

Operations and Maintenance of Rural Infrastructure in Community-Driven Development and Community-Based Projects

Lessons Learned and Case Studies of Good Practice





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Acronyms and Abbreviations

AM	Aide-Memoire
AzRIP	Azerbaijan Rural Investment Project
CDC	Community development council
CDD	Community-driven development
COP	Community of Practice
DDC	District development committee
DWSS	Department of Water Supply & Sanitation
FAO	Food and Agriculture Organization
GP	Gram panchayat
GPWSC	Gram panchayat water supply and sanitation committee
GRM	Grievance redress mechanism
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion and Results Report
ILO	International Labour Organization
ISR	Implementation Supervision Report
KALAHY-CIDSS	Philippines Comprehensive and Integrated Delivery of Social Services
LGA	Local government authority
LGU	Local government unit
NGO	Non-governmental organization
NSP	National Solidarity Program (Afghanistan)
O&M	Operations and maintenance
OED	Operations Evaluation Department
PAD	Project Appraisal Document
PAT	Project assistance team
PMD	Directorate General for Community and Village Empowerment
PMU	Project management unit
PNPM	National Program for Community Empowerment (Indonesia)

PPAR	Project Performance Audit Report
PPP	Public-private partnership
PRI	Provincial Road Institute
PRWSS	Punjab Rural Water Supply and Sanitation
RWSS	Rural water supply and sanitation
SHG	Self-help group
SLP	Sustainable Livelihood Project
VDC	Village development committee
WEF	World Economic Forum
WHO	World Health Organization
WSUC	Water and sanitation user committee
WSUG	Water supply user group

Executive Summary

1. The World Bank encourages the use of community-driven development (CDD) and community-based approaches to build rural infrastructure in some of the world's poorest countries and communities. Over the past 10 years, CDD projects and components have constituted between 5 and 10 percent of World Bank lending. CDD emphasizes community control over decision making and investment resources for local infrastructure and service delivery. The approach has significantly increased access to community infrastructure and services such as roads, irrigation, water and sanitation, electricity, basic education, and health (Wong 2012). CDD is widely used in the least-developed countries of the world and in fragile and post conflict contexts, and is often used by middle-income countries to reach the poorest or most marginalized populations.¹ Given the levels of investment and the importance CDD plays in extending basic services, particularly to the poor, continued operation and maintenance (O&M) of the basic investments supported under CDD (and other community-based operations) is a logical concern that has been raised by both practitioners and critics (OED 2005).

2. This paper highlights examples of successful O&M arrangements under community-driven and -based development projects to better understand the factors contributing to their success. The intended beneficiaries of this assessment are client governments implementing CDD and community-based projects for similar types of rural infrastructure, task teams, and other potential users. In addition to highlighting factors of success, this paper shares relevant materials, procedures, and guidelines to help support O&M systems.

3. This paper is based on a desk review of World Bank operational documents as well as external literature on O&M related to rural infrastructure across several sectors. The seven project cases analyzed for this review were selected based on evidence of successful O&M arrangements from a longer list of more than 50 projects compiled by members of the CDD Community of Practice (COP) and World Bank staff from the water, social protection, and transport sectors. The desk review of relevant project documents was supplemented by discussions with task team members and government project staff. The seven case study projects include:

- Afghanistan National Solidarity Program (NSP 1, 2 and 3)
- Azerbaijan Rural Investment Projects (1 and 2)
- India Punjab Rural Water Supply and Sanitation Project
- Indonesia National Program for Community Empowerment in Rural Areas (PNPM Rural),
- Nepal Rural Water Supply and Sanitation Projects (1 and 2)
- Peru Rural Roads Program (1–3)
- The Philippines' KALAHI Comprehensive and Integrated Delivery of Social Services/ National CDD Project

¹ Over the past decade one-third of CDD projects operated in Fragile and Conflict Situations (World Bank 2013).

4. The review found four critical factors for O&M success, and these areas serve as the analytical framework for this paper.

- i. **Organizational and institutional arrangements:** Comprising the organizational structure and roles and responsibilities for operating and maintaining the infrastructure at the community and local administration levels.
- ii. **Capacity building:** High-quality, timely training.
- iii. **Financing:** Revenue collection and cost-sharing mechanisms, and willingness and ability to pay.
- iv. **Technical considerations:** Design and technology choices, and complexity.

5. This note has classified rural infrastructure built under CDD and community-based projects into the broad categories of *public goods* and *toll goods* (commonly used to classify goods and services). Public goods include infrastructure such as roads, bridges, schools and health clinics, while toll goods include water supply, irrigation schemes, and electricity services. However, lines dividing these categories can be blurred, and the classification of a given good is not inherent to its nature, but rather depends on circumstances and agreed upon policies in-country.

6. Among the long list of over 50 projects reviewed (annex 1), 70 percent of projects' documentation referred to the status of subproject O&M, and the challenges or risks to these arrangements. While many projects reported that adequate O&M arrangements had been put in place (particularly in the water sector), several projects highlighted concerns regarding the sustainability of these arrangements. Moreover, all of the Implementation and Completion Results Reports (ICRs) for those completed projects reviewed showed the projects to have met or exceeded their target measure for O&M. However, ICR comments focused mainly around the long-term institutional and financial sustainability of O&M, highlighting the need for technical and financial support from central and local governments to help maintain infrastructure.

7. The review encountered some challenges in systematically identifying projects with potentially useful lessons. There are few detailed technical evaluations of O&M arrangements for CDD and/or rural infrastructure projects, therefore there is limited clear evidence regarding key factors that may have contributed to their success. The review was also constrained by the inability to conduct a field review of the projects and O&M systems, which would have allowed further data collection and, possibly, a deeper understanding of the factors that help or hinder good O&M.

Key Findings

8. **O&M arrangements appear to be most successful in single-sector projects (for example, rural roads or water supply),** where a relevant sectoral agency has specific responsibility for supporting O&M and where the projects tend to work to strengthen the O&M capacity of the sector. **Additionally, O&M efforts have been more successful for toll good investments,** such as water supply and irrigation, where communities and households will more readily pay for such services, and systems are well established to collect such payments. **Generally, O&M arrangements are more challenging for public goods, such as roads or**

bridges, where access and benefits are more difficult to control and collecting user fees is more challenging. The review also found that **rural communities more commonly carry out routine maintenance, which they contribute to either in-kind (through labor or materials) or in cash, versus periodic maintenance,** where costs tend to be higher and technical requirements greater.² Periodic maintenance generally requires technical and financial support from local government and traditional line ministries.

9. The review found that the following elements or arrangements contribute to a sustainable O&M system for various community-based investments:

- **Institutional arrangements:** Establishment of O&M committees at the beginning of the project, with O&M plans in place which clearly define the roles and responsibilities of the different stakeholders, include a schedule of routine maintenance activities, initial user tariffs, and collection mechanisms for at least the first few years after construction, as well as estimated O&M costs for the lifespan of the infrastructure. Establishment of formal links with local government authorities and line agencies should also be made, with their roles and contributions to O&M included in the plans, with the relevant government or agency representatives signing an agreement on completion of construction.
- **Capacity building:** O&M training, often provided exclusively to community groups, should be extended to other stakeholders, including local government authorities, and, where appropriate, small-scale contractors or private companies involved in the O&M. Distribution of simple pictorial manuals or guides to help communities in carrying out O&M activities has also been very useful. Finally, the frequency and timing of the capacity-building activities are important, and post-construction training and technical support to O&M groups should also be allocated for within the project budget. Capacity-building activities should include communication materials to inform communities on O&M issues and behaviors.
- **Financing:** Most projects are able to cover short-term financing needs for routine O&M; however, long-term financing for larger repairs appears to be a major challenge. O&M financing of water sector projects appears to be more successful because user fees are more easily collected to cover day-to-day O&M, compared to other public goods such as rural roads or bridges with nonexclusive benefits. Successful systems for longer-term O&M financing generally involve formal cost-sharing arrangements with local government units or line ministries.
- **Technical issues:** Evidence indicates that when designs are appropriate, including application of local technologies and use of local materials, materials are of required quality, and supervision is provided to ensure construction is according to specifications, community infrastructure tends to be in a better operational state.

10. Based on the desk review, this study presents six recommendations to support and improve CDD and community-based infrastructure O&M:

2 Routine maintenance covers activities conducted on a regular basis one or more times per year to keep the infrastructure in good working condition. Periodic maintenance covers activities needed once every few years that are more significant and technically complex and require specialized equipment and skills.

- i. CDD (and other rural infrastructure) investment projects should always include at least one O&M results indicator.
- ii. Explore the possibility of making second and subsequent block grant financing conditional on the set-up and operationalization of relevant O&M arrangements.
- iii. Analyze and include information on O&M costs and responsibilities in the community process of subproject prioritization.
- iv. Pilot and evaluate different ways for financing public infrastructure O&M (particularly for roads).
- v. Research the role that public-private partnerships (PPPs) can play in commercializing O&M efforts as an alternative to existing community-based mechanisms.
- vi. Given the lack of robust evidence of the end results of O&M arrangements, projects should conduct longitudinal technical and qualitative studies focusing on O&M arrangements and sustainability issues.



Section I: Introduction and Overview

1. Introduction

1.1 Background and Rationale

1. Community-driven development (CDD) is an approach that emphasizes community control over decision making and investment resources for local infrastructure and service delivery. CDD has been mainstreamed and scaled up across a range of sectors and contexts over the years and is often used to target the poorest regions and villages, mostly in rural areas. It has been particularly effective in increasing access to and use of infrastructure and services such as roads, water and sanitation, bridges, electricity, local schools and health clinics, among others (Wong 2012). Over the past 10 years, World Bank lending towards CDD projects averaged 5–10 percent of overall lending, and, as of March 2015, the active CDD portfolio consisted of more than 180 projects totaling US\$16 billion in over 75 countries, covering all regions.

2. Infrastructure O&M is critical to ensuring its continued effectiveness and productivity, and improper or inadequate maintenance arrangements can undermine the long-term utility of the investments and lead to more costly rehabilitation efforts. A report prepared under the World Economic Forum (WEF) Strategic Infrastructure Initiative indicates that current management of infrastructure assets is a cause for concern, and that publicly owned infrastructure assets have been managed sub optimally in both developed and developing countries, with O&M often the victim of pressured public budgets and political priorities (WEF 2014). The report cites the root causes of O&M underperformance as insufficient funding, inadequate capacity, and inappropriate governance structures. The 2005 Operations Evaluation Department (OED) review of the Bank's CDD and Social Fund portfolio found that, although community members were aware of the importance of maintenance, and a significant number of them had been trained, the lack of available resources on a continuous basis to fund O&M was a significant constraint (World Bank

2005). Similarly, inadequate infrastructure maintenance has been raised as an issue in both the rural roads and water sectors.³

3. Given these findings, and the breadth and scale of CDD operations worldwide, O&M has emerged as an area of interest to the CDD Community of Practice (COP) and among other teams working on rural or community infrastructure projects. Specifically, teams have expressed interest in better understanding the factors that contribute to effective O&M systems and in identifying good practices.

1.2 Objectives, Scope, and Audience

4. The objective is to review the O&M experiences of CDD and other community-based infrastructure projects to document cases of good practice and, ultimately, to improve O&M arrangements on similar Bank-supported projects. In addition, relevant supporting materials, where available, are included to enable projects to learn from each other.

5. This study covers CDD projects supporting small-scale rural infrastructure and other sector-specific community-based operations, such as rural roads, water and sanitation projects, and others. The study team reviewed documentation from over 50 World Bank projects (annex 1), of which a significant majority included references to O&M. Over 80 percent of the project appraisal documents (PADs) discussed arrangements for O&M within the subprojects to be financed, and almost half included an O&M indicator in the results framework.

6. This review aims to inform Bank staff and task teams supporting the design and implementation of CDD or community-based projects, government agencies implementing these projects, and broader CDD COP members, who may have questions on how best to design O&M systems within their projects.

1.3 Methodology and Analytical Framework

7. The main cases used for this review were identified by the CDD COP and staff from the water and sanitation, social protection, and transport sectors. The study team analyzed the operational documents related to these projects (PADs, aide memoires, technical audits, and others) to identify projects with clear evidence on or indications of successful O&M arrangements.⁴ The selected cases were then analyzed through review of operational manuals and guidelines and interviews with Bank task team members and government counterparts. Table 1 highlights the main case studies analyzed. This paper also draws on lessons from some of the other projects reviewed, as well as from World Bank technical papers and external O&M literature related to rural infrastructure in various sectors (transport, water supply and sanitation, buildings, and others).

3 Donges, Edmonds, and Johannesson (2007) note that rural road deterioration due to a lack of maintenance has become a growing issue in a number of developing countries, but the extent of the problem is not fully appreciated and the solutions are still not commonly understood. Also, Brikké and Bredero (2003) discuss the importance of O&M for water supply and sanitation technologies, noting that in many developing countries, O&M of small community water supply and sanitation systems has been neglected.

4 Evidence of successful O&M arrangements include satisfactory to good ratings of infrastructure maintenance in ICRs and technical studies, or other evaluations covering O&M and infrastructure sustainability.

Country	Project name (time frame)	Types of infrastructure
Afghanistan	National Solidarity Program (NSP; 2003 to present)	Roads, water supply and sanitation, irrigation, power, community centers, schools, health clinics, and livelihoods
Azerbaijan	Rural Investment Projects 1 and 2 (AzRIP; 2004 to present)	Roads, potable water, electricity, irrigation, drainage, health clinics, and schools
India	Punjab Rural Water Supply and Sanitation Project (PRWSS; 2006 to present)	Water supply systems and sanitation units
Indonesia	National Program for Community Empowerment (PNPM) Rural Program (2007 to present)	Roads, irrigation, drainage, water supply, health clinics, school buildings, sanitary facilities, jetties, electricity
Nepal	Rural Water Supply and Sanitation Projects (1996–2012)	Water supply systems, water points, and sanitation units
Peru	Rural Roads Projects (1995–2013)	Roads and nonmotorized tracks
Philippines	KALAH! Comprehensive and Integrated Delivery of Social Services/National Community Driven Development Project (KALAH!-CIDSS/NCDPP; 2002 to present)	Roads, bridges, schools, health systems, water supply systems, and mills

8. *Analytical framework.* This review found four key areas critical for O&M success. These four areas serve as the analytical framework for this paper.

- **Organizational and institutional arrangements:** The organizational structure and roles and responsibilities for operating and maintaining the infrastructure at the community and local administration levels.
- **Capacity building:** Quality and continuity of training.
- **Financing:** Revenue collection and cost-sharing mechanisms, and willingness and ability to pay.
- **Technical considerations:** Design and technology choices, and their complexity.

9. *Classification of infrastructure.* In analyzing O&M, the study found a general distinction in arrangements based on the type of infrastructure investment, broadly classified as follows:⁵

- **Public goods** are *nonrivalrous* (that is, when the good is consumed, it does not reduce the amount available for others) and *nonexcludable* (that is, people cannot be excluded from the benefits even if they do not pay, which can sometimes lead to a free-rider problem).
- **Private goods** are *rivalrous* (that is, when the good is consumed, it reduces the availability to another person) and *excludable* (nonpayers cannot access the good).
- **Toll goods** (or club or marketable public goods) are *nonrivalrous*, but *excludable*.
- **Common goods** are *rivalrous*, but *nonexcludable*, meaning that the supply can be depleted, but people are not restricted in their use (for example, natural resources, fish in the open sea).

5 Penn State University, <https://www.e-education.psu.edu/geog432/node/277>.

10. Rural infrastructure built under CDD and community-based projects generally fall under the category of public or toll goods. However, distinctions between these categories of goods can be blurred, and the classification of a given good is not inherent to its nature, but rather depends on circumstances and agreed upon policies in-country. For instance, roads and schools, generally considered public goods, can have tolls and fees that restrict access.⁶ Potable water infrastructure can be delivered through different systems (for example, wells, public taps or watering points, individual connections, and so forth) that could be classified as a public, toll, or common good, depending on the nature of the source and how easy it is to restrict access.

