Report No. 16738

Brazil
Impact Evaluation Report
Feeder Roads in Bahia

Secondary and Feeder Roads Project (Loan 1207-BR)
Second Feeder Roads Project (Loan 1730-BR)

June 13, 1997

Operations Evaluation Department

Currency Equivalents

Currency Unit = Brazilian Cruzeiro (CR$)

The Real (R$)

US$1 = R$1.00 (May 1997)

Weights and Measures

1 meter (m)	=	3.28 feet
1 kilometer (km)	=	0.62 miles
1 hectare (ha)	=	10,000 m2 = 2.47 acres
1 square kilometer (km2)	=	100 ha = 247.1 acres=0.386 sq. miles
1 cubic meter (m3)	=	1.31 cubic yards = 264.2 US gallons
1 ton (t)	=	1,000 kg = 2,205 pounds
1 arroba	=	15 kg
1 sack	=	60 kg

Abbreviations and Acronyms

ADT	Annual Daily Traffic
BNDES	National Economic and Social Development Bank
CAR	Company for Development and Regional Action in Bahia
CEPLAC	Executive Commission for the Cocoa Farming Plan
COOLEITE	Milk Producers Cooperative of Itapetinga
CRIBA	Municipal Road Consortium of the State of Bahia
DERBA	State Highway Department of Bahia
DNER	National Highway Department
EBDA	Bahia State Company for Agrarian Development
ERR	Economic Rate of Return
FGV	Getulio Vargas Foundation
FR	Feeder Road
FR I	Secondary and Feeder Roads Project (Loan 1207-BR)
FR II	Second Feeder Roads Project (Loan 1730-BR)
FR III	Third Feeder Roads Project (Loan 2224-BR)
GEIPOT	Brazilian Company of Transport Planning
GERCA	Executive Group for the Rationalization of Coffee Planting
IBC	Brazilian Coffee Institute
ICB	Cocoa Institute of Bahia
IE	Impact Evaluation
ISPN	Institute for the Study of Society, Population and Nature
MRH	Homogeneous Micro-Region
PAR	Performance Audit Report
PCR	Project Completion Report
PIDERP	Integrated Project for the Development of the Paraguaçu Region
POLONORDESTE	Development Program of Integrated Areas of the Northeast
SAR	Staff Appraisal Report
SEAIN/SEPLAN-PR	Secretariat for International Affairs; Secretariat for Planning, Budget and Coordination (Brasilia)
STCE	Transports, Communications and Power Secretariat of the State of Bahia
SUDENE	Superintendency for the Development of the Northeast
USAID	United States Agency for International Development

Fiscal Year

Government: January 1 - December 31

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Operations Evaluation

June 13, 1997

OED EVALUATIVE MEMORANDUM ON IMPACT EVALUATION REPORT

BRAZIL: Feeder Roads in Bahia
Secondary and Feeder Roads Project (Loan 1207-BR)
Second Feeder Roads Project (Loan 1730-BR)

Attached is the Impact Evaluation Report (IER) on the Secondary and Feeder Roads Project (Loan 1207, approved in FY76) and the Second Feeder Roads Project (Loan 1730-BR, approved in FY79). This evaluation examines the impact of feeder roads some 10-15 years after completion of the two projects. It focuses on a sample of 20 roads out 63 roads financed by the two projects in the State of Bahia and assesses economic, social, and environmental impacts. Field work was done in 1993 and was complemented in 1996.

The projects financed road improvements in areas where one major commodity (coffee, cocoa, or dairy), was the predominant economic activity. The study found that the improved roads helped expand production of these commodities, especially in the early 1980s when the road works had just been completed. Farmers were able to market their products more easily and possibly even more importantly, were able to bring in machinery and other modern inputs. Later in the decade, and in the early 1990s, a sustained and severe drop in the market prices of coffee and cocoa, which reached their lowest levels in 1993, discouraged production. Dairy also was affected by the drop in prices, but to a lesser extent, because it was a more established industry and the price drop was less drastic. In recent years the coffee and the cocoa regions have diversified their economies, making them substantially less sensitive to changes in market prices of individual commodities. The improved roads appear to have been an important contributing factor in the regions' diversification strategies. Traffic on three quarters of the roads increased by at least 3 times over the period under study. Benefit-cost ratios calculated on the basis of 1996 traffic suggest that the improvement of these roads are likely to have had satisfactory economic returns.

The road improvements appeared to also have been contributing factors to other changes. Notably, land tenure progressed significantly in all three regions, despite the fact that few changes happened nationally at the time. Other indicators showing substantial improvement were the availability of hospital beds and school attendance by children. The roads works, which basically followed the alignment of old tracks, did not in themselves cause major environmental effects. However, the increased production they helped induce in all three regions required land clearing and caused deforestation. About three quarters of the 20 roads were in fair to good condition in 1996; current policies to decentralize and devolve authority to the local authorities are likely to make the road improvements sustainable.

The report's findings and conclusions were discussed during a workshop in, held in Brasilia, in April 1997, organized by Brazil's Secretariat for Planning, Budgeting and Coordination in collaboration with OED.

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This study was prepared under the supervision of Albert Weckerle (Task Manager) by a team of the Institute for the Study of Society, Population and Nature (ISPN), a Brazilian NGO. Further data collection and analysis was done by Bahia-based consultant João Alberto Rocha. The final report was prepared by Hernan Levy, with the assistance of Claudio Volonte and Oliver Rajakaruna. Mmes. Cynthia Noronha and Maryvonne Mauprivez provided administrative assistance. (A detailed list of contributors is in Annex 6).

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Preface

This is an Impact Evaluation Report for investments made under the Brazil Secondary and Feeder Roads Project, Loan 1207-BR (FR I), and the Second Feeder Roads Project, Loan 1730-BR (FR II). Both loans, in the amount of US$55 million and US$110 million, respectively, were fully disbursed, and both projects were successfully implemented.

This study was first launched in 1993, when most of the field work was undertaken. A review of the data and analysis revealed that additional information was required to clarify and complement the existing data. Thus, a follow up, brief field study was conducted in 1996.

Assistance in the preparation of this study was received from many respondents and contributors in the more than 30 municipalities which the study team visited in 1993: mayors, aldermen, other local leaders, members of producers' associations and of workers' unions and other representatives of local communities. The State Highway Department of Bahia (DERBA) played a key role in that work as well as in subsequent data collection and analyses carried out in 1996. The Secretariat for International Affairs of Brazil's Secretariat for Planning, Budgeting and Coordination (SEAIN) coordinated the preparation of this study through all its phases.

Budgetary constraints substantially limited data collection that would have been required for a detailed quantification of economic as well as of social impacts. The report should be read as an effort aimed more at identifying and clarifying key issues than at providing authoritative responses to complex problems. The analysis is particularly difficult in view of major swings during the period under analysis in the prices of key commodities (notably, coffee and cacao) which the improved roads were expected to support.

Following standard procedures, OED invited government comments on an early draft of this report. Replies received from the Borrower are attached as Annex 2. Subsequently, the current report was discussed at a Workshop organized by SEAIN, together with OED, that took place in Brasilia in April 1997. Comments received at the workshop are also annexed to this report.

EXECUTIVE SUMMARY

O Futuro Pertenece a Quem Sabe Amar o Seu Pasado
(The Future Belongs to Those Who Know How to Love Their Past)

Inscription in a Monument in downtown Salvador, Bahia's capital

Introduction

1. This study deals with feeder roads in the State of Bahia. The macroeconomic context is that of Brazil and Bahia. Brazil's economy experienced large swings in the last three decades, with high growth rates until the mid-1970s, deteriorating conditions reaching negative growth rates in the early 1980s, and growth resuming thereafter. Bahia, one of Brazil Northeastern states, still relies heavily on agriculture, which represents some 20 percent of the state's gross domestic product.

2. In 1976, in support of Brazil's rural development strategy, the Bank shifted its lending for highways from trunk roads to feeder roads, that is, roads connecting agricultural production areas with villages and produce markets. This study deals with two such projects in the State of Bahia, approved in 1976 and 1979. These projects financed the improvement of some 1,500 kilometers of roads, distributed over 63 road sites.

3. The feeder roads supported by the two projects were designed to fit with the State's broader development strategy. The roads were to be built in areas with good agricultural potential but inadequate infrastructure. Notably, areas with potential for one of these products: coffee, cacao, or dairy. To ensure success of these programs, the major institutions with an interest in these commodities, including local producers' associations, were consulted in the preparation of road investment proposals. Many of the roads turned out to be interlinked or continuous, and, overall, they tended to form clusters or mini-networks rather than be isolated investments. The market price of the key commodities whose production the roads were intended to benefit dropped dramatically a few years after the roads' improvements were completed, and had a significant effect on the impact of the investments.

4. A major shortcoming of the two projects was the absence of a monitoring and evaluation system. This made the evaluation of the impact of the two projects especially difficult, particularly in light of the substantial changes in economic conditions at different times through the projects lives.

Study Scope and Methodology

5. The study grouped the roads financed under the two feeder roads projects into three regions according to their economic activity: the coffee, the cocoa and the dairy regions. These regions included 52 municipalities. Out of the 63 roads financed in Bahia, the study selected a sample of 20 roads (38 percent of the universe and forming 15 continuous roads), with a total extension of 410 kilometers.

6. The initial field work was conducted in 1993 by the Instituto Sociedade, Populaçao e Natureza (ISPN, a Brazilian NGO), under OED's direction. The nine-person ISPN team visited 23 municipalities and conducted 132 structured interviews; in addition, it conducted informal interviews with 650 residents along the sample roads. The team also collected socioeconomic data,

as well as data on traffic and road condition. A review of the data and findings of such work suggested that additional information was required to form a valid judgment, notably due to: incoherence in traffic data relative to other data; commodity prices, in view of their high volatility through 1993; and road condition. Thus, complementary field work was undertaken in 1996, focusing on these aspects. In 1993 as well as in 1996, manual, 12-hour traffic counts, with classification by vehicle type, were conducted on all sample roads. These one-day counts were expanded to average annual daily traffic (ADT) based on coefficients used by Bahia's Road Department (DERBA).

7. Neither of the two road projects identified control roads that could have helped to identify the net developmental effect of the road improvements, isolated from the effect of programs or policies in other areas. Under these circumstances, this study focuses on changes, qualitative as well as quantitative, "before and after" the road improvements, rather than "with and without" such improvements.

Impacts

8. The roads covered in the study serve about half a million people. About two thirds of them live in urban settings, and the rest live in rural communities. About 20 percent of them are poor: small farmers, landless farm workers, and urban unemployed or underemployed population.

9. In view of the differing socioeconomic conditions, the study analyzed the impacts by region. *The Coffee Region* extends over a substantial part of the state of Bahia which had traditionally grown coffee in a small scale. However, following the decimation of coffee trees in Brazil's largest producer State, Parana, in the mid-1960s, Bahia saw this as an opportunity to expand its growing coffee business. The feeder roads were an essential part of this strategy. *The Cocoa Region* is situated mainly along Bahia's southeast, especially along the coast. Cocoa was traditionally one of the most important agricultural products of the state. A key factor hindering this activity was poor roads: cocoa trees in the state are mostly in a tropical forest region subject to heavy precipitation, making road construction and maintenance expensive. Cocoa is environmentally friendly, as it is one of the few crops that coexist peacefully with the original forest cover. *The Dairy Region* is located in southern Bahia. Since the beginning of the century, that areas has been the center of cattle-raising and dairy farming economy. Several major national and multinational dairy companies were and are active in the region. Before the feeder road program, the region's larger producers had built cart tracks, which only four-wheel powered vehicles could access, and only during the dry season.

10. *Economic Impact.* The survey found that the roads helped expand production of the target crops, particularly coffee and cacao, especially in the early 1980s, when the roads had just been completed. In particular, farmers were able to market their products more easily and to bring in machinery and other modern inputs at a time when traditional production techniques were being upgraded. Later in the decade, and in the beginning of the 1990s, a sustained and severe drop in the world market price of these two crops, which reached their lowest level in 1993, discouraged production. The production of dairy was also affected by a drop in prices, but to a much lesser extent than cocoa and coffee. Also, being a more established production and less labor-intensive than the other crops, the road improvements caused less changes in the level of economic activity, and attracted little migration relative to the cocoa and coffee regions. The cocoa and the coffee regions, taking advantage of the better roads, were able to respond to the collapse in their primary commodities by diversifying production, and today they produce a large number of different crops; they also diversified into non-agricultural activities such as lumber extraction and charcoal production.

11. *Social Impact.* The study was able to collect information on social impacts, although quantitative data was difficult to obtain and was limited to a few indicators. One important indicator was the change in land tenure patters, where the proportion of small landholders increased significantly in all three regions, despite the fact that very few changes happened at the national level at that time. For example, the proportion of farms having less than 50 hectares increased in the coffee region from 74 percent in 1975 to 93 percent in 1985. Other indicators showing significant improvement after the roads were improved were the availability of hospital beds per inhabitant and school attendance by school-age children. The extent to which these changes can be attributed to the roads is unclear, but, as a minimum, it can be said that the changes coincided with the improvements of the roads.

12. *Traffic Impact.* Overall, traffic on the roads increased substantially during the period under review. While traffic on most of the roads was in the 20-40 vehicles per day in the late 1970s before the roads were improved, traffic in 1996 had surpassed 100 vehicles per day in 12 of the 20 roads in the sample. However, such levels were below the original forecasts. The roads with the higher traffic levels were those that became integrated with the state road networks and that were more important for long-distance travel than for the local area vehicles.

13. *Environmental Impact.* Because road improvement works generally followed existing tracks, the environmental impact of road construction was minor, and happened mainly in the cocoa region, where conditions of terrain, precipitation, traffic and inadequate maintenance combined to cause erosion. However, the survey found broader environmental effects from the increased economic activity generated by the roads: as a result of the need to clear land for expanding production of coffee, cocoa, and dairy, deforestation was common in all three regions. Deforestation caused alteration in the ecosystems, erosion of hillsides and siltation of creeks, thus reducing water availability and affecting local fauna.

14. *Surveys.* Study interviews and surveys signaled that the initial beneficiaries were the large producers, most of them natives from the respective regions. They also confirmed that the investments had had positive impacts in helping create conditions that led to improvements in standards of living and improving access to social services. One hundred percent of the interviewees in the dairy region thought that the improved roads brought positive benefits; the lowest percentage was in the cocoa region, at 75 percent. These percentages probably reflect the higher economic stability of the dairy region. By occupational category, the responses stating the roads' positive benefits ranged from 88-91 percent in the case of businessmen and blue collar workers to 74-80 percent for professionals and for politicians and civil servants.

Economic Analysis

15. During appraisal of the projects, the economic analysis was based on an estimate of the induced agricultural production and consequent value added that would be generated by the improved roads. Road investments accepted for financing under the feeder roads projects would need to have a minimum economic rate of return of 10 percent. Lack of agricultural output data, combined with extreme variations in commodity prices and hyperinflation affecting calculation of monetary values over a long period of time, made it unfeasible for this study to reproduce the economic analysis at appraisal and to calculate the economic returns of the investments. Instead, the study calculated a benefit-cost ratio based on 1996 traffic and on vehicle operating cost savings. This analysis found that 12 out of 20 roads had a satisfactory benefit-cost ratio. These results cannot be directly extrapolated to assess the likely economic returns, mainly because traffic levels in years closer to the completion of the roads were not known. An additional caveat is that a major benefit of the investments was the reduction, and, in many cases, elimination of road closures due

to rain and flooding to which the old roads were frequently subject. Lacking empirical data for the quantification of such benefits, this study took a conservative approach in their assessment.

Sustainability

16. The surveys conducted under the study found that some 10-15 years after the improvements were made, most of the roads were in fair to good condition. About a quarter were in poor condition. Their condition was, overall, slightly better in 1996 than in 1993. Funding for highway maintenance generally has suffered during the recent devolution of responsibilities from the federal to the state governments, where the states did not initially receive adequate funding or given instruments to raise funds to meet their maintenance responsibilities; states have tended to concentrate resources on the maintenance of the primary roads rather than the rural and feeder roads. In light of the current liberalization and growth-oriented policies currently in place in Brazil, the economic and social impacts appear to be sustainable.

Recommendations

17. The following recommendations emanate from this study:

(a) *Feeder Road Planning.* The experience of this study suggests that the following considerations are likely to improve the planning and ultimate impact of the feeder road investment:

(i) Clusters or mini-networks of roads fitting into a state and regional development strategy have a higher likelihood of attracting and retaining traffic than isolated road investments. In designing feeder roads programs, the concept of road clusters should be contemplated as a possible requirement for selection of road investments.

(ii) Social impacts are significant and should complement the traditional assessment of economic benefits. A strong involvement of beneficiaries at the grass-root level can help in this process. The involvement of beneficiaries would facilitate the task of state and local road planning agencies in the assessment of social benefits. Systematic institutional mechanisms should be put in place for the involvement of beneficiaries in road planning.

(b) *Environmental Mitigation Measures.* Controlling the adverse environmental effect of feeder roads should be effected by the adoption of proper engineering methods and by the preparation of regional environmental assessments and actions plans that focus on the environmental effects of anticipated economic developments. Such assessments and plans should be launched at the road planning stage.

(c) *Sustainability. Role of Beneficiaries.* Under current policies calling for further decentralization and devolution of responsibilities, beneficiaries including the private sector should be involved in the process of funding and managing road maintenance of rural roads; international experience is accumulating that such approach leads to better financing and a more effective road management.

(d) *Monitoring.* A simple monitoring system including periodic traffic counting and a few selected social indicators, the latter in conjunction with established, regular social sector surveys, should be set up to facilitate evaluation of the rural roads investments.

(e) *Research on Transport Costs by Non-Motorized Vehicles.* The key benefit of many rural road improvements is the reduction or elimination of road closures to motorized traffic. This benefit is difficult to quantify due to lack of empirical data. It is suggested that a Brazilian transport or rural development research institute carry out investigations on this matter, which would substantially contribute to improving the quality of economic analysis of rural roads investments.

1. Introduction

Snapshot of the Economies of Brazil and Bahia

1.1 This study deals with feeder roads in the State of Bahia. The macroeconomic context is that of Bahia's and Brazil's economies. Brazil's economy experienced large swings over the last 30 years. For about a decade until the mid-70s, it had an average growth rate of some 10 percent per year. At that time, economic growth began to slow down, and even became negative in the early 1980s. Subsequently, it has gone through a period of erratic growth patterns, although, overall, the growth rates have been relatively low, in the order of three to five percent annually. Income distribution is skewed regionally, with Bahia and the other northeastern states having the lowest per capita income.

Table 1.1 Brazil and Bahia - Selected Indicators

Basic Economic Data	*Bahia*	*Brazil*
GDP (1995, estimated) (US$ million)	20,375	426,77
GDP Growth Rate (1986-95 per annum), percent	-0.36	1.82
GDP per Capita (1995, US$)	1,644	2,74
Agriculture as a percent of GDP (1994)	21	13
Industry as a percent of GDP (1994)	34	39
Social Data		
Population (1995, estimated, million)	12.86	15
Rate of Population Growth (1990-95), percent	1.8	1.7
Urban Population Below Poverty Line (1995), percent	17.5	9.0
Rural Population below Poverty Line (1995), percent	22.4	23.6
Illiteracy Rate (1995), percent	32.3	17.8
Population with Sewerage Connection (1995)	5.1	34.5

Note: Central Bank of Brazil, Ministry of Finance and Brazilian Institute of Statistics. World Bank data.

1.2 While Brazil continued to industrialize during the last two decades, the agricultural sector also grew, and its share of the nation's gross domestic product increased slightly, reaching close to 13 percent in 1995. The northeastern states, which are much less industrialized than the rest of the country, base their economies on agriculture. In Bahia, agriculture represents over 20 percent of its gross domestic product, a proportion 60 percent higher than that of the country as a whole. The prices of two key commodities in Bahia's economy, cocoa and coffee, fluctuated significantly during the last two decades, and had a major impact on the program of roads reviewed in this study (Figure 1.1).

