

**Framework for quantifying social and economic benefits from rural road development;  
Some thoughts and practical insights**

**By Thampil Pankaj, Ph.D (Retired Principal Transport Specialist, World Bank)**

.....  
**1.An illustrative anecdote:**

The social and economic importance of rural roads which are obvious to ordinary folks and world leaders, and the concurrent inadequacy of present appraisal methods for capturing their importance is illustrated by the following incident:

- 1.1 In April 1988, the World Bank President Mr. Wolfensohn made a speech to a World economists conference in Washington, when he said that whenever he met heads of States in different countries, the priorities they raised were generally: poverty, health facilities, schools, and rural roads. He said rural roads were needed to facilitate schooling, health services and many other social and economic needs. Mr. Wolfensohn said the World Bank and world economists must find ways to address these issues which are put on the table of most development conferences attended by Bank Presidents and country Presidents. This statement was very heartening to me as a Bank staff member, since I had for long pressed Bank management and colleagues to change the way we evaluated rural roads so as to truly reflect their immense social and other non-quantifiable benefits in promoting development and reducing rural poverty.
- 1.2 The following week I sent an internal note titled “ Translating Mr. Wolfensohn’s speech into actions: Case of Rural roads” to the Bank’s Chief Economist Prof. Joseph Stiglitz, with copies to Mr. Wolfensohn and most concerned Vice-Presidents and Directors in the Bank. The comments and high-level discussions this paper generated was truly an example of the free and stimulating intellectual environment in the World Bank.
- 1.3 The note argued that while the Bank President and world leaders accept the value of rural roads from the totality of their crucial impacts on social and economic factors, and therefore accord a high priority for investing on them, the Bank’s methods of appraisal of rural roads was unrealistic as it looked at only the small quantifiable part of their benefits, and hence gave a very low priority to rural roads. The paper urged changing the woefully inadequate and narrow way in which the Bank looked at rural roads purely in economic terms, based on a minimum threshold of economic return (ERR) of about 10-12%, without giving any weight to rural roads’ immense social benefits in promoting education of girls ( which has even impact on family planning and reduction of population growth rates later) and also general education, health facilities, and many other marketing and labour mobility aspects. While these benefits are quite obvious to world leaders and rural communities across the world, the Bank’s appraisal methods are blind towards them as these are difficult to quantify. As a result rural road projects were difficult to justify in the Bank, and many staff were reluctant to even to initiate such projects.

- 1.4 In order to translate the vision of the Bank President and world leaders into reality, the paper suggested the following solutions:
- (1) there should be clear acceptance that rural roads produce major social benefits which should be given weight in our evaluation , though they are difficult to quantify. Spending huge amounts in estimating such social benefits in each case would be wasteful.
  - (2) to simplify procedures and to capture their significant non-quantifiable benefits, include a correction factor in economic evaluation. One way is to give an arbitrary weight for social impacts ( say 50%) , requiring the minimum threshold of Economic return to be , say, half of what is currently required. This method would substantially correct the present anomaly, and would be better than ignoring these valuable benefits, leading to wrong investment priorities.
- 1.5 The consensus that emerged from these discussions were the following: Yes, the Bank procedures need to change in this respect. However, giving an arbitrary weight for social benefits will not be scientific. Norms and correction factors can be applied only if their rationale is established through well-designed studies, What is needed is to make some case studies for selected representative regions to assess the extent of such social benefits, and based on such studies to develop suitable norms or correction factors which can be applied to the whole region. This will provide an acceptable rationale for applying simple norms for quantifying social benefits.
- 1.6 Since I was at that time preparing a rural access project in mountainous Bhutan ( which was considered an extreme case because of high road construction costs on the mountainous areas and low traffic levels) , I was encouraged to try out my ideas and develop a methodology applicable to the special conditions of Bhutan. ( My resulting work demonstrated that some social benefits can be quantified through a case study, which can then be applied to the whole of Bhutan because most areas were similar. The case study showed an economic return of about 15%, based on an assessment of both social and economic benefits. The traditional method would have provided only about 5% ERR for this project. The Bank accepted this methodology and estimates of economic return including the efforts in quantifying some of the social benefits. The the rural road project in Bhutan was later approved by the Bank, and is now well under way. ( More on the Bhutan study , later in this paper).

## **2. Status of current thinking on rural roads evaluation:**

Based on my many years of experience in the World Bank and in client countries, I outline below my current ( limited) wisdom on the subject:

- 2.1 Where traffic level is relatively high, as in Bangladesh or many parts of India, a **modified traditional** approach in quantifying transport cost savings may suffice. The modification needed is in regard to looking closely at the alternative transport costs,

in the absence of the project. Closer study will show that if it is head loading (portage ) it will cost about 2 person days to move a ton-km, thus costing about \$2 per ton-km (based on studies in Ghana and elsewhere). If it is mule transport ( as in Bhutan/Nepal) it may cost about \$3 per ton –km, which includes cost of the animal and the persons handling them.

