PN. ABT-152
91174

Provision and Production of Rural Roads in Developing Countries: A Synthesis of Research Findings

DFM
DECENTRALIZATION: FINANCE & MANAGEMENT PROJECT

DECENTRALIZATION: FINANCE AND MANAGEMENT PROJECT

Associates in Rural Development, Inc.
in collaboration with
Workshop in Political Theory and Policy Analysis, Indiana University
Maxwell School of Citizenship and Public Affairs, Syracuse University

A Guide to Sustaining Rural Infrastructure Investments

Prepared by:

Dr. Larry Schroeder

Prepared for:

U.S. Agency for International Development
Global Bureau Democracy Center
Contract No. DHR 5446-Z-00-7033-00

October 1994

FOREWORD

In 1988 Associates in Rural Development, Inc. (ARD), in collaboration with Indiana University's Workshop in Political Theory and Policy Analysis and the Maxwell School of Citizenship and Public Affairs at Syracuse University, began a research and development effort focused on decentralized public service provision. The Decentralization: Finance and Management Project (DFM), sponsored by the U.S. Agency for International Development (USAID), was designed to study problems associated with the failure of many development projects to achieve sustainable impacts--particularly those in rural areas managed by central government agencies. The project's research agenda has analyzed a variety of institutional arrangements and resource mobilization strategies to determine their effects on the sustainable provision of rural roads, irrigation infrastructure, health and education services, and the management of renewable natural resources. Field investigations and desk studies have also analyzed broader decentralization policies and issues relating to local government operations and finance.

In the initial years of the project, a series of state-of-the-art papers were prepared on the principal sectors of inquiry. These reports included a thorough review of the relevant literature and established a framework for field-level analysis. These early studies were the basis for two published books, several journal articles, and numerous conference papers dealing with the problems of rural infrastructure and irrigation management. In addition to these core research products, numerous policy studies, field research initiatives, and project designs and evaluations were conducted at the request of USAID missions in Asia and Africa and the central bureaus of USAID/Washington. These efforts provided project research staff the opportunity to test and refine analytic methods and to demonstrate the utility of institutional analysis to a variety of development problems.

At the conclusion of this major effort covering seven years and 15 different countries, a series of final papers has been prepared that synthesize the cumulative research findings and lessons learned from the project. These include a report summarizing four years of research and analysis on governance and management of irrigation systems in Nepal; a synthesis of several years of research on economic and institutional policy reform in Cameroon; an analysis of DFM research on decentralized public service provision in Africa; a research synthesis on local governance and management of renewable natural resources; a paper on the concept of social capital and its implications for development; and a synthesis of research on rural road maintenance. In addition, the DFM legacy includes two papers providing practical project design guidelines in the areas of rural infrastructure and natural resources and a final report summarizing the project's principal research and development accomplishments.

The DFM project staff from ARD, the Workshop in Political Theory and Policy Analysis, and the Maxwell School extend their sincere appreciation for the sponsorship of this project by USAID. The Agency's research programs aimed at improving our understanding

BEST AVAILABLE DOCUMENT

of the development process and thereby the effectiveness of financial and technical assistance represent a significant contribution to the donor community and its partners in the developing world. We would also like to acknowledge and thank the dozens of colleagues from the academic and development assistance communities as well as the citizens and representatives of host countries who have participated in our enterprise. Our group has learned a great deal from this project, much of which is reflected in this final series of documents. We hope that this learning experience has also benefitted our collaborators in the U.S. and abroad.

TABLE OF CONTENTS

PREFACE i

A Guide to Sustaining Rural Infrastructure Investments 1

I. Project Design and Sustainability 3

General Factors Affecting Sustainability 3

Concepts and Assumptions 9

II. Institutional Analysis 10

Why We Do Institutional Analysis 11

Describe the Institutional Arrangements 12

Analyze the Incentives 13

III. Financial Analysis 18

Why We Do Financial Analysis 19

IV. Summary 30

ENDNOTES 32

REFERENCES 34

PREFACE

This guidance paper is a principal research and development product of the Decentralization: Finance and Management Project (DFM) sponsored by the Office of Economic and Institutional Development of AID's Research and Development Bureau. It represents the cumulative lessons learned from extensive literature review, field work in a number of Asian and African countries, and reflection on the difficult problem of infrastructure sustainability. These guidelines are specifically tailored to development practitioners who are responsible for the design, implementation, and evaluation of infrastructure projects.

The author, Dr. Larry Schroeder, Professor of Economics and Public Administration at the Maxwell School of Citizenship and Public Affairs at Syracuse University, has been a principal research associate of the DFM project since its inception in 1988. Dr. Schroeder prepared an earlier work on rural roads titled "Managing and Financing Rural Roads in Developing Countries," and co-authored the DFM state-of-the-art paper on infrastructure sustainability with DFM research associates Elinor Ostrom and Susan Wynne (*Institutional Incentives and Sustainable Development*, Westview Press 1993). He has also led several teams conducting studies on institutional and public finance issues related to rural roads in the field. The author also wishes to thank several USAID officials for their comments on an earlier draft of this document.

A Guide to Sustaining Rural Infrastructure Investments

The sustainability of rural infrastructure investments in developing countries is, obviously, a crucial issue for those involved in development projects. This paper poses questions that should be answered during the design and implementation of rural infrastructure projects, programs, or policies involving such capital investments. We focus particularly on the analyses that should be conducted in preparing a project paper. These same questions can also help assess what might be going amiss when project or policy initiatives are implemented.

In preparing AID project papers, designers must complete several specific analyses for each project. Among these are economic, financial, and social soundness analyses. *Economic* analysis is intended to demonstrate the overall economic feasibility of the project, i.e., that the project can generate benefits that exceed its overall costs to society. *Financial* analysis is narrower in scope; it focuses on the specific monetary benefits and direct costs of the project. It is intended to determine whether the funds available are sufficient to insure that the project can be completed and will continue to function. *Social soundness* analysis measures whether the project "fits" within its intended social, cultural, and institutional setting.

FIGURE 1:

Four Factors That Affect Sustainability

- Technical Aspects
- Policy Environment
- Economic and Financial Aspects
- Institutional Arrangements

The underlying premise of this paper is that to sustain rural infrastructure investment, it is necessary and possible to conduct well-defined studies of the institutional and financial arrangements within which the project is to be undertaken. Similar analyses can ascertain the principal underlying causes of problems that arise when the project is implemented. Although such analyses must be specific to a country or, occasionally, to a particular site, certain guidelines can be followed.

To set the stage for the guidelines, Section I discusses what we mean by sustainability. This section lays out broadly the factors that threaten infrastructure investment sustainability--technical issues, the policy environment, economic/financial factors, and institutional issues--and illustrates them with specific case studies. We concentrate on the last two, since technical issues are outside our domain of expertise and the policy environment usually must be taken as given within a project.

Section II focuses on questions of institutional analysis and design. Section III discusses what the project manager/designer should do to ensure adequate financing for rural infrastructure projects. Section IV concludes the paper. It also discusses how institutional and financial analyses can be carried out.

Since the specific institutional and financing arrangements often differ greatly from project to project, the guidelines in Sections II and III are necessarily broad and general. Indeed, an essential lesson of institutional analysis is that it is inappropriate to attempt to devise "blueprint" solutions to problems that are likely to differ substantially from site to site, even within a single country. It would, therefore, be inappropriate to suggest a "solution" to the issue of infrastructure sustainability that can be applied to a wide array of infrastructure investments in many countries. Instead, the paper outlines the types of analyses that can be

conducted and gives specific examples of how these analyses might be carried out in particular environments.[1]

I. Project Design and Sustainability

Since it was popularized by the World Commission on Environment and Development (the Brundtland Commission), the term *sustainable development* has been bantered about in a variety of discussions and debates. The commission (WCED, 1987) defined the term to mean "development that meets the needs of the present without compromising the needs of future generations to meet their own needs" (p. 43). While the current paper focuses on a much narrower topic--the long-term sustainability of investments in rural infrastructure in developing countries--there is little doubt that unless such investments can be sustained, they interfere with the broader goal of sustainable development.

As argued in the World Bank's *World Development Report 1992* (p. 8), sustainable development requires that development policies be based on careful comparisons of benefits and costs. The same concept of sustainability is used here. Specifically, sustainable projects, programs, or policies must yield benefits that exceed their costs over the lifetime of the project. Failure to achieve this objective drains the already scarce resources of low-income economies.

This paper is intended to show how appropriate analyses of infrastructure projects can improve their sustainability; it is not a formal review of the literature. Nevertheless, previous studies suggest several factors that threaten infrastructure sustainability.[2] We will briefly review these factors in light of project design and implementation.

General Factors Affecting Sustainability

There are many underlying reasons why rural infrastructure projects break down or deteriorate more rapidly than originally planned. To appreciate these reasons, keep in mind that several steps are involved in the construction and operation of an infrastructure facility. These steps include the facility design, its construction, how it is operated and maintained, and how it is used.[3] Further, since these activities require investment of resources, financing mechanisms (or the lack of them) also play an important part. Box 1 gives more detail on these phases and how they relate to infrastructure sustainability.

There are several fundamental reasons why a facility may be poorly designed and constructed, or improperly operated and maintained. We recognize that a project officer is likely to have limited influence or control over only some of them.

