



**ASIAN DEVELOPMENT FUND (ADF)**  
**ADF XI MIDTERM REVIEW MEETING**  
12–13 November 2014                      Manila, Philippines

**Asian Development Fund  
and Infrastructure Sustainability:  
Building the Capacity for Asset Management**

**Asian Development Bank**

October 2014

## ABBREVIATIONS

ADB	–	Asian Development Bank
ADF	–	Asian Development Fund
CEFPF	–	Clean Energy Financing Partnership Facility
DMC	–	developing member country
O&M	–	operation and maintenance
TA	–	technical assistance

## NOTE

In this report, “\$” refers to US dollars, unless otherwise stated.

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## EXECUTIVE SUMMARY

The Asian Development Fund (ADF) is a major instrument of concessional financing that has delivered development solutions to Asia's lowest-income economies since 1973. Infrastructure delivery in the form of electricity, irrigation, roads, and water services represents the largest investment area. A principal question in evaluating such investments is whether the development results endure with time. Are the mechanisms and capacity in place to ensure long-term sustainability?

This paper analyzes infrastructure sustainability for ADF investments from 2005 through 2012, and seeks to identify the salient lessons in realizing effective asset management. In particular the paper examines the agriculture and natural resources, energy, transport, and water sectors.

During the ADF IX and X replenishment periods (2005–2012), 75% of completed energy sector projects were rated *most likely sustainable* or *likely sustainable* at project completion, followed by agriculture and natural resources at 48%, and then both transport and water at 42%. The energy sector has tended to perform better as its operations generate revenues from customers to finance operation and maintenance. However, all infrastructure sectors face challenges in governance and financing and in sustaining capacity to manage the challenges of asset management.

This paper details the experiences and lessons identified by the Asian Development Bank (ADB) with asset management initiatives. In ADB's regional departments, innovative approaches to asset management are being piloted and replicated. In the energy sector, while large power plants have performed relatively well, rural electrification and its accompanying challenges with limited technical and human resources for maintenance are a focus area.

With irrigation projects, rigorous asset management is a relatively recent focus for the sector, but ADF operations are increasingly investing in institutional capacity development and organizational reforms. Over \$600 million have been invested in activities related to irrigation asset management for ADF operations (2005–2012).

In the transport sector, virtually every ADB road project today in each region includes support for road maintenance, whether as the overall focus of the project, as a project output, or through accompanying technical assistance. Nevertheless, maintaining roads in good condition will remain a persistent challenge. The continued development of road maintenance funds and the use of technology to survey road quality are among mechanisms being developed. ADB has also made increasing use of performance-based contracting in the transport sector to appropriately incentivize asset management.

Effective asset operation and maintenance is integral to water service operations. Poor asset management leads to water losses, reduced service and quality, and higher costs. All water services projects address sustainability since by their nature they have a focus on operations, but nevertheless physical maintenance often falls behind a focus on financial sustainability. Improvements in cost recovery continue to be a priority. ADB has found that the best-performing water utilities take a holistic, long-term view to system planning.

This paper identifies the principal challenges and contemporary issues facing ADB in its drive for improved infrastructure sustainability. It recognizes the importance of incentivizing asset management and enhancing service delivery, and creating accountability.

Perhaps the single most important factor identified for improved infrastructure sustainability is ensuring an investment in human resources around asset management. Empowering local stakeholders with the appropriate skill set remains a cost-effective means to long-term sustainability. With a new capacity development framework under development, ADB is expanding its tools to build local capacity to create the conditions for responsible and accountable management of infrastructure assets.

## I. INTRODUCTION

### A. The Asian Development Fund and Infrastructure Investments

1. Since 1973, the Asian Development Fund (ADF) has supported more than \$50 billion in investments. During 2009–2013, the Asian Development Bank (ADB) Board of Directors approved more than 250 loans and grants through the ADF, with an approximate total investment of \$15.5 billion. Infrastructure represents a principal focus of ADF investment both in monetary terms and in providing the physical basis for inclusive and sustainable development. Among the ADF-financed infrastructure components and the associated outcomes achieved during this period are:

- (i) installation of 230 megawatts of new generating capacity;
- (ii) building or upgrading of 22,500 kilometers of electric power transmission and distribution lines;
- (iii) building or upgrading of 38,000 kilometers of roads;
- (iv) improvement of travel times for 123 million people;
- (v) installation of 16,500 kilometers of water pipes;
- (vi) upgrading of sanitation systems to 376,000 households;
- (vii) connection of water supply to 2.4 million new homes; and
- (viii) provision of irrigation, drainage, and flood management facilities to more than 2.3 million hectares of land.

2. While these figures are indicative of the physical outputs and beneficiary numbers from ADF investments, a principal question in analyzing the effectiveness of such investments is the long-term durability and sustainability of these efforts. Do the envisioned developmental benefits endure beyond the initial project completion period and provide lasting transformation to those recipients who most need it? Or does the lack of absorptive capacity mean that the quality and usability of the investments quickly fade? What mechanisms does ADB put in place to ensure countries have the capability and capacity<sup>1</sup> to maintain investments? These questions are particularly relevant for the 29 recipient countries of the ADF, as these countries are the most likely to lack the necessary resources to operate and maintain the new infrastructure over the medium and long term.

### B. Objectives and Scope

3. This paper analyzes the sustainability of ADF infrastructure investments from 2005 to 2012 and the contribution of asset management systems to long-term sustainability.<sup>2</sup> It seeks to articulate the state of infrastructure asset management with respect to ADF investments and the way forward in enhancing project sustainability. The paper is prepared as background input to the 2014 Midterm Review of the ADF's 10th replenishment (ADF XI).

4. The importance of infrastructure sustainability closely echoes many of the key findings of the recent Midterm Review of Strategy 2020,<sup>3</sup> the overarching corporate strategy of ADB.<sup>4</sup> The

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<sup>1</sup> "Capability" refers to possessing the appropriate skill sets to undertake asset management. "Capacity" refers to possessing the required resources (in terms of human and financial resources) to implement asset management.

<sup>2</sup> ADF IX (2005–2008) and ADF X (2009–2012).

<sup>3</sup> ADB. 2014. *Midterm Review of Strategy 2020: Meeting the Challenges of a Transforming Asia and the Pacific*. Manila.

<sup>4</sup> ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008–2020*. Manila.

review recognizes that “infrastructure will continue as a key focus of ADB operations” and that “improving weak governance and institutional capacity” is fundamental to project success. It emphasizes the core objective of “operational and financial sustainability of infrastructure projects.”

5. In 2013, ADB’s annual evaluation review by the Independent Evaluation Department focused on the sustainability of ADB operations with an emphasis on infrastructure asset management.<sup>5</sup> This work follows a 2010 study on post-completion sustainability of ADB projects.<sup>6</sup> While these studies looked at overall ADB performance with respect to sustainability and asset management, the current paper examines sustainability achievements within ADF infrastructure investments. This paper draws principally from specific ADF project experience and includes the general experience in ADF countries. It presents the specific project experiences with asset management in the infrastructure sectors of agriculture and natural resources, energy, transport, and water.

## II. ADF AND INFRASTRUCTURE SUSTAINABILITY

### A. Overview of ADF Infrastructure Investments

6. Infrastructure represents the largest investment area under the ADF. The principal infrastructure sectors are agriculture and natural resources, energy, transport, and water (Table 1). During ADF IX through ADF X, investment in these sectors rose significantly from 37.7% of total investments to 53.8%. The bulk of this increase stemmed from the transport sector. Growth in infrastructure financing has been notable in ADF-only countries where the investment share of transport and energy projects increased to 56.9% of approvals under ADF X.

**Table 1: Amount of ADF Loan and Grant Approvals by Sector, 2005–2012**  
(% share of ADF replenishment period total)

Sector	Country Classification/Replenishment Period					
	ADF-only <sup>a</sup>		Blend <sup>b</sup>		Total	
	ADF IX	ADF X	ADF IX	ADF X	ADF IX	ADF X
Energy	19.1	17.7	1.7	10.1	6.7	13.0
Transport	32.9	39.2	14.1	25.7	19.4	30.9
Water	5.0	9.2	14.2	10.3	11.6	9.9
Multisector	6.0	4.5	30.8	8.8	23.7	7.2
Finance	9.0	2.8	2.8	7.1	4.6	5.4
Education	5.5	7.5	9.7	10.4	8.5	9.3
Agriculture and natural resources	10.5	9.1	8.0	11.7	8.7	10.7
Health	1.2	1.6	10.0	6.0	7.5	4.3
Industry	1.4	1.0	0.3	0.8	0.6	0.9
Public sector management	9.5	7.4	8.4	9.1	8.7	8.4
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Total Approved Amount (\$ million)</b>	<b>2,316.1</b>	<b>4,538.5</b>	<b>5,797.3</b>	<b>7,319.8</b>	<b>8,113.3</b>	<b>11,858.4</b>

ADF = Asian Development Fund, ADF IX = 2005–2008, ADF X = 2009–2012.

<sup>a</sup> Based on classification as of 2014.

<sup>b</sup> Includes ADF approvals for current blend and graduated developing member countries and for regional projects.

Source: Asian Development Bank

<sup>5</sup> Independent Evaluation Department. 2013. *2013 Annual Evaluation Review*. Manila.

<sup>6</sup> Independent Evaluation Department. 2010. *Post-Completion Sustainability of Asian Development Bank-Assisted Projects*. Manila.

7. During ADF X, the number of projects with themes of capacity development, environmental sustainability, private sector development, and regional cooperation increased sharply from the ADF IX period (Table 2). The results show an alignment with priorities under Strategy 2020. Since capacity development is closely related to the effectiveness of maintenance practices, the increase during ADF X indicates that long-term sustainability is expected to improve with these projects.

**Table 2: ADF Operations by Strategy 2020 Priorities, 2005–2012**  
(% of projects or programs)

Theme	ADF IX	ADF X
Environmental sustainability	12	34
Regional cooperation	11	26
Capacity development and governance	58	71
Gender mainstreaming	39	55
Private sector development	16	28

ADF = Asian Development Fund.

Note: A project may contribute to more than one of the strategic agendas and drivers of change. Thus, the sum of the percentages may add to more than 100%.

Source: Asian Development Bank

## B. Effectiveness and Sustainability

8. Effectiveness refers to the project's achievement of the envisaged development outputs and outcomes. Sustainability is defined as the probability that human, institutional, financial, and natural resources are sufficient to maintain the outcome over the project's economic life and that risks can be managed. Table 3 summarizes the effectiveness and sustainability ratings by sector for completed ADF projects. Projects evaluated as highly effective or effective and most likely sustainable or likely sustainable form the basis of the scores in the table.

9. Energy operations achieved the highest sustainability ratings among infrastructure operations, with 75% rated sustainable, followed by agriculture and natural resources (48%), and then transport and water (both at 42%). The energy sector has tended to perform better on sustainability as efficient operations are usually a key part of the business case for power enterprises. The energy sector is able to generate revenues from customers that can finance operation and maintenance (O&M). The power system also typically works toward one national grid, and often possesses high technical and organizational capacity.

10. Sustainability scores of operations vary strongly by country, with economic status playing a more significant role than is the case for project success scores (footnote 5, para.71). The conclusion from this work suggests that sustainability has as much to do with sector mix of operations, sector capacity, and governance, as with country economic status and associated fiscal space.

11. Sustainability ratings correlate somewhat with effectiveness ratings but not strongly. In three of the sectors, above-average proportions of projects are rated effective but also less likely sustainable: (i) water, (i) transport, and (iii) agriculture and natural resources (sectors with a large proportion of infrastructure operations). This result may indicate that the economic resources being generated are not being devoted sufficiently to sustain outcomes (footnote 5, para. 73). A recent evaluation of post-completion project sustainability showed that operations rated likely sustainable (or better) performed well on institutional capacity (footnote 5, para. 74).



**Table 3: Effectiveness and Sustainability Rates of ADF Operations, 2005–2012**

Sector	Project Completion Reports (No.)	Effectiveness	Sustainability
		Highly Effective and Effective (%)	Most Likely Sustainable and Likely Sustainable (%)
Agriculture and natural resources	79	65	48
Education	38	75	78
Energy	21	90	75
Finance	28	60	53
Health	16	92	87
Industry	11	63	62
Multisector	41	77	61
Public sector management	27	58	50
Transport	40	89	42
Water	35	65	42
<b>All sectors</b>	<b>336</b>	<b>72</b>	<b>56</b>

ADF = Asian Development Fund, No. = number.

Source: Asian Development Bank.

12. A survey of ADB project officers conducted for this paper found that 83% of staff report that developing member country (DMC) officials generally prioritize infrastructure capital investment over effective O&M (Appendix 1). The survey also indicates that approximately 6% of all DMC assets are in good condition, 50% are in fair but deteriorating condition, 42% are in poor condition, and approximately 2% are in a current state far beyond their serviceable life. The principal reasons cited for poor performance of infrastructure O&M are (i) lack of budget; (ii) lack of data, information and systems; and (iii) lack of agency support. The survey indicates that for DMC clients (i) 6% had adequate capacity for asset management, (ii) 44% were somewhat capable but needed selective support, and (iii) 50% had limited capacity and needed extensive support.

