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BRAZIL

Integrated Solid Waste Management and Carbon Finance Project

Report No. 123798

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Report No.: 123798

PROJECT PERFORMANCE ASSESSMENT REPORT

BRAZIL

**INTEGRATED SOLID WASTE MANAGEMENT AND CARBON FINANCE
PROJECT
(IBRD- 79640)**

March 1, 2018

*Financial, Private Sector, and Sustainable Development
Independent Evaluation Group*

Currency Equivalents (annual averages)

Currency Unit = Brazilian Real (R\$)

2011	US\$1.00	R\$ 1.68
2012	US\$1.00	R\$ 1.78
2013	US\$1.00	R\$ 1.98
2014	US\$1.00	R\$ 2.43
2015	US\$1.00	R\$ 2.65
2016	US\$1.00	R\$ 2.65

Abbreviations and Acronyms

ABRELPE	Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais (Brazilian Association of Public Cleaning Companies)
BNDES	Banco Nacional de Desenvolvimento Econômico e Social (Brazil National Bank for Economic and Social Development)
CAIXA	CAIXA Econômica Federale
CDM	Clean Development Mechanism
CER	certified emission reduction (unit)
CO ₂	carbon dioxide
COMLURB	Companhia de Limpeza Urbana (Municipal Cleaning Company of the City of Rio de Janeiro)
CPF	Carbon Partnership Facility
CTR	Centro de Tratamento de Resíduos (Waste Treatment Center)
ERPA	emission reduction purchase agreement
ESMF	Environmental and Social Management Framework
FGTS	Fundo de Garantia de Tempo de Serviço
GHG	greenhouse gas
IBRD	International Bank for Reconstruction and Development
JSDF	Japan Social Development Fund
M&E	monitoring and evaluation
NSWP	National Solid Waste Policy
SABESP	Basic Sanitation Company of the State of São Paulo
SERB	Saneamento o Energia Renovável do Brasil
SWM	solid waste management
UNFCCC	United Nations Framework Convention on Climate Change

Fiscal Year

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<p>This report was prepared by Ramachandra Jammi and Márcia Côrtes Pereira de Oliveira, who assessed the project in August 2017. The report was peer reviewed by Frank van Woerden and panel reviewed by Fernando Manibog. Vibhuti Narang Khanna provided administrative support.</p>

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Principal Ratings

	ICR*	ICR Review*	PPAR
Outcome	Unsatisfactory	Unsatisfactory	Unsatisfactory
Risk to Development Outcome	Substantial	Substantial	Substantial
Bank Performance	Moderately Unsatisfactory	Moderately Unsatisfactory	Moderately Unsatisfactory
Borrower Performance	Unsatisfactory	Unsatisfactory	Unsatisfactory

* The Implementation Completion and Results (ICR) report is a self-evaluation by the responsible World Bank global practice. The ICR Review is an intermediate IEG product that seeks to independently validate the findings of the ICR.

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About this Report

The Independent Evaluation Group assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank's self-evaluation process and to verify that the World Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20-25 percent of the World Bank's lending operations through field work. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or World Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, interview World Bank staff and other donor agency staff both at headquarters and in local offices as appropriate, and apply other evaluative methods as needed.

Each PPAR is subject to technical peer review, internal IEG Panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible World Bank country management unit. The PPAR is also sent to the borrower for review. IEG incorporates both World Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the World Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

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Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, Country Assistance Strategies, Sector Strategy Papers, and Operational Policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. The efficiency dimension is not applied to development policy operations, which provide general budget support. *Possible ratings for Outcome:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* High, Significant, Moderate, Negligible to Low, Not Evaluable.

World Bank Performance: The extent to which services provided by the World Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for World Bank Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Preface

This is a Project Performance Assessment Report by the Independent Evaluation Group (IEG) of the World Bank Group on the Integrated Solid Waste & Carbon Finance Project in Brazil.

The project was approved on November 2, 2010, for a cost of US\$160 million, with World Bank support of US\$50 million. The project cost at completion was US\$122.7 million, with only US\$16.7 million of the World Bank's loan being utilized. The project was closed on December 31, 2015 as planned.

The overarching objective of the project was to improve the treatment and final disposal of municipal solid waste in Brazil. This was to be achieved through closing of open dumps and constructing modern and environmentally safe landfills, improving municipal solid waste management (SWM) practices, reducing poverty among waste pickers, increasing private sector participation in SWM service provision; and strengthening the implementing agency CAIXA Econômica Federale's capacity to manage carbon finance projects.

IEG selected this project for assessment because of potential lessons from experience with SWM in a complex demographic and institutional setting, and from leveraging carbon finance to improve the financial viability of such activities.

The assessment is based on a review of all relevant documentation, interviews with World Bank staff at headquarters and in the country office, and the findings of an IEG mission that visited Brazil during August–September 2017. Project performance was discussed with officials of the central government, the implementing agency CAIXA Econômica Federale, CICLUS Ambiental, the private operator of the Santa Rosa landfill serving Rio de Janeiro, and staff of the World Bank's country office. The list of persons met during the mission is attached in appendix B. Their cooperation and assistance in preparing the report is gratefully acknowledged.

The PPAR team also met with Silpa Kaza, Urban Development Specialist in the World Bank's solid waste community of practice, to exchange views on curating lessons from this assessment for staff learning.

Following standard IEG procedures, a copy of the draft PPAR was sent to the government officials and implementing agencies for their review but no comments were received.

Summary

This Project Performance Assessment Report (PPAR) assesses the development effectiveness of the Integrated Solid Waste & Carbon Finance Project in Brazil. The project was approved on November 2, 2010, for a cost of US\$160 million, with World Bank support of US\$50 million. The project cost at completion was US\$122.7 million, with only US\$16.7 million of the World Bank's loan being utilized. The project was closed on December 31, 2015 as planned.

The objective of the project was to improve the treatment and disposal of municipal solid waste in Brazil. This was to be achieved through closing of open dumps and constructing modern and environmentally safe landfills, improving municipal solid waste management (SWM) practices, reducing poverty among waste pickers, increasing private sector participation in SWM service provision, and strengthening the borrower and implementing agency CAIXA Econômica Federale's capacity to manage carbon finance projects.

Solid Waste Management in Brazil

Brazil faces a growing challenge in managing its municipal solid waste, with serious health, safety, and environmental implications. Between 2003 and 2014, the volume of waste generated in the country increased by 29 percent, several times greater than the population growth of 6 percent over the same period.

About 45 percent of that waste is disposed of in sanitary landfills, while the rest ends up mainly in open dumps. Only about 2 percent of waste is recycled or re-used, which is in a similar range to that of Chile (1 percent) and Mexico (5 percent). By contrast, most OECD countries recycle and re-use their waste, reducing the share of waste that is disposed of in landfills to between 19 percent (Japan and Greece) and 65 percent (Germany). The large gap separating the state of SWM in Brazil—an upper-middle-income country—from OECD countries at different income levels, contrasts sharply with the smaller gaps in infrastructure services for electricity, water, and sanitation, and transport. On the positive side, Brazil is a world leader in recycling of aluminum cans (98 percent in 2016), recycling a major proportion of steel cans, tires, and plastic, mostly built on informal collection.

National Solid Waste Policy. Brazil adopted a progressive National Solid Waste Policy in 2010 after protracted deliberations spanning 20 years, which indicates the scale of institutional and political challenges in the sector. The policy mandated solid waste plans to be prepared by all 5,570 municipalities in the country by 2012; closure of all dumpsites by 2014; reduction of organic waste by 53 percent; increase in recycling to 45 percent; raising waste-to-energy production from about 118 MWh (Megawatt-hour) presently to 300 MWh by 2031; and social inclusion of 75 percent of waste pickers by 2031. As of now, the country lags well behind all these targets. For instance, only 40 percent of municipalities had submitted SWM plans by 2015, and about 3,000 dumps are still open, mostly in the North, Northeast and Midwest regions.

Institutional arrangements, financial viability, and private participation. Municipalities have the primary responsibility for SWM in Brazil, but many have low capacity for planning, implementing, and supervising SWM infrastructure and services. Most municipalities do not

charge for solid waste services, and when they do, the revenue is insufficient to deliver financially viable service of acceptable quality.

The private sector could address the investment and technical gap, but it faces barriers that need to be overcome through an appropriate regulatory framework and sound governance to balance the commercial risk between the private sector and the government. Ensuring the financial viability of solid waste services is of prime importance. This requires political will on the part of local governments to improve cost recovery from waste charges/fees and subsidies from public budgets, supplemented by cross-subsidies and other revenue sources where feasible, such as waste-to-energy revenues or carbon finance from landfill gas capture and flaring. However, economic instruments to improve the financial viability of landfill projects by fostering landfill gas extraction, biogas production, or energy solutions, for example, have not yet been designed in Brazil. For smaller cities, there have been attempts to build consortiums of municipalities to make solid waste services financially viable and attractive to the private sector, but this approach has not yielded any significant results so far.

Project Performance and Ratings

*Relevance of the project's development objectives is rated **substantial**.* The project objectives mirror the concerns raised in the Country Partnership Frameworks for FY2012–15 and FY2018–23, and the 2016 Strategic Country Diagnostic, which notes the lack of adequate SWM as a major source of environmental degradation; the weak performance of municipal and local governments; and broader inefficiencies in the choice, design and implementation of public programs, including private participation.

*Relevance of project design is rated **modest**.* The project design combined a financial intermediary loan, a carbon finance component, and a technical assistance package, addressing key financial, institutional, technical, and environmental needs for SWM in the country. The project was the first fully blended International Bank for Reconstruction and Development (IBRD)-Carbon Finance operation in the Latin America and Caribbean Region.

The provision of a line of credit for solid waste investments was less relevant, given the large scale of federal funds available to the implementing agency, CAIXA Econômica Federale (CAIXA). CAIXA's main concerns were the need to build capacity to implement carbon finance, and environmental and social safeguards.

The complexity of SWM and its implementation by municipal governments called for developing policy, regulation, and support mechanisms. Pegged to an operational/financing level with CAIXA, the project design did not create space for engaging with relevant ministries to further policy dialogue and actions and move toward the goals and targets set by the national solid waste policy.