Bank Lending For Feeder Roads

1.3 In the mid-1970s the Bank shifted its lending for Brazil towards strengthening rural development, particularly in the Northeast, in support of government programs for the less developed regions of the country. This was done through a series of integrated rural

development projects, and through projects focused on specific sectors.[1] The Bank's lending for Brazilian highways started in 1964, and the main focus was to help develop a high quality network of primary highways. In consonance with the shift in the direction of Bank lending towards rural development, in 1976 the Bank approved its first rural roads project, the Secondary and Feeder Roads Project (FR I). This project was followed in 1979 by the Second Feeder Roads Project (FR II), and in 1982 by the Third Feeder Roads Project (FR III). These projects covered most of Brazil, but provided special incentives for the poorer states to receive funding from them.

1.4 The immediate objective of FR I was to construct and improve feeder roads, that is, roads linking agricultural areas and communities or providing access to isolated areas with good economic prospects. The project cost was US$237 million, of which US$55 million to be financed by the World Bank. The remainder was to be funded by state and federal governments. A minimum economic rate of return (ERR) of 10 percent was required for a subproject to be eligible for financing under the program. Subproject rates of return were expected to vary between 10 percent and 40 percent. The project represented a first attempt to establish collaboration at the central, state and municipal level, and the following institutions were involved in this process: the National Highways Department (DNER), the National Economic and Social Development Bank (BNDES), the State Highway Departments (DERs) and municipal authorities.

1.5 A major shortcoming of FR I was its inability to generate a significant number of road sub-projects in the Northeast, with the exception of Bahia. This failure was traced to the complexity of the administrative, economic and engineering pre-requisites. Inadvertently, this complexity ended up benefiting richer municipalities from more developed states, which had the resources to formulate and finance road investment proposals in accordance with the appraisal methodology and funding criteria.

1.6 In this light, the follow-up project, FR II, aimed specifically to increase the resources for municipalities in more remote or poorer areas. Through this project, the Bank contributed an additional $110 million for feeder roads. The total cost of this project was $338 million. The roads reviewed in this study were completed between 1979 and 1983.

1.7 Bahia, in contrast to other northeastern states, had been a main beneficiary of FR I. The ability of Bahia to take advantage of the resources being offered under FR I can be linked to the political prestige of the state's Governor and to the state's superior institutional capacity, relative to other Northeastern states. A total of 997 km of feeder roads was built in Bahia under that project, representing some 19 percent of all feeder roads eventually built in the entire country under FR I. An additional 581 km, representing 12 percent of total project length country-wide, were constructed under FR II in that state. Altogether, 1,578 km, distributed over 63 road sites, were built in Bahia under the two projects.

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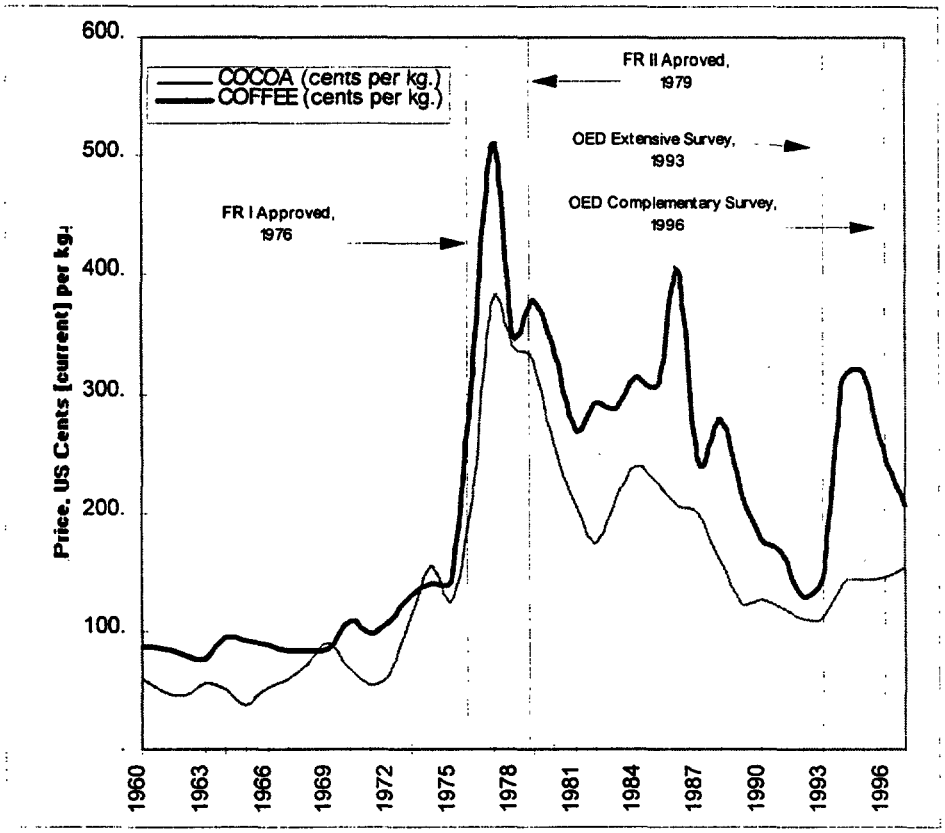
[1] The rural development projects were evaluated by OED. See Dynamics of Rural Development in Northeast Brazil: New Lessons from Old Projects. OED Report 10813, December 16, 1991.

Figure 1.1: Timeline: The Feeder Roads Projects, Cocoa and Coffee Prices, the OED study



Project Design

1.8 The feeder roads program in Bahia fit within the state's broader development strategy. Funds for road construction were allocated to areas considered to have good economic potential but inadequate economic infrastructure. It was believed that an improved network of feeder roads would be capable of significantly helping boost agricultural production, especially coffee, cocoa and dairy products. In the case of coffee, the feeder roads were geared to making Bahia a viable center of coffee production, at a time when it was being eradicated in Brazil's large producing areas due to sustained adverse weather conditions. In the case of cocoa, transport of produce in the rugged terrain and high rainfall conditions of cocoa lands represented a long-standing problem which the improved feeder road network was expected to resolve. Similarly, the dairy industry, already concentrated near the frontier with the state of Minas Gerais, badly needed roads to improve its competitiveness.

1.9 To ensure the economic potential of the feeder road investments, the interests of some of the major institutions and producers' associations such as the Brazilian Coffee Institute (IBC), the Commission for Cocoa Planting (CEPLAC) and multinational corporations in the dairy sector were taken into account. They shared the state and federal planning agencies' hopes to increase the production of these crops in Bahia. Social criteria were not specifically included in the methodology to identify and evaluate proposed feeder road investments, and neither were environmental or institutional criteria.

1.10 It turned out that many of the roads financed under FR I and FR II are interlinked or continuous, serving essentially the same geographic area and product. Others, though not directly interlinked, are complementary parts of the road network serving a wider agricultural basin. Thus, most of these roads were an integral part of a network, rather than isolated links. Also, they were concentrated in specific areas, rather than being distributed more or less uniformly throughout the state. Further, the roads did not purport to attend directly to the needs of the less-privileged population, but rather to support a regional development strategy based on fostering agricultural production. The coffee, cocoa and dairy areas were the primary beneficiaries. Strong swings in the prices of coffee and cocoa had a determining influence on the nature and duration of the roads' impact.

Project Implementation

1.11 Execution of the FR I and FR II contracts in Bahia was entrusted to the Intermunicipal Roads Consortium of Bahia (CRIBA) and the Highway Department of Bahia (DERBA). The CRIBA built some two thirds of all the roads, as shown in *Table 1.2.*

Table 1.2 Distribution of Feeder Roads By Implementing Agency in Bahia (FR I and FR II)

Responsible Agency	*Extension*	*Number of*
FR I	997	39
- CRIBA I	504	26
- DERBA	493	13
FR II	581	30
- CRIBA II	581	30
TOTAL	1,576	69

Source: Governo do Estado da Bahia. Secretaria de Transportes, Comunicações e Energia-STCE. Coordenação de Transportes.

Monitoring and Evaluation

1.12 One major shortcoming of FR I and FR II was their lack of a monitoring and evaluation system. This makes the evaluation of the investments financed under these projects especially difficult, both regarding the achievement of physical as well as developmental objectives. Assessment of the latter objective is even more difficult in view of the changing economic conditions prevailing in Brazil and Bahia during the life of the investments. Lack of monitoring and evaluation was also found to be a problem in the Bank-financed integrated rural development programs in Northeastern Brazil.[2]

[2] Report cited in the footnote to paragraph 1.3.

2. Study Scope and Methodology

2.1 This chapter discusses briefly the period of analysis, the field research, the sampling strategy and the traffic counting methodology.

Two-Period Analysis

2.2 This study was originally conducted in 1993 by OED and the Instituto Sociedade, Populaçao e Natureza (ISPN, a Brazilian NGO). A review of the findings suggested that three aspects required additional information to form a valid judgment: (i) traffic data, because data for several roads did not appear to be coherent with other information collected by the study; (ii) commodity prices, in view of their high volatility through 1993; and (iii) road condition, where available information was considered to be insufficient to assess the sustainability of the road investments. Thus, complementary data collection and field work was undertaken in 1996 in these areas.

Design and Implementation of Field Work

2.3 This study is based on extensive field work. Its purpose was to generate qualitative and quantitative data which would permit evaluation of socioeconomic changes induced or assisted by the feeder roads program, in each specific site and its respective area of influence. A major obstacle to overcome was paucity or lack of baseline data, in particular on social development.[3]

2.4 During the 1993 field work, a team of nine persons visited 23 municipalities in Bahia during a six-week period and conducted structured formal interviews with 132 knowledgeable respondents who had been associated with the design or implementation of the Bahia feeder roads program. In addition, the team conducted informal interviews with an additional 650 residents along the sample of roads. Data was gathered on the following aspects:

- socio-economic, environmental and institutional characteristics; data on volume of production, cultivated area, productivity, commercialization and costs of production were obtained for cocoa and coffee; information gathered on other crops was only qualitative; and
- physical condition and maintenance of roads as well as volume and composition of traffic in each road site.

Sampling Strategy

2.5 The approach underlying the design of Bahia's feeder road program was a major factor in program evolution and outcome. Based on that approach, for sampling and analytical purposes, the study grouped the roads constructed under FR I and II into three separate regions according to their economic activity: the coffee, cocoa and dairy regions. It also defined a fourth Region, that of Paraguaçu (Map - Feeder Roads and Economic Regions). While this region belonged to the coffee area, it had distinct socio-economic characteristics requiring special

[3] Comments by GEIPOT raised the question why the projects did not provide for the collection of base-line data on social impact.

analysis. The four regions included 52 municipalities, and they comprised seven major clusters of project road sites. In selecting specific road sites for in-depth field survey, a stratified sampling approach was utilized within each cluster. Three basic criteria were adopted:

- a minimum time span had elapsed since road construction for its impact to take root. Thus, only road clusters completed before 1985 were included in the sample (this criteria caused elimination of 6 of the original 63 road sites);
- the sample of sites had to be representative in terms of: type of principal economic activity, geographic condition, location, balance of FR I and II projects, feasibility studies' method of calculating ERRs, and political process prevailing at the time of road selection; and
- adjoining road sites, linked to each other in a functional manner, and having homogenous socio-economic characteristics, were redefined as "continuous" roads or as only one road.

2.6 The 63 road sites were regrouped into 40 continuous roads. From these, a sample of 20 road subprojects, forming 15 continuous roads, was randomly selected for field research. This sample represented about 38 percent of the universe of eligible road sites with an aggregate length 10 km.

Traffic Counts

2.7 Both the 1993 and the 1996 traffic counts were carried out utilizing conventional techniques under the supervision of DERBA's regional units. Each of these units recorded simple visual observations. All vehicles passing a selected checkpoint on a given road site on week days between 6:00 a.m. and 6:00 p.m. were counted. Prior experience, local knowledge and comparisons with analogous investigations served to verify these counts; no major disparities were encountered. Subsequently, these 12-hour counts were expanded to an "average daily traffic" (ADT) using expansion coefficients to generate estimates of 24 hour traffic, average weekly traffic and average annual daily traffic. These expansion coefficients were obtained from studies on similar roads carried out by DERBA.[4]

Before and After Analysis

2.8 Neither FR I nor FR II identified control roads, that is, roads not expected to be subject to improvement, that could have served to assess the impact of the road construction, as distinct from other factors that also may influence socioeconomic activity in the roads' areas. In these circumstances, this impact study focuses on changes, quantitative as well as qualitative, "before and after" the road improvements, rather than "with and without" such improvements.

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[4] The expansions were based on linear extrapolations from the existing counting stations in the area of influence of each of the roads under study. Seasonal data required to conduct the expansion are from 1979, but they are the most complete observations available for 24 hours and 365 days and are currently used by DERBA and DNER for traffic studies in Bahia.

3. The Impact of Feeder Roads

3.1 This chapter presents the main findings obtained from the field study. A detailed analysis by region appears in Annex 3.

3.2 As noted elsewhere, the regions are labeled on the basis of their main crops. For most of the roads reviewed in this study, their economic activity at the time of the projects was monoculture, either coffee or cocoa or dairy products. Over time, several of the areas served by the roads diversified their agroeconomy, and now grow a number of different crops.

3.3 The 20 roads covered in this analysis comprise in their vicinity about half a million people, representing about 15 percent of the total population of the coffee, cocoa and dairy regions combined. About two-thirds of the population covered by this study live in urban settings and the rest live in rural settings. About 20 percent of this half a million people are poor: they are small farmers and their families, landless farm workers and the urban unemployed or underemployed population.

Regional Characteristics

The Coffee Region

3.4 The Coffee Region extends over a substantial part of the state, encompassing the areas of the Chapada Diamantina and the Serra do Espinhaço. Morro do Chapéu, Santa Inês and Vitória da Conquista are the principal cities in the areas where the feeder roads were built.

3.5 Since the 1940s, coffee production in Brazil had been largely concentrated in the state of Paraná. In 1965, a large proportion of its coffee trees was hit by a severe frost. Simultaneously, agricultural production in Brazil began to undergo important changes, stimulated by massive subsidized credit. The decimation of coffee trees by frost in Paraná was coupled with the desire of farmers to put their land to other more modern and profitable uses; as a result, coffee production in other areas of the country was stimulated. In Bahia, which had traditionally grown coffee on a small scale, this was seen as an opportunity to expand its coffee-growing business.

3.6 Most roads in this region followed cattle trails or the original tracks which had been made for animal-drawn vehicles and they were frequently impassable during the rainy season. The inability of motor vehicles to ride on those roads hindered commercial traffic as well as access to social services. Despite the fact that several of the feeder roads were built on irregular terrain and receive only sporadic maintenance, traffic now flows continuously on a year-round basis on the majority of these roads.

The Paraguaçu Sub-region

3.7 The Paraguaçu Region is situated in the south-southeast section of the Chapada Diamantina, in the central part of the state. Long before the feeder roads program, infrastructure deficiencies had been identified as a major stumbling block to regional progress. In 1977, an

integrated project for the development of the Paraguaçu Region (PIDERP) was designed as part of a major regional development program for Brazil's Northeast (also financed by the World Bank) – the POLONORDESTE. Due to operational difficulties, however, the PIDERP was terminated in 1981 and its resources were re-allocated to other investments – among them, for feeder roads.

3.8 The road segments in the Paraguaçu region differ significantly from those of the other regions in size and function. They are longer and serve to integrate larger regions. They represent important lines of communication within the state and their areas of influence are economically more diversified. The roads are of better quality and one currently is paved.

The Cocoa Region

3.9 The Cocoa Region is located in Bahia's Southeastern part, especially along its coast. Itabuna and Ilhéus were, and continue to be, the focal cities of this region.

3.10 Cocoa was traditionally one of the more important agricultural products in the state of Bahia. Historically the object of many violent struggles, cocoa-producing lands in Bahia were also the source of riches and of political power. One of the primary difficulties in this activity was the transport of produce. Cocoa trees are commonly located in the uneven terrain of the Mata Atlântica, a tropical forest region subject to heavy precipitation. Road building and maintenance in these conditions is expensive. Consequently, much of the cocoa produced in the region was traditionally marketed on the backs of mules, in animal-drawn carts or in canoes.

3.11 From an ecological standpoint, cocoa has great advantages. It is environmentally friendly in the sense that it is one of the few crops which coexists peacefully with the original forest cover and which thrives on the rugged topographical conditions prevailing in the Mata Atlântica. All it requires is "shading", which can be provided by a number of tree species or even by cultivated plants such as bananas. If it wasn't for cocoa production, there is little question that the Mata Atlântica would already have been decimated to a much greater extent in Southern Bahia.

3.12 The Cocoa Region constitutes a territory in which construction and maintenance of roads is difficult. Most feeder roads in this region were established on tractor trails and mule train tracks. These roads were impassable during much of the year, isolating residents from even the most basic social and health services. In some areas, jeep or truck traffic was occasionally feasible but, during the rainy season, tractors would have to pull the vehicles. Construction of feeder roads, thus, had an enormous impact on both economic and social conditions.

The Dairy Region

3.13 The Dairy Region is located in the southern part of the state, on the border with the State of Minas Gerais. Itapetinga is its most important city. Since the beginning of the century, the area has been the center of a strong cattle-raising and dairy farming economy. Several major national and multinational dairy companies are active in the region.

3.14 The feeder roads in the dairy region generally follow cattle trails or mule train paths. Before the feeder roads program, the region's larger producers, with the support of the municipalities, had built cart tracks. These tracks, however, were inaccessible by motorized

traffic during the rainy season, and only four-wheel powered vehicles could drive on them during the dry season.

Economic Impact

3.15 The feeder roads built in Bahia are located in areas having highly differentiated terrain, climate and economic activity. Despite the variety of settings, they showed great uniformity in their development pattern as a result of the intense economic changes experienced by the state.

3.16 The feeder roads represented an important initiative within the socio-economic development efforts of the state. Normally , these roads served areas that had real economic potential which could be maximized by road construction and improvement. Local communities and entrepreneurs would have been unlikely to generate the resources necessary for the road improvements in the absence of the Bank loans.

3.17 The roads did help expand production of the intended crops – particularly of cocoa and coffee – during the first years of their existence. The inclusion of cocoa-producing regions in FR I and II brought important benefits for cocoa producers during the early 1980s. They were able to market their produce with greater ease and to bring in machinery and other modern inputs at a time when traditional production techniques were being upgraded. This happened at a time when international prices for cocoa were favorable and, furthermore, producers had access to credit and other subsidies. Meanwhile, commercial and service activities in urban areas experienced a period of considerable expansion.

3.18 Subsequent declines in prices and profits of both coffee and cocoa, however, largely wiped out the gains during the second half of the period under study. Yet, despite setbacks in the original plans due to the economic crisis, the roads helped bring about the diversification of crops and economic activities. *Table 3.1* provides a list of crops, as well as of non-agricultural activities, which expanded in each of the three main economic regions, during the period following the decline of coffee and cocoa.

Table 3.1 Diversification of Economic Activity in FR I and FR II Areas, by Economic Region

Economic Region	*Diversification by Type of Economic Activity*	
	Agricultural	*Non-Agricultural*
Coffee Region	Irrigated vegetable farming, irrigated fruit farming, cattle-raising, pig farming, chicken farming, irrigated coffee, manioc, beans, corn, potatoes, tomatoes, avocados, acerola, maracuja, guarana, orchids, sugar cane, dairy	Lumber extraction, charcoal production, masonry rocks, diamond extraction
Cocoa Region	Cattle-raising, vegetable farming, manioc, corn, beans, bananas, rubber trees, papaya, maracuja, watermelon, garlic	Lumber extraction, charcoal production
Dairy Region	Sugar cane	Graphite mining

Source: ISPN Field Research, July 1993.

