

Unlocking International Public Development Finance for Infrastructure Asset Management

December 2023

Prepared for the United Nations Department of Economic and Social Affairs by Justin DesRochers, Kaiwen Liu, and Luyang Gao
Advised by Isabelle Delalex





1. Acknowledgements

This report was produced for the Financing for Sustainable Development Office in the United Nations Department of Economic and Social Affairs in conjunction with Columbia University's School of International and Public Affairs (SIPA) as a Capstone Consultancy project. The authors Justin DesRochers, Luyang Gao and Kaiwen Liu are SIPA graduating students. Any views expressed herein are the authors' own and do not necessarily represent those of SIPA.

We would like to express our thanks to our interviewees at Omanos Analytics, Power Construction Corporation of China (POWERCHINA), Sinohydro Bureau 11 Co., Ltd., the township People's government, natural resources department and financial department where the Comprehensive Land Consolidation Project is in Yunnan Province, China who provided us with valuable information to support our research. We wish to extend our heartfelt appreciation to our mentors, advisors, and Suzanne Hollmann, Director of the Columbia Capstone Program, Saleha J. Awal, Capstone Workshop Program Coordinator and their team, who made this research possible. We wish to convey our gratitude to Isabelle Delalex, Faculty Advisor at Columbia University SIPA, for her expertise in financing sustainable climate-resilient infrastructure assets. Her guidance and review played a pivotal role in shaping our research project.

We also extend our gratitude to Navid Hanif, Assistant Secretary-General for Economic Development in the Department of Economic and Social Affairs (UN DESA), Sharon Spiegel, Director at the Financing for Development office (UN DESA), and Daniel Platz, Inter-Regional Advisor at the Financing for Development Office (UN DESA), for their trust, confidence, and invaluable expertise that guided our examination.

2. Table of Contents

1. Acknowledgements	1
2. Table of Contents	2
3. Research Abstract	3
4. Background	4
5. Research Objectives	5
6. Methodology	6
7. Findings and Analysis	8
7.1. Comprehensive mapping of existing and upcoming bilateral, multilateral, and philanthropic initiatives funding infrastructure ventures.	8
7.1.1 Infrastructure Mapping - Selection Criteria of Bilateral, Multilateral and Philanthropic Initiatives	9
7.1.2 Mapping Analysis	10
7.2. Curated Case Studies	13
7.2.1 Africa Case Studies: Mozambique, Tanzania, and Kenya	13
7.2.1.1 Urban Water Supply and Sanitation Project in Mozambique	13
7.2.1.2 Rural Road Development Project in Tanzania	17
7.2.1.3 gEOthermalKenya: Earth Observation Insights for Sustainable Growth of the Kenyan Geothermal Sector	19
7.2.2 Asia Case Studies: Nepal and China	21
7.2.2.1 Upper Marsyangdi A Hydropower Station Project in Nepal	21
7.2.2.2 Comprehensive Land Consolidation Project in Yunnan Province, China	23
7.3. Opportunities for triangular cooperation between IAM government entities with funders and UN DESA	27
8. Conclusions	28
9. Way Forward	30
10. References	32

3. Research Abstract

There is a significant need for financing for infrastructure to achieve the Sustainable Development Goals outlined in the 2030 Agenda for Sustainable Development. Data reveals that merely 15-30 % of an infrastructure asset's total expenditure is allocated to its construction or acquisition, while a significant 70-85 % of costs arise post-acquisition. Thus, enhancing the asset's management, resilience, and sustainability, while reducing costs, and bolstering revenue potential can lead to considerable long-term sustainable development benefits. This research aims to foster synergies between UN Department of Economic and Social Affairs (UN DESA's) Infrastructure Asset Management initiatives (IAM) and infrastructure asset funders to yield long-term benefits from the robust maintenance of assets throughout their lifecycle and identify opportunities for UN DESA to collaborate with relevant partners over the next 2-3 years.

This report focuses on infrastructure development assets within the transportation, energy, agriculture, and water sectors, with a particular emphasis on the involvement of sub-national governments and local communities in Africa and Asia. Through a global mapping of sustainable infrastructure development projects, and curated case studies in Mozambique, Tanzania, Kenya, Nepal, and China, this report finds that UN DESA is well-positioned to contribute to IAM capacity-building and community engagement in infrastructure development initiatives by:

- Coordinating with identified, actionable projects included in the Capstone's mapping,
- Working with funders to strengthen the consideration of IAM capacity-building and community engagement in funding awards,
- Supplying UN DESA's existing knowledge sources to funding awardees to strengthen IAM's role in sustainable infrastructure development projects that are beginning or in progress.
- Including the report's identified lessons learned and replicable good practices in future knowledge resources.

SUSTAINABLE DEVELOPMENT GOALS



4. Background

92 % of the Sustainable Development Goals (SDGs) and its targets rely on various forms of infrastructure. However, investments in infrastructure assets frequently result in waste due to inadequate attention and budgeting for the entire lifespan of these assets. This encompasses not just their construction or acquisition, but also the ongoing management and maintenance of the infrastructure. Consequently, to enhance the resilience, accessibility, and sustainability of public infrastructure in developing countries, UN DESA, the UN Capital Development Fund and the United Nations Office of Project Services (UNOPS) have created toolkits and knowledge products for public officials relating to infrastructure asset management (IAM) at local and national levels, including a publication entitled “[Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments](#)” and a “Massive Open Online Course on Infrastructure Asset Management ([MOOC](#))”.

This report contributes to greater consideration of IAM capacity building in infrastructure development initiatives by mapping and analyzing ongoing and recent infrastructure projects, to inform UN DESA’s strategy formulation for linking its existing IAM initiatives with existing and future infrastructure programs.

5. Research Objectives

Objective: Focus on potential projects at the sub-national level and identify replicable cooperation and management models



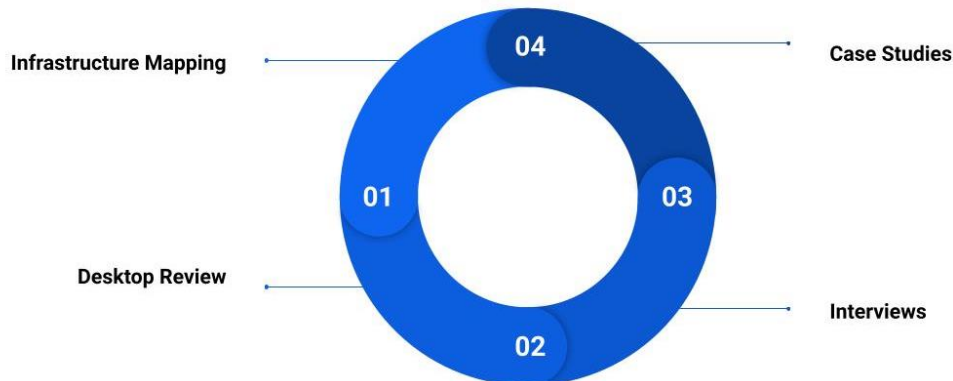
This Capstone project is composed of two deliverables: 1) a detailed mapping of infrastructure projects worldwide with an IAM capacity building component, based on selection criteria outlined in 7.1.1, to understand the current landscape of IAM capacity building initiatives (delivered to UN DESA as a standalone product); and 2) an analysis of the mapping exercise, five case studies of recent infrastructure projects analyzed for trends, lessons learned, and good practices with respect to IAM capacity building and community engagement, and strategic recommendations to UN DESA to link its existing IAM initiatives to existing and future infrastructure development projects.

Table 1: Deliverables and research objectives

Deliverable	Research Objectives
Mapping of infrastructure projects globally, specifically with IAM capacity building components, based off criteria detailed in 7.1.1	Understand the current landscape of IAM capacity building initiatives in relation to recent and current infrastructure projects.
Report	Identify trends, lessons learned, and good practices to inform UN DESA's strategy to link its existing IAM initiatives with existing and future infrastructure development projects.

6. Methodology

Methodology to analyze IAM capacity building initiatives in infrastructure projects at the sub-national level.



Infrastructure Mapping

The initial research phase of this project scanned the global landscape of infrastructure projects in developing countries. The scan pinpointed projects that satisfied various criteria and were identified as priority areas for UN DESA, aligning with the fields in which they operate:

- Engagement with subnational governments;
- Projects pertaining to transportation, water and sanitation, agriculture, and energy;
- Around 200 million USD in size;
- Preferably located in Least Developed Countries (LDCs)

The projects selected based on these criteria represent a wide geographic distribution, with locations spanning Asia, Africa, Latin America, and the Middle East; and include a wide variety of actors providing development assistance: bilateral foreign assistance from high-income states, loans from international development financial organizations (including the Bretton Woods institutions in addition to South-South oriented financial institutions, such as the New Development Bank), and involvement of other multilateral organizations.

