and Implications for the Future

92. The upgrading of the EWH and periodic maintenance work conducted with ADB assistance has generated substantial economic benefits in the form of savings in road user costs and maintenance expenditure. Analyses show that these primary benefits are largely passed on to the general public in the form of lower transport charges than would otherwise apply if the roads were in a deteriorated state. This good result is due to the improved roads having traffic levels above 300 vpd and the cost of the improvements being low. This leads to the expectation that most resealing and road improvement works along the EWH and on heavy traffic roads in the Terai and Kathmandu Valley will normally be economically justifiable on the basis of road user cost savings alone. Further, the appropriate management approach for these roads would focus on maximizing benefits by maintaining the roads in good condition with progressive upgrading in accordance with growth in traffic volumes.

93. Given the near completion of the upgrading of the EWH, if the relevant parliamentary acts are passed to bring the Roads Board and Road Fund into being, Nepal's requirement for external support for the EWH is likely to diminish. Interim support may be required until the Roads Board and Road Fund are operational, however. In general, the main focus of future ADB support to the road sector in Nepal is likely to be for hill and rural roads, and for specific large projects such as improvements on the Kathmandu ring road or the Kathmandu-India border link.

94. In the hill areas where traffic volumes are 100 vpd or less, road user cost savings are insufficient to justify the expenditures needed to upgrade gravel or earth roads to sealed all-weather status, even in combination with savings in road maintenance expenditure. In the hill areas, other benefits, such as from increased agricultural output, enhanced national integration, or social improvement, must also occur, or lower cost approaches devised, to justify expenditure on road sealing. The experience in the eastern hills and around Melamchi shows that agricultural development can be enhanced by road development. However, the results in Far Western Region and for the Chaugadha-Thingaun road indicate that agricultural development may not necessarily follow road development, and specific interventions to ensure that the expected development occurs may be required. In hill areas, therefore, feasibility studies need to give more attention to the assessment of agricultural potential and identify those factors that would lead to desirable change. For areas such as those of Far Western Region where change may occur only with substantial direct assistance, provisions for such assistance ought to be built into projects, either through specific components or by assurances over coordinated development and other means.

95. The evaluation of the hill roads suggests that such interventions can generate important social improvements and enhance national integration. These benefits are difficult to incorporate into economic analyses, and the formulation and evaluation of hill roads requires a broader view than the traditional focus on economic rates of return found in most of the past road projects.

96. Traffic growth in the hill areas is driven by increased movement of people by public transport and a greater movement of food and consumer goods into the area. Such traffic growth is indicative of important nonquantifiable benefits. The greater availability of food and consumer goods in hill areas with upgraded roads contributes to an improvement in living conditions in the area, and the increased mobility of the population contributes to the goal of national integration and offers the possibility of introducing social change in the form of a lessening of the rigidities of the caste system and improvement of the position of women. Such improvements were found in the areas studied. However, the major change in hill areas comes with the construction of the initial motorable access road, which has typically been an earth or gravel road; road upgrading brings a lower degree of change.

97. The low traffic volumes and consequent small road user cost savings from road improvements in the hill areas also indicate that the appropriate management approach would focus on asset preservation and the least cost way of ensuring a minimum level of serviceability. High standards, which implies substantial expenditure, are not rewarded by commensurately large benefits such as occur in the EWH with its greater volume of traffic.

98. It is common for feasibility and appraisal studies for the upgrading of hill roads to assume that upgrading will result in large maintenance savings. Such savings can account for up to half of all benefits. However, actual "without-project" maintenance expenditure on unsealed roads is less than most ex ante assumptions and the assumed benefits do not occur in full. Future studies should adopt a more realistic view of potential savings.

99. Modifications in scope such as occurred in the hill roads and led to the roads north of both Ilam and Dadeldhura ending arbitrarily at points between settlements can reduce benefits. Such modifications must be carefully thought out and examined prior to approval. In retrospect, it would have been better to fund only one of the northerly road extensions so that it ended at a settlement.

100. Road planning, particularly in hill areas, should be linked more strongly with rural development. Area development projects, such as the Seti Zone Rural Development Project, provide one way of having such a strong link. However, this approach has, in the past, caused the planning for specific roads to be done without reference to overall road network plans, leading to inappropriate network development. Road components in agricultural or area development projects need to be planned in relation to both the agricultural needs of the area and an overall development plan for the road network.

101. Domestic road construction contractors performed adequately. Except for a limited number of tasks, such as the laying of asphalt concrete surfaces, the use of domestic contractors on future road works would be appropriate. Efforts, such as the letting of maintenance contracts, to expand the volume of work and reduce the "lumpiness" of contracting opportunities, which typically occurs under foreign-financed projects, would help develop the local contracting industry. Domestic consultants also performed adequately. However, as occurs in many countries, domestic consultants are subject to various social and political pressures,

and combinations of international and domestic consultants would appear to be the most appropriate option for contract supervision.

102. The conclusion of para. 94 has an important implication for the proposed Fourth Road Improvement Project which has a component for sealing additional hill roads in Far Western Region. The findings of this IES suggest that such a component is unlikely to be economically viable by itself. Should ADB and/or the Government wish to proceed with this project, there is a need to review the design and justification of the road component. It is highly probable that either lower cost development or the inclusion of additional means to stimulate agriculture and traffic will be needed. Current thinking within ADB reflects this conclusion, and includes investigation of ways to integrate the hill road component with other projects for the area, including the proposed Crop Diversification Project and the Second Rural Infrastructure Development Project.

103. DOR's attention is drawn to the possibility of errors in traffic counts for the northern roads in Far Western Region, and the need to investigate the causes of premature deterioration in the hill road south of Ilam and along the northbound lane of the Hetauda-Birganj road. Improved road safety is also an area that warrants more attention in the future, and may require TA from external agencies such as ADB.

APPENDIXES

Number	Title	Page	Cited on (page, para.)
1	Projects Related to the Road Sector in Nepal	29	3, 8
2	Technical Assistance Grants of Relevance to the Road Sector in Nepal	30	3, 8
3	Results for Completed Road-Related Projects in Nepal	31	3, 9
4	The Eastern Hills	32	4, 13
5	Far Western Region	36	
6	Traffic and Transport	39	9, 29
7	Beneficiaries of Road User Cost Savings	45	10, 32
8	Economic Reevaluation	51	4, 36

PROJECTS RELATED TO THE ROAD SECTOR IN NEPAL
(\$ million)

A. Road Projects

Loan No.	Project Title	Loan Amount		Project Cost	
		Appraisal	Actual	Appraisal	Actual
117/274	Hetauda-Narayangarh Road ^a	10.1	14.9	14.0	23.4
651	Feeder Roads ^b	17.5	23.5	22.2	28.5
806	Road Improvement ^c	30.0	31.3	42.5	44.4
982	Second Road Improvement ^d	50.0	51.8	58.0	59.4
1377	Third Road Improvement	40.0	ongoing	50.0	ongoing
Total		147.6	121.5^e	186.7	155.6^e

^a A supplementary loan (Loan 274-NEP(SF)) was approved on 23 September 1976 for the amount of \$4.8 million.

^b Loan amount was equivalent to SDR17,958,585 at the time of approval. At the time of loan closing, loan amount was equivalent to SDR17,381,055.

^c Loan amount was equivalent to SDR24,600,000 at the time of approval. At the time of loan closing, loan amount was equivalent to SDR22,413,527.

^d Loan amount was equivalent to SDR39,034,415 at the time of approval. At the time of loan closing, loan amount was equivalent to SDR36,372,249.

^e Excludes ongoing project.

B. Nonroad Projects with Road Component

Loan No.	Project Title	Loan Amount				Project Cost			
		Total		Road Component		Total		Road Component	
		Appraisal	Actual	Appraisal	Actual	Appraisal	Actual	Appraisal	Actual
721	Hill Agriculture Development	17.8	8.2	2.2	2.2	22.3	15.9	2.7	4.2
748	Seti Zone Rural Development	20.0	14.9	7.6	10.3	25.0	19.1	9.5	13.2
867	East Rapti Irrigation	30.4	9.9	0.7	—	38.0	12.9	0.9	^a
1113	Rajapur Irrigation Rehabilitation	16.6	ongoing	1.9	ongoing	20.7	ongoing	2.4	ongoing
1114	Upper Sagarmatha Agricultural Development	13.3	ongoing	3.3	ongoing	18.2	ongoing	3.4	ongoing
1156	Tourism Infrastructure Development	10.4	8.1	0.6	—	14.6	8.9	0.7	0.7
1240	Kathmandu Urban Development	12.0	ongoing	3.7	ongoing	16.0	ongoing	4.9	ongoing
1450	Rural Infrastructure Development	12.2	ongoing	5.8	ongoing	16.9	ongoing	8.1	ongoing
1604	Second Agriculture Program	50.0	ongoing	—	ongoing	50.0	ongoing	—	ongoing
Total		182.7		25.8		221.7		32.6	

— = not available.

^a The Project was reformulated in October 1992. Appendix 1 (Project Costs) of the project completion report did not provide information on the cost of constructing farm and service roads.

Notes:

1. Loan 867-NEP(SF): Estimated cost of road component refers to the line item for on-farm works in Appendix 10 of the appraisal report.
2. Loan 1156-NEP(SF): Cost of road component refers to the cost of the Sarangkot Access Road subproject only.
3. Loan 1240-NEP(SF): Cost of road component refers to the cost of Part B: Bishnumati Link Road.

**TECHNICAL ASSISTANCE GRANTS OF RELEVANCE
TO THE ROAD SECTOR IN NEPAL**

TA No.	TA Title	TA Amount (\$'000)	
		Approved	Actual
A. PPTAs			
414	Feeder Roads Improvement	250.0	244.3
549	Feeder Roads	150.0	150.0
1027	Second Road Improvement	100.0	89.9
1704	Third Road Improvement ^a	118.0	112.2
2969	Fourth Road Improvement	775.0	ongoing
	Subtotal	1,393.0	596.4^b
B. AOTAs			
764	Transport Sector Profile Project	350.0	350.0
824	Institutional Strengthening of the Department of Roads	335.0	295.4
1216	Road and Road Transport Institutional Development	875.0	758.5
	Subtotal	1,560.0	1,403.9
C. Other TAs			
851	Improving the Program Budgeting and Project Monitoring System ^c	1,501.0	1,922.9
1746	Enhancement of Project Implementation Efficiency	366.0	199.1
2091	Training in Accounting and Disbursements of Accounting Staff of Selected Executing Agencies and Government Departments	100.0	99.8
2954	Strengthening the Project Performance Management System	500.0	ongoing
2992	TA to Improve Project Implementation	65.0	29.8
3306	Strengthening Project Implementation Practices	820.0	ongoing
	Subtotal	3,352.0	2,251.6^b
	Total	6,305.0	4,251.9

AOTA = advisory and operational technical assistance, PPTA = project preparatory technical assistance, TA = technical assistance.

^a Includes a supplementary TA approved on 10 October 1994 for \$18,000.

^b Excludes ongoing TAs.

^c As a result of supplementary TA approvals by the United Nations Development Programme, total TA amount reached \$2,216,693.52.

RESULTS FOR COMPLETED ROAD-RELATED PROJECTS IN NEPAL

A. Road Projects

Loan No.	Title	EIRR			Rating	
		AR	PCR	PPAR	PCR	PPAR
117/274	Hetauda-Narayangarh Road	14.3	6.9	10.6	PS ^a	GS
651	Feeder Roads	12.7	4.0	^b	PS	^b
806	Road Improvement	15.4	16.8	24.8	GS	GS
982	Second Road Improvement	24.1	23.9	^b	GS	^b

AR = appraisal report, EIRR = economic internal rate of return, GS = generally successful, PCR = project completion report, PS = partly successful, PPAR = project performance audit report.

^a This reflects the Operations Evaluation Mission's assessment of overall project performance as the PCR did not give an explicit rating.

^b Not available as Project was not postevaluated.

B. Nonroad Projects with Road Component

Loan No.	Title	EIRR			Rating	
		AR	PCR	PPAR	PCR	PPAR
Overall Project						
721	Hill Agriculture Development	24.3	25.0	14.9	GS	GS
748	Seti Zone Rural Development	14.7	(3.7) ^c	^b	PS	^b
867	East Rapti Irrigation	15.9	16.3 ^d	^b	GS	^b
1156	Tourism Infrastructure Development	12.3-21.4 ^e	26.0 ^f	^g	GS	PS ^g
Road Component						
721	Hill Agriculture Development	—	—	—	PS	PS
748	Seti Zone Rural Development	—	26.9	^b	GS	^b
867	East Rapti Irrigation	—	—	^b	GS	^b
1156	Tourism Infrastructure Development	17.7	—	^g	GS	GS ^g

— = not calculated.