13. Through a review by the ADB's Independent Evaluation Department, the presence of project preparatory technical assistance was found to be pivotal to overcoming weak institutional capacity and achieving project success.<sup>7</sup> Quality project preparation helps achieve sustainability by establishing realistic and appropriate technical, fiscal, and policy components at the outset. The report identifies close involvement of ADB resident missions as an important factor contributing to success.

### C. Future Infrastructure Investment and Maintenance Needs

14. ADB recently estimated future demand for key infrastructure investment and maintenance requirements in ADF countries during 2014–2024 (Table 4). Maintenance expenditure is estimated at \$291 billion, which is nearly the same as the amount projected for new infrastructure investment requirements at \$296 billion in ADF countries. The transport, energy, and water sectors combined are expected to represent 82% of total investment and maintenance spending over the 10 years, about 20% higher than the amount of project and program approvals under ADF IX and X. Road investment accounts for the largest share of the total spending at \$240 billion (41%), of which \$98 billion represents new investment and \$142 billion represents maintenance.

<sup>7</sup> Independent Evaluation Department. 2012. *The Asian Development Fund Operations: A Decade of Supporting Poverty Reduction in the Asia and Pacific Region*. Manila (para. 207).

**Table 4: Infrastructure Investment Needs for ADF Countries by Sector, 2014–2024**  
(\$ billion)

Sector/Subsector	New Investment		Maintenance		Total	Distribution
	Amount	%	Amount	%	Amount	(%)
<b>Transport</b>	<b>99</b>	<b>40</b>	<b>147</b>	<b>60</b>	<b>246</b>	<b>42</b>
Road	98	41	142	59	240	41
Rail	1	15	5	85	6	1
<b>Energy</b>	<b>121</b>	<b>70</b>	<b>52</b>	<b>30</b>	<b>172</b>	<b>29</b>
<b>Telecommunications</b>	<b>43</b>	<b>43</b>	<b>56</b>	<b>57</b>	<b>99</b>	<b>17</b>
Landline	3	27	8	73	11	2
Mobile	40	45	48	55	88	15
<b>Water</b>	<b>33</b>	<b>48</b>	<b>36</b>	<b>52</b>	<b>69</b>	<b>12</b>
Water	9	37	15	63	24	4
Sanitation	24	54	21	46	45	8
<b>Total</b>	<b>296</b>	<b>50</b>	<b>291</b>	<b>50</b>	<b>586</b>	<b>100</b>

ADF = Asian Development Fund.

Source: Asian Development Bank. 2014. *Estimating Infrastructure Demand and Financing Needs of ADF Countries for 2014–2024*. Manila (Table 1).

### III. EXPERIENCE AND LESSONS

15. ADB has gained substantial ADF-country experience with asset management across its core infrastructure sectors of agriculture and natural resources, energy, transport, and water services. This experience and lessons identified will influence ADB approaches to asset management and capacity development.

#### A. Agriculture and Natural Resources

16. While the agriculture and natural resources sector represents an array of investment types, the principal infrastructure component of the sector's investment portfolio relates to irrigation systems, which is the focus of this section. Irrigation infrastructure encompasses canals, drains, and supporting structures.

##### 1. Experience

17. **Comprehensive and rigorous asset management.** The main developments in approaches to asset management in irrigation occurred in the late 1990s. This coincides with a period of investments by development partners in institutional reform and recognition of public system decay in irrigation. Overall asset management remains less widely observed in the agriculture and natural resources sector, which is more typically characterized by renovation or modernization of existing infrastructure as a result of deferred maintenance. Under ADF IX and X, total lending for irrigation and flood management was \$1.41 billion. A summary of total investments is presented in Appendix 2, Table A2.1.

18. **Asset performance assessments lead to cost estimates for long- and short-term expenditure planning.** Asset assessments and management planning identify the relevant assets and quantify their condition and performance. Private sector engagement for asset management is more commonly observed in urban water and sanitation services. Irrigation and

water resources remain nascent in this context, although groundwater irrigation is quite often privately owned and operated by individual users.

19. **Asset management activities in ADF operations focus on institutional capacity development, organizational reforms, and physical investments.** ADB data indicate that about \$600 million was invested in asset management related activities through ADF lending operations (2005–2012), particularly under irrigation projects. Examples of strengthening asset management under new projects are provided in Box 1. Specific interventions for system diagnostics, use of information technology for asset inventory, management plan development, and skills training are being considered for the future.

**Box 1. Profiles of Capacity Development in Water Resources and Irrigation Projects**

**Bangladesh.** Under the Bangladesh Participatory Small-Scale Water Resources Sector Project (\$55 million ADF loan), the executing agency receives capacity-building training for operation and maintenance (O&M).<sup>a</sup> In addition, the agency's management information systems database is being expanded to provide more practical information relating to infrastructure maintenance planning. A more broad-based approach (incorporating technical, institutional, financial, and social aspects) to maintenance is being introduced through an O&M strategy for small-scale water resource subprojects. This prioritizes (i) increasing maintenance cost-sharing between the government and water user groups; (ii) developing more realistic maintenance cost estimates; and (iii) extending the subproject development process to include implementation of subproject O&M plans, and reorienting and mentoring subproject beneficiaries and government field staff for improved O&M.

**Viet Nam.** The Viet Nam Central Region Water Resources Project (\$74.3 million ADF financing) provides improved irrigation system management by (i) reforming service providers and concomitantly building capacity of client water users as partners in scheme O&M, and (ii) improving irrigation and drainage infrastructure to strengthen natural disaster risk reduction.<sup>b</sup> The project recognizes that participation of water user groups in the planning, design, implementation, and O&M of subprojects is not only indispensable for sustainable operation, but is also a cost-efficient means of helping service providers meet their goals.

<sup>a</sup> ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan to the People's Republic of Bangladesh for the Participatory Small-Scale Water Resources Sector Project*. Manila.

<sup>b</sup> ADB. 2005. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the Socialist Republic of Viet Nam for the Central Region Water Resources Project*. Manila.

Source: Asian Development Bank

20. **Deteriorating assets represent a key constraint even with asset management improvements.** India, for example, with the largest irrigated area in Asia, is grappling with rapid deterioration of existing irrigation systems. Maintenance is neglected leading to poor capacity utilization, declining groundwater, poor water quality, and low water productivity.<sup>8</sup> The ability to meet the future food-supply challenges may depend largely on sustainability of improvements made to irrigation infrastructure. Although India is not an ADF country, the lessons from the asset management of its irrigation systems are considered generally applicable to the region.

21. **Weak staff capacity and many small and fragmented agencies involved.** With limited capacity, fragmented responsibilities, limited involvement of commercial principles in water allocation, and weak strategic planning, irrigation holds much in common with water

<sup>8</sup> Productivity is the ratio between a unit of output and a unit of input, Food and Agriculture Organization. 2003. *Unlocking the water potential of agriculture*. Rome.

services. Mispricing and inefficiency in infrastructure and service provision results in substantial lost opportunities.

## 2. Lessons

22. **Technical institutions and practitioners need greater access to recent research and guiding literature on asset management.** Technical performance targets are rarely specified for irrigation and should be introduced as part of a more customer-oriented approach. The standards of customer service for irrigation require clearer definition of roles for regulators and providers.

23. **Appropriate policy and institutional frameworks are required for introducing more long-term planning and operating responsibilities, and setting performance targets.** The ineffective provision of government subsidies to the agriculture sector acts as a disincentive for improved system performance, cost recovery for irrigation services, and systematic maintenance. Scaling back subsidies, though politically challenging, can result in more commercially oriented irrigation. A critical objective is to reduce DMC reliance on infrastructure development as a solution to deferred maintenance and emergency repair works following flood damage. This tendency results in poor utilization of maintenance budgets, confusion between periodic and emergency maintenance needs, and repair works of low durability. The long-term budgetary implications of deferred maintenance mean that greater emphasis should be given to this issue during project design.

## B. Energy

### 1. Experience

24. **Energy sector work prioritizes support for renewable energy, energy efficiency, and access to energy for the poor.** The objective of ADB's Energy Policy is to help DMCs provide reliable, adequate, and affordable modern sources of energy for inclusive and sustainable growth.<sup>9</sup> ADB support for clean energy seeks to address the major issues facing the Asian energy sector, namely the threat of climate change and the need for greater energy security. ADB's focus on energy access is a response to widespread energy poverty in the region. All these facets of ADB energy sector work have critical asset management components: the O&M of new renewable energy infrastructure, and the retrofit and upgrade of existing systems for greater energy efficiency. Energy access for the poor has the added components of capacity building for poor beneficiaries and the requirement to provide after-sales services to ensure longevity of the systems.

25. **Energy represents 16% of ADF loan and grant funding operations under ADF IX and ADF X.** A summary of total energy sector investments is provided in Appendix 2, Table A2.2. Typical lending operations involve large-scale projects, such as the construction of new power plants or the upgrading of existing plants and power transmission infrastructure for greater efficiency. Large-scale projects are, by design, greatly concerned with asset management over the long term. Their implementing agencies have a high stake in the system's continued performance over its lifetime, which is often decades. In Nepal, the main component of the Energy Access and Efficiency Improvement Project supported the retrofit of run-of-river

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<sup>9</sup> ADB. 2009. *Energy Policy*. Manila.

hydropower plants to increase their efficiency after nearly two decades of operation.<sup>10</sup> The more efficient generation was enhanced through the construction of new transmission lines and substations to deliver the electricity to new low-income customers.

**26. Innovative approaches to asset management for rural electrification.** The experience of Bhutan's Green Power Development Project is indicative of the challenges with rural electrification projects: (i) higher O&M costs for electricity services to rural areas, (ii) customers with limited payment capacity, and (iii) local contractors with limited technical and human resources capacity for O&M.<sup>11</sup> To meet these challenges, ADB tasked the national Bhutan Power Corporation to implement the rural electrification component, through the use of funds generated by the project's main component—the construction of a hydropower plant that would sell power to India. The cross-subsidizing of lower tariffs for rural customers allowed Bhutan to achieve its national rural electrification targets. Further gains in O&M were made by improvements to Bhutan Power Corporation's administrative efficiency and by ADB assistance in developing a computerized inventory control system.

## 2. Lessons

**27. Sustainability of energy sector operations based on quality project design and dedicated financial instruments.** Sustainability among energy sector projects is relatively strong, with 75% rated *likely sustainable*. The diversity of types of energy projects has led ADB to a variety of approaches to asset management, even among projects that utilize similar technologies. For example, several ADF countries, especially those in the Greater Mekong Subregion and South Asia, have large, untapped hydropower resources. In the Lao People's Democratic Republic, ADB as part of a large group of stakeholders supported the country's first public-private partnership project for a hydropower plant, which would tap hydropower resources and then sell 90% of the generated power to neighboring Thailand. This cross-border regional trade in clean energy is expected to net the Lao People's Democratic Republic \$2 billion in revenue over 25 years. The Nam Theun 2 Hydroelectric Power Project was heavily scrutinized as both a public-private partnership project and for environmental sustainability reasons. ADB, working together with its project partners, ensured that the project could cover its O&M budget, including major maintenance, administrative costs, and the budget for management of the watershed and the national protected area to be established around the dam. One of the instruments for this was the inclusion of a major maintenance reserve account in the project design, which receives allocations to ensure the funding of the hydropower plant's two lifetime overhaul cycles.

**28. A sustainability gap persists with certain energy projects, especially small scale.** Because of the diversity of types of energy projects, three recent energy sector assistance program evaluations for Bangladesh,<sup>12</sup> the Greater Mekong Subregion,<sup>13</sup> and Bhutan<sup>14</sup> were reviewed and offered initial insights into the type of projects that rated poorly for sustainability.

<sup>10</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grants to Nepal for the Energy Access and Efficiency Improvement Project*. Manila.

<sup>11</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Loans, Asian Development Fund Grant, Technical Assistance Grant, and Administration of Grant to the Kingdom of Bhutan for the Green Power Development Project*. Manila.

<sup>12</sup> Independent Evaluation Department. 2009. *Sector Assistance Program Evaluation: Energy Sector in Bangladesh*. Manila.

<sup>13</sup> Independent Evaluation Department. 2010. *Sector Assistance Program Evaluation: Energy Sector in the Greater Mekong Subregion*. Manila.

<sup>14</sup> Independent Evaluation Department. 2010. *Sector Assistance Program Evaluation: Energy Sector in Bhutan*. Manila.