This mapping was presented to the client as an independent deliverable prior to the submission of this report.

Desktop Review

After scanning the projects fitting the criteria listed above, the projects were further curated to inform this report's findings and analysis, and recommendations, sections. Projects were selected on the basis of whether they had substantive gray literature and/or publicly available data to analyze for inclusion, patterns, good practices, and lessons learned of infrastructure asset management in relation to sustainable infrastructure development.

Gray literature from the surveyed projects, and publicly available data reviewed, are placed in conversation with one another in this report to identify commonalities, differences and

tensions, and underlying themes pertaining to infrastructure asset management in sustainable development.

Interviews

This report's qualitative findings were generated by the team's interviews with infrastructure asset managers. These interviews aimed to identify noteworthy projects, gather detailed information, context, good practices, lessons learned, challenges, as well as offer recommendations for others engaged in managing infrastructure assets within the realm of sustainable development.

Case Studies

From the review of gray literature, publicly identified data, and interviews, the following countries were identified as case study examples for this study:

- Mozambique: Urban Water Supply and Sanitation Project
- Tanzania: Rural Road Development Project
- Kenya: gEOthermalKenya: Earth Observation Insights for Sustainable Growth of the Kenyan Geothermal Sector
- Nepal: Upper Marsyangdi A Hydropower Station Project in Nepal
- China: Comprehensive Land Consolidation Project in Yunnan Province, China

The case studies serve to sharpen an understanding of infrastructure asset management in sustainable infrastructure development across a wide variety of contexts, with several applications with specific contexts, good practices, lessons learned, and possibilities of replicability considered. The combination of these case studies and the mapping constitutes the foundation for the recommendations presented in this research to UN DESA.

Scope of Research

This report focuses on projects at the subnational level, in low and lower middle-income countries, with thin fiscal revenues, and substantially less information available than for infrastructure projects in upper middle-income countries. Therefore, the research focuses primarily on examining infrastructure sectors with more available sources – specifically transportation, water and sanitation, agriculture, and energy. This approach acknowledges that other projects may have been excluded, which could potentially be the subject of future research.

7. Findings and Analysis

7.1. Comprehensive mapping of existing and upcoming bilateral, multilateral, and philanthropic initiatives funding infrastructure ventures

There are a significant number of social enterprises and financial institutions investing in the infrastructure market for profit or not-for-profit purposes.¹ This report presents a review of stakeholders in IAM, evaluated as potential future partners with UN DESA. This Report maps infrastructure projects worldwide, particularly in developing countries. These projects are financed and often managed in partnership with local governments or third-party organizations. In the process of mapping stakeholders in the marketplace and various global infrastructure projects, our approach involved two key steps: 1) initially determining the selection criteria for mapping infrastructure, which included bilateral, multilateral, and philanthropic initiatives; and 2) then conducting an analysis of the projects based on these criteria.

Global Mapping: Over 80 projects based on selection criteria

Stakeholders

- Developing country
- Sub-national government
- Local communities

Funding Size + Target Sector

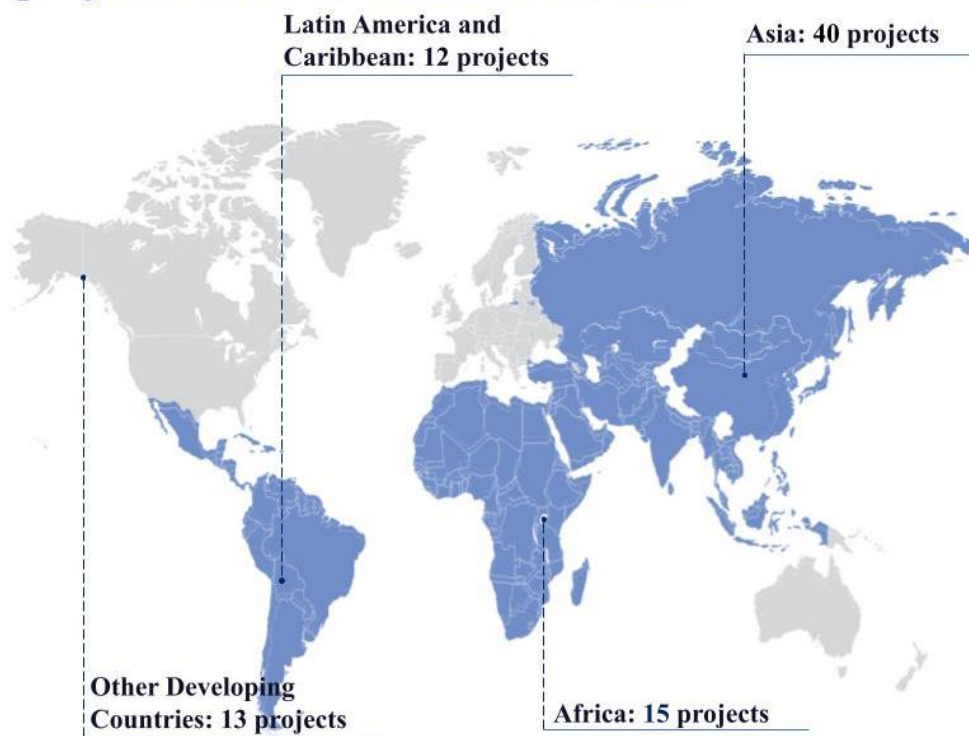
- 200m USD or below
- Demonstrated impact on the SDGs
- Selected focus: Transportation, Water, Energy, and Agriculture

Criteria

- Infrastructure funding gap
- Technical skill gap
- Low ROI
- Leveraging local communities in assets' operations or maintenance

Donors

- DFIs; IOs, SWFs
- Bilateral ODA
- Impact investment funds, corporations



¹ Funders include regional and global development banks (e.g. World Bank and Asian Development Bank), bilateral official development assistance (e.g. USAID and Global Affairs Canada), and sovereign wealth funds (e.g. Qatar Investment Authority).

7.1.1 Infrastructure Mapping - Selection Criteria of Bilateral, Multilateral and Philanthropic Initiatives

In order to better frame the worldwide mapping analysis, this report first identifies the selection criteria for bilateral, multilateral, and philanthropic initiatives in terms of country, size of funding, and sector. To further align with UN DESA's development objectives, this report focuses on infrastructure projects in developing countries, with community engagement in relation to infrastructure projects as a critical element.

In our global mapping analysis of stakeholders and projects involved with mainstream market institutions, funding size emerges as another crucial selection criterion for this report. Although the analysis includes infrastructure projects with funding ranging from hundreds of thousands to hundreds of millions of dollars, in line with the current requirements and development objectives of UN DESA, this report primarily concentrates on infrastructure projects with an investment size of around 200 million USD.

The term 'infrastructure' is exceptionally broad, encompassing projects that are focused on the development and maintenance of various services, facilities, and systems.² To refine the focus of this report, the research is concentrated on transportation, water and sanitation, energy, and agricultural infrastructure development. Additionally, the report considers how these initiatives contribute to the wide range of Sustainable Development Goals.

In developing countries, infrastructure tends to be less developed and extensive than in industrialized nations, and its management and utilization are often less efficient.³ This complexity is exacerbated by regulatory challenges, financial instabilities, and high borrowing costs. Therefore, this report will specifically address projects facing operational and managerial issues. It will also explore how UN DESA's expertise can assist these projects and identify potential opportunities for cooperation.

Overall, the report will focus on the projects that are short of long-term, local-currency financing for small-scale infrastructure projects – impeding local economic development in developing countries⁴.

² Bigrentz, "9 Types of Infrastructure Construction Projects in 2020," April 13, 2020, <https://www.bigrentz.com/blog/types-of-infrastructure>.

³ Timo Henckel and Warwick J. McKibbin, "The Economics of Infrastructure in a Globalized World: Issues, Lessons and Future Challenges," Brookings, June 4, 2010, <https://www.brookings.edu/articles/the-economics-of-infrastructure-in-a-globalized-world-issues-lessons-and-future-challenges/#:~:text=Well%20designed%20infrastructure%20facilitates%20economies>.