AR = appraisal report, EIRR = economic internal rate of return, GS = generally successful; OEM = Operations Evaluation Mission, PCR = project completion report, PPAR = project performance audit report, PS = partly successful.

^a This reflects the OEM's assessment of overall project performance as the PCR did not give an explicit rating.

^b Not available as Project was not postevaluated.

^c This excludes transport benefits as at appraisal. Including transport benefits, EIRR should have been estimated at 18 percent at appraisal and 17.5 percent at project completion.

^d EIRR was estimated at 13.7 percent at reformulation.

^e Overall EIRR for the Project was not calculated. The range given refers to EIRRs of the various components, except for the Pokhara Airport Upgrading component (for which EIRR was not calculated).

^f At PCR, only the EIRR for the Pokhara Airport Upgrading was calculated.

^g In preparation.

THE EASTERN HILLS

A. Study Surveys

1. Surveys were undertaken in a total of 10 locations within the influence area of the roads in the three districts of Ilam, Panchtar, and Taplejung. All 10 locations were within Ilam district. Four of these locations were along the road itself, one location was served by a fair-weather local road, and five were within six hours walk of the road. An additional four locations in nonroad-influenced areas in Bhojpur and Khotang districts were also surveyed to act as a “survey control.”

2. Bhojpur and Khotang districts are generally nonroad influenced. Their combined population in 1991 was 415,000 with a similar density as the three road-influenced districts, and although slightly lower than these three districts, both the proportion of land under cultivation (25 percent) and the average farm area per person (0.18 hectares) significantly exceed the national average for hill and mountain areas, which also is the case for the three road-influenced districts. Bhojpur and Khotang districts are food surplus areas. Their levels of average income and social indicators are lower than those for the three road-influenced districts.

3. The surveys indicated substantial production of cash crops—potato, tea, broom-bristle, cardamom, and ginger—throughout the area served by the roads, in addition to the basic subsistence crops of maize, millet, and wheat, with rice in limited areas. The extent of cash crop production was lower, and cereal cropping correspondingly higher, in the nonroad-influenced areas.

B. Profile of the Eastern Hills

4. The area comprises steeply sloping hills and mountains, with significant areas of agriculturally productive land in the southern part. The population is scattered in settlements throughout the area, with concentrations on the higher land and close to the main road alignment. In Ilam, almost 50 percent of the area is under forest, with a further 40 percent in agricultural production.¹ The total land area of the three districts is 6,600 square kilometers (sq km). The population densities of the more southerly hill districts (Ilam, Panchtar, and the two nonserved districts of Bhojpur and Khotang) are relatively high, at 130-140 persons per sq km, compared with a national average of 126 persons per sq km and 87 persons per sq km for hill and mountain areas (Table A4.1).

¹ Includes private forest.

Table A4.1: Population and Land Area

Item	Population (1991 census)	Land Area (sq km)	Population Density
Road-Served Districts			
Ilam	229,214	1,703	135
Panchtar	175,206	1,241	141
Taplejung	120,053	3,646	33
Three Districts	524,473	6,590	80
Nonroad-Served Districts			
Bhojpur	198,784	1,507	132
Khotang	215,965	1,591	136
Two Districts	414,749	3,098	134
All Nepal			
Hills and Mountains	9,863,019	113,162	87
Terai	8,628,078	33,401	258
Total	18,491,097	146,563	126

Source: *Nepal District Profile*, Fourth Edition, 1999.

5. The proportions of land under agriculture in these districts are also relatively high—at over 30 percent for Ilam and Panchtar and around 25 percent for Bhojpur and Khotang—compared with a national average of 11 percent for the hills and mountains (Table A4.2). Significantly, the average size of farm holdings (agricultural land area per person) is high for the three districts served by road—at over 0.20 hectares per person, compared with the national average of 0.12 for the hills and mountains. As a result of the favorable land/person ratio, the area as a whole produces sufficient food for its needs, although Taplejung has a deficit.

Table A4.2: Agricultural Land and Food Balance

Item	Agricultural Land (ha)	Percent of Total Land	Agricultural Land/Head (ha)	Food Balance (mt)	Percent of Food Produced ^a
Road-Served Districts					
Ilam	54,676	32	0.24	1,320	103
Panchtar	38,214	31	0.22	1,991	105
Taplejung	24,154	7	0.20	(1,864)	92
Three Districts	117,044	18	0.22	1,447	101
Nonroad-Served Districts					
Bhojpur	36,099	24	0.18	60,810	150
Khotang	39,600	25	0.18	19,445	144
Two Districts	75,699	24	0.18	80,255	149
All Nepal					
Hills and Mountains	1,193,308	11	0.12		
Terai	1,374,795	41	0.16		
Total	2,568,103	18	0.14	(34,351)	99

ha = hectare, mt = metric ton.

^a Proportion of total basic needs locally produced.

Source: *Nepal District Profile*, Fourth Edition, 1999.

6. There are significant volumes of cash crop production in the area, with shipment out of the area of ginger, potato, cardamom, and broom bristles (Table A4.3). Increasing proportions of the area are dedicated to tea production, and in recent years, seven privately-operated tea factories have been established. Milk production has also increased substantially with the introduction of chilling centers and regular daily collections by tanker. There have been major increases in the volumes of ginger, cardamom, broom, milk, and vegetables exported from the area in recent years. The current levels of export indicate an average of about 12-15 laden truck movements (excluding milk) out of the hills daily.

Table A4.3: Main Commodity Exports, Ilam District

Commodity	1982 (mt)	2000 (mt)
Ginger	—	5,000
Cardamom	600	2,500
Potato	4,500	5,000
Broom	240	1,200
Milk	1,000	9,000
Fruit and Vegetables	650	2,000
Tea	110	—
Chirito and Herbs	90	100
Timber	—	4,000

— = no data available, mt = metric ton.

Source: 1983 TA 414 Feasibility Study; Records from District Development Council and Study Interviews.

7. Potato was the major export crop in 1983, and production was established prior to the initial opening of the road in the mid-1970s. The crop was previously exported directly to India but, after the road was opened, the market shifted to the Terai. Cardamom was identified as a potential growth crop in 1983 and appears to have expanded substantially, together with the production of broom (amriso) for which a market in India had only just been established in 1983. Fresh fruit and vegetable production has increased with exports to both the Terai and India.

8. The export of fresh milk was started in 1983, with a single daily truck from India, in response to the newly sealed road. This activity has expanded dramatically in recent years following the upgrading of the road to Ilam and further north. Daily production is now in the range of 18,000 to 35,000 liters per day and 3-5 tankers per day collect milk from chilling centers along the road. Two new centers are presently under consideration, following the extension of the sealed road beyond Ilam.

9. The tea production figures for 1983 relate to the government tea estates only: the estate at Ilam produced around 30 tons then and this has now declined—due to imminent privatization—to around 15 tons per year. Individual farmers have, in recent years, converted substantial areas to tea production and a number of privately owned factories have been

recently established to process this tea. The output from these new initiatives has yet to mature² and no data on current production levels are available. There are currently seven privately owned and operated tea factories in Ilam District, of which five have been constructed in the past two years. A large number of smallholder farmers are switching to tea production.

10. The average income level in the Eastern Region (NRs7,429 per capita) is close to the national average—NRs7,673³—although the three road-influenced hill districts have a lower average of NRs5,880. The relatively affluent and productive areas in the Terai raise the average for the region. Adult literacy, years of schooling, and human development indices all suggest that the east, and the project districts in particular, are consistently above the national averages.

Table A4.4: Average Income Levels and Social Indicators

Item	Average Income per Capita 1996		Adult Literacy (%)	Human Development Index	Average Years of Schooling
	Amount (NRs)	Percent of National Average			
Ilam	6,354	83	48.6	0.380	2.898
Panchtar	4,263	56	40.7	0.328	2.193
Taplejung	7,337	96	39.8	0.363	2.596
Three Districts	5,880	77			
All Nepal					
Mountains	5,896	77	27.5	0.271	1.480
Hills	8,403	110	40.2	0.357	2.471
Terai	7,319	95	35.9	0.344	2.170
Total	7,673	100	36.7	0.325	2.250

Source: *Social and Development Indicators*, Integrated Center for Mountain Development (ICIMOD), Nepal.

² It takes five years for tea bushes in the hills to come into initial production, and a further five years to reach full production.

³ 1996 levels.

FAR WESTERN REGION

A. Study Surveys

1. Surveys were undertaken in 12 locations within the influence area of the road projects: four in Dadeldhura, six in Doti, and two in Achham. Two additional sites were surveyed in the more remote hills to the south.
2. Ethnically, the area is dominated by higher caste Brahmins, Chhetris, Thakuris, and Newars who make up around 70 percent of the total population. The lower caste Damai and Kami were also found in almost all settlements.
3. Almost all households were engaged in agriculture, with around 20 percent reporting additional income from either portering or laboring. In the major market centers, a significant proportion of households were engaged in trade. Remittances from work in India form a major source of income in the area.
4. The surveys confirmed the general regional profile of agricultural production and output, although at just over 200 percent, cropping intensity in the surveyed areas was higher than the regional average. All areas reported subsistence production of the basic cereal crops and limited cash crop production and dairy activity, mostly for household use rather than sale. There were reports of oilseed and soybean production to trade for rice. The only nonagricultural activities reported were the tapping of resin for the production of turpentine in the forest areas to the south. In Dadeldhura, the Forestry Department reported the collection and sale of moss for medicinal purposes, and the cultivation of mushrooms in community forest areas.

B. Profile of Far Western Region

5. The total population of the seven districts served by the hill roads in Far Western Region is slightly over 1 million, based on the 1991 census (Table A5.1). The two districts directly served by the Asian Development Bank (ADB)-improved roads, Dadeldhura and Doti, contain a population of 270,000. The district of Achham is served by the ADB-built gravel road from Silgadhi to Sanfegagar, and comprises a further 200,000 people. The remaining population of 530,000 is divided among the four more northerly districts of Baitadi, Bajhang, Bajura, and Darchula, which are accessed and supplied through the network of ADB-funded roads.¹
6. The area comprises steeply sloping hills and mountains, with pockets of population on the ridges, in small local valleys, and alongside rivers. There is little level land and much of the area is under forest, although deforestation and soil erosion are widespread. The total land area of the seven districts is 14,700 square kilometers (sq km). The overall population density is low at 68 persons per sq km, compared with the averages of 87 persons per sq km in the hills and mountains and 126 persons per sq km nationally.

¹ Baitadi is, however, served by the extension of the road from Dadeldhura and will be directly served by the improvement proposed under the Fourth Road Improvement Project: the other three district headquarters are currently nonroad served.

Table A5.1: Population and Land Area

Item	Population (1991 census)	Land Area (sq km)	Population Density
Dadeldhura	104,647	1,538	68
Doti	167,168	2,025	83
Achham	198,188	1,680	118
Baitadi	200,716	1,519	132
Bajhang	139,092	3,422	41
Bajura	92,010	2,188	42
Darchula	101,683	2,322	44
Seven Districts:	1,003,504	14,694	68
All Nepal:			
Hills and Mountains	9,863,019	113,162	87
Terai	8,628,078	33,401	258
Total	18,491,097	146,563	126

Source: *Nepal District Profile*, Fourth Edition, 1999.

7. The proportions of land under agriculture are low—around 6 percent, compared with a national average of 11 percent for the hills and mountains—and despite the relatively low population densities, the area of agricultural land per head of population is also below the national average (Table A5.2). On average, each person has about 0.09 hectares of agricultural land, compared with a national average for the hills and mountains of 0.12 hectares. Only Dadeldhura matches this; the areas in Doti and Achham are significantly lower.

Table A5.2: Agricultural Land and Food Balance

Item	Agricultural Land			Food Balance (mt)	Percent of Food Produced ^a
	Area (ha)	Percent of Total Land	Area per person (ha)		
Dadeldhura	12,129	8	0.12	(969)	96
Doti	11,503	6	0.07	(15,346)	56
Achham	10,678	6	0.05	(23,144)	44
Baitadi	21,247	14	0.11	(21,570)	50
Bajhang	9,068	3	0.07	(18,869)	33
Bajura	10,467	5	0.11	(8,869)	55
Darchula	11,247	5	0.11	(5,121)	75
Seven Districts	86,339	6	0.09	(93,888)	55
All Nepal					
Hills and Mountains	1,193,308	11	0.12		
Terai	1,374,795	41	0.16		
Total	2,568,103	18	0.14	(34,351)	

^a Proportion of total basic needs locally produced.