3.19 Although no quantification of these products was made, the variety of products cited as having flourished after the decline of coffee and cocoa attests to the relative dynamism of post-boom economic activity. The presumption is strong that the presence of a feeder road contributed to economic diversification. In some instances, the difference made by the road (as exemplified in *Box 1*) was dramatic.

BOX 1: Potato Farming in the Area of Influence of the Andaraí-Mucugê Feeder Road

Coffee was the main crop to benefit from feeder road construction in the area of influence of the Mucugê-Andaraí segment. However, the fate of coffee production there paralleled that of the rest of Bahia: by the time this study took place, most of the coffee trees had been eradicated. In its place, however, several promising crops had been introduced into the local economy; potatoes are one of them.

Some 700 hectares of irrigated potato fields are currently producing 21,000 tons or, approximately 1,615 truckloads of potatoes a year in the vicinity of the Mucugê-Andaraí feeder road. Productivity is reputed to be high – in the vicinity of 30 tons/ha every 90 days. Most of the produce is bought up by a major hamburger chain; the remainder is shipped to the State of Paraná where potato chips are industrially processed.

The feeder road is of paramount importance in this whole operation. All produce is hauled on the Mucugê-Andaraí stretch and from there to Vitória da Conquista, Recife, Salvador and São Paulo. The normal cost of transport is US$18/ton. When a bridge on the feeder road was out of order for a year, transport costs soared to US$30 a ton.

Traffic Impact

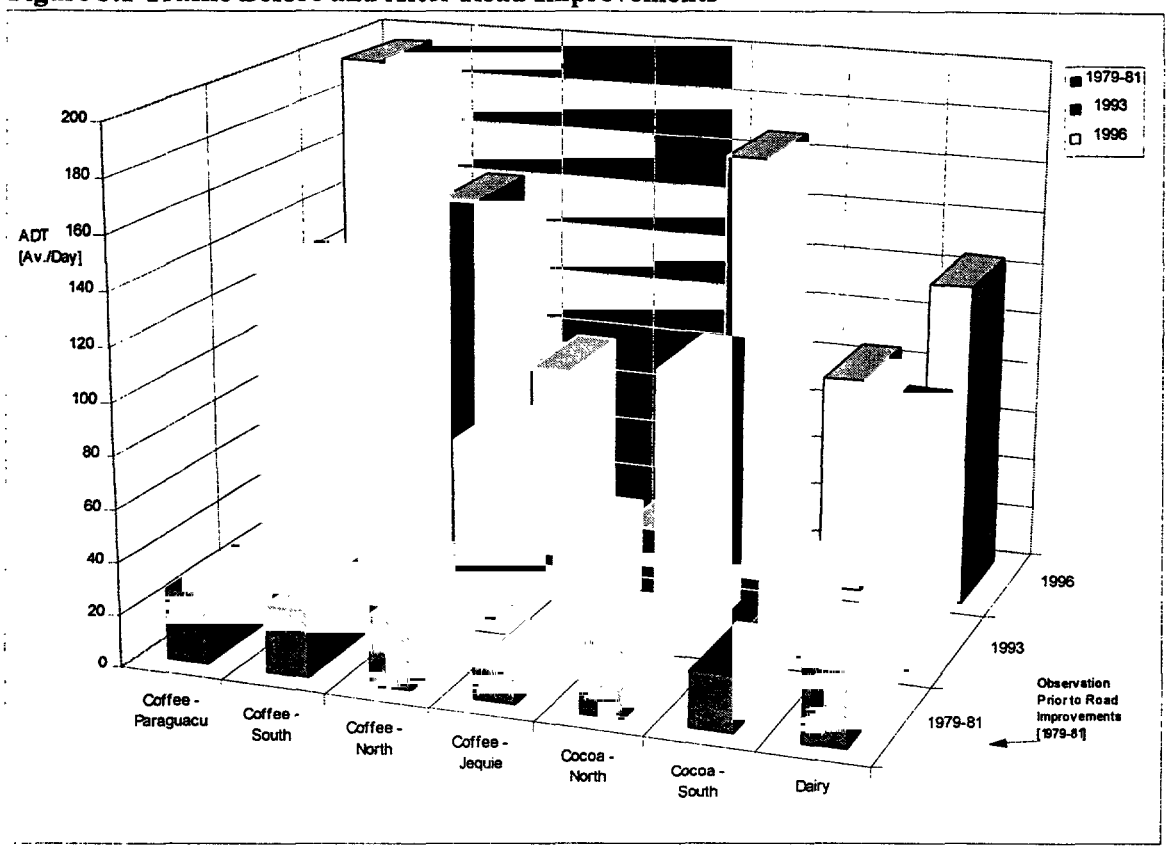
3.20 Overall, traffic increased substantially during the period under study. With only two exceptions, traffic grew consistently more than the GDP (which grew at just below two percent per year on average over the last 10 years), and for several roads, the average growth rate exceeded ten percent per year (Table 3.2 and Annex 4). There is no clear pattern of traffic levels or growth among the different regions, with high and low levels and growth rates occurring in practically all regions. However, in aggregate, the roads in the cocoa and the dairy regions appear as having the higher traffic levels at present. In some cases (6 out of the 20 roads) traffic between 1993 to 1996 fell, while in another case traffic has remained about the same.[5] One possible explanation is the continued drop in world prices for coffee and cocoa, that may have resulted in a sustained economic decline in the areas of those roads. For the roads that show large traffic increases through the period, a major factor for such growth is the road's integration as long-haul links in both federal and state networks (e.g., routes C90 and C10 in the cocoa areas).

Table 3.2 Average Daily Traffic (vehicles per day)

Region	Road	Initial Traffic (vpd)	Initial Year	1993 Traffic (vpd)	1996 Traffic (vpd)
Coffee-North	RS11.5	27	(1981)	53	56
Coffee-North	RS11.6	27	(1981)	86	98
Coffee-South	RS02.1a	...	...	160	203
Coffee-South	RS02.1b	...	...	304	99
Coffee-South	RS01.2a	...	...	145	109
Coffee-South	RS01.2b	...	...	67	119
Coffee-South	RS01.1	...	...	100	177
Coffee-Paraguacu	BA148	27	(1981)	184	...
Coffee-Paraguacu	BA142	28	(1979)	71	189
Coffee-Jequia	RS05.8a	14	(1979)	32	27
Coffee-Jequia	RS05.8b	14	(1979)	62	6
Coffee-Jequia	RS06.6	9	(1979)	14	114
Cocoa	C90	29	(1980)	108	89
Cocoa	C10	27	(1981)	101	245
Cocoa	C44	21	(1981)	41	142
Cocoa	C23	...	...	14	27
Dairy	L10a	29	(1980)	79	150
Dairy	L10b	28	(1980)	135	131
Dairy	L10c	28	(1978)	98	142
Dairy	L10d	28	(1979)	57	74

[5] To minimize errors in traffic counting, traffic counts in 1996 were done twice in all cases where the results showed large, unexplainable drops in traffic levels from 1993 to 1996. However, determination of average annual traffic levels based on one-day counts are subject to potentially large statistical error depending on the extent of weekly and seasonal traffic variations, and the validly of expansion coefficients for one-day traffic counts.

Figure 3.1 Traffic Before and After Road Improvements



3.21 While traffic on most roads increased, substantially in some cases, traffic projections turned out to be consistently over-optimistic. In a sample of six roads for which baseline data as well as projections were available, projections exceeded actual values in five of the six roads. (Table 3.3).

Table 3.3 Forecast and Actual Traffic (Sample of Six Roads)

Region	Road	Average Traffic Projected for Year 10 (vpd)	1993 Traffic (vpd)	Ratio Actual/Projected Traffic
Cocoa	C10	90	101	1.12
Cocoa	C44	89	41	0.46
Cocoa	C23	27	14	0.52
Dairy	L10a	392	79	0.20
Dairy	L10b	144	135	0.94
Dairy	L10d	138	57	0.41

3.22 The study found that the feeder roads program stimulated local producers to improve other feeder roads. Thus, traffic is likely to have increased on these other roads too.

Social Impact

3.23 Objective and quantified data on social change are hard to obtain for subregions. Nevertheless, some data on changes in land tenure, health, education and urbanization in each of the three main regions are available (*Table 3.4*). They show a significant improvement in land tenure in all regions: the proportion of small landholders increased significantly in all of them, despite the fact that very few changes were occurring at the same time at the national level. Similarly, the number of inhabitants per hospital bed fell, even during the period of economic decline, particularly in the coffee and dairy regions. In view of the lack of data for previous years, educational enrollment indicators are limited to the more recent period. But it is perhaps even more significant that the proportion of children attending school actually grew significantly in two of the three regions during the post-boom period; that is, the positive impacts persisted beyond the period of prosperity. Finally, the proportion of the population living in urban areas increased significantly in all regions, a fact which can be interpreted, *grosso modo*, as reflecting a trend towards modernization. The extent to which these changes can be attributed to improved feeder roads is unclear. It can be said, though, that the social changes described coincided with the improvements in feeder roads.

Table 3.4: Social Impacts in the Area of Influence of Feeder Roads by Economic Zones

Economic Zones	*Land Tenure*			*Health*		*Education*		*Urbanization*	
	% of estab. having 50 ha. or less			*No. of Inhab. /hospital bed*		*% of School-age Children in Attendance*		*% of Pop. in Urban Areas*	
	1975	*1980*	*1985*	*1985*	*1989*	*1985*	*1991*	*1980*	*1991*
Coffee Region	73.6	75.3	93.4	740.2	629.5	85.5	86.7	43.8	54.4
Cocoa Region	57.8	79.0	81.4	550.2	542.2	77.3	87.8	46.2	59.0
Dairy Region	48.8	65.9	69.4	636.6	573.3	82.6	90.9	47.5	61.3
Bahia	84.0	85.2	86.6	-	-	-	-	42.3	59.1
Brazil	83.1	82.0	82.6	-	-	-	-	67.6	75.5

Source: IBGE, **Censos Demograficos** and **Censos Agropecuarios**, various years.

Environmental Impact

3.24 The field survey revealed environmental degradation in the three economic regions studied. Deforestation was common to all three, due to the need to clear land for expanding coffee, cocoa and dairy production. Traditional slash and burn techniques were used in practically all regions. In some parts, valuable tree species were indiscriminately distroyed. Deforestation provoked alterations in the ecosystems, erosion on hillsides and siltation of creeks, thus reducing water availability and affecting local fauna.

3.25 The only statistical information available on this topic referred to overall changes in use of total land area: this indicator broadly reflected the incorporation of land area for agricultural purposes, much of which involves deforestation (*Table 3.5)*. The data indicate considerable changes in land cover during the period in which the feeder roads were built, particularly in the coffee and cocoa regions. Nevertheless, the rate of change in land cover, in the regions affected by feeder roads, was generally comparable to that observed in the rest of Bahia, and in Brazil as a whole. In the dairy region, the proportion of land area in agricultural activity actually decreased after the feeder roads were built, due to the effects of the economic crisis.

Table 3.5 Land Cover Losses, Selected Economic Zones, 1975-1985 (percent)

Economic Zones	*1975*	*1980*	*1985*
Coffee Region	21.4	32.0	34.7
Cocoa Region	36.3	39.1	45.7
Dairy Region	24.3	27.9	23.5
Bahia	28.4	36.1	38.2
Brazil	27.4	36.3	40.2

Source: IBGE, Censos Agropecuários, 1975, 1980 and 1985.

3.26 It would be misleading to attribute most forms of environmental degradation observed during the field survey to road-building. The only incidence of environmental degradation directly traceable to the feeder roads projects was the erosion caused by poor road construction and ineffective maintenance. This form of environmental degradation was encountered particularly in the Cocoa Region, where conditions of terrain, precipitation, heavy traffic and inadequate maintenance combined to cause erosion. All other forms — including deforestation, siltation, and the extended use of chemicals – were related to the expansion and intensification of economic activity which was propitiated by the road.

Results of Opinion Surveys

3.27 The initial beneficiaries of the roads were the large producers. Most of them were natives from the respective regions, but at least in the coffee region, entrepreneurs from other parts of Brazil came in important numbers as well. The roads did help expand production in some regions and generated a greater flow of wealth. This increased the number of jobs and attracted migrants. Living conditions improved appreciably. Social infrastructure, particularly in the cocoa and coffee regions, was significantly upgraded. The roads were a critical ingredient in the physical improvement of health, education and other social amenities and improved access to these facilities. Overall, the feeder roads, particularly during the prosperity cycle, ended up benefiting the entire local population (including the incoming migrants) whose access to basic social amenities increased significantly.

3.28 The great majority of respondents interviewed during the course of this study agreed that the feeder roads had provided positive benefits to their region. Eighty three percent of all respondents expressed a positive evaluation when questioned about the impacts of the feeder roads in the region (*Table 3.6*). It is noteworthy that the users who saw no real benefits, or who had mixed feelings about the road, tended to be concentrated in the cocoa region; this was the area which had the greatest difficulty in re-adapting to the post-boom phase. Moreover, an

analysis by duration of residence, revealed a high proportion of recent arrivals among those who did not perceive important benefits in the road. Evidently, lack of knowledge of "before the road" conditions influenced the outlook of these respondents; that is, they failed to appreciate the significance of the changes brought on by feeder roads.

Table 3.6 Opinion Survey Among Key Respondents on Benefits of Feeder Roads, by Economic Region (percent)

Economic Region	*Opinions as to the Role of Feeder Roads*			*Total*
	Road brought Positive Benefits	*Road brought No Real Benefits*	*Mixed Views or no Answer*	*(N= 100 percent)*
Coffee Region	84.60	3.8	11.50	78
Cocoa Region	75.00	7.5	17.50	40
Dairy Region	100.00	0.0	0.00	14
Total	83.30	4.5	12.10	132

Source: ISPN Field Research, 1993.

3.29 Blue collar workers (a category which includes a number of professional drivers), businessmen and agricultural producers tended to have a more positive outlook on the roads *(Table 3.7)*. Politicians and civil servants, while still showing a large proportion with a favorable opinion of the roads (80 percent), was the category with the lower proportion who saw benefits in the feeder roads.

Table 3.7 Opinion Survey Among Key Respondents on Benefits of Feeder roads, by Occupational Category of Respondents (percent)

Respondents by Occupational Category	*Opinions as to the Role of Feeder Roads*			*Total N = (100%)*
	Road brought Positive Benefits	*Road brought No Real Benefits*	*Mixed Views or No Answer*	
1. Agricultural Producers	85	2	13	51
2. Professionals	74	3	23	30
3. Politicians and Civil Servants	80	20	0	11
4. Businessmen	88	4	8	28
5. Blue Collar Workers	91	8	0	12
Total	83	5	12	132

Source: ISPN Field Research. 1993.

4. Economic Analysis

Approach at Project Appraisal

4.1 The feasibility studies on which the appraisal was based estimated the investments' economic rate of return based on three different criteria for assessing the benefits of the proposed road improvements:

(a) Benefits stemming from the reduction in vehicle operating costs. This approach was applied mainly to areas with a fairly established production, but which suffered from very high transport costs. This was mainly the case of the roads located in the cocoa region;

(b) Benefits measuring the valued added of the induced agricultural production expected to result from the improvement of a cluster of roads. This approach was applied to a group of roads mainly in the milk-producing region analyzed as a package, by quantification of aggregate benefits and aggregate investments costs; and,

(c) Benefits measuring the valued added of induced agricultural production, in the roads' direct areas of influence. This approach was applied mainly to roads in the coffee region, where the improved road condition were expected to generate a very substantial increase in coffee production.

Approach in the Impact Study

4.2 The original intention of the impact study was to assess the investments' returns by replicating the methodology used at appraisal. This required calculating the value added from induced agricultural production over the life of the roads. However, the characteristics of two economic variables made such calculation highly unreliable:

(a) Agricultural output. Three factors combine to make the measurement of value added in agricultural production attributable to the feeder roads unfeasible. First, lacking monitoring data on a yearly basis, it is virtually impossible to quantify the production of the key commodities in a road's area of influence at different times since road construction was completed. At the same time, using indirect methods to assess output would not be reliable, given major changes in world prices of cocoa and coffee at key periods in the life of the road projects and extreme variations from year to year in weather conditions affecting production of these commodities. Second, as shown in Table 3.1, production has diversified in many of these roads, further hindering the quantification of output. Third, it is not known the extent to which other investments beyond road construction influenced production level and mix. It is not possible to attribute increased agricultural valued added to the road improvements unless the value of the complementary investments is known.

(b) Inflation. During the period since the first roads opened in the late 1970s until today, there were many years with hyperinflation; for example, inflation in 1994 exceeded 2,000 percent. In this situation, even a small margin of error in the measurement of inflation would materially affect the computations of the economic analysis.

4.3 In view of these conditions, this study (i) did not attempt to determine economic rates of return, and (ii) followed the classical approach of assessing benefits from transport investments by quantifying the reduction in transport costs to road users, rather than following the value-added approach. While actual traffic data is not available for the opening years of each road, or for years immediately thereafter, traffic data is available for a year prior to improving the roads, as well as for 1993 and 1996. It is therefore possible to compare the condition prevailing for road users in the mid-1990s (with the investment) with that prior to the road improvements (without the investment). The study determines the benefit-cost ratio for each project by relating the benefit for a single year, 1996, with the annualized cost of the road investments. In this analysis, the 1993 traffic counts are used to verify and adjust the 1996 counts. The benefit-cost ratio thus obtained provides an indication of the return on the investments.

4.4 The analysis of benefits from reduction in transport costs, distinguishes three different categories of benefits: (i) savings in vehicle operating costs to the normal traffic, that is, the traffic that would have existed in the absence of the road improvements; (ii) savings in vehicle operating costs to the traffic generated by the improved road; and (iii) decrease in transport costs stemming from the reduction, or elimination in some cases, of road closures that were frequent before the roads were improved.

4.5 The analysis excludes quantification of social benefits, such as the improved access to education and health services, because no adequate basis exists for their quantification. Equally, the analysis does not evaluate the distribution of benefits among the different beneficiaries. However, a relative indication of benefit distribution can be derived from the degree of labor utilization in the various regions, as discussed later in this chapter (para 4.16).

Traffic

4.6 The evolution of traffic in the project roads is discussed in Chapter 3. For purposes of the economic analysis, to assess savings in vehicle operating costs, it is also necessary to know the composition of the traffic. This appears to vary from road to road.

4.7 In about half of the roads, vehicles with small freight capacity, pick-up and light trucks, predominate over passenger vehicles (Annex 4). Practically on all roads the percentage of heavy trucks is negligible. This traffic composition is consistent with the quality of the roads and the carriage of freight in small vehicles indicates that road transport costs are high. However, transport costs under current conditions are likely to be substantially lower than transport costs in the 1970s, when most of the roads were not accessible to motorized vehicles for long periods during the year.

Quantification of Benefits

4.8 The savings in vehicle operating costs between the unimproved and the improved roads have been quantified on the basis of data provided in the Project Completion Report (1986) for

the Secondary and Feeder Roads Project. Such data indicate the savings in operating costs for different types of vehicles, under different terrain conditions, and for different types of surface improvement (e.g., improvements from earth to gravel, gravel to asphalt). Due to the lack of empirical data, this analysis does not quantify benefits from time savings and therefore underestimate the economic benefits; in the roads that carry a relatively high level of freight, the underestimation may be significant.

4.9 To distinguish benefits to normal traffic from that of generated traffic, the analysis requires to determine traffic levels that would have occurred had the roads not been improved. To do this, and based on historical data in Brazil, it has been assumed that traffic on the original roads would have continued to grow at an average 3.0 percent per year. The difference between the traffic levels so obtained, and the actual traffic levels counted in 1993 and in 1996 is considered generated traffic.

4.10 Benefits from the avoidance of road closures, which were a common occurrence with the old roads and were practically eliminated with the improved roads, should normally be calculated considering the alternative transport costs when the road closes, such as carrying the freight by mule. Since empirical data for Brazil was not available, this study assumed that the savings in transport costs with the improved road, relative to the old road when closed, are 50 percent higher than compared to vehicles traveling on the old road (when the old road is open). This assumption yields benefits from avoiding road closures, on a unit traffic basis, that are lower than those obtained from empirical data in a recent rural road study in another country.[6] The economic value of road closures and its effect on the economic rate of return was tested through a switching-value analysis. In addition to increasing transport costs for freight, road closures have a severe effect on people, as they make access to social services practically impossible. As noted above, such social benefits have not been quantified.