The performance of the project objectives is rated as follows:

Objective 1 (*supporting the closing of open dumps and implementing sanitary landfills*) is rated **modest**. Three dumps were closed in the state of Rio de Janeiro, below the target of six, although investments to improve SWM in respect of recycling and composting were carried out in seven municipalities, against a target of four. The Santa Rosa waste treatment center (CTR) primarily serving Rio de Janeiro City was the sole investment financed by the project. The expectation of generating wider private sector interest to

implement landfills under CAIXA's 'Program of Activities' linked to carbon finance under the Clean Development Mechanism did not materialize.

Objective 2 (*improved municipal SWM practices*) is rated **negligible**. No activities were implemented because of the lack of interest from municipalities, and the absence of support from CAIXA.

Objective 3 (*reduction of poverty among waste pickers*) is rated **modest**. The project financed two Social Inclusion Plans for the waste pickers affected by the closure of the Seropédica and Itaguaí dumpsites as a result of the new Santa Rosa CTR. These efforts initially covered most of the intended beneficiaries, but the sustainability of the arrangements is uncertain. A Japan Social Development Fund (JSDF) grant, which complemented the investment loan and aimed at wider social inclusion initiatives for waste pickers, was cancelled because of several implementation and coordination challenges.

Objective 4 (*increased private sector participation in solid waste service provision*) is rated **modest**. Only two sub-projects—Santa Rosa CTR (which was under preparation prior to the project commencement) and São Gonçalo, which is yet to be completed, were taken up with private financing, against a target of four sub-projects.

Objective 5 (*strengthening CAIXA's capacity to manage carbon finance projects*) is rated **modest**. The World Bank assisted CAIXA in developing capacity to manage the CDM (Clean Development Mechanism) project cycle; and was effective in building its capacity for managing environmental and social safeguards for the solid waste sector. However, a dedicated carbon finance unit was not created as planned, and CAIXA was not able to expand the pool of projects for utilizing carbon finance.

Project efficiency is rated modest. Santa Rosa CTR, the main achievement of the project, is cost-effective in comparison to a similar landfill in Argentina. But two-thirds of the World Bank's loan was unutilized at completion, and the project faced delays at effectiveness and during implementation from lengthy administrative and procurement processes.

Overall Project Development Outcome is rated **unsatisfactory**, based on the combined ratings for relevance, project objectives, and efficiency.

Risk to development outcome is rated substantial. The project did not stimulate a larger portfolio of projects toward the development objective of scaling up the final disposal of municipal solid waste in Brazil. There has been little movement in addressing the fundamental issues holding back progress in the SWM sector—capacity and resources for municipal governments; and regulatory, financial and technical framework for encouraging investments. The prospect of leveraging additional carbon finance is uncertain with the weakened carbon market and new developments in international climate change negotiations.

World Bank performance is rated moderately unsatisfactory. Although the World Bank clearly recognized the scale and nature of the SWM challenge in Brazil, including investment needs, and limited municipal capacity, it overestimated (i) CAIXA's interest in availing itself of investment support; (ii) the municipalities' interest in utilizing opportunities for capacity building; and (iii) the private sector's response to investment opportunities with climate finance as an additional incentive. The World Bank could have put more effort during project design in probing cities' readiness to engage in SWM investments and improve their capacity

to operate and finance them. In retrospect, the World Bank could have opened a wider dialogue with relevant ministries to engage them on policy issues and to address factors behind the slow implementation of the project.

Borrower performance is rated *unsatisfactory*. The Government showed strong commitment to the project during preparation and up to effectiveness, but the Ministry of Finance did not engage with the World Bank on discussions over the performance of the project throughout its implementation. The CAIXA team was actively engaged during preparation of the project and contributed to the design of the operation, but it soon became clear that CAIXA's main interest lay in acquiring expertise for climate finance and safeguards management, and that the SWM program itself was not a key corporate priority.

Lessons

- **A project with sector-wide objectives must provide for engagement with the government at the policy level to lay a strong basis for achieving development outcomes.** This project had a sector-wide focus for solid waste management covering physical investments, institutional strengthening, and encouraging private sector participation. However, engaging primarily with a financial intermediary as the borrower and implementing agency was not sufficient to stimulate interest among municipalities and the private sector, which faced regulatory and institutional issues that need attention at the policy-making levels.
- **For an operation involving a financial intermediary, a minimum number of sub-projects must be committed at project effectiveness, to demonstrate quick successes and to develop further momentum during implementation.** Though a list of sub-projects had been pre-identified, only the Santa Rosa landfill in Rio de Janeiro was ready for financing, and the others had no specific project designs at project preparation stage.
- **In upper-middle-income countries with broad-based financial and institutional resources, the World Bank's interventions in a sector should focus on functional areas with a clear need and demand for external support and expertise.** Brazil had significant resources for investing in SWM infrastructure. The main needs were capacity building in the implementing municipal governments, and attracting private sector participation, which should have been the main focus of World Bank intervention.
- **In seeking to attract private sector investment and expertise to public service provision, the major barriers to entry must be clearly recognized and addressed. Incentives at the margin are unlikely to generate wide or sustained private sector interest.** The sole privately owned landfill supported to completion by this project (Santa Rosa facility for Rio de Janeiro city) was driven largely by its high public profile. This success could not be replicated in other situations largely because supportive regulation and appropriate incentives (remunerative contracts, tipping fees, and payment guarantees, etc.) were not yet in place for the sector, and carbon finance for landfill gas capture and flaring did not prove to be a significant determining factor.

José Carbajo Martínez
 Director, Financial, Private Sector, and
 Sustainable Development

1. Background and Context

1.1 Brazil is an upper middle income country¹ with a population of 207 million. It is among the most urbanized countries in the developing world with over 85 percent of its population living in cities. The 400 largest cities in the country concentrate 60 percent of the country's population and 75 percent of its GDP. The country has 5,504 municipalities, of which 100 have populations exceeding 100,000 each.

1.2 Despite strong improvements in access to basic services across the country (access to electricity, improved water supply, and improved sanitation cover 99 percent, 98 percent and 83 percent of the population respectively),² many cities in Brazil face big challenges to improving the quality of the urban environment including solid waste management.

Solid Waste Management in Brazil

1.3 Brazil produces 78 million metric tons of municipal solid waste per year; 90 percent of this waste is collected.³ The provision of household waste collection to the urban population in Brazil is near universal, having increased from 79 percent in 2000 to about 98 percent in 2008 (IBGE 2010). Solid waste collection is becoming increasingly privatized, as indicated by the growing number of companies affiliated to the Brazilian Association of Public Cleaning Companies (ABRELPE).⁴

National Solid Waste Policy

1.4 Policy for solid waste management (SWM) in Brazil is guided by the National Solid Waste Policy (NSWP) which came into force in 2010 after a long process of discussion that lasted more than 20 years.⁵ NSWP mandates that municipal solid waste be reduced, reused, recycled, treated, and recovered. Only after all these steps can it be sent to sanitary landfills. The policy also established targets and deadlines:

- **SWM plans:** Municipalities must submit their SWM plan by the end of 2012. Access to federal funds earmarked for solid waste management will be conditional on submission of these plans.
- **Closure of dumpsites and use of landfills:** All dumpsites should be closed by 2014, though the Brazilian senate approved postponement of the deadline per a schedule based on city size.
- **Reduce recyclables directed to landfills:** Reduction by 45 percent in the number of recyclables directed to landfills by 2031
- **Reduce organic waste directed to landfills:** 53 percent reduction of the amount of organic waste directed to landfills by 2031
- **Waste to energy:** Target of 300 MWh by 2031
- **Waste-pickers' welfare:** Social inclusion of 600,000 waste-pickers by 2031
- **Contaminated dumpsites:** Remediation by 2025 of areas contaminated by waste dump activities.

1.5 As of now the country lags greatly in all the NSWP targets and deadlines. The preparation of SWM plans by municipalities and the closure of dumpsites are not only far below quantitative targets but also well past the deadlines set for each of them. The country has yet to develop economic instruments to foster landfill gas extraction, biogas production or energy solutions, and to formulate a strategy for dealing with organic waste. A more detailed account of Brazil's solid waste issues and the status of each of the major NSWP targets is discussed in appendix D.

Institutional Issues

1.6 Municipalities and local governments have the primary responsibility for SWM in Brazil,⁶ like the practice in most countries. The share of attention that municipalities can give to SWM competes with their wide-ranging responsibilities and functions for the environment, urban planning, development, housing, and the provision of other physical and personal services. In response to the scale of challenges that the municipalities face in SWM, some states—Ceara and São Paulo—are seeking to play a direct role in this effort. For instance, Basic Sanitation Company of the State of São Paulo (SABESP⁷) is getting involved in the sector.

1.7 In this context, the World Bank Group's Country Partnership Framework for 2018–23 notes the overall weak performance of municipal and local governments. More broadly, the country faces public sector governance weaknesses and institutional arrangements that complicate necessary fiscal adjustment, and exacerbate inefficiencies in the choice, design and implementation of public programs, including those with private participation. Pricing policies need to be reviewed to improve the quality and resilience of service provision.

1.8 At the federal level, the Ministry of Environment oversees the implementation of the NSWP. It also coordinates the National Information System on Solid Waste Management (SINIR), which notes the origin, transportation and destination of the waste, and helps with technical capacity and design for SWM activities. The Ministry of Cities has the responsibility for promoting infrastructure in municipalities with more than 50,000 inhabitants while the National Health Foundation (FUNASA⁸) covers those with less than 50,000 inhabitants. The federal government enables investment programs sourced from the Worker Support Fund (FAT),⁹ General Budget of the Union (Orçamento Geral da União), and the Working Time Guarantee Fund (Fundo de Garantia de Tempo de Serviço or FGTS) to provide funds to municipalities for solid waste management. These funds are mainly channeled for SWM to municipalities through the Brazilian National Bank for Economic and Social Development (BNDES) and CAIXA, the largest public sector banks in the country.

1.9 One of the key issues for local authorities is to be equipped to deal with a wide variety of environmental, economic, and social responsibilities. In the absence of sufficient in-house capacity, municipalities have resorted to hiring consulting firms that often are not familiar with specific local conditions. Feedback from ABRELPE and some ministry officials suggests that in many cases private consulting firms produce standard action plans that are too far removed from real needs, as is corroborated by the experience of São Mateus and Vitoria in the Espírito Santo state (AMUNES, 2014).