BOX 1
Phases of Infrastructure Development and its Sustainability

Many discussions of sustainability focus on the ability and willingness of those overseeing the facility to maintain it. But in fact, sustainability can be affected at all stages in the infrastructure development process. Building on Uphoff (1986: 63-70) we emphasize that each of the following stages in the facility development process must be recognized--design, construction, finance, operation and maintenance, and use.

Design

Infrastructure design is integral to its sustainability; if a facility is improperly designed for its particular setting and specific use, its benefits may not exceed its costs. Such failures may take many forms: overly rapid deterioration (in spite of maintenance), outright collapse, excessive cost relative to the results produced, or a facility that is used inappropriately leading to insufficient benefits.

Construction

Facilities may be constructed by public or private enterprise. Regardless of the methods used, construction can significantly affect the project's sustainability. A structure may be well designed, but if this design is not followed in the construction process or if substandard materials or improper construction techniques are used, the quality of the structure may be jeopardized. Routine maintenance will never correct this deficiency.

Financing

Since scarce resources must be put into each phase of infrastructure development, financing these inputs is essential to sustainability. Sufficient funds must be available for both the construction and operation and maintenance (O&M) costs of the project. Not only must adequate funds be available, they must be allocated to maintaining the facility. This means that attention must also be paid to budget allocation as well as to the resource-mobilization process.

Operation and Maintenance

All capital facilities have operation and maintenance costs, although the amount and type will differ depending on specific structures. A rural road, on one hand, requires little if any additional labor to operate; on the other hand, a school without teachers does not operate at all. Maintenance needs will depend upon a variety of factors, including the design, construction, and even local weather.

Use

Also crucial to sustainability is how the facility is used. Appropriate maintenance for a rural road depends on the number and weight of vehicles using the road, the type of the road, and the quality of its construction. Rules limiting access to roads, particularly when they are most vulnerable to use-based damage, as from overweight vehicles or during extremely wet seasons, can be as effective as maintenance at slowing deterioration of the roadway.

This list of activities involved in infrastructure development has important implications for USAID project preparation. It is not sufficient to focus on only one or two of these activities if a facility is to generate net benefits over its expected lifetime. For example, if project managers focus entirely on raising the capital necessary for construction and on training personnel to maintain that facility, and overlook the need to fund O&M expenditures or to ensure that policy makers will allocate the funds for that purpose, their well-designed facility may still fail to be sustained. The attached table illustrates how these various activities, if inappropriately or insufficiently carried out, can reduce infrastructure sustainability. The table also anticipates the following discussion, giving underlying causes for these failures.

Activity	Possible Problems	Possible Causes
Design	Inappropriate for site Costly to maintain Insufficient benefits	Lack of local information Lack of technical skills
Construction	Low quality materials Insufficient quantity of inputs	Inadequate inspection, Inadequate funding, Lack of technical skills, Shirking, Inadequate equipment
Operation	Failure to yield benefits Inappropriately operated Not operated at all	Inadequate funding Unskilled operators Lack of spare parts
Maintenance	Inappropriate techniques Maintenance deferred	Inadequate funding, Unskilled personnel, Lack of spare parts, No resources allocated
Use	Inappropriate use	No control over use

BEST AVAILABLE DOCUMENT

Technical Aspects. Rural infrastructure investments can "fail" through breakdowns or overly rapid deterioration from a variety of technical reasons (see Box 1). Inappropriate design can lead to a technical failure in the facility. For example, insufficient drainage can cause rapid deterioration in road embankments. A rural road designed with too few bridges and culverts to handle the monsoon floods is likely to fail.

"Overdesign" of rural infrastructure can also threaten its sustainability. A facility designed to produce services far beyond the levels that realistically can be demanded results in vastly underutilized capital. In such a case, the construction, operation, and maintenance costs may far outweigh the benefits.[4]

A facility may be well designed but, for various reasons, may be poorly constructed or maintained. Inappropriate construction methods and materials may be used, either because of insufficient knowledge, equipment, and materials or because of intentional shirking by contractors. (Box 2 summarizes the sorts of technical issues faced in Bangladesh that has led, in many instances, to unsustained investments in rural roads.)

Purely technical deficiencies are less likely in maintenance activities, which often are not technically complex. Still, failures in maintenance can sometimes be traced to a lack of adequate or appropriate equipment, such as road graders that can effectively reshape a road surface to the proper camber. A closely related problem is improper upkeep of maintenance equipment.

Even when supposedly technical problems arise, it is often unclear whether the core issue is technical or whether there is another, more basic problem. That is, while failures to sustain may at first glance appear to be technical in nature, inadequate resources or inappropriate institutional arrangements may later reveal themselves as the real causes. For example, a road may be inappropriately designed, not because the design engineer is incompetent, but because the institutional arrangements did not provide him or her with enough local information to create an appropriate design. Similarly, a shortage of resources and lack of institutional incentives may be the real reasons why a road is not maintained, even though the problems initially appear to be poor equipment and insufficient training.

Policy and Other Environments. Underlying much of the current interest in structural adjustment policies is the recognition that the overall economic, political, and policy environments go far in explaining why some donor-supported investments have not yielded positive net payoffs and were, therefore, not sustained. During project preparation, a project officer must consider the policy and macroeconomic environment in which a project will be implemented.

BOX 2
Technical Problems Building Rural Roads in Bangladesh

An integral part of the Decentralization: Finance and Management Project's assessment of rural roads in Bangladesh was a review of the technical problems related to failures in the vast investments that have been made in the sector (DFM, 1989). Because economical solutions to at least some of these problems are not currently available, they are best considered constraints to the successful completion of sustainable investments. This is particularly true of the environmental conditions in the country.

Soil conditions. In an understatement, the assessment team noted, "The topography, soil conditions, and climate of Bangladesh combine to create a number of difficult challenges to the design, construction, and maintenance of rural roads" (p. 6). The country is primarily a flat, low-lying delta. Its soil consists mainly of silty clays and fine sands; there are few aggregates necessary for proper road building. The heavy annual monsoon rains and tremendous amounts of water entering the country from Nepal and India add to the challenges of designing appropriate road embankments. Neither of these conditions is amenable to either technical or institutional solutions.

Construction processes. Construction processes also threaten the technical success of road projects. The DFM assessment identified the following as being particularly problematic. First, construction of road embankments generally included too little compaction of the soil. This is especially a problem with the silt-laden delta soils found throughout most of the country. Without compaction, the embankments soon become saturated with water. When passed over by a vehicle, they collapse.

Materials. Construction is hampered by inadequate availability of materials, equipment, and personnel. Because rocks, stones, and gravel are scarce, bricks (both broken and unbroken) are used as aggregates. However, these clay-based materials do not have the durability of natural aggregates, and locally made bricks are often of poor quality.

Engineering. Private construction companies seldom employ competent engineers, which can contribute to technical failures in both construction and periodic maintenance efforts. Additionally, for bituminous roads these companies generally use wood-fueled fires to heat the bitumen. But without close monitoring, this method can overheat the seal coats, which soon become brittle and break up easily.

Wood Fuel. The heavy reliance on wood-fueled fires also has an undesirable environmental effect--it depletes an already limited supply of national forests. In fact, while this outcome is related to the production techniques used, the problem is actually a result of inappropriate pricing policies; the price of wood does not fully reflect its social costs.

Shortsighted Economies. The assessment also identified several other issues that, while mostly technical, are closely linked to institutional and financial issues. One of these is the underpricing of the scarce land that is used for road embankments. Also, to keep construction costs as low as possible, roads are designed with too few bridges or culverts. The result is other social costs that come with excessive flooding of lands by the impeded flow of water.

The DFM assessment found that institutional arrangements provided little incentive for proper equipment maintenance as well as for economical design of transport "systems," of which roads are only one part. Furthermore, the budget process used in the country does not encourage long-term road maintenance.

In summary, while there are certainly important technical challenges arising in the rural road sector of Bangladesh, the sector assessment characterized some of these as binding constraints that are unlikely to be surmounted by economic, technical solutions. More important, however, is that many of the seemingly technical issues are, at their root, institutional and financial.

Numerous external policy, economic, and political factors can affect infrastructure sustainability. A project planning officer should list all factors that might influence the future costs (both capital and recurrent) and benefits of a project. Box 3 includes several broad factors that might be included. Once compiled, the items can be classified as to whether (a) a formal forecast of the factor should be made and (b) the factor is at all controllable through the project.

Even if specific forecasts of a factor can be made, the project officer will have to judge whether the potential benefits of such a forecast exceed its costs. For

example, a roadbuilding project may serve primarily sugar growers who produce for export. In such an instance, the effort of building and estimating an international sugar market forecasting model may be justified. On the other hand, if a large variety of products are expected to be transported on the road, with only some of them exported, the expense of building several complex forecasting models is probably unjustified. Basic time trend or other simple models can be used in such instances.

For some factors on the list, no forecasts are feasible. Instead, the project officer will have to make assumptions or rough "guesstimates." This is particularly true for the "other" factors shown in Box 3.