Benefit-Cost Ratio Results

4.11 The resulting benefit-cost ratios are shown in Table 4.1 below. These ratios are based on the benefit quantification explained above and on the roads investment and maintenance costs. A discount rate of 10 percent has been used in the analysis, since this was the cut-off rate for accepting roads under the two feeder roads reviewed in this study. Detailed tables and description of the economic evaluation is shown in Annex 4.

[6] See Morocco - Impact Evaluation Report. Socioeconomic Influence of Rural Roads (Report No. 15808). Operations Evaluation Department, World Bank. June 28, 1996.

Table 4.1: Benefit-Cost Ratios

		Best Estimate	Sensitivity Analysis				Switching Value	
			VOC Savings		*Construction & Operating Costs*		Value Avoid Road Closure *To Enable B-C Ratio = 1*	
Region	Road	at percent Discount Rate	20 % Higher	20% Lower	20% Higher	20% Lower	Unit Cost per Vehicle per Day (US$)	Unit Cost per Vehicle per Day per km (US$)
Coffee (north)	RS.11.5	.72	.84	.59	.60	.90	13.23	.43
Coffee (north)	RS 11.6	1.16	1.30	1.02	.97	1.45	4.71	.21
Coffee (south)	RS.02.1a	1.51	1.61	1.40	1.26	1.88	1.59	.09
Coffee (south)	RS.02.1b	1.62	1.72	1.52	1.35	2.03	2.37	.08
Coffee (south)	RS.01.2a	1.41	1.55	1.28	1.18	1.77	3.11	.14
Coffee (south)	RS.01.2b	1.23	1.38	1.09	1.03	1.54	2.19	.21
Coffee (south)	RS.01.1	.70	.76	.64	.58	.88	6.11	.25
Coffee (Paraguacu)	BA 148	1.60	1.71	1.49	1.33	2.00	4.63	.08
Coffee (Paraguacu)	BA 142	.86	.94	.78	.72	1.08	17.64	.38
Coffee (Jequie)	RS.05.8a	.28	.33	.23	.24	.35	13.26	.93
Coffee (Jequie)	RS.05.8b	.17	.19	.14	.14	.21	12.81	.82
Coffee (Jequie)	RS.06.6	.13	.16	.11	.11	.17	23.35	2.07
Cocoa (north)	C90	.92	1.01	.83	.77	1.15	5.45	.42
Cocoa (north)	C10	1.68	1.81	1.55	1.40	2.10	1.34	.09
Cocoa (south)	C44	1.06	1.17	.95	.88	1.32	3.82	.23
Cocoa (south)	C23 *	.21	.25	.18	.18	.27	37.43	2.65
Dairy (south)	L10a	1.41	1.57	1.25	1.17	1.76	1.88	.16
Dairy (south)	L10b	1.75	1.92	1.58	1.46	2.19	.52	.11
Dairy (south)	L10c	1.47	1.63	1.31	1.22	1.84	2.06	.14
Dairy (south)	L10d	1.08	1.26	.91	.90	1.35	4.77	.31
No. > 1		**12**	**13**	**10**	**9**	**14**	-	-

4.12 Overall, the results show that (based on adjusted 1996 traffic), 12 roads, or 60 percent of the 20 roads in the sample, have a satisfactory benefit-cost ratio. Regionally, all roads in the dairy region would have been satisfactory investments, while it would be 2 out of 4 roads in the cocoa region, and 6 out 12 in the coffee region. In the sensitivity analysis, the results show that the benefit-cost ratio is more sensitive to changes in construction (and maintenance) costs than to savings in vehicle operating costs. Under a 20 percent variation in the former, the number of satisfactory road investments would range from 9 to 14.

4.13 The benefit–cost ratios cannot be directly extrapolated to assess the likely economic rate of return of the investments. The main caveat stems from lack of information about traffic levels in the early years after completion of the investments, a time when benefits have the bigger influence on the rate of return. Normally, in most road projects traffic grows steadily over time, causing the benefit-cost ratio to increase in later years. However, the situation of the feeder roads in Bahia may not have followed the conventional patterns. First, because out of the 15 roads in the cocoa and coffee regions for which there is traffic data for 1993 and 1996, traffic fell between these two years, suggesting a decline in economic activity in the roads' areas of influence. Second, because both cocoa and coffee prices were much higher in the early years of the roads project than in 1993 and in 1996, such higher prices would have provided producers with substantially higher net income and inducement to increase production: output and, correspondingly, traffic, may have been higher in those years (Tables 4.2, 4.3 and Figures 4.1, 4.2, 4.3). Thus, it is possible than in many of the roads situated in the coffee and in the cocoa regions, the benefit-cost ratio could have been higher in the early years than in 1996.

Avoidance of Road Closures: Switching Values

4.14 Roads that were inaccessible to motorized vehicles most of the year, today are passable practically year-round. Assessing the benefits from avoiding road closures is difficult due to lack of empirical data. It is possible that the real economic benefits from providing year-round traffic are substantially higher than estimated in this analysis.

4.15 In view of the potentially large margin of error in the calculation of benefits from avoiding road closures, a switching value analysis was conducted to determine the value of road closures at which the benefit-cost ratio (at 10 percent discount rate for 1996 traffic) is equal to one. As shown in Table 4.1, the 12 roads with benefit cost ratios greater than one require costs per vehicle kilometer ranging from US$8 cents to US$31 cents. This value is for an average traffic mix including passenger cars as well as small and medium size trucks. For a small truck, the higher value is equivalent to about US$10 cents per ton-km. In contrast, the alternative for people to carry produce themselves when the road is closed is estimated to require two person-days per ton-kilometer, or US$2.00 per ton-kilometer (assuming a subsistence cost of one dollar per person).[7] A recent study guided by England's Transport Research Laboratory found the cost of the ton-km in unpaved roads in Africa and Asia to range from about $1 per ton-km for animal-drawn vehicles to $5 per ton-km by headloading carriage.[8]

Distribution of Benefits

4.16 The roads' original objectives focused on economic development and improving access for the local population. On the economic front, most of the road improvements were geared to improve transport conditions for large-scale producers, rather than help the small farmer. On the social front, it is likely that the labor-intensive production of coffee and cocoa benefited a larger number of people compared to production of dairy that is largely industrialized.

4.17 At the same time, Brazil' road transport services are competitive, as they are fairly free of entry and rate regulations. This suggests that for the roads improved under the projects, transport services are likely to get better, both in quantity and in quality, and that savings in vehicle operating cost are likely to be passed on to the users of such services.

Regional, Commodity-Based Analysis

4.18 A brief examination of the regional economies helps convey a broader perspective than the single year analysis used in the benefit cost calculation. This is discussed in Annex 3.

4.19 The commodity-based analysis illustrates the economic impact of the changes in prices and outputs. In the case of coffee, this analysis shows that due to the combined effect of lower prices and outputs, the farmers' net income from coffee production fell by 38 percent in the period 1979-1992; in the case of cocoa, net income fell by 83 percent during the period 1985-1992. This situation contrasts with the expectations at the time of project appraisal, which foresaw increases in output and stability in prices. At the same time, the regional economies diversified, more so the coffee regions than the other regions. Thus, an analysis for specific

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[7] Based on data from the World Bank projects in South Asia.

[8] Simon Ellis, Ph. D Thesis (1996), Cranfield University, United Kingdom.

years and based solely on the original commodities would seriously misrepresent the regions' longer term economic conditions.

5. Sustainability

5.1 Sustainability of the benefits will depend essentially on Bahia's capacity to maintain the roads in good condition and on the roads' ability to attract traffic. This chapter discusses these two aspects of sustainability.

Road Conditions

5.2 This study surveyed the condition of the roads in 1993, some 10–15 years after completion of the road improvements, and again in 1996. The most recent survey found that most roads were either in fair or in good condition. A quarter was in poor condition. Taken together, the rating for the 20 roads was slightly better in 1996 than in 1993.

Table 5.1 Road Conditions[9]

		1993	*1993*	*1996*	*1996*
Region	*Road*	*Number Scale*	*Rating*	*Number Scale*	*Rating*
Coffee-North	RS11.5	6.0	Good	4.8	Fair
Coffee-North	RS11.6	6.1	Good	5.3	Fair
Coffee-South	RS02.1a	5.2	Fair	6.0	Good
Coffee-South	RS02.1b	4.8	Fair	5.8	Good
Coffee-South	RS01.2a	5.4	Fair	6.8	Good
Coffee-South	RS01.2b	6.3	Good	6.5	Good
Coffee-South	RS01.1	5.7	Fair	6.0	Good
Coffee-Paraguacu	BA148	5.8	Fair	...	...[10]
Coffee-Paraguacu	BA142	5.4	Good	8.8	Excellent
Coffee-Jequia	RS05.8a	4.0	Poor	3.5	Poor
Coffee-Jequia	RS05.8b	4.4	Poor	4.0	Poor
Coffee-Jequia	RS06.6	5.1	Fair	6.3	Good
Cocoa	C90	5.5	Fair	6.0	Good
Cocoa	C10	4.1	Poor	4.0	Poor
Cocoa	C44	3.5	Poor	5.5	Fair
Cocoa	C23	3.0	Poor	3.0	Poor
Dairy	L10a	5.9	Fair	5.0	Fair
Dairy	L10b	6.3	Good	5.5	Fair
Dairy	L10c	6.1	Good	5.0	Fair
Dairy	L10d	6.1	Good	4.3	Poor
Average Rating		5.23		5.37	

[9] The survey rated surface condition and visibility, giving a weight of 0.9 to the former and 0.1 to the latter.

[10] Improvement works were underway at the time of the survey.

5.3 Of the five roads rated as poor in 1996, three had traffic below 30 vehicles per day and their inferior condition could be assumed to be an important deterrent to traffic. On these roads, vehicles drive at low speed, between 20 and 30 km per hour. On the other 15 roads, the average speeds corresponded to the intended design, between 40–60 km per hour. None of the roads had serious drainage problems, suggesting that road closures due to flooding would be rare. The large majority of the roads had no signs indicating maximum speeds, distances to cities or other important driver information.

5.4 As shown in Table 5.2 below, the current condition of 18 gravel-surface roads surveyed (one of the 20 roads has been paved and one was not surveyed), is, overall, lower than that of the state of Bahia's network of gravel roads. While the comparison may not be statistically significant due to the small sample (18 roads represent about one quarter of the roads financed under the two feeder roads reviewed in this study) it would imply that the maintenance priority of the roads financed under the Bank projects is lower than accorded the average road in Bahia.

Table 5.2 Road Conditions: Bahia and the Feeder Road Projects

Road Conditions	Sample in Impact Study 18 roads (percent in each category)	State of Bahia Network (percent in each category)
Good	39	43
Fair	33	38
Poor	28	19

Road Maintenance Management

5.5 During the 1990s, Brazil has devolved a large part of infrastructure operations to the states. Under this policy, the planning, financing and maintenance of roads rests with the state road authority, DERBA, in the state of Bahia, irrespective of their administrative classification or the entity that initially built them. At present, gravel roads maintained by DERBA are administratively classified as follows: 71 percent are state roads; 24 percent are local roads (county or municipal), and the remaining 5 percent are federal roads (in part being transferred to the state).

5.6 Of the 19 gravel-surface roads, 18 are under the responsibility of DERBA. These roads are maintained by DERBA equipment and/or personnel. The remaining road is maintained under a municipal contract. Regarding maintenance programming, all 19 roads are subject to some level of maintenance, although the large majority are maintained only during the rainy season. Lack of funds prevent more systematic road maintenance and often forces the municipalities to carry out their own maintenance operations.

5.7 The above situation differs from the original intention that maintenance of the feeder roads would eventually be formally transferred to the municipalities, including an appropriate budget. Further, since the state government did not have enough resources, during periods of high prices for coffee and cocoa producers, the respective producers' associations financed the upkeep of the roads serving their products.

5.8 Presently, the regularity and quality of maintenance is often dependent on the ability of the local population or local businesses to exert political pressure for the allocation of funds. The long-term perspective for improving the management and financing of Bahia's road system hinges on completing the devolution program, including providing the states and local governments with legal rights to collect road user charges, and to incorporate users and other direct stakeholders in the management of such funds.

Agricultural and other Economic Benefits

5.9 If the roads are kept in a reasonable good condition, sustainability of benefits will depend on the roads' transport demand. Some of the roads have been integrated with the state's road network and serve long distance traffic; in these roads, the transit function generally largely exceeds the traffic derived from the economic activity in the roads' immediate area of influence. Unless other parallel roads are built or improved, which would offer a lower cost alternative to long-distance traffic, the sustainability of benefits of these project roads would be ensured. This is the case, for example, of two routes in the cocoa region (routes C10 and C90), and two routes in the coffee region (routes BA142 and BA 148), which, in addition are important for the promotion of tourism.

5.10 For those roads whose main function is to serve the economic activity in their immediate vicinity, their long-term benefits will depend essentially on the potential for sustaining or expanding such activities. The significant growth in traffic levels in practically all roads from their initial traffic prior to road construction until today, despite a decline in commodity prices, suggests that their economies have diversified and have a long-term potential. Partial recovery in the prices of coffee and coffee from their low 1993 levels reinforce this view.

5.11 The roads whose sustainability is most in doubt are those beset by the following problems: poor surface condition, continuation of monoculture, and competition by better, sometimes newly constructed, parallel roads. In the latter case, such better roads have taken away traffic from the project roads, even traffic generated in the roads' direct zone of influence, that seek to minimize the driving on low quality roads. Some project roads are affected by two (or even three) of these problems, for example, four roads in the coffee areas (three in Jequia and one in the North).

5.12 On the whole, the roads subject to the above problems and with unlikely or uncertain sustainability are essentially those that show a low benefit-cost ratio. Thus, the economic efficiency of the investment is a fairly good indicator of the roads' long term sustainability.

6. Main Findings and Recommendations

Main Findings

Project Design and Stakeholders' Roles

6.1 FRI and FR II represented an innovative approach to plan and finance improvements to low-traffic rural roads. The approach focused on helping to boost agricultural production and to raise living standards in isolated areas by providing them with access to markets and to social services. Within this framework, the investment criteria was based on economic returns.

6.2 Bahia was the first Northeastern state to avail itself of this program's resources. It could do so through an informal public-private partnership, that is, the combined efforts of federal, state and local governments together with the associations of agricultural producers.

6.3 The implementation of feeder roads in that state was part of a regional development strategy of agricultural growth poles. It focused on the promotion of agricultural production in regions of high-growth potential, notably for coffee, cocoa and dairy products, and poor transport infrastructure.

6.4 In the selection of subprojects and in assessing their economic merit, state authorities used the concept of road clusters defined within the context of the state development strategy. This approach had the likely effect of increasing the combined benefits of the roads, relative to individual investments foreseen in the projects' original methodology.

6.5 The role of the federal and state government was essential in helping Bahia improve its rural roads, since, in view of the local conditions of climate and terrain, the construction of all-weather roads had traditionally been too expensive an investment for either the local communities or private concerns.

6.6 The rapidly expanding production of coffee and cocoa, and to a lesser extent of milk in the late 1970s and early 1980s, is a good indicator of the soundness of the strategy followed by Bahia regarding development of feeder roads. While this expansion is best explained by favorable product prices and accessibility of credit and subsidies, without the roads it would hardly have been possible.

Economic Benefits and Returns

6.7 On the economic front, the main problem of the Bahia feeder road investments derives not from its initial strategy, but from the inability to anticipate future events. Sustained economic growth had been expected, but it was achieved only during the first few years after the roads were built. The decline in agricultural output and its impact on the economic and social benefits of the feeder roads program were unpredictable at the time of project formulation. Although Brazil began feeling the results of the world crisis in the early 1980s, few expected it to last as long, or to have the depth of consequences, which it eventually brought.

6.8 The economic returns calculated in the original feasibility studies proved to be exceedingly optimistic, at least when compared with the analyses based on this study's survey data in 1993 and 1996. Lack of monitoring and evaluation data throughout the life of the roads preclude passing a well-founded judgment on likely results had an analysis been carried out

based on conditions in the mid-1980s,[11] when production levels and economic prosperity in many of the road clusters reached peak levels.

6.9 The rate of economic and social decline in the roads' areas influence after the initiation of the crisis varied considerably between the sub-regions. The dynamism of local initiative, access to capital, effective agricultural potential, existence of alternative resources and other intangibles appear as key factors in explaining such variations. In particular, some of the coffee areas seem to have weathered the crisis better than the dairy or cocoa regions.

6.10 The initial beneficiaries of the feeder roads often tended to be larger-scale producers as many of the roads constructed actually begin or end on large plantations. Whether when and to what extent these benefits actually trickled down to poorer social strata depended more on prevailing forms of economic organization and social structure than on feeder road strategy. In some areas of the coffee region, there is evidence that small producers did benefit; elsewhere, the situation is less clear.

Social Benefits

6.11 The increased production of the main commodities, when it occurred, and the diversification of the outputs associated in part with feeder roads, helped trigger social change. Given the labor-intensive character of both cocoa and coffee, job-creation was high, migration was attracted in relatively large numbers (at a time when migration opportunities dwindled in the rest of the country) and living conditions improved. The milk-producing regions did not experience significant changes, to a large extent because milk production is not labor-intensive.

6.12 Social infrastructure, particularly in the cocoa and coffee regions, was significantly upgraded. The roads were a critical factor in the local authorities' programs to improve the population's access to health, education and other social services and amenities. Roads also had an impact on sociability and fostered rural-rural as well as rural-urban interaction. The roads materially increased the availability of consumer goods in the rural areas.

Environmental Impact

6.13 The increased economic activity triggered by the construction of feeder roads contributed to a rise in environmental degradation. The rate of environmental degradation grew since the beginning of the economic crisis, as deforestation, whether for the planting of other crops, for timber extraction or for the production of charcoal, expanded sharply. The existence of the feeder roads made all of these activities more viable. Deforestation was particularly disastrous in the cocoa region. Poor road design and/or inadequate use by heavy vehicles sometimes led to flooding, erosion and other environmental damage in the immediate vicinity of roads.

Institutional Impact

6.14 The study shows inconclusive results regarding how the feeder roads program affected the workings of different federal, state and local agencies. It appears that the institutional impact is generally related to investments' economic and social benefits and specifically associated to local prosperity. Improvements in the provision of education, health, electricity or modern amenities seems to have been directly related to the economic conditions in the community and

[11] In the view of GEIPOT, an "intermediate evaluation should have been planned for five years after the investments."

their capacity to finance such services. Similarly, economic stagnation seems to reduce the institutional ability to provide services at the local level.

Sustainability

6.15 The sustainability of the roads themselves appears to have been broadly satisfactory, as the majority of the project roads remain in fair condition or better. With few exceptions, the roads with the lower traffic are the less well maintained, which seems a rational use of the limited budget available for road maintenance. However, the maintenance situation is far from optimal, and more resources as well as further decentralization of responsibility may be required. Involvement of local jurisdictions and populations in route selection, road design and participation in construction may be a way of enhancing "maintenance ownership."[12] Sustainability of the economic benefits will depend on the extent that subregions diversify their economic base in the face of declining market prices for their primary products; many of the subregions have introduced new crops and are developing tourism and other sources of income.

Recommendations[13]

6.16 The findings of this study are based on conditions specific to Bahia, and its socioeconomic conditions, and are not necessarily replicable elsewhere. These findings, nonetheless, suggest the tentative recommendations listed below which, depending on the specific local, regional or national environment to which they are applied, can be useful for designing and evaluating feeder roads.