11. With the above discussion in mind, this paper proposes to classify and make reference to the various types of rural infrastructure as: (i) **public goods**—rural roads and bridges, schools, and health centers; and (ii) **toll goods**—water supply, irrigation, and electricity.

12. *Review limitations.* The review found that very few projects have conducted technical infrastructure audits or evaluations, especially years after infrastructure completion. Since most projects close after about six years of implementation, it can be difficult to assess the impact and performance of O&M measures: infrastructure that has been newly completed is unlikely to show deficiencies of poor or inadequate maintenance. Therefore, evidence on the state of maintenance of CDD-financed and community-based local infrastructure has been limited. While the Implementation Completion and Results Reports (ICRs) for several projects indicate O&M systems are satisfactorily in place, there was limited supporting documentation or evidence on the long-term success of these arrangements because there have been few post-ICR reviews. Therefore, this review broadened its initial basis for analysis from projects with documented evidence of O&M success to include examples of O&M arrangements that appear to be successful based on a more ad hoc or less robust qualitative assessment. Additionally, since the list of projects compiled for review was based mainly on the responses received from the CDD COP and sector staff, it is possible that there are other relevant projects with good O&M systems that were not identified. Finally, the scope of the study precluded field research that could have helped validate findings and provide further insights.

1.4 Organization of Paper

13. This paper is organized into three main sections. Section I presents the background, objectives, scope, and limitations of the study. It also provides a general definition of O&M and presents prototypical O&M arrangements for rural CDD and community-based subprojects. Section II presents the detailed case studies for the seven selected projects. Section III summarizes the conclusions from the review and recommends steps for moving ahead. Five annexes provide extra background information, including the complete list of projects from which the seven main case studies were selected, as well as: examples of maintenance requirements for rural infrastructure; considerations for task teams planning for O&M design and implementation; sample O&M measures and timelines; and links to O&M materials.

⁶ Therefore, such fees are generally not recommended, particularly in poor rural areas, where CDD operations are most common.

2. Defining Operations & Maintenance

14. The definition of O&M varies depending on the system or type of infrastructure. Some infrastructure types are more operations intensive, while others are more concentrated on maintenance. However, a general definition customized for community infrastructure and applied for this analysis is outlined here.⁷

- **Operations** deal with the actual daily running of a system or service and include the work and the operating costs (for example, rents, staffing, required materials or inputs, utilities, and others). In the case of water supply subprojects, this could include fees for technical service or for collecting user fees, fuel or electricity costs for pumps, water treatment chemicals, and so forth. Infrastructure investments such as schools or health clinics generally have significantly higher operating costs due to specialized staff (teachers, midwives), supplies (books, medicines, and so forth), and other usual costs (electricity, water, and so forth). However, these costs are generally assumed to be covered by relevant sectoral ministries or local government authorities, and most CDD projects require specific commitments from the responsible government agency as a precondition of financing. **Therefore, for the purposes of this analysis, these types of specialized inputs and resources required for day-to-day operations and to ensure the delivery of the relevant health or education services are not considered part of the O&M arrangements of these investments.**
- **Maintenance** deals with the activities necessary to keep the system or infrastructure in optimum working condition and to prevent delays, repairs, and/or downtime. There are three types of maintenance:
 - **Preventive or routine maintenance**⁸ is usually required on a regular basis, one or more times a year, to maintain and keep the infrastructure in good working condition. If performed correctly and regularly, routine maintenance can reduce the need for periodic maintenance and rehabilitation, and sustain the life of the infrastructure.
 - **Periodic maintenance** covers more significant activities that are carried out once every few years to ensure the smooth operation of the infrastructure, although the timing intervals can vary depending on the type of infrastructure. Periodic maintenance is generally more complex technically, can require specialized equipment and skills, is more costly, and communities generally need support from private contractors, the local government unit, or relevant government agency.
 - **Emergency maintenance** involves urgently needed, and generally significant, repairs in response to disastrous events such as floods, earthquakes, typhoons, or conflict. This type of maintenance is not considered in this note.

15. Annex 2 lists typical routine and periodic maintenance activities for various kinds of infrastructure.

⁷ Adapted from several sources, including Brikké (2000), Birmingham and Stankevich (2005), and the Best Practice O&M Program (<http://betterbricks.com/articles/best-practice-om>).

⁸ The expression "preventive maintenance" is more commonly used in the water sector, while "routine maintenance" is common in the road sector.

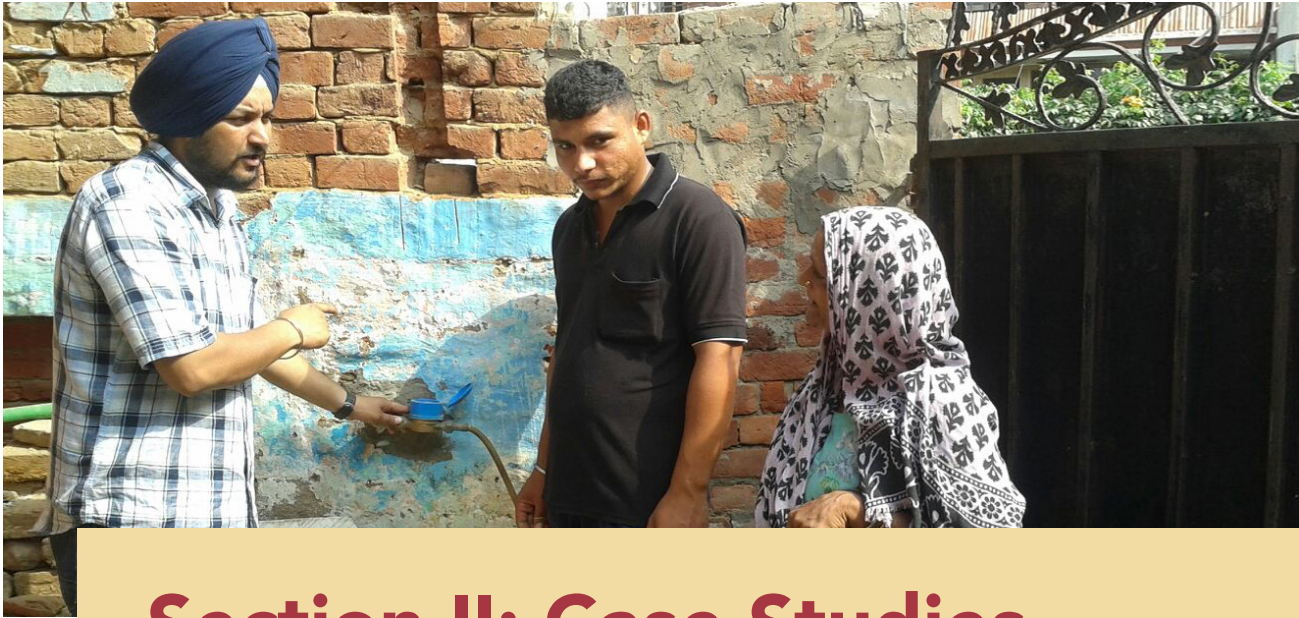
3. Standard Elements of an O&M System for Rural CDD and Community-Based Projects

16. As part of a typical CDD project, and subproject design and implementation, communities are generally required to prepare an **O&M plan** as part of their proposal submission that specifies the maintenance actions required; identifies the individuals, groups, or institutions responsible; and outlines the costs and financing arrangements. O&M plans are generally updated and finalized on completion of the subproject and formally agreed upon so that all parties bear responsibility for their maintenance obligations.

17. **O&M committees** are typically established at the community level and trained by the project. These committees are usually volunteers selected from the community and are established prior to or during the construction phase, and are responsible for O&M-related arrangements after infrastructure completion. Depending on the type of infrastructure, these committees take the form of community groups, user associations, parent-teacher associations, and so forth. O&M committees can be informal or legally registered, depending on local laws. The O&M committee is normally responsible for collecting community contributions, or user fees, based on the agreement in the maintenance plan, and organizing and overseeing routine maintenance of the infrastructure. Periodic maintenance can be handled by the community through local contractors, procured by the committee, or with assistance from the local government, municipality, or relevant agency if more substantial repairs are needed.

18. Communities will generally establish an **O&M fund** that is financed through fees collected from households based on fee structures established in the project's maintenance plan, or through periodic assessment. These fees usually go toward routine maintenance (generally smaller, simpler, and less expensive) overseen at the community level, but sometimes toward periodic maintenance (larger, more complex, and costly) as well.

19. Financing for **operating costs** varies by type of infrastructure. Operating costs for health clinics and schools, which require a steady stream of specialized inputs to operate (for example, nurses, doctors, teachers, supplies, and equipment) are normally covered by the relevant local government unit or line ministry, although community members may pay small fees for accessing these services. Other public goods infrastructure (such as roads) may have little or no operating costs, while the operating costs for toll goods are generally recovered through user fees. The type of infrastructure selected, therefore, has implications for how O&M is organized and financed.



Section II: Case Studies

1. Afghanistan National Solidarity Program
2. Azerbaijan Rural Investment Projects
3. India Punjab Rural Water Supply and Sanitation Project
4. Indonesia National Program for Community Empowerment in Rural Areas
5. Nepal First and Second Rural Water Supply & Sanitation Projects
6. Peru Rural Roads Projects
7. Philippines KALAHI Comprehensive and Integrated Delivery of Social Services (KALAHI-CIDSS)/National Community Driven Development Project

Afghanistan First, Second and Third National Solidarity Program (NSP 1, 2, and 3)

Project IDs: P084329, P102288, P117103

Program Period: 2003–Ongoing

Project Description Summary

The National Solidarity Program (NSP) uses a typical CDD approach, within a challenging and volatile environment, to improve the access of rural communities to social and productive infrastructure and services and to strengthen locally elected community development councils (CDCs) to be effective institutions for local governance and socioeconomic development. Begun in 2003 and currently in its third phase (US\$990 million), the program has financed a typical set of CDD subprojects in over 30,600 communities in transport, water supply and sanitation, irrigation and power, along with community centers, schools, health, and livelihoods. The project is currently developing a transition and sustainability plan as NSP-3 comes to a close in September 2015.

Institutional, Implementation, and O&M Arrangements

The Ministry of Rural Rehabilitation and Development implemented this project through national and provincial management units. At the provincial level, project implementation is supported by Facilitating Partners⁹ who mobilize communities at the village level to form CDCs,¹⁰ which are the units primarily responsible for the planning and execution of the subprojects, including O&M after subproject completion. Subproject funds are transferred to CDC accounts maintained in provincial bank branches. The Facilitating Partners support the community in preparing an O&M and cost-recovery plan and help with the selection and training of an O&M committee (prior to proposal completion), which is expected to ensure that subprojects are properly maintained after completion of the infrastructure.

There are three designated methods for collecting O&M funds (any one or more of which can be used by a village):¹¹

- **User fees.** Community members pay for a service (such as the provision of electricity or water). Fees are not set in advance and are only collected from community members who can afford to pay (as determined by the CDCs).
- **Regular collection.** Community members contribute money regularly to a collection box for routine or periodic maintenance (or in the event of an unforeseen subproject breakdown caused by the failure of a key component or a natural disaster such as flooding).
- **Spontaneous.** Community members contribute additional funds when a project breaks down or loses functionality (where no money is set aside in the collections box or if additional money must be raised following project breakdown or a natural disaster).

9 The facilitating partners (international and national NGOs and private firms) have established staff capacities at the regional and district levels that include a trained network of social organizers, engineers, trainers, monitors, and provincial coordinators.

10 The CDC is a community-based decision making body that includes a chairperson, vice-chairperson, secretary, and treasurer. A project management committee and a procurement committee are also often established to support the CDC. CDCs were initially elected through a show of hands, but are now designed to be elected through a universal suffrage secret ballot election and to include women as part of the community representatives.

11 However, less than one-third of the villages sampled in the sustainability evaluation collect fees, with most donating materials and labor toward O&M.

Evidence and Elements of Successful O&M

Evidence of Success

- A subproject sustainability study (2013) was conducted to assess the condition of assets built under NSP 1 and 2, as well as the maintenance activities performed, and to understand the variables that influenced the condition of the subprojects. The study looked at a sample of 100 subprojects (out of more than 55,000 completed through 2013) implemented over the previous six years in mostly secure areas. The study found that 79 percent of the infrastructure was functional—22 percent in good condition and 57 percent in poor condition¹² due to both lack of O&M and poor quality of construction and materials. Communities were performing adequate or some maintenance on 58 percent of all infrastructure requiring maintenance. Less technically complex subprojects (such as canals and irrigation systems) tended to be better maintained than more complex subprojects, such as roads and water supply systems, which were in poorer condition.¹³
- Subprojects implemented under NSP-2 were better maintained than those under NSP-1, probably due to increased focus on planning, organizing, and mobilizing maintenance at the community level.

Elements of Success

- The project's results framework has an indicator monitoring the number of completed subprojects that have O&M plans in place, and the number of subprojects that are functional and used by communities a year after completion.
- A realistic and technically viable O&M plan (including cost recovery, where required), prepared by CDCs with support from Facilitating Partners, is needed for subproject approval. The O&M committee also needs to be selected and trained before the subproject proposal is finalized.
- The project creates awareness of the need for O&M through several channels including videos on O&M issues that are shown by mobile cinemas in the villages and also aired on local TV stations; radio features; and regular national conferences that enable CDCs to share their experiences and learn from each other.
- Increased focus on technical training for Facilitating Partners and engineering staff and simplification of O&M manuals.
- Second-block grants (which began in NSP-3) are made only to communities that are successfully maintaining completed infrastructure from their earlier grants.

Helpful Links

- [NSP Web site](#)
- [NSP Impact Evaluation Results](#)
- [NSP Operations Manual](#)
- [O&M Water Supply TORs](#)
- [O&M Plans for MHP](#)

12 “Functional and in good condition” indicates that all key components are properly maintained. “Functional and in poor condition” indicates that at least one key component was not properly maintained.

13 The NSP impact evaluation (March 2013) found that the project improved access to clean drinking water and increased the use of electricity, but that irrigation and transportation subprojects were less successful, indicating that there appeared to be no link between effectiveness of subprojects and sustainability, at least as measured by quality of infrastructure several years after subproject completion.

Azerbaijan First and Second Rural Investment Projects (AzRIP1 and 2)

Project IDs: P076234, P122944

Project Period: 2004–Ongoing

Project Description Summary

AzRIP is employing a CDD approach to improve the living standards of rural communities and increase their access to infrastructure services. With AzRIP-2 (US\$80 million including US\$50 million in additional financing), the project is expected to reach over 1,800 communities in 58 rayons across the country. In addition to financing a typical range of CDD subprojects, including roads, potable water, electricity, irrigation, health clinics, schools, and drainage, AzRIP-2 is scaling up livelihood activities and launching a pilot connector roads initiative, engaging with clusters of communities and improving rural road connectivity.

Institutional, Implementation, and O&M Arrangements

The project is implemented by the State Agency for Agricultural Credits in the Ministry of Agriculture, which works through national and regional-level structures (Project Assistance Teams [PATs])¹⁴ for program management and implementation. The program is supported by regional and local government—municipal, regional, and local executive committees (which represent the various ministries and line agencies of government). PATs act as service providers, working closely with communities throughout the subproject cycle.

Community groups (including the community engineer), facilitated by PATs and in partnership with technical design companies,¹⁵ prepare maintenance plans and a cost-sharing formula for maintenance of assets in conjunction with municipalities and service providers.¹⁶ Plans for capital reinvestment and medium- and longer-term maintenance are included in subproject design and updated on completion of the subproject. The O&M committee or user association (selected at the start of the project and overseen by the community group) is responsible for handling O&M and collecting fees after completion of construction. Fee collection varies by type of subproject and by village, and the amount is based on the fee structure outlined in the maintenance plan. For example, some villages collect user fees for water projects monthly, while others do so annually. Fees for other types of subprojects (such as roads) are usually collected on an as-needed basis.