- 2.2 Where non-motor traffic ( NMT) is an important part of the transport system both before and after the project, ( as is the case in Bangladesh), it is important to bring in their cost and performance data more clearly into the analysis. Studies in Bangladesh showed that provision of tarred roads is beneficial and justified, even where the motorised vehicles are much below the usual thresholds; this is because the human energy cost of pulling a rickshaw van is considerably more on a gravel road than on a tarred road; it was found that on many rural roads in Bangladesh, the nmt traffic level which continued after the road improvement was high enough for investing on paving the roads. This approach has now been widely accepted by the World Bank and other donors in the case of Bangladesh.
- 2.3 However, for a wide array of cases, even the above modifications in estimating transport costs more carefully, will not provide enough quantifiable benefits for producing an economic rate of return of about 10-12%. Some form of quantification of the “social benefits “ is therefore needed. This is do-able, since social benefits also reflect economic gains which can be quantified with special efforts, at least in part.
- 2.4 Some agencies accept that a correction factor to vaguely reflect the social benefits could be added to standard transport cost savings approach. I understand some departments of the US Federal Government ( as the Indian Reservations Administration ) accept such norms. I do believe that if some norms can be designed based on actual case studies, and can be accepted by the investing agency , it will be great. It will simplify procedures in appraising rural road investment, and make them more realistic , compared to the situation where these benefits are ignored altogether.
- 2.5 I have no hope that an agency like the World Bank would accept the above approach, without having a rational basis for providing such adjustment norms, which would vary from region to region, depending on various regional factors. My experience narrated at the beginning of this paper confirms this view.
- 2.6 In order to gain acceptance of the economic experts and management of lending agencies like the World Bank, it is important that the case studies should be scientifically designed and should use rigorous economic and statistical analysis.
- 2.7 **I therefore suggest the following approach:** Make case studies in selected areas /regions so as to apply the findings to the larger area/region which broadly shares similar characteristics. For the selected area /region, make a detailed study and effort for quantifying some of the social benefits from rural roads, using available data and new research. Also carefully evaluate the transport cost savings as discussed earlier. The results showing overall benefits from rural access improvements under the case

study should then be expressed as a simple norm ( related to population of road users, investment per beneficiary, or simply as a correction factor to be applied to traditional economic analysis).

- 2.8 I would suggest that **international agencies and national agencies interested in promoting rural development and poverty alleviation should fund a number of well-designed case studies** in selected areas/ regions/countries. For large countries, I would suggest that such case studies be done in 3 or 4 different areas , while one or two areas will suffice in small countries. For example, separate studies may be done for India in 4 or 5 distinctive regions, while in medium size countries at least two or three studies could be done. While these case studies will be costly, there will be the advantage that their results would give a better basis for applying special norms or correction factors while evaluating rural road projects in the whole region/country. These studies may have to be repeated after 4-5 years if the conditions in the country change.
- 2.9 Over a period of time, sufficient good case studies from different countries will be available to enable broader conclusions to be drawn regarding the value and benefits of rural roads. **Hopefully, what has happened in the education sector will happen for rural roads in future. For education investments, major efforts were made since the 1960's to show that education was a human capital investment with tremendous economic benefits; gradually, specific studies to prove this point gave way to a general acceptance that education investments were generally high priority for social and economic development, and did not need to be justified on an individual basis. In the World Bank, education and health investments are today not subjected to economic return calculations to satisfy a threshold of ERR; they are only subjected to an analysis of whether the project components are optimal from the point of cost-effectiveness ( examples: Should the project spend more money on primary education or secondary education? Should more be invested on primary health or district hospitals, etc.)**
- 2.10 Many social benefits ( such as health benefits, education ) can be quantified in economic terms, at least partly, since they express themselves through some identifiable economic impact ( reduced days of sickness and absenteeism from work; increased income due to higher education, etc.).
- 2.11 The largest amount of benefits emerge when a region is getting its first access road, since first-time accessibility will open up the area to schools, health facilities and markets. However, even where present facilities exist, non-maintenance and neglect would gradually reverse the access benefits enjoyed so far, and a reverse movement of the area to lack of access to education and health facilities etc. will gradually result. In such situations the “ without project scenario” should be defined accordingly. This approach will provide a basis for justifying projects for maintaining/improving existing rural access roads.

2.12 Where already roads have been developed to varying degrees, the social impacts are not as massive as from opening a new road, but still significant. A recent study in India ( where road connections and connectivity of some kind exist in most regions) showed that the socio-economic development of areas , considering education, health , family planning, employment, income and other variables, were generally positively correlated with the type and condition of the roads. In other words, areas with poor accessibility were worse off compared to areas with better road access, the highest social and economic progress occurring in areas with established paved roads for a long time.

2.13

### **3. Design of case studies: Some Conceptual Issues:**

**3.1** I believe that the study design will vary with the situation in hand, depending on availability of existing data, need for new surveys, availability of funds etc. It also depends on the ingenuity and knowledge of the study authors. One has to think originally about how to use existing data and other information or new information to quantify the social and other benefits which are obvious to the common folks, and yet need to be expressed in terms of numbers/ dollars.

### **3.2 How to quantify perceived social benefits?**

First, one has to define the nature of social benefits related to the proposed rural access projects/investments. The following excerpt from a note to me by a highly regarded senior economist in the World Bank in the context of the of the Wolfensohn speech mentioned at the start of this paper, is very illuminating as a possible methodology: Referring to my paper on the inadequacy of the World Bank evaluation methods of rural road investments, he wrote :

**“ I hadn’t realized that rural roads were so difficult to defend economically, and thought that we didn’t count social benefits because they were additional icing on the cake. ....I would think it would be relatively straightforward to establish a rationale for investing in rural roads beyond the obvious benefits from lower transport costs and time savings. One line of argument could well be in terms of lowering the cost of investing and maintaining ( as well as providing access to ) social infrastructure—Schools, primary health care etc...weighted by population served to come up with a systematic and sensible quantification of indirect benefits from expanding the rural road network and hence a prioritized rural roads program we could support”. (Source: A note by Fred Kilby, World Bank)**

**The above definition of additional social benefits and methodology of quantification will indeed be a welcome change . I suggest that this methodology should be seriously pursued to check the results.**

**3.3** However I find two problems with the above method: (a) firstly, the reduced transport costs in sending construction materials to the new schools, and health centers and the reduced cost of maintaining these facilities and of providing operational inputs for the new schools/health centers etc. indirectly reflect the transport cost savings estimated through “generated traffic”. It is possible that generated traffic assumptions may not appropriately take these new facilities into account, and to that extent , the

estimates using the above method may be better. But to avoid “**double counting**” ( an issue raised in the TRLL’s concept document) , while using the above method, the generated traffic from these sources should be excluded.