BOX 3
Policy and Macroeconomic Factors That Affect Sustainability

MACROECONOMIC FACTORS

- International demand for locally produced commodities
  - Directly associated with project
  - Not directly associated with project but affecting the macroeconomy
- International prices for imports
  - Directly used in the project
  - Not directly used in the project but affecting the macroeconomy
- Domestic prices
- Domestic business conditions

DOMESTIC POLICIES

- Agricultural input and output pricing policies
- Fertilizer and credit supply policies
- Private enterprise policies
  - Regulation
  - Property rights and justice system
- Administrative and institutional arrangements

OTHER FACTORS

- Political stability
- Activities of other donors
- Unpredictable natural disasters

Even though some factors can be forecasted, individual projects are unlikely to have any direct control over them. Although crucial to its long-term sustainability, a project simply cannot influence some policies. On the other hand, project officers, using the leverage which a major project provides, can sometimes effect changes in other policies, such as more liberal agricultural pricing. In fact, project agreements can require the host country to design policies addressing long-term infrastructure maintenance needs. Of course, for such conditions to be ultimately effective, the donor organization must also be willing to carry out its implied threat of abandoning a project if the conditions are not fulfilled. Thus, the success of such policy intervention will likely depend on the size of the project, its importance to the host country, and the political will of the donor to hold the recipient country to its comittments.

Policy initiatives can sometimes be an integral part of an infrastructure project. For example, a project that assists in the construction of village drinking water

systems can be tied to new water pricing policies and support for the administrative apparatus necessary to collect these fees. In this instance, the project design process must highlight the financing and institutional issues that follow.

Economic and Financial Aspects. Since projected benefits must exceed the costs, the economic analysis portion of the project preparation process is crucial. Unfortunately, to be overly optimistic about the effects of a project, the speed of its completion, or its costs can cause planners to overstate the net benefits.[5] And, if one unstated objective of a project is to "move development assistance money," project designers have strong incentives to accept upwardly biased benefit estimates.

Managers must also be willing to alter projects while they are being implemented if new evidence suggests that sufficient net benefits will not be realized because of poor planning or overly optimistic estimates. However tempting it may be, to ignore such information is to risk wasting resources on unsustainable investments.

There is a second aspect of economic and financial analysis, which we will discuss in detail in Section III--the ability of the host country to operate and maintain the facility. Financing the operating and maintenance costs is an obvious necessity. If benefits exceed costs, the finance problem has two parts: (1) a portion of the flow of benefits must be transformed into revenues that can cover these costs, and (2) the funds so generated must be actually allocated to that purpose. This means that the public finance and budgeting systems must be carefully considered when projects are being evaluated.

Institutional Arrangements. By institutional arrangements we mean the written or unwritten rules that govern interactions among individuals. Drawn from the new institutional economics and institutional analysis, this approach has several important implications for the project designer-manager.

First, by *institutions* we do not limit ourselves to *organizations* . As elaborated upon in the following section, project designers should not restrict their analysis to formal organizational structures in the public sector that may be providing rural infrastructure. Instead, they must include the informal network of individuals that influences the planning, design, construction, operation, maintenance, use, and financing of infrastructures.

Second, by considering both written and unwritten rules, project planners need to recognize that not all rules that govern behavior in a society or even within an organization are formalized and written down. This is particularly true in developing countries where interactions among members of a society have

continued for centuries. Though they have never been written, the "rules" that govern these interactions are understood by all. It is important for the analyst to understand these rules as thoroughly as the formal written statutes and rules since they are deeply ingrained in the culture. Furthermore, there are instances in which written rules are mere mirages for the actual practices that lie behind them.

Development specialists agree that institutional arrangements are crucial to the longer-term sustainability of rural infrastructure. For example, two major reviews of investments in roads in developing countries (Robinson, 1988: 18; and Harral and Faiz, 1988: 2) both suggest that institutional issues are more important than technical problems. In spite of this, USAID's project preparation requirements do not specifically ask for an analysis of institutional arrangements. We recommend that such analysis be an important part of the process. In Section II we explain what can be done to carry out such analysis. Before turning to that discussion, however, it is useful to present here some *concepts* and *assumptions* that we rely upon in both Sections II and III.

Concepts and Assumptions

Incentives. Throughout this paper, we emphasize the incentives faced by participants in the rural infrastructure development process--by elected officials, government employees, and facility users. Our underlying assumption is that individuals act in ways that will maximize the net benefits they can enjoy. At the same time we assume that individuals seldom have full or certain knowledge of these benefits and costs; therefore, they are likely to make mistakes. They can learn from these mistakes and also can learn by investing in additional (but costly) information. We also recognize that individuals may behave "opportunistically" by using deceit to improve their own welfare at the expense of others.

The concept of incentives used here is also broader than just financial rewards and penalties. They are positive and negative outcomes that individuals believe will result from their actions. Thus incentives include "payoffs" such as opportunities for distinction, prestige, and personal power; desirable physical conditions of work; service for family or others; or personal comfort and satisfaction in social relationships.

Provision and Production of Infrastructure Services. When considering how rural infrastructure is developed and, we hope, sustained by the public sector, it is also useful to differentiate between provision of that infrastructure and its production. Decisions relating to the public *provision* include:

- The kinds, quantity, and quality of goods and services to be supplied
- How these goods and services are to be financed
- How these goods and services are to be produced

- How the performance of those who produce these goods and services is to be monitored

When applied to publicly provided infrastructure, all of these decisions are the domain of the public sector. However, the third item in the list suggests that, although the public sector may be involved in the provision, there are often alternative methods for the *production* of such services. *Production* refers to the process of transforming inputs into outputs and can be organized in ways that require greater or lesser direct involvement by the public sector. For example, investments in a rural road will benefit all users of the road, so no single business or individual will have a strong incentive to provide this infrastructure. On the other hand, production of road services--such as construction and maintenance of the road, bridges, and culverts--does not have to be carried out by public sector employees. Instead, private construction firms can be used for these activities. Indeed, these firms are likely to have stronger incentives to carry out the tasks efficiently.

Since both institutional and financial arrangements are crucial to project sustainability, an analysis of both can help lead to successful outcomes. We consider each in turn.

II. Institutional Analysis

Institutional arrangements are so important to the ultimate success or failure of infrastructure projects that these arrangements should always be analyzed as part of the USAID project design and evaluation process. While such an analysis is not currently mandated in that process, the project paper is to contain a social soundness analysis that, among other things, answers the questions:

What is the basic organization structure through which the innovation should be channeled? Should a new organization be created or will existing local Government or village organization be sufficient? (USAID, p. 3F-3)

Although these questions (and others associated with social soundness analysis) relate to institutions as previously defined, we recommend taking a broader approach, particularly for infrastructure design and evaluation. The sections that follow discuss the objectives of institutional analysis, and how it relates to the production and provision aspects of infrastructure development. We also give guidelines for describing institutional arrangements and analyzing the incentive structure, including how the arrangements might be altered to improve the incentives toward sustainability.

Why We Do Institutional Analysis

A working definition of institutional analysis is that:

"[It] attempts to explain human behavior by reference to the incentives provided by institutional arrangements used in a given physical and cultural environment. Institutional arrangements are defined as the set of working rules used in any process that determine who is involved, what actions are available to participants, the kind of information available, how decisions will be made, and how benefits and costs are distributed." (DFM, 1990, p. 25)

Everyone from time to time has probably engaged in informal institutional analysis by considering, for example, how a donor agency might function differently if certain working rules were altered.

In analyzing the structure of an institutional arrangement, the analyst needs to investigate who is involved, what their stakes and resources are, and how the participants are linked to one another and to outcomes in the world. Specifically, the analyst identifies the types of actions that actors can take, the type of information available to them, how actions lead to outcomes, and how rewards and punishments are allocated in light of the outcomes achieved and the actions taken. Then the analyst predicts the actions and overall outcomes that are most likely given the structure of the incentives. When he or she verifies predicted actions and outcomes, the analyst has arrived at an initial explanation for what is being observed.

In any environment, institutional analysis asks the following questions:

- Whose decisions will influence the outcome? What is their stake in that outcome?
- What *rule systems* shape the decision-making environment?
- What *incentives and disincentives* does this rule system create for these actors?
- What *information* is available to them? What are their incentives to use it?
- How will their *actions in response* to these incentives and information likely affect the long-term infrastructure investments?
- What *changes to the working rules* might alter incentives in ways that would lead to more desirable outcomes?

The first four of these questions describe the current situation and predict the behavior of the participants. To be most useful to project designers and evaluators, the analysis should include the last question--what changes in

institutional arrangements would improve the likelihood that the rural infrastructure will be sustained.[6]

Describe the Institutional Arrangements

In describing institutional arrangements, we begin by identifying the individuals or groups who will influence the flow of infrastructure services. Once this list has been compiled, we can consider the rules which govern their decisions.

Identify the Actors

As emphasized in Box 1, every stage of infrastructure development can affect the long-term sustainability of capital investments. Furthermore, for publicly provided infrastructure, these stages directly or indirectly involve many individuals:

- Central government personnel working in central ministries (including both the ministry directly involved in the project as well as other ministries, such as a Ministry of Finance or Ministry of Planning).
- Central government personnel posted where the infrastructure is located.
- Elected or appointed local public officials
- Local government employees
- Construction and/or maintenance contractors
- Suppliers of goods and services used by contractors or producers of infrastructure services
- Direct users of infrastructure services
- Other individuals directly or indirectly affected by the infrastructure, such as local landowners
- Donor agencies (USAID and others)

This is a long list of individuals potentially involved in the provision and production of rural infrastructure. Note especially the relative roles of local and central government officials. Are decision-making arrangements decentralized or centralized? Under any arrangement, the decision-making participants will be influenced by the rule system that governs their actions.