Source: *Nepal District Profile*, Fourth Edition, 1999.

8. The region is a food deficit area. Only about 55 percent of total basic needs are locally produced, the balance being supplied by Government, through aid programs such as the World Food Programme, which provides rice in part payment for work on infrastructure development projects, or imported from the Terai, India, and other areas. Only Dadeldhura district comes close to producing sufficient food to meet its own needs. The available agricultural land is used predominantly for subsistence cereal crops—wheat, paddy, and maize—with a cropping

intensity of 142 percent. Only small areas are used for cash crop production and there are no significant exports of farm produce from the area.

9. Dadeldhura produces a few vegetables—following an initiative by a Canadian nongovernment organization—and fresh vegetables are now available in the local market. Small surpluses are sent to neighboring Doti. Prior to the road upgrading, vegetables were not generally available in the local market and the improved road has permitted their import as well as facilitating local production.

10. Data for 1996 indicate that average income levels in Far Western Region were NRs5,927 per capita, lower than the national average of NRs7,673. Adult literacy, years of schooling, and human development indices are also consistently below national averages. Table A5.3 includes data for the seven districts served by the hill roads in Far Western Region.

Table A5.3: Incomes and Social Indices

Item	Average Income per Capita 1996		Adult Literacy (%)	Human Development Index	Average Number of Years of Schooling
	Amount (NRs)	Percent of National Average			
Dadeldhura	5,881	77	37.9	0.265	1.974
Doti	4,959	65	30.2	0.249	1.582
Achham	5,035	66	24.5	0.235	1.277
Baitadi	5,609	73	36.4	0.256	2.149
Bajhang	4,930	64	27.4	0.201	1.284
Bajura	3,428	45	23.3	0.173	1.159
Darchula	4,876	64	38.4	0.286	2.032
Seven Districts	5,047	66			
All Nepal					
Mountains	5,896	77	27.5	0.271	1.480
Hills	8,403	110	40.2	0.357	2.471
Terai	7,319	95	35.9	0.344	2.170
Total	7,673	100	36.7	0.325	2.250

Source: *Social and Development Indicators*, Integrated Center for Mountain Development (ICIMOD), Nepal.

TRAFFIC AND TRANSPORT

A. Eastern Hills

1. Traffic movement on the eastern hill roads started in 1976. By 1983, the daily volume on the section from the Terai up to Fikkal was around 30-35 vehicles, comprising approximately 20 trucks, 4 buses, and the remainder light vehicles. The first 32 kilometers (km) of the road from the Terai (up to Kanyam) had been sealed by this stage. Beyond Fikkal, the daily traffic volume to Ilam was lower—at approximately 15-20 vehicles per day (vpd)—and around 15 vpd used the spur from Fikkal to the Indian border at Pashupatinagar. Beyond Ilam, in 1983, the road was under construction as a jeepable track with no regular traffic.

2. The total two-way volume recorded in July 2000 at Kiteni (16 km north of Charali, the starting point of the road in the Terai) was 229 vpd, comprising trucks (31 percent), buses (24 percent), taxis (26 percent), cars and jeeps (14 percent), and others, including tractors (4 percent) (Table A6.1). Volumes decrease with distance north of this point with 144 vpd being recorded just south of Ilam and 67 vpd around Biblate. Approximately 120 vpd two-way were observed on the Fikkal to Pashupatinagar link. Half of these are taxis, mostly of Indian registry, operating across the border up to Fikkal and a further 25 percent are trucks. There are eight buses each way per day, all making long-distance journeys.

Table A6.1: Traffic Volumes in Eastern Hills, July 2000 (vehicles per day)

Item	Km from Charali	Car and Jeep	Bus	Taxi	Truck	Other	Total
Kiteni (DDC Border)	16	33	55	59	72	10	229
South of Ilam	69	17	36	40	40	11	144
North of Biblate	82	3	20	12	24	8	67
Spur from Fikkal	0	5	16	61	30	8	120

DDC = District Development Council, km = kilometer.
Source: Study surveys.

3. The surveys for estimating the traffic volumes reported in Table A6.1 were undertaken in July, during the monsoon, when traffic levels are below the annual average due to the condition of the unsealed sections of road and the generally low levels of movement of both passengers and goods. The counts were adjusted based on seasonality factors derived from the long-term Department of Roads (DOR) automatic traffic counts and from interviews with bus and truck operators. Bus volumes show little seasonal variation, but truck movements are substantially higher during the winter months. The adjusted figures are presented in Table A6.2.

Table A6.2: Annual Average Traffic Volumes in Eastern Hills, 2000 (vehicles per day)

Item	Car and Jeep	Bus	Taxi	Truck	Other	Total
Kiteni	35	60	65	95	10	265
South of Ilam	18	40	44	60	8	170
North of Ilam	12	23	14	36	0	85
Road to Phidim	8	17	0	25	0	50
Spur from Fikkal	6	18	70	36	10	140

Sources: Traffic surveys, interviews, Department of Roads seasonality adjustments.

4. The adjusted traffic volumes of Table A6.2 are broadly comparable with other DOR counts, including the regular surveys at Charali which indicated average annual daily traffic (AADT) counts of 371 vpd and 587 vpd for 1998 and 1999, respectively. The DOR automatic counter tallies include substantial volumes of local traffic and taxis. A similar count undertaken for the Third Road Improvement Project in 1998 showed 389 vpd at a site 1 km north of Charali.

5. From an economic perspective, truck traffic is the most significant. Truck operations have expanded from between 6 and 10 movements each way per day in 1983, to current levels of between 35 and 50 per day (the higher figure in each case referring to the dry-weather volume). This includes about 15-20 trucks per day to the Fikkal and Pashupatinagar area, 5-10 to Ilam, and about 15-20 trucks per day bound for destinations north of Ilam—Ranke, Phidim, and Taplejung. In addition to the truck traffic from the Terai, there are approximately two local truck movements per day (each way) north of Ilam. Commodities carried into the area include rice, maize, aggregate and building materials, and general retail goods. An average load of 6.3 tons was observed. Exports from the area include ginger, cardamom, vegetables, wood, potato, and broom: these amount to around 18-20 laden trucks per day, with an average load of 3.5 tons. About half of all trucks, however, return to the Terai empty. Additionally, 3-5 milk tankers make a round trip every day from Biratnagar or India.

6. Truck services have been controlled by a truckers' association, which fixed the haulage rates and the allocation of cargoes to vehicles on a strict rotation basis. However, this system recently started to break down due to the efforts of the major traders in Birtamod who resent the controls imposed by the truckers' association and who own their own trucks. As a result, other cargo owners and truck operators have left the controlled system and haulage rates have recently dropped by between 20 and 25 percent. For example, rates for haulage between Birtamod and Ilam have fallen from NRs90 to NRs75 per quintal, and from Birtamod to Phidim from NRs200 to NRs150 per quintal.

7. The charges fixed by the truckers' association reflect the condition of the road. For the fully paved section from Birtamod to Ilam (83 km) the rate per km is NRs1.08 per quintal; to Phidim, which is paved for 127 km and poor condition gravel for 24 km, the rate is NRs1.32 per quintal per km; and to Taplejung, which is paved for 127 km and then earth for 109 km, the rate increases to NRs1.53 per quintal per km. These charges imply a rate per km on the unpaved sections of between NRs2 and NRs2.5 per quintal, compared with around NRs1 per quintal on the paved sections.

8. On average, there are 30 bus movements per day each way on the section north of Charali. These have increased from two per day in 1983. Ten of these movements are to Fikkal or Pashupatinagar, nine to Ilam, and 11 to destinations further north—Ranke, Phidim, or Kabeli. Most of these services originate from Birtamod (20), with others from Biratnagar or Dharan (4), or further afield including night buses from Kathmandu (6). In addition to the bus traffic, shared taxis are operating from Birtamod to both Ilam and Pashupatinagar with around 30 departures per day—20 to Ilam and 10 to Pashupatinagar. A small number, estimated at between 5 and 10 per day, also operate north of Ilam as far as Ranke. In the dry season, jeep taxi services are also provided on a number of district roads, for example, to Mangalbare, Mai Pokari, Naya, and Rabi. There is a frequent local jeep taxi service operating between Ilam and Bilate, which is 5 km to the north of Ilam. With the exception of taxis, other light vehicle movements throughout the area are very low.

9. Services are provided through a number of bus operators' associations which operate a system, similar to that operated by the truckers' association, to control fares and allocate specific departures to individual members. The route timetables are agreed between the associations. Maximum fares are fixed by the Department of Transport Management and the local zonal Transport Management Office (TMO) issues route permits.¹ A total of 87 route permits are currently issued by the zonal TMO in Birtamod for services on the Ilam road—mostly for local routes from Birtamod/Bhadrapur to Kabeli, the current road-head for Taplejung (61), Ilam (12), Singapur (2), and Phidim (2). The remaining permits are for long distance day and night services.

10. Bus fares (Birtamod-Ilam) are officially quoted as between NRs90 and NRs100 one way, but in practice current fares range from NRs90 to as low as NRs75. Fares (per km) are higher on the unsealed sections of the highway north of Pauwa Bhanjang (km 44 from Ilam). The Ilam-Phidim fare is NRs117 (NRs1.72/km), compared with NRs0.9-1.2/km for the Ilam-Birtamod sector. This year (i.e., 2000), for the first time, a local bus service was operated from Ilam to Mai Pokhari in the dry season with a fare of NRs40 per person, equivalent to NRs3.3 per km.

11. Bus travel times between Birtamod and Ilam have been reduced from 5 hours in 1983 to 3.5 hours today, although this could be further reduced if time lost waiting for passengers could be eliminated.

12. For the jeep services the single passenger fare is NRs120, with a journey time of 2.5 hours. The rate for the hire of the whole vehicle is NRs2,000, one way. Jeep taxi fares for the local service between Ilam and Bilate (4 km to the north) are NRs10 per passenger. The fare for the 12 km from Bilate to Mai Pokhari is NRs100 and similarly high fares are quoted for other local roads. In general, it was evident that the taxi services were well patronized, with passengers apparently preferring the faster, more frequent, and comfortable taxi over the conventional—but cheaper—bus.

B. Far Western Region

13. Regular traffic on the hill roads in Far Western Region became established in the early 1980s following the completion of the gravel track to Dadeldhura. Overall traffic levels in 1983 were light. Available data² show that on average 16 vpd, comprising 10 trucks, 5 buses, and 1 light four-wheel drive vehicle operated north of Godawari, near to the East-West Highway in the Terai.

14. Surveys over 24-hour periods conducted in July 2000³ indicate a two-way traffic volume on the hill section north of Godawari of 80 vpd. This volume comprised 40 buses (50 percent), 25 trucks (31 percent), and 15 light and other vehicles. It should be noted that the survey was undertaken during the monsoon when traffic levels were at their lowest and some sections of road were only passable with difficulty: these volumes have therefore been adjusted (see below).

¹ It is noted, however, that route permits may also be issued by other zonal offices for inter-zonal travel.

² TA 414 Feasibility Study, Valentine Laurey and Davies.

³ Twenty four-hour, two-way origin-and-destination surveys were undertaken for three days at Atariya, Syaude, and Dipayal.

15. A similar survey at Atariya—immediately north of the East-West Highway—recorded a total of 140 vpd, of which 60 vpd (43 percent) were local movements within the Terai—including significant numbers of truck and tractor-trailer movements to Godawari to collect stone and gravel. These local movements within the Terai have been excluded from subsequent analyses. DOR maintains a regular count at this location using an automatic traffic logger, supplemented by manual counts (Table A6.3). Within these data, the DOR manual count for 2000 is questionable. Automatic count data are not yet available from DOR for 1999 or 2000.

Table A6.3: DOR Traffic Counts at Atariya, Far Western Region (vehicles per day)

Year	Automatic Count	Manual Classified Counts				Total
		Bus	Truck	Car/Jeep	Other	
1995	95					
1996	102					
1997	137					
1998	135	38	81	25	0	144
1999	—	56	79	14	0	149
2000	—	69	136	107	48	360

— = data not available, DOR = Department of Roads.
Source: Department of Roads.

16. The DOR traffic logger at Atariya (N) indicates a seasonality⁴ factor of 1.43 for July based on data for four years. Assuming that this effect applies primarily to traffic travelling into the hills—and specifically to trucks—then the July 2000 survey estimates of traffic north of Godawari should be adjusted to 130 vpd,⁵ comprising 50 buses, 60 trucks, and 20 light vehicles. Traffic volumes on various sections of the roads in Far Western Region based on study surveys and adjusted according to the seasonality factors are shown as AADT in Table A6.4. The annual volumes agree with estimates of local officials and truck and bus operators.