6.17 **Feeder Road Planning.** The experience of this study suggests that the following considerations are likely to improve the planning and ultimate impact of the feeder road investment:

(a) Clusters or mini-networks of roads fitting into a state and regional development strategy have a higher likelihood of attracting and retaining traffic than isolated road investments. In designing feeder roads programs, the concept of road clusters should be contemplated as a possible requirement for selection of road investments.

(b) Social impacts are significant[14] and should complement the traditional assessment of economic benefits. A strong involvement of beneficiaries at the grass-root level can help in this process. The involvement of beneficiaries would facilitate the task of state and local road planning agencies in the assessment of social benefits. Systematic institutional mechanisms should be put in place for the involvement of beneficiaries in road planning.

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[12] The Bahia state government commented in 1994 as follows: "Under the tax policy now in force there has been an impoverishment of Brazilian municipal governments, especially in the Northeast. Bahia has 415 municipalities; approximately 95 percent have no means of maintaining their road network. Such work may be done by the state government. Only with that reform and a return to financial autonomy would these municipalities be in a position to maintain their road networks. ... in the last 3 (three) years more than 40,000 km of municipal roads ... [had to be] maintained."

[13] The findings and recommendations of this study were reviewed at a workshop organized by SEAIN and held in Brasilia in April 1997 (Annex I).

[14] The importance of social impact led the Bahia state government "to recommend that greater attention be paid to the social dimensions, without prejudice to the economic dimension".

6.18 **Environmental Impact: Mitigation Measures.** Feeder road investments can lead to environmental degradation (i) in the roads' immediate vicinity (primarily through erosion), by road construction and maintenance and activities and, (ii) more importantly, in their general areas of influence, by the increased economic activity they generate. Controlling the roads' adverse environmental effects should be done in two ways: erosion in the roadbed vicinity should be limited through appropriate engineering methods; environmental damage in the roads' general area of influence should be controlled through regional environmental assessments and action plans. Such assessments and plans should be launched at the road planning stage.

6.19 **Sustainability: Role of Beneficiaries**. Under current policies calling for further decentralization and devolution of government activities, such as road maintenance, it appears essential that local governments be provided with appropriate funding by the central government, or alternatively, with the authority to collect user charges from roads' users. At the same time, the experience in Brazil and in other countries suggests that with appropriate incentives the private sector could play an active role in the operations, management and finance of rural road maintenance.

6.20 **Monitoring**. Lack of continuous monitoring data makes evaluation of the rural roads impact on their area of influence, difficult. As a minimum, a low-cost system of traffic counts should be conducted ideally on yearly basis. To the extent possible, agricultural, education and health surveys regularly conducted by the respective state authorities could be customized to include specifically a sample of feeder roads areas.

6.21 **Research on the Value of Avoiding Road Closures.** Avoiding road closures is likely to be a major, if not the main, benefit of many rural road improvements. However, empirical data to assess such benefits are practically nonexistent, making the quantification of this benefit unreliable. Research on this matter would be desirable to improve the quality of economic analysis. Such research should include the alternative cost (use of non-motorized transport or the opportunity costs of suspending transport altogether) incurred by producers, shippers and people when the road they normally use is closed. Research should preferably be carried out by a center interested in rural development or in transport.

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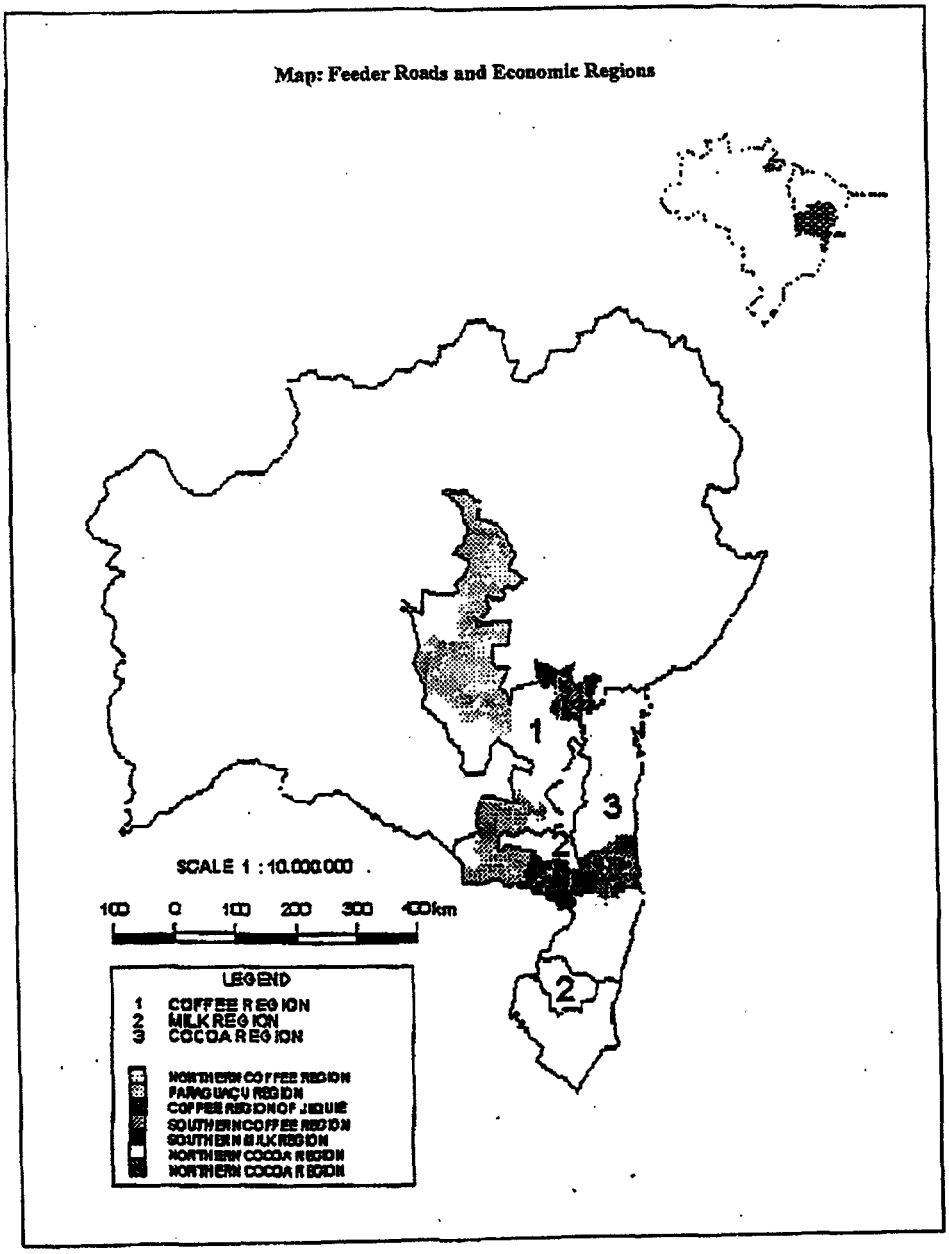
Map: Feeder Roads and Economic Regions
1
2
3
2
SCALE 1 : 10.000.000
100 0 100 200 300 400km
LEGEND
1 COFFEE REGION
2 MILK REGION
3 COCOA REGION
NORTHERN COFFEE REGION
PARAGUAÇU REGION
COFFEE REGION OF JEQUIE
SOUTHERN COFFEE REGION
SOUTHERN MILK REGION
NORTHERN COCOA REGION
NORTHERN COCOA REGION

Annex 1

SEAIN/OED WORKSHOP IN APRIL 1997

A workshop to discuss the findings of the study organized by SEAIN and OED was carried out in Brasilia during April 22-23, 1997. This Annex contains a brief summary report prepared by a working group and the presentation by a representative of the State of Bahia.

A. WORKING GROUP REPORT

The Working Group considered the following points:

1. The methodology for economic evaluation of rural road projects should be based on the reduction of vehicle operating costs, considering both normal and generated traffic.

2. Social and other indirect benefits could also be taken into account within a socioeconomic framework of analysis.

3. Traffic data, through periodic monitoring, is an essential element in the evaluation of rural roads, since traffic is the most direct indicator of socioeconomic activities stemming from regional development.

4. Roads' technical design characteristics should be reviewed to ensure that they are flexible to meet the specific conditions of the regions where they are located.

During Plenary discussions, the following points were also mentioned:

5. Environmental impact and mitigating measures should be considered early in the planning and design of rural roads.

6. A cluster approach to rural road investments, in the context of local regional development plans, is recommended to improve the probability of financing satisfactory projects.

7. Beneficiaries, including those in the private sector, should be made part of the planning, implementation and maintenance of rural roads.

8. The avoidance of road closures resulting from improving rural roads appears as an important benefit, the quantification of which would warrant research.

Annex 1

B. PRESENTATION BY ING. MARIA DAS GRACAS, STATE OF BAHIA

FEEDER ROADS: THE EXPERIENCE OF THE STATE OF BAHIA

The State of Bahia assigns a high value to feeder roads as it considers that such roads are an important factor of economic growth. In this context, in addition to isolated activities related to individual road sections connecting productive areas with the main road network, the State of Bahia in the recent past carried out programs (of feeder roads) specifically targeted to areas with agricultural potential. The most important of these programs focused on:

- The coffee and dairy regions;
- The dairy and cocoa regions;
- The Jaguaquara region;
- The Paraguaçu region;
- The Ribeira do Pombal region.

In the context of the IBRD/BNDS/DNER programs, the coffee and dairy (FR-I) and the cocoa and dairy (FR-II) regions were covered.

These regions have a population of about 3.0 million people, representing about 25 percent of the State's population. Population-wise, the regions account for the following percentages: coffee region, 38 percent; cocoa region: 48 percent; dairy region: 14 percent.

These projects were implemented between 1979 and 1985; they consisted of 69 roads with a total length of about 1576 km.

In preparation for these projects, work included identification of the main production center, analysis of the road network, and potential location of distribution centers. The analysis considered the economic development poles of the productive areas, and led to the identification of the roads to be proposed for new construction or for improvement.

The economic methodology for these studies followed, in general terms, the convention of quantifying costs and benefits. Benefits considered included both the value added and the transport costs, in accordance with BBD's[1] manual for feeder roads.

An important aspect of the studies was the adoption of appropriate technical specifications, in the understanding that for a feeder road to be economically feasible, it must have limited construction and maintenance costs, taking into account the traffic expected to flow on it. On the other hand, roads built with low construction costs, when located in rainy areas, are likely to have high maintenance costs. Since feeder roads normally do not have a satisfactory maintenance structure, it is likely that such roads will deteriorate over time.

[1] Not explained in the original report.

Results

A realistic evaluation shows that, on average, the results of the feeder roads programs were satisfactory. Among the positive points, it is worth noting: (i) consolidation of the economy in the areas covered by the programs; (ii) establishment of municipalities, in areas where prior to the road improvements they were just subdivisions of other municipalities; (iii) some roads in the coffee and dairy regions had a substantial traffic growth that justified their inclusion in the PRE and main arteries; and (iv) substantial improvements in access to education, health, energy, water and rural extension services. On the negative side, the main issue are the road sections of short economic life, whether due to poor quality construction or to inadequate maintenance. A great challenge for road administrators is setting up adequate institutional arrangements for the management of the feeder road network. Due to their nature, technical and operating characteristics, length and type and level of traffic, local roads – most commonly called feeder roads – typically are municipal roads.

Over the last decades, only very few municipalities had the technical and financial resources to design, construct, maintain and operate these roads. Therefore, roads that should have been under the municipal governments had to receive support from the State. In order to advise the State, the Intermunicipal Road Consortium was created, a mixed-economy enterprise comprising the State, the municipality as well as private enterprises. The consortium currently is under liquidation, with its functions being transferred to DERBA.

The tax reform currently in force provides a better allocation of resources among the federal, state and municipal governments. In the meantime, the vast majority of the municipalities lack the technical and operational capacity to build and maintain the roads, and to prepare financing plans. In this context, it is likely that the management of feeder roads will be reviewed in the near future, with a view to improving coordination between the state and the municipal authorities.

Technical Specifications

In revisiting the feeder roads programs, in addition to the political-institutional dimension, it is imperative to review the technical specifications and norms, taking into account that its main role is that of providing access, not mobility. It is evident that a dirt or gravel road cannot provide the same level of service as a trunk or arterial highway. Similarly, a wooden bridge cannot bear the weight of heavy vehicles. For these reasons, the technical specifications of feeder roads should be revised. It is essential that such roads remain passable 365 days per year, without interruption that hinder the flow of production. Similarly, the terms of reference for the preparation of feasibility studies for such roads should also be revised. In particular, the economic indicators should be perhaps more modest than those that apply to larger investments in the transport sector. At the same time, the teams preparing such studies should be given more flexibility in the choice of models they use for economic analysis, including the possible use of social indicators when properly justified. To achieve such objectives, the State of Bahia should take into account its own experience, as well as the experience of other states and of other countries. In addition, the availability of storage facilities should be considered in such studies as transport and storage are complementary.

Annex 1

Final Considerations

The State of Bahia has a positive experience regarding feeder roads through the Road Consortium. The programs involved regions with large differences in climate and orography, and carrying out close to 12,000 km of feeder roads.

In this light, we would like to make the following suggestions:

1. It is important to establish, within the state organization, agencies that can advise municipalities to meet the planning and building requirements of financial sources;

2. More studies and research should be conducted regarding technical alternative designs for low-cost feeder roads;

3. Given the importance of roads within integrated development programs, the cost of the roads should be included as part of those programs;

4. It is imperative to set up better mechanisms for the maintenance of feeder roads, for example, through mechanized brigades.

Annex 2

COMMENTS RECEIVED FROM THE BORROWER

PRESIDENCY OF THE REPUBLIC
SECRETARIAT FOR PLANNING, BUDGET, AND COORDINATION
SECRETARIAT FOR INTERNATIONAL AFFAIRS

FAX No. 3711/94 BRASILIA, Oct. 10, 1994

TO: Mr. YVES ALBOUY
Chief of Infranstructure and Energy Division
Operations Evaluations Department - OEDD 3 - World bank
FAX No. 202-522-3125

FROM: Roberto Bastos Carreiro
Coordinator of Performance Evaluation
SEAIN/SEPLAN-PR
FAX No. (061) 225-4022

No. OF PAGES: 11 (including cover) OBS: In case of bad transmissions please call (061) 225-7185

Re: Brazil - Feeder Roads in Bahia - Impact Evaluation Report

Dear Sir:

Responding to the fax of Oct. 24, 1994, attached please find a copy of the comments on the above-mentioned report made by the Government of the State of Bahia and by the Ministry of Transportation, through the National Highway Department (DNER) and the Brazilian Transport Planning Company (GEIPOT).

Despite the delay in forwarding these, due to a change in the chief of this coordination office, I would appreciate your understanding in receiving these comments, which I hope are still timely.

I take this opportunity to express my esteem and consideration.

Sincerely,

[signature]
ROBERTO BASTOS CARREIRO

Annex 2

IMPACT EVALUATION REPORT OF FEEDER ROADS IN BAHIA

(SEAIN OFFICIAL DOCUMENT NO. 40:/94)

Comments by the National Highway Department (DNER)

1. The following comments are based on an analysis of the Report prepared by the Institute for Society, Population and Nature (ISPN) and put in final form by the Operations Evaluation Department of the World Bank in English, without taking into consideration any other local information or opinions about the benefits of the feeder roads.

2. It would be useful for SEAIN to provide a centralized translation into Portuguese of this type of report before distributing it. It is assumed that this translation would be easier for the SEAIN in view of the number of its technical staff with international experience, and the suggestion is aimed at avoiding duplication of effort and/or interpretations.

3. The conclusions of the report cast many doubts on the success of this Program, for the following reasons:

Because of the criteria adopted in the original analyses, the results fell short of the forecasts, as follows:

– Internal Rate of Return	Forecast	Actual
Coffee Region	48%	4% to 7%
Cocoa Region	20%	-2% to -5%
Dairy Region	23%	6% to 12%
(p. vii of the Executive Summary)		

– Traffic

Tables 3.2 (p. 9) and 5.3 (p. 28) indicate that the volumes of traffic observed are generally less than the projections for Year 10, and in some cases are less than in the baseline year. It is assumed that the traffic would be the definitive sign of success, as it represents socioeconomic development.

a) The standard of living worsened (paragraph 4.64 of the Report) beginning in the1980s, and emigration ensued. on the environment apparently were not very favorable (paragraph 26, p.
b) The impacts vii of the Executive Summary).
c) Maintenance of the roads is inadequate (paragraph 3.15).
d) Despite all this, the Report ends up supporting projects of this kind since feeder roads have a great potential to support economic and social conditions in poor rural areas (paragraph 37 of the Executive Summary). For example, mention is
e) made of electricity, but by including this service as a benefit of a feeder road, one would also have to discount the cost of the towers and transmission lines.
f) The report recommends including parameters for measuring the social impact in feasibility studies, ex-post evaluations, and impact evaluations, considering that "the original analyses place much emphasis on economic results, and little emphasis on social outcomes." (Paragraph 38 of the Executive Summary).

4. light of the foregoing, it would be useful for the group in charge of the study in question [i] to try to include in more quantified form the social benefits of the 20 roads analyzed, [ii] to make specific suggestions on the methodology based on one of the three objectives of the study (paragraph 3 of the Executive Summary, which says: "to provide methodological insights for similar evaluations of the impact of feeder roads."

5. In particular, it is suggested that the ISPN/World Bank include in the Final Report:

a) More specific information on the social impacts and specific methodological suggestions. This information would contribute to developing a new evaluation methodology.

b) Standardization of Tables 5.1 and 5.2 on pp. 25 and 26 so as to include information on coffee and cocoa for 1979 (baseline year), 1985 (year development peaked), and 1992. (In the draft document analyzed, Table 5.1 offers data on coffee in 1979 and 1992, while the data on cocoa are for 1985 and 1992). A similar table should be included on dairy production.

c) Some additional explanations are also in order:

- For example, in the case of coffee, based on figure 3 on p. 11 (a), it appears that the production of coffee in the state of Bahia increased from some 60,000 tons in 1979 to 118,000 tons in 1990 (97 percent increase), though according to Table 5.1, in the region benefited by the feeder roads production fell from 58,700 arrobas in 1979 to 42,000 arrobas in 1992 (28 percent decrease). Could it be that the feeder roads do not even allow the regions that are relatively better off with respect to the rest of the state to maintain their status?

- In the case of cocoa, on June 6 of this year the price indicated in the "Gazeta Mercantil" for cocoa contracts for September deliveries at the New York Exchange was US$1,390 per ton, considerably more than the figure cited in paragraph 4.26 of the Report (US$800 in July 1993). Could it be that cocoa prices have recovered in the last 12 months?

d) At the very least, available data on the production of other crops in the municipalities analyzed (even without the historical series), in an effort to give an idea as to whether there are many important products that have already replaced coffee and cocoa, which have been in crisis. For example, in some parts of the state major strides were made with soybean cultivatio

6. The production of milk and coffee (two of the three predominant products in the regions under study) is quite common in several different parts of Brazil. Therefore, in view of the importance of this matter, which involves millions of U.S. dollars in investments, it is suggested

that the analysis be performed in another region of Brazil that benefits from feeder road programs.

7. In a new analysis, it would be interesting to try to consider, in greater depth, what other complementary measures are essential for programs of this sort (special agricultural loans, agrarian reform, irrigation projects, etc.) to improve the success of this type of project.

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GEIPOT

BRAZILIAN TRANSPORT PLANNING COMPANY

[LINE WITH ADDRESS/PHONE/TELEX/FAX, NOT ALL LEGIBLE]

NOTE

Re: Considerations on the "Impact Evaluation Report on Feeder Roads in Bahia - May 1994"

The Report under study sets out to achieve the following objectives:

- to analyze the economic, social, and environmental impact of the Feeder Roads Program;
- to identify the implications in regard to these aspects, with a view to formulating a policy for financing feeder roads; and,
- to propose methods of evaluating impacts related to these factors.