Describe the Rules that Govern Their Behavior

Once the actors have been identified, we need to understand how these actors influence provision and production decisions. We can learn this most effectively

by asking questions related to outcomes of the various stages in the infrastructure development process. These questions will, of course, depend on the particular

infrastructure investment being considered. For example, the following questions could be asked about annual investments in a local road network:

1. How are decisions reached concerning which portions of the network within a locality will be constructed, reconstructed, or maintained during a particular year?
2. Can road users affect those decisions? How?
3. By whom are the improvements designed? How?
4. Once designed, how are decisions reached about carrying out production?
5. What rules govern which individuals/organizations will carry out production?
6. Who is responsible for monitoring the production process and inspecting the final outcome?
7. What monitoring and inspection methods are used?
8. If the monitoring and inspection reveal inappropriate outcomes, what recourse is possible? What procedures are used?
9. How are disputes between participants in the process resolved?
10. How is inappropriate use of the infrastructure monitored and limited?

These questions cannot be answered at the desk. While written rules should be examined, only discussions with those involved in the process--including the users--will provide a full picture of the working rules that actually determine outcomes. These discussions may also reveal constraints to the process that are not in the rules. Such discussions may also disclose that working rules other than those in the statutes have been used in certain locations and have resulted in positive outcomes. Sometimes, it is possible to alter the written rules to repeat these successes.

Once it is understood who makes provision and production decisions and how, the next step is to focus on the incentives that these decision makers face.

Analyze the Incentives

As stated in Section I, we assume (1) that individuals act in ways that will maximize the net benefits they can enjoy, (2) that they do so with imperfect information, and (3) that they may behave opportunistically to achieve this objective. Thus, at the heart of institutional analysis is an appraisal of the incentives that the rule structure provides for their behavior.

Identify and Assess the Incentives

We begin by assessing the incentives that can significantly motivate the principal actors. Given the distinctive characteristics of different environments, it is impossible here to list all the incentives that are likely to be important. Although not all incentives will necessarily be counterproductive, it is not difficult to envision a set of incentives that can have an adverse effect on sustainability (see Box 4). Note that the incentives listed in Box 4 are neither inevitable nor universal--and they all assume a willingness to engage in opportunistic behavior.

BOX 4

Examples of Adverse Incentives of Principal Infrastructure Actors

Actors	Incentives	Adverse Effects
Centrally posted officials	To maximize resources over which they retain control	May refuse to allow local decision makers any autonomy
Locally posted, central government employees	To impress central decision-makers to obtain positive job evaluations	May not respond to local preferences when conflict with central superiors
Locally elected officials	To control additional external resources and use in ways to insure reelection	May prefer new investments that result in "ribbon-cutting" ceremonies over maintenance spending
Engineers	To be retained to design and construct infrastructure	May prefer new investments over maintenance efforts
Local landowners	To obtain infrastructure services that will maximize returns from their land	May engage in rent-seeking to insure that infrastructure is constructed near their land
Contractors and other input suppliers	To maximize profits by winning bids at the highest feasible levels and keeping costs as low as possible	May engage in collusive bidding and shirk on construction quality
Laborers	To minimize effort while retaining position	May shirk in efforts

Writing new rules to "forbid" these various types of opportunistic behavior may be an appealing knee-jerk response, but without proper incentives to monitor behavior and enforce the rules, they are likely to be ineffective. Here again, it is the institutional arrangements that can create such incentives. Even though many citizen-users of a facility may prefer to be free riders, for example, requiring them to pay directly for their use of it will motivate them to put pressure on decision makers to ensure that the services are sustained.[7]

Assess the Availability of Information

Information is critical to the outcome of institutional relationships. In analyzing institutional arrangements, it is important to consider what sorts of information is (or should be) made available to decision-makers. What incentives do the various actors have to supply and/or use it? Since information is seldom perfect, some actors may know more than others. When one party to a transaction has information not available to the other, the latter is at a disadvantage.

For infrastructure development, two different types of information are particularly important. These include both *technical information*, such as that known by trained engineers, and *localized information* unique to the local environment. There are often severe constraints on the amount of technical information available in developing countries. For example, only a few well-trained engineers may be available. Yet, even in relatively small countries, there can be significant local differences in soil structures, amount and timing of annual rainfall, economic activity, and cultural practices. This means that appropriate design, construction, and maintenance activities, as well as use patterns of any facility require local information.

A key task in analyzing institutional arrangements is assessing the likelihood that both technical *and* localized information will be brought to bear in developing infrastructures. For example, if the rules require rural infrastructure facilities to be designed exclusively by central ministry engineers and those standards must be followed in all locations, the resulting infrastructures are less likely to be sustainable than where the designs can be tailored to fit local situations. And, if the infrastructure design includes no scientific technical information, again the resulting facility is likely to fail.

Differences in local cultures also need to be recognized in project designs. For example, the DFM team in Indonesia (see Box 7) found that it would be feasible in one district to rely on voluntary group labor by users to maintain roads. Yet, in a neighboring district this method was rejected because villagers were strongly opposed. To have imposed it on the local road users would have led to failure.

Predict the Behavior of the Actors

By knowing the working rules, the incentive structures, and limitations on information, the institutional analyst can predict the behavior of the parties involved in infrastructure development. For example, without adequate safeguards, contractors are likely to engage in collusive behavior to obtain their "fair share" of contracts and to shirk on the labor and materials they use. Likewise, if the rules permit the same officials to choose which contractor will be awarded the contract, to monitor the work of that contractor, and to approve the completed work, the officials have an ideal opportunity to enter into unethical collusion with contractors.

Modify the Institutional Arrangements

When such weaknesses in the rule structure are detected, one can try to create *counteracting institutional arrangements*. By this we mean rule structures that permit others, acting in their self-interests, to offset the undesired results of the existing rule system. These counteracting rules should:

- Expand information flows and transparency in decision making

Full and perfect information is never available, but institutional arrangements can be designed to increase the amount of information available to decision-makers. The more information is available to all actors, the more opportunistic behavior is hindered. Similarly, some institutional arrangements are better than others at taking local information into account during the infrastructure development process. Decentralized decision-making arrangements usually have better access to localized information and are usually better at involving infrastructure users in the decision-making process than are centralized arrangements.

- Promote competition

One way to improve production efficiency is for firms to compete for *public contracts*. Private firms are likely to have stronger incentives than are public enterprises to minimize costs. But competition need not be limited to private enterprises. Some public agencies may also be able to carry out a construction or maintenance contract. Allowing these agencies to bid against private firms can enhance competition as can lowering or removing artificial barriers to entry by new firms.

- Enhance accountability by the use of "exit" and "voice"

Using the "exit" response means moving from one supplier of a service to another one (as occurs within a competitive market with alternative suppliers). The "voice" response involves active feedback or protest by users who are dissatisfied with services.[8] Institutional arrangements that rely as heavily as possible on competition (having several suppliers of the same infrastructure services) and that offer ways for users to make a difference exacts the most accountability from

those providing infrastructure services. Service users who recognize that they have a direct stake in the outcome, for example, where direct user fees are used to finance projects, as discussed in Section III, will have more incentive to change suppliers or protest than those who see no obvious link between their payment of taxes or fees and services received.

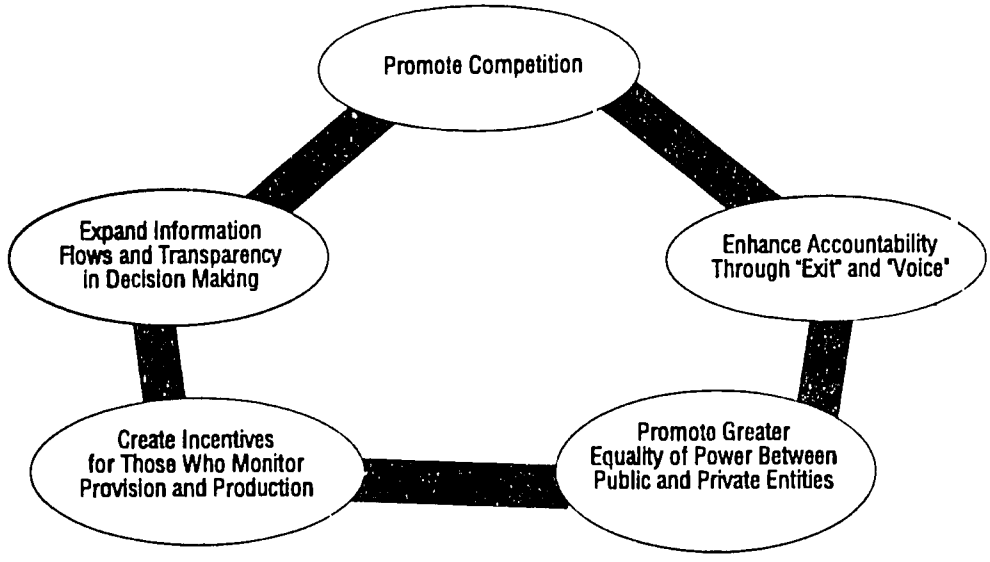
- Create incentives for those who monitor provision and production

Better transparency and information flows certainly can assist the monitoring process. However, even more effective are arrangements that put those responsible for monitoring activities at some economic risk if they fail to adequately monitor others' behaviors. For example, a private firm may be auditing the financial accounts of a public agency. If it is subsequently determined that the public agency used improper financial practices, the private firm can be held liable for the losses sustained. Such an arrangement would give the auditing firm much more incentive to monitor the accounts.[9]

- Promote greater equality of power between public and private entities

In countries that do not have an independent judicial system, dispute resolutions are likely to favor the more powerful party. In fact, where the disputes involve the government and the private sector, the former is in a much more powerful position. It is unlikely that a single infrastructure project can create a fair dispute resolution process, but it may make some progress at the margin. For example, allowing a contractor to bid on contracts in a variety of areas breaks the monopsony (single buyer of contract services) position of the local government and therefore weakens its power in settling a dispute (see Box 5).