This was followed by a review of completion reports prepared during 2008–2013 for energy sector projects in ADF countries. Two types of energy projects were found to often rate poorly for sustainability: (i) power generation projects often in conflict zones or small countries with substantial political interference in the sector, and (ii) small-scale rural electrification projects. A clear solution for power generation projects in conflict zones is unlikely, but the effects of political instability can be linked to poor tariff setting. The recent completion report for the Samoa Power Sector Improvement Project rated the project *unsustainable* due to inadequate attention to tariff setting and indexation.<sup>15</sup> ADB seeks to address such inadequacies through capacity building and training, whether through loans or technical assistance (TA), and by acting as a reliable, trusted knowledge partner for the DMCs.

29. **Expansion of efforts with rural electrification.** ADB is expanding its energy access operations to low-income communities, including both rural applications of renewable energy sources and grid expansion. Many projects feature off-grid renewable energy sources developed for poor rural communities, such as in Bhutan, where ADB is using an innovative approach to address its sustainability (Box 2).<sup>16</sup> ADF projects include access to energy interventions beyond electrification, especially in areas with TA. For the Cambodia Rural Energy Project, ADB is providing TA to displace the use of highly polluting biomass fuel supplies with clean cooking stoves.<sup>17</sup>



Local woman in Bhutan trained on the maintenance of solar photovoltaic panels.

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<sup>15</sup> ADB. 2001. *Completion Report: Power Sector Improvement Project in Samoa*. Manila.

<sup>16</sup> ADB. 2003. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Technical Assistance Grants to the Kingdom of Bhutan for the Rural Electrification and Network Expansion*. Manila.

<sup>17</sup> ADB. 2014. *Technical Assistance to the Kingdom of Cambodia for the Rural Energy Project*. Manila.

### Box 2. Enhancing Sustainability of Rural Off-Grid Solar Energy Systems in Bhutan

Due to the wide spread and low density of rural communities and the mountainous terrain in Bhutan, electrifying remote villages is costly and difficult. Where the grid extension is assessed technically or economically unfeasible, off-grid electrification has been pursued. ADB's Rural Renewable Energy Development Project specifically developed off-grid rural electrification operations.<sup>a</sup>

The project helped install an additional 930 solar home systems to electrify new households and conducted countrywide surveys to identify existing solar home systems. The surveys concluded that 250 users required immediate operation and maintenance (O&M) services. To rehabilitate these solar home systems and keep adequate stocks for maintenance, the project is helping procure full sets and the parts for solar panels, batteries, controllers, lamps, and wires.

The project also established a sustainable O&M business model to ensure long-term operations of the systems. The Department of Renewable Energy outsourced its O&M services to the Bhutan Power Corporation, the competent national distribution and transmission utility. Bhutan Power Corporation adopted a village technician scheme, which helped it conduct O&M services in remote on-grid rural electrification areas. The village technicians support off-grid customer care and awareness improvement, and regular maintenance and checkup of solar home systems.

The Department of Renewable Energy's new proposal intends to extend this scheme to O&M services of off-grid rural electrification areas. The new systems to be installed through the project will have the upgraded specifications, including maintenance-free batteries, energy-efficient light-emitting-diode lights with long life, and better quality controllers designed to minimize the downstream requirements for repair and maintenance. In addition, the users of solar home systems are requested to pay for 10% of the costs of the replacement parts to instill ownership so the users will be less likely to abuse or misuse the systems causing premature breakdown.

<sup>a</sup> ADB. 2010. *Report and Recommendation of the President to the Board of Directors: Proposed Grant to the Kingdom of Bhutan for the Rural Renewable Energy Development Project*. Manila.  
Source: Asian Development Bank

## C. Transport

### 1. Experience

30. **Road maintenance a priority under ADB's 2010 Sustainable Transport Initiative.** ADF countries possess a combined road network of 1.6 million kilometers, half of which are paved. Approximately 50% of roads are currently assessed as being in poor condition overall. In view of these conditions, ADB has increased its focus on addressing road maintenance.

31. **Transport sector operations, mainly roads, represent about 37% of ADF loan and grant funding operations under ADF IX and ADF X.** A summary of transport investments is provided in Appendix 2, Table A2.3. Typical lending operations include road reconstruction and priority maintenance works, as in the Afghanistan Transport Network Development Investment Program, which supports road maintenance capacity building and the introduction of road asset management systems.<sup>18</sup> In Cambodia, ADF financed the Northwest Provincial Road Improvement Program to improve the provincial road network and a cross-border facility with

<sup>18</sup> ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the Islamic Republic of Afghanistan for the Transport Network Development Investment Program*. Manila.

Thailand.<sup>19</sup> The project includes support for road maintenance and road safety. In South Asia, ADB has been including performance-based contracts and institutional strengthening as a project component to help road agencies introduce modern road asset management systems. Improvements in rural roads are being undertaken in several ADF countries, including Viet Nam where ADF is supporting improvement of 1,000 kilometers of national roads, 2,100 kilometers of rural roads, and hundreds of small bridges with supporting asset management systems. In the Solomon Islands, ADB has supported the establishment of a comprehensive asset management system including the National Transport Fund Act and National Transport Plan, adopted in 2010, and a new asset management system implemented in 2011.<sup>20</sup>



Men laying asphalt on a road in Fiji, which is part of the Road Maintenance Sector Project. Roads in ADF countries are rated as in poor condition overall, but varying by country.

32. **Virtually every ADB road project in each region includes support for road maintenance, as the overall project focus, as a project output, or through accompanying technical assistance.** Similarly, financing agreements for road projects include assurances not only on the proper maintenance of ADB-financed facilities but generally also on increasing the overall financing available for maintaining the road network. Often road conditions and the adequacy of maintenance financing from budgetary and other sources (e.g., tolls) are directly factored into the formulation of lending and TA support. One major past initiative was the 2003 regional TA for Road Funds and Road Maintenance that provided ADB-wide support for disseminating best practices in maintenance and advocating the establishment of road funds as a way of ensuring sufficient funding for road maintenance.<sup>21</sup> However, while many DMCs explored the option of road funds, few implemented them. Even with those that did, the financing provided by road funds was generally not sufficient. Road funds were concluded to be a valuable but not the only component to address road maintenance.<sup>22</sup>

33. **Maintaining roads in good condition is an ongoing challenge.** Even though DMCs have made progress with road maintenance, the expansion of their road networks and

<sup>19</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loans to Cambodia for the Greater Mekong Subregion Northwest Provincial Road Improvement Program*. Manila.

<sup>20</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Asian Development Fund Grant and Administration of Grants to the Solomon Islands for the Second Road Improvement (Sector) Project*. Manila.

<sup>21</sup> ADB. 2003. *Road Funds and Road Maintenance: An Asian Perspective*. Manila (RETA 5871).

<sup>22</sup> V. Vincent, R. Allan, and P. Valley. 2003. *A Regional View of Road Funding Initiatives in Asia*. ([www.worldbank.org/transport/transportresults/partners/adb-rd-funding-2004.pdf](http://www.worldbank.org/transport/transportresults/partners/adb-rd-funding-2004.pdf)).



associated road use has led to rapid increases in the road maintenance workload. Overloading of trucks, which is a common problem in many ADF countries, can cause premature structural failure of road pavement and bridges, significantly shortening the economic life of the road assets. The Independent Evaluation Department recently undertook a desk review of country and sector programming, approval, and evaluation documents<sup>23</sup>, across 22 DMCs, 15 of which were ADF countries.<sup>24</sup> The review found 16 recurring issues relating to the maintenance of publicly funded roads. Inadequate governance and road maintenance capacity, and planning and asset management systems were recognized to be a widespread issue.<sup>25</sup> Sometimes other issues also complicate road maintenance, such as war and/or conflict (reported in four countries) and the occurrence of natural disaster (reported in five countries).

## 2. Lessons

**34. Securing broader, deeper, and more reliable sources of funding is essential.** Across all sectors, 85% of responses for the survey of ADB project officers indicate that budget transfers from finance ministries are the main source of operations and maintenance (O&M) funding. Funding for road and other transport investments is usually done on a year-to-year basis, often as a result of negotiations, resulting in unpredictable maintenance funding that constrains effective management of infrastructure assets over their lifetime. Unavailability of funds for road maintenance was reported for all 22 country situations assessed. Where roads are tolled, maintenance is not usually a problem. Dedicated road funds were established (or were planned) with limited success in 10 of the 22 DMCs studied in 2013. A medium-term perspective for asset management within a longer-term planning framework is considered essential to road sustainability.

**35. Competent staff is needed to operate asset management systems, and to procure and undertake road maintenance.** The strengthening of capacity for planning and implementation by sector agencies in DMCs is a critical challenge as identified by the survey of ADB staff. Capacity enhancement is needed particularly at subnational levels, such as provinces and districts. Engendering ownership and accountability for the quality of planning and implementation of road works and other types of investment is fundamental to providing the necessary environment for effective capacity development. Facilitating the use of competitively tendered, periodic road maintenance contracts using private contractors can improve road maintenance. This approach was proposed to overcome capacity constraints in Timor-Leste through the Road Upgrading Network Sector Project.<sup>26</sup> Inadequate road safety also results from poor road maintenance even if road infrastructure is designed to high initial standards of road

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<sup>23</sup> Independent Evaluation Department. 2013. *Linked Document E: Issues in Road Maintenance*. Manila (In support of the 2013 report entitled *Annual Effectiveness Review*).

<sup>24</sup> Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, People's Republic of China, Fiji, India, Indonesia, Kazakhstan, Kyrgyz Republic, Lao People's Democratic Republic, Mongolia, Nepal, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Tajikistan, and Viet Nam.

<sup>25</sup> In relation to governance and road maintenance capacity, the main issues reported were limited capacity and number of qualified staff (17 times), lack of institutional capacity (17 times), need for strong private sector participation (15 times), weak governance (8 times), poor transparency and risk of corruption (7 times), lack of quality contractors (6 times), and lack of advanced technology (6 times). In relation to planning and asset management, the main issues reported were inadequate maintenance (18 times), poor road design (12 times), lack of road asset management system (11 times), untimely maintenance (7 times), and limited construction materials (4 times).

<sup>26</sup> ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loans to the Democratic Republic of Timor-Leste for the Road Network Upgrading Sector Project*. Manila.

safety.<sup>27</sup> Climate proofing of roads also assists asset management, as such investment creates resilience from the impacts of climate damage to roads. Effective means of involving stakeholder groups, external to transport agencies, is needed in all aspects of road use management.<sup>28</sup>

**36. Effective asset management needs timely and appropriate information on road assets and their condition.** The development of appropriate asset management systems is dependent on the technical capacity of road agency staff. These systems contain data on the features, location, and condition of road networks, with analytical functions to analyze how changes in road use and alternative maintenance treatments can slow road deterioration. In turn, the systems can then assist in identifying optimal approaches to maintenance. The survey of ADB project officers notes that insufficient availability of accurate and timely data for decision-making is a principal reason why current O&M activities exhibit poor performance. The Yunnan Sustainable Road Maintenance (Sector) Project is addressing road maintenance on a number of fronts by: (i) introducing performance-based road maintenance on a pilot basis on 164 kilometers of trunk roads, (ii) setting up a road asset management system, and (iii) implementing an institutional development plan.<sup>29</sup> This experience in the People's Republic of China may be an approach transferrable to ADF countries.

## **D. Water Services**

### **1. Experience**

**37. Water services represent 11% of ADF loan and grant operations under ADF IX and ADF X.** A summary of total water service investments is provided in Appendix 2, Table A2.4. In Dhaka, Bangladesh, the ADF financed a project to enhance urban water supply and sanitation as a means to improve public health.<sup>30</sup> For Cambodian cities, the ADF supported improvements to enhance operation of urban water treatment plants and the upgrading of others to increase service coverage.<sup>31</sup> In Nepal, Sri Lanka, and the Greater Mekong Subregion, urban water supply enhancements are being made in small urban centers and rural villages. In Uzbekistan, ADF-financed projects have promoted the independence of water service enterprises and sector reform. Within in the Kyrgyz Republic, support is being given to improve financial management and revenue generation, and prepare an asset inventory to support effective long-term asset management.<sup>32</sup> In the Pacific, support is being given to strengthen planning and asset management of sanitation and water supply in Kiribati.<sup>33</sup>

**38. Effective asset operation and maintenance are integral to water service operations.** Poor asset management leads to (i) water losses that exceed industry good practice; (ii) less than a continuous water supply service and frequent concerns over water quality; (iii) incomplete, inaccurate, and unreliable asset records; (iv) maintenance that mostly addresses breakdowns; (v) minimal asset planning not based on sound analysis and records; and (vi) costs, and ultimately prices, that are higher than they should be. For water service providers (or water utilities), asset management involves achieving the least cost and least risk of owning and operating assets over their lifecycle while meeting service standards for customers. Consequently, utility managers need to put in place policies, plans, and strategies.

<sup>27</sup> International Road Assessment Program. 2014. *Road Safety Toolkit*. <http://toolkit.irap.org/> (accessed 4 August 2014).