Considerations:

1. The document does not indicate, up front, the methods that were used to evaluate the impacts, so its analysis is totally undermined in that it does not present any methodological procedure, indeed it does not even state the parameters used in the document's analysis.

2. The analysis presented was superficial; as a result it merely communicates facts such as:

   "jobs multiplied"; ...
   "there were improvements in education";
   "commercial activity intensified"; ...
   "facilitating access to social services," etc. This information lacks quantitative data that could facilitate *ex-ante* and *ex-post* analysis.

3. The text of the Report says that the work teams traveled 17,000 km to collect data. One wonders: Why weren't those data processed and the results presented?

4. The text also says that this impact evaluation, done 10 years after the roads were built, is weakened by the economic crisis affecting the country; in order to obtain good results, an intermediate evaluation should have been planned five years after the investments were made.

5. The Report suggests that "the analyses of future projects should include, either *ex-ante* or *ex-post*, research on the full gamut of social outcomes." One wonders: During the

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planning of the work to assess the impacts produced in the region by the roads as part of the Program, were there no plans for collecting all the information on the social aspects?

It should also be noted that in 1975 the GEIPOT was beginning the Feeder Roads Research project that resulted from the agreement signed by the Planning Secretariat, Office of the Presidency, and the Ministry of Transportation (MT).

In 1977, the Company published "Rodovias Vicinais - Critérios de Planejamento" ("Feeder Roads: Planning Criteria"); that same year work began in the area of "Research on the Impacts of Feeder Roads," whose final results were published in 1982 (complete collection, in the annex).

Since implementation of the feeder roads of the Program was begun in 1979, according to the Report, and as both programs were financed by the World Bank, one wonders: Why was a joint effort not made?

6. To undertake an impact evaluation on feeder roads, plans must be made to collect a series of items of information (some listed below) which, in an *ex-ante* and *ex-post* analysis, yield comparative data through which innumerable important conclusions can be drawn regarding the impact of building a road in a given region:

7.
- population of the road's area of influence;
- access to education (No. of students);
- population per physician, dentist, hospital bed;
- technological level of agriculture;
- population's income;
- number of jobs generated;
- access to public services, banks, leisure, etc.

Conclusion:

As we understand that the Report is preliminary, and given that it appears that field data were collected that make possible quantification of the impact of these roads, we suggest the document be reworked with an explanation of the methodology used in the analysis, so that it may serve as a basis for a process of evaluating feeder roads and also for formulating a policy for their financing.

DEPRO

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GOVERNMENT OF THE STATE OF BAHIA SECRETARIAT FOR ENERGY, TRANSPORTATION, AND COMMUNICATION, TRANSPORTATION COORDINATION

FEEDER ROADS IN BAHIA

INTRODUCTION

These comments are on the document "Impact Evaluation Report - Brazil - Feeder Roads in Bahia," prepared by the World Bank.

This document refers to Programs FR I and FR II, which were executed by the Government of the State of Bahia, and encompassing the COFFEE, DAIRY, COCOA, and PARAGUAÇU regions.

The State of Bahia is pleased to have participated in all the Programs, as it is the only state of the Northeast that participated in FR 1, and especially because it is the subject of this first evaluation by the World Bank of the program Feeder Roads in Brazil.

It is important to highlight the validity of this type of work, even with all the shortcomings inherent in any pioneer effort; no doubt it will come to constitute an important opportunity for new and improved evaluations of investments in feeder roads.

The consultants in charge of preparing this *ex-post* evaluation visited the offices of the Government of the State of Bahia responsible for the preparation and execution of the studies and works, having received from them, in a timely fashion, all the information requested.

SPECIFIC COMMENTS ON THE DOCUMENT PRESENTED

Since the evaluation report was presented in English, which is a significant obstacle to clearly understanding it in its entirety, a detailed translation was made of the introductory chapters and the main observations and recommendations (chapter 7). These comments are based primarily on these two parts. The other parts of the evaluation report were simply read and used to round out understanding of any points that were not clear in the translation.

Following are the comments and/or clarifications deemed necessary.

1. The total amount invested in Bahia under FR I and II was US$74 million, with US$51.5 million in external financing and US$22.5 million in counterpart financing from the State.

2. All the roads included in the programs were given a ballasted surface, contrary to what is indicated in item 12 of the introduction.

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1. The entire network was absorbed by the DERBA for maintenance purposes. Nonetheless, due to difficulties in obtaining resources for roads, a problem found in all states of Brazil and the federal government, the DERBA was not in a position to perform all desirable maintenance services over these years. Some sections, of priority interest to private persons and municipalities, were maintained by a partnership between DERBA and said persons.

2. For reasons having to do with methodological criteria adopted by the ISPN, the evaluation of the impacts in the coffee region did not take into consideration the benefit resulting from increased production of other crops, preferring instead to adopt the same system used in the *ex-ante* feasibility study, which led to very low figures for internal rate of return. As is reflected in the report itself, had this had taken into account the diversification of crops, the results of the evaluation certainly would have been quite different.

3. The comment made in para. 31 of the introduction is not correct, as can be verified in table 3.2 of this study. The information refers to just one section, without considering the other results obtained and the comments made under paras. 3.9 and 3.10 of the same evaluation report.

4. In relation to paras. 33 and 34 of the introduction, it should be noted that:

   - The studies were done abiding strictly by the provisions of the manuals for the FR I and FR II programs;
   - The data used in these studies were obtained from field research, official information from plans and goals of Federal Government agencies (IBC and CEPLAC), and State government agencies (Group for the Eradication of Foot-and-Mouth Disease - GERFAB), and from dairy industries and cooperatives in the region.
   - All the stages of the study were monitored and audited rigorously by the technical staff of the BNDES, the World Bank, and DNER, who also participated in selecting the sections of roads to be financed.
   - Therefore, the comments on the lack of reliability of the materials and lack of critical perspective on the data in the Feasibility Study are unjustified.

FINAL CONSIDERATIONS

This report satisfactorily met its objectives, which are:

- to analyze the socioeconomic impacts of the FR I and FR II loans;
- to present the implications of these analyses in the formulation and implementation of lending policies; and,
- to make a methodological contribution for similar evaluations of the impact of feeder roads.

The analysis in the report finds that feeder roads perform a very important social function, which leads the state government to recommend that greater attention be paid to the social dimensions, without prejudice to the economic dimension.

Another issue that should be highlighted has to do with maintenance of the feeder roads. Under the tax policy now in force there has been an impoverishment of Brazilian municipal governments, especially in the Northeast. Bahia has 415 municipalities; approximately 95% have no means of maintaining their road network. Such work may be done by the state government. Only with tax reform and a return to financial autonomy will these municipalities be in a position to maintain their road networks.

The lack of financing for feeder roads in recent years left a major gap in this sector, given that, as was noted above, most of the municipalities are not in good financial shape, which to some extent overburdens the states as they provide services to the municipalities. In the specific case of Bahia, in the last 3 (three) years more than 40,000 km of municipal roads were maintained. In this context, the State of Bahia regards as auspicious the decision of financial agencies to analyze once again the question of feeder roads, examining their most important aspects from the social, economic, and financial points of view, in view of the chronic shortage of resources for this sector, which is an important means of supporting the development of rural areas. Their importance is brought into relief if one analyzes the results obtained in Bahia, where some existing districts were boosted by the progress attained through the construction of feeder roads.

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COMMENTS FROM THE BORROWER
(Translated from Portuguese original)

MINISTRY OF PLANNING AND BUDGET
INTERNATIONAL AFFAIRS SECRETARIAT

Brasilia, June 9, 1997

FAX # 1549/97

TO: Hernan Levy, Task Manager
Infrastructure and Energy Division
OED / World Bank

FROM: Roberto Bastos Carreiro
Coordinator, Performance Evaluation

Dear Mr. Levy:

Following consultation with the agencies involved in the Feeder Roads Projects, we submit our agreement with the contents of the Impact Evaluation Report prepared by OED, taking into account its conclusions and recommendations, which may be of great value in the development of new directives for the approval and execution of future sector projects in Brazil.

Sincerely yours,

(signed)

Annex 3

DETAILS OF REGIONAL IMPACTS

THE COFFEE REGION

Economic Impact

1. Many factors and incentives, construction of feeder roads among them, contributed during the first half of the 1980s to a significant expansion of coffee-producing areas in the region. The roads facilitated the inflow of inputs and manpower as well as the outflow of produce during the days when coffee was a viable business. Meanwhile, commercial activity was greatly intensified in the urban areas. These changes generated a demand for labor, which in turn caused important demographic growth.

2. However, the adverse conditions bearing on the coffee sector from 1986 caused the virtual abandonment of many coffee fields and bankruptcy. Only a few large companies attempted to increase coffee productivity through irrigation and other modern inputs or to even keep up their trees utilizing cheap labor. The coffee crisis consequently brought a reduction in municipal income, in employment and, generally, in the local economy.

3. In some areas, coffee was rapidly substituted by more diversified commercial agriculture, cattle-raising and by subsistence agriculture. Several new and lucrative crops, including vegetables and fruit, are being grown on land which only fifteen years earlier had been cleared to plant coffee. After the introduction of coffee, the land set aside to such traditional crops as beans, manioc, corn and sugar cane also expanded. Even large coffee plantations installed in the region are diversifying into various other types of cash crops.

4. The characteristics of soil, topography and climate in the coffee region favor the cultivation of specialized or technically-demanding crops. Small farmers are successfully turning to vegetable and fruit farming, whereas larger producers are increasingly switching to cattle and dairy farming. The extraction of minerals has also been profitably initiated in a part of this region. Parts of the coffee region have adapted rapidly to post-boom conditions. The existence of feeder roads has been a contributor to this relatively successful conversion.

Social Impact

5. Inasmuch as they supported the coffee boom, feeder roads contributed to the creation of jobs and income during its first years. At the time, population increased rapidly; later, growth occurred only in the region's urban areas. Despite the economic decline, most people perceived a clear improvement in their quality of life after road construction.

6. The construction of feeder roads brought improvements in access to education, health and electricity in the various communities, especially in the coffee region. Educational services were expanded, new schools were built and both teachers and students commuted more easily to and from the municipal seats. Medical and dental clinics were established and rural people now have access to them. Small-scale producers, during the boom, had easier access to extension services.

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Electricity is now available in most towns and in the road's immediate vicinity; water supply has also improved.

7. Whether or not these benefits persisted in a given sub-region, or would have occurred even without the feeder roads projects, depend a great deal on its capacity to adapt when the (coffee) boom ended. Rural population decreased in all sub-regions; migration to the cities and rapid urban growth is commonplace. Some of the social benefits produced by the roads were, at least temporarily, negated by the decline of the coffee; employment decreased and out-migration was common. In others, new sources of economic dynamism stabilized population; the reduction in the demand for manpower was offset by the diversity of the region's economic base. In some cases the diversification did not help, for instance, the switch from coffee to cattle ranching was, predictably, disastrous in terms of employment generation.

8. This situation obviously generates an ambiguous image of the final results of road construction. It is difficult to separate economic cycles from social impacts. The roads, nevertheless, had social consequences which go beyond the recent economic crisis. Improvements in access to educational and health facilities, as well as in access to other social amenities, transcend the effects of the crisis.

Environmental Impact

9. The original vegetation in much of the Chapada Diamantina was significantly altered as a result of the introduction of coffee cultivation. The feeder roads were a factor in the substitution of the original vegetation with coffee trees and, later, with pasture. Traditional slash and burn techniques were used to clear the area. With the downfall of coffee prices, timber is being extracted and sold in the state capital (Salvador), or it is being transformed into charcoal. This has become an important source of income for people who have lost their livelihood. Several valuable tree species have been indiscriminately destroyed.

10. Deforestation provoked alterations in the ecosystem, erosion on hillsides and siltation of creeks, thus reducing water availability and affecting the local fauna. Chemical inputs were improperly applied and many workers, particularly women, were harmed while manipulating them.

11. It would be inappropriate, however, to attribute negative environmental consequences predominantly to road-building alone. Most forms of environmental degradation derived from the increase in economic activity which the road stimulated. Many of these effects might have been reduced by a combination of environmental awareness and careful planning. However, environmental awareness was still very incipient at the time the roads were built. It is probable that the long-term effects would have been less devastating had the prosperity generated by coffee persisted.

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THE COCOA REGION

Economic Impact

12. The areas of influence of feeder roads in the cocoa region went through the clearly-demarcated prosperity and decline cycle, essentially reflecting the market demand and prices for cocoa. Cocoa crops were transported by mule or canoe prior to road construction. The roads thus produced a radical change in the journey to market, which previously could take up to a few days, to a few hours. Moreover, they helped promote the first incursions of modernization in a conservative social and economic structure.

13. Traditional cocoa producers found it difficult to adapt to the current circumstances. The characteristics of the soil and terrain, the traditional reticence towards diversification and the conditions of the social structure all made change difficult. After the cocoa crisis, timber extraction constituted one of the most dynamic economic activities in the region; the roads made it possible to extract timber on a commercial scale. Cattle-raising is also being adopted sporadically. Production of bananas, manioc and other crops is increasing.

14. Part of the difficulty in generating complementary sources of sustainable agricultural activity in the Cocoa Region stems from its physical habitat. Cocoa is generally cultivated in rugged terrain, unsuitable to other forms of agriculture. Part is due also to the socio-cultural framework of cocoa monoculture, in which the "easy riches" traditionally generated by this crop have long deterred other types of agricultural initiatives.

15. Altogether, improved roads were insufficient to resolve the region's grave structural and circumstantial problems. However, without the roads, the situation would likely have been much worse.

Social Impact

16. Construction of feeder roads in the cocoa region had social consequences similar to those in the Coffee Region. Actually, given the higher population density and the greater isolation of the Cocoa Region, due to the nature of the terrain, the positive impact was even more meaningful here. Traditionally, cocoa plantations paid low daily wages and generally ignored existing legislation protecting workers. The adoption of more modern organizational practices visible in some regions are, at least in part, attributable to the change in mentality of both workers and employers. Increased communication with the outside world is an important source of such change; the construction of (mostly) all-weather roads in previously isolated regions was an important contributory factor in this process.

17. Nevertheless, the crisis had an even greater impact here due to the incapacity of cocoa producers to generate adequate alternatives. Cocoa production is, like that of coffee, labor-intensive. Hence, a sustained, large-scale crisis brings widespread difficulties. Employment has

declined significantly; meanwhile, cocoa producers complain that legal wages are impracticable. Available jobs tend to be poorly remunerated. There has been heavy migration to the periphery of the municipal seats. The increase in ranching activities is contributing to the large-scale rural exodus. The period 1991-93 witnessed particularly intense migratory movements, according to local respondents. Cocoa prices recovered somewhat after hitting a low peak in 1993.

18. Educational facilities and quality improved with the arrival of school teachers who, without the road, might not have accepted work in this isolated area. Children also can travel to school much more easily. The same impact is evident in the domain of health; patients can now be transported rapidly to hospitals in nearby towns and cities. Electricity now is provided to the hamlets and villages of the region.

Environmental Impact

19. Traditionally, deforestation was not a major problem in the prosperous cocoa-producing regions since the cocoa trees blend into the surrounding forest. However, timber extraction is now being carried out in earnest and with devastating effects for the remaining coastal rainforest (Mata Atlântica). There appears to be little effort at rationalizing this extraction or at preventing wholesale damage. The rainforest is also being invaded by would-be small farmers, and larger landowners are allegedly burning the forest to discourage this.

20. The flow of heavy vehicles has caused erosion of the roadbed. This is basically due to traffic of cattle and timber trucks, as well as cocoa transport during harvest season. The roads in the region show signs of erosion in various segments.

THE DAIRY REGION

Economic Impact

21. The dairy products which originate in the feeder roads areas are transported to Salvador, Rio de Janeiro and São Paulo, via Vitória da Conquista. Evidently, the type and magnitude of production involved cannot be handled by mule trains or jeeps. Refrigerated trucks, specialized equipment and heavy machinery are all part of this scenario.

22. The feeder roads were thus an essential condition for the transformation of this region into a nationally-significant and prosperous economic zone. Nevertheless, this nucleus of activities never did grow in accordance with expectations. Although the problems of the local dairy industry did not reach the same proportions as those experienced in coffee and cocoa, the crisis seriously endangered the fulfillment of the region's economic potential. The bottom line probably is that, without better prices for dairy products, no amount of indirect incentives can fully take up the slack.

23. Other types of economic activity are attempting to expand. Graphite-extraction is one of these ventures. The production of basic foodstuffs, however, has decreased in the region. Small

farmers do not seem to be motivated to produce for the local markets, claiming that the local population prefers food produced and packaged outside the region. Some farmers are turning to the production of sugar cane for distillation of cachaça (sugar cane alcohol).

Social Impact

24. Historically, cattle raising and commercial-scale dairy farming do not require large numbers of workers. Hence, investments in this region generated less jobs than did those in coffee and cocoa. Migrants never arrived in large numbers to the region, even during the period when expectations of future economic dynamism were high. By the same token, out-migration has not been massive, although demographic data in the 1980s do show a reduction in rural population and an increase of urban population.

25. Job opportunities in the region are scarce. The new graphite factory does not provide much direct or indirect employment. Employers and potential employees complain about the labor legislation which deters them from hiring cheap labor or from entering into long-term share-cropping contracts involving permanent crops.

26. The main social advance witnessed in the period since construction of the feeder roads appears to be improvement in transport and health services. Local authorities set up public health clinics. Meanwhile, bus lines between local communities were installed. This also facilitated the transport of school teachers and the improvement of educational quality in the region.

27. Overall, the expansion of dairy production associated with feeder roads in the dairy region does not seem to have fulfilled expectations of significant economic and social improvements. One reason for this –in addition to the obvious and possibly overwhelming effects of the economic crisis– might be that dairy products do not generate taxes for the municipalities in which production is generated, but rather where it is consumed. Consequently, milk production is not directly associated with increased public spending in the region.

Environmental Impact

28. Land-extensive cattle-raising and dairy production usually involve deforestation for purposes of seeding pasture. In the present instance, this had already happened before the feeder roads were built. Graphite mining is a potential threat to the environment which has arisen since the roads were built.

THE PARAGUAÇU REGION

Economic Impact

29. Prior to FR I and II, local communities were much dependent on mining activities. Diamond extraction was a major source of jobs and revenue. The construction of feeder roads brought coffee trees, and the development of this activity replicates that of the coffee region.

30. Other crops such as sugar cane, beans and garlic, as well as subsistence agriculture also benefited from improvements of the original precarious roads. Agricultural production became more diversified. Modern entrepreneurs now have a strong role in the region. Moreover, more modern production techniques and machinery are being used. Overall, agricultural employment, both in the primary sector (irrigated production) and in the secondary sector (commerce) has been on the increase. Potatoes are one main crop and one in which productivity is high. They are commercialized in Vitoria da Conquista, and most of the production is bought by firms from the modern sector.

31. Diamond extraction is still an important source of employment and revenue. However, since the rocks are commercialized and polished elsewhere, little profit remains in the community. It is difficult to perceive what concrete impact the road had on this activity.

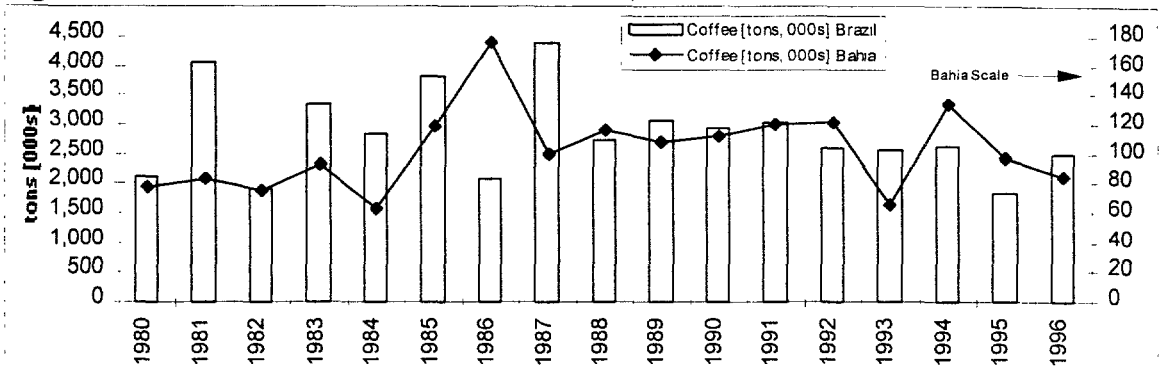
Social Impact

32. The two roads studied in the Paraguaçu region facilitated both in- and out-migration. A number of small farmers installed themselves in the region during recent years and are practicing more modern forms of commercial agriculture. Nevertheless, local residents mention massive out-migration; indeed, urban areas are growing some four times faster than the rural areas. Unemployment is high in those sections of the municipalities which were most affected by the coffee boom and decline, particularly where a suitable substitute for coffee has not been found.