1.10 **Behavior change:** The National Solid Waste Policy appears to have fostered a change in attitudes toward solid waste among manufacturers, businesses, and the public at large. However, all varieties of respondents with whom the IEG mission interacted—the federal government, lenders, private sector, local government, and World Bank staff—agree that public buy-in to and compliance with the new regulations are too low. The average person simply does not see the connection between their individual behavior and Brazil’s waste problem. There is a need for more information campaigns focusing on the enormous impact that improper waste management has not only for the environment, but also for improving public health, and for using resources in a sustainable manner.

1.11 **Barriers to private sector participation in SWM in Brazil.** Municipalities have the primary responsibility for SWM in Brazil, but many have low capacity for planning, implementing, and supervising SWM infrastructure and services. Most municipalities do not charge for solid waste services, and when they do, the revenue is insufficient to provide acceptable service delivery. The private sector can potentially play a large role in addressing the investment and technical gap facing the whole range of solid waste services from collection to safe disposal and treatment in the country. But this calls for an appropriate regulatory framework and sound revenue basis and governance to balance the risk between the private sector and the government.

1.12 The private sector could address the investment and technical gap; but it faces barriers that need to be overcome through an appropriate regulatory framework and sound governance to balance the commercial risk between the private sector and the government. The financial viability of solid waste services is of prime importance to the private sector. This requires political will on the part of local governments to improve cost recovery from waste charges/fees and subsidies from public budgets, supplemented by cross-subsidizing from other sources such as waste-to-energy revenues or carbon finance from landfill gas capture and flaring, where feasible. However, economic instruments to improve the financial viability of landfill projects by fostering landfill gas extraction, biogas production, or energy solutions have not yet been designed in Brazil. For smaller cities, there have been attempts to build consortia of municipalities to make solid waste services financially viable and attractive to the private sector, but these efforts have not yielded much results so far.

1.13 The most significant activity in the private sector is in solid waste *collection*, as evidenced by the increase in the number of the number of companies engaged in this activity and affiliated with ABRELPE¹⁰ However, private participation in downstream solid waste activities is far lower. Even where opportunities exist, the private sector faces difficulties in finding land, and obtaining licenses and permits for landfill construction. For instance, it took seven years to obtain licensing for the Santa Rosa landfill. Feedback from World Bank sector staff suggests that this is consistent with the experience in many developing countries, where leaving land issues to be sorted out by the private sector may be a recipe for failure.

Solid Waste Management and Carbon Finance

1.14 Carbon finance is the generic name for the revenue streams generated by projects from the sale of their GHG reductions, or from trading in carbon permits.¹¹ To qualify for

carbon finance under the Clean Development Mechanism (CDM), a project should demonstrate additionality; that is, it should provide evidence that its emission reductions are additional to what would occur without carbon finance. Projects that capture or flare landfill gas,¹² which is a mix of methane and CO₂, are among those that have the least difficulty in demonstrating additionality (for example, in comparison with energy efficiency, transport, or forestry projects).¹³ Greenhouse gas (GHG) emission reductions are achieved through capturing and flaring the landfill gas; or capturing and using it as a fuel or for electricity production that displaces a more GHG-intensive energy source. Global estimates suggest that 50 million tons of methane are generated annually from landfills (UIPCC 2014). A more detailed discussion on carbon finance and solid waste management is presented in appendix E.

1.15 Without the revenue stream from carbon finance, a landfill project proponent would have little economic incentive to capture the waste gas.¹⁴ Therefore, collection and flaring of landfill gas is not common practice in developing countries without the incentive of carbon finance. However, the capture and use of landfill gas as an energy source may be feasible if there are renewable portfolio standards or feed-in tariffs that enable projects to cover costs and provide capital investment for methane collection systems.

1.16 **Recent Developments in Carbon Finance.** With the adoption of the Paris Agreement,¹⁵ which establishes a mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development (Article 6.4), it appears that the CDM as a mechanism of the Kyoto Protocol, will end. However, in its standards, procedures and institutional arrangements, the CDM certainly forms an important basis for the elaboration and design of future international crediting mechanisms. The actual certified emission reduction (CER) supply depends on various conditions of the global carbon market and particularly on price expectations. However, even under normal market conditions, price forecasts are very uncertain and this may increase under post-2012 market conditions. A recent study notes that landfill gas flaring is among the few project types identified that have a high likelihood of ensuring environmental integrity, and they will continue to be attractive to potential CER buyers.¹⁶

World Bank Support for SWM and Carbon Finance in Brazil

1.17 In addition to the project being evaluated in this report, the World Bank's involvement in SWM in Brazil in the past decade was limited to two Carbon Offset projects for landfill gas: namely, Nova Gerar Landfill Rio de Janeiro Project (2005–17) under the Prototype Carbon Fund; and the Nova Gerar Carbon Finance and Solid Waste Management Project II (2007–15) under the Spanish Carbon Fund.

1.18 The first project put in place a methane gas collection system on two landfills: an old waste dump located in Marambaia and a new state-of-the-art sanitary landfill in Adrianopolis, in the larger metropolitan area of Rio de Janeiro. The project reports satisfactory performance in generating CERs as assessed in the last Implementation Completion and Status Report, dated October 2015.

1.19 The second project was an umbrella operation for three landfill gas sub-projects: (i) the Itaoca landfill (Rio de Janeiro); (ii) the Candeias landfill (Recife); and (iii) the Santa Rosa landfill (Rio de Janeiro). Carbon credits were covered in two emission reduction purchase agreements (ERPAs) financed by the Spanish Carbon Fund, one for the Itaoca and Candeias landfills, and another for the Santa Rosa landfill. Subsequently, all gas generation commitments were transferred to new ERPAs with the Carbon Partnership Facility (CPF) following the cut-off date for the Spanish Carbon Fund. Overall CER commitments are being met, even though ongoing social issues have delayed installation of flaring equipment at Itaoca.

2. Objectives, Design, and their Relevance

2.1 **Project Development Objective.** The project development objective¹⁷ was to improve the treatment and final disposal of municipal solid waste in Brazil while supporting the following:

- a. the closing of open dumps and the implementation of modern and environmentally safe landfills or alternatives to waste disposal;
- b. improved municipal solid waste management practices;
- c. reduction of poverty among waste-pickers;
- d. increased private sector participation in solid waste service provision; and
- e. strengthening CAIXA's capacity to manage carbon finance projects.

Components and Costs

2.2 Component 1. Infrastructure Investments in Solid Waste Disposal and Treatment (estimated cost at project appraisal: US\$154 million; at project completion: US\$122.7 million): Provide financing to public or private entities for infrastructure investments to improve final waste disposal and treatment within comprehensive SWM strategies reducing negative environmental and health impacts, such as: (i) the construction and operation of sanitary landfills; (ii) the closing of open dumps and related management of environmental impacts; and (iii) the development of alternative waste treatment facilities.

2.3 Component 2. Technical Assistance, Institutional Strengthening, and Project Management (estimated cost at project appraisal: US\$6 million; at project completion: data not available; no IBRD funds were disbursed; CAIXA allocated its own training budget and resources to these capacity-building activities). Support the development of an integrated approach to SWM in Brazil by preparing regulatory, financial, and technical guidelines to enable and encourage investments by supporting CAIXA with: (i) technical assistance and capacity building for preparation of SWM investments; (ii) technical assistance to strengthen institutional capacity to manage, supervise and monitor SWM investments; and (iii) ensuring proper management and supervision structures for project implementation.

2.4 **Financing.** The project cost at completion was estimated to be about US\$122.7 million, 77 percent of the original estimate of US\$160 million. IBRD provided a Financial Intermediary Loan of US\$50 million to CAIXA with a guarantee from the

Federal Republic of Brazil. Only 33 percent of the loan was disbursed (US\$16.7 million) by project completion. The Borrower (CAIXA) contributed US\$97.7 million, somewhat lower than the appraised estimate of US\$110 million. The private company, Saneamento e Energia Renovável do Brasil (SERB)¹⁸ contributed another US\$8.3 million during implementation.

2.5 A carbon finance operation, Caixa Solid Waste Management (2012–19) was linked to the project, under which an ERPA was signed between IBRD and CAIXA on December 5, 2011. The carbon finance operation is ongoing and is scheduled to close in December 2019. In addition, a recipient-executed Grant Agreement was signed on January 28, 2011 with the Japanese Social Development Fund (JSDF) for the Solid Waste Picker Social Inclusion Initiative (Brazil Solid Waste Picker Social Inclusion Initiative (2010–14), with a total value of US\$ 2.7 million. The JSDF project was conceived as a complement to the investment loan aimed at financing social inclusion initiatives for waste pickers. Only about 5 percent of this grant was disbursed, and the planned activities were cancelled because of several implementation and coordination challenges. These are detailed in the section on “Implementation” and “Efficacy.”

Relevance of Objectives

2.6 Relevance of the project objectives is rated *substantial*. The challenges in SWM across Brazil were recognized in the World Bank’s Country Partnership Frameworks for FY2008–11, FY2012–15 and FY2018–23. The 2016 Strategic Country Diagnostic states that Brazil’s environmental challenges threaten its competitiveness and productivity, and lack of sanitation and of adequate solid waste management is a major source of environmental degradation. The Country Partnership Framework for 2018–23 notes the overall weak performance of municipal and local governments, and the broader inefficiencies in the choice, design, and implementation of public programs, including those with private participation.

2.7 At the time of project preparation, the government was formulating the NSWP Law, which was finalized in 2010 after protracted negotiations, to provide a regulatory framework for SWM. High priority was given to SWM by the central government through the Ministry of Environment and the Ministry of Cities, to provide financial resources and technical assistance to municipalities to comply with ambitious investment targets under NSWP.

Relevance of Design

2.8 Relevance of the project design is rated *modest*. As explained under “Sector Background,” closing dumpsites and constructing sanitary landfills was a major priority for the country. For this task, many municipalities did not have adequate capacity for planning and implementation, and lacked financial resources to implement new projects. The municipalities also needed support for ensuring the welfare of waste pickers whose livelihoods would be affected by the closure of dumpsites.