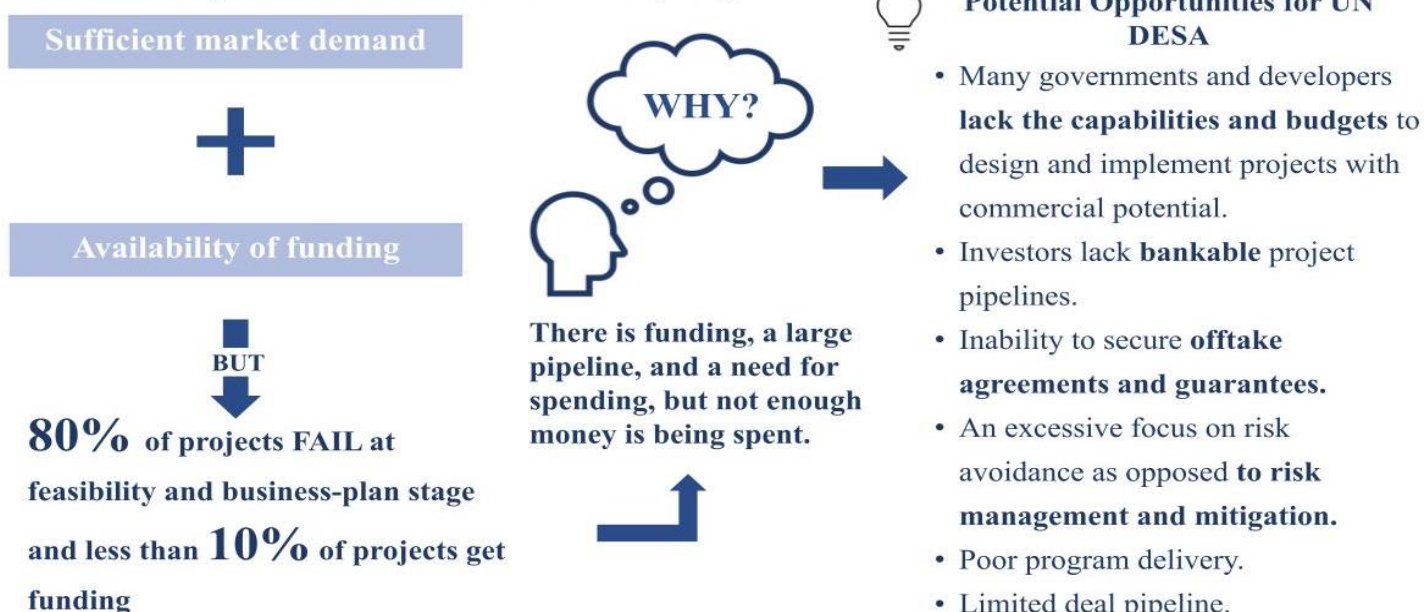
⁴ Daniel L. Bond, Daniel Platz, and Magnus Magnusson, "Financing Small-Scale Infrastructure Investments in Developing Countries" (Department of Economic and Social Affairs, May 1, 2012).

7.1.2 Mapping Analysis

This report maps infrastructure asset management, including existing infrastructure projects and infrastructure markets in developing countries, to explore potential opportunities for UN DESA's involvement. In total, we have compiled details of over 80 infrastructure projects, as well as the infrastructure market in developing countries. This report organizes a selection of infrastructure projects that are on an off-track trajectory from intended impact goals, while compiling curated case studies of good practices and lessons learned from sustainable infrastructure development projects combining IAM capacity-building and community engagement components.

Global Mapping: Paradox of Infrastructure Market in Developing Countries

From Concept Phase to Financial Close - Early Stage



I. Infrastructure Paradox - From Concept Phase to Financial Close (Early Stage)

In many developing countries' capital markets, there is an 'infrastructure market paradox' in which funding is available, there is a pipeline of projects, and a significant need for investment, yet funds specifically allocated for infrastructure projects are insufficient. From the demand side, it is clear that in developing countries, citizen's need for infrastructure is enormous. A majority of developing countries are receptive to foreign investment in infrastructure; and enhancing infrastructure is a primary development goal objective.⁵

From the supply side, international investors' interest in developing countries continues to grow, as these markets offer unexplored opportunities and risks. While risks (e.g. COVID-19) have deterred some investment firms, long-term upsides attracting international investors. Following a significant recovery in 2021, Global Foreign Direct Investment (FDI) decreased by

⁵ For example, in Paraguay, The National Development Plan "Paraguay 2030" (PND 2030) defines the transport sector as being of high priority to achieve the proposed developmental goals.

12% in 2022, primarily due to inflation and geopolitical risk. This downturn was predominantly observed in developed economies, where FDI decreased by 37%. However, inbound flows to developing countries grew by 4%.

However, the overall market dynamics do not accurately mirror the interplay between demand and supply, underscoring the presence of the 'infrastructure market paradox' previously highlighted. For example, in Africa, 80% of projects never go beyond the feasibility and business-plan stages and less than 10% of projects are funded. These market failures could be imputed to:

- Weak feasibility study and business plan. Developers and governments lack the crucial expertise and resources and the capacity to assess key technical and financial risks.
- Inability to secure offtake agreements and guarantees, mainly due to governments' inability to provide sovereign guarantees (e.g.: weak balance sheets).
- Investors lack bankable project pipelines.
- Excessive focus on risk avoidance as opposed to risk management and mitigation.
- Poor program delivery, the result of insufficient capabilities in planning (including technical design), managing, and execution of large projects.
- Limited deal pipeline.

Mapping Analysis: Funding and Management Gap

Construction, Operation and Maintenance Phase

Infrastructure Funding Gap	Actionable Projects
<ul style="list-style-type: none"> • Delay deliver • Cost overruns • Effective management of fiscal risks ensures infrastructure performance 	<p>Ghana</p> <p>The Ghanaian capital of Accra is seeking additional funding as part of a vast US\$102 million transport management project that aims to increase urban mobility and reduce transport-related GHG emissions.</p> <hr/> <p>Tanzania</p> <p>The Dar es Salaam Rapid Transit Buses project in Tanzania, currently in the Post-implementation phase. The project is fully funded by the Central Government at an estimated cost of US\$50 billion. The project is currently partially funded and is seeking additional funding.</p> <hr/> <p>India</p> <p>The Subansiri Lower Hydroelectric Project has been delayed by 176 months, and now expected to be completed by May 2025 after it suffered landslides, redesigns and some political opposition during its construction. It is expected to supply 2,000 MW of power when completed.</p>
<p>Technical / Management Gap</p> <ul style="list-style-type: none"> • Adverse effects of ageing infrastructure • Skilled labor shortage • Risk monitor • AI management 	

II. Infrastructure Funding Gap - Construction, Operation and Maintenance Stage

After moving from the conceptual phase to the financial close, there are difficulties encountered during the construction, operation and maintenance phases of a project. These challenges can be grouped in two categories: (1) the infrastructure funding gap and (2) the technology and management gap.

Funding gaps occur throughout the life cycle of infrastructure projects. Funding shortfalls in the planning and construction phases can lead to delayed deliveries, and UN DESA could connect donors to important projects including IAM capacity-building and community engagement. During the operational phase, cost overruns are a common issue. UN DESA could leverage its expertise to improve effective management of financial risks to ensure project performance.

There are many projects in the global mapping supplement to this report that have funding demands. Faced with a rising population and higher levels of road congestion and pollution, the Ghanaian capital of Accra is seeking additional funding as part of a vast US\$102 million transport management project that aims to increase urban mobility and reduce transport related GHG emissions⁶. The Dar es Salaam Rapid Transit Buses project in Tanzania, currently in the post-implementation phase, aims to construct a modern bus station/terminal to receive incoming buses into the city and relocate the existing centrally located bus station to the city's suburbs. The project is fully funded by the Central Government at an estimated cost of US\$50 billion, with the Central Government contributing to the operating costs of the project, while other costs amounting to approximately US\$12 billion will be funded by the Dar es Salaam Municipality. However, the project is seeking additional funding.

Lack of funding in water infrastructure remains a key barrier to addressing the challenges with water quality, availability, and accessibility in Africa. Many projects that could make a significant improvement in the quality of life for residents are seeking financial support. To accommodate an expected rise in water demand, Bulawayo city council in southwest Zimbabwe is aiming to undertake a study to assess the feasibility of constructing a new US\$2.5 million water treatment plant. Kisumu, the third largest city in Kenya, is seeking additional funding of up to US\$64.3 million to upgrade and modernize the county's water distribution pipeline network.

III. Skilled Labor and Technology Gap - Construction, Operation and Maintenance Stage

Lack of expertise and technology is one of the main reasons for the delay or even suspension of infrastructure projects. India has 135 infrastructure projects delayed by five years or more, and according to the latest report for July 2023 by the Infrastructure and Project Monitoring Division (IPMD), 809 projects were delayed, and 213 projects were behind schedule even after being granted extensions⁷. The road transport and highways sector had the greatest number of delayed projects at 262, followed by the railways at 115. The Subansiri Lower Hydroelectric Project has been delayed by 176 months, and it is expected to supply 2,000 MW of power when completed. The project is now expected to be completed by May 2025 after it suffered landslides, redesigns and some political opposition during its construction. So far, the project has cost about Rs 18,903.2 crore at an initial cost of Rs 6,285.33 crore, with a revised cost of Rs 21,247.54 crore. Similarly, a lack of skilled personnel or management expertise is common in infrastructure projects, and UN DESA can leverage its experience to help revitalize these infrastructure projects in crisis.