14 PATs consist of regional-level teams of consultant trainers, mobilizers and an engineer, and support several communities within the region.

15 Technical design companies are hired by the project management unit. The project paid a fixed rate of US\$3,600 to the design communities, plus an 18 percent value-added tax. The average subproject grant was US\$55,000.

16 Some communities set up a maintenance contribution fee structure based on usage (for example, households contribute to the potable water supply system depending on the number of family members). Similarly, in the case of roads, owners of heavy vehicles (for example, trucks and tractors) are expected to contribute more than owners of light vehicles and those who do not own a vehicle. This arrangement ensures that community members' maintenance contributions reflect the extent to which they contribute to causing damage to the roads.

Evidence and Elements of Successful O&M

Evidence of Success

- According to the ICR for AzRIP-1, over 90 percent of its subprojects are still operational, and some communities have engaged private contractors to oversee repairs and maintenance (ICR 2012).
- A technical assessment of AzRIP-1 (2010) found 65 percent of the infrastructure to be in good or excellent physical condition, and 35 percent in satisfactory condition (although the latter were considered borderline and could become unsatisfactory in time if neglected (Western World Consultants 2010).

Elements of Success

- Before implementation can begin, the approval of a cooperation agreement by the community, municipality, and project management unit (PMU) is required to confirm that the O&M plan is feasible and that the communities and relevant agencies will fulfill their maintenance obligations.
- The project hires technical design firms to help communities more effectively select projects. These firms identify alternative technical solutions (for example, gravel rather than paved roads) for each of the top three priorities and inform communities of associated lifecycle costs, including investment costs, future maintenance costs, and number of beneficiaries. The firms also help the communities prepare implementation, monitoring, and maintenance plans.¹⁷
- Local governments and regional representatives of relevant ministries or agencies are involved throughout the subproject cycle. Relevant agencies have to sign off when the subproject is approved and confirm their responsibilities and their share of the maintenance costs (as do the communities) when the subproject is completed and handed over to the community.
- In addition to training the community groups and project engineers, the project also provides technical workshops to strengthen the technical capacity of the design firms.
- There is a strong focus on learning. The project includes a community networking strategy—a peer-to-peer learning initiative—that supports the sharing and dissemination of best practices and lessons learned (including on O&M) and facilitates integration, business relations formation, and cross-fertilization throughout AzRIP communities.
- The PMU visits a sample of the projects after subproject completion (20 percent after one year and 10 percent after two years) to evaluate whether maintenance operations are ongoing. Results are tracked through an indicator in the results framework.

Helpful Links

- AzRIP Web site
- Operational Manual
- AzRIP O&M plans
- Technical Design Firm TORs
- Handover Agreement, Annex 23 of OM
- O&M Flyer

¹⁷ Approximately 10 percent of the communities discarded their initial first choice based on input from the design teams and identified other technical solutions that balanced investment costs and benefits with future maintenance outlays.

India Punjab Rural Water Supply and Sanitation Project

Project ID: P090592

Project Period: 2006–Ongoing

Project Description Summary

The Punjab Rural Water Supply and Sanitation (PRWSS, US\$104 million) Project began implementation in December 2006 to assist government efforts to scale up a nationwide RWSS reform approach by developing statewide projects. The PRWSS Project uses a demand-driven approach under which rural water supply and sanitation schemes are constructed, operated and maintained by communities, and private connections and the use of water meters are encouraged. Project sustainability will be based on its ability to generate adequate cash flows for future maintenance and repairs from the villagers who are involved in the water supply and sanitation functions.

Institutional, Implementation, and O&M Arrangements

The project is implemented by the Punjab Department of Water Supply and Sanitation (DWSS), which works closely with and provides technical support to the village-level gram panchayats (GPs)¹⁸ who are responsible for seeking project assistance from the DWSS. The GPs set up village water and sanitation committees (GPWSCs)¹⁹ composed of elected and nonelected members who represent the user communities and are responsible for project implementation and O&M management (including working out the water tariffs needed to fully cover the system's O&M costs). The capital expenditure funds for the schemes directly flow to the GPs. During the post-implementation phase, the GPs are responsible for monitoring the sustainability of operations and ensuring that the GPWSCs conduct their O&M management functions (including levying and collecting sufficient user charges).²⁰ The GPWSCs are responsible for management of investment and O&M funds for all types of village schemes.

Evidence and Elements of Successful O&M

Evidence of Success

- O&M is satisfactory in most villages managed by communities (ISR, April 2014). Sixty-four percent of participating water and sanitation committees are meeting full O&M costs through user charges, and 73 percent have a medium or high rating for operational sustainability of their schemes.²¹
- About 90 percent of consumers are paying their water bills regularly, and some villages now have a sizable savings in their O&M accounts, which are being reinvested in existing water systems.

18 The gram panchayat (GP) is a local self-government institution at the village or small town level in India and consists of elected members.

19 The GPWSC is a subcommittee under the GP and consists of both elected and nonelected members. The elected head of the GP is the Chairperson of the GPWSC, which has 11–21 members, with maximum of four elected representatives. The nonelected members are from the general village (*gram sabha*). The details of GPWSC's composition, functions, and powers are elaborated in the project implementation plan.

20 Water tariffs are devised to cover the system's O&M costs in full (including salaries of the operator and cashier, electricity charges for pumping water, minor repairs, and routine maintenance). Meters are read monthly by the pump operator (and the cashier) in the presence of the consumer and a household's monthly water bill averages between Rs. 70–120 (approximately US\$1–US\$2).

21 Based on annual sustainability surveys conducted by the project.

Elements of Success

- On completion of construction, all subprojects are required to have a finalized O&M plan that addresses technical, institutional and financial issues; an O&M budget that identifies specific tariffs and tariff collection procedures; O&M back-up support for the user communities; and various capacity-building activities.²²
- The project's results framework includes two indicators: the first tracks the percentage of participating GPWSCs rated high or medium for scheme operational sustainability, and the second tracks the percentage of participating GPWSCs meeting full O&M costs through user charges.
- The promotion of private service connections contributes to the project's financial sustainability. As part of the pipe-laying process during construction of the subproject, the district and water committees lay the groundwork for providing individual household connections to avoid re-excavation of village roads when private connections are requested. When a completed water scheme is taken over and operated and maintained by the concerned water committee, it generally takes about six months to achieve financial sustainability based on regular collection of user fees.
- Metering and billing are used to encourage people to save water and to more equitably allocate costs with consumption.²³ As of April 2014, over 300 villages (8 percent) had individual connections for all households, while in 554 villages (61 percent) at least 70 percent of households had individual connections.
- The project has a complaints redress system for village water supply schemes monitored by a private agency, which includes a 24-hour toll-free number that users can call, and an online complaints submission and tracking mechanism. The system helps check on the performance of staff working in remote villages, improves the quality and speed of the service delivered, and makes management of the water supply more transparent and accountable.
- The project emphasizes the importance of training and information campaigns. Behavior change communication materials have been developed to initiate dialogue on the need for and advantages of safe drinking water in the village, as well as to explain the long-term community commitment required to sustainably run the water systems. Post-implementation O&M training is also conducted for GPWSCs, along with workshops on improving sustainability for villages with underperforming schemes (focused on how to deal with technical, financial, and O&M issues).

Helpful Links

- [Punjab RWSS Web site](#)
- [Project Technical Manual](#)
- [Complaints Redress System](#)
- [Punjab RWSS O&M Cost Estimates](#)
- [O&M Training Outline](#)

22 The capacity building of the GP and village water and sanitation committees are in technology selection, construction and operation of schemes, and management of investment and O&M funds, including back-up support during the post-construction period.

23 The metered connections have benefitted the poor and made water more affordable, since they generally consume less water than more prosperous households. Under the normal flat rate, everyone paid the same regardless of how much water they consumed.

Indonesia National Program for Community Empowerment in Rural Areas (PNPM Rural)

Project IDs: P105002, P108757, P115052, P122810, P128832 **Program Period:** 2007 – Ongoing

Project Description Summary

The PNPM national program builds on 10 years of successful CDD experience in the Kecamatan Development Program, which began implementation in 1998. The PNPM Rural Program was established in 2007 and is a core component of PNPM Mandiri, the government of Indonesia's main program for community-based poverty alleviation efforts. PNPM Mandiri covers all rural villages (through PNPM Rural, which is in its fifth phase, totaling US\$2.5 billion to date) and urban wards (through PNPM Urban) in Indonesia, and is one of the largest CDD programs in the world. The project finances typical CDD social and economic subproject investments including roads, water supply, irrigation and drainage systems, schools, health clinics, and others.

Institutional, Implementation, and O&M Arrangements

PNPM Rural is implemented across five levels: national, provincial, district, subdistrict, and village. The Directorate General for Community and Village Empowerment (PMD) is responsible for program execution under the Ministry of Home Affairs. PMD is supported through the deployment of a combination of national and regional management consultants and field-based facilitators who work with the village teams. Project funds are transferred directly to a collective village account at the subdistrict level and then released for implementation of the approved subprojects. Village assemblies choose several village teams (including a maintenance team) that are trained to support subproject proposal preparation, implementation, and O&M. Several villagers are also selected and trained to form an empowerment or technical cadre. Maintenance teams are responsible for collecting maintenance fees, inspecting the infrastructure periodically (with assistance of technical staff), and assigning community members to conduct the required maintenance.²⁴

Evidence and Elements of Successful O&M

Evidence of Success

- A PNPM Mandiri Rural Infrastructure Technical Report Evaluation (2012) looked at a sample of subprojects completed between 2007 and 2011 (40 percent consisting of roads) and found that 96 percent of the infrastructure was of acceptable (14 percent) or high quality (82 percent). Additionally, 90 percent of the subprojects inspected were still functioning as intended and were being used by beneficiaries two to five years after completion. However, the study did find that a significant number of the subprojects (particularly roads, but also public buildings and water supply facilities) were adversely affected by poor drainage, which arose from poorly planned or implemented drainage infrastructure and not necessarily from poor maintenance.

²⁴ The time frame for collecting maintenance fees is agreed upon by each village. Maintenance fees are usually collected monthly for toll goods infrastructure such as water supply, markets, and electricity. Fees for irrigation services are collected at harvest time, two or three times a year, and as needed for public goods such as roads, bridges, and drainage canals. However, the cost of maintaining infrastructure is estimated at approximately 2.8 percent of a household's total consumption, and a November 2010 World Bank study, *Village Capacity in Maintaining Infrastructure Study: Evidence from Rural Indonesia*, found limited financial capacity at the village level for road maintenance.

Elements of Success

- The project's results framework tracks two O&M indicators: the percentage of infrastructure works of high quality, and the percentage of villages with O&M committees and O&M arrangements in place and functioning, which leads to greater focus on O&M.
- The project emphasizes capacity building for village O&M teams and has prepared three volumes of simple picture books on infrastructure O&M. These volumes cover the maintenance of roads and bridges, water supply and sanitation and other infrastructure works; emphasize the importance of O&M activities; and outline what is needed for maintenance, including the roles and responsibilities of key groups. Pictures showing examples of "good" and "bad" infrastructure identify the problems in the latter case and show how to make repairs.
- Based on past experience, the project has made concerted efforts over the years to improve design quality and construction by using technical facilitators at the district and subdistrict levels (in addition to social facilitators) to support villages during the design, preparation, implementation, and maintenance stages.²⁵ Given the nationwide scale of the program, quality engineering support is still an issue in some areas; however, innovative methods are being tested in some of the poorer provinces—such as the Barefoot Engineers program in Papua, which trains local high school graduates to become technical engineers, thus creating a local source of technical expertise that may be more likely to remain in place in a competitive job market.
- Additionally, recognizing the important role that facilitators play in ensuring program procedures are applied throughout subproject planning and implementation, a facilitator certification program was developed in 2013. All facilitators (including technical facilitators) are required to undergo three weeks of preservice training and twice a year attend week-long refresher training.

Helpful Links

- [PNPM Project Web site](#)
- [PNPM Operations Manual](#)
- [The Good and Bad: O&M of Infrastructure](#)

²⁵ At the district level, there are three senior facilitators, an engineer, a social facilitator, and a finance facilitator. At the subdistrict level (which average about 14 villages), there is a social facilitator, a technical facilitator, and, where necessary, an assistant facilitator to support communities on project implementation.

Nepal First and Second Rural Water Supply & Sanitation Projects (RWSSP I & II)

Project ID: P010516 and P071285

Project Period: 1996–2012

Project Description Summary

The two phases of the Nepal Rural Water Supply and Sanitation Projects (totaling US\$42.6 million) used a demand-driven approach to provide rural water supply and sanitation services to communities, who were involved in all stages of planning, implementation, operation, maintenance, and monitoring and evaluation of the schemes, which included different types of WSS schemes, water points, and sanitation units.

Institutional, Implementation, and O&M Arrangements

The projects were implemented at the national level by the Rural Water Supply and Sanitation Fund Development Board (the Fund Board),²⁶ which was responsible for overall oversight, including policy implementation and project monitoring and implementation. At the local level, district and village development committees (DDCs and VDCs) were involved in the formation and registration of the user groups, the opening of user group bank accounts, and the resolution of community disputes. At the village level, the main implementing actors were water and sanitation user groups and their respective user committees (WSUCs),²⁷ which were assisted by support organizations, generally national or international NGOs or private local firms.²⁸ The support organizations provided assistance on all aspects of the project, including technical design appraisal, O&M, and periodic post-implementation support. WSUCs collected O&M funds up front for the first year, followed by collection of monthly water tariffs from all users thereafter.²⁹

Evidence and Elements of Successful O&M

Evidence of Success

- The project undertook several short- and long-term sustainability studies after three and five years of completion of the different WSS schemes, which were implemented in batches (or groups) of villages. Results from long-term sustainability studies of schemes from batches I and II (6–10 years after completion) showed that 92 percent of the schemes were in good condition, with 78 percent assessed as fully sustainable.³⁰ Infrastructure rated

26 The Fund Board was established by the government of Nepal based on the experience of “JAKPAS,” a successful pilot project implemented in Nepal during 1993–96.

27 The WSS user group is a legally registered body consisting of representatives of every household in the scheme area. The user group elects a WSS user committee (representing the community) to implement, operate, and maintain the RWSS facilities, including collection of up-front contributions and O&M funds.

28 Support organizations are legally registered national or international NGOs or private sector firms selected to assist the user group and provide assistance on technical, financial, and social aspects of the project, including appraisal of technical design, O&M, and periodic support during the post-implementation phase.

29 Household tariffs range from NPR 5 to 50 per month. Since most of the schemes are gravity schemes, the O&M costs are affordable for most households (ICR 2004).

30 Using four major indicators related to sustainability (that is, institutional, social/environmental, financial and technical). Each indicator is broken down into a number of subindicators (for example, existence of user committees, level of participation, size of O&M funds, status of infrastructure, and others).

unsustainable included those damaged from floods, landslides, or water depletion. Design and construction quality overall were rated very high (over 95 percent).

- Technical quality results (based on infrastructure condition and functionality) from the batch II long-term sustainability study showed 22 percent of the schemes in excellent condition, with 72 percent in fair to good condition. Results from batch V showed that 50 percent of the schemes are functioning well, with 48 percent needing minor repairs.