Table A6.4: Study Estimates of Traffic Volumes for Far Western Region, 2000 (vehicles per day)

Item	July 2000				AADT 2000			
	Bus	Truck	Jeep	Total	Bus	Truck	Jeep	Total
Godawari-Syaude	40	25	15	80	50	60	20	130
Syaude-Dipayal	28	14	16	58	35	35	20	90
Silgadhi-Sanfebagar	10	3	0	13	15	20	10	45
Dadeldhura-Khopde	10	6	0	16	15	20	10	45
Khopde-Baitadi	5	4	0	9	10	12	5	27
Khopde-Bajhang	4	2	0	6	5	8	3	16

AADT = average annual daily traffic.
Source: Study surveys and discussions with operators.

⁴ The surveys were undertaken in July at the height of the monsoon and planting season when traffic volumes can be expected to be at their lowest. This particularly affects truck traffic, as (even though the road may not be directly affected by the rains) the onward transport and distribution into the hills is affected. During the surveys, the road north of Dadeldhura was passable only with difficulty and the road to Sanfebagar was open only to Santinagar.

⁵ Seasonally adjusted volume at Atariya = 200 vpd (140*1.43), less 60*1.12 for local movements to Godawari gives 130 vpd on the hill section: bus and light vehicles have been adjusted upward by 25 percent with the remainder added to the truck volume—increased from 25 to 60 movements per day.

17. DOR has also undertaken a number of traffic counts in recent years at locations north and east of Syaude, both as part of its regular ongoing traffic count program and specifically in connection with the feasibility studies under the proposed Fourth Road Improvement Project. The results of these regular counts, undertaken for DOR by consultants in March of each year, at three sites are presented in Table A6.5 below. These counts show substantially higher traffic volumes on all sections. A seven-day count undertaken for the Fourth Road Improvement Project north of Patan (on the Khopde-Baitadi section) indicated a daily volume of 80 vpd—again significantly higher than the study estimate of 27 vpd.

**Table A6.5: DOR Manual Classified Counts for Far Western Region, 1998-2000
(vehicles per day)**

Location	DOR Annual Manual Counts			Study Estimate
	1998	1999	2000	
Khanidanda (15 km north of Godawari)	178	191	394	130
Koryal (east of Syaude)	146	120	136	90
Anar Kholi (24 km north of Dadeldhura)	140	144	189	45

DOR = Department of Roads, km = kilometer.
Source: Department of Roads, Planning Branch.

18. The traffic count data of Table A6.5 cannot be reconciled with the surveys undertaken in the field as part of this study, the long-term DOR count data from Atariya, and discussions held with officials, operators, and traders. It would appear that there is consistent overestimation of traffic volumes in the DOR manual count data. It is noted that the manual counts are done under contract by local consultants, and it is further recognized that the counts are being done in the relatively remote areas which are difficult to supervise.

19. There are on average 25 bus movements into the hills daily. Sixteen of these go on the Doti road to Dipayal and Silgadhi, with eight continuing past Silgadhi to Sanfebagar. Eight travel north beyond Dadeldhura, five to Baitadi, and three to Bajhang. These figures are based on the study's annualized average traffic flows, which are 25 percent higher than those observed in July.

20. Local bus services operate mostly from Mahendranagar with about a third from Dhangadhi. The majority operate at night which would appear to be the preference of the passengers, many of whom are travelling to more distant destinations in India; an early morning arrival allows onward travel without an overnight stop. Travel time between Mahendranagar and Baitadi ranges between 12 and 18 hours, depending on road conditions. Additionally, longer-distance services operate to Kathmandu (2 or 3 per day, 20-24 hours), Nepalganj, and Tikapur: the fare from Dadeldhura to Kathmandu is NRs604.

21. Truck operations have expanded considerably since the road was first opened. In 1983, an average of five trucks per day travelled north to Dadeldhura and Doti, some taking as much as three days to reach Dipayal. An average of 30 trucks per day now operate (each way), with higher volumes in the peak four winter months. During the surveys in July, an average of 12 trucks per day were observed.

22. The substantial increase in the number of truck trips directly corresponds to a similar increase in the volume of commodities consumed. The volume of export (back-haul) goods is

insignificant and is restricted to timber (when permitted) and resin. The area served by the road has expanded with the inclusion of parts of Baitadi, Darchula, and Bajhang, which were previously accessed from India, now being connected to the road. Similarly, parts of Achham and Bajura are now served through the Doti road. These extensions to the catchment area of the road will have contributed also to the growth in passenger numbers carried by bus.

23. Most goods are imported to the area from Dhangadhi, with only limited truck traffic from either Mahendranagar, Nepalganj, or beyond. Current freight rates, as determined by the truckers' association, from Dhangadhi are NRs80 per quintal to Dadeldhura, NRs120 to Dipayal, NRs200 to Baitadi, and NRs275 to Sanfebagar. Free market (i.e., noncontrolled) rates are approximately 10 percent lower. Rainy season rates to Baitadi and Sanfebagar are about 50 percent higher (at NRs300 and NRs400, respectively): rates on the bitumen sections of road are not affected in the monsoon.

24. Ten years ago, a total of 40 trucks were operating on the road, with about 8-10 trips per day. Rates were somewhat higher than today at NRs135 to Dadeldhura and NRs150 to Dipayal. Before the earthen road was opened to Dipayal, the freight charge—for a two-day journey by porter or pack animal from Faltude—was around NRs1,000 per quintal; this reduced to NRs250 per quintal with the earth road and to NRs120 now (from Dhangadhi).

BENEFICIARIES OF ROAD USER COST SAVINGS

A. Introduction

1. The direct beneficiaries of the savings in road user costs resulting from road upgrading are vehicle owners. The extent to which these benefits are passed on to the general population depends upon the ownership structure of the vehicle fleet and the extent of competition among bus and freight operators. Only a small proportion of vehicles other than motorcycles operating on the Asian Development Bank (ADB)-supported roads are used for private transport. For-hire freight trucks and buses predominate, and competition among operators of these vehicles is important to ensure that cost savings are passed on to the broader community in the form of lower bus fares and freight rates. It is only when such savings are passed on that broader stimulus to commerce and industry occurs. It is assumed that if benefits are passed on to traders in the form of reduced freight rates, then competition between traders would lower retail prices. Similarly, lower freight rates for farmers are assumed to result in higher farm gate prices for outputs and lower input prices, both of which should increase input use and consequent output. Irrespective of the degree of competition, bus passengers should derive benefits directly from road upgrading in the form of time savings and improved comfort.

2. Two factors pose difficulties for an analysis of the effect of road upgrading on bus fares and freight rates. First, there was rapid inflation during the 1990s. During such periods, prices can rise even though savings are passed on, which tends to mask the beneficial price-reducing aspects of road improvement. Second, there are controls on bus and truck operations in Nepal that restrict price competition. The controls are of two types, namely, Government-stipulated rates for bus fares, and the operation of transport associations. These controls have tended to keep bus fares low but freight rates higher than in a free market. There are two national transport associations operating in Nepal: the Nepal Federation of Transport Operators' Associations and the National Federation of Transport Operators' Associations. The first was established in 1976 and operated as a single federation of transport operators until 1993, when the second federation was established. These two federations have transport operators' associations in each zone of the country and area-specific transport operators' associations within the zones. Most of the bus and truck operators are members of the Nepal Federation; the members of the National Federation are mostly taxi, mini-bus, and tempo¹ owners.

B. Bus Operations and Bus Fares

3. Almost all of the bus services in Nepal are operated under the "dial" created by the associations. Under the dial system, departures are allocated to members in rotation. A bus may be in dial for different routes if it has taken route permits for other routes. All buses must be registered and enter the dial of the specific association of a zone after the bus has been given a route permit to operate on a route by the Transport Management Office (TMO). The associations never bar new operators from joining them and operating their buses within the dial. On most routes, there is overcapacity in the bus fleet and buses may be idle for 50 percent of the time. The buses of Sajha Yatayat (government cooperative) and those of Makalu Bus Service (private operator) operate outside the dial system, however.

4. There is one zonal level bus operators' association in each of the 13 zones of Nepal except in Karnali. In the zones, there are route-specific bus operators' committees such as the Arniko Highway Committee in Bagmati, the Prithivi Highway Committee in Gandaki, and the Eastern Committee in Koshi. The office of the zonal or route specific association takes NRs100 per trip per bus from the operators, of which NRs10 per trip is passed on to the central federation.

¹ Small motorized three-wheeler vehicles for local passengers and general use.

5. In the Eastern Region, the Koshi Zone Association has control over operations of bus services on the Mechi Highway to Ilam, Phidim, and up to Taplejung. The Far Western Association (Dhangadhi) and the Seti Mahakali Association (Mahendranagar) have control over the operation of bus services on the Dadeldhura, Baitadi, Darchula, Bajhang, Doti, and Achham roads in Far Western Region.

6. The Department of Transport Management (DOTM) specifies bus fares on a route basis, which are intended to be the upper limit of fares which operators should charge passengers. However, the bus operators' associations now charge more than the specified maximum fares on most routes. There have been major disputes between DOTM and the associations over fares. DOTM has not been successful in compelling the associations to reduce fares to the maximum fares set.

7. Up to 1996, the associations more or less did keep fares to the maximum fares quoted by DOTM. At this time, the reference rates used by the DOTM in setting fares were as follows:

Paved Roads:

Terai	NRs0.45 per kilometer (km) (night service)
	NRs0.35 per km (day service)
Hills	NRs0.57 per km (night service)
	NRs0.46 per km (day service)

Unpaved Roads: NRs0.68 per km

8. The higher rates for night bus services was because they were restricted to newer buses. The actual fares set did not always follow these reference rates. For example, the Kathmandu to Melamchi fare was set using a rate of NRs0.46 per km, as if the road is paved, whereas, in fact, approximately 37 km are paved and 22 km unpaved. Similarly, the fare for Kathmandu to Kuringhat was NRs0.40 per km compared with the reference fare for such a route of NRs0.46 per km. In some cases, the maximum fares set for a route were well above the reference rates shown above. This was especially so in the case of routes involving unpaved roads in the hill areas. Examples of fares are given in Table A7.1 below.

Table A7.1: Representative Bus Fares—1996 and 2000

Route	Km	1996 Fares (NRs)		2000 Fares (NRs)		1996 Fares/km (NRs)		2000 Fares/km (NRs)	
		DOTM	Actual	DOTM	Actual	DOTM	Actual	DOTM	Actual
Birtamod-Ilam	83	85.6	111.3	89.3	90.0	1.03	1.34	1.08	1.08
Ilam-Phidim	68	70.1	91.2	94.7	117.0	1.03	1.34	1.39	1.72
Birtamod-Phidim	151	137.0	178.1	178.1	199.0	0.91	1.18	1.18	1.32
Kakarbita-Itahari	93	41.0	53.3	56.0	65.0	0.44	0.57	0.60	0.70
Birganj-Hetauda	50	21.9	28.5	29.6	33.0	0.44	0.57	0.59	0.66
Birganj-Narayangarh	128	52.6	68.4	68.4	76.0	0.41	0.53	0.53	0.59
Lamahi-Gorahi-Tulsipur	47	30.6	39.8	41.4	48.0	0.65	0.85	0.88	1.02
Nepalganj-Surkhet	114	58.2	75.7	75.7	87.0	0.51	0.66	0.66	0.76
Dhangadhi-Dadeldhura	134	108.9	141.6	141.6	176.0	0.81	1.06	1.06	1.31
Dhangadhi-Baitadi	219	205.7	267.4	267.4	321.0	0.94	1.22	1.22	1.46
Dhangadhi-Silgadhi	197	134.8	175.2	175.2	218.0	0.68	0.89	0.89	1.11
Dhangadhi-Sanfebagar	266	180.7	234.9	235.1	287.0	0.68	0.88	0.88	1.08
Kathmandu-Biratnagar	501	248.2	322.7	322.7	326.6	0.50	0.64	0.64	0.65
Kathmandu-Birganj	270	124.1	161.4	161.4	180.0	0.46	0.60	0.60	0.67
Kathmandu-Chaugadha	82	42.4	55.1	57.2	66.0	0.52	0.67	0.70	0.80
Kathmandu-Dhangadhi	688	316.3	411.2	387.9	447.0	0.46	0.60	0.56	0.65

DOTM = Department of Transport Management, km = kilometer.

Source: Compiled by the Operations Evaluation Mission from data supplied by DOTM and transport associations.