⁶ CDP Disclosure Insight Action, "Africa Infrastructure Projects in Need of Funding (2021-2022)," n.d., <https://www.cdp.net/en/research/global-reports/africa-infrastructure-projects-in-need-of-funding-2021-2022#footnote-1>.

⁷ Yaruqhullah Khan, "Seven of 10 Most-Delayed Infrastructure Projects in India Are Rail Lines," Moneycontrol, August 29, 2023, <https://www.moneycontrol.com/news/business/seven-of-10-most-delayed-infrastructure-projects-in-india-are-rail-lines-11273691.html>.

7.2. Curated Case Studies



7.2.1 Africa Case Studies: Mozambique, Tanzania, and Kenya

7.2.1.1 Urban Water Supply and Sanitation Project in Mozambique

Context

Poor water and sanitation infrastructure, and sanitation in general, is an enduring challenge in urban and rural settings throughout Mozambique.⁸ The Government of Mozambique and the Millennium Challenge Corporation (MCC) implemented the 203.6 million USD Water Supply and Sanitation (WSS) Project under the five-year (2007-2011) Millennium Challenge Account - Mozambique compact (MCA-M) to increase economic growth and reduce poverty.⁹ 178 million USD of this sum was allocated to strengthening urban water supply system activities – with 9.6 million USD allocated to capacity-building.¹⁰



⁸ Mozambique Urban Water Supply and Sanitation Evaluation: Final Report, Millennium Challenge Corporation, xvii ; Second-order effects of water and sanitation infrastructure deficiencies, including poor health and economic outcomes, costs the country nearly 136 million USD annually – equivalent to 1.2% of Mozambique’s GDP – with the majority of the economic burden falling on the most destitute.# Health challenges include cholera and diarrhea outbreaks that emanate from poor hygiene and sanitation conditions, and an absence of access to clean water.# Failed drainage infrastructure leads to runoff water mixing with latrine sewage, contributing to water-borne diseases, including malaria.

⁹ Ibid, xvii

¹⁰ Ibid, xvii ; The WSS Project was comprised of six components: (1) Rehabilitation and expansion of the Nampula city water supply system (44.2 million USD); (2) Rehabilitation and expansion of the Nacala city water supply system (18.3 million USD); (3) Rehabilitation of the Nacala Dam (39.9 million USD); (4) Emergency works for the Mocuba city water supply system (4.8 million USD); (5) An urban drainage and sanitation component (61.2 million USD); and (6) A capacity-building component (9.6 million USD).

Table 2: Organizational responsibility for components post-compact¹¹

Compact Infrastructure component	Organizations responsible post compact
Nampula water supply component	FIPAG
Nacala water supply component	FIPAG
Nacala Dam	ARA
Mocuba water supply component	AIAS Collins (Private operator) FIPAG
Nampula drainage and sanitation component	AIAS EMUSANA (Nampula municipality)
Quelimane drainage and sanitation component	AIAS EMUSA (Quelimane municipality)

Description of capacity-building and community engagement

The capacity-building component engaged stakeholders including the municipalities of Nampula and Quelimane, and the autonomous sanitation companies under local governments' auspices in the respective municipalities. This included building the capacity of the autonomous sanitation companies – the Investment Fund and Water Supply Asset Holder (FIPAG), the Water Supply and Sanitation Infrastructure Administration (AIAS), and Quelimane Municipal Sanitation Company (EMUS/NA)¹² while establishing the Nampula Municipal Sanitation Company (EMUSANA) – to increase access, reliability, and quality of sanitation and hygiene services in urban and peri-urban communities.¹³

Capacity-building was mainly delivered through workshop sessions and on-the-job training by MCA-M technical staff. This involved selecting employees from FIPAG and AIAS to join the MCA-M team in implementing activities, working together to design final activities, hire contractors, and oversee activity implementation with technical workshops to build specific competencies occurring in tandem. Project implementers also conducted public outreach to improve hygiene practices; built sanitation facilities in marketplaces; and supported the shaping of legislation, advocacy strategies, monitoring and evaluation plans, and human resource development. The WSS project assisted in the establishment of the municipality of Nampula's autonomous sanitation company, the Nampula Municipal Sanitation Company (EMUSANA), through legislative drafting assistance to collect businesses' trash, removing residential neighborhoods' trash, maintaining the central business district's cleanliness, and managing public toilets.¹⁴

Analysis

The dosage, duration, and type of capacity development required in specific context need to be considered in future investments in the water sector. Experience demonstrated that continuous support delivered over longer time periods contributed to higher rates of successful

¹¹ Ibid, 46.

¹² FIPAG was created in 1998 by the Government of Mozambique and provides water supply services to the country's 21 largest cities. AIAS was created in 2009 under this project to provide water supply across Mozambique's 130 small- and medium-sized cities.

¹³ Ibid, xvii, 9.

¹⁴ Ibid, 9; 41.

transitions to autonomous management. Interviewees in the final project evaluation suggested that the “on the job” training model where MCA-M and FIPAG/AIAS/ARA staff worked together led to the most substantive learning and capacity-building outcomes. In contrast, the organizations created in Nampula and Quelimane to manage drains and solid waste lacked the needed capacity to maintain the infrastructure, and there was no way to continue capacity-building support to the entities after the project was completed. Whereas FIPAG and AIAS personnel had nearly two years to work alongside technical experts to build capacity, EMUS/NA staff had less than a year of capacity-building – which was delivered in the form of technical assistance, which while helpful, was too short in duration.¹⁵



An image of water infrastructure in Tanzania that is a part of the Urban Water Supply and Drainage and Sanitation Activities of the Water Supply and Sanitation Project.

¹⁵ Ibid, 112.

Table 3: Organizational and technical comparison of FIPAG and AIAS¹⁶

	FIPAG	AIAS
Organizational structure	<p>Created in 1998 Has slowly expanded to provide water supply services to 21 large cities in Mozambique.</p> <p>Structure includes a governing body; fiscal council; and technical consultative committee to advise FIPAG.</p>	<p>Created under the WSS activities in 2009 Responsible for water supply across 130 small and medium cities in Mozambique.</p> <p>Responsible for sanitation in all of Mozambique. Structure includes a governing body, fiscal council and technical consultative committee.</p>
Staffing	<p>More than 2,700 full time staff across 21 cities, including technicians from the MCA-M team.</p> <p>Full administrative, financial, legal, and human resource divisions within regional offices.</p>	<p>Around 50 full time staff across 135 water systems.</p> <p>Full administrative, financial, legal, and human resource divisions.</p> <p>Challenges maintaining staff in the field due to low salaries and budgets for maintenance of equipment.</p> <p>Lack of clear roles and responsibilities in Nampula and Quelimane vis a vis EMUSA/NA.</p>
Technical capacity	<p>Strong technical and administrative capacity. Donors noted strong leadership from executive management and the high capacity of field and operations staff. Observations confirm strong technical knowledge of staff in Nampula and Nacala.</p>	<p>Stakeholders noted the lower technical quality of AIAS staff in the field.</p> <p>High turnover suggests capacity building provided by MCA-M may have been lost.</p> <p>Not clear what type of capacity development staff continue to receive.</p>
External Funding	<p>Since CED, FIPAG has worked with the World Bank and the Government of the Netherlands to secure financing to complete the Nacala water supply systems works. It has also been able to obtain external funding from other donors for other projects.</p>	<p>Legal restrictions prevent AIAS from pursuing external funding.</p> <p>Reliant on government budgets, which are low.</p>

¹⁶ Ibid, 41.