(b) Secondly, the above method limits the assessment essentially to the implied transport and time savings in providing the facilities, and fails to capture at least some of the social benefits from accessing primary health care and schools. Since the road facilitated the location and use of the school, some of the benefits from schooling also should be attributed to the road investments. Schooling increases the income of the school-going children in the long run, and also bring in several other benefits such as better productivity (which is why income increases in the first place), and better awareness of family planning etc.. In the long run acceptance of family planning reduces the high growth of population in developing countries, which is one reason for poverty.. A study in Kenya showed that over a period of 30 years when education and health facilities improved, the growth rate of population declined substantially, producing tremendous economic impact. Roads had a definite role in facilitating the needed education and health inputs, and should receive part of the credit for this major social and economic benefit. Researchers should investigate ways of quantifying these benefits if possible

**3.4.** In the case of the Bhutan study ( see para 4.1.) we estimated in rough terms the net income increases due to new schools started in the area opened up by the road, and attributed a share of that benefit to roads. Similarly, access to health centers helps to reduce the level of morbidity, and cuts the number of days of sickness and of absence from productive jobs. I suggest that some of these additional benefits from improved access to education , health , etc. should be quantified and a share attributed to the road investments which helped facilitate or even cause the creation of these facilities. **While making such estimates from additional income etc., appropriate steps should be taken** to include the school and health care investments and expenditures also in the cost-matrix. In principle this makes the additional benefits to be result of joint investments including road and school investments; an apportionment of these additional benefits should be done on a proportionate basis or using some other yardsticks. Even if all road projects and school projects are not in the planning phase, a scenario can be designed where road access will be accompanied by other social investments, and along with them, other social benefits.

**3.5 New studies** ( such as the one in Vietnam, which focuses on poverty impact of roads, see below) may help design other methods of assessing social benefits from roads. Indeed reducing poverty and misery is a qualitative phenomenon, and its benefits may be hard to assess, beyond the measures on additional income from schooling , value of more productive days and savings in health care costs due to better access to health care facilities . **However there is scope for more thinking on how these poverty impact studies of rural infrastructure can be used to make a better, and more quantitative argument in favor of improving rural access.**

**3.6 Issue of double counting:** The TRLL concept paper raises this issue. The answer is indeed that this problem can be handled by sharp common sense by the

researchers doing the studies. Some “double-counting” situations have been discussed above. Another arose in the case of the Bhutan study. The Bhutan study includes a separate assessment of the agricultural impact ( net value added due to the road) of the road project, in terms of an expected change in cropping patterns with a shift to more cash crops. The study uses reduced transport costs of inputs and outputs following the switch to new crops, in order to estimate the new agricultural value added. We had separately estimated transport cost savings due to the road, using some growth factors in passenger and commodity traffic. In order to avoid double counting, we excluded the agricultural commodities from the traffic projections and transport cost saving estimates. Otherwise, adding the “net value added” from agriculture would have resulted in some double counting of transport cost savings.

### 3.6 Other issues raised in the letter of from TRLL:

- (a) **When to measure social benefits:** I believe that since measuring social benefits is difficult, this needs to be done only if transport cost savings and time savings approach ( the traditional methodology for transport projects) does not provide enough justification in terms of ERR ( economic rate of return) estimates. Where such traditional ERR is high enough to satisfy the threshold, references can be made to the nature and extent of social benefits from the project, without measuring them. Efforts in measuring them may not be essential in such cases. If relevant case studies are available, and if norms or correction factors are already available and allowed by the funding agency, these can be applied as a correction to the basic estimate. However, for low volume roads, the standard ERR estimates will not be able to justify investments in most cases. Then the data from comparable, relevant case should be used ( for example as done in the case of the Bhutan study discussed below). If international funding agencies will initiate scientifically designed case studies in different countries and geographical areas, covering a variety of situations, a sufficient body of evidence can be built up in the next 4-5 years, to argue successfully for using a correction factor for social benefits based on these studies. This strategy will give a rational basis for future use in many countries and situations, without repeating studies to justify each project.
- (b) **Nature of social benefits:** Social and economic benefits are mixed to a large extent. As mentioned, many of the social benefits can be quantified as they express themselves through economic impacts/parameters. In addition to economic benefits such as increased profitability of currently marketed goods, incentives for larger production and greater diversity of farm and non-farm production, better access will promote: (1) labor mobility and larger employment opportunities; (2) improved access to health, more work days available due to reduced morbidity and sick days per person; (3) better access to schools and higher percentage of people with basic education and literacy, which has been associated with better productivity and acceptance of change in farm and other production methods; (4) more girls receiving education with attendant benefits of improved, and healthier home management and better bringing up of children; greater acceptance of family planning which will

subsequently reduce overpopulation; (5) greater personal transport and increased social mobility with transfer of knowledge, more opportunity for new businesses and entrepreneurship etc. Above all, better access increases income and employment and also helps alleviate poverty in many ways. Raising people above the threshold of poverty is a major social impact. The Study in India referred below calls these multiple sectoral benefits from improved rural access as increase **in the level of KAP (Knowledge , Attitude, and Practices) of a community**. This study makes a detailed analysis of these impacts through education, health etc., using survey data of several villages and house holds under different levels of road connectivity.

- (c) **Not necessarily causal relationship:** Two aspects are important to note: Road connectivity is often only one of many factors that influence change in the state of development, social and economic, of a community. There are several other factors which are at work simultaneously ( including resource endowment, political factors etc) . Moreover, it is often not possible to establish a causal relationship between the road and the social and economic changes in its area of influence. Very often what a study can establish is simply that the road connectivity , along with other factors , are positively correlated with a given change. Multivariate analysis can be designed to indicate the extent of change due to road connectivity alone; two references to this kind of analysis done in India is mentioned in section 4 below ( Ref. Para 4.2 and 4.6).

#### **4. Case Studies: Examples**

This section will discuss some case studies related to quantification of social benefits from improved rural access: Mainly, the Bhutan study ( which is referred widely in the above discussions) and other recent studies from Vietnam, India and Bangladesh.