9. In 1996, the associations asked DOTM to increase the maximum fares by 30 percent. The DOTM did not agree but the associations began to charge fares 30 percent more than the maximum specified. This situation continued until late 1999. Then DOTM increased the maximum fares by 30 percent generally, with a 35 percent increase on routes of less than 100 km, reflecting actual fares charged. However, in early 2000, the associations again increased fares by approximately 22 percent in response to the increased price of diesel fuel.

10. The bus associations operating in Far Western Region hill roads are charging about 22 percent more than the current maximum fares specified by DOTM and do not differentiate between night and day fares. However, on some routes in the eastern hills, bus associations are charging fares in keeping with the official maximum. The reason for the latter is believed to be the strong competition from commercial taxi services operated by utility jeep vehicles. The taxi services are faster and are often preferred to buses. On the Ilam-Birtamod route, the bus fare is NRs90, compared with a taxi fare of NRs120. Journey time is reported to be four hours by bus and two and a half hours by taxi.

11. There is clearly a relationship between bus fares and both road condition and whether the road is in the hills or the Terai. Therefore, if roads are allowed to deteriorate, it is likely that bus fares will increase. However, in practice, it seems that neither official nor actual fares are adjusted automatically to reflect improvements in road conditions. In particular, the recent completion of the upgrading of the road to Dadeldhura and the upgrading of the Lamahi-Tulsipur road should have resulted in a lowering of the latest (2000) fares charged on these routes. The introduction of competition in the form of taxis appears to have had a major impact on fares. As these services only started after the completion of a sealed road to Ilam, such competition and its effect on fares may be a direct benefit of the road upgrading.

C. Truck Operations and Freight Rates

12. Historically, strong truck operators' associations operated in the zones where there are major trading points between Nepal and India, such as Birganj (Narayani Zone), Biratnagar (Koshi Zone), Bhairahawa (Lumbini Zone), and Nepalganj (Bhari Zone). In addition to these associations, truck operators' associations existed in all other major centers such as Kathmandu (Bagmati Zone), Dhangadhi (Seti Zone), Mahendranagar (Mahakali Zone), and Janakpur (Janakpur Zone). The truck operators' associations use a dial system in the same manner as used by the bus operators' associations. To the extent possible, the associations do not allow trucks to transport goods outside the dial in their area. Organizations that require transport for their goods have to contact the association for allowing their trucks to transport the goods. The zonal associations take NRs150 from the operator for each trip, and the central Nepal Federation of Truck Operators' Associations receives NRs10 per trip.

13. In the past few years, some truck associations have been disbanded and others weakened, but strong associations still operate in Hetauda, Dhangadhi, and Mahakali. The Truck Operators' Association in Hetauda is particularly strong. An association with published rates still operates on the Mechi Highway in the Eastern Region but the dial system has recently broken down, with competitive rates also available from nonassociation operators. The weakening of the control of the associations appears to have come about because of traders buying their own trucks for transport of their freight, and offering spare capacity to other traders. Indian trucks also now freely enter Nepal with freight brought in from India, whereas before such freight was transshipped at border points.

14. The freight rates quoted by the associations are relatively high; where there is no association, competition results in lower rates. This can be seen from a comparison of freight rates to Kathmandu from both Birganj where there is no association and Hetauda where there is a strong association (Table A7.2). From Birganj to Kathmandu, the freight rate is currently NRs550 per ton whereas from Hetauda to Kathmandu, it is NRs714 per ton. This is despite Hetauda being 50 km closer to Kathmandu on the same road.

Table A7.2: Freight Rates to Kathmandu
(NRs per ton)

Year	From Birganj	From Hetauda
1991	429	360
1992	532	430
1993	559	460
1994	630	520
1995	480	519
1996	450	519
1997	540	519
1998	540	540
1999	570	580
2000	550	714

15. In the Eastern Region where the Mechi Hill Truckers' Association now faces competition from nonassociation operators, the rates have been reduced by about 20 percent as shown in Table A7.3.

Table A7.3: Freight Rates on the Mechi Highway

From Birtamod to	Km	Association Rate		Competitive Rate	
		NRs/ton	NRs/t-km	NRs/ton	NRs/t-km
Fikkal	47	500	10.6	—	—
Pashupati Nagar	58	600	10.3	—	—
Ilam	83	900	10.8	750	9.0
Ranke	118	1,500	12.7	1,200	10.2
Pauwa Bhanjyang	126	1,600	12.7	1,300	10.3
Phidim	150	2,000	13.3	1,500	10.0
Kabeli	211	2,900	13.7	2,400	11.4
Taplejung	235	3,600	15.3	—	—

— = data not available, km = kilometer.

Source: Truck operators' associations and independent truck owners and traders.

16. The freight rates of both the associations and the independent truck owners reflect road surface conditions, however. As can be seen from Table A7.3, freight rates increase beyond Ilam.² Rates are in the range of NRs10-13 per t-km on sealed roads. For journeys to locations on the unsealed sections north of Pauwa Bhanjyang on the Mechi Highway, the implied rates are NRs15-17 per t-km. For journeys involving use of district roads with an earth surface, the implied rates are NRs25-50 per t-km for the earth road section. The situation in Far Western Region parallels that in the east, with both association and competitive rates much higher for unsealed roads than sealed roads (Table A7.4). The rates shown in Table A7.4 apply to movements in the dry season; during the rainy season the association rates to Sanfebagar and Baitadi are more than NRs13 per t-km.

Table A7.4: Freight Rates in Far Western Region

From Dhangadhi to	Km	Association Rate		Competitive Rate	
		NRs/ton	NRs/t-km	NRs/ton	NRs/t-km
Dadeldhura	135	800	5.9	600	4.4
Dipayal	185	1,200	6.5	1,100	5.9
Sanfebagar	266	2,750	10.3	2,800	10.5
Baitadi	220	2,000	9.1		

km = kilometer, t = ton.

Source: Truck operators' associations and independent truck owners and traders.

17. There is clearly a significant difference in rates to hill areas in the east and Far Western Region. This is especially true in the case of sealed roads, where the per t-km rate in Far Western Region is less than half the rate in the east. This is despite the fact that the chance of a backhaul load is far greater in the east and is presumably the result of the association establishing a higher rate in the east, which has not yet been brought down by competition.

D. Comparison between Bus Fares/Freight Rates and Calculated VOCs

18. Economic evaluation of the road improvements (Appendix 8) are based on calculated savings in vehicle operating costs (VOCs). Such VOCs are based on economic prices; however, the financial equivalents of the economic VOCs have been estimated in Table A7.5 to compare with actual bus fares and freight rates.³

² The road has recently been sealed as far as Pauwa Bhanjyang, and it is probable that rates will be revised to reflect the improvement.

³ Apart from the difference in unit prices (i.e., financial versus economic prices), these costs differ from those calculated for the evaluation of projects in that passenger time costs were excluded and full standing costs for buses and trucks were included.

Table A7.5: Financial Truck and Bus VOCs
(NRs per km)

Item	Gradient 0%		Gradient 3%	
	IRI 4	IRI 20	IRI 4	IRI 20
Truck	13.6	34.2	15.8	39.5
Bus	12.3	25.6	14.6	32.7

IRI = international roughness index, km = kilometer, VOC = vehicle operating cost.

19. When converted to a cost per t-km, assuming six tons per truck, the truck operating costs on a good road (IRI 4) are NRs2.3-2.6 per t-km. On a bad road, they are in the order of NRs5.7-6.6 per t-km. Because of the shortage of backhaul freight, it is likely that operators will expect a freight rate of approximately double their operating cost per km. It seems that the current freight rates in Far Western Region have been brought down to the level of the operating costs on bad and improved roads; in other words, the benefits are more or less fully passed on to customers. However, in the east, there is scope for significant reductions from present rates.

20. In the case of buses, the fares charged seem to be well above actual operating costs. Normally, similar loadings could be expected in both directions. Typical loadings are 40 to 45 passengers, but even if an average of 30 passengers is assumed, the fares will more than cover costs as estimated by the use of calculated VOCs. On a good road, costs are NRs0.4-0.5 per passenger km, and on bad roads NRs0.9-1.1 per passenger km. It is possible that the model used to calculate VOCs underestimates actual costs, although the overcapacity in the bus fleet suggests the alternative, namely, that actual costs are much lower than fares leading to high profit margins, which is encouraging overinvestment in buses. The relationship between fares and calculated VOCs with different road conditions is similar, suggesting that the lower fares on improved roads are a reasonable reflection of the benefits obtained by operators, even if there is apparent scope for lower fares overall.

ECONOMIC REEVALUATION

A. Basic Approach

1. The economic reevaluation of the Asian Development Bank (ADB)-funded roads in Nepal follows conventional economic appraisal methodology for road projects as outlined in the ADB's *Guidelines on the Economic Analysis of Projects*. The quantified benefits were savings in road user costs and maintenance expenditure. These benefits were compared with the investment cost through the calculation of the economic internal rate of return (EIRR). Appraisal of each of the road projects also included these benefits and approach. However, at the time of appraisal, each project was also expected to have a clear impact on agriculture and benefits from increased agricultural output were included in the appraisal analyses. Although there is evidence of impact on agriculture in the eastern hills, insufficient data are available to quantify the benefits attributable to the roads. There was no evidence of an agricultural benefit in Far Western Region. The same conclusion was reached in the project completion report for the Seti Zone Rural Development Project, which found that the Silgadhi-Sanfegagar road had no appreciable effect on agriculture, but there were significant road user cost benefits. In the east, the reevaluation will underestimate benefits to the extent of any real road impact on agriculture.

2. Benefits for each road section were estimated over a 20-year period. The first year of benefits was the year before completion of the works, with benefits assumed to be half of that in the year after completion. This allows benefits from partial completion to be captured. No disbenefits for road users caused by disruptions to traffic during the construction period were included, however. The overall evaluation period is from 1974, the first year in which costs were incurred on the Hetauda-Narayangarh road, to 2019, the final year of the 20-year benefit period for the last sections of the Third Road Improvement Project.

3. Historical prices were converted to 2000 levels using the National Urban Consumer Price Index produced by the Nepal Rastra Bank. This index was used as there is no separate index of construction costs available for Nepal. The latest National Urban Consumer Price Index figures were for January 2000 only, but road construction price increases since then have been minimal and the January index has been taken as a mid-2000 figure. A conversion factor of 0.88 was applied in converting financial prices to economic prices, and the shadow labor wage rate was 75 percent of the market rate.

B. Road Sections Evaluated

4. The evaluated roads were grouped into three packages for reevaluation, namely, Far Western Region, the east, and the East-West Highway (EWH). There were two main reasons for doing this. First, in some cases, it is impossible to separate the costs associated with individual road sections. In particular, the costs associated with the initial contract for the Feeder Roads Project were incurred on several sections of road, and it was not possible to allocate all costs to individual sections. Secondly, benefits in the form of savings to generated traffic and potential development benefits are only obtained after a series of improvements to the network, and cannot be accurately allocated to individual sections of road. These benefits are most realistically considered on a network or package basis. However, within the three groupings, individual road sections have been defined as a basis for the calculation of benefits. These sections are generally homogeneous in terms of type of works, year of implementation, and traffic level. The road sections evaluated are detailed in Table A8.1.

C. Road User Cost Savings

5. Road user savings include vehicle operating cost (VOC) savings and travel time savings. In the case of one road, that from Silgadhi to Sanfebagar, the ADB-funded project opened the route to vehicles for the first time. In this case, road user savings are based on the replacement of portering of freight and personal travel on trails by truck and bus transport.

6. Benefits were estimated for normal and generated traffic. The limited number of alternative roads offers little scope for diverted traffic, although it is noted that some diversion may have taken place for the Hetauda-Narayangarh road. A rate of 8 percent per annum was used as the growth rate for normal traffic. All increase in traffic over this level was assumed to be generated. Growth levels of 7-8 percent were measured by automatic counters of the Department of Roads (DOR) on other non-upgraded hill roads. In comparison, the annual rate of increase in fuel sales during the 1980s and 1990s were 9.7 percent for gasoline and 11.7 percent for diesel. The increase in fuel sales would be higher than normal traffic growth, as sales also reflect generated traffic growth and expansions to the road network. The benefit to generated passenger traffic is taken as 50 percent of that applied to normal traffic, which is the conventional approach to estimation of this benefit.