FIGURE 2: Techniques for Modifying Institutional Arrangements



BOX 5
Using Institutional Reforms to Strengthen Road Contractor Performance

A DFM Project team analyzed the performance of private firms contracted to rehabilitate rural roads in South Sulawesi and Nusa Tenggara Timur provinces of Indonesia. The team reviewed laws, rules, and procedures associated with construction and maintenance of *kabupaten* (district) roads. It also interviewed road contractors and did in-depth case studies of USAID-sponsored road rehabilitation projects.

The study concluded (p. 2) that contractor performance was overall acceptable. It noted, however, a particular problem area.

The critical failure of the *kabupaten* road industry is a widespread inability to negotiate and enforce valid contracts. This problem manifests itself in the following types of contracts:

1. Contracts between *kabupatens* and contractors for road rehabilitation and/or maintenance

2. Employment contracts between civil servants and the government agencies that employ them

3. Contracts (project agreements) between donors/lenders and the GOI [Government of Indonesia]

With respect to contracts with private firms, the study observed that the contractor firms are at a competitive disadvantage. No reliable dispute resolution forums are available; competitive bidding procedures are seldom used; and due to current regulations and the state of the industry, the districts are both near monopsonists in purchasing contractor services and monopoly sellers of construction materials and equipment. Worse still, the contracts are generally "lump-sum" contracts; they require the contractor to complete the work for a prespecified price even if the contract specifications changed.

To help overcome these noncompetitive constraints to an efficient road construction/maintenance industry, the team made several recommendations:

- that open public tenders be made mandatory for all procurement in excess of Rp. 20 million

- that contract awards be made on the basis of a technical evaluation committee

- that contractors have full and independent authority to purchase materials from any source for the contracts that they implemented

- that contracts be written as unit-price contracts (based on the work carried out) rather than lump-sum contracts.

Finally, to lessen the monopsonistic position of district governments, the team recommended that province-approved contractors be allowed to bid on contracts throughout the province rather than have their opportunities restricted to particular districts.

Obviously, to make such changes in institutional arrangements is unlikely to be simple. Because such changes upset the status quo, those who benefit from the current incentives are likely to put up considerable resistance. At the same time, many others can benefit from the changes. With careful crafting of rules that are to be used on USAID-sponsored infrastructure projects, new arrangements can be implemented. Institutional analysis shows that, under current rule systems, projects are very unlikely to be sustained. Disregarding these implications is unfair to both the recipient nation and to those who are funding the project.

III. Financial Analysis

In addition to economic analysis of the benefits and costs of a project, USAID's project design process requires that a financial analysis also be performed (as well as social, administrative, environmental and technical analyses). With project

sustainability in mind, this section details the analyses that should be carried out for rural infrastructure facilities.

Why We Do Financial Analysis

This financial analysis relies on two conditions. For an infrastructure investment to be sustained, it is necessary, though not sufficient, that:

- sufficient resources be available to cover the costs of operating and maintaining the infrastructure
- the available resources actually be allocated towards O&M

We also assume that the facility will yield positive net benefits, as determined by the economic analysis. We assume that any infrastructure project that is implemented satisfies that constraint.

Financial analysis assesses whether the needed resources are available to meet the costs of sustaining the investment. There are three analytical steps:

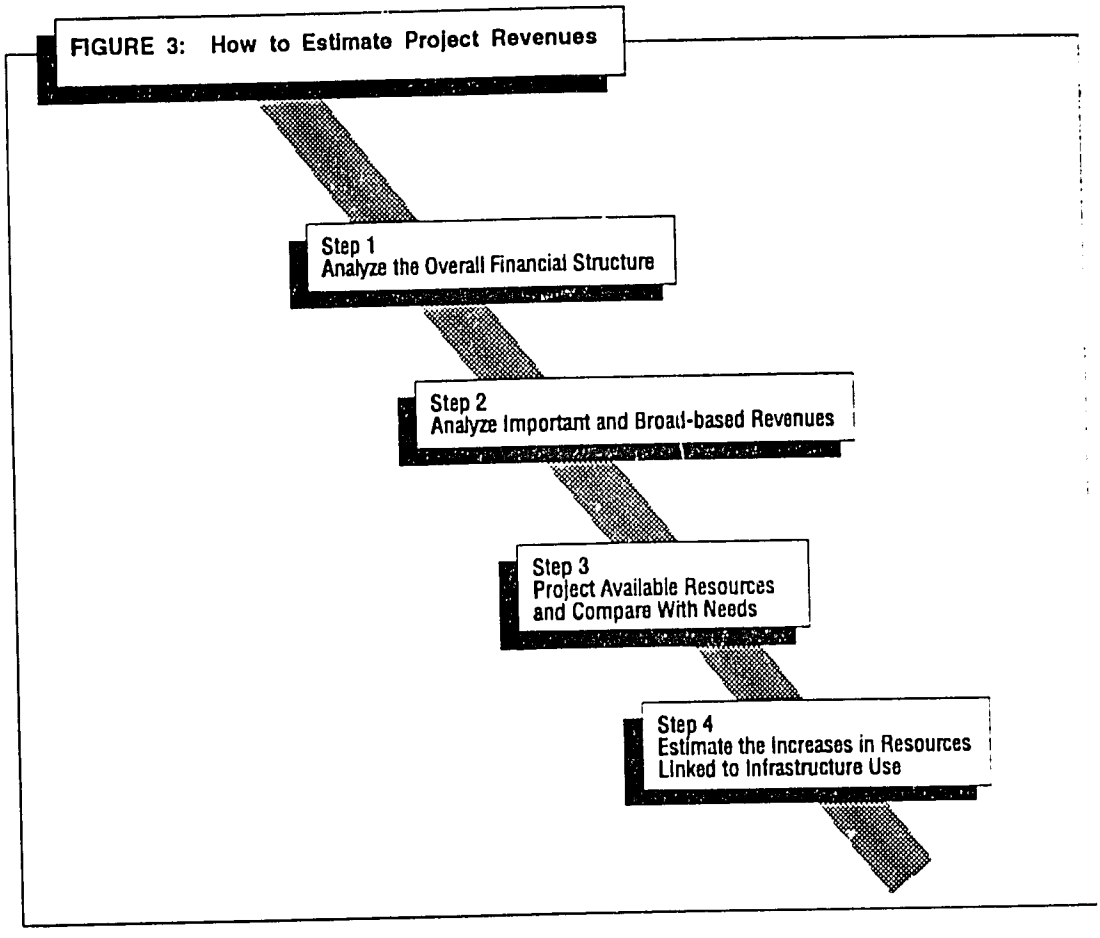
1. Estimating the *costs* that must be covered
2. Estimating the *revenues* that might be generated to cover those costs
3. Analyzing the *process* that converts the generated revenues into actual expenditures

The first item is essentially a "recurrent-cost" analysis, which should be part of any capital budgeting process (see Heller, 1979 or USAID, 1982). The second item relies heavily on public finance economics. The third item, which concentrates on budgeting and resource allocation processes, is crucial: even if revenues are found to exceed O&M costs, unless those revenues are allocated to maintenance, the project is unlikely to be sustained.

Estimating Costs

Since estimating costs is an integral part of the economic analysis (which is necessary to justify a project), this portion of the financial analysis is likely to be the easiest. For most capital infrastructure projects, attention can be limited to the costs of operating and maintaining the facility. Thus, unlike economic analysis, no concern need to be given to any external costs associated with the facility.

A crude first approximation of the operating and maintenance costs of a project can be obtained by using the so-called *r* coefficient--the ratio of necessary O&M costs to capital investment costs (see USAID, 1982). However, more detailed O&M cost requirements probably can be estimated. We distinguish between a project that focuses on a single, stand-alone capital facility and one that includes both new and existing infrastructure.



Cost Estimation 1: From engineering information and input price data, we estimate the outlays on recurrent operating and maintenance activities that will be necessary to produce the flow of benefits assumed in the economic analysis. (This is likely to be a prime portion of the economic analysis but includes only the monetary costs.)

Cost Estimation 2: If the project has both new and existing infrastructure, estimating costs is more complex. The estimation must include the costs of maintaining (if economically justified) existing infrastructure, which may have been allowed to deteriorate. For example, for rural road networks we should consider not only the costs of operating and maintaining the portion of the network directly affected by the project, but the entire maintainable network. This is not necessarily an easy task (see Box 6).

BOX 6
Estimating Road Maintenance Costs

Estimating the costs of maintaining a road network may appear simple, but it is complicated by *conceptual* difficulties--exactly what it is that one wants to estimate--and *practical* issues of data availability.