##### **4.1 Bhutan Case Study:**

This study ( done in 1999) was led by me ( as World Bank staff member) with other colleagues, and formed the basis of an appraisal of a rural roads project in Bhutan which the World Bank later approved ; that project is in good progress now. A more detailed summary of that study is presented as Annex 1 to this paper, and therefore, what is given below is only a brief overview of the study .

Bhutan lies on the high slopes of the Himalayas, and is therefore very mountainous, and road construction very expensive. However, 85% of its population lives in the remote rural areas in widely dispersed small valleys, with farming as their mainstay. The average distance of villages to nearest roads is often 3 or more **days'** walking distance. The Royal Government of Bhutan ( RGOB) considers it important to provide better access to education and health facilities for these rural areas so that most population will share in these benefits in their own rural settings, rather than to migrate to the limited and overcrowded urban centers in the country causing urban strife and sprawl. Given the high cost of road construction in Bhutan ( about \$100, 000 per kilometer compared to about \$10,000 in India or Bangladesh) and the low level of road use after road

construction ( about 30-50 vehicles per day compared to 10 times as many in India or Bangladesh), a justification for these road investments in terms of the traditional transport savings approach would be impossible to make. So the study made some rough estimates of some of the quantifiable social benefits: such as additional kids who will go to school and their future net additional income spread over the next 40 years, benefits from reduced sick days and more work days due to better access to health facilities, and net additional income from agriculture due to switch to more marketable cash crops , etc.

It was agreed from the beginning that since making detailed social benefit analysis will take considerable time and expenses, a sample study of one of the project roads would be adequate. Since most of Bhutan has similar characteristics of remoteness and economic endowments, the results from one case study would be applied to the other roads without repeating the study in their service areas. The project road selected was a road from Dakpai to Buli ( about 37 km) in the Zhemgang District of Bhutan ; most of the villages in the areas to be served by this road are currently 3-5 days' walking distance from nearest road. The present mode of travel is walking or mule transport, which has many limitations. Apart from the high cost of mule transport ( about \$3 per ton-km) , it cannot physically carry many construction materials needed to build schools and health centers.

The study received a head start from a previous study funded by the Norwegian Economic Development Agency ( NEDA) which showed contrasting socio-economic data from two neighboring groups of villages in the Zhemgang district , where the project road is located. It showed that two groups of villages similar in most respects but for proximity to roads, showed very different economic and social features. The villages which was within about 0.5 day of walking distance from the nearest road had higher income, and higher school enrollment than the villages about 3-5 days walking distance from nearest road. For example, enrollment rates for boys in these two areas were, respectively, 73% and 43 %, and the enrollment rates for girls were 64% and 22% respectively. During the road project study, it was estimated that about 75-100 additional kids will go to schools every year after the road is built ( since schools could now be located closer to these villages for which Govt. had already plans following the road completion ). Without the road, these kids would have remained illiterate, their income generally remaining at the level of farm labor, the minimum wage. Given the chance for school enrollment, many of them will go for higher education, and overall they will end up in better jobs through their life. A model using the current patterns of drop out rates through the school /college education system, and income distribution of educated Bhutanese was used for estimating net income from education over a period of about 40 – 50 years.

The cost of providing the education ( both public investment and running costs of schools, and the private costs in schooling and continuing education /training in later career, were taken into account to arrive at “net additional income” from education, attributable to the road investment. The fact that Bhutan has near full employment for its educated segment and may continue so for the next generation or so, made this approach realistic. Otherwise, adjustments would have to be made for unemployment rates as applied to the additional educated kids/individuals.

For estimating health benefits, existing data from Govt. sources and surveys were used to estimate the number of sick days of adult population in areas with and without access to health facilities. Similarly, farm models related to change of cropping patterns and switch to more cash crops ( such as oranges and vegetables) were used to estimate such changes in the project area; this was facilitated by the availability of such models some other districts of Bhutan.

In addition to the above estimated social benefits, the traditional transport cost savings estimates were also made, assuming a slow rate of growth in traffic using the road, and taking steps to avoid any double counting of benefits. The total benefits streams spread over a 40-year life span of the road was developed from the above analysis. It was accepted that a 40 –year life span for a well-designed rural access road is feasible with regular maintenance since its daily use will remain moderate, far from congestion levels.

The result of the above analysis showed an ERR of 15% for the Dhakpai-Buli road, based on quantifiable social and economic benefits. The ERR would have been only 8% without counting the education and health benefits ( making it non-viable with reference to a 10% ERR usually required. If the traditional assumption of 20 year life ( as against the 40 years we used ) were taken the ERR for the total benefits would have been only about 10.5%, and the ERR for traditional transport cost savings alone would have been only about 5%.

**Applying standards for other road components:**The World Bank accepted the above comprehensive analysis as a rational approximation, and approved the project investments as viable investments. Considering 8000 project beneficiaries for the Dhakpai-Buli road, it was estimated that per capita investment per beneficiary of \$450 would be viable ( yielding 15%ERR). Sensitivity analysis showed that an investment of about \$600 would yield a 12% return. For applying as a norm to other sub-projects under the total project ( the project had different roads totalling 120km), \$600 investment ( in 1999 prices) per beneficiary was therefore accepted , applying similar definition of “beneficiaries” as used in the Dakpai-Buli study. This simplified the economic analysis of the other roads to simply satisfying this criterion of remaining within the accepted per-beneficiary investment level.

An important note: This norm of \$600 per-beneficiary investment cannot be used in other countries without fresh analysis. This is in fact an extreme case, due to the high cost of road construction in Bhutan, low use per day, and the significant social benefits arising from the present remoteness of many rural communities ( 3-5 days’ walking distance to nearest roads). In most countries, such situations are not typical. For example in Bangladesh, the per beneficiary investment justified in recent projects is about \$30 as against \$600 in Bhutan.