7.2.1.2 Rural Road Development Project in Tanzania

Context

Despite considerable investment in improving main roads, Tanzania's rural roads had not received sufficient attention by 2012, providing impetus for this project. Rural roads are crucial for market access, and the insufficient investment in rural road improvement led to between 20 to 40% of agricultural produce being lost due to the delay in transportation from farms to processing and storage facilities. Furthermore, an estimated 70% of market costs of commodities arose from delayed and costly transport. USAID and the Government of Tanzania identified inadequate rural roads as a hindrance to private investment and economic growth, and this project was formulated to address this challenge to increase access to markets.¹⁷



The Rural Road Development Project (RRDP) was divided into a Phase 1 (2012-2016) and Phase (2017-2018).¹⁸ This case study examines Phase 1 due to its narrower focus on rural road development and associated capacity building components (the Phase 2 final evaluation covers irrigation infrastructure and provides less room for discussion on capacity building activities). Phase 1 was implemented by engineering and construction firm CDM Smith; provided capacity building to district engineers and community groups (called "Road User Associations") to improve 179.7 km of rural roads in Kilombero and Mvomero districts in Morogoro region, and Kiteto and Kongwa districts in the Manyara and Dodoma regions; and was funded by USAID, with 5,515,946 USD allocated to the four local governments engaged in the project, as shown in Table 4.¹⁹

Table 4: Funding allocated by USAID to local government authorities for rural road development

Name of Roads	Region	District	Implementing Partner	No. of Roads & Lengths	Amount (USD)
Olboroti-Matui Engusero-Njiapanda Engusero-Orkine	Manyara	Kiteto	Kiteto LGA	3 roads – 76.8km	2,060,667
Pandambili-Njoge Suguta-Kibaigwa	Dodoma	Kongwa	Kongwa LGA	2 roads – 41.0km	1,069,878
Wamidakawa-Dihombo Langali-Nyandira	Morogoro	Mvomero	Mvomero LGA	2 roads – 24.6km	973,276
Namwawala-Mofu Mpanga-Ngalimila Mgudeni-Mhelule	Morogoro	Kilombero	Kilombero LGA	3 roads – 37.3km	1,412,123
Total				179.7	5,515,946

¹⁷ Performance Evaluation of Phase 1 of the Rural Road Development Project in Tanzania, i.

¹⁸ Final Performance Report - Technical Assistance to Support the Development of Irrigation and Rural Roads Infrastructure Project (IRRIP2), USAID. https://pdf.usaid.gov/pdf_docs/PA00TQ45.pdf

¹⁹ Performance Evaluation of Phase 1 of the Rural Road Development Project in Tanzania, USAID, 2; 4.

Description of capacity-building and community engagement

CDM Smith helped develop community groups (“Road User Associations” or “RUAs”) to provide routine maintenance and upkeep of rehabilitated roads, a task that existing contractors avoided due to the low value of such contracts. CDM Smith and each district’s Council Manager and District Community Officer identified villages that would host RUA groups before asking the local leadership to help select three people – two people from the community (one man and one woman) and a member of the village council – to be trained in labor-based routine maintenance. First, a labor-based technology engineer provided a “training of trainers” in a one-week format to district engineers, district community development officers, and technicians. Then, the district engineers provided 4-5 days of training to the three members selected from each RUA.²⁰ The three members then returned to their villages to form RUAs using different selection methods per community: in some villages, community members were asked to volunteer; some villages also converted existing cooperative groups into RUAs.²¹



Analysis

Although the project successfully enhanced district engineers’ capacity to maintain roads through the creation of RUAs that could be engaged for routine maintenance of roads, RUAs faced several constraints. For instance, the training of RUA members faced limitations as many participants had to travel far distances and therefore were tired or had to leave early. District engineers were also limited in their effectiveness as instructors since they were also new to labor-based technology, with their experience chiefly with machine-based maintenance methods, and the “train the trainers” from CDM Smith was insufficient for the district engineers to train others.²² Additionally, while local government authorities failed to provide routine maintenance for more than three years, the registration process for RUAs to become authorized contractors eligible for contracts was unexpectedly long, further denying routine upkeep of the rehabilitated road.²³

Even after RUAs were registered, only one in four RUAs were contracted to provide routine maintenance. Local governments did not budget for contracting out routine maintenance to RUAs²⁴ and on occasion, maintenance needs exceeded the capacities of RUAs. This endangered RUAs’ survival, and while some adopted other income-generating activities to contribute to their own sustainability, there was a risk that RUAs not contracted would be unable to hold on to their members – particularly those counting individuals from vulnerable groups as

²⁰ This training consisted of 2 days of classroom instruction and 2-3 days of practical training at a site.

²¹ Ibid, 29.

²² Ibid, 29.

²³ Ibid, 30-31.

²⁴ Once a road was completed, funds were diverted to other roads rather than to maintenance. Local officials viewed allocating funds to roads currently in good condition as a waste of funds. Ibid, 30-31.

members.²⁵ RUAs faced other challenges such as a lack of reference material and equipment to carry out routine maintenance, issues relating to payment, and a lack of ownership by RUA members in some areas (such as an absence of youth interest in RUA participation or gender norms inhibiting women’s membership).²⁶

7.2.1.3 gEOthermalKenya: Earth Observation Insights for Sustainable Growth of the Kenyan Geothermal Sector

Context

Kenya’s 2030 Vision includes universal access to electricity for the country’s 55 million citizens, a three-fold increase from 2017 values. Central to realizing Kenya’s 2030 Vision’s aspiration is the use of geothermal energy, which already has abundant potential due to Kenya’s location near the East African Rift Valley, where numerous active volcanoes have led the area to become the largest producer of geothermal energy in Africa and eighth in the world.²⁷



However, investments in geothermal energy are at risk due to the lack of due diligence in environmental and social standards. Extensive boreholes, pipe networks, and access roads at Kenya’s key geothermal site in the designated national park, Hell’s Gate, have raised concerns that the region’s natural beauty is being overrun and compromising the natural ecosystem. Several villages, mostly indigenous communities, were also relocated – and while many of these relocations were negotiated, media and civil society reporting suggest that language barriers may have prevented communities from fully understanding the implications. Complaints have thus arisen on the reduction of available land, access issues, insufficient housing, and instances of forced relocation without compensation. This has also posed risks for the government and companies to lose significant amounts of money because of corrective action within the project lifecycle, late-stage funding withdrawal, and expensive litigation.²⁸

The UK Space Agency funded a 300,000 GBP project implemented by Omanos Analytics, in partnership with Global Surface Intelligence (GSI), with the Kenyan National Environment Management Authority to assist the Government of Kenya in the impact of geothermal plants on environments and communities, with this improved monitoring capability leading to enhanced consideration of environmental and community impacts in the expansion of Kenya’s geothermal sector.²⁹ The award required a 30% contribution from Omanos, and the Government of Kenya participated in an advisory role in the preparation of the award proposal.

²⁵ Ibid, 30-32.

²⁶ Ibid, 36.

²⁷ “gEOthermalKenya: Space for Communities (IPP Project Blog),” Space for Development, August 18, 2021, <https://www.spacefordevelopment.org/blog/2021/05/geothermalkenya-space-for-communities/>.

²⁸ Ibid.

²⁹ Gavin Tweedie, “Intelligence for the Sustainable Growth of the Geothermal Sector in Kenya,” Surface Intelligence, August 21, 2020, <https://www.surfaceintelligence.com/post/intelligence-for-the-sustainable-growth-of-the-geothermal-sector-in-kenya>.



An image of geothermal infrastructure in Kenya.

Description of capacity-building and community engagement

The project combined intelligence collected from local stakeholders with satellite and other geospatial data from Omanos Analytics' base in Glasgow.³⁰ Community intelligence was comprised of ground data, narrative reports, media reports, participatory mapping, and interviews and was complemented by radar and multispectral imagery, medium and high resolution, freely available, and gas flaring satellite data to characterize and monitor land use around current and prospective geothermal plants to map and forecast impact.³¹ In particular, interviews with local stakeholders enabled the identification of recurring negative impacts of geothermal sites, including on air quality, water quality, noise, and employment opportunities.

Communities were also trained through virtual workshops – due to the COVID-19 Pandemic – in a variety of data collection methods, including land classification, and collecting soil and water samples. Omanos also partnered with Procol Kenya, an NGO, in a training of trainers where Procol personnel were trained in data collection methods before training local tribes. Omanos also undertook field exercises to collect water, soil, and noise samples to verify findings from community interviews.³²

Analysis

Engagement with local communities was both beneficial for communities and essential for the project. Interviews with local stakeholders provided critical data for the training of machine learning algorithms designed to assess land use around geothermal locations and forecast community and environmental impacts of future geothermal expansion. Notably, Omanos shared ownership of data with Procol Kenya and community members who participated in interviews, while providing compensation for the use of data – an unusual practice. Benefits for rural

³⁰ Ibid.; “Space Agency Funding for Company Developing Clean Energy,” STV News, August 19, 2020, <https://news.stv.tv/west-central/space-agency-funding-for-company-developing-clean-energy>.

³¹ “2021-2022 Geothermal Kenya - UNOOSA,” United Nations Office for Outer Space Affairs, accessed December 21, 2023, https://www.unoosa.org/documents/pdf/psa/activities/2022/UN-Austria/Davies_Celia.pdf.