Ideally, an analyst would project the monetary outlays needed to keep a road network operating *efficiently*. Such an estimate not only involves the *costs* of maintaining various portions of a network, but also the *benefits* of such maintenance. Any outlays not justified by the benefits would be uneconomic.

A project design or monitoring team would probably not have the resources necessary to make localized estimates of the benefits of road maintenance, so the analysis must be based on certain assumptions. One reasonable assumption, which partially addresses the efficiency issue, is that maintaining any road that has already deteriorated will be inefficient.

A second conceptual issue (but one which is also related to data availability) concerns how much detail to put in the estimates. The more detailed approach, useful for long-term budgeting, is to estimate maintenance outlays for each year of the useful life of the infrastructure. A less detailed approach is simply to estimate the average annual maintenance outlays that will be needed. This second approach usually suffices for project planning.

But how to estimate these costs, since data are often limited in developing countries? Ideally an analyst would have the following information available: (1) inventory of the length, numbers and types of related structures, surface type, and condition of the network; and (2) unit costs of maintaining roads of various surface types as well as the unit cost of maintaining these structures.

In fact, many developing countries do not even keep full inventories of their roads. When information on the extent of the network is available, the data seldom also contain information on the length, by surface type, and its condition. For example, *kabupatens* in Indonesia publish information on length of the network by surface type and the condition of the network, but they do not give the two variables--surface *and* condition--simultaneously. The analyst must assume a relationship between the variables.

Even more surprising, to anyone who has never attempted to estimate total costs, is that reasonably accurate estimates of the unit costs of maintaining roads may not even be available. And those that are available may differ greatly. For example, in the DFM (1991) research in Indonesia, estimates of the annual costs of maintaining a kilometer of gravel road ranged from Rp. 2.2 million to Rp. 10.1 million! The differences were primarily due to different assumptions made about the costs of periodic maintenance. The lesson to be learned is that a considerable amount of local research is needed to arrive at reasonably accurate estimates of annual costs for road maintenance.

The table shows estimates for the costs of road maintenance for selected *kabupatens* in Indonesia, where USAID is administering a rural roads maintenance systems project. The differences among *kabupatens* are due to variations in (1) the length of *kabupaten* roads, (2) the maintainability of those roads, and (3) the road surfaces. While the numbers were derived using only a single set of annualized unit cost estimates, the estimation technique is obviously

Resource Needs to Maintain Kabupaten Roads in Good and Fair Condition by USAID Project District (in millions of rupiahs)

Kabupaten	Annual Resource Requirements for:	
	Routine Maintenance Total	Routine and Periodic Maintenance Total
Bone	540.4	1,119.4
Bulukumba	106.0	219.5
Jeneponto	1,574.2	3,260.8
Pinrang	148.7	308.1
Sidrap	455.8	944.2
Sinjai	493.5	1,022.2
Takalar	534.8	1,107.8

Note: Routine maintenance is assumed to cost Rp. 2.8 million/km and is applied only to asphalt and gravel roads deemed to be in good and fair condition. Periodic maintenance is assumed to cost Rp. 3 million/km on an annualized basis and also applies only to asphalt and gravel roads deemed to be in good and fair condition. - Source: DFM (1991: 23).

The outcome of these steps will be estimates of the revenues that must be made available to operate and maintain this infrastructure. Two questions remain: whether such resources are potentially available and whether they are likely to be supplied.

Estimating Revenues

To explain exactly how to estimate the revenue available to support the operation and maintenance of rural infrastructure is difficult because each situation is unique. But the first step in the process is to understand the public financing system that governs the operation and maintenance of infrastructure. With that understanding, we can perform in-depth analysis on those revenues that are either sizeable or directly tied to the infrastructure being considered. We can then project probable flows of these revenues. Finally, since we should anticipate likely revenue shortfalls, we can analyze other potential revenue sources. We consider each step here, recognizing that the details will depend greatly upon the particular situation.

Step 1. Analyze the Overall Financial Structure

To analyze the financial structure, we begin by reviewing the statutory provisions that govern the sources of resources available to support infrastructure, as well as any limitations on their use. We should also conduct on-site analysis to ascertain how closely actual practice conforms to the statutes. It may be useful to construct a table similar to the one below. By specifying each major revenue source that is available for both initial capital investments and the operation and maintenance of infrastructures, the analyst and users of the analysis can determine what resource mobilization instruments are available and where adjustments to those flows might be made.

EXAMPLE TABLE

Alternative Sources and Uses of Revenue

SOURCES AND FLOW OF FUNDS	AMOUNT	USE	
		Capital	O&M
Direct Central Government Spending			
Subnational Government Revenues			
Central Govt. Grants (by program)			
Loans (by source of credit)			
Own-Source Revenue			
Local Taxes (by major source)			
User Charges Linked to Infrastructure Use			
Other User Charges			
Other Own-source Revenues			
Other Resources			
User Groups and Non-govt. Resources			

Even greater detail than that in the above table can sometimes be useful. For example, it can be helpful to differentiate between revenues for labor costs and those for non-labor inputs, such as fuel for vehicles, electricity, gravel, and so on. It is also often worthwhile to create separate tables for the different accounts maintained by a subnational government (where the statutes call for separate accounts). For example, some grants are required by statute to flow into a capital account and be used exclusively for new capital investments. Other revenues must flow into a current account, with additional interfund transfers into the capital account either mandated, allowed, or forbidden.

Tables resembling the example will differ greatly in different countries. For example, in many countries of francophone Africa the central government directly finances both capital and O&M expenditures; no formal role is given to subnational governments, to user groups, or to other nongovernmental organizations. In other countries the central government directly finances all capital spending and all labor associated with O&M spending, but it relies on local governments or other groups to finance non-labor spending. There are also situations where, although subnational government accounts show large amounts of resources, a substantial portion of these resources come from intergovernmental grants. The use of these grants may be controlled centrally. In Indonesia, for example, all labor expenditures and a significant portion of non-labor spending (for both capital investments and recurrent expenditures) flow from the central government through several different grant programs.

Information on the availability and their use of credit can be revealing when we assess the ability of local governments to finance and maintain infrastructure facilities. Credit can give its recipients a stronger incentive to use and maintain capital facilities more judiciously because they are taking on a longer-term liability.

Local resources are also often available. We must distinguish, however, between revenues collected as general taxes and those directly tied to particular services, such as drinking water or use of a public market. Local revenues are generally available to purchase either labor or non-labor inputs. The example table also includes another important potential resource to support local infrastructure--user groups or other nongovernmental organizations. These resources may be monetary or may be in kind--as labor, land, or materials.

The table may best be constructed in two phases. First, as we have mentioned, it is imperative that we understand the legal or statutory basis for the revenues that are potentially available for infrastructure investment and its operation and maintenance. This requires some study of the ordinances governing local finance, including what grant programs are in effect, any limitations or restrictions on how those funds are to be spent, and what sorts of revenues local governments are permitted to collect (as well as the rules which govern their administration, collection, and use). Second, we should gather data to complete the "amounts" column in the table to see the relative sizes of these various revenues. Although such data are sometimes available centrally, they may have to be collected from individual local jurisdictions (which greatly increases data collection costs). If data available centrally are only compiled on an aggregate basis (for all local governments in the country), local data collection at the project sites will be necessary to clarify their revenue situation. In fact, local data is generally preferable because it can then be used to carry out Step 2.

Step 2. Analyze Important and Broad-based Revenues

The objective of this step is to understand how the flows of specific revenues are administered and how various economic and political factors affect them. Such analysis is crucial to complete the steps that follow. The exact analysis tasks will depend upon the findings from Step 1. On one hand, if nearly all formal revenues supporting the operation and maintenance of rural infrastructure are direct central government revenue flows (the first line in the table) with additional revenues coming from formal or informal user groups, analysis of how O&M costs might be covered should probably focus on local nongovernmental and user groups. On the other hand, if the financial structure involves formal local governments, we will want to use other types of analysis.

For important revenues, two types of analysis are appropriate. One examines the base and rates of these revenues and how these attributes can be and have been

changed. The analyst should, for example, review the history of statutory definitions of the rates and bases of a revenue source and should determine how these statutes are enforced at the local level. Are the rates being imposed at their statutory maximums? How is the revenue base assessed? What administrative procedures are used to collect the revenues? Finally, what steps are followed to collect delinquent revenues?

A second, more quantitative analysis considers what socio-economic and policy factors are likely to have influenced revenue flows in the past. For example, given 10-12 years of revenue history, to what degree have revenues responded to changes in measures of economic activity, population, and administrative factors such as changes in assessments?

Step 3. Project Available Resources and Compare With Needs

From the analysis of broad-based revenues, we can project incremental resources. It is sometimes possible to produce revenue projections in a highly formal manner using relatively sophisticated estimation models (see, for example, Schroeder and Wasylenko, 1989). But more often the data needed for such a projection will not be available, and we will have to estimate future resources. Ultimately, we are comparing the resources potentially available for O&M expenditures of the rural infrastructure with the previously estimated costs. This step frequently projects a shortfall of available resources, so the next step is also needed.

Step 4. Estimate the Increases in Resources Linked to Infrastructure Use

Incentives play a crucial role in producing additional resources to help sustain infrastructure investments. Since these facilities benefit their users, it is reasonable for a portion of those benefits to be used to support the operation and maintenance of the infrastructure. (How to ensure that these resources are, in fact, reinvested in these facilities is addressed in the section, "Budget Allocations.")