**4.2 India Study:” Socio economic Impact Study of Rural roads in two Indian States”, by Centre of Studies in Social Sciences, Pune , India. (2001)**

This study was funded by the Swiss Development Cooperation (SDC) through the World Bank, and was supervised by World Bank staff. It is an attempt to assess the impact of different levels of road development (such as seasonal roads, gravel roads, black-topped roads etc) on the social and economic development of the rural communities served by these roads. It selected contrasting sets of communities, representing different geographical and cultural attributes, spread over two Indian States, and uses both secondary sources of data and fresh household surveys. It concludes that the social and economic indicators show a positive correlation to improvements in road type (quality).

This study has a wealth of data and conceptual discussion on the variety of social and economic impacts of roads. A well-designed follow-up study to have further surveys of the same village households, and for additional data analysis will further enhance the value of this study, and will provide a rich source of information for applying to different parts of India, and possibly elsewhere. I recommend funding such a study in any future research programs.

**4.3 Recent Study in Bangladesh:** Rural roads impact studies under the Second Rural Roads Improvement project funded through IDA and SDC (still in progress; draft report available from the World Bank Bangladesh team, or from the Bangladesh Institute of Development Studies. Contact in the Bank: Mr. Binyam Reja). This is a well-designed study of control villages (without projects) and project villages, spread over 4 years, and is based on extensive survey and other data. This study will be a rich source for findings related to the impact of rural roads, which can be relevant for many countries with similar characteristics.

4.4 Recent Study in Vietnam:

**The study mentioned below is possibly the best designed study of social impact assessment of rural roads.** When completed, it will be a rich source for understanding social and economic impacts of rural access and for designing scientific studies in the area which will be acceptable to the economic experts in development institutions. The reference below is from a draft paper on the subject, and a more advanced version of the study must be available by now.

Impact Evaluation of a Rural Road Rehabilitation Project  
Dominique van de Walle and Dorothyjean Cratty\*, *World Bank*

*Abstract: Assessing the welfare impacts of rural roads poses a number of problems, with implications for data collection and evaluation methods. The paper reports on a study being conducted to assess the impacts on living standards of a World Bank rural road rehabilitation project in Viet Nam. The evaluation approach combines double differencing with propensity score matching. Subject to a number of caveats, preliminary findings suggest impact on road quality in the project communes along with a shift in rehabilitation efforts from earth to sealed roads. We find that the project was to some*

---

*extent targeted to poor communes and that time savings were most pronounced for the poorest households.*

4.5. The World Bank has also prepared a **draft paper on methodology for future studies**, based on the Vietnam study format ( see below). This is an excellent model for designing future studies.

**SOCIOECONOMIC IMPACT ASSESSMENT OF  
SRURAL ROADS:**

**METHODOLOGY AND QUESTIONNAIRES**

This work was commissioned by the Roads and Rural Transport TG and the Transport Economics and Poverty TG. This document was drafted by Christiaan Grootaert, under the guidance of Christina Malmberg Calvo.

**4.6 Other studies:** The following paper gives an overview of many other studies which may be of use to researchers in the field. This was a presentation I made in the XXIst Road Congress in 1999. I particularly draw attention to a very significant research paper on impact of infrastructure on agriculture in India, by Biswanger, Khandker and Rosenzweig, as well as to some other papers listed therein.

“Socio-economic impact of rural roads in South Asia: Evidence from studies and lessons from experience “, Thampil Pankaj, Journal of the Road Engineering Association of Asia and Australia, Vol.8. No.1

Note: An annex is added with a fuller summary of the Bhutan Study; this can be detached.

## E.3 Bhutan: Rural Access Project: Economic Analysis<sup>1</sup>

### **A. Introduction**

**1. An IDA Credit for a “Rural Access Project’ in the Kingdom of Bhutan was approved by IDA Board in December 1999. The main project objective is to improve access of rural communities to markets, schools, health centers and other economic and social infrastructure, in order to improve the quality of life and productivity of rural communities. The project will , among other things, help construct about 120 kms of rural access roads in four districts ( dzongkhag) in Bhutan, where people have to walk about average two days to reach the nearest road. Bhutan has good agricultural potential, but its villages are on the slopes of its Himalayan ranges, and lack of access roads is a major socio-economic problem. The Royal Government of Bhutan ( RGOB) attaches great importance to improving rural access , as it will provide rural communities better access to markets, schools and health centers, and also help prevent rural to urban migration.**

**2. The note presented below is essentially Annex 4 of the Project Appraisal Document ( PAD; IDA report no.19795-BHU, dated Nov.19, 1999). It summarizes the economic analysis of one typical project road, the Dakpai-Buli road( 37 km) , which is taken as typical of the remaining project roads of about 85 km.**

**3. The main economic analysis and report was done by a team consisting of Thampil Pankaj, ( Team Leader for the Bhutan roads project preparation at the World Bank) and Eddy Bynens, with considerable support from Kynghkhor consultants of Bhutan who conducted various field studies and some of the analysis. The study received valuable guidance from Frannie Leautier, and support and advice from Juan Gaviria and other Bank colleagues, and full support from the RGOB. The detailed study is available from the Web-Page of the Rural Roads Thematic Group of the World Bank.**

### **B. General Approach**

4. A cost benefit analysis of the project investments has been carried out <sup>1</sup>; its main assumptions and findings are summarized below. Since gathering socio-economic data for each project rural road for purposes of estimating its economic rate of return (ERR) is difficult and expensive, and since these are low-volume roads (vehicles per day below 30), the following methodology has been used: for one typical project road (such as the 37 km. Dakpai-Buli road which has the advantage of considerable area-specific socio-economic data collected and analyzed by the Netherlands funding agency NEDA under their integrated development project for the district), its ERR was estimated in detail based on quantification of social and economic benefits. (Please see discussion of Bhutan's rural access constraints

---

<sup>1</sup> For detailed data and analysis, please see “Rural Access Roads: Details of Socio-Economic Analysis” by T. Pankaj, and E. Bynens , Dec.99 ( Available in the web-page of the Rural transport Thematic Group, World Bank).

and related data under Section 2 of the main text in the PAD). Based on this sample exercise, socio-economic norms and criteria were developed to test the viability of all other project roads.