³² gEOthermalKenya: Space for Communities (IPP Project Blog),” Space for Development, August 18, 2021, <https://www.spacefordevelopment.org/blog/2021/05/geothermalkenya-space-for-communities/>.

communities also extended to employment opportunities for communities badly affected by the COVID-19 pandemic.

On community capacity-building, although the COVID-19 pandemic prevented in-person workshops on data collection methods, communities experienced increased capacity through the establishment of a start-to-finish processing flow for community intelligence data collection that could be utilized in future work associated with the project. This improved capacity is also reflected in Procol Kenya's continued engagement with participating communities after the project's conclusion. Omanos also benefited from improved capacity, since this project enabled the company to reflect on the project's good practices – specifically, in establishing ethical guidelines, data collection, data localization, and risk assessment process – and replicate them in other initiatives.³³

The nexus of two threads – using space data solutions to benefit local communities faced with major changes emanating from large-scale development, while integrating affected communities' engagement – could ensure future geothermal expansion is environmentally and socially responsible while expanding access to electricity without contributing to carbon emissions.³⁴

7.2.2 Asia Case Studies: Nepal and China

7.2.2.1 Upper Marsyangdi A Hydropower Station Project in Nepal

Context

The Upper Marsyangdi A Hydropower Station is a run-off water diversion hub project focused on power generation, located on the upper reaches of the Marsyangdi River in the Gandaki region of western Nepal. The river upstream of the dam site is 82.3km long, with a drainage area of 2,740km². The normal reservoir water level is 902.25m, the dead water level is 901.25m, the verified flood level is 903.10m, the total storage capacity is 593,000 m³, and the power station installed capacity of 50 Megawatt (MW)³⁵.



The infrastructure asset includes barrages, diversion canals, sedimentation tanks, diversion tunnels, surge wells, pressure pipelines, ground power plants, switch stations and transmission projects. The Upper Marsyangdi A Hydropower Station has been in commercial operation since January 1, 2017. Currently, the actual operations meet projected operations and benefit 1.4 million people in the Gandaki and Kathmandu Provinces, with an annual power generation capacity at 100 million kilowatt-hours.³⁶

³³ Ibid.

³⁴ Ibid.

³⁵ 1 Megawatt = 1000 Kilowatt

³⁶ Nepal's Upper Marsyangdi A Hydropower Station Project Introduction and Evaluation Report 2023

Description of Capacity-building and Community Engagement

Funding Model

Upper Marsyangdi A Hydropower Station cost 165.9 million USD during the construction phase (2013-2017) and adopted a BOOT (Build-Own-Operate-Transfer) model for investment and development. The investment included two parts: (1) The investment from two funding parties, Power Construction Corporation of China Overseas Investment Co., Ltd. (Holding) and Nepal Sagarmatha Power Co., Ltd. in proportion to their equity; and (2) A loan from the financing party China Export-Import Bank. According to the project contract, the project concession period is 35 years in total, including the construction period of 5 years and the commercial operation period of 30 years. After the operation is completed, the infrastructure assets will be handed over to Nepal Electricity Authority (NEA) free of charge and NEA would be in charge of operating and using the project in the future.³⁷

Economic Activities Beneficial to Local Communities

The project provides a platform to promote local employment and enhance the skill level of local employees. During the construction period, the project created employment opportunities for local communities, hiring over 2,000 local employees at the peak. The construction company has trained more than 300 local workers in a variety of skills. During the operational phase, the operating companies have been focusing on localized management, progressively reducing the number of Chinese employees and increasing the number of trained local employees in key management roles. In the initial stage of the project's operation, there were 32 Chinese employees for operation and maintenance, and 37 Nepalese employees (5 operations, 10 maintenance, 6 cleaning, and 16 security), with a ratio of local Nepali workers to Chinese workers of 53.62%. Up to now, with the full implementation of localization, there are 20 Chinese employees for operation and maintenance construction, and 44 Nepalese employees (12 operations, 10 maintenance, 6 cleaning, and 16 security), with an increased ratio of Nepalese workers to Chinese workers of 68.75%.³⁸

Since the inception of the project, the construction and operating companies have been engaged corporate citizens. They have supported local education through resource assistance, ensured medical security, and generated employment opportunities. They have undertaken extensive repair and maintenance work on local roads, bridges, and drinking water infrastructure, all of which have proven beneficial to the local population. Furthermore, the construction and use of the project power station enables local towns and villages to further develop tourism by enhancing local tourism visibility and stimulating the development of local communities' livelihood and economy.³⁹

This Infrastructure Asset Management (IAM) model is designed to effectively reduce wear and tear on both the buildings of the power station and its power generation equipment. The goal is to ensure a seamless handover of the power station's infrastructure to the local government upon the completion of the Build-Own-Operate-Transfer (BOOT) agreement. By robustly managing the asset throughout its lifecycle, the project aims to maintain sustainable and efficient power generation, as well as achieve profitability. Furthermore, the power station and its

³⁷ Ibid.

³⁸ Ibid.

³⁹ Ibid.

Infrastructure Asset Management (IAM) enable local towns and villages to further develop tourism opportunities, thereby improving the local economy and the standard of living in local communities.⁴⁰

To engage local communities in the management of the asset, annual shareholders' meetings are organized. These meetings (1) report on the annual operational progress; (2) submit the budget for approval; and (3) present the operators' upcoming key objectives to the community. The meetings have enhanced communication among stakeholders, while increasing local community engagement. These meetings have created a favorable environment for the developer to progress in the ongoing phase of its IAM.⁴¹

Analysis

The BOOT (Build-Own-Operate-Transfer) Model used by the Upper Marsyangdi A Hydropower Station Project is a replicable and effective model for infrastructure asset management. Its main advantage lies in enabling funding and ownership of infrastructure in countries with limited access to capital markets. The model fosters a seamless allocation of responsibilities and transition of control over an asset's life cycle. The concession period's specifics are negotiated between a private entity and the local government. Typically, during construction, the private entity operates the asset to generate a return on investment and maintains it properly throughout the operating period.

This model utilizes private sector expertise and capital for infrastructure development, effectively managing risks and promoting long-term public interests. However, certain key factors must be considered when implementing a BOOT Model for infrastructure asset management:

- Adaptability to Local Context
- Robust Legal Framework Enforcing Concession Terms
- Accurate Risk Mitigation Assessment
- Enhancing Conditions for Capacity Building
- Fostering Stakeholder Engagement
- Establishing a Transparent and Competitive Bidding Process
- Implementing Performance Monitoring and Evaluation of the Asset throughout its Life-cycle

7.2.2.2 Comprehensive Land Consolidation Project in Yunnan Province, China

Context

In August 2016, the People's Government of Yunnan Province launched the "Regional Development and Poverty Alleviation Plan for Wumeng Mountain Yunnan Area (2016-2020)". This plan, focusing on regional development and targeted poverty alleviation, set out five main objectives: (1) infrastructure construction, (2) improvement of rural production and living conditions, (3) enhancement of basic public services, (4) development of characteristic



⁴⁰ Ibid.

⁴¹ Ibid.

industries, and (5) ecological construction and environmental protection. The aim was to engage the entire society in reducing poverty in the Wumeng Mountain Area of Yunnan Province.⁴²

To support the "Regional Development and Poverty Alleviation Plan for Wumeng Mountain Yunnan Area," the Department of Land and Resources in Yunnan Province launched the Major Land Consolidation Project in the Wumeng Mountain Area. This project, specifically focusing on Villagers Committees A and B, is part of a larger initiative in the area. Under the "Organic Law of the Villagers Committees" of the People's Republic of China, these committees represent grassroots self-governing organizations where villagers manage their own affairs democratically. Both Villagers Committees A and B are living below Nepal's average poverty levels. Committee A has a total of 859 households with 2,868 people, including 94 poor households with 307 people; Villagers Committee B has a total of 638 households with 2,357 people, including 106 poor households with 303 people. The land management project has played a crucial role in alleviating poverty. It has improved resource security, promoted the adoption of modern farming methods, optimized land use patterns, and stimulated local economic growth. Reduction of poverty imputed to the policies has had a notable social and ecological environmental impact.⁴³

The project, with a budget of 58.4891 million RMB from the central government's poverty reduction fund, started on February 14, 2019, and was completed by September 10, 2019. It focused on land leveling, irrigation and drainage, constructing field roads, improving rural settlements, protecting farmland, and maintaining the ecological environment. The project covered 1,276.1165 hectares, adding 26.7236 hectares of new cultivated land, thereby increasing the total cultivated area to 1019.3314 hectares (net area). This expansion represents a 2.09% increase in the cultivated land rate and can support an additional 157 people, considering an average of 2.56 acres of land per person. The project included land leveling, irrigation and drainage projects, field roads, rural settlement improvements, and farmland protection and ecological maintenance.⁴⁴

After implementing land consolidation in the project area, there have been substantial increases in annual output, output value, and net profit, significantly enhancing agricultural production conditions. This improvement has effectively boosted the local rural economy. The 1019.3314 hectares of high-quality, stable farmland created through this consolidation are expected to increase grain production by 2.9854 million kilograms annually. Additionally, this results in an annual increase in output value by 5.217 million yuan and in profits by 5.1099 million yuan. The investment has a return rate of 9.47%, with a theoretical payback period of 10.67 years.⁴⁵

Description of Capacity-building and Community Engagement

- (1) Establish a special coordination agency In the Comprehensive Land Consolidation Project, local communities were actively involved via the Villagers Committees. Notably, a specialized work coordination agency was established by the local Municipal People's Government on

⁴² 云南省人民政府关于印发云南省脱贫攻坚规划（2016-2020年）的通知_最新文件_云南省人民政府门户网站, August 15, 2017, https://www.yn.gov.cn/zwgk/zcwj/zxwj/201708/t20170814_142279.html.