As we have noted before, institutional arrangements for the financing of local infrastructures differ significantly from country to country. Here are three typical scenarios:

a. Local governments are involved in the provision of rural infrastructure, but any incremental public resources must be mobilized within the constraints of the current fiscal structure.

b. Local governments are involved in the provision of rural infrastructure; their experimental efforts to mobilize additional public resources are permitted.

c. Local governments are not involved in the provision of rural infrastructure.

In case (a) increments to formal revenue streams are restricted to raising rates, broadening revenue bases, or improving administration of existing revenue instruments. However, local informal user groups or nongovernmental organizations may also be able to contribute labor or in-kind services needed to maintain many infrastructures.

Strategies to improve the productivity of existing revenue instruments should emerge from the analysis of broad-based revenues already discussed. One strategy, working within the existing revenue framework, is to improve revenue administration. Relatively simple administrative changes can sometimes yield significant results. For example, collecting a local property tax with a business license tax can improve property tax compliance of businesses.

A second strategy works on a more macro level. It is common to find revenue systems where central governments control the specific rates that can be imposed on such activities as use of markets. However, it is also common for these rates to go unchanged for years despite dramatic increases in price levels (which mean lower effective tax rates). Increases in the maximum permissible rates can, in these instances, greatly improve revenues.

Case (b) gives a project officer more flexibility in designing a sustainable infrastructure project. Again, when developing pilot resource mobilization schemes, it is crucial to keep in mind the nature of the service being provided as well as the incentives of the users. Box 7 illustrates how the DFM project relied on these principles when it was asked to design experimental resource mobilization techniques to be used by district (*kabupaten*) governments in Indonesia.

Case (c) may be the most challenging environment in which to create potentially productive incremental resource mobilization instruments. If it is unlikely that more resources will flow from the center, we must reach out to voluntary organizations or informal user groups to carry that burden. But the voluntary nature of most informal organizations means that their powers to mobilize resources are severely limited. And unless appropriate safeguards are built into their rule structures, members may be able to engage in free-riding behavior (see Box 4).

This does not mean that informal resource mobilization techniques for rural infrastructures are impossible in such instances. As DFM work on irrigation systems in Nepal has shown (Hilton, 1990), user-managed infrastructure systems can mobilize the resources to maintain such systems. Hilton's research found the following conditions necessary for users to contribute substantially to cost recovery (p. viii):

- Users must feel that they have some degree of direct control over system decisions,
- Policies must be tailored to local requirements rather than be imposed identically on all systems,
- Service delivery must be reliable,
- The rules governing the system must be understandable and be agreed upon by the users, and
- The system must be operated and managed as a producer of useful goods or services rather than as a political entity.

Irrigation services are different from some other types of local, jointly used infrastructure investments such as roads. For example, the failure of an irrigation system may be catastrophic for local farmers, whereas the failure of a road during the rainy season may simply be somewhat costly and inconvenient. Likewise, unmaintained roads may deteriorate more slowly than unmaintained irrigation systems. Thus, assisting users to design workable, informal resource mobilization methods may be more complex than for irrigation. Nevertheless, the principles of institutional analysis and establishing incentives must be considered of utmost importance.

Insuring Budget Allocations

To insure that operating and maintenance expenditures will be made, mobilizing resources is necessary, but it is not sufficient. The funds must also be used for that purpose. For a public sector organization, this means that the money must be budgeted for maintenance and then spent effectively. Here we are concerned mainly with budgeting.

Decentralization raises an interesting dilemma for a project officer. On the one hand, there are good reasons to expect that decentralization *can* result in more effective and efficient decisions, which take into account local information not available centrally. On the other hand, considerably less control over local actions is possible.[10]

One way to ensure that local budgeting results in sufficient infrastructure maintenance funds is to use *mandates or rules* concerning how local governments must allocate their resources. Mandates can obtain the desired results; however, they are achieved by diminishing local discretion and reducing the advantages of using local information. Practically speaking, such rules will be effective only if they are monitored. Since financial auditing capabilities in many developing countries are quite limited, mandates may be ineffective.

Another approach is to use *financial* incentives to help local decisions coincide with the broader interests of the project officer. Here are four financial arrangements that can improve this probability.

Earmarking funds

Earmarking funds means specifying for what purpose certain funds may be used. This approach sounds good, but it has two drawbacks. First, funds that are earmarked for a particular purpose cannot be spent on other, possibly more productive, services. Second, even though earmarking is contained in the statutes, in many developing countries it is ultimately not practiced. Still, earmarking is worth strong consideration during project design and implementation.

Implement cost-sharing grant mechanisms

Intergovernmental grants make up a large portion of the resources of local governments in many developing countries. Grant systems can offer incentives for effective local operation and maintenance of capital infrastructure. A cost-sharing grant requires that the recipient jurisdiction match some proportion of the funds it receives for constructing the infrastructure. The expectation is that, by having invested some of its own resources, the local jurisdiction will have a greater incentive to insure that the facility is maintained.

Explore greater use of credit financing

Closely linked to cost-sharing grants is the use of credit to fund infrastructure investments (or it may be used with a cost-sharing grant). Again, its "ownership" of the investment and the responsibility for a long-term payback of the funds gives the local government the incentives to maintain the facility effectively.

Create non-traditional service districts

Some local infrastructure services may be most amenable to the creation of special districts that do not necessarily correspond with government jurisdictions. This technique is widely used for certain types of urban infrastructures, such as water and sewer systems, where the service area spans more than a single jurisdiction. The single purpose of special districts permits them to focus explicitly on service flows and increases the likelihood that the necessary funds will be put into operation and maintenance.

As with institutional arrangements, major changes in financing mechanisms are not likely to happen easily or quickly.[11] Again, it is necessary to show how such changes will result in improved project sustainability. As suggested in Box 7,

designing pilot projects as a part of a larger infrastructure project can be a useful way to demonstrate the feasibility and payoff from such changes.

BOX 7
Pilot Road Maintenance Experiments in Indonesia

While the local government finance structure of Indonesia is highly centralized, the system does permit controlled local experimentation with financing mechanisms. The DFM Project designed several pilot projects that are currently being tried in several *kabupatens* within the country. Here we describe the principles that DFM relied upon when designing those pilot projects. Throughout the design process *benefit-based* resource mobilization techniques were chosen because they are seen as equitable (what you pay is directly related to what you get). This approach encourages compliance.

In choosing roads for the pilot project, DFM set up two initial conditions that had to be met:

"The road had to be judged by local engineers to be in a maintainable condition to insure that any funds generated and spent on maintenance would have benefits.

"The road had to be judged by local officials *and*--more important, by local users--as providing realized benefits to the users. This condition made it more likely that users would have an incentive to comply with resource mobilization techniques. Subsequent analysis then confirmed that the perceived incremental benefits by users were greater than the costs of maintenance.

In choosing the particular resource mobilization instrument, DFM recognized that not all roads have identical characteristics. This means that *it is not reasonable to take a single "blueprint" approach to local financing of roads, since no technique works equally well in all situations.*

To elaborate on this point, some rural roads are used by reasonably well-defined, homogeneous groups. Other roads serve not only those living near the road but also serve persons living many miles away. These differing characteristics of what otherwise might be identical roads help determine the type of resource mobilization instrument that is viable. For example, if the users of the first type of road perceive enough benefits, they may organize themselves into a users' group and take on the responsibility of maintaining the road. But, for the road serving non-residents, a users' group approach is unlikely to be feasible; most of the benefits will be enjoyed by non-contributors.

When a road serves distant locations, direct charges imposed on road users may be economically feasible. This depends on the demand for the road--that is, upon the number and types of users and the availability of substitute routes. Where there are no good substitutes for a road and where there is enough demand to offset the collection costs, direct user fees can be feasible.

For such user charges to be successful and sustainable, however, there should be some assurance that the monies raised from the tolls will be reinvested in the road. For that reason, the DFM project also suggested administrative and rule changes to create special earmarked funds into which all user fees would be deposited and from which maintenance expenditures on the road would be made.

Maintainable and benefit-producing roads that satisfied the criteria for both user groups and user charges were located in South Sulawesi Province of Indonesia. In addition, a road which primarily serves a single shrimp hatchery was located. The owners of the hatchery were willing to assume maintenance responsibilities for this road, which produced significant benefits for them. (A similar analysis of rural roads in Nusa Tenggara Timur [NTT] Province found no roads which met the dual criteria mentioned above due to the generally low level of economic activity in the area. Thus no pilot projects were recommended for NTT.)

The principal lesson to be learned from the DFM experience in Indonesia is that by matching the attributes of specific rural infrastructure investments with the characteristics of users and logical incentive structures, we can design resource mobilization instruments that have good potential to generate the resources necessary to maintain that infrastructure.

BEST AVAILABLE DOCUMENT

IV. Summary

This paper has provided some basic guidelines for USAID project officers who face the difficult task of designing rural infrastructure projects that have a reasonable likelihood of success--that is, of yielding benefits well in excess of their costs. Although the failure to achieve sustainable infrastructure is sometimes due to technical problems associated with projects, it is probably more common for these failures to be attributable to the inappropriate incentives that the existing institutional arrangements offer to those with the responsibility to design, construct, operate, maintain, finance, and oversee the use of these facilities.