Elements of Success

- The project's results framework tracked several indicators showing that O&M was being adequately performed (for example, number of schemes functioning satisfactorily with community O&M and the percentage of user committees reporting on post-implementation status including repairs, fund collection, and frequency of meetings).
- District and village committees are fully involved in the planning and implementation of the water schemes and, along with the user group and service provider, were required to sign an agreement prior to scheme implementation indicating their commitment to fulfilling their roles and responsibilities. The water schemes are also included in district plans, with relevant authorities responsible for major rehabilitation or repair works that are beyond the capacity of the community.
- Prior to the start of subproject implementation, the water user groups collected O&M funds upfront from community members (3–4 percent of total scheme cost). These funds were used to perform minor repairs as needed for the first year, after which monthly user fees were collected.
- All water schemes hired a local village maintenance worker, who was trained and paid by the user group. This aspect of the project was seen as one of the key factors contributing to a high percentage of schemes' functionality and sustainability.
- The user groups were also supported by Mother and Child Tap Stand Groups. These groups were responsible for daily cleaning and maintenance of the tap stands and for helping to collect user fees, another element that helped improve overall sustainability.
- To enhance long-term sustainability, RWSSP II provided post-implementation support, under which the supporting organizations continued to provide refresher training and technical support to the user committees for scheme-level problems that the community was unable to resolve.
- Finally, the project piloted an insurance program in 36 schemes. The insurance program was designed to help communities mitigate risks from natural disasters (for example, earthquake, floods and landslides).³¹ While no claims have yet been made, this approach is promising and there are plans to scale it up.

Helpful Links

- Nepal RWSS Web site
- Nepal RWSS O&M Section of Operations Manual
- Nepal RWSS Step-by-Step Manual
- Roles and Responsibilities of O&M Stakeholders
- Nepal RWSS Post Construction Guidelines

31 Based on these schemes, the financial burden of the insurance premium borne by the community was estimated to be less than NPR 4 per month for each household (US\$0.05), which is less than the price of a cup of tea.

Peru First and Second Rural Roads Projects and Decentralized Rural Transport Project (Rural Roads Program)

Project ID: P037047, P044601, P095570

Program/Project Period: 1995–2013

Project Description Summary

The Peru Rural Roads Program (through three phases, totaling US\$185 million) was a countrywide program focused on upgrading the condition of the rural road network (including nonmotorized tracks) through the rehabilitation of existing infrastructure and establishment of decentralized mechanisms to sustainably maintain the infrastructure. Subproject selection was conducted through a participatory planning process involving poor rural communities and other local stakeholders to identify and prioritize rural infrastructure needs.

Institutional, Implementation, and O&M Arrangements

Institutional arrangements evolved over the three phases of the project as a result of the decentralization process adopted by the government. During the first two phases, responsibility for project implementation was with a central agency unit (*Provias Descentralizado*) within the Ministry of Transport and Communication (MTC). Toward the end of the second phase, responsibility was transferred to the municipalities at the provincial level through the creation of decentralized Provincial Road Institutes (PRIs).³² During the third phase of the project, the central agency unit was responsible for overseeing project implementation, channeling resources to local governments, and providing management and technical assistance to the PRIs. Rehabilitation of rural roads was contracted out by the PRI to private contractors, while subsequent routine maintenance was contracted out to microenterprises formed under the program, supplemented as needed by periodic maintenance contracted out to private companies. Finally, the improvement of nonmotorized transport tracks in the most isolated and poorest communities was handled by locally formed road committees, with technical and organizational support from local NGOs and district authorities.

Evidence and Elements of Successful O&M

Evidence of Success

- The third phase of the project was rated as highly satisfactory in achieving its development objective of “reduced transport costs and better rural transport infrastructure” (ICR 2014). The ICR noted that the 3,277 km of rural roads that were rehabilitated received regular routine maintenance.

Elements of Success

- Maintenance was an important focus of the program, and the project’s results framework included relevant O&M indicators (for example, number of qualified microenterprises created and delivering quality maintenance, and number of kilometers of rural roads periodically maintained at project standards).
- Contracting out routine maintenance of rehabilitated roads to community-formed

32 The Provincial Road Institute (PRI) is a decentralized unit in the provincial municipalities responsible for rural roads. PRIs are governed by a Provincial Road Board, which includes the provincial and district mayors, and their operating costs are covered by contributions from central government transfers and municipalities.

microenterprises was a successful approach used through all phases of the program.³³ During the first 10 years of program implementation, microenterprises were contracted directly to handle routine maintenance of roads at a fixed price. After this period, the bids became competitive, with microenterprises competing with local construction firms for maintenance contracts, and, in most cases, winning the bids. The performance incentive was embedded in the results-based contracts, which imposed penalties if the roads were poorly maintained. Since the microenterprise owners lived close to the roads being maintained, they had a direct interest in maintaining them: they benefitted from the improved access and the source of income.

- Institutions have been strengthened at several levels in the context of the national decentralization reforms in Peru that started in 1993: (i) at the national level, through the progressive evolution of *Provias Descentralizado* from an executing agency to a regulatory agency; (ii) at the municipal level, the establishment of PRIs, which were piloted in selected provinces during the second phase and designed to increasingly take over responsibilities from the central agency and sustainably manage the maintenance and upgrading of the rural roads under their jurisdiction;³⁴ and (iii) at the community level, through the design and implementation of inclusive participatory mechanisms (for example, prioritization workshops) and institutions (microenterprises and rural roads committees for nonmotorized tracks).
- Long-term project sustainability is linked to the establishment of a cofinancing mechanism. By the end of the third phase of the project, the central government had funded two-thirds of maintenance costs, with one-third financed by municipalities. Throughout the second phase, the central agency worked actively with the Ministry of Economy and Finance to make the budget transfer permanent. This was achieved in 2006 with a Supreme Decree from the MTC, which makes the microenterprise model for routine maintenance sustainable.

Helpful Links

- [Business Management Training for Rural Road Maintenance](#)
- [Microenterprise Technical Manual on Road Maintenance \(Spanish\)](#)
- [Team Based Routine Maintenance of Rural Roads: Experiences from Latin America](#)

33 A microenterprise is a legally registered entity composed of between 10–25 people (at least 10 percent women) from neighboring rural communities and is responsible for the maintenance of a 10–25 km local road segment. It consists of a core group of members (selected by local authorities after a lengthy consultation process with the community), supplemented by seasonal workers from the community who are contracted on a three-month basis (to rotate and share benefits among community members). The project financed all activities related to the promotion and forming of the microenterprises, as well as training and back-up support. Project support included the recruitment of “road monitors”—young graduates (engineers, economists, or social scientists)—contracted for a year to provide on-the-job technical assistance and business administration training to the enterprises.

34 By the end of the third phase of the project, 90 percent of routine maintenance and 28 percent of periodic maintenance were being contracted and managed by PRIs (ICR 2014).

Philippines KALAH-CIDSS³⁵/National Community Driven Development Project (NCDDP)

Project ID: P077012, P127741

Program/Project Period: 2002 – Ongoing

Project Description Summary

The KALAH-CIDSS/NCDDP applies a typical CDD approach to empower communities and improve access to services in the poorest municipalities in the Philippines. In 2014, the government negotiated a US\$479 million IBRD loan to help extend the project to cover all of the estimated 847 poorest municipalities in the country.³⁶ The project finances a typical set of social and economic subproject investments including: water systems, health stations, school buildings, farm-to-market roads, bridges, drainage and flood control structures, irrigation canals, community enterprise facilities, and others.

Institutional, Implementation, and O&M Arrangements

The project is implemented by the Department of Social Welfare and Development (DSWD), which works through national, regional, and municipal-level structures for project management and implementation. At the municipal level, area coordination teams (consisting of a coordinator, an engineer, a finance officer, and community facilitators) oversee and support subproject planning and implementation at the village level (referred to as *barangays*). Area coordination teams are housed in the local (municipal) government unit and work closely with municipal administrative and sectoral staff. Subproject funds are transferred to village accounts and managed by community volunteers. Arrangements for O&M can vary across subprojects. O&M groups can be formed from existing community-based organizations, selected by the village committees from volunteers, or elected by consumers (for example, for water supply subprojects). In the case of roads, bridges, and drainage facilities, barangay LGU infrastructure committees are responsible for maintenance and annually allocate sufficient funds. User fees or tariffs are calculated during the design stage and updated prior to construction completion.

Evidence and Elements of Successful O&M

Evidence of Success

- DSWD carries out a sustainability evaluation within six months of subproject completion and every six months thereafter.³⁷ A 2006 study found that systems (including an organization or committee, plans, clear indication of responsibilities, and financing arrangements) were generally in place for pump-driven water systems, day care centers, school buildings and health centers, while less so for roads and gravity-fed water systems. A 2014 aide-memoire indicated that approximately 75 percent of subprojects had a sustainability rating of satisfactory or better.

35 KALAH is: “*Kapitbisig Laban Sa Kahirapan*” meaning “Linking Arms to Fight Poverty and CIDSS is Comprehensive and Integrated Delivery of Social Services

36 The National CDD Project does not cover the autonomous region of Muslim Mindanao, which contains another 100+ “poor” municipalities.

37 The evaluation is conducted on a sample basis by a composite team of LGU staff, community representatives, and DSWD staff. The evaluation covers the following areas: (i) utilization; (ii) organization and management; (iii) institutional linkages; (iv) financing; and (v) physical and technical aspects.

Elements of Success

- The project's results framework includes an indicator for subproject sustainability, which has led to increased emphasis on O&M. The project regularly monitors community compliance with planned O&M activities using the Subproject Sustainability Tool. The results of the review, which is carried out by a municipal inspectorate team, are discussed with the O&M committee.
- The project provides funding under the subproject component that allows communities to contract technical assistance for the design of subprojects, which includes the preparation of an appropriate O&M plan.
- A technically viable, long-term O&M plan is required for subproject approval by the municipal-level committee.³⁸
- Once a subproject has been selected for funding, a village committee is formed to oversee implementation and another committee formed to oversee O&M responsibilities.
- Where called for, an O&M fund must be established for the collection of user fees or community contributions prior to the release of subproject financing to communities.
- A mutual partnership agreement is signed between communities, LGUs (barangays and/or municipalities), and/or sector ministries to confirm roles and responsibilities of the various parties (including O&M requirements) at the completion of the subproject. Approximately 75 percent of the municipalities have provided funds based on earlier agreed upon plans.

Helpful Links

- [KALAHI-CIDSS/NCDDP Web Site](#)
- [Subproject Sustainability Tool Evaluation Example](#)
- [Sample Forms and Schedule for Road Maintenance](#)
- [Infrastructure Subprojects Operations Manual](#)
- [Sample O&M Plan](#)
- [O&M Committee TORs](#)
- [Sample Partnership Agreement](#)

³⁸ The sustainability plan or maintenance program typically outlines the general monthly, quarterly, and yearly activities that they think are required to keep the infrastructure in good and operational condition. The plan also contains estimated costs and the possible sources of funding to undertake the maintenance program.



Section III: Overview of Good Practices and Lessons Learned

20. This section presents the findings and lessons learned primarily based on the selected case study projects, as well as other World Bank and non-Bank projects. Specific examples of successful or innovative O&M arrangements or systems are shown under each area of analysis, with links to relevant materials where available.

21. The discussion is broken down into the four areas of analysis introduced earlier: organizational and institutional arrangements; capacity building; financing; and technical considerations. However, it is important to emphasize that all themes are closely interrelated, and evidence indicates that all need to be in place to have a successful O&M system. Sustainability is a process that runs through all stages of the lifecycle of a given infrastructure, starting with planning and continuing through the design and construction and different O&M arrangements post-construction. If there are problems with the design or construction quality, no amount of good maintenance will compensate.

1. Organizational and Institutional Arrangements

22. **Long-term institutional and organizational structures for O&M arrangements that clearly define and delineate the roles and responsibilities of stakeholders, are key to sustaining rural infrastructure.** This can be a challenge for some public goods projects (roads and bridges), where a common problem is lack of clarity over who owns or has the responsibility for managing the infrastructure. All projects with successful O&M indicated that organizational arrangements for O&M were in place and functioning at subproject completion. Yet another obstacle reported by many projects was difficulty in obtaining adequate support from local government authorities, line ministries, and/or private organizations.

O&M Committees

23. In all of the case studies, user groups or committees were set up at the start of the subproject and trained to supervise subproject implementation, monitor subproject condition, and organize and carry out maintenance activities. Furthermore, all projects had prepared plans for O&M interventions.³⁹ Various methods are used for setting up O&M committees: elected community or village groups can select from among community volunteers with relevant O&M technical skills (for example, the Azerbaijan Rural Investment Project [AzRIP] and Indonesia's National Program for Community Empowerment [PNPM]); committee members can be elected by the community (common for water supply subprojects as in Nepal's Rural Water Supply and Sanitation [RWSS] Project, Nicaragua's RWSS Project, and the Philippines KALAHI-CIDSS Project; or through a mix of elected and nonelected members (for example, India's Punjab RWSS Project).

24. Experiences suggest that the existence of a well-functioning O&M committee is an important factor for continued infrastructure maintenance. Specifically, findings from the Afghanistan National Solidarity Program (NSP 1–3) showed that the formation of an O&M committee has had a strong and positive impact on the physical condition and functionality of subprojects, as well as on maintenance activities. According to the project's sustainability report, subprojects were more than twice as likely to be properly maintained in communities with O&M committees compared to those without.⁴⁰ Similarly, findings from Indonesia's PNPM in Rural Areas (PNPM Rural) show that villagers' willingness to contribute labor or cash to a project are positively and significantly correlated with the responsiveness of the O&M committee in immediately addressing reported infrastructure problems. However, there was also evidence from PNPM that O&M was carried out in communities without functioning O&M committees at the same level as in communities with committees, so the context and culture within the local community also contribute to how maintenance arrangements can be organized.

Water Supply Infrastructure

25. The two water supply project case studies in India and Nepal established user groups that were legally registered and responsible for collecting user fees from community members and managing routine or periodic maintenance activities. In these cases, the user groups hired private workers or contractors (from the fee income collected) to undertake O&M activities. Box 1 illustrates the institutional arrangements in the Nepal RWSS Project.

26. The establishment of O&M committees is reasonably common, and evidence indicates that they are sustained in the short-term during the construction and early implementation phases (usually over a 12–18 month period). O&M responsibilities, however, are longer term, and the organizational requirements for O&M groups are different post-construction. It may prove harder to keep these groups functioning, especially if they primarily consist of volunteers. **In general, findings suggest that there is more success in sustaining O&M institutions for**

39 See annex 4 for sample TORs and O&M plans.

40 The formation of an O&M committee also had a significant impact on subproject condition and functionality. Fifty-nine percent of the subprojects reviewed that were considered functional and in good condition had an O&M committee, compared to 35 percent of subprojects that were functional and in poor condition (Altai Consulting 2013).

Box 1. Institutional Arrangements in the Nepal Rural Water Supply and Sanitation Project

The Nepal RWSS Project created water supply user groups (WSUGs) **to represent the community, coordinate with local government authorities, manage the construction of civil works, and collect O&M fees.** WSUGs are registered as co-operatives and have 9–13 members (at least one-third must be female, and with representatives from indigenous groups and lower castes) who are elected by the community during the subproject planning stage. These user groups are the main implementing institutions at the community level and are responsible for planning, implementation, and O&M of the water supply schemes. The groups coordinate closely with local government authorities (village and district development committees), who play an active role in helping to form and register the user groups, open bank accounts, provide training, and mitigate disputes. WSUGs manage the construction of civil works (assisted by NGOs) and collect O&M fees up front to cover estimated costs for the first year, after which monthly water tariffs are collected from community members based on revised estimates of annual O&M costs. WSUGs are supported by Mother and Child Tap Stand Groups, which were formed and trained after construction of the water schemes. These groups are responsible for daily cleaning and maintenance of tap stands and for helping to collect monthly user fees. Each water scheme also hired a village maintenance worker, paid monthly by the WSUGs, to take care of routine maintenance and minor repairs. The final sustainability study for the project found that more than 90 percent of the WSUGs are sustainable (as measured by holding meetings at least annually)^a and are maintaining records of key decisions.