<sup>28</sup> Independent Evaluation Department. 1998. *Special Evaluation Study: Operation and Management of Road Facilities and their Impact on Project Sustainability*. Manila.

<sup>29</sup> ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for the Yunnan Sustainable Road Maintenance (Sector) Project*. Manila.

They must also develop and implement a set of processes that cover asset acquisition, operation, maintenance, overhaul, and disposal. Asset management also means applying tools that help make these processes effective, such as setting service standards, computing life-cycle asset costs, maintaining an asset register, monitoring asset condition and performance, and carrying out risk analysis of possible asset failure.

39. **Infrastructure asset management for water services is complex and varied.** Water supply operations provide a similar potential for revenue generation from customers as energy, which can in turn fund proper maintenance. Nevertheless, the water sector achieves lower sustainability ratings (para. 9). A potential explanation relates to the more dispersed nature of water utilities in small towns and villages, where technical capacity is lower and the opposition to tariff increases is often emotionally charged. Asset management for water utilities is often more demanding than in most other sectors because of: (i) the number, variety, age, condition, and location of assets; (ii) the magnitude of asset investment; and (iii) the difficulty of inspecting and maintaining buried assets. This complexity is often compounded by lack of finance, information, and skills that can impede acquiring, commissioning, maintaining, overhauling, and replacing assets at the optimum time.

40. **Weak staff capacities.** The lack of staff capacity is a common weakness in the water services sector of ADF countries. Moreover, water agencies often lack sufficient autonomy for effective decision making, and suffer from overlapping responsibilities among institutions. Compounding these problems are weak regulatory environments for service standards, limited private sector participation, and a lack of planning to guide investments. Most local governments have limited fiscal space to allow the scaling-up of investments and hence limited ability to address longer-term asset management.

41. **Improvements in cost recovery are a priority.** Lack of adequate financing is a key reason for inadequate maintenance for many ADF country utilities, which remain heavily dependent on subsidies, since tariffs are often set well below cost recovery. All ADB investment projects include specific covenants that require tariffs to be adjusted to better reflect actual costs of service delivery. A few projects such as the South Tarawa Sanitation Improvement Sector Project in Kiribati (footnote 33) include TA support to assist utilities in implementing tariff adjustments.

## 2. Lessons

42. **All water services projects address sustainability given their focus on operations.** However, sustainability is mostly focused on capacity development and financial sustainability (e.g., appropriate tariff setting), and consideration of financial sustainability does not always include depreciation of assets. For the 32 ADF-funded water supply, wastewater management, and sanitation projects during 2005–2012, 14 included recommendations to prepare an asset

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<sup>30</sup> ADB. 2007. *Report and Recommendation of the President to the Board of Directors: Proposed Loans and Technical Assistance Grant to the People's Republic of Bangladesh for the Dhaka Water Supply Sector Development Program*. Manila.

<sup>31</sup> ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan to the People's Republic of Bangladesh for the Third Urban Governance and Infrastructure Improvement (Sector) Project*. Manila.

<sup>32</sup> ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Asian Development Fund Grant to Kyrgyz Republic for the Issyk-Kul Sustainable Development Project*. Manila.

<sup>33</sup> ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Grant Republic of Kiribati for the South Tarawa Sanitation Improvement Sector Project*. Manila.

management plan and/or to provide training on asset management planning. The other 18 did not mention asset management, but considered sustainability mostly through financial interventions, primarily for tariffs. O&M is usually mentioned in the design and monitoring framework as an output or as a risk mitigation measure.

43. **Good asset management involves most people in the organization.** Water services staff must carry on with daily service delivery, while working to improve asset management. This resource issue represents a substantial change in programming. As a basis for effective asset management, utility managers need to: (i) put in place an asset management policy, (ii) develop implementation and monitoring plans to achieve the targeted services and demand forecast, and (iii) obtain a good understanding of the condition of all their assets and identify the potential risks and consequences if they fail. Experience also shows that a strong external regulator that monitors service delivery for the community can help sustain good practices.

44. **The best water utilities exhibit strong leadership, with a holistic and long-term view.** Well-performing water utilities generally possess three specific characteristics: (i) they initiate and lead the change to more effective asset management enabled by the active support of the most senior executives, and in turn supported by a detailed bottom-up commitment to specific, targeted improvement initiatives; (ii) they regard asset management as an integrated whole and create initiatives that lead to improvement as part of a cohesive plan; (iii) they appreciate that building a strong asset management capability takes years, they see it as a journey, and no matter what other issues they confront, they stay focused on the core asset management improvement tasks. Box 3 illustrates a new project that aims to provide comprehensive and long-term support to asset management of water services infrastructure.

### Box 3. Holistic Approach in a New Water Services Project

**Pakistan: Sindh Cities Improvement Program Facility Concept** (funded by the Asian Development Fund and ordinary capital resources). The core reform under the investment program is the delegated management of water supply, wastewater, and solid waste management services to professional management under contractual agreements. Starting in northern Sindh, the program supports the formation and operationalization of urban services corporations (each jointly established under the Companies Ordinance 1984) to deliver these services to specified coverage areas comprising the former urban local council areas. Service provision is being delegated to three urban services corporations through service and asset management agreements that clearly define roles and responsibilities while specifying service targets, standards, and agreed investment and service charges.

Under the Urban Services Corporation model, the disconnect between asset creation and asset management is addressed, as existing system components are inventoried and their performance assessed before deciding on where, how much, and when to invest. This institutional reform helps to break the costly cycle of asset creation and rapid deterioration. Properly corporatized utilities, governed under an independent board of directors and able to act in accordance with sound commercial principles, should ensure focus on cost recovery to achieve financial sustainability, particularly in water supply.

<sup>a</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility and Technical Assistance Grant to the Islamic Republic of Pakistan for the Sindh Cities Improvement Investment Program*. Manila.

Source: Asian Development Bank

#### IV. CHALLENGES AND OPPORTUNITIES

45. **Common sector challenges.** Despite the differences in sector characteristics of the four major infrastructure sectors—agriculture and natural resources, energy, transport, and water services—they share several common challenges, (i) how to ensure that O&M of assets is effective and efficient from the outset, (ii) how to incentivize good asset management and enhanced service delivery to customers, and (iii) how to facilitate appropriate institutional settings that foster effective asset management including supporting technical capacity to occur over the medium term.

46. **Changing asset management funding and management.** Across ADB's DMCs, asset investment and maintenance are now increasingly financed from domestic sources. The survey of ADB staff indicates a reluctance of DMC sector agencies to seek stronger support for asset management and maintenance from ADB and other development partners relative to a focus on new infrastructure investment. Governments often do not give priority to addressing management and financing constraints to encourage regular maintenance. While the lessons identified remain valid, new approaches and innovative modalities for better engagement of governments need to be considered in this context.

##### A. Ensuring Effective and Efficient Operation and Maintenance Following Civil Works

47. **Irrigation projects.** The inclusion of more rigorous maintenance support is evident in countries like Bangladesh where longer project implementation facilitates after-care support. Overall, the emphasis on O&M and post-construction support is limited. Greater emphasis remains on infrastructure development and reliance on government procedures for future O&M support. Maintenance planning should be institutionalized through project implementation.

48. **Energy projects.** Realistic assessments of revenue, capacity, and governance are needed to ensure sustainability of operations where energy projects are at risk. Attention to sector reform for power generation projects and securing the right tariffs is important to provide the basis for sustainability. For poorly performing small-scale rural electrification projects using off-grid renewable energy sources, the key project design issues are addressing limited technical capacity and providing realistic attention to revenue enhancement. Any use of subsidies needs to be transparent, explicit, and targeted to the poor.

49. **Road projects.** Performance-based maintenance provided by competent private firms procured on a competitive basis offers potential in addressing a growing road maintenance task. The management of truck overloading and vehicle speeds can make greater use of innovative technologies to incentivize road users and transport firms to comply with road use regulations and standards. In 2013, approved projects in Kyrgyz Republic, Tajikistan, and Timor-Leste proposed performance-based maintenance with measures such as institutional strengthening, improvements in governance arrangements, development of asset management systems, addressing truck overloading, and capacity enhancement.

50. **Water services.** Effective O&M support following investments in assets is needed. For example, ADB operations in the Pacific region are increasingly providing follow-on O&M support as part of investment projects. In Timor-Leste, the District Capitals Water Supply Project will seek to trial 2-year O&M contracts in two district towns. The Private Sector Development Initiative in the Pacific is helping the government to assess the feasibility of a management contract for Dili water supply given the National Directorate for Water Services' limited capacity to manage the system. In the city of Chuuk, experienced operations and finance managers have

been recruited with ADB assistance to take up positions within the Chuuk Public Utility Corporation. These managers have then been able to implement a number of key reforms to support sustainable utilities operations. In Cambodia, ADB's long-term engagement with the water sector is helping sector reform and shaping approaches to asset management (Box 4).

#### **Box 4. Water Supply Reform in Cambodia through Long-Term Engagement**

Asian Development Bank (ADB) is currently assisting urban water supply reform in Cambodia. The Cambodian Ministry of Industry and Handicraft is leading sector reform. Its main focus is on improvements in operating and financial performance through improved management and corporatization, targeting autonomy of all public waterworks by the end of 2018. To achieve this, each public waterworks is expected to improve operation and maintenance and reduce nonrevenue water through small targeted investments from the waterworks own operating budget to make best use of their current assets.

In the meantime ADB projects are targeting investments to enhance improvements at waterworks operations, through rehabilitation and new infrastructure. Under the proposed Urban Water Supply Project (for approval in 2014), such operating and infrastructure improvements will be undertaken at seven water treatment plants, while at two other waterworks the focus is on new infrastructure to increase service coverage for the medium to long term. A planned sector project is in the pipeline for 2017 approval, which will provide infrastructure to increase service coverage for the long term. Better quality design and construction, and operation and maintenance will increase sustainability, and asset management will be a component of this.

Source: Asian Development Bank

## **B. Incentivizing Asset Management and Enhanced Service Delivery**

51. **Irrigation.** Enhancing cost recovery for irrigation can contribute to improved service delivery. The lack of cost recovery can stem from limitations in measuring irrigation supplies. Most investments are upgrading existing systems, which do not lend well to inclusion of measurements. Without this, cost recovery and service provision are also challenged. ADB investments in the agriculture and natural resources sector have attempted to strengthen institutional and user capacity in irrigation design and project implementation. Capacity building for asset management requires greater emphasis.

52. **Energy.** Supporting the use of commercial principles for energy producers and retailers would enhance revenue generation, service delivery, and effective asset O&M, which are fundamental for profitability. Sector and governance reforms although challenging are needed to instill commercial behavior in less-sustainable power producers. Long-term engagement by ADB with the sector, whether through a pipeline of standalone projects, or a multitranches financing facility as being used by ADB since 2008, is an ideal way to provide targeted, long-term support.

53. **Roads.** Optimizing the level of service offered across the road network, rather than maintaining all roads to a consistent standard irrespective of use or role, is the first step to making efficient use of available budgets.<sup>34</sup> Such an approach means considering the O&M of a road beyond the initial implementation, which is integral to asset management. Commercial toll-road operators, and increasingly public sector road agencies in developed nations optimize the

<sup>34</sup> ADB. 2013. *Recent Trends in Road Asset Management and Case Studies: Workshop Proceedings*. Manila (presentation by I. Greenwood).

level of service provided to their customers and maintain their roads accordingly. While this service-oriented approach is a long-term goal, it can only be achieved by effective asset management systems operated by competent staff on an ongoing basis. Increasingly important is the challenge of building DMC agency demand for effective maintenance and service delivery. Use of results-based lending is being applied to incentivize road agencies and at the same time to support the development of asset management systems and technical capacity (Box 5).

#### **Box 5. Incentivizing Effective Road Asset Management in Cambodia**

Over the past 20 years, the Asian Development Bank (ADB) and other development partners have supported Cambodia in rehabilitating the core road network. Development efforts have brought the paved national road network to about 2,700 kilometers, representing about 25% of the total national and provincial road network.

Previous attempts at road asset management have met with mixed success: performance-based maintenance, where undertaken, has been successful, but use of force-account maintenance dominates the \$50 million national expenditure on maintenance with limited transparency. Widespread truck overloading is damaging roads, with the issue now recognized at the political level. While resistance is met to reducing force-account maintenance at the sector level, the Ministry of Finance and stakeholders largely support the use of competitively tendered, periodic maintenance contracts with qualified firms.

ADB is currently designing the new Second Road Asset Management Project with a hybrid modality involving both project-based lending and results-based lending. The intention is to link disbursements of civil works finance to core results-based lending milestones on: (i) more effective and efficient maintenance, (ii) effective control of truck overloading, (iii) improvements to sustainability of maintenance financing, (iv) improvements in road safety, and (iv) safeguard compliance. The approach is expected to incentivize sector agencies and their subnational offices to improve road asset management.