### C. *Cost Benefit Analysis of Dakpai-Buli Road*

#### Project Benefits

5. The project roads will provide many types of benefits: (a) It will improve access to social infrastructure (schools and health centers) providing many benefits from increased education and health facilities, and improved social interaction and mobility, which are important for social, and economic development. (b) It will provide better access to markets, by reducing transport costs, and also by making it physically feasible for the first time to transport certain types of goods (such as construction materials), since the existing mode of mule transport or portage cannot handle such items which are important for many economic activities (house building, school building, small hydro-electric projects, etc.) and for general economic development. (c) It will improve marketability of perishable goods through timely and cheaper transport, and this will provide a direct incentive for more market-oriented agriculture, with more profitable cash crops, and also raise rural income and employment. (d) Lastly, it will help sustain isolated rural communities spread over the difficult mountain slopes of the country (where 85% of Bhutan's population live and where 36% of the country's national income is produced) to remain accessible to the country's mainstream economy, and prevent their migration to urban areas which do not have the capacity to absorb them. Indeed, the project impact in all these benefit-categories will be limited primarily to the project areas.<sup>2</sup>

6. In what follows, an attempt is made to quantify some of the project benefits described above: from (a) social benefits, (b) transport cost savings, and (c) agricultural benefits. Benefits from (d), and other benefits such as industrial and regional development, will be difficult to quantify and therefore no attempt is made to assess these impacts. Even where quantification has been made, the limitations of data make it a partial assessment, thus resulting in a conservative estimates of project economic return. The analysis focuses on one project road, the Dakpai-Buli road, as discussed in para. 2 above.

7. **Social benefits:** A novel feature of the analysis is quantification of part of the social benefits (in addition to transport cost savings); we have made rough estimates of the value of better access to education which the road will provide, using Bhutanese data on enrollment levels with improved road access, and income levels of educated and uneducated persons. Improved road access (removing the present constraint of about 2 days' walking) will allow easy transport of children to schools, or schools may get located closer to the communities, leading to higher school enrollment levels, and improvement in the quality of schools. RGOB already plans on building new Elementary and Junior High Schools after some of these roads are constructed; at present the physical constraints in transport make school construction extremely difficult. Our preliminary estimates, based on higher enrollment rates in the more accessible areas in the same district, indicate that about 75-100 children, (over years) would additionally go to schools every year if the road is built (more girls because of

---

proximity, and more boys who would be released from the task of transporting goods); the life-time earnings of the educated vs. uneducated provides an estimate of the income differentials; the net incremental income has been estimated after deducting estimated education and continuing education costs: this is attributable as net value added by the road since the additional enrollment would not have happened without the improved access provided by the road. Indeed education (especially education of girls) brings many more social benefits than income benefits, but we limited our estimate to incremental income from education. We have also estimated some health benefits (in reduced sick days, and reduced maternity and other deaths) attributable to improved access to health facilities, based on available local data. Overall, about 30% of the project benefits come from quantifiable social benefits (estimated through a partial exercise).

### **Transport cost savings: `**

8. Basic traffic data has been estimated from traffic surveys in the project area (particularly existing mule traffic, and house-hold consumption patterns) conducted by local consultants, as well as data on actual traffic growth in another similar area of the district where a feeder road was completed about 5 years ago. The current traffic level in goods (all traffic that is likely to shift to the road, currently moved as mule traffic or portage) is about 10 tons per day, which is small. However, with the road and the physical possibility of moving many items which are difficult to transport on mules (such as several items for house -construction and school buildings, small equipment for household and other use, and more consumption goods, and forest produce and handicraft items from the project area), traffic will increase after the road is built. The estimates assume a traffic growth from about 10 vehicles per day (3 trucks, 2 buses and 5 light vehicles/pickups) in the opening year (2002) to about 22 vehicles per day in the 5th year, which is supported by traffic demand growth in the area, and the growth pattern observed after road development in a similar area in the district ( Tingtibi-Gomphu road). Traffic is assumed to reach a level of about 100 vehicles per day in year 27, when the capacity of this one-lane mountain road is expected to reach saturation. This projected traffic is an aggregation of all traffic (agricultural, non-agricultural, in existing, normal and induced growth). This modest level of traffic growth spread over such a long period underlines the conservative assumptions used.

9. *Defining accessibility in Bhutan:* It should be added that in a region where 2-3 days walking to the nearest road is usual, reducing this to even one day walking distance to/from a road is considered beneficial.. Villagers have said that a distance of one day walking allows them to go to the road for sending produce by truck or for other services (often staying with relatives overnight), or for services such as health centers or community schools to be located within such villages. It was mentioned that a common practice is for school children to stay with relatives, if the road /school area is within at least a day's walking distance so that parents can visit them often with food and other supplies. Longer distance is considered "too far" for such purposes. We have therefore considered villages within a day's walking distance (say 25 km) as falling within the direct beneficiary zone of project roads