7. In the hill areas of Nepal, there is evidence of significant generated inward freight traffic which must be included in the analysis. The main source of generated freight traffic appears to be the upgrading of the Doti road from Syaude to Silgadhi, and especially the later extension of the road to Sanfebagar. In the case of the road to Sanfebagar, the road made the replacement of portering of goods by truck transport possible. The cost saving of this change is much larger than from road upgrading and is considered to have had a sufficient impact to generate freight imports. In terms of benefit, the same approach as applied to generated passenger traffic was used for generated truck traffic. The generation is assumed to be the result of an increase in demand resulting from a price reduction in the goods related to freight cost savings. The consumer surplus benefit is assumed to be 50 percent of the freight cost saving.

8. Benefits relating to changes in the way vehicles are used were not included. For example, the load carried by trucks may be increased due to the improved road condition. Such a change increases the operating cost of each truck but produces an overall benefit because fewer vehicles are required to move a given amount of freight. However, no attempt has been made to include such a benefit.

9. Surveys carried out by the Maintenance and Rehabilitation Coordination Unit (MRCU) of DOR in the early 1990s showed that the Indian relationships for the World Bank's HDM-III VOC model predicted costs closer to actual VOCs in Nepal than the standard relationships normally used in HDM-III, which are based on research carried out in Brazil. Subsequently, some of the Indian relationships were further adapted for Nepal conditions by the MRCU. This includes inclusion of a VOC model appropriate for high roughness roads. The MRCU-modified HDM-III using Indian relationships was used to estimate road user cost savings for the reevaluation.

10. Six vehicle types are used in the Nepal VOC model to represent the motorized vehicle fleet in Nepal. These are (i) car, (ii) utility/jeep, (iii) bus, (iv) mini-bus, (v) truck, and (vi) mini-truck. The mini-bus and mini-truck types are not common on the roads to be evaluated in this study and were deleted in the analyses. In eastern Nepal, reconditioned and modified Indian vehicles of the utility type are used as public transport vehicles. They are referred to as taxis, but carry up to 16 passengers and provide a service similar to buses. Because they have much

larger passenger loads and higher utilization than the utility type vehicles in general use, a taxi category was created using the utility as a basis, giving a total of five vehicle types.

11. Current unit prices were collected to update the VOCs in the MRCU model to a mid-2000 basis for use in the reevaluation. The price of fuel was based on an international oil price of \$20 per barrel. There is clear evidence that the bus and truck fleets in Nepal are significantly larger than required. On some routes, twice the number of buses required to operate services are available. Even though this situation is starting to change, the oversupply of vehicles is expected to continue for many years. This excess in the size of the commercial vehicle fleet was noted in the mid-1980s, and was reported in the Study of the Road Transport Industry in 1987 and in the Appraisal of the Road Improvement Project in 1998. As a consequence of the oversupply of transport, any journey time savings will not be converted into additional trips, and standing charges for buses and trucks were excluded from the VOC estimates. Standing charges, however, were applied to the taxi, utility, and car categories of vehicles as there is no evidence to indicate that the fleet size exceeds need.

12. Passenger travel time costs are normally included in road evaluations in Nepal. The values recommended by the MRCU were out of date, and for the reevaluation, rates were based instead on those from the 1996 study forming part of the ADB Third Road Improvement Project. This study calculated a basic value of NRs15 per hour for working time. For car and utility passengers, the basic value was increased by 100 percent to reflect higher incomes, and for bus passengers it was reduced by 50 percent to reflect lower incomes. A nonworking time figure of NRs3.84 per hour was estimated from observed preferences to pay for bus travel rather than walking, and was applied in all cases. These values were applied to each vehicle type assuming that 25 percent of car and utility passenger time and 10 percent of bus passenger time was work related. The above rates were increased to 2000 levels by applying a factor of 1.20 to reflect inflation since 1996. The adopted standard occupancy rates were 45 per bus, 15 per taxi, 2 per truck and utility, and 3 per car.

13. Savings to road users from VOC and travel time reductions were calculated for each type of vehicle for different estimates of road surface roughness and road gradient. Surface roughness was estimated in terms of the international roughness index (IRI). Since almost all the projects used the old alignments, it was assumed that there was no change in the road gradients.

14. For the “without project” case, initial road roughness figures were taken from appraisal reports or feasibility studies, where available. For unpaved roads where no reliable figures were available, a general level of 20 IRI was assumed. It was assumed that these roads would receive sufficient maintenance to keep them open to traffic and that the initial roughness levels would continue throughout the evaluation period. In the case of bitumen roads, it was assumed that routine and recurrent maintenance (mostly pot-hole filling) would be carried out, but that pavement deterioration would lead to progressively increasing roughness at a rate of 1 IRI per year, with a limit of a maximum of 18 IRI.

15. For the “with project” case, an initial roughness of 3 IRI was assumed for bitumen roads after project completion. Information on actual road roughness levels was available from DOR surveys for the strategic road network in 1999, with some information also available for 2000. This was used to amend the initial roughness assumption where actual roughness was higher than that projected for 1999. The bitumen roads were generally assumed to receive routine and periodic maintenance throughout the 20-year benefit period, with periodic maintenance involving

reseals every six years. Nevertheless, the roads will become progressively rougher, and the following progression in annual roughness was applied:

Year	IRI Increment	
0	0.1	
1	0.1	
2	0.1	
3	0.2	
4	0.3	
5	0.6	
6	(0.8)	Reseal
7	0.1	
8	0.1	
9	0.2	
10	0.3	
11	0.6	
12	(0.6)	Reseal
13	0.1	
14	0.1	
15	0.2	
16	0.3	
17	0.6	
18	(0.4)	Reseal
19	0.1	
20	0.1	

IRI = international roughness index.

16. In the case of the Hetauda-Narayangarh road, which has been resealed twice since the ADB-funded upgrading, the actual resealing years have been applied. Similarly, the resealing of the Syaude-Silgadhi road has been deferred to reflect the actual situation.

17. Only one "with project" case, the Silgadhi-Sanfegagar road, involves a nonbitumen surface. This road was built as a gravel road under the ADB Seti Zone Rural Development Project. If correctly maintained, such a road should keep to an average roughness of about 9 IRI. However, DOR road condition information for 1999 indicates a roughness level of more than 20 IRI for the road. No information is available for 2000. The initial section of the road was inspected during this study, and the condition appeared to be much better than 20 IRI. However, a failed section closed the majority of the road, and since parts of the road could not be inspected, the roughness level of 20 IRI was adopted for 2000. Given the general performance of the maintenance of unsealed roads in Nepal, it is likely that the road will only receive routine maintenance appropriate for an earth road, that is, without grading and regravelling. It is assumed that the general roughness of 20 IRI will continue for the duration of the benefit period. It was also assumed that the road will be effectively closed for three months each year, the situation reported by local traders.

18. Portage costs were estimated for reevaluation of the Silgadhi-Sanfegagar road. The economic cost of portage was based on the shadow price for unskilled labor, taken as

75 percent of the wage rate in Nepal.¹ An issue to be considered in deriving an average economic rate for portering is the economic rate for portering when owner-carriers are involved. There is no fundamental difference in the nature of the work, but it is reasonable to assume that a proportion of owner-carriers are transporting goods to the hills when returning from a trip made for other purposes. In other words, they would be making the journey anyway if not carrying goods. In these cases, the cost of the journey can be considered as only the extra time taken for a laden trip as opposed to an unladen trip. In order to allow for these movements, the overall economic cost of portering has been taken as 80 percent of the economic cost of commercial portering. This gives a figure of NRs7,800 per ton on the Silgadhi-Sanfegagar route.

19. When mules are used as pack animals, each mule typically carries a load of 70-90 kilogram (kg), with one person controlling five mules during the journey. Often, large groups move together. The charges are lower than for portering. The average rate on the Silgadhi-Sanfegagar route was about NRs500 per 80 kg, or NRs6,250 per ton. In 1988, the Remote Area Access Study estimated the cost of this form of transport, rather than relying on the use of charges as a proxy for costs. An annual cost for each mule was estimated and journey costs estimated with different utilization patterns. It appears that actual costs were very similar to charges if costs were included for unpaid family labor and free grazing. Assuming that this relationship remains current, the commercial cost can be considered as an economic cost.

20. No information is available on the relative quantities of freight transported on the Silgadhi-Sanfegagar road by human portering and pack animals, but the economic costs are sufficiently close that the distribution is not critical. A 50:50 split was assumed. With an estimated original trail distance of 40 km and a road length of 67 km, and assuming that the average truck load is 6 tons, the average economic trail cost is equivalent to a truck operating cost of NRs629 per km.

21. A further potential benefit from the change from portering/mule transport to motorized transport, namely, the reduction of damage to produce in transit, has not been considered. In the Horticulture Master Plan Main Report, published in 1991, it was stated that damage to fruit and vegetables carried by porters or mules can be as high as 40 percent. However, it was not possible to determine the net difference in average damage during transportation by different means of transport and no allowance for such a benefit has been included.

22. In hill areas where there is no road access, personal trips are normally made by walking along trails. Sanfegagar is served by an airport, but before the road was constructed, most journeys out of the area were along trails to Silgadhi, and air services still operate, suggesting that there has been little modal diversion from air to road transport. The air services are vital when the road is closed. The main cost of personal travel on trails is the time cost of the travelers. In this study, an average cost of NRs5 per hour has been adopted for bus passengers. In addition to the value of their time, some travelers on trails incur costs, such as accommodation and the hiring of porters to carry their belongings. The Feeder Road Study estimated that 10 percent used porters and the cost of this, plus the food and accommodation costs on the journey above those incurred if staying at home, was about NRs10 per day. The

¹ It is sometimes argued that the economic cost of portering should be very low because there would be no alternative employment for porters if they are displaced by motor transport. However, it appears that the introduction of motor transport does not necessarily diminish the demand for portering. No specific information is available for the Silgadhi-Sanfegagar area but studies in other areas have shown that road construction may even increase the demand for portering due to the need to distribute newly imported goods from roadheads to off-road consumption points. That is, the demand for portering continued but on different routes.

equivalent in present prices would be about NRs25 per day. These amount to an additional NRs3 per hour, and this has been added to the time cost to give an overall cost of personal travel on trails of NRs8 per hour. Normally, the journey between Silgadhi and Sanfebagar took two days so the total journey cost was approximately NRs128 per person. With a road length of 67 km and assuming that the average bus load is 45 persons, the economic personal travel cost is equivalent to a bus operating cost of NRs86 per km.

23. The Silgadhi-Sanfebagar road is not open throughout the year; currently, it is reported as being effectively closed for three months of the year. Therefore, the benefits have been reduced to 85 percent of the maximum possible. Anticipation of the closure during the rainy season means that the reduction in benefit should be less than the duration of the closure.

D. Maintenance Costs

24. Road maintenance costs comprise annual routine and recurrent maintenance plus periodic maintenance. Where maintenance costs are lower with an improved road, the cost saving is considered to be a benefit. Actual maintenance costs are difficult to determine in Nepal due to the way funds are allocated and recorded. Actual periodic maintenance costs were available for, and applied to, the Hetauda-Narayangarh road. In other cases, generalized costs have been applied. These are based on estimates of maintenance costs in economic terms made by the MRCU in 1999. Given the current low rate of inflation, these costs were taken as 2000 costs. These generalized maintenance costs for bitumen roads are (i) routine: NRs5,000 per km in hill areas and NRs10,000 per km in the Terai; (ii) recurrent: NRs45,000 per km; (iii) periodic: NRs210 per sq m for double-bound surface treatment (DBST) and NRs137 per sq m for single bound surface treatment (SBST); and (iv) rehabilitation: NRs900 per sq m. To simplify the calculation of earth road maintenance costs, the following formulas were used to estimate annual costs, in NRs per km (where AADT is the Annualized Average Daily Traffic):

Hill Areas:	$547 * AADT + 111,000$
Terai:	$275 * AADT + 69,700$

25. All unsealed roads were regarded as earth roads as there is no evidence that conventional gravel road maintenance involving grading and regravelling takes place. No periodic maintenance was allowed for in the case of earth roads. Periodic maintenance in the form of SBST reseals every six years was assumed in the case of hill roads and DBST reseals on the EWH.

E. Traffic

26. Annual traffic levels required for benefit calculation have been interpolated between current traffic figures and historic traffic data obtained from appraisal reports, feasibility studies, and DOR traffic counts.

27. In the case of the hill area roads, traffic has been classified in three vehicle categories: utilities, buses, and trucks. In the east, the utility category was further divided into two, with utilities operating a public transport service, and referred to as "taxis," treated as a separate category. In the case of the evaluation of sections of the EWH, cars were also included as a vehicle category. Motorcycles, three-wheelers, tractors, and nonmotorized traffic were not considered. Although significant in numbers on some sections of the EWH, such vehicles are normally operating over short distances and numbers are difficult to determine for an evaluation.