The project design addressed key institutional, technical, and financial issues for SWM in Brazil. It covered investment support for closing open dumps and constructing safe

landfills; improving municipal capacity for these activities; developing technical and financial tools to promote private sector participation; and tapping carbon finance from landfill gas capture to improve the financial viability of landfill operations. Given the sector context, the project component activities were appropriate to achieving the development objective of improving the treatment and final disposal of municipal solid waste in Brazil in an environmentally sustainable manner. The project also provided for securing the welfare of waste pickers, thus ensuring social sustainability of the project activities.

2.9 The project was the first fully blended IBRD-carbon finance operation in the Latin America and Caribbean region. It combined a financial intermediary loan (FIL), a carbon finance component, and a technical assistance package, together aimed at improving the economic feasibility, as well as the environmental and social sustainability of interventions in SWM. Financing from the JSDF aimed to reduce poverty among waste pickers who would be affected by the project.

2.10 The provision of a line of credit for solid waste investments, as a component of project design, was less relevant, given CAIXA's main needs and interests, which were to strengthen the capacity for implementing carbon finance and environmental and social safeguards. The line of credit provided by the FIL was relatively small compared to the ambitious development objective of the operation, and compared to the scale of financial resources available to CAIXA for the sector.

2.11 At project preparation, the national solid waste policy had taken shape, but there was little further planning on follow-up movement toward policy goals and targets. The complexity of SWM and its implementation by municipal governments called for more policy features, regulation, and support mechanisms to be developed. By pegging the project design to an operational/financing level with CAIXA, the project design did not create space for furthering policy dialogue and actions through engaging with relevant ministries.

Monitoring and Evaluation

2.12 **Monitoring and Evaluation (M&E) Design.** The main outcome and intermediate outcome indicators were at the level of municipal governments, CAIXA's SWM portfolio, and private sector participation namely, (i) number of open dumps closed and monitored; (ii) increased volume of waste disposed of in environmentally sustainable sanitary landfills; (iii) increased volume of waste composted and recycled in targeted municipalities; (iv) number of solid waste projects with private financing; and (v) growth of CAIXA's SWM portfolio. These indicators were appropriate for the overarching objective of improving the treatment and final disposal of municipal solid waste in Brazil. However, the results framework did not reflect the financial intermediary aspects of the project. The M&E framework should have included intermediate indicators and targets for process-oriented steps for on-lending activities; the lack of these proved to be a bottleneck in project implementation. Also, the indicators did not cover the strengthening of CAIXA's capacity to manage carbon finance; and tracking poverty reduction among waste pickers was not included.

2.13 **M&E Implementation.** The M&E indicators and targets as designed were monitored during implementation in coordination with the CAIXA team. The M&E scheme was not revised at the time of mid-term review. This may have been a missed opportunity to put the focus on elements that were not covered in the original M&E design. However, the difficulty of making meaningful changes at that stage is recognized, given the changes in the SWM sector context; the evolving carbon market; CAIXA's internal reorganization and process delays; and low interest in utilizing investment and assistance in municipal capacity building. The impact evaluation planned at project closure was dropped, given the low level of investment from the project, which extended to only one sub-project.

2.14 **M&E Utilization.** With the shortcomings in M&E design, slow progress of project activities, and low disbursements, the M&E framework was of limited use in tracking progress on the main bottlenecks in implementation, and in capturing the downstream impacts of the project.

2.15 Overall M&E Quality Rating is rated *modest*.

3. Implementation

3.1 The initial thinking about this project began as early as 2005, soon after the Kyoto Protocol came into force. At that time, the World Bank and CAIXA had preliminary discussions on carbon finance opportunities. CAIXA started an internal strategic planning process to assess their portfolio and decided to invest in SWM because they saw an opportunity to combine their SWM and carbon finance strategies. In the absence of dedicated funding for developing expertise in carbon finance as well as related environmental and social safeguards, CAIXA approached the World Bank for assistance. CAIXA also applied to the Ministry of Cities to make the CDM applicable to federal Fundo de Garantia de Tempo de Serviço (FGTS) funds that are a major source of finance for SWM, and received approval from the ministry in 2008.

3.2 In 2007, the federal government launched the Growth Acceleration Program (*Programa de Aceleração do Crescimento* or PAC), which covered SWM among other infrastructure sectors. Under this program CAIXA began to finance landfill projects. To supplement this effort, the World Bank would lend US\$50 million to CAIXA as a financial intermediary under the Integrated Solid Waste Management and Carbon Finance Project, for on-lending for SWM to municipalities and the private sector, and for capacity building in CAIXA.

3.3 In keeping with the strategy of blending IBRD financing with carbon finance, CAIXA signed a Seller Partnership Agreement in 2009 with the World Bank-administered Carbon Finance Partnership. The World Bank engaged with CAIXA on carbon finance through a Program of Activities, which was a more efficient alternative to preparing a separate ERPA (Emission Reduction Purchase Agreement) with each project implementer. CAIXA and the World Bank signed their first ERPA in 2011. The Program of Activities for this purpose was signed by the United Nations Framework Convention on Climate change (UNFCCC) in October 2012.

3.4 **CAIXA's Program of Activities for Carbon Finance.** Under the Program of Activities arrangement, CAIXA is a Coordinator Management Entity for coordinating the registration process of carbon credits with the UNFCCC. Each activity/project seeking investment and carbon finance from CAIXA can apply to be included in a Program of Activities based on specified criteria. The project entity concludes an agreement with CAIXA, placing the latter at the core of the CDM cycle.¹⁹

3.5 The first sub-project to enlist under the Program of Activities was the Santa Rosa CTR (waste treatment center in Seropedica in 2011. More recently, a new sub-project, the landfill São Gonçalo in Rio de Janeiro, was added to the Program of Activities on March 31, 2016.²⁰ The Santa Rosa CTR was designed to serve the city of Rio De Janeiro and some contiguous urban areas. It would replace the Jardim Gramacho open dumpsite adjoining the Guanabara Bay, which had served Rio city for 34 years until 2010. Over the years, the dumpsite covered an area of about 14 million square feet with trash piled 300 feet high. At its peak, the site was receiving 9,000 tons of garbage every day. The environmental impact of the site was huge: the rotting trash was releasing large amounts of greenhouse gases into the atmosphere, while run-off leaked into the sea, polluting Rio's Guanabara Bay. The dump had grown on top of unstable, ecologically sensitive marshland and for nearly 20 years, functioned with no administration. There was no lining on the massive landfill's floor to prevent leaks of toxic wastes.

3.6 The political impetus for pursuing the Santa Rosa CTR and its inclusion in the Program of Activities under the project came from the then upcoming Rio+20 summit in 2012, the World Cup in 2014, and the Summer Olympics in 2016. Under an existing contract a private company, Haztec, was charged with transporting solid waste from Rio to a landfill in Seropedica. Originally, Haztec and the Julio Simoes Group each had a 50 percent stake in Ciclus Ambiental, which was the operator of the landfill. Subsequently, Haztec was sold to the Foxx Group, which led to a delay of one year during which CAIXA carried out due diligence for Foxx, as was required before signing a new contract with the World Bank.

3.7 CAIXA recognized that any project that can meet the requirements of the CDM project cycle and its technical audits would have a reduced risk profile. On this basis, CAIXA used the CDM revenues as a partial guarantee, by linking the interest rate of loans offered by CAIXA to the performance of the landfill project. Specifically, sub-projects within the Program of Activities became eligible for discounted financing rates (for implementation, operation, and CDM/biogas components) based on risk profiles that incorporated CDM considerations. Sub-projects could avail themselves of a first discount on their loan interest rates after registration with UNFCCC, and a second discount upon delivery of a minimum volume of emission reductions, in line with agreed annual contract volumes.²¹ Thus CAIXA became the only bank in Brazil to offer loans that accepted future carbon revenues as partial guarantees.

3.8 While the IBRD loan is closed, the World Bank Carbon Partnership Facility (CPF) operation (Caixa Solid Waste Management Project) is still ongoing, and activities related to the Program of Activities will require additional supervision until the ERPA closing date of December 31, 2019. For this, the necessary budget provision has been made together with arrangements for coordination with the urban and safeguards team.

In the case of this project, safeguards responsibilities cannot yet be transferred to the World Bank's Carbon Finance Unit because (i) construction of the Santa Rosa facility has not been completed, and new sub-projects may be incorporated to the Program of Activities in the near to medium term, which will require the World Bank's approval of their compliance with environmental and social safeguards.

3.9 The Mid-Term Review was delayed until October 2014 when it could better tailor recommendations to the new institutional structure of CAIXA, following its lengthy internal reform. The Mid-Term Review recommended restructuring the project with partial cancellation of the unused balance. However, CAIXA was not interested in a major restructuring of the project to shift the focus from investment to technical assistance, and the unused amount was canceled.

3.10 **Environmental and Social Safeguards.** The project was classified in Category FI (financial intermediaries) under the World Bank's environmental and social safeguards framework. This category applies where the World Bank finances a financial intermediary (CAIXA in this case) for on-lending to multiple sub-projects. The following safeguard policies were triggered: environmental assessment (OP 4.01), natural habitats (OP 4.04), pest management (OP 4.09), physical and cultural resources (OP 4.11), and involuntary resettlement (OP 4.12). As required for Category FI, the borrower had to prepare an environmental and social management framework that applies to all sub-projects under the World Bank loan. The World Bank piloted the "Use of Country Systems" for environmental and social safeguards in Brazil with CAIXA. Under this pilot, CAIXA developed an Environmental and Social Management Framework (ESMF) that conformed to World Bank guidelines and would apply to SWM sub-projects to be financed under the World Bank project. This was later extended to CAIXA's larger portfolio. Supervision arrangements required the World Bank's approval of at least the first two sub-projects identified under the project, as well as monitoring of CAIXA's capacity during implementation. Regular safeguards supervision confirmed that the ESMF and other related safeguards were applied in a satisfactory manner throughout implementation.

3.11 **Fiduciary Compliance.** Financial management performance ranged from satisfactory to moderately satisfactory throughout project implementation. Minor shortcomings relating to the inability of the Project Monitoring and Reporting System to automatically generate standard financial reports were ultimately resolved, and World Bank requirements were complied with adequately. All project audit reports were reviewed and found acceptable to the World Bank. Procurement management throughout the lifetime of the project was rated as moderately satisfactory. Procurement was carried out only for one investment under the project, and the capacity of the project implementation unit to apply the World Bank's procurement rules remained limited.