Source: Case Study

a. The same study found that 40 percent of user groups met at least quarterly.

toll good infrastructure when access or use can be easily limited or controlled. Findings from a 2006 survey conducted for the Philippines KALAHI-CIDSS Project showed that 70 percent of surveyed road subprojects had an O&M association, compared to 93 percent of water supply subprojects (Araral and Holmemo 2007).⁴¹

Other O&M Institutional Arrangements

27. In some cases, O&M responsibilities are spun off to small-scale enterprises or contractors, at times trained by the project, and hired by the community or relevant sector agency to ensure timely maintenance activities are performed. The Peru Rural Roads Project (box 2) is a successful example of the creation of community-level microenterprises for routine road maintenance, **effectively addressing the challenge of keeping isolated rural roads well maintained while also generating local employment.** More detailed information on these microenterprises can be found in the Peru case study in Section II.

Links between Community and Local/Subnational Governments

28. In many projects, O&M arrangements involve close links to local government units (LGUs) and/or subnational line ministries. In the Nepal RWSS Project, the district and village development committees along with the water user committees and service providers, sign an agreement prior to project implementation that specifies the roles and responsibilities of each entity throughout the project, including for O&M. In AzRIP, local governments and regional repre-

41 Philippines Role of O&M Group in Roads/Bridges Manual.

Box 2. Use of Microenterprises in Routine Maintenance of Rural Roads in Peru

One of the innovative design features of the Peru Rural Roads Program was to create, train, and support microenterprises at the community level to carry out routine maintenance activities on rehabilitated roads, such as filling potholes, clearing vegetation, cleaning drainage, removing small obstacles and doing general emergency work, particularly during the rainy season. These microenterprises are legally registered entities consisting of 10–25 people from neighboring rural communities who are responsible for the maintenance of a 10–25 km road segment. The microenterprises consist of a core group of permanent members (selected by local authorities after a lengthy consultation process with the communities) along with seasonal workers from the community who live near the road sections to be maintained and are contracted on a three-month basis (to allow jobs and wage benefits to be shared). On-the-job training in technical and business administration skills is provided to the microenterprises by “road monitors” (young university graduate engineers, economists, or social scientists) contracted for one year. During the first 10 years of program implementation, these microenterprises were directly contracted (single source) by the local governments to handle routine maintenance of roads at a fixed price. After this period, contracting was made competitive with local construction firms. In most cases, the project-formed microenterprises have been successful in winning the maintenance contracts.³ An additional benefit of this approach is that members of the microenterprises live close to the target roads and directly benefit from the roads being well maintained. These enterprises have also become contact points for extension services and have helped to mobilize untapped local resources for local community ventures.

Source: Case Study

a. By the end of the third phase (Peru Decentralized Rural Transport Project), there were 857 microenterprises maintaining 16,867 km of roads (an average of 20 km per microenterprise) in 143 provinces

representatives of relevant ministries are required to sign off when the subproject is approved and confirm their responsibilities and their share of the maintenance costs when the subproject is completed and handed over.⁴²

29. Such links with LGUs and sector agencies are considered key to long-term investment sustainability, and often lead to the mobilization of additional funds for the project. For instance, evidence in both the Nepal and Azerbaijan projects shows that additional financing was allocated by municipalities and the central government toward maintenance costs. The Nepal RWSS Project closely monitors these additional resources and found that 16 percent of community subprojects had successfully raised additional funds, while a further 20 percent have initiated such links. In AzRIP, municipalities and the central government provided additional O&M funds as well as additional operational support (health equipment) totaling approximately 7.5 percent of overall subproject financing.

2. Capacity-Building and Training Support

30. **The effectiveness of O&M committees and user groups to organize and manage O&M activities is determined to a considerable extent by their managerial and organizational capacity.** Not surprisingly, if O&M committee members and other stakeholders do not have the right set of organizational and technical skills to oversee the required O&M activities, or do not understand the importance of maintaining their infrastructure subprojects, the physical condition of the infrastructure will suffer. Training for maintenance teams should cover techni-

42 Nepal RWSS Agreement and AzRIP Handover Agreement.

cal issues (how, when, and where to implement maintenance activities), as well as managerial aspects (how to organize the teams and fund collection and management). Findings from the Afghanistan NSP show that community development councils, when receiving some form of O&M training and shown how and when to maintain a project, were 21 percent more likely to maintain subprojects in satisfactory condition. All projects reviewed included capacity building and training for O&M committees and technical staff. However, to be fully effective, this study found that capacity building should be more frequent and scheduled both before infrastructure is completed (which is more common) and after (when O&M activities become a reality).

31. AzRIP explicitly engages technical staff and firms outside of the project communities to work with the communities to improve the design and sustainability of the subprojects. AzRIP extends training (including O&M) beyond community groups to the project engineers and consultant design firms who provide the communities with design options and assist them in preparing monitoring, implementation, and maintenance plans.⁴³ The design options include an assessment of short- and long-term O&M costs for different subproject types that enables the communities to select the best option that balances short-term needs with longer-term financial realities. By strengthening the technical capacity of these firms and generating connections between the private sector and communities, the project was able to improve subproject O&M. AzRIP has also successfully used peer-learning events (more than 200 during the current project) both within and across regions to improve overall project management, specifically including topics dealing with O&M, such as “The Role of the Monitoring Group,” “Sustainability and Maintenance of Community Projects,” and “Collaboration with Government Structures.”

32. The Nicaragua RWSS Project provides additional evidence on the importance of capacity building for O&M success. The project put in place a sophisticated structure for supporting capacity building from the national level down to the community level (referred to as a “sustainability chain”). This structure, and the capacity-building activities it supports, is credited with more than doubling the numbers of local WSS groups in the project municipalities that are working in a sustainable way, enhancing the functionality of the systems and preventing a premature need for reconstruction/rehabilitation.⁴⁴ Under the second phase of the project (which became effective end-July 2014), US\$4.7 million (27 percent of the Bank’s loan) is dedicated to institutional strengthening of the WSS sector, with capacity-building activities focused particularly at the municipality and community levels.

33. As part of these capacity-building efforts, some projects have developed innovative user-friendly manuals to aid communities in performing O&M activities (box 3).

34. In certain cases, awareness raising and behavior change of the public at large can also help sustain infrastructure investments. For instance, the water and sanitation projects in Nepal and India promote the maintenance of infrastructure by teaching community members about the importance of clean and sustainable water sources. The India Rural Water Supply and Sanitation Project (Punjab State) raised awareness by distributing flyers and booklets and putting

43 AzRIP Training Program.

44 The second phase of the project, Nicaragua Sustainable Rural Water Supply and Sanitation Sector Project (2014), plans an impact evaluation that will assess the impact of municipal strengthening on the functionality and sustainability of the water systems.

Box 3. “Good” and “Bad” Infrastructure Manuals

The PNPM Project in Indonesia has produced O&M manuals (*The Good and The Bad Infrastructure, Volumes 1, 2, and 3* with examples of different types of small-scale infrastructure (for example, roads, bridges, buildings, irrigation, and so forth) and related O&M activities. The manuals contain photographs showing examples of well- and poorly implemented infrastructure, along with easy instructions for making repairs. The manuals are intended for both communities and municipality staff responsible for O&M, and can be used for training or for implementation guidelines.

The Bangladesh Local Governance Support Project has produced the *Bangladesh Handbook on Improving Rural Infrastructure Services*, which is a collection of good practices (with pictures and simple text) on the design, construction, and maintenance of roads, culverts, drains, and embankments for use by project staff and communities.

The *O&M Section of Nepal RWSS Operations Manual*, along with the post-construction guidelines, clearly lays out the importance of O&M and the roles and responsibilities of the various stakeholders.

Source: Case Studies

up posters linked to each stage of the project’s lifecycle, including O&M management, and provided water-testing kits, which initiated dialogue on the need for safe drinking water. The communication materials and ongoing dialogue have helped promote the advantages of safe drinking water and gain the long-term commitment needed from communities to sustainably operate and maintain the water systems. These materials have also sensitized villagers to the importance of water conservation and made them more willing to pay for services and do their part to ensure good O&M management of the water supply schemes.

35. **The review found that the impacts of capacity-building activities appear to be limited by their short-term duration and timing**—generally during subproject implementation, rather than during post-construction when O&M becomes necessary. The Nepal Rural Water and Sanitation Project recognized and addressed this problem by providing post-implementation funding for two years for organizations (local NGOs that provide organizational and technical support to communities and user groups) to provide communities with support for O&M problems that they are unable to resolve on their own. This allows the support organizations to conduct periodic follow-up, sustainability monitoring visits, and provide technical support during the post-implementation phase. In AzRIP, the regional design firms were also available to provide post-implementation O&M technical support on demand to communities, while the Laos Poverty Reduction Fund Project visits a sample of subprojects at 6 and 12 months post-construction to observe the O&M and provide technical guidance.

3. Financing

36. For O&M to be effective, sustainable financing mechanisms must be established. For this to happen, the review found three key questions that need to be answered: which O&M costs are to be financed (for example, operations and minor repairs versus major repairs or capital costs), how O&M costs will be financed after subproject completion (for example, revenue collection mechanisms such as user fees), and whose responsibility it will be to pay for O&M (for example, communities and/or local government authorities). Equally important is how, and how well, O&M funds are managed. A guiding principle for maintaining CDD infrastructure at the

community level is to make realistic estimates of communities' needs and financing capacity (in cash and in-kind) for O&M.

37. **Community financing of operations and routine maintenance activities over the short term is less of an issue than long-term financing**, which must cover higher costs for periodic maintenance and other major repairs that are usually performed by outside contractors. However, O&M financing can be more challenging for public goods than for toll goods, where access to the goods is easier to control and collection of user fees more widely accepted. In this context, evidence of successful financial O&M arrangements across the materials reviewed is particularly strong in the water and sanitation sector. Water and sanitation-related infrastructure often collect user fees, compared to, for example, rural roads projects. The case studies and literature for water supply and sanitation provide many examples of relatively successful cost-sharing mechanisms and innovative ways of collecting and sharing some of the O&M costs.

Estimating O&M Costs

38. Estimating costs is challenging for many programs. The review found that communities usually require support in accurately estimating O&M costs, which will vary by type of investment, technology/design options, and local conditions.⁴⁵ Sharing such information at the sub-project planning/prioritization stage, as under AzRIP, enables communities to make informed decisions about infrastructure based on both need and long-term costs. Estimates from the Philippines KALAH-CIDSS indicate that that O&M annual costs range from 2.4 percent of the capital cost for a gravity-fed water supply scheme to 2.8 percent for a health clinic (excluding costs for personnel and supplies; Araral and Holmemo 2007).⁴⁶ Table 2 presents estimates for other types of projects based on data from this review.

Subproject type	O&M costs (% of capital costs)	Comments
Water systems (gravity/pump)	2.4–15	Range between Philippines KALAH-CIDSS and Pakistan Northwest Frontier Province (NWFP) Community Infrastructure Project (with gravity-based systems having lower O&M costs than pump-based systems)
Roads	3–10	Range between Philippines KALAH-CIDSS and Pakistan NWFP Community Infrastructure Project
Micro-hydropower	5	Nepal Kabeli Transmission Project
School building	2.8	Philippines KALAH-CIDSS (excluding costs for staff and learning materials)
Health care center	4.4	Philippines KALAH-CIDSS (excluding costs for staff and medical supplies)

Sources: *Projects Documentation*

45 Time horizons for O&M plans will vary depending on the infrastructure types and design choices, but generally a five year plan and cost estimate should be prepared.

46 KALAH-CIDSS/NCDDP included the costs for staff and supplies when calculating O&M costs for schools (44 percent) and health clinics (27 percent), but these costs have been excluded in the estimates reflected in table 2, in keeping with standard methods of calculating O&M for buildings.

Box 4. Planning for O&M Sustainability in Azerbaijan

The *Azerbaijan Rural Investment Project (AzRIP)* uses simple economic analysis to assist communities in making informed decisions about their infrastructure priorities. To help the communities decide which investments to prioritize, technical design firms (hired by the project) prepare alternative technical solutions for each of the top three or four priorities and inform the communities of the full costs (including O&M costs) and benefits of the investment options.^a After deciding which infrastructure project to prioritize, communities develop detailed annual maintenance plans based on estimated maintenance costs over the life of the investments. This allows communities to better prepare for future maintenance costs through different financing and cost-sharing mechanisms. The fact that over 90 percent of road rehabilitation subprojects (covering more than 2,000 km) were found to still be operational at the end of AzRIP 1 suggests that using O&M costs to guide subproject selection is having a positive impact on sustaining O&M.

Source: Social Development Note, No. 126, ICR 2012.

a. AzRIP Technical Design Firms TOR.

39. In the case of AzRIP, O&M was an integral part of the subproject prioritization and technical design processes, and communities were assisted by technical design firms to more effectively select subprojects by balancing their short-term needs with longer-term financial realities and in a way that maximized sustainability and the number of beneficiaries (box 4).

O&M Fund Collection Mechanisms

40. **Unsurprisingly, establishing and capitalizing a formal O&M “fund,” and doing so in advance of any significant O&M costs, appears to make longer-term O&M arrangements more likely to be sustained.**⁴⁷ Findings from the Afghanistan NSP show that user groups or committees with a system to collect user fees are more likely to perform adequate maintenance activities than communities where no user fee is collected.⁴⁸ In all of the seven case studies, O&M funds for the first year were established and capitalized up-front through either communitywide contributions or by levying user fees. In setting up such a fund, however, projects are faced with two important issues: (i) how to calculate the user fee or contribution that should be made by individuals or households, and (ii) how to ensure that people pay as agreed.

41. Obviously, some subproject investments and related services that can be metered or objectively measured (water, electricity, and irrigation) make calculating use and associated fees simple. In other cases, or in the absence of appropriate infrastructure or technology, other customized measures are commonly used, such as fees for many services on a per household basis; per number of children (school); by type of vehicle (roads); or number of hectares (irrigation). Furthermore, some fees are levied or assessed on an ad hoc or as needed basis, often based on the estimated cost of a certain repair or upgrade. Allocating these costs within a community

47 Up-front collection of O&M funds by the water user committees is considered to be one of the contributing factors to the success of the Nepal RWSS Project. Minor repairs were/are undertaken by the committees using this fund, ranging from 3–4 percent of total scheme cost, depending on technology choice.

48 A 2013 sustainability study of the project showed that 42 percent of effectively maintained subprojects were managed by communities that had instituted a system to collect user fees, and that 80 percent of the poorly maintained subprojects were managed by communities that did not collect user fees.

Box 5. Various Approaches to Water System O&M Fee Collection

Private service connections in the Punjab. The India Rural Water Supply and Sanitation Project (Punjab State) has been successful in operating and maintaining its water supply schemes and meeting the full O&M costs through user charges.^a About 90 percent of consumers pay their water bills regularly, and some local water committees have sizable savings in their O&M accounts. Two key factors to the project's success are (i) the promotion of private service connections, and (ii) individual metering and billing, which encourage people to save water, prevent waste, and only pay for what they use. Village water and sanitation committees set the water tariffs to cover O&M costs in full, maintain the accounts, oversee billing and collection, supervise and manage the pump operator, and hold nonpayers accountable. Meters are read monthly by the pump operator (and the cashier) in the presence of the consumer; monthly household water bills average Rs. 70–120 (approximately US\$1–US\$2).^b

Collecting water user fees in Nepal in the absence of meters. The Nepal Rural Water Supply and Sanitation Project did not use private connections and metering. Instead, the local water user committees collected O&M funds for the first year upfront (1 percent of the total scheme cost) to cover minor repairs, followed by collection of monthly user fees (generally NRs 30, or approximately US\$0.30 per household) to cover the costs of regular repair and maintenance, pay the maintenance workers, and also cover future rehabilitation and extension costs. User fees were estimated at 3 percent of investment costs for gravity schemes, and 4 percent for groundwater schemes. Regular collection of these fees has contributed to the schemes' success—96 percent of which were found to be sustainable 3–5 years after completion. The study credits the Mother and Child Tap Stand Groups—which exert effective peer pressure on their fellow women community members to both pay fees, act appropriately to conserve the taps, and protect water quality—and the contracted community workers with the overall sustainability of the schemes.^c

Using social capital to ensure fee collection and positive O&M behaviors. The Maharashtra State Jalswarajya Project in India uses a different model for collecting user fees in water projects. The model (called Khambegaon) is based on entrusting women and local self-help groups (SHGs) with the responsibility of water tax collection and day-to-day O&M of the water supply scheme. The SHGs collect an advance of Rs. 100 (approximately US\$1.50), followed by monthly collections of a flat rate of Rs. 30 (approximately US\$0.50) per household. It was implemented successfully (90 percent collection rate) and replicated in 235 other villages across Maharashtra. The high collection rate is the result of good communication with households explaining the importance of the user fees, as well as the incentive for the SHGs—who were allowed to control 80 percent of the funds collected for regular operation of the water supply schemes, and surpluses could be used for income-generating activities. The 20 percent balance went to a maintenance fund managed by the gram panchayat (local government unit).^d

a. *Handbook for Gram Panchayats*, Punjab RWSS.

b. "India Innovations in Development Note," Issue 10, World Bank (2013).

c. *Sustainability Study of Batch V*, ICR (2013).

d. *Towards Drinking Water Security in India—Lessons from the Field*, Water and Sanitation Program (January 2011).

could draw on any one of the customized measures, or draw on other data such as the well-being of households.