Also, the benefits to them are small in comparison to other vehicle types and so excluding them has little impact on the result.

28. A general normal traffic growth of 8 percent per year was assumed. Where traffic has grown significantly faster than this, the additional traffic was classified as generated traffic for evaluation purposes. On the EWH, no generation was assumed. Only in the case of the Hetauda-Narayangarh road has traffic increased significantly faster than 8 percent, but much of this would be the result of improvements to the network in the area. In particular, there has been diversion from the Hetauda-Naubise section of the Rajpath (the original access road to Kathmandu from the south). For simplicity, all traffic on the Hetauda-Narayangarh road was classified as normal, since to classify it accurately would require a complete analysis of traffic patterns on the strategic road network in central Nepal. All traffic, normal and generated, was projected to increase at 8 percent per year from the present levels.

F. Construction Costs

29. The costs included for the roads were those for the civil construction works and the consultancy for design and supervision. These costs mostly were taken from project completion reports, in which final contract amounts are given in Nepalese rupees. In many cases, the consultancy costs had to be allocated to several individual road projects, which was done on the basis of the proportional size of each road contract. Project preparation costs were not included. For the evaluation, costs and benefits have been calculated from unit prices expressed in economic terms, rather than using actual market or financial prices. In some cases, actual costs were available in economic terms from the project performance audit reports. If not, economic construction costs were estimated from contract costs by applying the standard conversion factor of 0.88 recommended by the MRCU.

30. No residual values were applied. A residual value for the project at the end of the evaluation period is often included in project appraisals. If included, it is usually calculated simply as a percentage of the construction cost. Often, this will not represent the true remaining value of the project to the economy. A more accurate valuation would often be based on the estimated future net benefits to be obtained beyond the evaluation period, which are not related to the original construction cost. However, in cases where the road project is expected to be further upgraded to a higher standard at the end of the evaluation period, or to require rehabilitation to restore it to the original condition, the residual value can be considered to be the reduction in the cost of the works required compared with those if the original project had not been implemented. Because of these difficulties, and the fact that the impact in present value terms is very small, a residual value has not been applied in the case of road upgrading and rehabilitation.

G. Results

31. The results are outlined in Tables A8.2-A8.4. The three packages of roads gave recalculated EIRRs of 3 percent for the east, 5 percent for Far Western Region, and 17 percent for the EWH. The low results for the hill areas reflect the low traffic volumes in relation to the costs of road upgrading. The relatively high traffic levels along the EWH underlie the good results for that package. The benefits in Far Western Region are dominated by those from the Silgadhi-Sanfegagar road, highlighting the strong impact on road user costs that provision of motorized access can have, and conversely, the limited impact on those costs of road upgrading.

32. As indicated in para. 1, the above results for the eastern hills underestimate the actual result because benefits from increased agricultural output could not be quantified. “Back-of-the-envelope” type calculations suggest that the incremental value of dairy production could add one percentage point to the EIRR for the east.

Table A8.1: Reevaluated Road Sections

ADB Project	Section	Work Type	Length
Far Western Region Roads			
Feeder Roads Project	Godawari-Sahajpur	Upgrade	41
Third Road Improvement Project	Sahajpur-Syaude	Upgrade	66
“	Syaude-Dadeldhura	Upgrade	3
“	Dadeldhura-km 132	Upgrade	12
Road Improvement Project	Syaude-Dipayal	Upgrade	54
“	Dipayal-Silgadhi	Upgrade	11
Seti Zone Rural Development Project	Silgadhi-Sanfebagar	New Road	67
Eastern Roads			
Feeder Roads Project	Charali-Kanyam	Reseal	28
“	Kanyam-Fikkal	Upgrade	10
“	Fikkal-Maikhola	Upgrade	27
“	Fikkal-Pashupatinagar	Upgrade	11
Third Road Improvement Project	Maikhola-Ilam	Upgrade ^a	15
“	Ilam-km 119	Upgrade	44
East-West Highway			
Road Improvement Project	Belbari (km 78)-Chuharwa (km 218)	Rehab. ^b	134
Second Road Improvement Project	Chuharwa (km 218)-Dhalkebar (km 267)	Rehab. ^b	49
“	Dhalkebar (km 267)-Pathlaiya (km 366)	Reseal	99
“	Hetauda-Pathlaiya	Rehab.	29
“	Pathlaiya-Birganj	Rehab.	28
Hetauda-Narayangarh Road Project	Hetauda-Narayangarh	Upgrade	78

ADB = Asian Development Bank, km = kilometer.

^a Maikhola-Ilam was also regravelled as part of the earlier Feeder Roads Project.

^b Belbari-Chuharwa-Dhalkebar was widened during rehabilitation.

Table A8.2: East
(NRs'000)

Year	Charali-Kanyam			Kanyam-Fikkal			Fikkal-Maikhola			Fikkal-Pashupatinagar			Maikhola-Ilam			Ilam-km 119			Total Benefits	Economic Costs	EIRR
	Maintenance Saving	Road User Savings		Maintenance Saving	Road User Savings		Maintenance Saving	Road User Savings		Maintenance Saving	Road User Savings		Maintenance Saving	Road User Savings		Maintenance Saving	Road User Savings				3%
		Normal	Generated		Normal	Generated		Normal	Generated		Normal	Generated		Normal	Generated		Normal	Generated		Net Benefits	
1983																					
1984																					
1985																					17,828
1986																					14,247
1987																					- 60,636 (60,636)
1988																					- 61,032 (61,032)
1989																					- 41,386 (41,386)
1990																					- 13,928 (13,928)
1991																					- 27,083 (27,083)
1992																					- 199,716 (199,716)
1993		332	147		2,081	687		3,271	1,213		499	1,067									9,297 172,264 (162,967)
1994	1,260	664	293	1,381	4,162	1,374	3,286	6,543	2,425	1,136	998	2,134	3,693	1,339							30,689 85,079 (54,391)
1995	1,260	1,089	456	1,415	4,490	1,481	3,340	7,076	2,614	1,143	1,076	2,300	2,697	962							31,398 17,861 (13,537)
1996	1,260	1,653	664	1,451	4,843	1,597	3,397	7,652	2,819	1,151	1,161	2,479	1,523	538							32,186 50,986 (18,800)
1997	1,260	2,362	914	1,490	5,217	1,717	3,460	8,263	3,032	1,159	1,250	2,665	744	261							33,795 120,827 (87,032)
1998	1,260	3,237	2,387	1,533	5,610	3,457	3,527	8,905	6,324	1,168	1,344	2,858	1,924	5,714	4,032	4,469	2,791				60,539 269,807 (209,267)
1999	1,260	4,232	2,986	1,578	5,995	3,672	3,600	9,536	6,720	1,178	1,436	3,039	1,964	6,182	4,346	4,994	8,938	5,583			77,241 327,218 (249,977)
2000	(21,756)	5,904	4,146	(6,592)	6,563	4,053	(18,925)	10,479	7,412	(7,771)	1,572	3,350	2,007	6,687	4,685	5,056	9,642	6,019			22,530 178,376 (155,846)
2001	1,260	7,636	5,232	1,681	7,077	4,366	3,763	11,299	7,986	1,200	1,696	3,609	2,052	7,203	5,039	5,122	10,400	6,489			93,112 - 93,112
2002	1,260	9,728	6,522	1,739	7,632	4,704	3,853	12,183	8,603	1,212	1,828	3,888	2,101	7,747	5,407	5,194	11,202	6,983			101,787 - 101,787
2003	1,260	12,199	8,008	1,801	8,216	5,053	3,950	13,111	9,244	1,225	1,968	4,179	2,154	8,287	5,759	5,272	12,045	7,498			111,228 111,228
2004	1,260	15,093	9,713	1,869	8,826	5,412	4,054	14,079	9,902	1,239	2,114	4,478	(10,119)	9,062	6,334	5,356	12,877	7,994			109,545 109,545
2005	1,260	18,343	11,554	1,941	9,416	5,739	4,168	15,008	10,506	1,255	2,255	4,754	2,273	9,774	6,826	(30,722)	14,091	8,780			97,220 97,220
2006	(21,756)	22,883	14,344	(6,200)	10,295	6,312	(18,315)	16,422	11,550	(7,688)	2,466	5,223	2,340	10,540	7,357	5,544	15,196	9,464			85,975 85,975
2007	1,260	24,655	15,436	2,105	11,097	6,797	4,422	17,700	12,439	1,290	2,658	5,625	2,412	11,349	7,910	5,650	16,387	10,201			159,392 159,392
2008	1,260	26,562	16,610	2,196	11,962	7,319	4,564	19,076	13,395	1,309	2,865	6,058	2,490	12,197	8,482	5,764	17,642	10,972			170,724 170,724
2009	1,260	28,540	17,805	2,295	12,866	7,857	4,718	20,513	14,382	1,330	3,081	6,506	2,574	13,026	9,022	5,887	18,955	11,773			182,390 182,390
2010	1,260	30,567	19,005	2,402	13,804	8,405	4,884	22,000	15,389	1,353	3,305	6,963	(9,666)	14,227	9,894	6,020	20,235	12,535			182,582 182,582
2011	1,260	32,394	20,008	2,517	14,687	8,893	5,064	23,390	16,289	1,377	3,515	7,375	2,762	15,338	10,659	(30,005)	22,110	13,732			171,367 171,367
2012	(21,756)	35,442	21,986	(5,578)	16,025	9,739	(17,347)	25,533	17,834	(7,556)	3,836	8,071	2,868	16,536	11,483	6,319	23,835	14,797			162,067 162,067
2013	1,260	38,158	23,645	2,776	17,265	10,483	5,467	27,504	19,197	1,432	4,133	8,689	2,982	17,792	12,339	6,486	25,694	15,944			241,247 241,247
2014	-	-	-	-	-	-	-	-	-	-	-	-	1,440	-	-	6,667	27,643	17,138			52,888 52,888
2015	-	-	-	-	-	-	-	-	-	-	-	-	1,440	-	-	6,863	29,670	18,371			56,343 56,343
2016	-	-	-	-	-	-	-	-	-	-	-	-	(10,890)	-	-	7,074	31,604	19,520			47,308 47,308
2017	-	-	-	-	-	-	-	-	-	-	-	-	1,440	-	-	(28,866)	34,455	21,316			28,345 28,345
2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,548	37,127	22,960			67,635 67,635
2019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			- -
2020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			- -

Table A8.3: Far Western Region
(Rs'000)