3.12 In contrast to environmental and social safeguards, where the project piloted the use of country systems, CAIXA was required to follow World Bank procedures to disburse IBRD resources, which in turn required CAIXA to create new operational procedures that significantly delayed implementation. Managing IBRD resources in compliance with the World Bank's fiduciary requirements meant putting in place a separate system of controls within CAIXA, both for executing and for reporting

expenditures. Almost two years were needed to have all the procedures in place for CAIXA to use project resources, for matters as simple as the hiring of individual consultants. Another example of the difficulty in harmonizing the procedures of the World Bank and CAIXA was the implementation of a US\$2.79 million grant from the JSDF, executed by CAIXA and aimed at supporting the social and economic inclusion of informal recyclers in SWM projects.

4. Achievement of the Objectives (Efficacy)

4.1 The efficacy of the overarching project development objective—to improve the treatment and final disposal of municipal solid waste in Brazil—is assessed through the achievement of the five specific objectives pursued by the project.

4.2 **Objective 1: Supporting the closing of open dumps and the implementation of modern and environmentally safe landfills or alternatives to waste disposal.** Rated *modest*. Three dumps were closed in the state of Rio de Janeiro, fewer than the targeted six: (i) in the municipality of Seropédica, where the Santa Rosa CTR is located; (ii) in the municipality of Itaguaí; and (iii) Jardim Gramacho (Duque de Caxias), which was the original dump of the City of Rio de Janeiro. The closure of Jardim Gramacho was not financed by the project, but the start of operations at the Santa Rosa CTR allowed the City of Rio to close the Jardim Gramacho dump. Santa Rosa CTR was the only sanitary landfill sub-project that was financed by the project (Box 4.1). This success was not replicated under the project.

Box 4.1. Santa Rosa CTR (Waste Treatment Center)

Santa Rosa CTR is a sanitary landfill and is considered one of the most secure, modern, and efficient solutions for treating solid waste in Latin America. About 10,000 tons of waste is received daily at this facility from Rio de Janeiro city (90 percent), Seropédica, Itaguaí and Mangaratiba (5 percent) and big generators (5 percent).

Santa Rosa CTR is owned and operated by the private company Ciclus Ambiental, under a 25-year concession contract beginning 2011 with COMLURB, a public company owned by Rio de Janeiro City. The project cost was about US\$112.7 million. The World Bank, CAIXA, and the private developer contributed US\$16.7 million, US\$97.7 million, and US\$8.3 million respectively.

The IEG mission was given a detailed technical presentation by the company management, with emphasis on the environmental safety features.

The facility covers 2 million square feet, with 0.6 million more for future expansion. Waste brought in by trucks is weighed, identified by categories, and deposited in the landfill and covered with clay to avoid the spread of odors. The bottom-lining system ensures that the leachate generated by the accumulated rubbish does not pollute any groundwater or surface water. Sensors are located at 12 points to monitor groundwater pollution. The leachate generated from the decay of organic matter (and includes rainwater and free water from the waste) is treated and transformed into recycled water.

The facility has a network of pipes embedded in the landfill to capture the biogas produced by the decay of organic matter. The biogas is flared to transform methane into CO₂, which is less polluting. Santa Rosa CTR plans to use the biogas as a renewable energy source in the future.

The project has integrated the existing urban infrastructure into the project design and improved roads and streets of nearby communities. It also implemented a green belt around the site that works as a natural barrier to hold dust, odor, and noise.

A 'Center for Environmental Education' located at the facility serves to interact with, inform, and educate local communities about environmental issues and recycling procedures. The facility provided for improvement of working conditions of waste pickers at the closed dumps.

4.3 **Outcome:** The project resulted in improving the treatment and final disposal of solid waste to the extent of 10,000 tons/day in an environmentally safe manner (as described in Box 4.1) at the Santa Rosa CTR following the closure of three dumpsites in Seropédica, Itaguaí, and Jardim Gramacho. As described in Box 4.1, the Santa Rosa CTR meets the requirements of a modern and environmentally safe landfill.

4.4 **Objective 2: Improved municipal solid waste management practices.** Rated *negligible*. While the CAIXA team was actively engaged during preparation of the project and contributed to the design of the operation, it became clear after project implementation began that CAIXA's main interest lay in acquiring expertise for carbon finance and safeguards management, and that the SWM program itself was not a principal corporate priority.

4.5 Therefore, under this objective, there was no movement toward the target of helping the five participating municipalities adapt to the new NSWP framework; filling gaps in knowledge on technical, administrative, and procurement issues; or preparing well-designed projects with private sector participation. Though it was expected that this effort would have a demonstration effect and a transformational impact on municipal SWM capacity, no activities were implemented, because of lack of outreach to municipalities. For this purpose, the World Bank had counted on institutional support

from CAIXA, which has a broad engagement with municipalities and a strong field presence; but the expected support was not forthcoming.

4.6 **Objective 3: Reduction of poverty among waste pickers**. Rated *modest*. The project provided technical support and financed the implementation of two Social Inclusion Plans that were prepared by Ciclus Ambiental for the waste pickers affected by the closure of the Seropédica and Itaguaí dumpsites. The plans, prepared in accordance with the Environmental and Social Management Framework of the project, benefited a total number of 59 waste pickers in Itaguaí and 57 in Seropédica. The Plans included support to the waste pickers and their families, which included assistance for registration in government assistance programs, education and vocational training, support in the preparation of business plans, support in the formalization of recycling cooperatives, and others. The IEG mission visited the cooperative at Itaguaí and were told that 47 waste pickers had enrolled originally. Now, there are 30 members in the cooperative, with only seven members working actively. The respondents at the cooperative said that others had moved over to other jobs, including some in a sorting plant. The current members do not have a vehicle to transport the materials and need to depend on other means for the purpose. The IEG team was told that there was no data to track the reduction of poverty among waste pickers.

4.7 CAIXA and the World Bank had agreed on an action plan with support from a grant from the JSDF to work with the operator of the Itaoca site for training 246 former waste pickers, as well as the establishment of a recycling cooperative for 50 workers. However, motivated by policies implemented by the City of Rio de Janeiro related to the closure of Jardim Gramacho, ex- waste pickers at Itaoca requested monetary compensation for the loss of livelihoods that resulted from the closure of the dump. With the participants unable to reach a consensus, these planned activities were cancelled.

4.8 **Objective 4: Increased private sector participation in solid waste service provision**. Rated *negligible*. The project sought to increase private sector presence in SWM by strengthening municipal capacities for project design and improving contractual documents and management modalities that would make it more attractive for the private sector to engage in the sector. However, little or no progress was made in this regard under the project. A diagnostic was produced using PPIAF²² funding, of the viability of various management models with the private sector, but its impact is unclear. CAIXA officials with whom the IEG mission met were not immediately familiar with this product.

4.9 A list of possible sub-projects had been pre-identified, in the states of Rio de Janeiro, São Paulo, Pernambuco, and Espiritu Santo, most of which involved private sector facilities. But only the Santa Rosa landfill in Rio de Janeiro was ready for financing, and the others had no specific project designs at project preparation.

4.10 Ultimately, two sub-projects—in Santa Rosa and São Gonçalo, both in Rio de Janeiro—were taken with private financing, against a target of four. While the Santa Rosa CTR has been functioning since 2011, São Gonçalo was added to the Caixa Program of Activities on March 31, 2016. The Santa Rosa sub-project in Rio de Janeiro was already in place at the start of the project and involved a leading private solid waste

operator (SERB) that is also part owner of most companies that have ongoing carbon finance agreements under CAIXA's Program of Activities. The target of introducing at least two commercial banks to financing or co-financing municipal solid waste projects was not achieved. Overall, the original objective of a more diversified engagement with the private sector in SWM did not materialize.

4.11 **Objective 5: Strengthening CAIXA's capacity to manage carbon finance projects.** *Rated modest.* The World Bank assisted CAIXA in developing capacity to manage the CDM (Clean Development Mechanism) project cycle, from project identification and evaluation, to registration by the UNFCCC Executive Board, and monitoring. The World Bank was also effective in building CAIXA's capacity for managing environmental and social safeguards for the solid waste sector.

4.12 With the implementation of the Santa Rosa sub-project in the metropolitan region of Rio de Janeiro, CAIXA registered Brazil's first programmatic solid waste management program under the CDM. CAIXA became the only bank in Brazil to offer loans that accepted future carbon revenues as partial guarantees, through the introduction of an innovative mechanism for financing of landfills, by linking the interest rate of loans offered by CAIXA to the performance of the landfill project. CAIXA's SWM program of activities and its ability to access CF was showcased as a corporate asset and disseminated publicly.

4.13 Ciclus Ambiental, which runs the Santa Rosa facility, receives about 2 million Brazilian reais for the carbon credits that are generated every month from flaring landfill gas. They have also contracted to sell landfill gas to a company, Gas Verde.

4.14 Though a task force within CAIXA was established for the management of carbon initiatives, a dedicated carbon finance unit at CAIXA was not created as planned. The knowledge and capacity to develop carbon finance sub-projects under the Program of Activities was confined to a small team in Brasilia that identified and implemented a small number of carbon finance operations. The scope and size of the Program of Activities could have been expanded but CAIXA did not approach other buyers outside the World Bank to exploit a pool of possible projects. About 10 additional landfills were registered in Brazil under CDM after the registration of the Program of Activities. Against a target of six, two sub-projects with legal agreements (ERPAs) were signed with CAIXA: Santa Rosa and São Gonçalo. The limited results from this component can be attributed to a decrease in commitment on the part of CAIXA over the project period, as well as insufficient interest on the part of the sub-project developers. Further, the slowdown in the carbon market reduced interest among potential providers of carbon finance.

4.15 In respect of safeguards, an Environmental and Social Management Framework (ESMF) that was developed during preparation was later applied to CAIXA's entire solid waste management portfolio. Training was provided to align the Environmental and ESMF between the CAIXA and the World Bank. The resulting framework Plano de Gestão Socio Ambiental, was adopted by CAIXA for its entire SWM portfolio; it is publicly available through the CAIXA website, and has become one of the technical

assistance tools that CAIXA can make available to municipalities. Following the project, CAIXA has adopted the Equator Principles for risk management.