We have argued that by carrying out institutional and financial analyses, either during the preparation or monitoring stages of USAID-sponsored projects, we can shed considerable light on the specific reasons for infrastructure investment failures and can recommend how such projects might be improved. Both of these analytical techniques reveal the incentives, either perverse or accommodating, that the institutional and financial arrangements provide. We feel strongly that it is neither possible nor desirable to produce "blueprints" for such analyses. But we have provided some suggested courses of action both for the conduct of these studies and for the steps that might be taken based upon their specific findings.

As a practical question, how might such studies be carried out? We recommend that formal institutional analysis be a significant part of social soundness analysis. It should rely heavily on field interviews with a wide variety of individuals, ranging from elected officials to current or potential infrastructure users. Much of the analysis is likely to rely on individual cases, preferably previous failures as well as successes, so that the strongest conclusions possible can be reached about what working rules lead to success.

Those teams engaged in institutional analysis should have expertise in (1) institutional analysis, (2) public administration or political science, (3) engineering (necessary for a full understanding of the infrastructure production process) and, ideally, (4) local legal structures and practices. Since institutional, political, and cultural constraints differ greatly across countries, it is important that members of the institutional analysis team have a thorough understanding of the specific constraints they face in the host country.

Teams engaged in public financial analysis should have expertise in (1) public finance economics, (2) financial administration and, (3) for estimating

infrastructure costs, engineering. Since the specifics of financial structures differ significantly across countries, it is again crucial that members of the financial analysis team thoroughly understand the specific financial arrangements used in the host country. Similarly, the study must be designed to permit the team to spend a significant amount of time in the field. Only through field visits can the financing mechanisms actually used be studied and evaluated. While it is unlikely that such a team can, in a short period, conduct a full, in-depth analysis of the public finance system, a short-term analysis is quite likely to lead to suggestions as to how financing arrangements can be improved to increase the sustainability of a rural infrastructure project.

ENDNOTES

1. The analysis relies heavily on the concepts outlined and discussed in Ostrom et al. (1992).

2. Obviously, we are not the first to address the general issue of sustainability. See for example Honadle and VanSant, 1985, and Bamberger and Cheema, 1992. There has also been a variety of analyses of the longer-term results of infrastructure investments in specific sectors. For example, issues pertaining to the sustainability of rural roads are addressed in Anderson and Vandervoort, 1982; Harral and Faiz, 1987; Robinson, 1988; and Schroeder, 1989.

3. Uphoff (1986: 63-71) includes design, construction, operation and maintenance as the principal phases of infrastructure development. We add *use* to this list because, as will become apparent in the discussion, improper use can significantly increase the speed at which a capital asset deteriorates.

4. See, for example, Berg et al. (1980), which evaluates a USAID roads project in Jamaica. The design standards used greatly exceeded those necessary for the traffic using the roads.

5. See, for example, Gerhard Pohl and Dubravko Mihaljek. 1992. "Project Evaluation and Uncertainty in Practice: A Statistical Analysis of Rate-of-Return Divergencies of 1,015 World Bank Projects." *The World Bank Economic Review* 6(2) (May): 255-77.

6. Although it focuses exclusively on irrigation systems, Ostrom's (1992) monograph provides a very readable illustration of how institutional analysis can be used to improve the sustainability of such infrastructure.

7. For such pressures to be effective, of course, also requires mechanisms by which users voice their demands for the service.

8. These notions are elaborated upon by Paul (1991), who builds on the concepts of Hirschman (1970).

9. Utilizing such mechanisms does, of course, also rely heavily on the availability of a set of laws and a fair justice system which insure that the guilty party is held liable.

10. This is a classic example of the "principal-agent" problem. The principal--in this instance the project manager and, perhaps, the central ministry--prefer that infrastructures be maintained. The agent--in this instance local decision makers--may or may not have identical preferences or incentives. Ferris and Winkler (1991) discuss the principal-agent aspects of intergovernmental relations.

11. In fact, financing arrangements are simply one type of institutional arrangement. We have focused on it here separate from the discussion of institutional analysis for two reasons. First, mobilization enough resources to meet recurrent cost requirements is a crucial, necessary condition for infrastructure sustainability. Second, under current USAID project design procedures, financial analysis is separate from social soundness analysis.

REFERENCES

Anderson, G. William, and Charles G. Vandervoort. 1982. *Rural Roads Evaluation Summary Report.* Program Evaluation Report No. 5. Washington, D.C.: U.S. Agency for International Development.

Bamberger, Michael and Shabbir Cheema. 1992. *Case Studies of Project Sustainability: Implications for Policy and Operations from Asian Experience* EDI Seminar Series. Washington, D.C.: The World Bank.

Beenhakker, Henri L. and Abderraouf Chammari. 1979. *Identification and Appraisal of Rural Roads Projects,* World Bank Staff Working Paper No. 362. Washington, D.C.: The World Bank.

Berg, Robert J., Carleen Gardner, Michael M. Horowitz, Palmer Stearns, and Charles Vandervoort. 1980. *Jamaica Feeder Roads: An Evaluation.* Project Impact Evaluation No. 11. Washington, D.C.: U.S. Agency for International Development.

Connerley, Edwin and Louis Siegel. 1990. "Special Study on Contractor Performance." Burlington, Vt.: Associates in Rural Development.

Decentralization: Finance and Management Project (DFM). 1990. "Bangladesh Rural and Feeder Roads Sector Assessment." Burlington, Vt.: Associates in Rural Development.

Decentralization: Finance and Management Project (DFM). 1991. "Special Study on Local Resource Mobilization for Road Maintenance in Indonesia." Burlington, Vt.: Associates in Rural Development.

Ferris, James M., and Donald R. Winkler. 1991. "Agency Theory and Intergovernmental Relationships," in Remy Prud'homme, ed., *Public Finance with Several Levels of Government.* Pp. 155-66. The Hague: Foundation Journal Public Finance.

Harral, Clell G., and Asif Faiz. 1988. *Road Deterioration in Developing Countries: Causes and Remedies.* Washington, D.C.: The World Bank.

Heller, Peter. 1979. "The Underfinancing of Recurrent Development Costs." *Finance and Development* (16)1 (March): 38-41.

Hilton, Rita. 1990. "Cost Recovery and Local Resource Mobilization: An Examination of Incentives in Irrigation Systems in Nepal." Burlington, Vt.: Associates in Rural Development.

Hirschman, A. 1970. *Exit, Voice and Loyalty*. Cambridge, Mass.: Harvard University Press.

Honadle, George, and Jerry VanSant. 1985. *Implementation for Sustainability: Lessons from Integrated Rural Development*. West Hartford, Conn.: Kumarian Press.

Levi, Margaret. 1988. *Of Rule and Revenue*. Berkeley: University of California Press.

Nabli, Mustapha K. and Jeffrey B. Nugent. 1989. "The New Institutional Economics and Its Applicability to Development." *World Development* 17(9): 1333-347.

Ostrom, Elinor. 1992. *Crafting Institutions for Self-Governing Irrigation Systems*. San Francisco, Calif.: Institute for Contemporary Studies.

Ostrom, Elinor, Larry Schroeder and Susan Wynne. 1993. *Institutional Incentives and Sustainable Development*. Boulder, Colo.: Westview Press.

Paul, Samuel. 1991. *Strengthening Public Service Accountability: A Conceptual Framework*. World Bank Discussion Papers, No. 136. Washington, D.C.: The World Bank.

Pohl, Gerhard and Dubravko Mihaljek. 1992. "Project Evaluation and Uncertainty in Practice: A Statistical Analysis of Rate-of-Return Divergencies of 1,015 World Bank Projects." *The World Bank Economic Review* 6(2) (May): 255-77.

Robinson, R. 1988. *A View of Road Maintenance Economics, Policy and Management in Developing Countries*. TRRL Research Report 145. Crowthorne, U.K.: Transport and Road Research Laboratory.

Schroeder, Larry. 1989. "Managing and Financing Rural Roads in Developing Countries." Burlington, Vt.: Associates in Rural Development.

Schroeder, Larry and Michael Wasylenko. 1989. "Public Sector Forecasting in the Third World," *The International Journal of Forecasting* 5:333-345.

Schroeder, Larry, et al. 1991. "Special Study on Local Resource Mobilization for Road Maintenance in Indonesia" (three volumes). Burlington, Vt.: Associates in Rural Development.

Thomson, James. 1991. *Decentralization, Governance and Problem-Solving in the Sahel. Sahel Decentralization Policy Report, Volume 1.* Decentralization: Finance and Management Project. Burlington, Vt.: Associates in Rural Development.

U. S. Agency for International Development (USAID). 1982. *Recurrent Costs: Problems in Developing Countries.* AID Policy Paper, Bureau of Program and Policy Coordination. Washington, D.C.: USAID.

U. S. Agency for International Development (USAID). 1987. *AID Handbook.* Washington, D.C.: USAID.

Uphoff, Norman T., ed. 1986. *Local Institutional Development: An Analytical Sourcebook with Cases.* West Hartford, Conn.: Kumarian Press.

World Bank. 1992. *World Development Report 1992.* New York: Oxford University Press.

World Commission on Environment and Development. 1987. *Our Common Future.* New York: Oxford University Press.