42. Once the amount of fees have been determined, another challenge communities often face is how to ensure that all individuals or households pay their respective fees or contributions. Several projects reviewed (Nepal RWSS, Pakistan NWFP Community Infrastructure, and the Romania Rural Development Projects) require that an O&M fund be established and capitalized (generally for a year of O&M expenses) as a precondition for approval of a subproject, which places considerable pressure on a community and individual beneficiaries to contribute as agreed. Systems that can restrict access to services (most commonly in the cases of water, electricity, or irrigation) in the event of nonpayment are generally effective in ensuring a reasonably high level of compliance, as long as the service remains reliable (box 5). In the event that restricting access to a given structure or service is technically or socially impractical, successful

O&M systems have also used social networks and peer pressure to ensure adequate fundraising (box 5).

43. **User fees and contributions depend on the communities' ability and willingness to pay.** As suggested previously, willingness to pay is linked to the type of infrastructure, its relative demand among the community members or users, and the extent to which access can be measured and restricted. However, even when toll goods are not metered, community members are willing to pay regular fees for services, such as water supply, when they perceive a direct benefit. Nonetheless, it is easier to charge and collect user fees for toll goods than for public goods infrastructure, where access to benefits is difficult to restrict and therefore incentives to pay are weakened.

44. **While metering and collecting user fees for toll goods are easier, it is not impossible to employ these approaches to other types of infrastructure, although successful examples are rare** (and generally nontypical, both from economic and social perspectives). The best example is AzRIP, where some communities collect user fees for maintenance of local roads based on usage and type of household vehicle (which serves as a proxy for road usage). There are some ad hoc reports of other projects where user fees are applied to the types of public infrastructure often exempted from such fees. Afghanistan NSP reports that some communities are collecting fees for the repair of roads, and, in the Philippines' KALAHI-CIDSS Project, tolls are often applied for bridge subprojects based on the types of users (car, motorcycle, bicycle, person, and so forth).

45. Community contributions to routine maintenance can also come in the form of paid or unpaid labor. Evidence from Afghanistan NSP indicates that where routine maintenance "costs" primarily involve labor (for example, canals, culverts, retaining walls, and unpaved roads), the infrastructure is more likely to be better maintained. In addition, and not surprisingly, NSP data suggest that community members' ability and willingness to pay also depend on the overall cost of O&M, which is linked to the technical complexity of the subprojects. Where subprojects were more technically complex and maintenance costs higher, subprojects were less likely to be functional and in good condition. However, data from Afghanistan NSP and Indonesia PNPM show that when maintenance can be conducted using donated, unskilled, labor, it is more likely to happen. However, project arrangements that encourage labor donated by residents, particularly for recurring maintenance activities, can prove contrary to other project objectives such as poverty reduction, short-term employment generation, and wage transfer. There is also a risk that the labor burden will fall on the more disadvantaged, less powerful households for which labor is their primary asset.

Cost-Sharing Mechanisms

46. Even if funds are collected regularly and managed properly by communities, they may not prove sufficient for long-term infrastructure maintenance requirements. Findings from Afghanistan NSP, Indonesia PMPM, and the India Maharashtra Water Supply Projects confirm that, even if communities can cover short-term financing related to minor operational and routine maintenance costs, some degree of external financial support or cost sharing is needed for periodic maintenance. Regular and operational costs for services such as health care or education, and for other more costly periodic or emergency maintenance (where communities would not

Box 6. Examples of Links with Local Government Authorities and/or Line Ministries

Local government budget allocations for O&M activities in Sri Lanka. To further strengthen the O&M strategy of the Sri Lanka Community Development and Livelihood Improvement (GemiDiriya) Project (2004–14), all local government institutions agreed to allocate a minimum of 10 percent of their annual budget for O&M activities. While this agreement has only been in operation since early 2014, nine local governments have approved 2014 budgets with an average allocation of 15 percent for O&M. In addition, for the first time, O&M units are being systematically established in each local government across Sri Lanka.^a

Versatile resource mobilization approach in the Philippines. The Philippines KALAHI-CIDSS Project approach for financial sustainability of O&M costs includes collecting funds from community members and local village (barangay) and municipal governments, particularly in cases of larger subprojects with more costly maintenance requirements (for example, roads and bridges). Municipal allocations for O&M are usually charged against the municipality development fund and contributions vary across municipalities.^b This can also be supplemented as needed by specific revenue collection and cost-sharing mechanisms for each type of subproject constructed (for example, local school and health boards).^c

a. AM (2014).

b. For example, Mulaney allocated P30,000 (approximately US\$670) per village, and Talaingod allocated P50,000 (approximately US\$1,115) per village, while Barotac Viejo provides a yearly block fund allocation of P400,000 (approximately US\$9,000) for O&M of subprojects (ADB 2012).

c. Philippines KALAHI-CIDSS, *O&M Strategy for Small-Scale Infrastructure*.

usually have the skills, mandate, or financing available) are generally covered by the relevant agencies or local governments. For this purpose, CDD programs generally require that the formal commitment of the relevant government unit is secured at the time subprojects are approved. Though such commitment⁴⁹ is not a guarantee that the relevant authorities can or will fulfill all relevant O&M responsibilities, explicit links to and support from local governments or line agencies are widely seen by CDD practitioners as necessary to ensure the sustainability of community infrastructure. There are several examples among the projects reviewed where these links have led to commitment, which in turn led to successful and sustained O&M systems.

47. Furthermore, findings from the case studies indicate that O&M appears to be more successful and sustainable in projects that have established a link between O&M committees and local government authorities and/or line ministries to assist with costs (box 6). This approach is promising, although in some cases (for example, Sri Lanka and Mongolia), it is still too early to know whether the cost-sharing arrangements will work in practice and if the budget transfers are sufficient to cover long-term maintenance costs.

48. The Second Mongolia Sustainable Livelihood Project proved successful in ensuring long-term O&M support for rural infrastructure through the allocation of government funds (box 7).

49 These commitments take the form of the relevant line agency endorsing the subproject that pertains to their area of technical support, a signed letter between the CDD program and the relevant line agency, or a specific memorandum of understanding.

Box 7. Budget Allocations to Districts for O&M in Mongolia

The Sustainable Livelihood Project (SLP) in Mongolia has improved basic services at the local level through the construction, rehabilitation, and renovation of basic infrastructure (schools, hospitals, cultural centers, kindergarten, street lighting, and so forth). A significant outcome of the second phase of the project was the passage, in December 2011, of a budgetary law that created the Local Development Fund (LDF), modeled in part on the SLP, which allocated funds to all districts (*soums*) for local-level community development starting in 2013. The Third SLP has recently been approved (June 2014) and is designed to support the transparent implementation and institutionalization of the LDF, using participatory budgeting to respond to community priorities, and to help maintain rural public facilities and infrastructure financed under SLP-2. While it is still too early to measure the results, it is expected that O&M of infrastructure built under the earlier phases of the project will be sustainable as a result of the LDF.

Source: ICR (2013); PAD (2014).

Box 8. Private Sector Involvement in O&M in India's Punjab RWSS

As more and more villages in Punjab take over responsibility for the O&M of their water supply systems, performance has been mixed; while many gram panchayat water supply and sanitation committees (GPWSCs) are performing well (particularly under the World Bank-funded RWSS project), others are facing challenges. A study was commissioned by the World Bank in 2012 to assess different PPP arrangements in the rural water and sanitation sector in Punjab and compare them with non-PPP initiatives, including those managed by the Department of Water Supply and Sanitation (DWSS), gram panchayats, and GPWSCs. The different private sector arrangements reviewed included:

- annual contracting of a private operator by DWSS to manage the O&M of water supply schemes for a cluster of villages, with tariffs set and collected by DWSS;
- long-term PPP contracts for construction and O&M of water treatment plants covering groups of villages;
- three-year contracting by GPWSC of a private operator to manage O&M, including billing and collecting user fees; and
- PPP contracts for development and O&M of sewage schemes.

The study found that: (i) private agencies have the lowest per capita cost in undertaking O&M of water supply schemes; (ii) the local water and sanitation committees (GPWSCs) are more efficient in collecting revenue and ensuring coverage and continuity of water supply within villages; and (iii) local governments (gram panchayats) and DWSSs have the worst collection efficiency and higher per capita O&M costs (The study confirms that O&M of village water supply schemes can be successfully managed by community groups (GPWSCs) with full cost recovery, but recommends that, for individual villages or multivillage schemes where O&M is less successful, it can be improved by contracting private operators using performance-based management contracts.^a

a. Credit Rating Information Service of India Limited [CRISIL] 2013).

Private Sector Partnerships

49. Another strategy used in financing O&M is public-private partnerships (PPPs). While PPPs are a common strategy for large infrastructure investment and operation, they are less commonly used in CDD operations and for rural infrastructure. However, this review found innovative PPP applications in two water and sanitation projects located in Nepal and India (boxes 8 and 9).

Box 9. Introduction of Insurance Scheme for Emergency Maintenance in Nepal

Nepal ranks as the fourth most climate-vulnerable country in the world and is highly exposed to a range of hazards such as floods, droughts, and earthquakes. The effects of natural disasters can be mitigated to some extent through good O&M, because well-maintained infrastructure is more resilient. However, overall O&M cannot prevent destruction or damage to infrastructure. Therefore, the Nepal RWSS Project piloted an insurance scheme for its water supply infrastructure in response to demands from some communities facing threats from natural disasters. The pilot involved the RWSS Fund Development Board (the national implementing agency), an insurance company, and initially seven communities that paid for the insurance. The project's Fund Board worked with the insurance company to develop communications and training materials for inclusion in the standard training sessions for communities, and the insurance scheme was extended to cover a total of 36 other WSS schemes by project close in 2012. While no claims have yet been made by the insured communities, the insurance scheme was deemed successful and is expected to continue to be implemented and mainstreamed by the Fund Development Board. While not directly related to what is considered O&M, such schemes could be a useful option in areas prone to natural disasters.

Source: Case Study

4. Technical Considerations

50. A number of technical issues relating to subproject design and implementation also have a direct and significant impact on the O&M system and its sustainability. These include technology complexity, quality of project design and materials, and supervision of construction.

Technical Design, Quality, and Supervision Issues

51. **Infrastructure deficiencies are not always the result of inadequate maintenance.** If a newly completed infrastructure subproject has a major breakdown or needs replacement of a key component (for example, water pumps, leaky roof, road washout) within the first year or so, reasons other than improper maintenance may be the cause. Potential reasons include poor design, low-quality building materials, or lack of proper supervision resulting in poor construction that does not meet agreed upon technical specifications.

52. Poor infrastructure design will always lead to more maintenance requirements. In some cases necessary fixtures might not be included, or structures might not be designed to withstand given loads. In addition, good design can be compromised by the quality of the materials used or by lack of proper supervision during construction. Finally, good design, proper materials, and appropriate supervision can be undermined by the improper use of infrastructure. For example, a few heavy trucks using a community-built village road can quickly do more damage than regular local transport vehicles carrying moderate loads of goods and passengers, especially right after a long period of rainfall.

53. **Nonetheless, there was little evidence from the project documentation and evaluations reviewed of any major technical design issues, or of problems with quality of materials or supervision. On the contrary, technical reviews and anecdotal evidence indicate that designs, materials, and supervision met or exceeded specifications,** presumably due to the increased community participation called for under the reviewed projects. For example, under the Second Sri Lanka Community Development and Livelihood Improvement Project, a review showed that rural roads and multipurpose buildings were of higher quality than the

construction completed under some of the other rural programs.⁵⁰ The technical assessment of Indonesia PNPM found that 91–94 percent of the subprojects inspected had appropriate designs, although the quality of technical supervision was not always up to standards, and there were examples of cheap and low-quality materials used in construction. To address technical supervision issues, most projects include engineering staff to help supervise and oversee the quality of construction. AzRIP used the regional design firms to strengthen supervision quality during construction. Findings from Afghanistan NSP also indicate that high-quality subprojects are 28 percent more likely to be properly maintained than low-quality subprojects, confirming the importance of top-notch design, materials, and technical supervision.

Technical Complexity

54. Complexity of project design not only affects the communities' ability to carry out maintenance, but also the costs. Projects should select appropriate technology that will help optimize the tradeoffs between the lifecycle costs (investment costs and O&M requirements) and the scale of benefits to the community. The importance of appropriate technical designs to O&M is highlighted by the AzRIP experiences described earlier, where regional technical design firms prepare and cost alternative technical solutions for each of the top three priorities identified by the communities. After the introduction of alternative design options, about 10 percent of the communities discarded their initial first choice when it became clear to them that other investments (based on an alternative design) would be better from a sustainability perspective.

55. Technical complexity of project design can also have a negative impact on maintenance and the condition of the infrastructure. For example, in the Pakistan NWT Second Community Infrastructure Project, some of the communities opted to improve local streets through the use of cobblestones and bricks. The skills and equipment needed for this project were relatively simple and easy for the local maintenance committee to manage. Similarly, in the Nicaragua Rural Roads Infrastructure Improvement Project, some communities use local labor to pave their roads with *adoquines* (a form of paving blocks). This technology is less expensive than traditional paved roads, and more durable and easier to maintain than gravel surfaces. Other types of infrastructure such as water supply and electricity systems can vary widely, with more complex designs requiring specialized equipment, and more technical know-how and skills for maintenance and repair. Findings from Afghanistan NSP confirm that subprojects that were classified as technically more complex (for example, microhydro plants, water supply networks, and solar panels) were generally in poorer condition than less complex infrastructure.

5. Other Success Factors in Promoting O&M

56. *Grievance redress mechanisms.* Effective complaints handling, or grievance redress mechanisms (GRMs), have also been credited with improving O&M. For instance, in the Punjab Rural Water Supply and Sanitation Project, the grievance redress system managed by a third party agency has helped increase the responsiveness of technicians to local communities' service requests (box 10). In addition to supporting the improved maintenance and repair of the water systems, GRMs have also had a positive impact on the trust of communities in the overall water schemes and O&M arrangements, which in turn increases user fee payments.

50 The quality of infrastructure was also good—local officials estimated that completed works would have a 25–30 percent longer lifespan compared to equivalent government built infrastructure.

Box 10. Complaint Redress System for Village Water Supply Schemes in India

In 2009, Punjab State introduced a complaint redress system for village water supply schemes, *Shikayat Nivaran Kendra*. The system's objective is to improve service delivery quality by monitoring O&M of rural water supply schemes more efficiently. The system includes a 24-hour toll-free number and an online complaint submission and tracking mechanism that can be accessed by all Department of Water Supply and Sanitation officials. Submitted complaints are registered by a private agency and forwarded to the relevant officials through email or text message for action. The third party agency monitors progress on a daily basis, and the complaint is escalated to higher levels if not rectified within a determined time frame. The system helps check on the performance of staff working in remote villages, improves the quality and speed of the service delivered, and makes water supply management more transparent and accountable.