5. Efficiency

5.1 Rated *modest*. At appraisal, a cost-benefit analysis estimated one single benefit that was the financial income (fees) generated by the project. No other benefits were calculated; the impacts of investments in landfills on environmental conditions and household health indicators were planned to be estimated by an impact evaluation. There were six alternative scenarios offered that represented the replacement of dumps and inadequate facilities by sanitary landfills from 0 (without project) to 100 percent (with project). An internal rate of return was estimated at 34 percent with a net present value ranging from R\$26.6 million to R\$227.7 million under six alternative scenarios, with a discount rate of 12 percent.

5.2 The impact evaluation planned for project closure was dropped, given the low level of investment from the project which extended to only one sub-project. Instead, a cost effectiveness analysis was carried out to compare investment and operation costs per ton of solid waste disposed at the Santa Rosa landfill with similar systems financed under World Bank lending operations in Argentina, based on costing formulas developed by the Colombian Water and Sanitation Regulatory Commission. This analysis showed that the cost of waste disposed and actual operating cost per ton for the Santa Rosa landfill was US\$49.80 and US\$58.30 respectively. These figures compared favorably with US\$41.60 and US\$54.60 for a landfill in Mendoza, Argentina, given that the latter landfill is in a less urbanized area, where costs of labor, land and services are lower than in Rio de Janeiro.

5.3 The project closed on the original closing date with 67 percent of the funds remaining undisbursed. There were delays in effectiveness, long internal administrative processes and procurement, delays as discussed in para 3.12 in the section on “Implementation.”

6. Ratings

Outcome

6.1 The overall development outcome is rated *unsatisfactory*. The relevance of project development objectives was *substantial* with respect to the challenges in Brazil’s solid waste sector. Owing to some weaknesses in project design, relevance of design is rated *modest*. The project support to improving the treatment and final disposal of municipal solid waste in Brazil had mixed results that were pursued under its five specific objectives. The project overachieved its outcome target of the increased volume of waste disposal through support of the Santa Rosa landfill that serves the metropolitan area of Rio de Janeiro; such support to safe landfills, however, has not been replicated in other municipalities. The objectives related to improving municipal solid waste management practices and increasing private sector participation in solid waste service provision were not achieved and rated *negligible*, because the related activities were not implemented

under the project. The objective of reducing poverty among waste pickers is rated *modest* especially because of the lack of progress in the social inclusion plans. The project objective to strengthen CAIXA's capacity to manage carbon finance projects was *modestly* achieved; CAIXA was able to register Brazil's first programmatic solid waste management program under the UN Clean Development Mechanism, though the number of carbon finance initiatives managed by CAIXA was lower than expected. Efficiency is rated *modest* because only 33 percent of the project funds were used during five years of project duration and the project experienced several avoidable delays in process and decision making throughout implementation.

Risk to Development Outcome

6.2 The most notable outcomes from the project were the waste management capacity added by Santa Rosa CTR, and added capacity in CAIXA for managing the carbon finance process and environmental and social safeguards. The gains from these outcomes are likely to be sustained in the coming years.

6.3 Santa Rosa CTR is considered a state-of-the-art facility; its management conveyed to the IEG mission that they are seeking to upgrade its technical capabilities by seeking out new developments in landfill technology from developed countries as well as peer upper-middle-income countries. The facility is making effective use of its carbon finance contract. Though the generation of emissions reduction credits in compliance with the ERPA was considerably lower than projected during the first two years of operation of the landfill gas capture system, they have picked up since 2015.

6.4 CAIXA officials told the IEG mission that they believe the transfer of knowledge from the World Bank for managing environmental and social safeguards has been mainstreamed into CAIXA and extends beyond SWM to other sectors. There is a modest risk to maintaining the capacity developed within CAIXA to manage carbon finance operations. This is partly because of the general decrease in interest in carbon finance worldwide after the carbon price dropped in recent years, and the number of prospective buyers of certified emission reduction units has dropped. A planned dedicated Carbon Finance Unit within CAIXA was not created. However, it appears that a limited number of individuals have retained the capacity to manage carbon finance projects because of their engagement in the implementation of the ongoing sub-projects under the Program of Activities.

6.5 The IEG mission's discussions with officials of the Ministry of Cities noted the urgency and emphasis being placed by the government on speeding up the development of SWM plans by municipalities and their funding and implementation. Similarly, the Ministry of Environment conveyed the renewed emphasis on implementing NSWP, especially reverse logistics and recycling.

6.6 While the project provided support to the Santa Rosa CTR, it was not able to stimulate a larger portfolio of such projects for scaling up the final disposal of municipal solid waste in Brazil. Importantly, there has been little movement to address the fundamental issues holding back progress in the SWM sector: capacity and resources for municipal governments; and regulatory, financial and technical framework for

encouraging investments in the sector. The prospect of leveraging the additional incentive of carbon finance is uncertain with the weakened carbon market and new developments in climate change negotiations. Taking these factors into account, the overall risk to development outcome is rated **substantial**.

World Bank Performance

6.7 **Quality at Entry.** *Rated moderately unsatisfactory.* At project preparation, the World Bank clearly recognized the scale and nature of the SWM challenge in Brazil, related investment needs, and limited municipal capacity for planning and implementation in the sector. Among other inputs, analytical work carried out with PPIAF resources helped to assess the solid waste sector and opportunities for private sector involvement. Lessons from similar ongoing projects in the region (Argentina, Colombia, and Mexico) were taken into account. The project design also responded appropriately to the interest shown by CAIXA for developing expertise in applying the Clean Development Mechanism (CDM) to solid waste management projects, and for implementing environmental and social safeguards in the sector.

6.8 Significant emphasis was placed on advancing the identification of carbon finance subprojects and a comprehensive framework for addressing environmental and social safeguards. A list of possible infrastructure sub-projects that could be financed with the loan was pre-identified, including potential operations in the states of Rio de Janeiro, São Paulo, Pernambuco and Espiritu Santo.

6.9 In retrospect, however, the World Bank did not develop a good understanding of the interest, capacity, and commitment (“readiness”) from municipalities to engage with the project. There was too much dependence on CAIXA in this respect. It was expected that CAIXA, with offices in most Brazilian municipalities, would be in a unique position to reach out to municipal governments and provide technical assistance and financing for SWM. These expectations did not materialize.

6.10 There could have been more effort during project design to probe cities’ readiness to engage in SWM investments and improve their capacity to operate and finance these systems. This could have been done through assessing commitment (pro-activity demonstrated in SWM) and capacity to make improvements (current budget expenditures and operational performance) and complemented by making sure that at least a few cities have been identified during preparation that were ready to step in as “early adopters” for others to follow.

6.11 The World Bank also overestimated CAIXA’s interest in availing itself of investment support; and the private sector’s interest in investment opportunities with carbon finance as an additional incentive. The World Bank did not adequately foresee how the complexity of CAIXA’s internal administrative processes would affect the pace of project implementation.

6.12 The project piloted the use of Country Systems in its approach to environmental and social safeguards, which was implemented smoothly. However, in respect of operational and fiduciary procedures, CAIXA, it took longer than expected to conform to

the World Bank's procedures, and the delay affected the delivery of results. In addition, there were also significant weaknesses in the project's results and monitoring framework, as discussed in the section on "Monitoring and Evaluation." A diagnostic was produced using PPIAF funding, of the viability of various management models with the private sector, but its impact is unclear. CAIXA officials with whom the IEG mission met were not familiar with this product.

6.13 **Quality of Supervision.** *Rated moderately unsatisfactory.* The World Bank carried out three missions per year between 2011 and 2015, with teams composed of technical staff (solid waste and carbon finance specialists), environmental and social safeguards specialists, and financial management and procurement specialists. This support proved to be an important factor for strengthening CAIXA's capacity to manage safeguards and carbon finance operations. Fiduciary teams conducted training at least once a year, and worked with CAIXA in the preparation of periodic fiduciary and audit reports. The task team met with municipal governments and with the private sector in efforts to identify sub-projects and demand for technical assistance.

6.14 However, the lack of initial involvement by relevant ministries appears to have made it difficult to open a dialogue with them on policy issues and lack of project implementation progress. The World Bank was also not able to get CAIXA involved to any significant extent in bringing municipalities on board for improving SWM practices, or for creating greater interest among private developers in the sector. The World Bank also missed the opportunity to restructure the project given the lack of traction for these components.

6.15 In the case of the carbon finance operation, periodic supervision of environmental and social safeguards will be required at the Santa Rosa landfill (including the Tanque and Penha transfer stations), as well as the São Gonçalo, Ipojuca, and other facilities that may request incorporation under the Program of Activities. The Carbon Finance Unit and the CPF have agreed to continue coordination with the World Bank's Urban and Safeguards team, and the required budgetary provision has been made.

6.16 Overall World Bank performance is rated **moderately unsatisfactory**.²³

Borrower Performance

6.17 **Government Performance.** *Rated moderately unsatisfactory.* The Government placed a high priority on addressing solid waste management issues in the country. The Solid Waste Law was adopted in 2010 after a decade of political debate that set a regulatory framework for the sector and assured a flow of financial resources to meet ambitious investment targets. The closure of the dump at Jardim Gramacho, the largest in Latin America, was advanced to early 2012, due to its political importance ahead of major international events. However, the signature between CAIXA and SERB, the private sector company that owned the Santa Rosa landfill, was postponed for over one year, resulting in major implementation and disbursement setbacks for the project. The Government provided the guarantee for CAIXA to directly access the IBRD loan and showed strong commitment to the project during preparation and up to effectiveness.

However, communication with the central government after effectiveness was limited to the audit reports prepared by the central auditors.

6.18 Throughout implementation and until closure, the Ministry of Finance did not engage with the World Bank on discussions over the performance of the project. Greater engagement by the Ministries of Finance, Cities, and Environment, may have stimulated greater action in the stalled components of the project.

6.19 **Implementing Agency Performance. *Rated unsatisfactory.*** CAIXA was the project implementing agency, as well as the coordinator and management entity for the Carbon Finance program. The CAIXA team was actively engaged during preparation of the project and contributed to the design of the operation, but it soon became clear that CAIXA's main interest lay in acquiring expertise for CF and safeguards management, and that the SWM program itself was not a principal corporate priority. Thus, the organization's primary interests in pursuing the project were to: (i) access global knowledge and expertise that the World Bank could provide; (ii) strengthen its capacity to design, management, and monitor CF operations and to develop blended projects with alternative sources of financing; and (iii) to strengthen safeguards capacity for SWM projects.