Regional, Commodity-Based Economic Analysis

33. *The Coffee Region.* The economic conditions in Bahia's coffee region deteriorated substantially from the 1980s to the 1990s. Production, productivity and market prices all declined, by some 30 percent, except for a temporary recovery in prices in 1986. For several years after completion of the roads, production costs exceeded market prices. This situation contrasted with the expectations at the time of project appraisal, which foresaw increases in output and stability in prices. On the other hand, the economy in those regions diversified, and an analysis purely based on coffee production, as had been done at appraisal, would seriously misrepresent the actual economic development that took place.

Figure: 1: Coffee Production in Brazil and Bahia, 1980-1996



FIBGE (1980-92) Brazilian Statistics Yearbooks, FIBGE Municipal Dairy Production, FIBGE Monthly Milk Survey (1995-96); FAO Production Year book; Note: 1996 figures are projected based on first five month's output.

34. The table below shows the drop in net income to producing coffee.

Table 1 Income from Coffee - Coffee Region Site (Values in 1992 US$)

Indicators	*1979 (a)*	*1992 (b)*
Cultivated Area (ha)	5,870	6,000
Productivity (sacks/ha)	10.0	7.0
Production (arrobas)	58,700	42,000[2]
Surplus (sacks)	58,700	42,000
Average Price (US$/sack)	92.4	58.8
Unitary Cost (US$/sack)	81.8	50.0
Income Generated (US$)	622,220	387,000

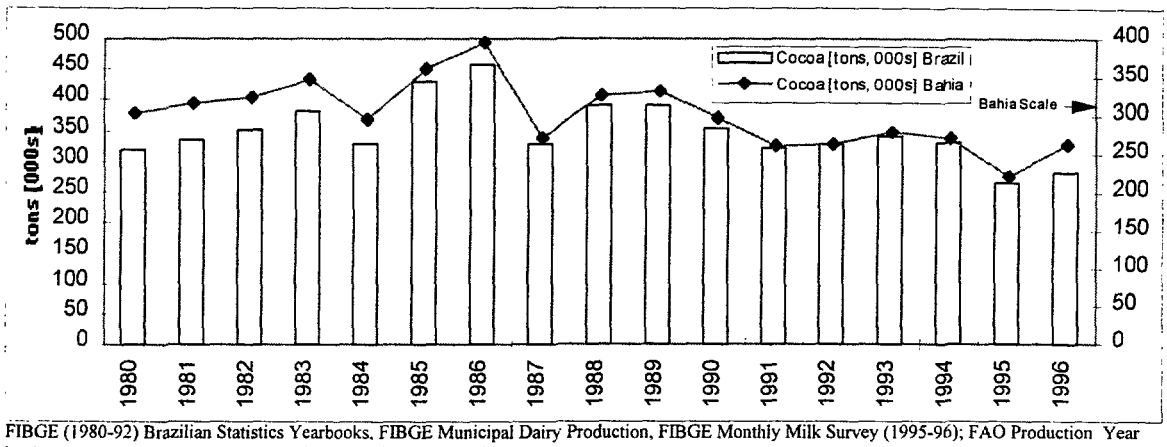
Source: (a) Plano de rodovias alimentadoras da região cafeteira. Op. cit. (b) ISPN, Field Research, July 1993.

35. *The Cocoa Region.* The main event was the devastating collapse in cocoa prices, which fell more than 50 percent in current US dollars (and even more in constant dollars) between the early 1980s when the roads were built and the time of this study. In parallel, the cocoa margin–the difference between unit cocoa prices and cocoa production costs–shrunk by some 90 percent (Table 2). In one road site area analyzed in this study, productivity remained unchanged and production increased by some 53 percent between the date of road completion and the date of the impact evaluation. However, cocoa production overall in Bahia was lower in 1993 and 1996 than during the 1980s and early 1990s. The cocoa area showed fewer signs of significant agricultural diversification than the coffee region. In any case, as explained above, diversification was not amenable to quantification.

[2] The evolution of coffee production from 1979 to 1990/92 was different for the IE site studied (Table 5.1) and Bahia as a whole (Figure 3). The IE did not analyze the reasons for and implications of the difference.

Annex 3

Fig. 2 Cocoa Production in Brazil and Bahia, 1980 - 1996



FIBGE (1980-92) Brazilian Statistics Yearbooks, FIBGE Municipal Dairy Production, FIBGE Monthly Milk Survey (1995-96); FAO Production Year book; Note: 1996 figures are projected based on first five month's output.

Table 2. Income from Cocoa - Cocoa Region Site (Values in 1992 US$)[3]

Indicators	*1985 (a)*	*1992 (b)*
Cultivated Area (ha)	807	1,200
Productivity (arrobas/ha)	39.0	40.0
Production (arrobas)	31,473	48,000
Surplus (arrobas)	31,473	48,000
Average Price (US$/arroba)	38.9	10.5
Unitary Cost (US$/arroba)	10.7	7.4
Income Generated (US$)	887,539	148,800

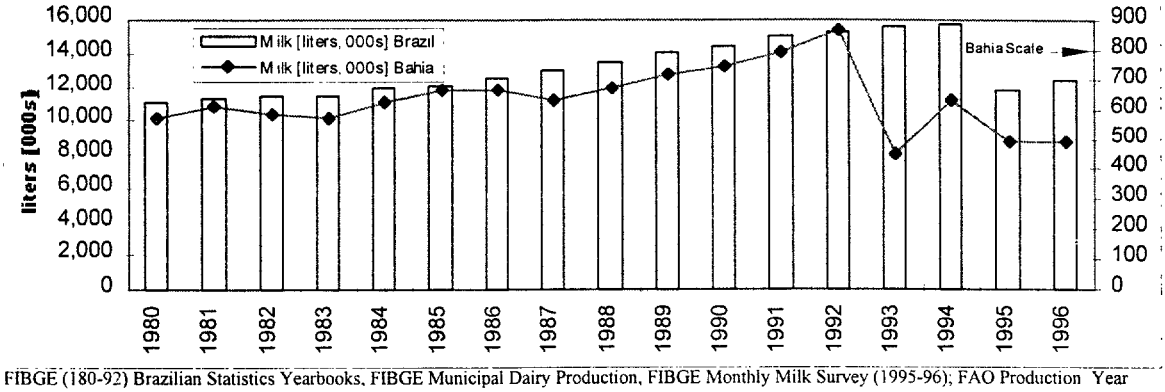
Source: (a) Plano de rodovias alimentadoras da região cafeteira; and IBGE - Anuário Estatistico. (b) ISPN, Field Research, July 1993.

36. *Dairy Region.* Economic conditions in this region followed the pattern of the cocoa and coffee regions. Production of milk during the 1980s and early 1990s was some 20-60 percent higher than the 1993 and 1996 levels.

[3] Tables 5.1 and 5.2 were not standardized to show identical baseline years because the coffee and cocoa analyses refer to different scenarios. The coffee road was constructed in 1979, and the cocoa road in 1985/86.

Annex 3

Fig 3: Milk Production in Brazil and Bahia, 1980-1996



FIBGE (180-92) Brazilian Statistics Yearbooks, FIBGE Municipal Dairy Production, FIBGE Monthly Milk Survey (1995-96); FAO Production Year book, Note: 1996 figures are projected based on first five month's output.

Annex 4

DETAILS OF THE ECONOMIC ANALYSIS

OVERVIEW

1. A typical evaluation to assess the economic rate of return entails three basic steps:

   I. The initial cost of the investment ($C) is determined which represents the actual cost at the start of a project/investment and its life span, in years (n).

   II. A stream of annual benefits/savings for the project's life is assessed along with maintenance costs and, if applicable, a salvage value.

   III. a. Internal (Economic) Rate of Return: is the rate at which the discounted present value of the stream of benefits/savings sums to the initial cost/investment, i.e., $\$C = \sum^{n}_{1} \{B_k [1 + i]^{-k}\}$; k = 1,n.

   b. Benefit-Cost Ratio: Instead of estimating the rate at which these two streams are equated (costs and benefits), a pre-determined discount rate is used to assess whether the project's benefits exceed the costs, i.e., whether the project is profitable.

In this study, III.b rather than III.a was followed, as explained in Chapter 4 of this report.

ANALYSIS

2. Assessment of Costs: he cost of each road includes construction and maintenance costs (assessed as 3% of construction costs, annually). In the analysis, the road construction cost is converted to an annualized cost, using a 10% discount rate.

3. Assessment of Benefits: Rural road improvements benefit the agricultural areas, and may help trigger: (i) increases in produce output, (ii) development of new areas for cultivation, (iii) a change in composition from low value cereals to perishable but high value agricultural produce (iv) higher value added of products, (v) use of more efficient inputs, and (vi) lower vehicle operating costs (VOCs). It is conjectured that increase in all or any of those activities including other rural and social impacts, must be reflected through traffic patterns with benefits linked directly to lower VOCs. In part, this benefit stems from the improved road that remains open throughout the year whereas the old road might have been impassable previously, due to bad weather. There are several measures of such benefits:

   a. lower VOCs to normal traffic, "without" the improvements

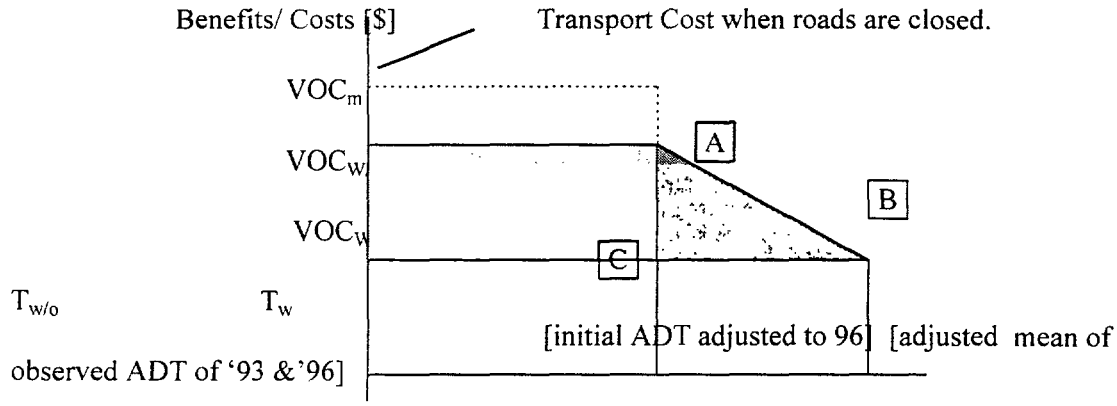
   b. lower VOCs to generated traffic due to reasons cited above

   c. lower VOCs due to avoidance of road closure

Annex 4

A detailed analysis of these is given below.

Figure 1: Computation of Vehicle Operating Costs based on Average Daily Traffic



4. The figure indicates two types of benefits that will be generated due to an improvement or a construction of a road:

IV. Average Daily Traffic (ADT) will rise, with a contribution to/and facilitating economic activity of the road's influence area, whether it is dairy farming, cocoa or coffee cultivation or marketing

V. Vehicle Operating Costs (VOC) will be lower for the current and generated traffic.

VI. In addition, other social benefits would also rise such as access to markets, social services, educational centers and other rural development activities. These benefits are considered as intangible and have not been quantified in this study.

Step One: The Basic Computation

A. The benefits derived by existing traffic are equivalent to the area of the rectangle marked as "$VOC_{W/O}$, VOC_W, A, C. Thus, the benefits when roads are open is the area of the rectangle:

$$^{o}B_n = [VOC_{W/O} - VOC_W] \times T_{w/o}$$

B. The savings due to generated traffic is equivalent to the area of the triangle marked as "ABC". The benefits when roads are open, due to generated traffic are indicated by the area of the triangle "ABC", however, the benefits are treated as if derived from separate origins, i.e., when roads are open and close:

(a) $^{o}B_g = 0.5 \times [VOC_{W/O} - VOC_W]\,[T_w - T_{w/o}]$; normal VOCs apply.

(b) $^{c}B_g = 0.5 \times [VOC_m - VOC_W]\,[T_w - T_{w/o}]$; higher VOCs apply.

Step Two: Additional Benefits due to Avoidance of Road Closure

Suppose bad weather closes road for d days/annum prior to modernization; then the commuters "with out" the modernization would have to make an extra effort to transport goods and services, i.e., the cost would now be VOC_m which is greater than $VOC_{w/o}$ and VOC_W. Initially, assuming that extra effort required would be m-times the average level of effort, this benefit would be:

$$^{c}B_n = [d \times m] \times [VOC_m - VOC_W] \times T_{W/O}$$

Step Three: The sum of these three quantities would be the total of VOC savings:

$$\begin{aligned} {}^{o}B_n + {}^{o}B_g + {}^{c}B_g + {}^{c}B_n = {} & [VOC_{W/O} - VOC_W] \times T_{w/o} \\ & + [VOC_{W/O} - VOC_W] \times [T_w - T_{w/o}] \times 0.5 \\ & + [VOC_m - VOC_W] \times [T_w - T_{w/o}] \times 0.5 \\ & + [VOC_m - VOC_W] \times T_{W/O} \times [d \times m] \end{aligned}$$

Step Four: The Benefit-Cost Ratio of an individual road would be the ratio of total benefits and its annualized investment, $\$C_a$:

$$\textbf{Benefit-Cost Ratio} = [{}^{o}B_n + B_g + {}^{c}B_n] / C_a.$$

5. Traffic Counts

Two ex-post traffic counts were conducted in mid-1993 and mid-1996 utilizing conventional methodology (i.e., recording of simple, visual observations), supervised by DERBA's engineers. All vehicles passing a selected check point on a given road site on week days between 6:00 and 18:00 hrs. were counted and verified subject to prior experience, local knowledge and comparisons with analogous investigations. These daily counts were checked with local respondents for consistency. Subsequently, these figures were expanded to a reliable "average daily traffic" (ADT) using expansion coefficients for 24-hour traffic, average weekly traffic and average annual daily traffic, which were obtained from studies on similar roads carried out by DERBA.[4] Tables 1, 2 and 4 present the coefficients of conversion and observed traffic counts for years 1993 and 1996. The coefficients of conversion converts the observed traffic numbers to an annualized ADT, through a stepwise approach, say initially to a 24-hr. average, then to a weekly average and finally an annual average. Table 1 shows the ADTs for the sample which were obtained by multiplying the observed count by three periodic coefficients, i.e.,
ADT of road RS.11.5 = 43 x 1.478 x 0.926 x 0.934 = 55.

[4]These expansions were based on linear extrapolations from the existing counting stations in the area of influence of each of the roads under study. Seasonal data dates from 1979, but is the most complete observation available for 24 hours and 365 days and is used by DERBA and DNER for traffic expansion studies in Bahia to this day.

Annex 4

I. The expansion coefficients based on counting stations on roads with greater traffic but in the same economic region where seasonal traffic behavior tends to be homogenous, considered as relatively reliable.

II. The coefficient of expansion to extrapolate a 12-hr. count to a 24-hr. estimate although it appears high it represents the best methodology available and is also used by DERBA.

III. These linear extrapolations had been used previously for similar studies conducted (by DEBRA and DNER in Bahia) for the relevant area of influence of the individual road and its counting station. Moreover, computed ADTs (1996) were further verified by comparing with its forecast for 1993 and the percentage deviations to analyze unusual variations.

Table 1: Conversion of Average Daily Traffic Using Expansion Coefficients per Day/Week/Year

Region	Road	Type	Count	24 Hours	Week	Year	ADT '96
Coffee (north)	RS.11.5	S	43	1.478	0.926	0.934	55
Coffee (north)	RS 11.6	S	64	1.478	1.011	0.934	89
Coffee (south)	RS.02.1a	S	168	1.366	0.963	0.918	203
Coffee (south)	RS.02.1b	S	80	1.366	0.987	0.918	99
Coffee (south)	RS.01.2a	S	78	1.408	0.961	1.031	109
Coffee (south)	RS.01.2b	S	85	1.408	0.961	1.031	119
Coffee (south)	RS.01.1	S	129	1.408	1.02	0.955	177
Coffee (Paraguacu)	BA 148	S	0				0
Coffee (Paraguacu)	BA 142	S	145	1.37	0.962	0.987	189
Coffee (Jequie)	RS.05.8a	M	19	1.593	1.031	0.865	27
Coffee (Jequie)	RS.05.8b	M	4	1.593	1.031	0.926	6
Coffee (Jequie)	RS.06.6	S	6	1.593	1.019	0.926	9
Cocoa (north)	C90	S	64	1.25	0.993	1.075	85
Cocoa (north)	C10	S	201	1.25	0.871	0.932	204
Cocoa (south)	C44	M	114	1.316	1.005	0.942	142
Cocoa (south)	C23	M	23	1.316	0.942	0.942	27
Dairy (south)	L10a	M	108	1.408	0.957	1.031	150
Dairy (south)	L10b	M	94	1.408	0.957	1.031	131
Dairy (south)	L10c	M	102	1.408	0.957	1.031	142
Dairy (south)	L10d	M	53	1.408	0.957	1.031	74

Note: ADT 1996 = Count x [Coeff.24-hrs] x [Coeff.week] x [Coeff.year]; M=Municipal, S=State Road

Source: Complementary and Updating Evaluation Study; J. G. C. Rocha, Coordinator.

Table 2. Average Daily Traffic (ADT) for 20 road sites by Vehicle Type - 1993

Region	Road	Extension (km)	C	P	B	LT	HT	T	OT	TOTAL
Coffee (north)	RS.11.5	30.5	14	11	0	18	7	0	3	53
Coffee (north)	RS 11.6	22.1	20	39	0	13	4	0	10	86
Coffee (south)	RS.02.1a	17.1	60	56	4	23	8	1	8	160
Coffee (south)	RS.02.1b	31	137	57	4	87	10	0	9	304
Coffee (south)	RS.01.2a	22.4	67	23	9	41	4	0	1	145
Coffee (south)	RS.01.2b	10.5	36	7	0	7	4	0	13	67
Coffee (south)	RS.01.1	28.4	48	22	11	15	0	0	4	100
Coffee (Paraguacu)	BA 148	55	59	23	2	18	4	0	78	184
Coffee (Paraguacu)	BA 142	47	33	27	2	7	2	0	0	71
Coffee (Jequie)	RS.05.8a	14.2	9	10	0	12	0	0	1	32
Coffee (Jequie)	RS.05.8b	15.7	25	7	0	12	0	0	18	62
Coffee (Jequie)	RS.06.6	11.3	13	0	0	0	0	0	1	14
Cocoa (north)	C90	13	44	38	0	17	0	0	9	108
Cocoa (north)	C10	15	20	27	2	35	6	0	11	101
Cocoa (south)	C44	16.4	21	7	0	0	0	0	13	41
Cocoa (south)	C23 *	14.1	12	2	0	0	0	0	0	14
Dairy (south)	L10a	12	32	7	2	16	21	0	1	79
Dairy (south)	L10b	4.8	70	16	2	23	21	0	3	135
Dairy (south)	L10c	14.3	50	10	2	18	18	0	0	98
Dairy (south)	L10d	15.2	35	7	0	11	3	0	1	57
Totals		410	805	396	40	373	112	1	184	1911

Source: ISPN Field Research, July 1993.
Legend: C=Cars; P=Pickups; B=Buses; LT=Light Trucks; HT=Heavy Trucks; T=Tandem; OT=Other Transport.