10. Traffic projections: (see the detailed paper in Web Page for fuller discussion). As noted, the initial traffic level on the completed road is based on traffic surveys of present traffic level on mules and headloads, and the nature of unmet demand for construction

materials and other items which cannot be physically carried on mules. Traffic projections have been made on realistic, conservative assumptions: (1) For the first 5 years of traffic growth, we have used the simple assumption that it will follow traffic growth observed on in a similar road completed 5 years earlier in the same district (the Tingtibi-Gomphu road), which had similar traffic levels before the road was built. Traffic nearly doubled on this road from about 10 vehicles equivalent to 20 vehicles per day in five years, and since the Buli area has greater traffic potential, this rate of growth is conservative. 2) The normal traffic growth for goods has been taken at annual 6% for the entire traffic projection period of 27 years, reflecting the recent annual GDP growth rate in Bhutan of 6%, which is expected to continue. This again is a conservative assumption since traffic growth in a developing area like this could normally be about 1.5 times the GDP growth rate. (3) During the first 5 years, when traffic is assumed to double, the growth in excess of 6% normal annual growth rate has been taken as “induced traffic” due to the impetus of the road. the induced traffic growth is assumed to grow at 9% for 3 more years, the impetus for induced traffic wearing out in a total of about 8 years. After this phase, only normal growth will continue, assumed at 6%. About 35% of initial level goods traffic is agricultural traffic, based on traffic surveys; this is assumed to grow at a lower rate. (Details in the full paper in Web Page). (4) For passenger traffic, an annual growth rate of 5% is assumed (though many studies elsewhere show it will grow at higher rate than goods traffic); of this, 3 % is considered induced traffic, and 2% normal growth. (A low rate is used partly to avoid double counting of project benefits for school and health center visits, which is assessed separately).

11. Transport benefits have been estimated for the following four major categories: (i) transport savings on the normal growth of non-agricultural goods traffic assuming traffic levels without the road project (agricultural traffic is excluded since the benefits from transporting agricultural goods will be indirectly included in the estimate of incremental agricultural income); (ii) transport savings on the induced non-agricultural goods traffic (additional non agricultural traffic induced by the availability of the road); (iii) transport savings on the normal growth of passenger traffic (persons traveling in the absence of the new road); (iv) transport savings on the induced passenger traffic .

12. *Avoiding the error of double counting benefits:* The passenger traffic estimates are modest, since normally passenger traffic growth is found to exceed goods traffic growth in most cases. These figures exclude future bus traffic, if any, of children to/from schools or of people to/from health centers; since education benefits and health benefits are estimated separately on a different basis, we did not want to count their transport savings also as it would have meant double-counting of benefits; moreover such traffic is considered not significant. In the case of agricultural traffic, which is significant, the traffic was considered only for estimating road capacity/ saturation levels, but their transport savings were excluded to avoid double-counting of benefits. ( See also para 5.2)

13. The unit cost savings are significant since the alternative cost of mule transport is very high, about US \$3.0 equivalent per ton-km (as per field surveys and mule tariff established by RGOB), as against possible trucking cost of about \$0.4 per ton-km (assumed high in this terrain) after the road is built. For normal growth in existing traffic, the full reduction in costs is counted as project benefits; for induced traffic, only 50% of net benefits is counted as project benefits. Road transport benefits are assumed frozen at the level reached in 27th year since the road will reach saturation level of traffic at that time; the 27th year level of benefits is continued for the full road life of 40 years.

14. **Agricultural benefits:** As regards the agricultural benefits induced by the road, the estimate is based on a detailed analysis of the present cropping patterns in the area and the likely switch in cropping patterns to more profitable cash crops which will be induced by easier access and transportability to markets. A farm model with local production and cost coefficients has been used for this estimate. It estimates the net value added in agricultural production due to reduced transport costs of farm inputs and output, and increased switch-over to cash crops (such as oranges, chilies, other vegetables), based on similar experiences in Bhutan. It has been verified that apart from marginal increase in extension services and the use of more fertilizers and improved seeds, no significant agricultural investments in land improvements would be required to adapt to the expected switch towards marketable crops. The net incremental benefits from agriculture (after meeting all additional costs of farming and transport) have been taken as benefits brought about by the road, since the absence of a road is the main bottleneck in producing more market-oriented crops in this area.

( Note: See para 25, which notes a finding that even if the agriculture benefits were not estimated separately, instead taking only the transport cost savings related to the agricultural traffic, the project economic return would not have been very different).

### **Project Costs**

15. The construction of a road and its maintenance requires major initial investments, followed by subsequent smaller routine and periodic maintenance costs. The Dakpai-Buli road is being built from year 1 (1999) to year 3 (2001); the first year of full road use is taken as year 4 (2002), ignoring interim benefits from partial use of completed road sections. The stream of benefits and costs has been calculated for a 40 year period, (year 2002 to year 2041). This is justified since a well- designed mountain road with low traffic will last much more than 40 years if routine maintenance is done every year, and if periodically major repair works are undertaken. Adequate routine maintenance and a four-year cycle of periodic maintenance has been assumed in the cost stream to ensure a long life for the road. Moreover, Bhutan has a good past record on road maintenance, and community involvement in road maintenance is increasing, all of which will help sustain the road over a long life. For converting financial costs into economic costs, foreign components (mainly in construction costs) have been converted using c.i.f. ( import) prices without adjustments; all other local costs and benefits have been converted into economic (border) prices using a factor of 0.9.

#### D. *Overview of Results*

16. The analysis of project costs and benefits indicates a base case Economic Rate of Return ( ERR) of the project to be about 15% , indicating strong project viability. The following summarizes the results of ERR analysis:

Net present value (NPV) of economic cost benefit streams (at 12% discount rate),  
(in US\$ 000):

Cost of road investment and maintenance	3817
Total Benefit attributable to the road	6244
Transport benefits (non-agricultural traffic)	3476
Net agricultural benefits	956
Net education benefits	1699
Net health benefits	113
<b>ERR (base case)</b>	<b>15.1%</b>

#### **Main Assumptions:**

17. The main assumptions relate to higher school enrolment levels after road construction; traffic growth and transport savings; agricultural benefits; project life, and maintenance costs. These are described in paragraphs 5 through 13 above.

#### **Sensitivity analysis / Switching values of critical items:**

18. Varying the economic cost and benefit streams of the base case produces the following sensitivity table:

Variations in Cost stream	Variations in Benefit stream		
	80%	100%	120%
80%	ERR 15.1%	ERR 16.9%	ERR 18.5%
100%	ERR 13.6%	ERR 15.1%	ERR 16.5%
120%	ERR 12.5%	ERR 13.9%	ERR 15.1%

Varying the economic cost and benefit streams produces the following switching values (at 10% and at 12%) for the ERR.