6.20 During implementation, CAIXA was not sufficiently responsive to implementation delays, and showed limited initiative in trying to resolve problems and improve overall performance. Lengthy internal administrative processes led to delays, and two major internal restructuring processes of CAIXA in 2012 and 2013 significantly affected the team managing the project. It took about two years to develop mechanisms that complied with World Bank procedures for utilizing the World Bank loan and the JSDF grant.

6.21 In respect of carbon finance, the scope and size of the Program of Activities could have been expanded, if CAIXA had been more proactive in seeking buyers of carbon emissions other than the World Bank. This limited the scope for expanding the Program of Activities to include other landfills. In the existing arrangement, about 10 additional landfills were registered under the Clean Development Mechanism after the registration of the Program of Activities, which indicates latent demand in the sector. The approval process for the Santa Rosa credit took over one year, and after that the business development team had little interest in pursuing additional sub-projects.

6.22 Overall borrower performance is rated **unsatisfactory**.

7. Lessons

7.1 **A project with sector-wide objectives must provide for engagement with the government at the policy level to lay a strong basis for achieving development outcomes.** This project had a sector-wide focus for solid waste management covering physical investments, institutional strengthening, and encouraging private sector participation. However, engaging primarily with a financial intermediary as the borrower and implementing agency was not sufficient to stimulate interest among municipalities

and the private sector, which faced regulatory and institutional issues that need attention at policy-making levels.

7.2 For an operation involving a financial intermediary, a minimum number of sub-projects must be committed at project effectiveness, to demonstrate quick successes and to develop further momentum during implementation. While a list of possible sub-projects had been pre-identified, only the Santa Rosa landfill in Rio de Janeiro was ready for financing, and the others had no specific project designs at project preparation.

7.3 In an upper middle-income country with broad-based financial and institutional resources, the World Bank's interventions in a sector should focus on functional areas with a clear need and demand for external support and expertise. Brazil had significant resources for investing in solid waste management infrastructure. The main needs were capacity building in the implementing municipal governments, and attracting private sector participation, which should have been the focus of World Bank intervention.

7.4 In seeking to attract private sector investment and expertise to public service provision, the major barriers to entry must be clearly recognized and addressed. Incentives at the margin are unlikely to generate wide or sustained interest. The sole privately owned landfill supported to completion by this project (Santa Rosa facility for Rio de Janeiro city) was driven largely by its high public profile. This success could not be replicated in other situations largely because supportive regulation and appropriate incentives (remunerative contracts, tipping fees, and payment guarantees, etc.) are not yet in place for the sector, and carbon finance for landfill gas capture and flaring did not prove to be a significant determining factor.

¹ GDP per capita (current US\$) was US\$8649 in 2014.

² <https://data.worldbank.org/country/brazil>. 2014 figures.

³ 1.1 (ref: environmental technologies) (ref: National Waste policy).

⁴ ABRELPE (Brazilian Association of Public Cleaning and Special Waste Companies) is a non-profit NGO created in 1976 to represent, develop, and promote the professional sector in Brazil. http://www.abrelpe.org.br/abrelpe_quemsomos.cfm

The number of companies engaged in solid waste collection and affiliated with ABRELPE increased from 45 in 2000 to 92 in 2009; together they collected about 183,000 tons of waste daily in 2009.

⁵ Until then, the Sanitation Law (number 11.445 from January 5, 2007) guided the solid waste sector in Brazil.

⁶ Brazil's Constitution of 1988 decentralized some urban development responsibilities, including solid waste management, to municipalities.

⁷ SABESP is a joint-stock corporation founded in 1973 and currently responsible for water supply, sewage collection and treatment of 367 municipalities in the State of São Paulo.

⁸ FUNASA, <http://www.funasa.gov.br/>.

⁹ The resources of the Worker Support Fund (FAT) are intended for economic development programs financing through Brazil National Bank for Economic and Social Development (BNDES), in the proportion of at least 40% (according to the article 239 of the Federal Constitution), while the remaining portion goes

to the unemployment insurance and salary bonuses.

(<http://www.bndes.gov.br/wps/portal/site/home/transparencia/fontes-de-recursos/fundos-governamentais/fundo-de-amparo-ao-trabalhador-fat/fat-bndes>)

¹⁰ ABRELPE (Brazilian Association of Public Cleaning and Special Waste Companies) is a non-profit NGO created in 1976 to represent, develop, and promote the professional sector in Brazil.

http://www.abrelpe.org.br/abrelpe_quemsomos.cfm; the number of companies engaged in solid waste collection increased from 45 in 2000 to 92 in 2009, which together collected about 183,000 tons of waste daily in 2009.

¹¹ It is part of the larger response to leverage existing development finance, and complements other financial instruments focused on mitigating and adapting to the impacts of climate change. The Clean Development Mechanism (CDM) was one of the Flexible Mechanisms defined in the Kyoto Protocol (IPCC, 2007) that provides for emissions reduction projects that generate Certified Emission Reduction units (CERs), which may be purchased or traded in emissions trading schemes.

¹² Decomposition of solid waste in landfills generates CO₂ and methane in roughly equal proportions. This landfill gas can be captured and flared or captured and used for electricity production or as a fuel. GHG emission reductions are achieved through the destruction of methane, and in the case of energy production, displacement of a more GHG-intensive energy sources. Global estimates suggest that 50 Mt of methane are generated annually from landfills. **[[Note: this paragraph is repeated identically at endnote #38 below. Also, I've deleted the paragraph number that evidently came when the paragraph was cut from the main text.]]**

¹³ For example, in comparison with energy efficiency, transport, and forestry projects.

¹⁴ Sometimes referred to as the “methane kick”, given the higher global warming potential (GWP) of methane (the landfill gas) compared to CO₂, the CDM provides a value to capturing landfill gas. The captured landfill gas, which would otherwise be vented into the atmosphere, can instead be flared and transformed into CO₂ (with much reduced greenhouse gas impact on the atmosphere) or used for power generation.

¹⁵ http://unfccc.int/paris_agreement/items/9485.php

¹⁶ Cames, Martin, Ralph O. Harthan, Jürg Füssler, Michael Lazarus, Carrie Lee, Peter Erickson, and Randall Spalding-Fecher. 2016. “How Additional is the Clean Development Mechanism? Analysis of the Application of Current Tools and Proposed Alternatives. Study prepared for DG CLIMA.. . 10.13140/RG.2.2.23258.54728.

¹⁷ As stated identically in the Loan Agreement (between IBRD and Caixa Economic Federal) and the Project Appraisal Document.

¹⁸ Saneamento e Energia Renovável do Brasil (SERB) S.A. is private company based in Rio De Janeiro, and operates a waste treatment center and various waste transfer stations in the city.

¹⁹ CAIXA carries out the following: (i) identification of activities in compliance with the UNFCCC rules; (ii) preparation of the Project Design Development; (iii) communication with the UNFCCC that a project wants to apply; (iv) contacts audit firms to start the validation process; (v) follows up with auditors who prepare a validation report and sends the final version to the UNFCCC. (vi) receives UNFCCC approval and certification of CER (Certified Emissions Reductions); and (vii) makes payments to the project entities.

²⁰ A second potential addition was presented by CAIXA for consideration of the Carbon Partnership Facility in late 2015, but does not appear to have progressed.

²¹ If the project delivered the Certified Emissions Reductions (CERs) according to the Emission Reduction Purchase Agreement (ERPA) schedule, there would be another reduction of the interest rate. However, if the project did not meet the deadlines and the volume of CERs the interest rate would rise again and return to the initial agreement.

²² The Public Private Infrastructure Advisory Facility (PPIAF) is a multi-donor technical assistance facility financed by 11 multilateral and bilateral donors and housed inside the World Bank Group. www.ppiaf.org

²³ When the quality of entry and quality of supervision fall on either side of the satisfactory/ unsatisfactory range, the overall Bank performance gets the lower rating if the development outcome is in in the unsatisfactory range, which is the case for this project.