Annex 4

Table 3. Average Daily Traffic (ADT) for 20 road sites by vehicle type - 1996

Region	Road	KM.	C	P	B	LT	HT	T	M.C.	OT.	TOTAL *
Coffee (north)	RS.11.5	30.5	30	0	0	10	2	0	1	1	43
Coffee (north)	RS 11.6	22.1	38	0	0	24	2	0	0	0	64
Coffee (south)	RS.02.1a	17.1	77	33	5	30	6	2	15	0	168
Coffee (south)	RS.02.1b	31	28	18	2	16	2	0	14	0	80
Coffee (south)	RS.01.2a	22.4	19	29	6	24	0	0	0	0	78
Coffee (south)	RS.01.2b	10.5	12	35	6	32	0	0	0	0	85
Coffee (south)	RS.01.1	28.4	71	32	10	14	0	0	2	0	129
Coffee (Paraguacu)	BA 148	55	0	0	0	0	0	0	0	0	0
Coffee (Paraguacu)	BA 142	47	65	39	3	30	3	1	4	0	145
Coffee (Jequie)	RS.05.8a	14.2	2	17	0	0	0	0	0	0	19
Coffee (Jequie)	RS.05.8b	15.7	4	0	0	0	0	0	0	4	4
Coffee (Jequie)	RS.06.6	11.3	2	4	0	0	0	0	0	3	6
Cocoa (north)	C90	13	35	13	2	14	0	0	0	3	64
Cocoa (north)	C10	15	63	69	6	36	11	0	16	40	201
Cocoa (south)	C44	16.4	27	41	8	38	0	0	0	0	114
Cocoa (south)	C23	14.1	5	14	0	4	0	0	0	0	23
Dairy (south)	L10a	12	24	40	6	38	0	0	0	0	108
Dairy (south)	L10b	4.8	13	35	6	40	0	0	0	0	94
Dairy (south)	L10c	14.3	23	36	7	36	0	0	0	0	102
Dairy (south)	L10d	15.2	7	20	4	22	0	0	0	0	53
Totals		410	545	475	71	408	26	3	52	51	1580

Source: ISPN Field Research, July/August 1996. *O.T. is not included in the Total.
Legend: C=Cars; P=Pickups; B=Buses; LT=Light Trucks; HT=Heavy Trucks; T=Tandem; OT= Other Transport.

Table 4: VOC for Hilly Terrain (US$1986/1000km)

Type of vehicle	*Earth (without road)*	*Gravel (with road)*	*Paved (with road)*
Cars	126.9	94.1	80.2
Pick-up	222.2	151.5	120.2
Bus	495.4	398.9	349.8
Light Truck	529.5	314.5	222.5
Heavy Truck	1110.0	612.0	402.8

Source: Project Completion Report, 1986. Secondary and Feeder Roads Project (Loan 1207).

6. Results

All computations are shown in Tables 5 and 6. A step-wise guide to the computations are appended below.

I. We use III.c above to compute the Annualized cost of the project and its value in 1996, using future value rate "Investment, 1996" is the cost per km times the length {km} plus 3% of **cost per km** adjusted to 1996 $s, by dividing with the appropriate index value, 0.731).

II. Next we use the data shown in Table 4, "VOC for Hilly Terrain" to compute $VOC_{W/O}$ and VOC_W per km. and each type of vehicle. The traffic by type (as a percent of total) of vehicles for 1996 is shown in columns C to HT (Table 6). A weighted mean of $VOC_{W/O}$ and VOC_W is computed using percentage of traffic type as weights and multiplied by the road length. Notice also that most of the roads do not remain open during the entire year.

III. With the information obtained in I and II above, benefits could be computed, as shown in Table 7 which indicates that at 10% discount rate, about 12 projects fulfill the evaluation criteria as their Benefit Cost Ratio is greater than 1.

IV. Encouraged by these results, we advanced the computations further. Suppose we drop the assumption that greater benefits occur to those vehicles if the roads were not improved , thus the investment (I), now is evaluated on normal and generated benefits only, such that what are the break-even benefits per vehicle per day or equivalently, break-even unit cost per vehicle, that would yield a B - C ratio of 1:

$$(I - [{}^{o}B_n + {}^{o}B_g]) / (\underline{\text{Adj. Mean ADT, 1996}} \times \underline{\text{Days Open With}})$$

Also, we calculated this unit cost in terms of per km. by dividing this quantity by road length, which is shown in Table 7:

$$(I - [{}^{o}B_n + {}^{o}B_g]) / (\underline{\text{Adj. Mean ADT, 1996}} \times \underline{\text{Days Open With}} \times \underline{\text{Length, km}})$$

Annex 4

Table 5: Preliminary Computations to obtain the Investment, Annualized Investment and VOCs

Region	Road	Length (km)	Investment, 1996	$\$C_a$	C	P	B	LT	HT	VOC_w	VOC_o	VOC_m	$d.VOC_n$	$d.VOC_m$
Coffee (north)	RS.11.5	30.5	$1,633,064	$174,381	70%	0%	0%	23%	5%	.36	.23	.54	4.01	9.50
Coffee (north)	RS 11.6	22.1	$1,183,302	$126,355	59%	0%	0%	38%	3%	.42	.26	.63	3.50	8.16
Coffee (south)	RS.02.1a	17.1	$915,587	$97,768	46%	20%	3%	18%	4%	.34	.22	.51	2.06	4.99
Coffee (south)	RS.02.1 b	31	$1,659,836	$177,240	35%	23%	3%	20%	3%	.33	.21	.49	3.62	8.71
Coffee (south)	RS.01.2a	22.4	$1,199,365	$128,070	24%	37%	8%	31%	0%	.43	.28	.65	3.30	8.13
Coffee (south)	RS.01.2 b	10.5	$562,202	$60,033	14%	41%	7%	38%	0%	.47	.30	.71	1.75	4.21
Coffee (south)	RS.01.1	24.8	$1,841,882	$196,679	55%	25%	8%	11%	0%	.30	.21	.45	2.25	6.00
Coffee (Paraguacu)	BA 148	55	$2,944,870	$314,458	55%	22%	3%	16%	3%	.35	.23	.52	6.54	16.13
Coffee (Paraguacu)	BA 142	47	$2,516,525	$268,718	45%	27%	2%	21%	2%	.35	.23	.41	5.82	8.40
Coffee (Jequie)	RS.05.8a	14.2	$760,312	$81,187	11%	89%	0%	0%	0%	.29	.20	.44	1.30	3.36
Coffee (Jequie)	RS.05.8 b	15.7	$840,627	$89,763	100%	0%	0%	0%	0%	.17	.13	.26	.70	2.07
Coffee (Jequie)	RS.06.6	11.3	$605,037	$64,607	33%	67%	0%	0%	0%	.26	.18	.39	.90	2.37
Cocoa (north)	C90	13	$696,060	$74,326	55%	20%	5%	22%	0%	.35	.23	.52	1.50	3.77
Cocoa (north)	C10	15	$803,146	$85,761	31%	34%	3%	18%	5%	.39	.25	.59	2.12	5.06
Cocoa (south)	C44	16.4	$878,107	$93,766	24%	36%	7%	33%	0%	.44	.29	.66	2.50	6.11
Cocoa (south)	C23 *	14.1	$754,958	$80,615	22%	61%	0%	17%	0%	.35	.23	.52	1.69	4.15
Dairy (south)	L10a	12	$642,517	$68,609	22%	37%	6%	35%	0%	.44	.29	.67	1.88	4.54
Dairy (south)	L10b	4.8	$257,007	$27,444	14%	37%	6%	43%	0%	.49	.31	73	.84	2.02
Dairy (south)	L10c	14.3	$765,666	$81,759	23%	35%	7%	35%	0%	.45	.29	.67	2.25	5.45
Dairy (south)	L10d	15.2	$813,855	$86,905	13%	38%	8%	42%	0%	.49	.31	.73	2.65	6.37

Notes: 1. The cost per km. is $38,000 plus a 3% maintenance charge.; 2. VOCs are multiplied by road length to obtain the weighted average.

Legend: C=Cars; P=Pickups; B=Buses; LT=Light Trucks; HT=Heavy Trucks; T=Tandem; OT=Other Transport.

NOTES ON COMPUTATIONS:

i. Investment: {[$38, 000 + .03 x $38,000] x Length [km]}/0.731[standard WB deflator which adjust an investment valued in US$1980 to US$ 1996].Annualized Investment: we use the formula $\$C_a = \$C/(1 + 10\%)^n$ where n=20 to compute the annualized value.

ii. The columns titled as C, P, B, LT and HT show the actual traffic levels as a percent of total traffic.

iii. We use the numbers shown in Table 4 to compute the cost per mile per vehicle and adjusted to US$s, 1996 for each category, i.e., earth-without road, gravel with road and paved with road to compute a mean using vehicle type percentages as weights to compute values in columns VOC_w and $VOC_{w/o}$. The column titled as $d.VOC_m$ is 1.5 times the $VOC_{w/o}$.

iv. The columns title as shows the difference between VOC_w and $VOC_{w/o}$,VOC_m , multiplied by the road length.

Table 6: Computation of VOC and Benefit - Cost Ratio at 10% Discount Rate

Region	Road	Initial ADT adj. to 1996	Adj. Mean ADT 96	In 1996 Dollars $^{o}B_g$	$^{c}B_g$	$^{o}B_n$	$^{c}B_n$	Total Benefits	Benefit -Cost Ratio at 10%	Unit Cost per Vehicle per Day (US$)	Unit Cost per Vehicle per Day per km (US$)
Coffee (north)	RS.11.5	45	57	4,497	10,721	32,727	77,179	125,124	0.72	13.23	0.43
Coffee (north)	RS 11.6	42	96	17,158	40,276	26,918	62,495	146,847	1.16	4.71	0.21
Coffee (south)	RS.02.1a	40	189	27,887	68,014	15,064	36,338	147,303	1.51	1.59	0.09
Coffee (south)	RS.02.1b	40	216	57,768	140,019	26,464	63,444	287,695	1.62	2.37	0.08
Coffee (south)	RS.01.2a	40	134	28,187	69,679	24,192	59,152	181,209	1.41	3.11	0.14
Coffee (south)	RS.01.2b	40	96	8,910	21,634	12,774	30,679	73,997	1.23	2.19	0.21
Coffee (south)	RS.01.1	40	143	21,144	56,621	16,491	43,680	137,936	0.70	6.11	0.25
Coffee (Parag.)	BA 148 * *	42	201	94,695	234,641	50,381	123,478	503,195	1.60	4.63	0.08
Coffee (Parag.)	BA 142	46	133	18,480	106,671	78,634	28,368	232,154	0.86	17.64	0.38
Coffee (Jequie)	RS.05.8a	23	31	925	2,409	5,488	14,137	22,958	0.28	13.26	0.93
Coffee (Jequie)	RS.05.8b	22	37	966	2,851	2,812	8,210	14,839	0.17	12.81	0.82
Coffee (Jequie)	RS.06.6	14	15	51	136	2,303	6,047	8,538	0.13	23.35	2.07
Cocoa (north)	C90	47	104	3,886	29,439	19,117	15,973	68,415	0.92	5.45	0.42
Cocoa (north)	C10	42	178	26,132	62,748	16,300	38,713	143,894	1.68	1.34	0.09
Cocoa (south)	C44	33	93	13,830	33,918	14,995	36,374	99,118	1.06	3.82	0.23
Cocoa (south)	C23 *	18	21	242	1,789	8,329	6,794	17,155	0.21	37.43	2.65
Dairy (south)	L10a	47	118	12,250	29,766	16,005	38,468	96,488	1.41	1.88	0.16
Dairy (south)	L10b	45	139	7,243	17,407	6,938	16,493	48,082	1.75	0.52	0.11
Dairy (south)	L10c	46	125	16,002	39,062	19,029	45,945	120,038	1.47	2.06	0.14
Dairy (south)	L10d	46	68	5,276	12,748	22,460	53,674	94,158	1.08	4.77	0.31

* Initial ADT is unadjusted for 1993 ; * * 1993 ADT was adjusted to 1996 as road construction prevented observations.

NOTES ON COMPUTATIONS:

i. "Initial ADT adjusted to 1996" is computed with an annual growth rate of 3% from the initial year to 1996. "Adjusted mean ADT, 1996" is the mean of 1993 ADT adjusted to 1996, and 1996 ADT.

ii. Days Open W/O is assumed as 183 except for BA 142, C90 and C23 which is 292 and 274, in both. "With" improvements, roads are assumed open 365 days.

iii. $B_g = [VOC_{W/O} - VOC_W] \times [T_w - T_{w/o}] \times 0.5$; shows the product of $d.VOC_{W/O}$ (Table 5) and the net gain in ADT (difference between "Adj. Mean ADT, 96" and "Initial ADT adjusted to 1996") times the days open during year; note also that due to the downward sloping demand curve, only half of the benefits (savings) are included.

iv. ${}^oB_n = [VOC_{W/O} - VOC_W] \times T_{w/o}$; the quantity in brackets is substituted with d.VOCn shown in Table 5. $T_{w/o}$ is the product of "Initial ADT adjusted to 96" and "Days W/O", i.e., the number of days the road is open per annum.

v. ${}^cB_n = [VOC_m - VOC_W] \times T_{W/O} \times [d \times m]$; the product of $d.VOC_m$ (Table 5) and the days closed (due to bad weather, i.e., the difference between "Days open With" and "Without") times the "Initial ADT adjusted to 1996." m= 1.5, the level of effort required either when roads are closed or worse conditions due to bad weather, to transport produce, as compared when roads are open.

vi. "Benefit - Cost Ratio" is the ratio of "Total Benefits" (sum of ${}^oB_n$, ${}^oB_g$, ${}^cB_g$, and ${}^cB_n$) and $C, the annualized investment (Table 5). A ratio equal or greater than 1.0 indicates the particular project satisfies the 10% per annum investment criteria.

7. Sensitivity Analysis: The sensitivity of the Benefit - Cost Ratio is presented in Chapter 4 of this report.

BASIC DATA SHEETSSECONDARY FEEDER AND ROADS PROJECT (LOAN 1207-BR)

Key Project Data

	Appraisal Estimate	*Actual Forecast*
Total Project Cost (US$ million)	237.0	214.0
Loan Amount	55.0	55.0
Loan Disbursed	55.0	49.5
Date Physical Components Completed	12/31/80	06/30/84
Proportion of Physical Components Completed by Original Schedule (%)	100	12
Time Overrun (%)	0	72
Economic Rate of Return (%)	n.a.	n.a.

Cumulative Estimated and Actual Disbursements

	FY77	*FY78*	*FY79*	*FY80*	*FY81*	*FY82*	*FY83*	*FY84*	*FY86*
Appraisal	0.5	8.0	24.0	40.0	52.0	55.0	55.0	55.0	55.0
Actual	0	0	2.0	6.5	7.4	18.1	23.3	45.5	49.5
Actual as % of Appraisal	0	0	8	14	16	14	33	83	90

Date of Final Disbursement: 09/13/84

Annex 5

Program Dates

	Original	Actual
Initiating Memorandum	-	01/07/74
Negotiations	-	12/18/75
Board Approval	n.a.	02/10/76
Signing	n.a.	03/01/76
Effectiveness	06/01/76	07/13/76
Loan Closing	12/31/81	06/30/84

Staff Inputs (staff weeks)

	FY76	*FY77*	*FY78*	*FY79*	*FY80*	*FY81*	*FY82*	*FY83*	*FY84*	*FY85*	*FY86*	*Total*
Pre-appraisal	28.8	1.0									29.7	
Appraisal		32.2									32.2	
Supervision		2.8	6.8	5.0	11.1	32.7	10.6	6.2	6.1	6.2	6.9	94.6
Other		.1			0.3	0.2	0.1		.4	1.0	2.1	
Total	28.8	36.0	6.8	5.0	11.4	32.9	10.7	6.2	6.1	6.6	7.9	158.6

Other Program Data

Follow-up Operations	*Loan No.*	*Amount (US$M)*	*Board Date*
Second Feeder Roads Project	1730-BR	110.0	06/19/79
Third Feeder Roads Project	2224-BR	154.0	12/21/82

SECOND FEEDER ROADS PROJECT (LOAN 1730-BR)

Key Project Data

Item	*Appraisal Estimate*	*Actual or Current Estimate*
Total Project Cost (US$ million)	338.5	205.8
Loan Amount	110.0	110
Loan Disbursed	110.0	90.5
Completion of Physical Components	12/31/86	8/31/87
Proportion Actually Completed by Above Date (%)		85.5
Economic Rate of Return	n.a.	n.a.

Cumulative Estimated and Actual Disbursements

	FY80	*FY81*	*FY82*	*FY83*	*FY84*	*FY85*	*FY86*	*FY87*
Appraisal Estimate	0	5	18	39	66	76	85	90.5
Actual	0	3	18	30	48	67	90	90.5
Actual as % of Appraisal	0	65	100	76	73	87	106	100

Date of Final Disbursement: 12/31/86

Annex 5

Program Dates

	Original	*Actual*
Initiating Memorandum	n.a.	n.a.
Negotiations	n.a.	05/11/79
Board Approval	n.a.	06/19/79
Signing	n.a.	08/24/81
Effectiveness	09/18/79	11/20/81
Loan Closing	12/31/86	12/31/87

Staff Inputs (staff weeks)

	FY79	*FY80*	*FY81*	*FY82*	*FY83*	*FY84*	*FY85*	*FY86*	*FY87*	*FY88*	*Total*	
Pre-appraisal	2.9										2.9	
Appraisal	41.8										41.8	
Negotiations	8.7										8.7	
Supervision	.6	6.9	8.1	8.3	5.2	6.0	8.1	3.8	.5	.6		48.2
Other	.9	.9	.2				.0				1.1	
Total	54.9	6.9	8.3	8.3	5.2	6.0	8.1	3.8	.5	.6		102.7

Other Program Data

Follow-up Operations	*Loan No.*	*Amount (USSM)*	*Board Date*
Third Feeder Roads Project	2224-BR	154.0	12/21/82

Annex 6

LIST OF KEY CONTRIBUTORS AND REVIEWERS

The following are the key persons/organizations involved in the preparation and review of this study.

- Mr. Albert Weckerle, OED, was the Task Manager for this study from its inception through early drafts in 1994.

- Instituto Sociedade, Pesquisa e Natureza (ISPN), directed by Mr. George Martine, carried out the survey work in 1993 and prepared the main reports.

- The State of Bahia Road Department, DERBA, contributed personnel and expertise through the preparation as well as through the review stages. Key contributors were:

  - Ing. Genario Lemos Couto, Transport Coordinator
  - Ing. Maria das Gracas L.F. Matos, Assistant Transport Coordinator

-The National Economic and Social Development Bank (BNDES) - Roberto Macedo, Renato Garavello Antoniazzi, Luis Geraldo Japiassu and Vinicius Almeida.

- The Brazilian Company for Transport Planning (GEIPOT) - Nelson Campos, Arnaldo Farias, Francisco Magalhaes, Rilson Raposo, Clovis Aragao and Francisco Rocha Neto.

- Government of the State of Bahia - Waldeck Ornelas, Generario Couto Maia, Marcus Alban, Paulo Ermida and Nadja Holtz.

- SEAIN and GEIPOT (Borrower), reviewed both the early drafts and the final draft versions.

- Mr. Joao Gualberto Rocha and his team prepared the complementary report in 1996/1997.

- Messrs. Claudio Volonte and Oliver Rajakaruna, OED consultants, contributed to the preparation of the final report.

- Mr. Hernan Levy, OED, was the Task Manager for the preparation of the complementary data collection in 1996, and for preparation of the final report.

IMAGING

Report No.: 16733
Type: IER