Source: WSP Compendium (2013)

57. Ex post monitoring of infrastructure. Technical evaluations of infrastructure after completion of construction were carried out in five of the seven selected case studies (Afghanistan, Azerbaijan, Indonesia Nepal, and the Philippines) to assess the physical condition and functionality of completed subprojects, and to identify some of the technical challenges that communities faced in maintaining and sustaining their infrastructure. Summary results from three of the evaluations are shown in box 11. The evaluations emphasize the importance of O&M to communities and relevant government agencies, and will enhance efforts to improve O&M arrangements in future operations and other government efforts.

Box 11. Results from Technical Evaluations

Afghanistan. According to a recent report on subproject sustainability, 29 percent of subprojects in NSP were found to be functional and in good condition due to good construction, quality materials, and adequate maintenance. Fifty-six percent were considered to be functional, but not in good condition (that is, at least one key component in poor condition) due to either lack of adequate O&M, poor or incomplete construction, poor materials and design flaws; and 14 percent of subprojects were not functional due to natural disasters, breakdown of key components, or insufficient operational funding.^a

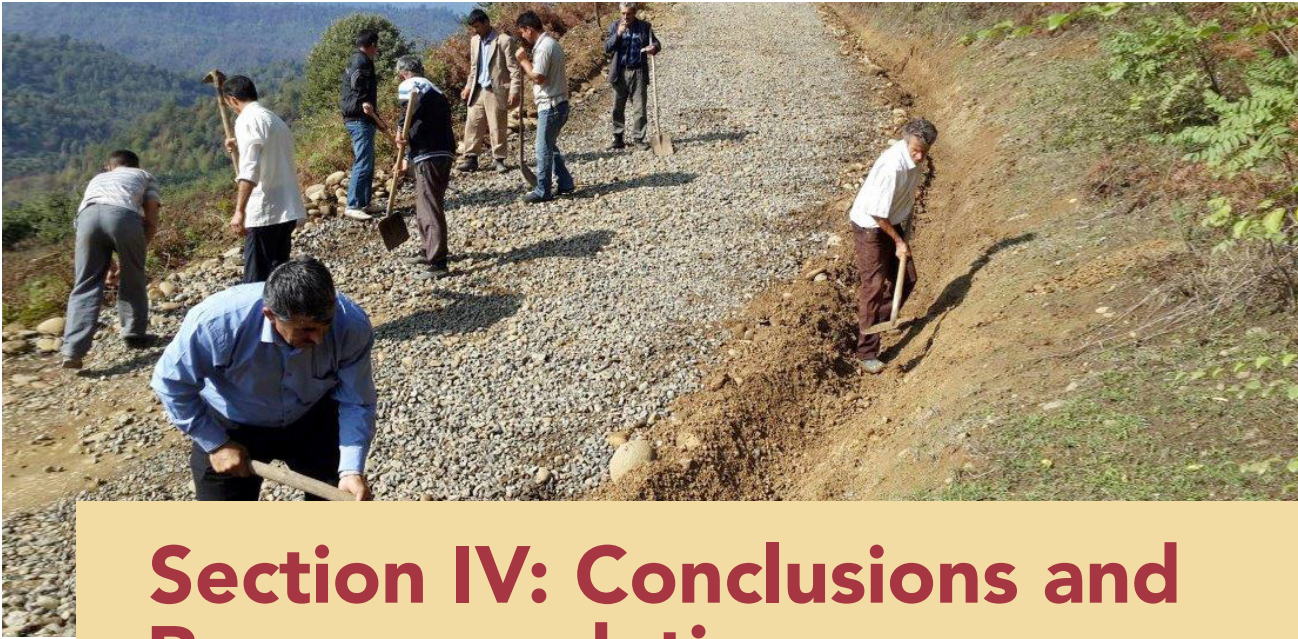
Indonesia. The technical evaluation for the PNPM Project (2012) found that 82 percent of the infrastructure inspected was "high quality," 14 percent "acceptable quality," and 4 percent was considered "failed." Some of the issues faced by the subprojects were attributed to design quality, cheap building materials, and inadequate oversight during construction (for example, poor drainage in roads, buildings, and water subprojects; hydraulic design deficiencies in water supply subprojects; and water supply fixtures falling quickly into disrepair).

Nepal. Short- and long-term sustainability studies on the RWSS during the span of the two project phases included technical reviews of the water schemes. Technical sustainability results from the latest study, Batch V (conducted three years after subproject completion) indicate that 78 percent of the water schemes are highly sustainable; 18 percent are sustainable, and 4 percent are moderately or not sustainable.^b Issues faced by the last category include damages due to floods or landslides and water depletion. Design and construction quality overall have been rated very high (over 95 percent).

Sources: NSP Subproject Sustainability (2013); PNPM Rural Impact Evaluation (2012); Nepal RWSS Sustainability Studies (2012)

a. The technical evaluations of NSP subprojects differentiate by subproject type. Canals and karez (type of water scheme) had the highest percentage of subprojects assessed as functioning and in good condition (on average 71 percent), while only one-third of the culverts, protection walls, and water supply network subprojects were found to be in a similar positive state. Microhydro plants, shallow wells, solar panels, and tertiary roads had no subprojects that were assessed to be fully functioning and in a good condition.

b. In the case of the Nepal evaluations, technical sustainability considers three areas: source yield, condition and functionality, and functioning of taps.



Section IV: Conclusions and Recommendations

58. This review looked at four key aspects of O&M systems (institutional arrangements, capacity building, financing, and technical considerations) and found several examples of good practices. Nonetheless, few projects had hard data to quantify the effect of their O&M systems, and fewer still had analyzed the links between these different system elements and the overall success of O&M. This lack of robust data is in part due to the fact that O&M systems (and their success or failure) are typically not recognized until after the typical investment lending project cycle. Nevertheless, the project documentation reviewed and the case studies analyzed have provided some basic insights into some of the key obstacles to and options for improving O&M within these types of programs, along with materials related to O&M in various sectors that might be useful to project teams.

59. **Overall, the review found that O&M arrangements appear to be more successful in single-sector projects (for example, roads, water supply),** where the project generally works with and builds the capacity of the specific sectoral agency that is responsible for ensuring that O&M arrangements are in place and actually carried out. For example, in the Peru and Nicaragua roads sector programs, the projects supported the creation of a national road maintenance agency and microenterprise formation for maintenance of rural roads, but when the projects ended, these were absorbed into the road maintenance agency budgets. **Additionally, the review found that O&M is more successful for toll goods investments,** such as water supply and irrigation, where communities and households can be easily billed for services and systems are already established to support such payments. **O&M arrangements are less successful for other public goods projects,** where access to and benefits from the infrastructure are more difficult to control and collecting user fees is more challenging. **The review also found that rural communities more often carry out basic or routine maintenance rather than periodic maintenance,** where costs tend to be higher and technical requirements greater. Proper periodic maintenance generally requires technical and financial support from local government and traditional line ministries.

60. The review found that effective O&M systems generally include the following elements or practices:

- **Institutional arrangements.** Establishment of O&M committees at the beginning of the project with O&M plans that clearly define the roles and responsibilities of the different stakeholders, include a schedule of routine maintenance activities, initial user tariffs and collection mechanisms for at least two to three years after construction, along with estimated O&M costs for the lifespan of the infrastructure. Another key element is establishing formal links with local government authorities and line agencies, with their roles and contributions to O&M included in the plans, with relevant representatives signing an agreement on completion of construction.
- **Capacity building.** Capacity-building activities covering all aspects of O&M—from the planning, implementation, and post-construction stages—should be provided for key stakeholders, including the communities, local government authorities, and private companies (to the extent that they are involved in design and supervision of construction). These activities should also include information campaigns (as seen in the water supply sector in Nepal) to encourage appropriate behavior in support of O&M, such as proper use of infrastructure, fee payment, and so forth. Preparation and distribution of simple pictorial manuals or guides that can help communities perform the necessary O&M activities have also been very useful. Finally, the frequency and timing of the capacity-building activities are important. Post-construction training has been effective in Nepal RWSS and follow-up technical support for a year or two after completion of the subproject was helpful in addressing real-time O&M issues as they arose.
- **Financing strategies.** Most projects are able to cover short-term financing needs for routine O&M through basic user fees and donated labor. However, long-term financing appears to be a major challenge to O&M sustainability. O&M financing for water sector projects appears to be more successful because user fees are more easily charged and collected compared to other types of infrastructure, such as rural roads or bridges, where it is difficult to limit access to the benefit of the investment and where user fees are more difficult to collect. Public goods subprojects should, therefore, formally explore O&M cost-sharing arrangements with local government units or line ministries for periodic maintenance and major repairs (such as in the Azerbaijan, Philippines, Mongolia, Sri Lanka, Peru, and Nicaragua projects).
- **Technical issues.** Effective O&M by communities also depends on the appropriateness of infrastructure design, the quality of materials, and supervision of construction. Well-constructed infrastructure generally requires less maintenance in the first few years after construction; infrastructure that falls into disrepair soon after construction is usually the result of bad design or low-quality construction materials. While only a few projects conducted a technical audit or sustainability study to examine these issues, results from Afghanistan showed that the majority of the subprojects in good condition were those that were less technically complex with quality designs and materials.

61. This study presents six recommendations to improve the sustainability of O&M systems of community-driven and -based infrastructure:

- i. **CDD (and other rural infrastructure) investment projects should always include at least one O&M results indicator.** Over 40 percent of the 54 projects reviewed had such an indicator in the results framework, which task team leaders indicated helped keep projects focused on O&M.
- ii. **Explore the possibility of making second and subsequent block grant financing conditional on the setup and operationalization of necessary O&M arrangements.** Two of the successful cases reviewed for this study, the Afghanistan National Solidarity Program and Azerbaijan Rural Investment Project make funding for subsequent grants contingent on the beneficiary community having successfully completed an earlier subproject, which includes sustainable O&M of the constructed infrastructure.
- iii. **Analyze and include information on O&M costs and responsibilities in the process of subproject prioritization by communities.** All of the successful projects reviewed required O&M plans and procedures to be in place as part of subproject proposal submission, but some were more detailed than others. In the case of Azerbaijan, the subproject design and prioritization process included different subproject technical options, with short- and long-term O&M costs, which guided final subproject selection.
- iv. **Pilot and evaluate different ways for financing public infrastructure O&M (particularly roads).** For example, several projects, including the Philippines CDD program (KALAH-CIDSS) and the Peru and Nicaragua Roads projects formalized cost-sharing arrangements with local government authorities or line agencies.
- v. **Research the role that public-private partnerships can play in commercializing O&M efforts** as an alternative to existing community-based mechanisms, such as in the India Punjab RWSS, and in the Nepal RWSS with the introduction of the insurance scheme for emergency maintenance).
- vi. Given the lack of robust evidence of the end results of O&M arrangements, **projects should conduct longitudinal technical and qualitative studies focusing on O&M arrangements and sustainability issues.** These could also include piloting and evaluating different O&M design variation arrangements within a project to see what specific elements or approaches work best (for example, when and how the O&M committees are set up; how often and when capacity-building activities are conducted; who is trained; and so forth).

62. Finally, to assist task teams in planning for O&M design within their projects, this paper includes: (i) a list of relevant questions to be considered in planning for O&M design and implementation (annex 3); (ii) links to useful O&M materials (annex 4); and (iii) a list of O&M measures and a timeline for their monitoring and evaluation (annex 5).

Annexes

- Annex 1 Projects Reviewed
- Annex 2. Examples of Maintenance Requirements for Rural Infrastructure
- Annex 3. Questions for Task Teams When Planning for O&M Design and Implementation in CDD Projects
- Annex 4. Links to O&M Materials
- Annex 5. Sample O&M Measures and Performance Assessment Timeline

ANNEX 1

Projects Reviewed

Community-Driven Development

1. Afghanistan: National Solidarity Program (P084329, P102288, P117103)
2. Albania: Community Works Support Program (P066335)
3. Azerbaijan: Rural Investment Projects (P076234, P122944)
4. Bangladesh: Local Government Support Projects (P124514, P098273)
5. Bolivia: 2nd Participatory Rural Investment (P101298)
6. Bolivia: Community Investment in Rural Areas (P107137)
7. China: Poor Rural Communities Development Project (P071094)
8. Ethiopia: Pastoral Community Development Project (P130276)
9. Ethiopia: Promoting Basic Services III Project (P128891)
10. Ghana: Community-Based Rural Development Project (P081482)
11. Guinea-Bissau: Rural Community-Driven Development Project (P090712)
12. Haiti: Community-Driven Development Project (PRODEP) (P093640)
13. Honduras: Rural Infrastructure Projects (P086775, P144324, P057538)
14. India: Mumbai Slums Community Sanitation Program
15. Indonesia: PNPM Rural Program (P128832, P122810, P125600, P108757)
16. Jamaica: National Community-Driven Development Project (P076837)
17. Lao Peoples' Democratic Republic: Poverty Reduction Fund I & II (P077326, P123480)
18. Madagascar: Community Development Project (P055166)
19. Madagascar: Rural Development Support (P051922)
20. Mongolia: Sustainability Livelihoods Projects (P096439, P125232)
21. Morocco: National Initiative for Human Development (P100026)
22. Pakistan: AJK Community Infrastructure and Services Project (P071454)
23. Pakistan: NWFP Community Infrastructure III (P082621)

24. Philippines: Comprehensive and Integrated Delivery of Social Services (KALAHI-CIDSS; P077012)
25. Romania: Rural Development Project (P057960)
26. Senegal: National Rural Infrastructure Project (P057996)
27. Sri Lanka: Community Development & Livelihood Projects (P074872, P087145)
28. Vietnam: Community-Based Rural Infrastructure Project (P062748)
29. Vietnam: 2nd and 3rd Program 135 Phase 2 (P107062, P117610)

Water Supply/Irrigation

30. Ecuador: Rural and Small Towns Rural Water Supply and Sanitation (P049924)
31. India: Punjab Rural Water Supply and Sanitation Project (P090592)
32. India: Kerala Rural Water Supply and Environmental Sanitation Projects (P055454, P121774)
33. India: Maharashtra Rural Water Supply and Sanitation Project (P073369)
34. India: Uttarkhand Decentralized Watershed Development Project (P078550)
35. India: Himachal Pradesh Mid-Himalayan Watershed Development Project (P093720)
36. Kenya: Microfinance for Water Services Project
37. Malawi: Irrigation Rural Livelihoods and Agricultural Development Project (P084148, P121120, P131760)
38. Nepal: Rural Water Supply and Sanitation Projects (P010516, P071285)
39. Nicaragua: Rural Water Supply and Sanitation (P106283, P147006)
40. Paraguay: 4th Rural Water Supply and Sanitation Project (P039983)
41. Tanzania: Sustainability Assessment of National Rural Water Supply and Sanitation (P047762)
42. Vietnam: Irrigated Agriculture Improvement Project (P130014)

Roads

43. Bangladesh: 2nd Rural Roads and Markets Improvement (P009518)
44. Nicaragua: Rural Roads Infrastructure Improvement Project (P123447)
45. Peru: Rural Roads Projects (P037047, P044601, P095570)
46. Uruguay: Transport Infrastructure Maintenance and Rural Access (P057481)

Social Funds

- 47. Armenia: Social Investment Fund II (P057952)
- 48. Malawi: Social Action Fund Projects (P001668, P110446, P075911)
- 49. Tanzania: Social Action Funds (P085786, P065372)
- 50. Yemen, Republic of: Social Fund for Development (P068830, P082498, P117949)
- 51. Zambia: Social Investment Fund (P063584)

Other

- 52. Ethiopia: Public Sector Capacity-Building Program Support Project (P074020)
 - 53. Nepal: Kabeli Transmission Project (P112893)
 - 54. West Bank Gaza: Village and Neighborhood Development Project (P104257)
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ANNEX 2