⁴³ The Performance Evaluation Report of Comprehensive Land Consolidation Project in Yunnan Province, China

⁴⁴ Ibid.

⁴⁵ Ibid.

August 20, 2018. This agency was set up to expedite the project's smooth progress in the impoverished areas of Wumeng Mountain in Yunnan Province. Its responsibilities include organizing, implementing, and managing the project, as well as serving as the primary liaison with the Villagers Committees.⁴⁶

- (2) Villagers committee managing project implementation plans. The Municipal Natural Resources Bureau took on a coordinating role in the asset's planning and construction phase, from February 15, 2019, to September 10, 2019, incorporating input from the Villagers Committees. After this phase, the responsibility After the construction phase, the asset's management was handed over to the Villagers Committees. The Municipal Natural Resources Bureau implemented a detailed plan, specifying the project's goals, tasks, and funding. Divided into eight sections, the project saw eight construction and one supervision units selected through bids in February 2019. Starting on February 15, 2019, and completed by September 10, 2019, it included land leveling, irrigation, drainage, field roads, rural settlement, farmland protection, and ecological maintenance.⁴⁷
- (3) Fund management accountability in alignment with regulations. Overseeing changes in procedures and regulations. The Villagers Committees were key in the project implementation. Funds, managed by the Municipal government, were distributed through a rigorous system ensuring regulatory compliance, management by specialized personnel, and standardized fund use⁴⁸ Funds were disbursed in phases, aligned with progress in improving livelihoods. The Villagers Committees acted as intermediaries between villagers and local government, relaying community feedback and managing project impacts. They also had authority over changes in project rules, requiring their consent for any modifications. Additionally, these committees provided a platform for resolving disputes among stakeholders during construction.⁴⁹ Project changes during construction were strictly regulated. Any modifications required adherence to specific procedures and approval from higher authorities, with unauthorized changes prohibited. Conflicts and disputes during construction were promptly addressed by mobilizing town and village cadres, ensuring smooth and rapid project progress.⁵⁰
- (4) Construction-related conflict resolution framework. This land consolidation project enhanced agricultural infrastructure, operations, and the sustainable land use in the area. It introduced new agricultural practices and management methods, changing traditional mindsets. Local farmers gained a better understanding of national land regulations and laws through their involvement. The use of science and technology in agriculture improved irrigation and increased farmers' income. Adjusting for local factors, this pilot project can be replicated to improve the standard of living in rural areas.⁵¹

Analysis

If other communities were to adopt a model similar to China's Villagers' Committees, as observed in the Comprehensive Land Consolidation Project, it could prove to be a successful approach. These committees, composed of elected community representatives, oversee public

⁴⁶ Ibid.

⁴⁷ Ibid.

⁴⁸ Ibid.

⁴⁹ Ibid.

⁵⁰ Ibid.

⁵¹ Ibid.

affairs, coordinate community activities, mediate local disputes, and serve as intermediaries between the government and residents. Specifically in infrastructure management, they assess local needs and oversee projects to ensure these align with community requirements. By actively involving and gathering feedback from local communities, these committees ensure infrastructure initiatives positively contribute to community development.

Such a model could be replicated in different infrastructure development scenarios. Communities might establish local governance bodies akin to Villagers' Committees, tailored to their unique contexts, to manage and supervise infrastructure projects, ensuring they meet specific local needs and encourage community participation:

- **Encourage Community Engagement in Infrastructure Planning:** Promote active involvement of the community in the planning and management of the local infrastructure projects to reflect the community's needs and priorities.
- **Maintain Open and Clear Communication:** Ensure community input for infrastructure projects by serving a liaising function and engaging in regular, transparent communication with the community and project implementers on key decisions and information (e.g.: infrastructure plans, operations' progress, community's concerns).
- **Capacity Building:** UN DESA's contribution could be on improving the capacity of these local governance bodies, by facilitating its existing IAM resources to both the national (in a "train the trainer" format)⁵² and local governance bodies to provide essential training in project management, financial management, and stakeholder engagement to enhance community engagement with infrastructure asset management. Local governance bodies could subsequently train community members in these subjects, enabling wider-spread community participation in the management of infrastructure assets.

⁵² For instance, national government personnel participating in a "train the trainer" programs for establishing and maintaining local governance bodies could leverage their new expertise by assisting in the creation of local governance bodies in communities and facilitating training programs for local governance bodies' leaders.

7.3. Opportunities for triangular cooperation between IAM government entities with funders and UN DESA

UN DESA can play an essential central role in mainstreaming IAM capacity-building and community engagement in infrastructure development projects by advising two categories of actors: funders and funding awardees. Specifically, UN DESA can:

- Work with funders to consider IAM capacity-building and community engagement in infrastructure funding awards. Upon request from funders, UN DESA can develop guidance and tools for assessing the feasibility and effectiveness of capacity-building and community engagement components in project proposals competing for funding. This ensures that awards are granted to the strongest proposals that include these elements. In leveraging its expertise on IAM, UN DESA could share the benefits and importance of IAM with funders, with the aim of more funders' award requirements stipulating IAM capacity-building and community engagement elements. UN DESA could develop knowledge resources on how to develop such capacity-building and community engagement award requirements, such that they encourage the adoption of evidence-based good practices but flexible enough for different infrastructure development contexts.
- For funding awardees, UN DESA could supply knowledge resources, including the existing "[Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments](#)" and the "Massive Open Online Course on Infrastructure Asset Management," to strengthen IAM capacity among project implementers. Emphasizing the role of community engagement in IAM, UN DESA could guide project implementers on designing and implementing community-based capacity-building initiatives. This guidance could include replicable good practices and analyses from the case studies discussed in the following section.



8. Conclusions

This report's analysis has determined that nearly \$3.3 trillion USD must be allocated annually until 2030 to support the expected rates of global growth. However, there is an annual shortfall of \$350 billion USD, – particularly in developing countries that lack access to capital markets.⁵³ Infrastructure projects also face management or technical challenges. For instance, this report highlights consistent challenges such as the shortage of skilled labor and technology, as well as a high rate of failure in the feasibility and business planning stages, particularly among infrastructure projects in Sub-Saharan Africa.⁵⁴

The examined case studies have shown that there are instances of capacity-building and community engagement in sustainable infrastructure development projects in Africa and Asia, spanning across water and sanitation, transportation, energy, and agriculture sectors. Some replicable best practices include:

- “On-the-job” training models that pair targeted populations with IAM experts for long periods of time, enabling participatory learning in executing the management of infrastructure assets in different functional roles;
- Establishing mutually beneficial and reinforcing capacity-building partnerships between the private sector, NGOs, and communities where private sector entities benefit from replicable business models, NGOs benefit from deepened relationships with communities, and communities benefit from strengthened capacity and participation in IAM;

⁵³ Michael S. Burke and Clive Lipshitz, “The Infrastructure Gap: Funding the Future,” [infrastructure.aecom.com](https://infrastructure.aecom.com/infrastructure-funding), n.d., <https://infrastructure.aecom.com/infrastructure-funding>.

⁵⁴ Kannan Lakmeeharan et al., “Solving Africa’s Infrastructure Paradox,” McKinsey, March 6, 2020, <https://www.mckinsey.com/capabilities/operations/our-insights/solving-africas-infrastructure-paradox>.

- The BOOT model which can effectively leverage private sector expertise and capital for infrastructure development while managing risks, enhancing public long-term interests, and enabling local communities' management of an infrastructure asset;
- Forming local governance bodies to foster community engagement in infrastructure development projects, sustain clear and open communication, and improve the capacity of community members to manage infrastructure assets.