Source: Asian Development Bank

54. **Water service.** Active support for capacity development is needed to overcome constraints in service delivery, O&M, and regulation of water service infrastructure assets and operations in many ADF countries. In the past, ADB TA projects, loans, and grants have typically supported capacity development for planning and implementing capital works. Support needs to be broadened to enhance operations. Examples include investment loans or grants accompanied by TA to strengthen sector institutional arrangements to support the development of financially and managerially autonomous service providers. For example, ADB has provided support for the establishment of the new water and wastewater operations division within the Palau Public Utilities Corporation, to ensure that sewerage investments supported under the Koror–Arai Sanitation Project can be effectively managed and operated.<sup>35</sup> In Timor-Leste, the Dili Urban Water Supply Improvement Sector Project has been accompanied with TA assistance to promote more sustainable service delivery arrangements.<sup>36</sup>

<sup>35</sup> ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loans for the Republic of Palau for the Koror-Arai Sanitation Project*. Manila.

<sup>36</sup> ADB. 2007. *Report and Recommendation of the President to the Board of Directors: Proposed Asian Development Fund Grant to the Democratic Republic of Timor-Leste for the Dili Urban Water Supply Improvement Sector Project*. Manila.

### C. **Accountability for Effective Infrastructure Asset Management**

55. **Enhancing accountability.** Increasing the accountability of infrastructure asset owners and operators for their performance can be supported by appropriate definition of their objectives, role, and the appropriate institutional structure. The asset owners and operators also should be given sufficient autonomy and adequate financial resources to do their work. Under appropriate leadership, competent infrastructure agency executives should be required to define and execute their strategic investment plans, medium-term programs (investment and maintenance), and human resources plans; and develop asset management, budgeting, accounting, and procurement systems to fulfill their role and meet their objectives. Development of a competent asset owner and manager requires 5–8 years and active external support to implement the full spectrum of components needed for asset management.<sup>37</sup> Continued dialogue with ministries of finance and key stakeholders on broadening revenue sources and making such revenues available for soundly based maintenance programs is required. Sector-specific actions need to support agreed DMC sector plans and priorities, but be flexible and able to respond to emerging priorities, and ideally be provided on a long-term continuous basis.

56. **Effective asset management planning.** An important first step to achieve adequate maintenance and service delivery is to ensure effective asset management planning. Most recently approved project preparatory technical assistance covering water supply and sanitation have included support for the development of asset management plans to promote improved maintenance practices, e.g., the Tarawa Sanitation Improvement Project in Kiribati (footnote 33), and the Ebeye Water Supply and Sanitation Project in the Marshall Islands.<sup>38</sup> Maintenance of infrastructure depends on the availability of resources, the capability and amount of autonomy of organizations managing infrastructure, and degree of accountability for performance and quality of service provision. Adequate technical support and effective capacity development are essential for maintaining the veracity of plans and systems once established.

## V. **WAY FORWARD**

57. The need for broad-based improvements in asset management to sustain the value of infrastructure investments and their benefits is growing in importance. ADB is pursuing several mechanisms to enhance asset management.

### A. **Capacity for Asset Management**

58. **ADB capacity development framework.** In 2007, ADB produced a framework strategy to address capacity development in ADB-wide operations over the medium term.<sup>39</sup> In the report, ADB acknowledged that strengthened country capacity is not only a means to achieve public sector performance but a goal in its own right. The 2007 report stressed that

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<sup>37</sup> ADB. 2013. *Recent Trends in Road Asset Management and Case Studies: Workshop Proceedings*. Manila (Presentation by C. Bennett).

<sup>38</sup> ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Administration of Grant to the Republic of Marshall Islands to the Ebeye Water Supply and Sanitation Project*. Manila.

<sup>39</sup> ADB. 2007. *Integrating Capacity Development into Country Programs and Operations: Medium-Term Framework and Action Plan*. Manila.



...funding agencies need to be able to: (i) develop an understanding with DMCs on capacity development concepts and objectives; (ii) emphasize country leadership, ownership, and systems orientation; (iii) support result-oriented and inclusive processes with accountability structures primarily aimed at domestic constituencies; and (iv) use country systems to the extent possible...

Currently, an updated framework is being developed to underscore the fundamental role of capacity development in project effectiveness and sustainability.

59. **Utilization of institutional assessments.** Project officers are being encouraged to conduct institutional assessments as a standard practice in project preparation. An effective institutional assessment will identify and evaluate institutional structures, staff and management skill and capacity, and resource availability in relation to efficient project delivery, including long-term project sustainability. The outcome of the institutional assessment should include the creation of a capacity development program that encompasses support for skill enhancement to long-term O&M.

60. **Diversification of capacity development tools.** Several capacity development tools are available to project teams, and ADB is working to ensure such tools are actively utilized by project teams. Among the options available are: (i) targeted training programs and study tours; (ii) embedded national or international expert within project management unit; (iii) conferences, seminars, and workshops; (iv) partnerships with local educational facilities (Box 6); (v) peer-to-peer learning through twinning programs (i.e., Water Operators Partnership Program); (vi) information technology tools and e-learning modules; and, (vii) knowledge products. Certainly the particular context of any given project will determine which is appropriate, but more support will be given to project teams, especially within the context of an institutional audit, to utilize the appropriate options.



ADB has supported efforts to strengthen capacity as part of infrastructure operations, as illustrated by this vocational school training.

### Box 6. Building Local Capacity with Vocational Education: Pakistan

To support Pakistan's efforts to overcome chronic electricity shortages, in 2013 the Asian Development Bank (ADB) approved a \$900 million loan for the installation of a net 600-megawatt power plant in Sindh province.<sup>a</sup> The ADB assistance comprised \$870 million from ordinary capital resources and \$30 million from the Asian Development Fund.

The ADB assistance will be utilized to build energy infrastructure and increase the financial, technical, and operating capacity of the executing agency, GENCO Holding Company, a government-owned corporation. One of its subsidiaries, Jamshoro Power Company, will be the implementing agency. The project aims to have at least 50 relevant staff pass the assessment test on project administration, safeguard, procurement, financial and technical operation and maintenance aspects.

To broaden its capacity building network on power plant operation, the government will partner with a vocational technical school to: (i) provide on-the-job training, and (ii) integrate subject matter into the curriculum of the school.

<sup>a</sup> ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility and Technical Assistance Grant to the Islamic Republic of Pakistan for the Sindh Cities Improvement Investment Program*. Manila.

Source: Asian Development Bank

## B. Project Design and Planning

61. **Strategic initial investments for durable design.** Outdated design and construction standards that involve structural and physical weaknesses may not be able to be economically addressed by adequate maintenance. Inappropriate or incomplete designs where essential drainage is not provided will shorten pavement life. Likewise, lower-quality materials for road construction create maintenance vulnerabilities, which can then be exacerbated by the effects of climate change and natural disasters. As a response to these issues ADB is seeking to ensure higher-quality design and materials to lessen maintenance requirements.

62. **Innovative design solutions for longer-term sustainability.** Where appropriate, an economic case can be made to build stronger roads initially to delay the onset of deterioration. Concrete roads, for example, require almost no maintenance for 15–20 years.<sup>40</sup> Due to higher initial investment and the potential for reduced road length outputs, road agencies may be reluctant to adopt such a course. Offsetting strategies, such as staged construction (with expansion tied closely to actual demands), application of locally available materials, and use of new technologies, may assist in overcoming such concerns. Design and technology solutions to improved maintenance include:

- (i) upgrading design standards and specifying appropriate materials to ensure that the initial infrastructure delivery has a longer expected lifespan;
- (ii) using performance-based maintenance contracts on a periodic basis with adequate supervision, either as part of initial construction contracts or separately;
- (iii) enhancing capacity for contract design, procurement, and supervision; and
- (iv) building long-lasting infrastructure initially to provide long almost maintenance-free periods with reduced lifecycle costs, where appropriate.

<sup>40</sup> World Bank. 1988. *Road Deterioration in Developing Countries: A World Bank Policy Study: Causes and Remedies*. Washington. p. 15.

63. **Standalone projects for asset management and capacity development.** ADB has begun to experiment with projects that focus exclusively on the maintenance requirements of existing infrastructure components and the underlying capacity development needs. These initiatives are typically tied to strong support for improving sector-wide technical capacity as well as developing and applying asset management systems. The capturing of lessons to date from these efforts will assist in expanding efforts to focus more on asset management as a core investment area.

64. **Medium-term planning for more consideration of asset management.** ADB is looking to strengthen medium-term planning and programming of both new investment and maintenance on a rolling basis (typically 5 years). It can bring the following important benefits: (i) increased stability of funding for maintenance and priority investment subprojects, (ii) enhanced coordination of transport improvements with service delivery by other sectors, (iii) increased accountability for maintenance quality including safeguard management, (iv) a positive influence on the strengthening of local engineering and contractor capability by having more stable workloads, and (v) enhanced capacity development.

### **C. Funding Options for Asset Management and Capacity Development**

65. **Broadening country revenue sources for sustainable operations.** DMC revenue sources can be broadened to establish dedicated funds for asset management and capacity development. Using the transport sector as an example, among the mechanisms to enhance revenue collection are: (i) improving computerized vehicle registration and driver licensing systems that would support other government activities such as road safety, traffic management, heavy vehicle management, and enhanced revenue generation; (ii) ensuring vehicles pay their way with taxes and charges reflecting the road damage, greenhouse gas and exhaust emissions, and congestion they cause (second generation road funds relying on the fee-for-services concept, based on dedicated revenue sources such as fuel and vehicle taxes, will be looked into further and supported by ADB);<sup>41</sup> (iii) engaging in dialogue with ministries of finance and key stakeholders on broadening revenue sources and making such revenues available for soundly based maintenance programs; and, (iv) continuing support for adequate funding of the agreed medium-term sector plans such that all domestic and development partner funding is applied in a coordinated and disciplined way.

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<sup>41</sup> Footnote 6. *Linked document E: Issues in Road Maintenance*, para. 54.

66. **Increasing technical assistance resources available to capacity development.**

**Box 7. Clean Energy Financing Partnership Facility  
Raising Capacity for Successful Implementation**

Established in April 2007, the Clean Energy Financing Partnership Facility (CEFPF) is a financing and knowledge resource facility aimed at helping development member countries improve energy access and security, and move to low-carbon use through cost-effective investments, especially in technologies that result in greenhouse gas mitigation. The CEFPF was established to support the Clean Energy Program of the Asian Development Bank (ADB), particularly to increase clean energy investments, deploy new clean energy and/or carbon capture and storage technologies, and lower barriers to new clean energy technologies. Of the total CEFPF allocation as of 30 June 2014, about \$52.5 million (or 35%) was allocated to 49 technical assistance (TA) projects with capacity building components. In this sense, the CEFPF is a resource that augments the broader ADB loan portfolio with the capacity development required for successful implementation.

As an example of the CEFPF's impact, the fund's support for a TA initiative in Sri Lanka (Building the Capacity of Sustainable Energy Authority) provided \$600,000 to strengthen the institutional capacity and technical capability of a statutory authority in Sri Lanka, the Sustainable Energy Authority (SEA). Under component 1, the TA successfully laid out SEA's procedures and manuals for processing renewable energy projects and provided support for the application review process and staff training. Under component 2, the TA aimed to increase the institutional capacity development of SEA and create an enabling environment by establishing institutional, financial, and regulatory mechanisms. The TA has generally achieved its planned objective and contributed to enhancing SEA's capacity to implement energy efficiency and energy conservation initiatives and develop renewable energy. The successful completion of the TA will benefit the follow-up loan project, Sustainable Power Sector Support Project for Sri Lanka, which has been approved by ADB for implementation.