Examples of Maintenance Requirements for Rural Infrastructure

Infrastructure type	Routine/preventive maintenance	Periodic maintenance
<p>Rural roads (life span varies according to traffic volume and surface type, but can range from 5 years for earth and gravel roads to 20–30 years for asphalt and cement roads)</p> <p>Responsibility</p>	<p>Regular inspections; erosion control on shoulders and slopes; clearing of vegetation; cleaning drains and culverts; filling of potholes and ruts; spot re-gravelling; and road sign repairs</p> <p>Communities, with support from private contractors as needed</p>	<p>Major repairs to structures; reshaping shoulders; resurfacing or regravelling of entire road; installation of new culverts; stockpiling gravel for use during routine maintenance</p> <p>Communities, with support from private contractor and/or municipalities</p>
<p>Bridges</p> <p>Responsibility</p>	<p>General clean-up of bridge and drainage channel; clearing of vegetation; maintenance of bridge ramp; periodic painting of structure</p> <p>Communities</p>	<p>Maintenance of upper structure, wood, concrete planks, metal construction, and so forth; maintenance of bridge abutment and pillars; replanting grass</p> <p>Communities, with support from private contractor and/or municipalities</p>
<p>Water supply, 01</p> <p>Hand pumps (lifecycle 2 years)</p> <p>Responsibility</p>	<p>Daily cleaning of pump and site and checking performance; occasional replacement of seals and washers</p> <p>Usually by community operator</p>	<p>Repair of pump platform, repair or replacement of pump</p> <p>Community using local mechanic with support from municipality or government agency if needed</p>
<p>Water supply, 02</p> <p>Public taps/standpipes (average life span, 5 years)</p> <p>Responsibility</p>	<p>Daily inspection and cleaning of site and drains, checking for drips or leakages, replacement of washers and other parts</p> <p>Usually by community caretaker</p>	<p>Repairs to pipes, wall, apron, or drains as needed; maintenance of buildings</p> <p>Usually annually by community using local plumber and mason</p>
<p>Water supply, 03</p> <p>Drilled wells or boreholes (life cycle usually over 20 years)</p> <p>Responsibility</p>	<p>Daily cleaning of apron, occasional cleaning of drain and fence repairs; regular maintenance of pump</p> <p>Usually by community caretaker on an ongoing basis</p>	<p>Desilting or rehabilitation of well (5–8 years); repair of pump</p> <p>Usually by a specialized well company with financing from community in coordination with municipality and water agency</p>

Infrastructure type	Routine/preventive maintenance	Periodic maintenance
Water supply, 04 Irrigation drainage canals (5–7 years) Responsibility	Ongoing cleaning of artesian site; weed clearance; removing floating debris; monitoring water quality; maintaining seeding or fencing of banks Community (with assistance as needed from municipality)	Silt clearance (2–3 years); repairing structures (3–6 years) Private contractor, municipality
Public buildings (schools, health posts) (life span 5–15 years) Frequency/responsibility	Cleaning and general maintenance of buildings and grounds; disposal of medical waste (by health staff) Community responsible for cleaning and general maintenance	Repainting, repairing cracks, broken fixtures, replacing broken windows and doors (3–5 years); reroofing (10 years); rewiring, maintaining, and fixing or renewing plumbing Community, supported local contractors, local government, and relevant agency (education or health)
Electricity system (transformer construction) Frequency/responsibility	Regular cleaning of site; maintenance of area around the substations Communities on an ongoing basis	Repair to power lines Electricity authority

Source: Adapted from World Bank, WHO, FAO, and ILO reports.

ANNEX 3

Questions for Task Teams when Planning for O&M Design and Implementation in CDD Projects

Community Capacity

- What degree of local capacity is available at the community level for planning, design, procurement, contract management, and supervision of small-scale infrastructure projects? How can this capacity be supported or enhanced? Are there trained engineers in the community who can lead or represent communities on technical matters including O&M?
- How will capacity be mobilized to manage O&M responsibilities?
- Are there competent local contractors or private firms who can be hired for O&M?

Technical Support

- How can communities be provided with appropriate technical support at the design and construction stages, to improve both the quality and cost-efficiency of small-scale infrastructure (including various design choices, costs and O&M requirements)?
- How much emphasis do community participation processes and community capacity development place on technical aspects of asset management?
- Are O&M plans technically adequate, itemized, and costed out? Do they include costs for routine maintenance and wear and tear, as well as periodic maintenance and capital repair?
- Are O&M plans reviewed and approved by technically competent experts?
- Do local governments and line ministries have adequate technical capacity to support communities?

Financing

- How will O&M be financed after subproject completion—will it be financed by communities or will there be cost sharing or resource allocation from local authorities or agencies?
- Do local governments and line ministries have the resources to support O&M? If so, do they have multiyear budgeting, or do they have annual budgeting?
- If communities finance O&M expenses, how will fees be charged and collected? Will users pay fees based on usage, or based on norms (for example, household size), or some other criteria that will ensure fair contribution to O&M requirements?
- Are O&M funds set up prior to construction completion, and are they based on anticipated mid-term O&M outlays, or on how much community members can afford?

Institutional Arrangements

- What are the institutional arrangements for ensuring the sustainability and effectiveness of O&M (for example, maintenance plans, resource allocation, clearly defined roles and responsibilities assigned across communities and different levels of administration, governance structures, and so forth)?
- Are ownership and management responsibilities (which can be assigned to different entities) clear?
- Can communities legally own assets? If not, will local government or relevant line ministry formally include the built infrastructure in their log of assets?

ANNEX 4

Links to O&M Materials on CDD Intranet Site

Operational and Other Manuals

- AzRIP OM (Vol. 2)
- Afghanistan NSP OM (May 2012)
- India Maharashtra Rural Water Supply Community Operational Manual (2003)
- India Punjab RWSS OM (Section III, Implementation Arrangements)
- Indonesia PNPM OM (March 2014)
- Moldova Social Investment Fund OM (2007)
- Nepal RWSS—O&M Section of Operations Manual (Annex 22)
- Nepal RWSS—District Level WASH Implementation Guidelines
- Philippines KALAH I Community-Based Infrastructure Subprojects Manual
- Philippines KALAH I Rural Water Supply O&M Manual (WPP—2012)
- Philippines KALAH I Roads and Bridges Manual
- Romania RDP O&M
- Sri Lanka Gemidiria—Managing O&M Section of Operations Manual

TORs

- Philippines—Role of O&M Group (extracted from Roads and Bridges Manual)
- Afghanistan NSP O&M Committee TOR for Water Supply Subprojects
- Azerbaijan Rural Investment TOR for Design Firms
- Armenia SIF 3 TOR for Quality of Works Supervisor
- Nepal RWSS—Roles and Responsibilities of O&M Stakeholders (extracted from OM)
- Myanmar Technical Audit TOR
- Lao PDR Technical and Cost Effectiveness Study TOR

O&M Plans (Template and Examples)

- AzRIP O&M plans
- Afghanistan NSP Motorized Water Supply Network O&M Plan
- Afghanistan NSP Well with Hand Pump O&M Plan
- Afghanistan NSP Microhydro Plan
- Afghanistan NSP Guidelines and O&M Plan Template for Microhydro Projects
- India Punjab RWSS O&M Cost Estimates
- Philippines KALAH I Sample O&M Plan
- Format for an O&M RWSS Plan (Uganda RWSS)

- Guidelines for RWSS Tariff Setting (Uganda RWSS)
- Methods of Collecting Funds (Uganda RWSS)

O&M Training/Guidance Materials for Communities

- AzRIP O&M Brochure
- Indonesia PNPM—Good and Bad Infrastructure (Volume A, Roads and Bridges)
- Indonesia PNPM—Good and Bad Infrastructure (Volume B, Other Infrastructure)
- Bangladesh LGSP Good Practices Handbook
- India Handbook for Gram Panchayats (Water)
- India RWSS O&M Training Course Outline for Engineers
- Nepal RWSS Post-Construction Guidelines
- Nepal Handbook on Communitywide Water Safety Planning
- Nepal Radio Campaign Messages on Water and Health
- Philippines Roads and Bridges Manual (pp. 151–79, Strategy for O&M)
- Philippines Small-Scale Infrastructure Manual (pp. 119–35, Strategy for O&M)
- Romania RDP O&M Training Outline and Materials
- Linking Technology Choice with O&M in Community Water Supply and Sanitation
- Training Toolkit on Building Maintenance for Engineers (HSMI/F/GR 2003)
- Performance-Based Routine Maintenance of Rural Roads: Manual for Maintenance Groups (ADB)
- Team-Based Maintenance of Rural Roads: Implementation Manual (ILO)

Forms and Schedules for O&M

- Philippines: Forms and Schedules for Road Maintenance (taken from PHL Roads and Bridges Manual)
- Philippines: Forms and Schedules for Bridge Maintenance (taken from PHL Roads and Bridges Manual)
- Philippines: Forms and Schedules for Concrete Pavement Maintenance (taken from PHL Roads and Bridges Manual)

Other

- Nepal RWSS Agreement between District Authorities and Communities (including maintenance arrangements)
- Philippines KALAHI-CIDSS Sustainability Evaluation Tool Example
- Philippines KALAHI-CIDSS Mutual Partnership Agreement
- Uganda RWSS: O&M Factors and Requirements for Different Technologies

ANNEX 5

Sample O&M Measures and Performance Assessment Timeline

O&M measure	Time frame for assessment	Source
O&M committee in place, trained and functioning as planned.	Before subproject approval; during project implementation; post-construction (semiannual spot checks).	PIU and Bank team semiannual project supervision missions. O&M evaluation audit 1–2 years after infrastructure completion.
O&M plans (including schedule of activities, role definition, and financing) in place at start of project and updated post-construction.	Before subproject approval; post-construction (semiannual spot checks).	PIU and Bank team semiannual project supervision missions. O&M evaluation audit 1–2 years after infrastructure completion.
<p>Condition/functionality of infrastructure (examples below):</p> <p><i>Roads</i></p> <p>Road elements cleared and kept free of damaging vegetation (surface, side drains, culverts, bridges);</p> <p>Vegetation planted on slopes to prevent erosion;</p> <p>Road elements repaired as needed (ruts, rills, potholes, shoulders, drainage systems, retaining walls).</p> <p>Water pumps/public standposts</p> <p>Site kept clean</p> <p>Drains cleaned</p> <p>Minor repairs made as needed (seals, washers, pump rod, handle, cylinders, valves, piping, and so forth).</p>	Semiannual spot checks after infrastructure completion, or when it is likely that maintenance will be needed. For example, with roads, more maintenance work is needed during the rainy season to avoid damage from flowing water and to control the vegetation.	<p>Post-construction O&M audits conducted by engineers or technical teams 1–2 years after completion.</p> <p>Technical evaluations conducted 3–5 years after infrastructure completion.</p>

References

- ADB (Asian Development Bank). 2012. "The KALAHI-CIDSS Project in the Philippines—Sharing Knowledge on Community-Driven Development".
- Araral, E., and C. Holmemo. 2007. "Measuring the Costs and Benefits of Community-Driven Development: The KALAHI-CIDSS Project, Philippines." Social Development Paper 102, World Bank, Washington, DC.
- Altai Consulting. 2013. "Afghanistan NSP Subproject Sustainability".
- Barron, P. 2011. "Community-Driven Development in Post-Conflict and Conflict Affected Areas—Experiences from East Asia." Working Paper 61225, World Bank, Washington, DC.
- Beath, A., F. Christia, and R. Enikolopov. 2013. "Randomized Impact Evaluation of Afghanistan's National Solidarity Project." World Bank, Washington, DC.
- Brikké, F. 2000. "Operation and Maintenance of Rural Water Supply and Sanitation Systems." IRC, Delft, Netherlands, prepared for WHO.
- Brikké, F., and M. Bredero. 2003. "Linking Technology Choice with Operations and Maintenance in the Context of Community Water Supply and Sanitation". WHO and IRC Water and Sanitation Center, Geneva.
- Burmingham, S., and N. Stankevich. 2005. "Why Road Maintenance Is Important and How to Get It Done." Transport Note No. TRN-4, World Bank, Washington, DC.
- Carter, R. 2009. "Operations and Maintenance of Rural Water Supplies." Rural Water Supply Network Perspective No. 2.
- CRISIL. 2013. "Study of PPP Opportunities in Achieving Long-Term Sustainability of Rural Water Supply and Sewerage in Punjab". World Bank, Washington, DC.
- Donges, C., G. Edmonds, and B. Johannesson. 2007. "Rural Road Maintenance: Sustaining the Benefits of Improved Access". International Labour Organization.
- FAO (Food and Agriculture Organization). 1986. "Organization, Operation and Maintenance of Irrigation Schemes." Irrigation and Drainage Paper 40, Rome.
- Gnagey, R. 2010. "Community-Based Maintenance for PNPM." Submitted to AusAID.
- Harral, Clell, and A. Faiz. 1988. "Road Deterioration in Developing Countries: Causes and Remedies". World Bank Policy Study, Washington, DC.
- Lebo, J., and D. Schelling. "Design and Appraisal of Rural Transport Infrastructure: Ensuring Basic Access for Rural Communities." Technical Paper No. 496, World Bank, Washington, DC.
- Mackie, Peter, John Nellthorp, and James Laird. 2005. "Treatment of Maintenance." Transport Note No. TRN-13, World Bank, Washington, DC.
- Malmberg Calvo, C. 1998. "Options for Financing and Managing Rural Transport Infrastructure." Technical Paper No. 411, World Bank, Washington, DC.
- Mansuri, G., and V. Rao. 2013. "Localizing Development: Does Participation Work". World Bank, Washington, DC.
- Ministry of Water and Environment. 2011. "National Framework for Operation and Maintenance of Rural Water Supplies in Uganda."
- Muzira, S. 2014. "Rethinking Infrastructure Delivery: Case Study of a Green, Inclusive and Cost-Effective Road Program in Nicaragua." Transport Paper 43, World Bank, Washington, DC.
- Neate, Neil. 2012. "Indonesia PNPM Mandiri Rural Infrastructure Technical Evaluation Report". PNPM Support Facility.
- OED (Operations Evaluation Department). 2005. "The Effectiveness of World Bank Support for Community-Based and Driven Development: An OED Evaluation". World Bank, Washington D.C.
- Practical Action, Schumacher Centre for Technology and Development. [[Q: need date]] "School Buildings in Developing Countries." Practical Action Note, Warwickshire, UK.

- Simatovic, M. 2008. "Impact of the Rural Roads Program on Democracy and Citizenship in Rural Areas of Peru". Washington, DC: World Bank.
- Van Rijn, J. 2006. "Road Maintenance Planning." In *Development*, the Netherlands.
- WEF (World Economic Forum). 2014. "Strategic Infrastructure Steps to Operate and Maintain Infrastructure Efficiently and Effectively." Industry Agenda, prepared in collaboration with the Boston Consulting Group.
- Western World Consultants. 2010. "Ex-Post Technical/Engineering Assessment of AzRIP".
- Whitford, Peter, and Kavita Mathur. 2005. "The Effectiveness of World Bank Support for Community-Based and -Driven Development." Background Paper, Safeguard Policy Review, World Bank, Washington, DC.
- Wong, S. 2012. "What Have Been the Impacts of World Bank Community-Driven Development Programs? CDD Impact Evaluation Review and Operational and Research Implications." Working Paper 69541, World Bank, Washington, DC.
- World Bank. 2007. "Enabling East Asian Communities to Drive Local Development: East Asia Region CDD Flagship Report." Unpublished mimeo.
- World Bank 2010. "Village Capacity in Maintaining Infrastructure: Evidence from Rural Indonesia". Jakarta.
- World Bank 2013. "Designing Community-Driven Development Operations in Fragile and Conflict Situations: Lessons from a Stocktaking". Social Development Department, World Bank, Washington, DC.





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