The case studies have also identified obstacles encountered during IAM capacity-building and community engagement efforts. Specifically, project planners and implementers interested in such initiatives must carefully consider how to sustain community engagement by addressing legal and regulatory procedures and barriers, ensuring long-term financial and resource provision, and garnering the necessary political support. Capacity-building activities need to thoughtfully consider the appropriate dosages, durations, and types based on beneficiary-specific needs and contexts.



9. Way Forward



Foster robust stakeholder partnerships

Link UN DESA's existing IAM knowledge resources with existing real-world needs by **liaising with donors and mainstreaming IAM capacity-building and community engagement** into funding award requirements.

Liaise with **funding awardees and project implementers** to disseminate UN DESA's knowledge resources in IAM capacity-building.



Replicable Mode

Assist projects in planning for **sustained, contextualized capacity-building and community engagement** throughout an asset's lifecycle, beginning in the project design phase.

Capacity-building replicable practices: BOOT model, Villagers' Committees, "On-the-job" training model.

Community engagement: Assess legal and regulatory considerations and barriers, financial sustainability, capacity-building and resource provision, and political support when developing community groups or engagement.



Capitalizing on Existing Opportunities

Utilize the **identified actionable projects** of the mapping deliverable for UN DESA engagement.

In the long term, there is potential collaboration with those projects that have been interrupted at an early stage due to **insufficient expertise, technology or risk management**.

There is a significant need for financing for infrastructure to achieve the Sustainable Development Goals outlined in the 2030 Agenda for Sustainable Development. Moreover, there is a significant need to specifically consider IAM within sustainable infrastructure projects, an often-overlooked element. In this respect, community engagement can play an essential role in ensuring infrastructure assets meet the needs of the communities they were constructed to serve, while also ensuring long-term sustainability of infrastructure assets with communities' continued participation in management and operation. UN DESA's existing IAM initiatives address these themes, and UN DESA is well-positioned to contribute to the landscape of global infrastructure development.

This report recommends that UN DESA leverage its IAM expertise to:

- **Coordinate with the identified, actionable projects outlined in Section 7.1.2: Mapping Analysis** that include IAM but are off track to meet their goals because of funding gaps and management or technique difficulties in the operation phase.
- **Make a business case for funders** to focus on capacity-building. Emphasizing IAM capacity-building and community engagement in funding awards. UN DESA could develop guidance and tools for funders to use in assessing capacity-building and community engagement elements of award applications, assist funders in developing criteria for capacity-building and community engagement in award application guidelines, and

encourage more donors to require capacity-building and community engagement in award requirements.

- **Provide technical expertise to funding awardees** by supplying existing resources, such as the “Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments” and the “Massive Open Online Course on Infrastructure Asset Management,” to strengthen IAM’s role in sustainable infrastructure development projects that are beginning or in progress. Special emphasis on community engagement in IAM represents another strategic entry point for UN DESA. UN DESA could develop additional tools for funding awardees to build the capacity of local stakeholders to play a central role in IAM throughout assets’ lifecycles.
- **Include the identified lessons learned and replicable good practices from Section 7.3.1: Africa Case Studies and 7.3.2: Asia Case Studies in future resources** to ensure planned and implementing IAM activities avoid the mistakes identified and have additional potential good practices to draw from:
 - Good practices: BOOT model, Villagers’ Committees, “On-the-job” training model, and expounding the benefits to private sector entities for engaging in community-based capacity-building.
 - Lessons learned:
 - Appropriately structuring the dosage, duration, and type of capacity-building needed based on existing capacities.
 - Assessing legal and regulatory considerations and barriers, financial sustainability, capacity-building and resource provision, and political support when developing community groups or engagement.

10. References

- Bigrentz, “9 Types of Infrastructure Construction Projects in 2020,” April 13, 2020, <https://www.bigrentz.com/blog/types-of-infrastructure>.
- CDP Disclosure Insight Action, “Africa Infrastructure Projects in Need of Funding (2021-2022),” n.d., <https://www.cdp.net/en/research/global-reports/africa-infrastructure-projects-in-need-of-funding-2021-2022#footnote-1>.
- Daniel L. Bond, Daniel Platz, and Magnus Magnusson, “Financing Small-Scale Infrastructure Investments in Developing Countries” (Department of Economic and Social Affairs, May 1, 2012).
- Final Performance Report - Technical Assistance to Support the Development of Irrigation and Rural Roads Infrastructure Project (IRRIP2), USAID. https://pdf.usaid.gov/pdf_docs/PA00TQ45.pdf
- Gavin Tweedie, “Intelligence for the Sustainable Growth of the Geothermal Sector in Kenya,” Surface Intelligence, August 21, 2020, <https://www.surfaceintelligence.com/post/intelligence-for-the-sustainable-growth-of-the-geothermal-sector-in-kenya>.
- “gEOthermalKenya: Space for Communities (IPP Project Blog),” Space for Development, August 18, 2021, <https://www.spacefordevelopment.org/blog/2021/05/geothermalkenya-space-for-communities/>.
- Kannan Lakmeharan et al., “Solving Africa’s Infrastructure Paradox,” McKinsey, March 6, 2020, <https://www.mckinsey.com/capabilities/operations/our-insights/solving-africas-infrastructure-paradox>.
- 2021-2022 Geothermal Kenya - UNOOSA,” United Nations Office for Outer Space Affairs, accessed December 21, 2023, https://www.unoosa.org/documents/pdf/psa/activities/2022/UN-Austria/Davies_Celia.pdf.
- Michael S. Burke and Clive Lipshitz, “The Infrastructure Gap: Funding the Future,” infrastructure.aecom.com, n.d., <https://infrastructure.aecom.com/infrastructure-funding>.
- Mozambique Urban Water Supply and Sanitation Evaluation: Final Report, Millennium Challenge Corporation.
- Nepal’s Upper Marsyangdi A Hydropower Station Project Introduction and Evaluation Report 2023

Performance Evaluation of Phase 1 of the Rural Road Development Project in Tanzania, USAID.

Space Agency Funding for Company Developing Clean Energy,” STV News, August 19, 2020, <https://news.stv.tv/west-central/space-agency-funding-for-company-developing-clean-energy>.

The Performance Evaluation Report of Comprehensive Land Consolidation Project in Yunnan Province, China

Timo Henckel and Warwick J. McKibbin, “The Economics of Infrastructure in a Globalized World: Issues, Lessons and Future Challenges,” Brookings, June 4, 2010, <https://www.brookings.edu/articles/the-economics-of-infrastructure-in-a-globalized-world-issues-lessons-and-future-challenges/#:~:text=Well%20designed%20infrastructure%20facilitates%20economies>.

Yaruqhullah Khan, “Seven of 10 Most-Delayed Infrastructure Projects in India Are Rail Lines,” Moneycontrol, August 29, 2023, <https://www.moneycontrol.com/news/business/seven-of-10-most-delayed-infrastructure-projects-in-india-are-rail-lines-11273691.html>.

云南省人民政府关于印发云南省脱贫攻坚规划（2016-2020年）的通知_最新文件_云南省人民政府门户网站, August 15, 2017, https://www.yn.gov.cn/zwgk/zcwj/zxwj/201708/t20170814_142279.html.

Image Sources:

CDM Smith. “Laying the Foundation for Economic Growth in Tanzania,” n.d.

<https://www.cdmsmith.com/en/Client-Solutions/Projects/USAID-Tanzania-IRRIP>.

Civil & Environmental Consultants, Inc. “Water Resources Development Act of 2020 Provides Funding for Critical Water Infrastructure Projects | Civil & Environmental Consultants, Inc.,” September 1, 2020. <https://www.cecinc.com/blog/2020/08/31/water-resources-development-act-of-2020-provides-funding-for-critical-water-infrastructure-projects/>.

IMF. “Kenya Taps the Earth’s Heat,” December 1, 2022.

<https://www.imf.org/en/Publications/fandd/issues/2022/12/country-case-kenya-taps-the-earth-heat>.

MCC. “Expanding Urban Water Supply and Drainage in Mozambique,” n.d.

<https://www.mcc.gov/resources/doc/evalbrief-032320-moz-urban/>.

Rivera, Manuel, and Camilo Carrillo. “Guide to investing in infrastructure projects in Peru

2022/2023,” October 18, 2022. https://www.ey.com/es_pe/infrastructure/guide-to-investing-in-infrastructure-projects-in-peru.

UN Environment. “New Report Reveals How Infrastructure Defines Our Climate,” n.d.

<https://www.unep.org/news-and-stories/press-release/new-report-reveals-how-infrastructure-defines-our-climate>.



COLUMBIA | SIPA

School of International and Public Affairs