Source: Asian Development Bank

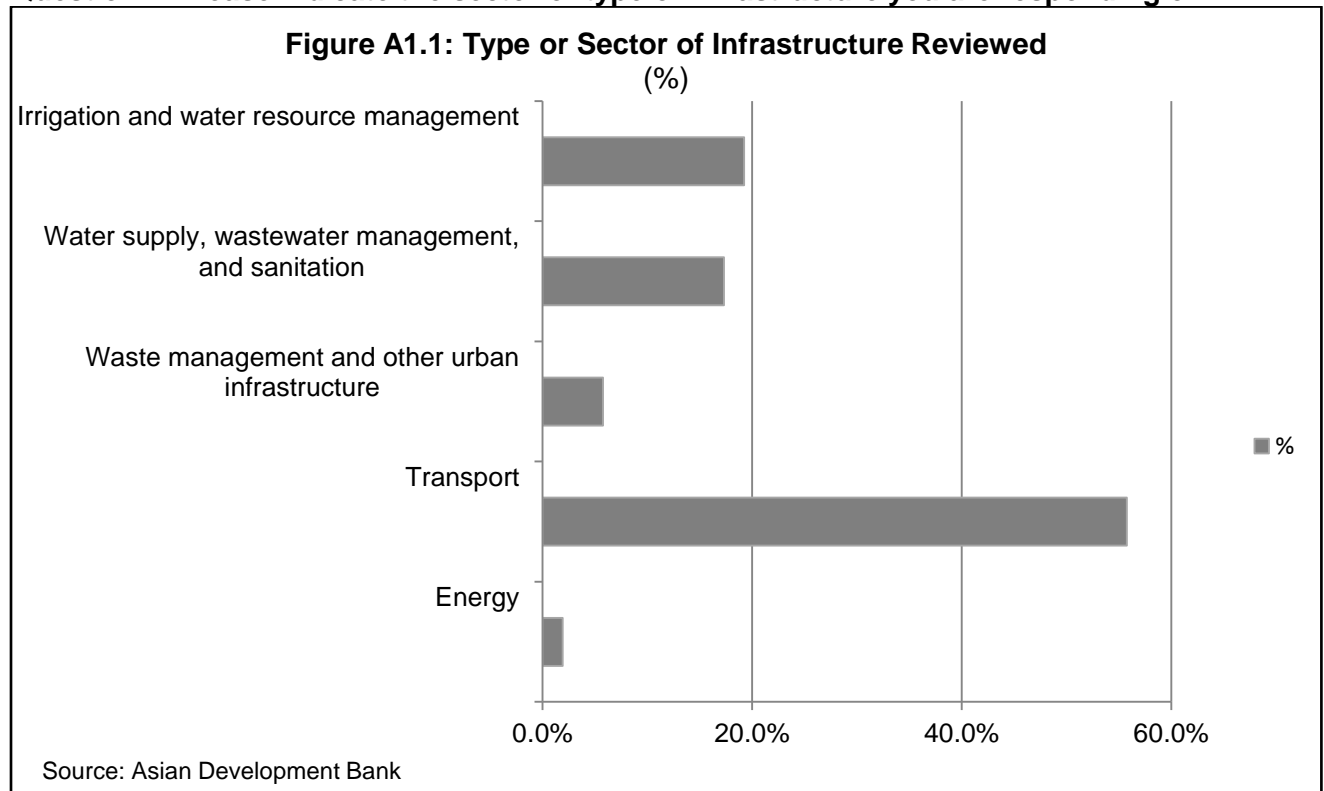
67. The current available technical assistance resources may not be sufficient to fully address the needs to ensure long-term O&M of investments, as such funds are currently subscribed to a range of needs and themes. In some cases, dedicated facilities have been created to ensure key priority areas receive sufficient support. For example, the Clean Energy Financing Partnership Facility has successfully complemented new investments in renewable energy and energy efficiency by strategically adding project funds for capacity development (Box 7). Financing partnership facilities developed jointly with like-minded development partners are an appropriate option to provide the resources required for building asset management capacity.

### INFRASTRUCTURE SUSTAINABILITY SURVEY WITH ADB PROJECT STAFF

1. A brief survey on infrastructure sustainability and asset management was distributed via electronic means to members of the energy, transport, and water communities of practice of the Asian Development Bank (ADB) in August 2014.<sup>1</sup> The survey was designed to review the capacity of low-income countries to maintain and operate infrastructure assets over the medium and long term, and to gauge whether ADB investments simply fall into disuse after a short time. The survey was formulated to assist the paper on the sustainability of infrastructure investments, especially in countries supported through the Asian Development Fund.

2. The following is the list of survey questions asked and the corresponding results based on a total of 52 respondents:

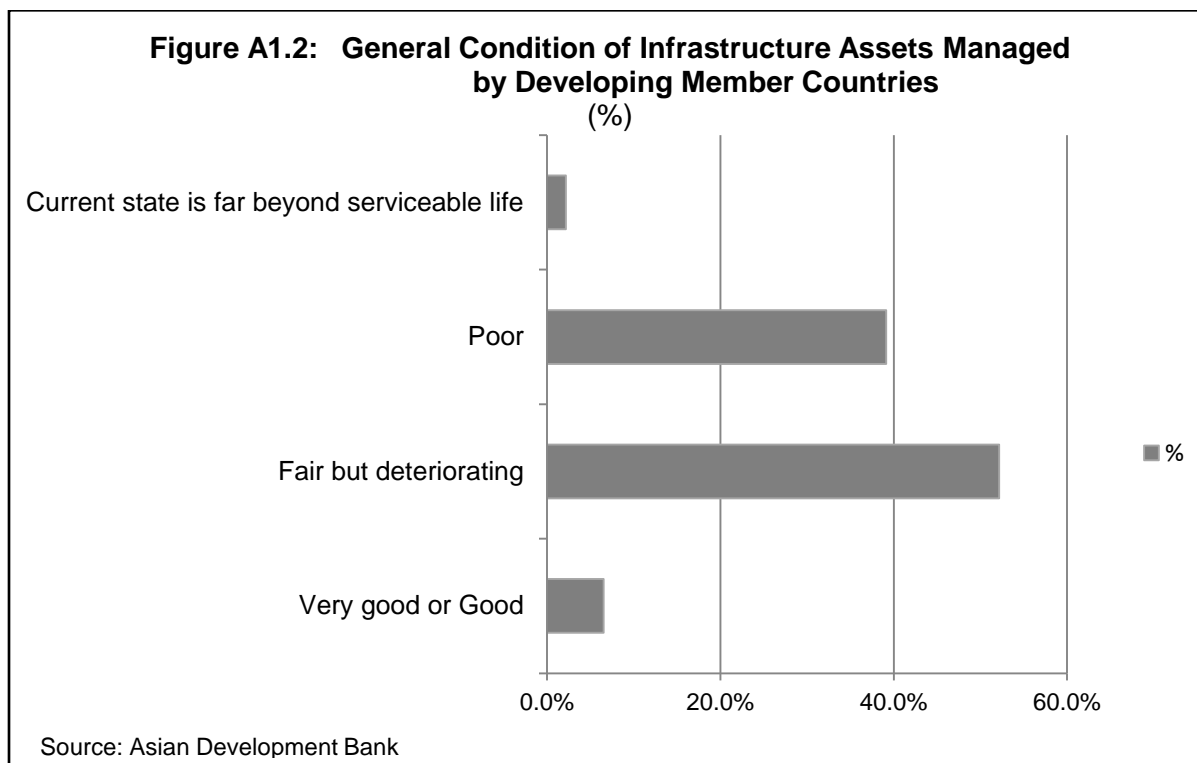
**Question 1. Please indicate the sector or type of infrastructure you are responding on.**



<sup>1</sup> Online survey can be found at <https://www.surveymonkey.com/results/SM-XLY2TQ68/>

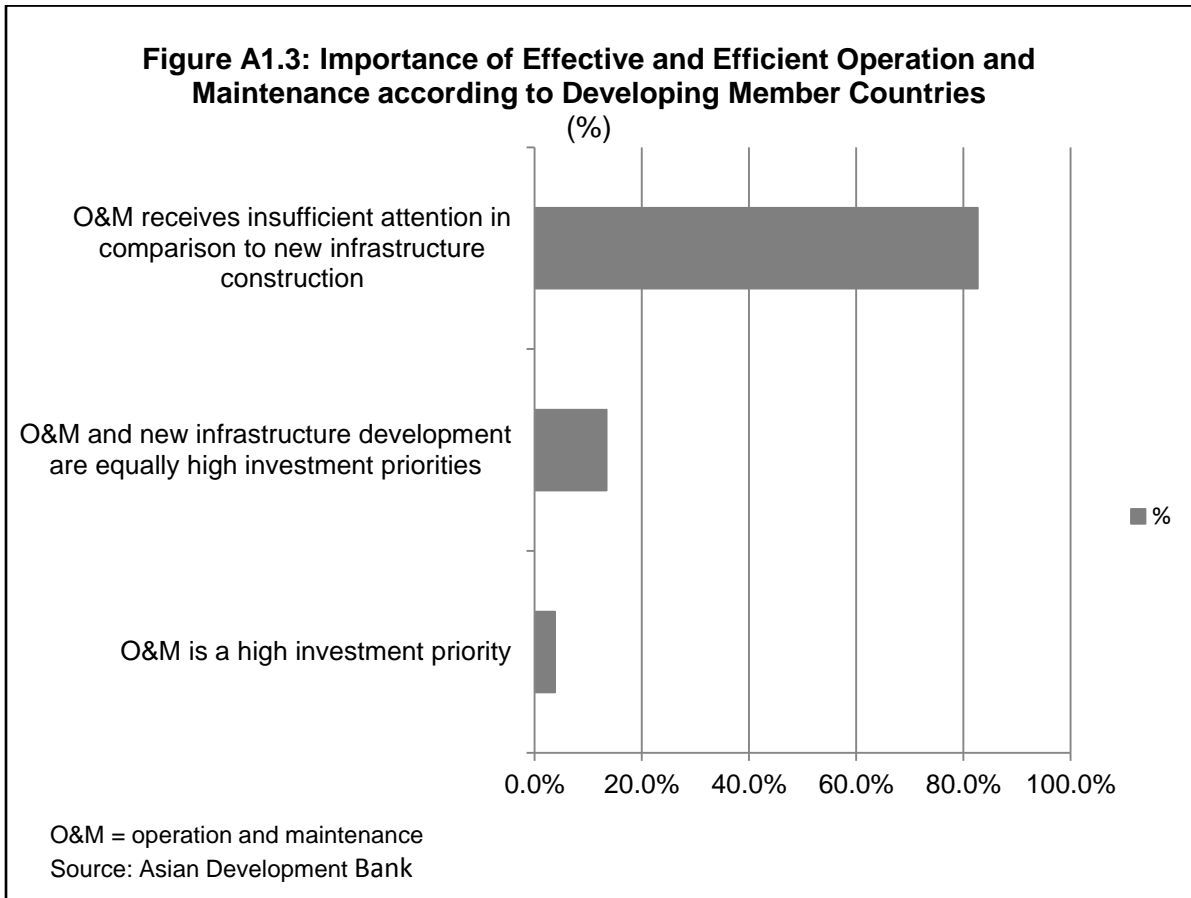
**Question 2. How would you categorize the general condition of infrastructure assets managed by your developing member countries?**

Answer Choices	Responses	%
Very good or good	3	6.52
Fair but deteriorating	26	52.17
Poor	22	39.13
Current state is far beyond serviceable life	1	2.17
<b>Total</b>	<b>52</b>	



**Question 3. Is the importance of effective and efficient operation and maintenance (O&M) clearly articulated in general by your client developing member countries' officials or does interest in infrastructure investment take precedence?**

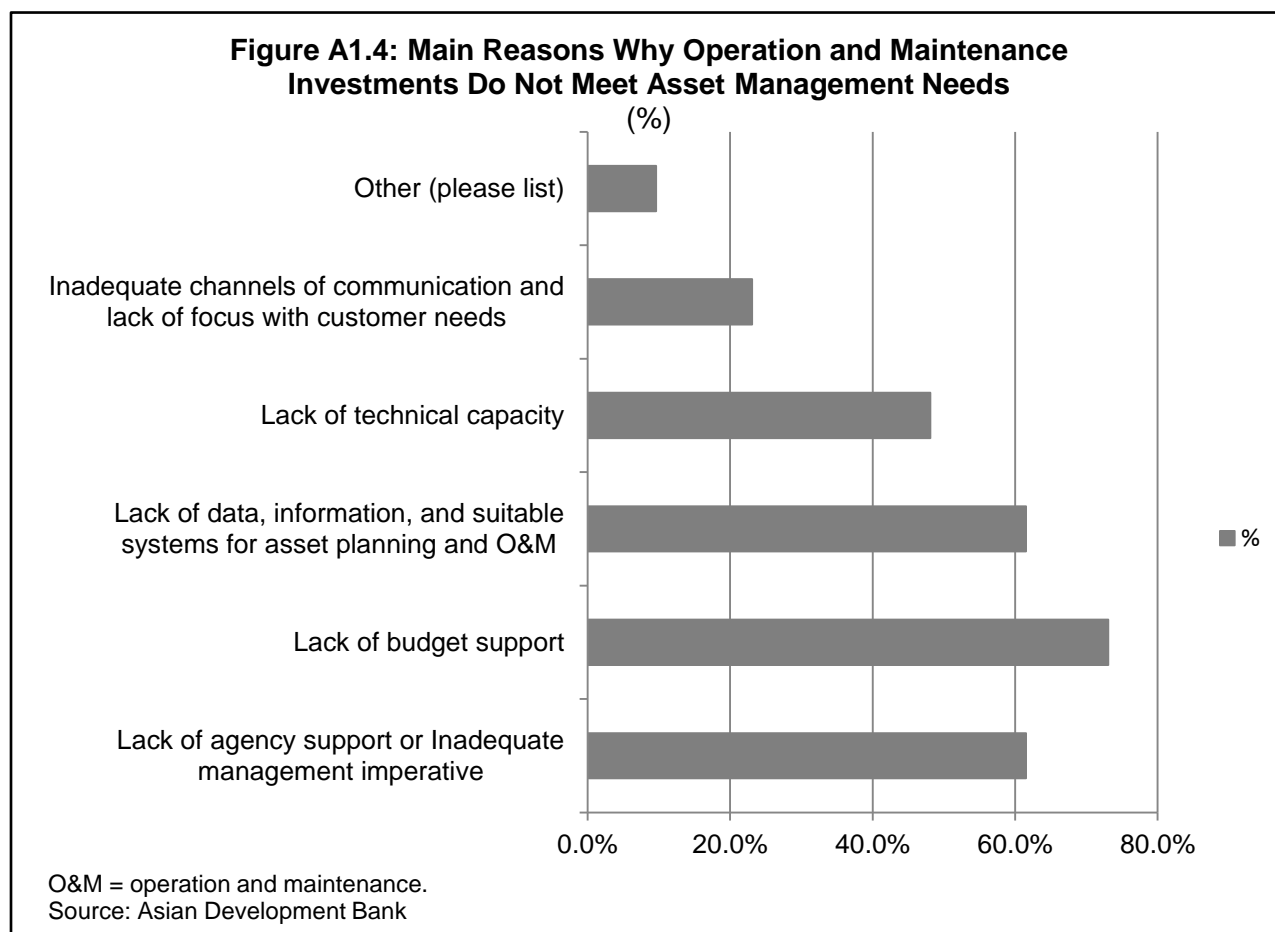
Answer Choices	Responses	%
O&M is a high investment priority	2	3.85
O&M and new infrastructure development are equally high investment priorities	7	13.46
O&M receives insufficient attention in comparison with new infrastructure construction	43	82.69
<b>Total</b>	<b>52</b>	