Variations in Cost stream	Variations in Benefit stream		
	42%	61%	100%

100%	ERR 10.0%	ERR 12.0%	ERR 15.1%
162%			ERR 12.0%
237%			ERR 10.0%

The above figures show that the ERR estimates are robust, under varying pessimistic assumptions.

19. **Assumption regarding Life of the Road.** A separate sensitivity analysis was done with regard to the life of the road. The Base case ERR is based on 40 years life of the road, which is a realistic assumption, because this is a well designed mountainous road with low traffic, which should have even longer life; moreover, adequate maintenance allocation has been made in the analysis. Bhutan has a good past record of satisfactory road maintenance, and local user community involvement in road maintenance is part of the project design and understanding with RGOB.

For life assumption of 30 years and 20 years, the base case ERR will decline to 12.9% and 10.1% respectively. As noted above, these reduced life assumptions are not realistic. The results however highlight the need for good maintenance policies and practices to ensure viability of such road investments.

#### **Applying the Dakpai-Buli Road ERR analysis to the total Project:**

20.

We consider Dakpai-Buli as typical of other project roads. We have seen from the above analysis that this road (37 km costing about US\$3.6 million with about 8000 direct beneficiaries) produces an ERR of 15%. This amounts to a per capita cost of about US\$450 in terms of project cost per beneficiary. Based on this, the per capita investment corresponding to 12% ERR will be about US\$600 equivalent (assuming about 20% reduction in benefits under sensitivity analysis). In other words, based on the Buli road impact analysis, a per capita investment per beneficiary of US\$600 (in 1999 prices) is considered viable at 12% ERR. In view of the difficulty of repeating such detailed studies for all the project roads, and since the access problems and economic conditions are similar in the service areas of other project roads, we apply the norm of a maximum per capita (per beneficiary) cost of US\$600 as an acceptable threshold for economic viability. These criteria will need to be satisfied for all project roads, to be eligible for funding..

#### **Road Selection Criteria for Project Roads:**

21. Based on the above analysis, the following criteria ( among others) were agreed with RGOB for the selection of new roads under the project:

(i) The project roads have to be part of the list of feeder roads included as priority roads in the ongoing Eighth Five Year Plan. These road priorities have been decided on the basis of extensive participatory discussions involving local communities, district administrations, the Planning Commission and sector Ministries, and His Majesty the King, who visited all districts for discussion on plan priorities with the local communities. They reflect a

participatory, socio-economic prioritization process, based on national economic and regional development objectives; and

(ii) Based on the economic return calculations made for the Dakpai-Buli Road, a per capita investment per beneficiary of US\$600 (in 99 prices) is considered viable at 12% ERR (see para 13 above). All project roads should satisfy this criteria, in the sense that the investment per beneficiary should not exceed US\$600 (1999 prices) per direct beneficiary. The direct beneficiaries are to be estimated using population of directly benefiting villages (defined as villages without one day's walking distance from/to project road); it can be increased by about 10% to include other beneficiaries who would directly benefit from trade with or visits to the newly accessible areas. (This was the procedure followed for the Dakpai-Buli Road). The road construction costs are to be calculated in 1999 prices, including 15% physical contingency.

#### .E. Concluding Remarks:

22. This case study presents an extreme case where (i) the road investment cost is very high at about \$100,000 per km, even for a one-lane gravel road (because of mountainous terrain and the decision to use environmentally-friendly 'cut and fill method'); (ii) the number of beneficiaries per road is small due to sparse population (about 8 000 direct beneficiaries); (iii) and per capita investment is high, at about \$450 per beneficiary (compared to below \$100 in other countries). And yet the ERR is well above 12%. In spite of the high cost, the Bhutanese Government is keen to invest on such rural access, since it is critical for meeting the country's socio-economic priorities in strengthening rural economy and rural communities.

23. What the case illustrates is that, by attempting to carefully quantify the true economic costs of present transport bottlenecks (two-days walking distance to nearest road, use of expensive mule haulage which cannot physically transport many items such as building materials for schools and health centers, and the abundant socio-economic benefits which the investment will bring to the project area in future, the inherent case for the project could be established in quantitative way. The use of realistic mule transport costs in the absence of the project, quantification of social benefits, and the use of realistic 40-year life assumption for the road, have all contributed to the viable ERR estimate, in spite of high costs of the project. The 40-year life assumption for the project road was widely endorsed by experienced road engineers who reviewed the project, since it will be a well-built mountain road with relatively less traffic and good potential maintenance standards based on the good road maintenance record in Bhutan at present.

24. IDA Executive Directors, during Board consideration of the project, commended this new approach in assessing social benefits in rural road projects. The Quality Assurance Group of the Bank, which reviewed the project for quality at entry also commended the project for overall quality including the innovative method used in economic analysis. Indeed, such detailed studies of individual roads are expensive, but can be effectively undertaken on a sample basis, to establish an acceptable threshold of investment, as was done for this project. If the magnitude of economic benefits and viability can be established for one or two roads, it could be extended to show viability of other roads in the same area under similar conditions, by developing suitable criteria based on the sample studies.

25. Separate analysis of agricultural benefits: A comment needs to be added on the exercise in estimating separate benefits from net value added in agriculture due to switch to

market-based crops induced by the new road access. This was an elaborate procedure, using farm models from other parts of Bhutan where road availability has induced changes in cropping patterns. However, we later concluded that this exercise was not essential. The ERR estimates would have been almost similar, if agricultural traffic was included as part of total traffic, and their benefits assessed using transport cost savings and reasonable traffic growth assumptions..This would make the analysis much simpler and less time-consuming. A lesson for the future!

T.Pankaj  
7/20/00