Year	Godawari-Sahajpur			Sahajpur-Syaude			Syaude-Dadeldhura			Dadeldhura-km 132			Syaude-Dipayal			Dipayal-Silgadhi			Silgadhi-Sanfegagar			Total Benefits	Economic Costs	EIRR 5%	Net Benefits	
	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated	Maintenance Saving	Road User Savings Normal	Road User Savings Generated					
1983																										
1984																										
1985																								30,756	(30,756)	
1986																								67,692	(67,692)	
1987																								286,982	(286,982)	
1988																								228,457	(228,457)	
1989																								147,290	(147,290)	
1990																								198,355	(198,355)	
1991													3,240	1,120		660	228							251,720	(251,720)	
1992												5,775	6,480	2,239	1,176	1,320	456						17,447	603,815	(586,369)	
1993		4,118	841									5,822	6,987	2,414	1,186	1,423	492						23,282	377,477	(354,194)	
1994	4,773	8,236	1,682									5,873	7,532	2,603	1,196	1,534	530						33,959	418,330	(384,371)	
1995	4,840	8,882	1,813									5,928	8,105	2,801	1,208	1,651	571		20,849	42,056			98,702	293,018	(194,316)	
1996	4,912	9,579	5,494									5,988	8,702	6,117	1,220	1,773	1,246	(8,536)	41,698	84,112			162,303	456,317	(294,014)	
1997	4,990	10,313	5,911									6,052	9,273	6,521	1,233	1,889	1,328	(8,624)	44,879	90,434			174,200	424,983	(250,783)	
1998	5,074	11,082	6,345		9,138	6,035			374	217		(38,267)	10,190	7,162	(7,795)	2,076	1,459	(8,719)	48,021	96,491			148,884	76,360	72,524	
1999	5,165	11,830	7,766	8,315	18,276	12,071	367	748	433		1,160	133	6,196	10,984	7,720	1,262	2,237	1,573	(8,822)	50,828	101,499		239,743	125,434	114,308	
2000	(28,438)	12,971	8,535	8,473	19,709	13,013	373	806	476	1,366	2,321	267	6,277	11,838	8,321	1,279	2,412	1,695	(8,933)	54,894	109,619		227,275	57,200	170,075	
2001	5,370	13,985	9,200	8,644	21,253	14,027	380	870	513	1,383	2,503	288	6,365	12,732	8,951	1,297	2,593	1,823	(9,052)	59,286	118,388		280,797		280,797	
2002	5,485	15,077	9,916	8,829	22,877	15,089	387	936	552	1,402	2,699	310	6,459	13,658	9,604	1,316	2,782	1,956	(9,182)	64,029	127,859		302,040		302,040	
2003	5,609	16,224	10,663	9,028	24,575	16,193	395	1,005	592	1,422	2,906	334	6,561	14,530	10,222	1,337	2,960	2,082	(9,321)	69,151	138,088		324,554		324,554	
2004	5,742	17,418	11,438	9,244	26,212	17,239	404	1,071	630	1,444	3,123	359	(37,716)	15,930	11,202	(7,683)	3,245	2,282	(9,472)	74,683	149,135		295,929		295,929	
2005	5,887	18,560	12,167	(44,776)	28,769	18,969	(2,053)	1,177	693	1,467	3,335	382	6,791	17,164	12,070	1,383	3,496	2,459	(9,635)	80,658	161,066		320,029		320,029	
2006	(27,659)	20,317	13,341	9,728	31,015	20,443	423	1,268	747	(8,372)	3,655	420	6,919	18,492	13,005	1,409	3,767	2,649	(9,811)	87,110	173,951		362,819		362,819	
2007	6,211	21,896	14,374	9,999	33,433	22,030	434	1,367	805	1,519	3,941	453	7,058	19,872	13,978	1,438	4,048	2,847	(10,001)	94,079	187,867		437,649		437,649	
2008	6,393	23,597	15,486	10,292	35,968	23,684	445	1,471	866	1,549	4,249	488	7,208	21,291	14,979	1,468	4,337	3,051	(10,206)	101,605	202,897		471,119		471,119	
2009	6,590	25,371	16,640	10,608	38,600	25,394	458	1,578	928	1,580	4,573	525	7,370	22,594	15,903	1,501	4,603	3,239	(10,427)	109,734	219,129		506,491		506,491	
2010	6,802	27,204	17,828	10,950	41,094	26,984	472	1,679	987	1,615	4,910	563	(36,843)	24,695	17,377	(7,505)	5,031	3,540	(10,666)	118,512	236,659		491,886		491,886	
2011	7,032	28,913	18,916	(42,933)	45,023	29,619	(1,980)	1,840	1,083	1,652	5,234	600	7,734	26,594	18,714	1,575	5,417	3,812	(10,925)	127,993	255,592		531,506		531,506	
2012	(26,423)	31,570	20,677	11,718	48,517	31,907	502	1,983	1,167	(8,172)	5,727	657							(11,204)	138,233	276,039		522,898		522,898	
2013	7,547	34,005	22,266	12,149	52,278	34,370	519	2,137	1,257	1,735	6,173	708							(11,505)	149,292	298,122		611,051		611,051	
2014				12,614	56,190	36,920	538	2,296	1,350	1,782	6,652	763							(11,831)	161,235	321,972		590,481		590,481	
2015				13,116	60,222	39,534	558	2,460	1,446	1,832	7,153	820							(12,182)	174,134	347,730		636,821		636,821	
2016				13,658	63,933	41,898	579	2,611	1,533	1,886	7,672	879											134,649		134,649	
2017				(40,008)	69,861	45,835	(1,863)	2,853	1,676	1,945	8,159	934											89,392		89,392	
2018				14,876	75,237	49,348	628	3,073	1,805	(7,856)	8,905	1,020											147,036		147,036	
2019										2,077	9,593	1,098												12,768		12,768
2020																										

**Table A8.4: East-West Highway
(NRs'000)**

Year	Belbari (km 78)- Chuharwa (km 218)		Chuharwa (km 218)- Dhalkebar (km 267)		Dhalkebar (km 267)- Pathlaiya (km 366)		Hetauda-Pathlaiya		Pathlaiya-Birganj		Hetauda-Narayangarh		Total Benefits	Economic Costs	EIRR 17%		
	Maintenance Savings	Road User Savings	Maintenance Savings	Road User Savings	Maintenance Savings	Road User Savings	Maintenance Savings	Road User Savings	Maintenance Savings	Road User Savings	Maintenance Savings	Road User Savings			Net Benefits		
1974															32,383	(32,383)	
1975															30,686	(30,686)	
1976															96,413	(96,413)	
1977															-	327,284	(327,284)
1978		-		-		-		-		-		-		-	355,178	(355,178)	
1979		-		-		-		-		-		-		-	142,115	(142,115)	
1980		-		-		-		-		-		-		-	129,086	(129,086)	
1981		-		-		-		-		-		80,008	80,008		107,261	(27,253)	
1982		-		-		-		-		-	12,784	160,016	172,800		152,587	20,214	
1983		-		-		-		-		-	13,515	174,192	187,707		81,938	105,769	
1984		-		-		-		-		-	14,459	192,740	207,200			207,200	
1985		-		-		-		-		-	15,510	213,049	228,559			228,559	
1986		-		-		-		-		-	16,680	235,177	251,857			251,857	
1987		-		-		-		-		-	17,983	258,073	276,056			276,056	
1988		-		-		-		-		-	19,437	282,730	302,167			302,167	
1989		-		-		-		-		-	(77,219)	319,750	242,531			242,531	
1990		-		-		-		-		-	22,876	354,843	377,719	272,425		105,295	
1991		-		-		-		-		-	24,907	394,036	418,943	151,564		267,380	
1992		-		-		-		-		-	27,182	436,883	464,065	342,180		121,885	
1993		18,142		-		-		-		-	29,734	483,467	531,343	557,253	(25,909)		
1994	6,008	36,285		-		-		-		-	32,601	530,779	605,672	359,908	245,765		
1995	6,008	58,754		3,956		4,570		-		-	35,825	581,810	690,923	397,575	293,348		
1996	6,008	88,717	2,205	7,912	4,455	9,141	14,545		11,797	39,458	661,876	846,113	416,206	429,907			
1997	6,008	126,529	2,205	14,340	4,455	22,230	22,230	1,305	29,091	1,260	23,594	43,557	738,022	1,012,595	370,733	641,862	
1998	6,008	173,460	2,205	22,958	4,455	40,041	40,041	1,305	42,182	1,260	34,862	48,190	823,687	1,200,612	9,907	1,190,706	
1999	6,008	226,988	2,205	33,729	4,455	62,209	62,209	1,305	58,773	1,260	49,311	53,437	917,362	1,417,040		1,417,040	
2000	(162,203)	321,960	2,205	46,926	4,455	89,260	89,260	1,305	78,955	1,260	67,132	58,174	987,605	1,497,034		1,497,034	
2001	6,008	412,445	2,205	61,494	4,455	118,155	118,155	1,305	103,181	1,260	88,769	62,456	1,044,452	1,906,184		1,906,184	
2002	6,008	521,090	(59,535)	88,994	(120,285)	176,569	176,569	1,305	130,343	1,260	113,456	-	859,205			859,205	
2003	6,008	648,264	2,205	116,023	4,455	233,938	233,938	(35,235)	174,217	(34,020)	151,843	-	1,267,698			1,267,698	
2004	6,008	796,134	2,205	148,732	4,455	303,618	303,618	1,305	219,287	1,260	192,377	-	1,675,380			1,675,380	
2005	6,008	959,955	2,205	187,199	4,455	385,242	385,242	1,305	272,977	1,260	240,850	-	2,061,456			2,061,456	
2006	(162,203)	1,195,466	2,205	232,103	4,455	480,158	480,158	1,305	335,631	1,260	297,755	-	2,388,135			2,388,135	
2007	6,008	1,287,475	2,205	281,795	4,455	583,348	583,348	1,305	408,303	1,260	364,108	-	2,940,262			2,940,262	
2008	6,008	1,386,462	(59,535)	354,927	(120,285)	738,960	738,960	1,305	460,774	1,260	412,500	-	3,182,376			3,182,376	
2009	6,008	1,488,418	2,205	431,858	4,455	904,076	904,076	(35,235)	506,168	(34,020)	452,202	-	3,726,135			3,726,135	
2010	6,008	1,592,168	2,205	465,060	4,455	972,531	972,531	1,305	545,220	1,260	487,262	-	4,077,474			4,077,474	
2011	6,008	1,683,314	2,205	499,257	4,455	1,041,751	1,041,751	1,305	587,239	1,260	524,999	-	4,351,792			4,351,792	
2012	(162,203)	1,844,564	2,205	534,054	4,455	1,110,589	1,110,589	1,305	630,636	1,260	564,184	-	4,531,050			4,531,050	
2013	6,008	1,985,154	2,205	564,618	4,455	1,165,790	1,165,790	1,305	674,929	1,260	604,420	-	5,010,144			5,010,144	
2014	-	-	(59,535)	618,711	(120,285)	1,283,650	1,283,650	1,305	714,245	1,260	640,869	-	3,080,221			3,080,221	
2015	-	-	2,205	665,866	4,455	1,379,852	1,379,852	(35,235)	782,173	(34,020)	700,922	-	3,466,218			3,466,218	
2016	-	-	-	-	-	-	-	1,305	841,923	1,260	754,710	-	1,599,198			1,599,198	
2017	-	-	-	-	-	-	-	-	-	-	-	-	-			-	
2018	-	-	-	-	-	-	-	-	-	-	-	-	-			-	
2019	-	-	-	-	-	-	-	-	-	-	-	-	-			-	
2020	-	-	-	-	-	-	-	-	-	-	-	-	-			-	

			Length
Far West Roads			
1	Feeder Road:	Godavari-Sahajpur	41
2	TRIP	2A Sahajpur-Syaule Bazar	66
		2B Syaule Bazar-Dadeldhura	3
		2C Dadeldhura-km 132	12
3	Roads Improv	3A Syaule Bazar-Dipayal	54
		3B Dipayal-Silgadhi	11
4	Seti Zone RD	4 Silgadhi-Sanfe Bagar	67
East Roads			
5	Feeder Road:	5A Charali-Kanyam	28
		5B Kanyam-Fikkal	10
		5C Fikkal-Mai Khola	27.5
		5D Fikkal-Pashupatinagar	10.9
6	TRIP	6A Mai Khola-Ilam	15.2
		6B Ilam-km 119	
East-West Highway			
7	Roads Improv	7 Belbari (km 78)-Chauharwa (km 218)	134
8	Second Road	8 Chaharwa (km 218)-Dhalkebar (km 267)	49
9	Second Road	9 Dhalkebar (km 267)-Pathlaiya (km 366)	99
10	Second Road	10A Hetauda-Pathlaiya	29
		10B Pathlaiya-Birgunj	28
11		11 Hetauda-Narayanghat	78

Future traffic growth 1.08

VOC Coefficients

	Car	Utility	Taxi	Truck	Bus	Truck	Bus	Truck	Bus
A	7.08	8.90	3.92	5.61	6.66	6.95	8.10	5.61	6.66
grad	0.0066	0.0166	0.0383	0.0530	0.1941	0.1098	0.2465	0.0530	0.1941
IRI	-0.1150	-0.0560	0.2340	-0.1710	0.2160	0.0230	0.3430	-0.1710	0.2160
IRI ²	0.0322	0.0498	0.0319	0.0377	0.0415	0.0438	0.0526	0.0377	0.0415

WITHOUT standing charges

WITH standing charges

WITHOUT standing charges

Road Maintenance Economic Costs (Rs/y, 1999)

Source: Maintenance and Rehabilitation Coordination Unit (MRCU)

Black top, major highways 6-7m wide often with two 1m paved shoulders

Routine per km	15000	Hills
	10000	Teari
Recurrent per km	45000	
Periodic per sq m	137	SBST
	210	DBST

Roughness without case hill roads	IRI	20.0
Initial Roughness with case	IRI	3.0
Maximum paved roughness	IRI	18.0
Annual increments with only routine and recurrent maintenance	IRI	1.0

Roughness progression increments (IRI)
for a maintained black top ('with' project)

Year	IRI increment		
0	0.1		0.1
1	0.1		0.1
2	0.1		0.1
3	0.2		0.2
4	0.3		0.3
5	0.6		0.6
6	- 0.8	reseal	0.6
7	0.1		0.6
8	0.1		0.6
9	0.2		0.6
10	0.3		0.6
11	0.6		0.6
12	- 0.6	reseal	0.6
13	0.1		0.6
14	0.1		0.6
15	0.2		0.6
16	0.3		0.6
17	0.6		0.6
18	- 0.4	reseal	0.6
19	0.1		0.6
20	0.1		0.6