**Question 4. What do you feel is the principal reason that operation and maintenance investments do not completely meet asset management needs?  
(Check up to three reasons)**

Answer Choices	Responses	%
Lack of agency support and/or inadequate management imperative	32	61.54
Lack of budget support	38	73.08
Lack of data, information, and suitable systems for asset planning and operation and maintenance	32	61.54
Lack of technical capacity	25	48.08
Inadequate channels of communication and lack of focus on customer needs	12	23.08
Other (please list)	5	9.62

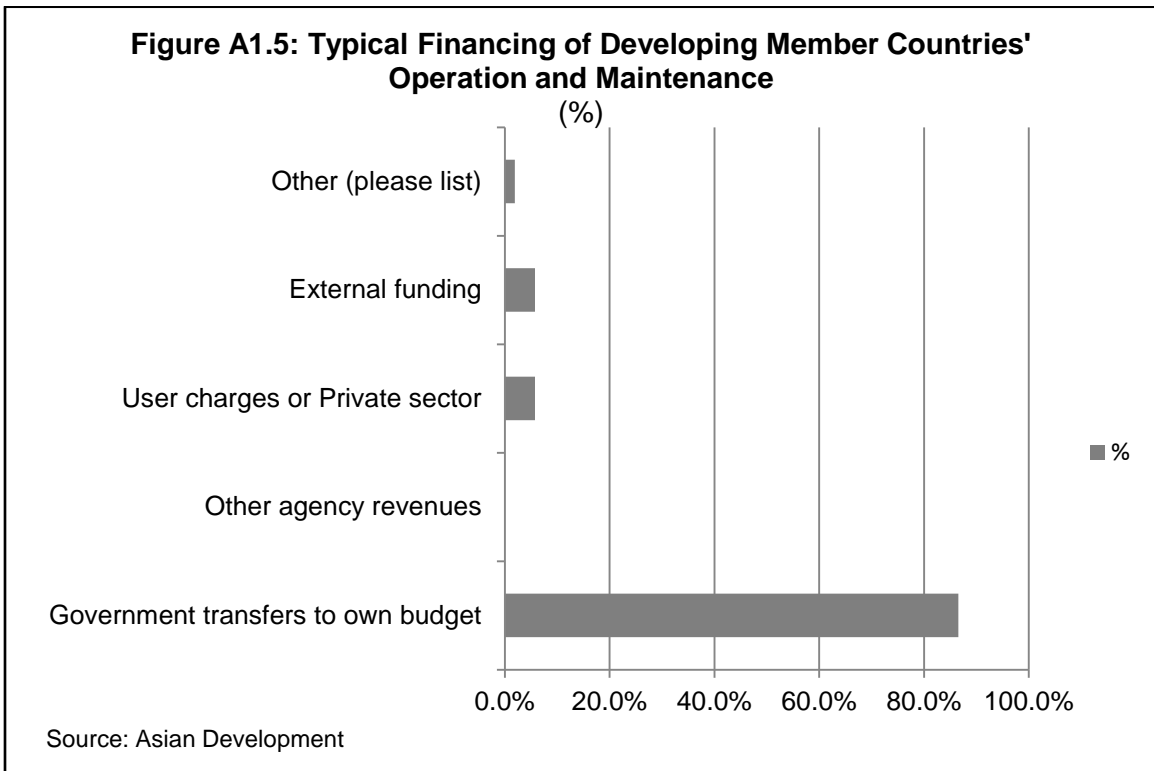
Note: Total respondents: 52





**Question 5. How is your developing member countries' operation and maintenance typically financed (exclude consideration of staff salaries when responding)?**

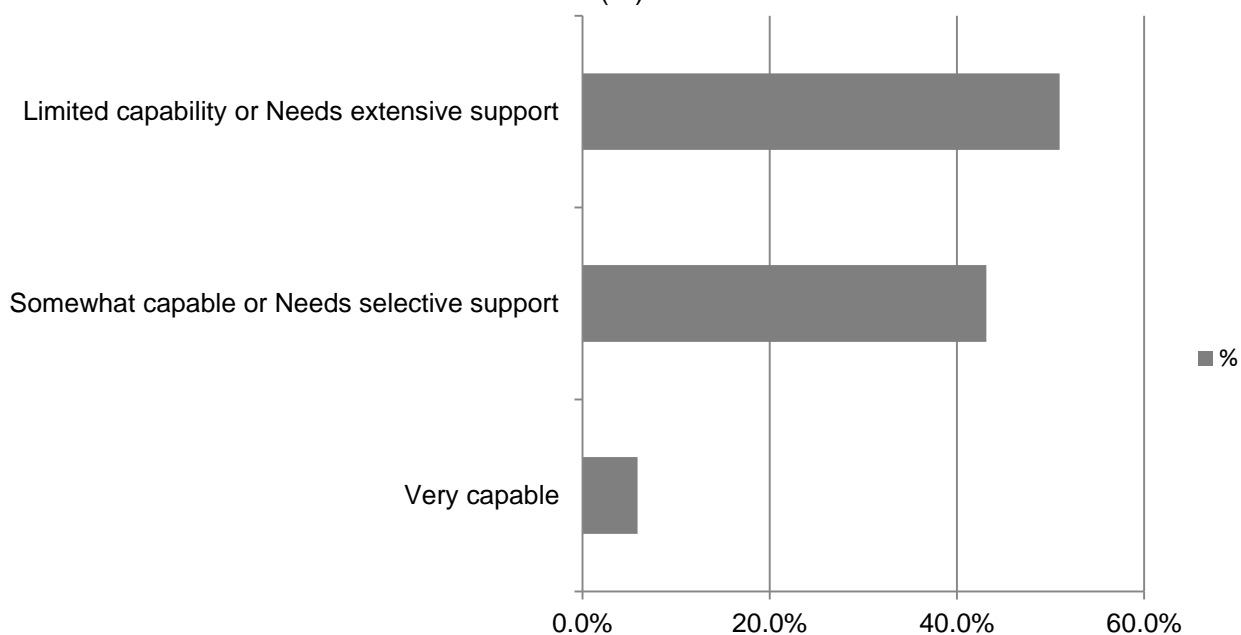
Answer Choices	Responses	%
Government transfers to own budget	45	86.54
Other agency revenues	0	0.00
User charges and/or private sector	3	5.77
External funding	3	5.77
Other (please list)	1	1.92
<b>Total</b>	<b>52</b>	



**Question 6. How would you assess your developing member countries' capability to achieve effective agency and individual performance in terms of asset management?**

<b>Answer Choices</b>	<b>Responses</b>	<b>%</b>
Very capable	3	5.88
Somewhat capable and/or needs selective support	22	43.14
Limited capability and/or needs extensive support	26	50.98
<b>Total</b>	<b>51</b>	

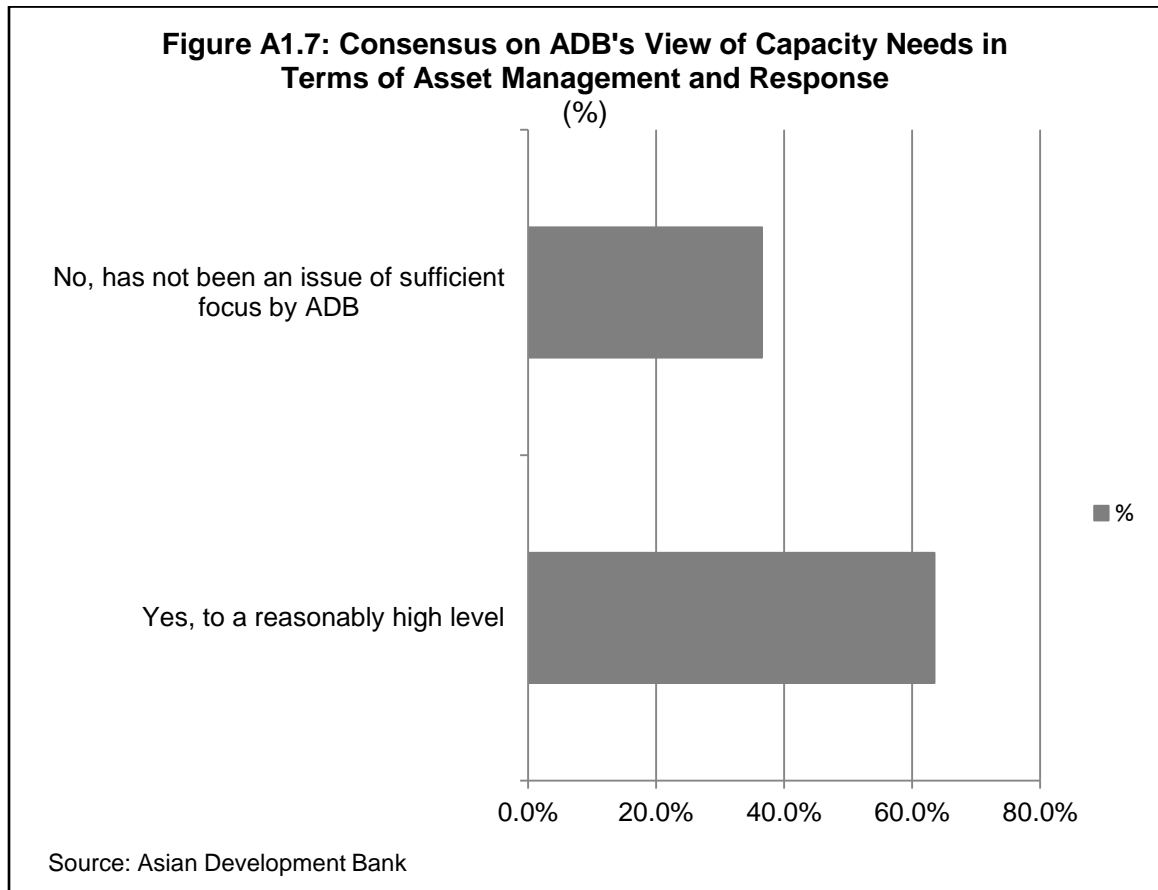
**Figure A1.6: Developing Member Countries' Capability to Achieve Effective Agency and Individual Performance in Asset Management (%)**



Source: Asian Development Bank

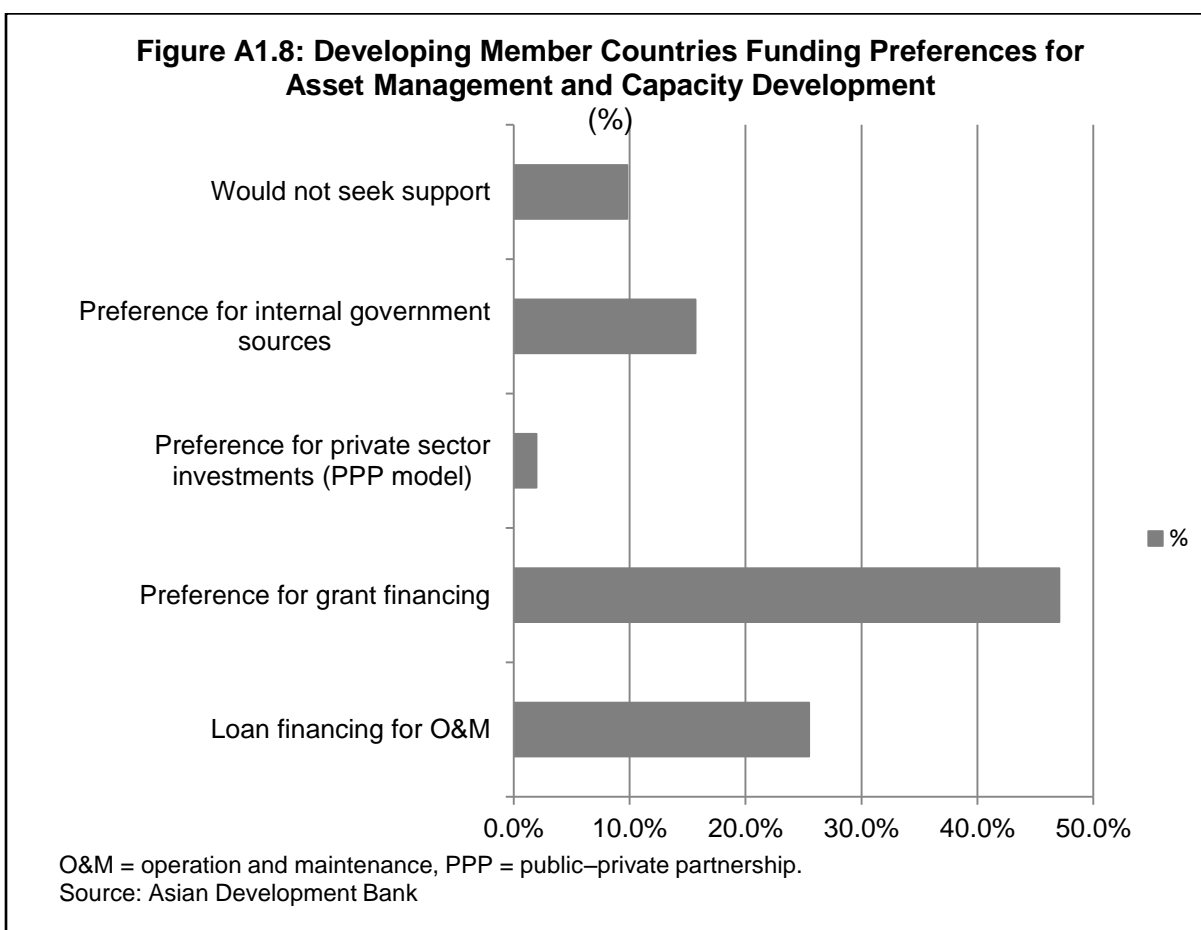
**Question 7. Do you think ADB and other development partners have a clear view of capacity needs with respect to asset management and how to respond?**

Answer Choices	Responses	%
Yes, to a reasonably high level	33	63.46
No, has not been an issue of sufficient focus by ADB	19	36.54
<b>Total</b>	<b>52</b>	



**Question 8. During instances when your developing member countries have sought support for asset management and/or related capacity development, what are their preferences for funding these activities?**

<b>Answer Choices</b>	<b>Responses</b>	<b>%</b>
Loan financing for operation and maintenance	13	25.49
Preference for grant financing	24	47.06
Preference for private sector investments (public-private partnership model)	1	1.96
Preference for internal government sources	8	15.69
Would not seek support	5	9.80
<b>Total</b>	<b>51</b>	



**Question 9. Please list any ADB projects with lower-income DMCs that include a good practice example of incorporating asset management and any related capacity development (list project name and briefly summarize the best practice aspects).**

Comments
<p>Timor-Leste Road Network Upgrading Project and Road Network Upgrading (Sector) projects both incorporate 2 years of post-construction maintenance by the main contractor for the civil works contracts. This will provide an opportunity for experience and training, and subsequent rolling out to larger stand-alone performance-based road maintenance contracts that are not currently feasible because of the poor road condition and unquantifiable maintenance risks.</p>
<p>People's Republic of China: Yunnan Sustainable Road Maintenance Project. Comprehensive framework for improving asset management. Mongolia: Road Sector Capacity Development TA. Comprehensive policy and capacity building support on various road issues.</p>
<p>People's Republic of China: Yunnan Sustainable Road Maintenance (Sector) Project. Best practices: sector road map with increasing funding allocations to maintenance, the prioritization of roads based on traffic and road condition information, annual reporting against defined performance metrics, and the development of institutional capacity to develop the technical human capital to make the changes sustainable.</p>
<p>Solomon Islands: road sector; Timor-Leste: road sector</p>
<p>Solomon Islands: Domestic Maritime Support Project and Transport Sector Development Program. These projects combine infrastructure development with major institutional restructuring including the establishment of a ring fenced fund for O&amp;M.</p>
<p>Yet to demonstrate good results by DMC in one of the ongoing projects (SASEC Road Connectivity Project)</p>
<p>Cambodia: Water Resources Management Sector Development Program includes work on the Cambodian Irrigation Scheme Information System (CISIS) (asset inventory).</p>
<p>Armenia: Water Supply and Sanitation Sector Project. The Armenian Water Sewage Company (AWSC), the water utility, is under a management contract. This has increased the quality and speeded up implementation of the works.</p> <p>In late 2007, ADB approved a \$36 million loan to rehabilitate, replace, and expand the water supply and sewerage systems in the project towns and villages and improve water supply services. It also aimed to strengthen the management and operational capability of AWSC by engaging a private sector operator from France, Saur, to provide best-practice managerial know-how and operational efficiency under a management contract.</p> <p>In 2008, Saur was awarded a 5-year contract to manage the operations of AWSC. Based on its success, this contract was recently extended by 2 years until 2013. The project is tracking well against implementation targets and physical completion is 12 months ahead of schedule and will be completed in October 2012. This performance is attributed to a simplified supervision and implementation arrangement through a project management unit established within AWSC.</p>
<p>The project also benefited from adopting a logical sequence of interventions, focusing on optimizing the operation of existing infrastructure. The project also created pilot zones to</p> <p><b>Comments</b></p>

<p>demonstrate 100% water supply coverage, 100% metering, 24-hour water supply, and 100% collection efficiency.</p> <p>Lessons from these pilot zones were applied in other project towns and villages. The project has helped AWSC significantly reduce the electricity it uses, mostly in pumping stations. This has reduced carbon dioxide emissions and thereby the carbon footprint of the project by about 70%. AWSC received the Global Water Award 2012 from for "an initiative undertaken by a water utility which represents the most significant commitment to improving the long-term performance of water services to the public".</p>
Yunnan Sustainable Road Maintenance Project
Yunnan Integrated Road Network Development Project
Phnom Penh Water Supply Authority, Dhaka Water Authority, Colombo Water Authority
Third Irrigation Sector Project Indonesia Participatory Irrigation Sector Project Indonesia
<p>Georgia is not a lower-income DMC, however, until recently, ADB has provided ADF resources to mitigate the impact of the war with the Russian Federation in 2008. CDTA for Developing a Geospatial Management System for WSS Sector in Georgia—an innovative project piloted by ADB in Georgia—proved to be very successful since it provided the public water utility with a universal technical tool of many applications ranging from asset development and O&amp;M planning and management to revenue management and tariff collection.</p>

ADB = Asian Development Bank, AWSC = Armenian Water Sewage Company, CDTA = capacity development technical assistance, DMC = developing member countries.

Source: Asian Development Bank

**Question 10. Please list any ADB projects with lower-income DMCs in which asset management and any related capacity development work did not succeed or was excluded from the project (kindly list project name and briefly summarize the problems).**

Comments
<p>Timor-Leste Road Network Development Sector Project. Confined its institutional asset management support to only 3 of 13 districts and seriously underestimated the cost of restoring roads to a maintainable condition (while at the same time implementing climate proofing measures). The project is on-going and is now implementing a pilot performance-based road maintenance contract, the form of which is expected to be suitable for maintaining newly upgraded or reconstructed roads.</p>
<p>Numerous small side components on past ADB PRC expressway/highway projects. They generally proved insufficient to have a lasting sector-wide impact.</p> <p>All loan covenants mandating good maintenance of the specific project road.</p>
<p>Kathmandu Sustainable Urban Transport Project. Lack of ownership from EA/IAs</p>
<p>The construction of weighbridge to limit overloading trucks to manage road assets was cancelled under the Road Rehabilitation 2 Project.</p>

ADB = Asian Development Bank, DMC = developing member countries, EA = Executing Agency, IA = Implementing Agency, PRC = People's Republic of China.

Source: Asian Development Bank

## SECTOR INVESTMENTS UNDER ADF IX AND ADF X

**Table A2.1: ADF Agriculture and Natural Resources Investments per Country, 2005–2012**  
(\$ million)

ADF Countries	ADF IX (2005–2008)	ADF X (2009–2012)
<b>ADF-Only Countries</b>		
Afghanistan	105.00	86.60
Cambodia	50.00	157.44
Kyrgyz Republic	20.00	0.00
Lao People's Democratic Republic	20.00	94.28
Nepal	18.00	75.30
Tajikistan	29.10	0.00
<b>ADF-Blend Countries</b>		
Bangladesh	138.60	114.50
Mongolia	14.72	0.00
Pakistan	83.00	287.98
Sri Lanka	15.00	1.05
Timor-Leste	0.00	0.57
Uzbekistan	27.60	0.00
Viet Nam	151.47	448.85
<b>Graduates</b>		
Indonesia	33.30	0.00

ADF = Asian Development Fund

Source: Asian Development Bank

**Table A2.2: ADF Energy Investments per Country 2005–2012**  
(\$ million)

ADF Countries	ADF IX (2005–2008)	ADF X (2009–2012)
<b>ADF-Only Countries</b>		
Afghanistan	249.00	336.50
Bhutan	54.28	21.59
Cambodia	20.00	45.00
Kyrgyz Republic	0.00	99.80
Lao People's Democratic Republic	0.00	36.92
Nepal	0.00	142.50
Samoa	42.00	0.00
Tajikistan	76.27	122.00
<b>ADF-Blend Countries</b>		
Bangladesh	70.00	105.00
Georgia	0.00	48.00
Pakistan	30.00	170.00
Papua New Guinea	0.00	16.40
Sri Lanka	0.00	65.00
Uzbekistan	0.00	142.00
Viet Nam	0.00	193.66

ADF = Asian Development Fund

Source: Asian Development Bank



**Table A2.3: ADF Transport Investments per Country 2005–2012**  
(\$ million)

ADF Countries	ADF IX (2005–2008)	ADF X (2009–2012)
<b>ADF-Only Countries</b>		
Afghanistan	409.20	870.00
Bhutan	32.00	47.03
Cambodia	55.00	156.13
Kiribati	0.00	12.00
Kyrgyz Republic	45.60	131.00
Lao People's Democratic Republic	27.00	47.00
Maldives	5.33	0.00
Nepal	89.20	200.81
Samoa	0.00	4.00
Solomon Islands	14.35	47.25
Tajikistan	83.40	240.00
Tonga	0.00	9.70
Vanuatu	0.00	14.71
<b>ADF-Blend Countries</b>		
Armenia	47.92	108.64
Bangladesh	50.70	423.00
Georgia	0.00	249.80
Mongolia	37.60	144.20
Pakistan	19.00	77.02
Papua New Guinea	158.00	165.62
Sri Lanka	0.00	164.69
Timor-Leste	10.00	55.15
Uzbekistan	0.00	215.00
Viet Nam	472.00	279.18
<b>Graduates and Regional</b>		
Azerbaijan	13.00	0.00
Cook Islands	6.88	0.00
Regional	1.50	0.00

ADF = Asian Development Fund  
Source: Asian Development Bank

**Table A2.4: ADF Water Investments per Country 2005–2012**  
(\$ million)

ADF Countries	ADF IX (2005–2008)	ADF X (2009–2012)
<b>ADF-Only Countries</b>		
Bhutan	24.60	16.30
Cambodia	18.00	57.55
Kiribati	0.00	7.56
Kyrgyz Republic	30.00	60.00
Lao People's Democratic Republic	10.00	68.20
Maldives	6.00	0.00
Nepal	0.00	204.28
Samoa	5.00	0.00
Tajikistan	22.00	0.00
Tonga	0.00	4.05
Vanuatu	0.00	1.11
<b>ADF-Blend Countries</b>		
Armenia	36.00	36.90
Bangladesh	261.00	74.89
Georgia	0.00	96.64
Mongolia	0.00	15.00
Pakistan	98.00	45.14
Palau	0.00	3.40
Sri Lanka	179.50	164.87
Timor-Leste	6.00	9.33
Uzbekistan	55.00	256.96
Viet Nam	127.52	103.51
<b>Graduates</b>		
Indonesia	60.59	0.00

ADF = Asian Development Fund  
Source: Asian Development Bank