References

- AMUNES (Associação dos Municípios do Estado do Espírito Santo). 2014. Ata da Reuniao TCA- Nova Venécia 2014-04-02.
- Banna, Farouk Mollah, Perinaz Bhada-Tata, Renee Yuet-Yee Ho, Silpa Kaza, Marcus Lee. 2014. Main Report Vol. 2 of “Results-based Financing for Municipal Solid Waste.” No. 20, Urban development series knowledge papers. World Bank, Washington DC.
<https://hubs.worldbank.org/docs/imagebank/pages/docprofile.aspx?nodeid=20328140>
- Besen, Gina Rizpah, and Ana Paula Fracalanza. 2016. “Challenges for the Sustainable Management of Municipal Solid Waste in Brazil.” *disP-The Planning Review* 52, no. 2 (2016): 45–52.
<http://www.tandfonline.com/doi/full/10.1080/02513625.2016.1195583>
- Bing, Xiaoyun, Jacqueline M. Bloemhof, Tania Rodrigues Pereira Ramos, Ana Paula Barbosa-Povoa, Chee Yew Wong, and Jack GAJ van der Vorst. “Research Challenges in Municipal Solid Waste Logistics Management.” *Waste Management* 48 (2016): 584–592.
<http://www.sciencedirect.com/science/article/pii/S0956053X15302099>
- Bosi, Martina, Scott Cantor, and Felicity Spors. 2010. *10 Years of Experience in Carbon Finance: Insights from Working with the Kyoto Mechanisms*. Washington, DC: World Bank.
<https://hubs.worldbank.org/docs/imagebank/pages/docprofile.aspx?nodeid=12536620>
- Bufoni, A., M. Carvalho, L. Oliveira, and L. Rosa. 2014 “The Emerging Issue of Solid Waste Disposal Sites Emissions in Developing Countries: The Case of Brazil.” *Journal of Environmental Protection*. 5 (10): 886–894.
<https://www.scirp.org/Journal/PaperInformation.aspx?PaperID=48321>
- Cames, Martin, Ralph O. Harthan, Jürg Füssler, Michael Lazarus, Carrie Lee, Peter Erickson, and Randall Spalding-Fecher. 2016. “How Additional is the Clean Development Mechanism? Analysis of the Application of Current Tools and Proposed Alternatives.” Study prepared for DG CLIMA. 10.13140/RG.2.2.23258.54728.
- Carneiro, Beatriz Martins. 2013. “Policy Update from Brazil. Ministry of Development Industry and Foreign Trade.” <https://www.epa.gov/sites/production/files/2014-05/documents/brazil.pdf>
- Castagnari, Eduardo 2005. *Municipal Solid Waste Management in Brazil: Conditions, Problems and Solutions*. International Solid Waste Association, Vienna.
http://www.iswa.org/uploads/tx_iswaknowledgebase/wm_2005_153paper.pdf
- Marino, A., G. L. D. Chaves, and Santos Jr JL. 2014. Caracterização de equipes envolvidas com a gestão dos resíduos sólidos urbanos nos municípios brasileiros.
- da AGM Juras, I., and S. M. V. G. de Araujo. 2003. “A Law for the National Policy on Solid-Waste Management: The Brazilian Case.” *WIT Transactions on Ecology and the Environment* 67 (2003).
- de Lorena Diniz Chaves, Gisele, Jorge Luiz dos Santos Jr, and Sandra Mara Santana Rocha. 2014. “The Challenges for Solid Waste Management in Accordance with Agenda 21: A Brazilian Case Review.” *Waste Management & Research* 32 (9_suppl): 19–31.
<http://journals.sagepub.com/doi/abs/10.1177/0734242X14541987>
- de Sousa Jabbour, Ana Beatriz Lopes, Charbel José Chiappetta Jabbour, Joseph Sarkis, and Kannan Govindan. 2014. “Brazil’s New National Policy on Solid Waste: Challenges and Opportunities.” *Clean Technologies and Environmental Policy* 16, (1): 7–9.
<https://link.springer.com/article/10.1007/s10098-013-0600-z>
- Ehrmann, Eric. 2017. “Brazil’s Garbage Becomes an Olympic Challenge.” *Huffington Post*.
http://www.huffingtonpost.com/eric-ehrmann/brazils-garbage-becomes-a_b_921982.html
- Ferri, Giovane Lopes, Gisele de Lorena Diniz Chaves, and Glaydston Mattos Ribeiro. 2015. “Reverse Logistics Network for Municipal Solid Waste Management: The Inclusion of Waste Pickers as a Brazilian Legal Requirement.” *Waste Management* 40 (2015): 173–191.
<http://www.sciencedirect.com/science/article/pii/S0956053X15001397>

- Hammer, Stephen, Silpa Kaza, and Claire Markgraf. 2014. "Solid Waste Management Portfolio Review and Strategic Areas of Focus: Strategic Areas of Focus Based on Solid Waste Management Trends in Developing Countries and the World Bank Group Solid Waste Portfolio Review". World Bank, Washington, DC.
<https://hubs.worldbank.org/docs/imagebank/pages/docprofile.aspx?nodeid=19788516>
- IBGE (Instituto Brasileiro de Geografia e Estatística). 2010. Pesquisa Nacional de Saneamento Básico, 2008. Rio de Janeiro: IBGE.
- IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007- Synthesis Report. Geneva.
- Jacobi, Pedro Roberto, and Gina Rizpah Besen. 2011. "Solid Waste Management in São Paulo: the Challenges of Sustainability." *Estudos Avançados* 25 (71): 135–158.
http://www.scielo.br/scielo.php?pid=S0103-40142011000100010&script=sci_arttext&tlng=en
- Kruljac, Shani. 2012. "Public–private Partnerships in Solid Waste Management: Sustainable Development Strategies for Brazil." *Bulletin of Latin American Research* 31 ((2): 222–236.
<http://onlinelibrary.wiley.com/doi/10.1111/j.1470-9856.2011.00659.x/full>
- Lino, Fatima A. M., and Kamal A. R. Ismail. 2013. "Contribution of Recycling of Municipal Solid Waste to the Social Inclusion in Brazil." *Journal of Waste Management* 2013 (2013).
<https://www.hindawi.com/archive/2013/429673/>
- Nordi, Guilherme Henrique, Reynaldo Palacios-Bereche, Antonio Garrido Gallego, and Silvia Azucena Nebra. 2017. "Electricity Production from Municipal Solid Waste in Brazil." *Waste Management & Research* (2017): <https://www.ncbi.nlm.nih.gov/pubmed/28553775>
- Polzer, V., and M. A. Justi Pisani. 2015. The Challenge of Solid Waste Collection in Precarious Settlements in São Paulo, Brazil. *Edorium Journal of Waste Management*, 1 (2015).
- Scartezin, Vanda. 2013. "Redeeming E-waste in Brazil." *Waste Management World*. January 4, 2013.
<https://waste-management-world.com/a/redeeming-e-waste-in-brazil>
- World Bank. 2016. Brazil—Integrated Solid Waste Management and Carbon Finance Project. World Bank, Washington DC
<https://hubs.worldbank.org/docs/imagebank/pages/docprofile.aspx?nodeid=26557118>

Appendix A. Basic Data Sheet

INTEGRATED SOLID WASTE MANAGEMENT AND CARBON FINANCE PROJECT Key Project Data (amounts in US\$ million)

	<i>Appraisal estimate</i>	<i>Actual or current estimate</i>	<i>Actual as % of appraisal estimate</i>
Total project costs	50	16.7	33.44%
Borrower	110	97.7*	88.8%
Cancellation	-	-	-

* The private company, Saneamento e Energia Renovável do Brasil (SERB) contributed another US\$8.3 million during implementation.

Cumulative Estimated and Actual Disbursements

	<i>FY11</i>	<i>FY12</i>	<i>FY13</i>	<i>FY14</i>	<i>FY15</i>	<i>FY16</i>
Appraisal estimate (US\$M)	2	14	28	42	50	50
Actual (US\$M)	0	0	0	14.8	14.8	16.6
Actual as % of appraisal	0	0	0	35.2%	29.6%	33.2%
Date of final disbursement:						4/7/ 2016

Project Dates

	<i>Original</i>	<i>Actual</i>
Concept Review	5/30/2007	5/30/2007
Appraisal	1/1/2008	7/31/2009
Board approval	9/9/2008	11/2/2010
Signing	-	12/5/2011
Effectiveness	-	1/30/2012
Closing date		12/31/2015

Staff Time and Cost

<i>Stage of Project Cycle</i>	<i>Staff Time and Cost (Bank Budget Only)</i>	
	<i>No. of staff weeks</i>	<i>USD Thousands (including travel and consultant costs)</i>
Lending		
FY08	24.94	108.29
FY09	27.18	134.92
FY10	19.15	75.81
FY11	7.20	60.65
Total:	78.47	379.67
Supervision/ICR		
FY11	11.47	62.77
FY12	8.79	66.97
FY13	8.29	70.35
FY14	10.36	73.79
FY15	18.93	116.62
FY16	7.72	46.78
Total:	65.56	437.28

Task Team Members

<i>Names</i>	<i>Title</i>	<i>Unit</i>	<i>Responsibility</i>
Lending			
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Miguel Navarro-Martin	Lead Financial Officer	FABBK	
Paul Procee	Program Leader	LCC5C	
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Jennifer J. Sara	Director	GWADR	
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S.A. Dan Biller	Sector Manager	MIGEC	

<i>Names</i>	<i>Title</i>	<i>Unit</i>	<i>Responsibility</i>
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Beatriz Eraso Puig	Consultant	GSU10	

Appendix B. List of Persons Consulted

Ministry of Cities

Olavo de Andrade Lima Neto, *Secretary*

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Sérgio Wippel, *Director*

Nicola Speranza, *International Relations Advisor*

Ministry of Environment

Jair Vieira Tannús Júnior, *Secretary*

Cláudia Monique Albuquerque, *Head of Cabinet*

Sabrina Andrade, *Advisor*

Ministry of Science and Technology

Márcio Rojas da Cruz, *General Coordinator for Global Climate Change*

Sônia Regina Bittencourt, *Executive Secretary of the Brazilian DNA*

CAIXA Econômica Federale

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Carlos Andre Lins Rodriguez, *Client and Business Manager*

Ana Maria Borges Tomé

Flavia Caldeira Mello

Priscila Vieira da Cunha

ABRELPE

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Paul Procee, *Program Leader, Brasilia*

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IFC

Javier Coloma, *Carbon Finance Specialist, Sao Paulo*

OTHER

Denise Seabra (Independent consultant and Retired CIAXA staff)

Priscila Zidan, *Managing Partner, Evolui Consultoria Ambiental*

Appendix C. Sector Background: Solid Waste Management

Municipal Solid Waste²⁴ or Solid Waste Management (SWM) covers the generation, storage, collection, transport or transfer, processing, and disposal of solid waste materials generated by households and similar types of waste from offices, the commercial sector, and other sectors that tend to be managed in combination with household waste. It excludes waste categories such as hazardous waste, industrial waste, medical waste, and construction and demolition waste. Around the world, solid waste generation rates are rising. In 2012, the world's cities generated 1.3 billion tons of solid waste per year, amounting to 1.2 kilograms per person per day. With rapid population growth and urbanization, municipal waste generation is expected to rise to 2.2 billion tons by 2025.

Managing waste properly is essential for building sustainable and livable cities, and it remains a growing challenge in many developing countries. Compared to those in developed nations, residents in developing countries, especially the urban poor, are more severely affected by unsustainably managed waste. In low- and middle-income countries, waste is often disposed of in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences. Poorly managed waste interferes with floodwater drainage and sewerage, contaminates water bodies and soil, serves as a breeding ground for disease vectors, contributes to global climate change through generation of methane, and even promotes urban violence.

Solid waste management is generally the domain of local governments and municipalities. Effective waste management is expensive, often accounting for 20 to 50 percent of municipal budgets. Underfunding for SWM in cities in developing countries is exacerbated by low cost recovery as residents are unwilling to directly pay for waste services²⁵ and limited use of economic instruments by governments to improve waste management services.²⁶ Private sector involvement could address the investment and technical gap;²⁷ however, this would need to be supplemented by sound governance to reduce risk to the private sector, and by an appropriate regulatory framework to reduce risk for the government.

In developed countries, it is typical to find a large-scale material recovery facility where different types of waste (paper, plastic, organic, etc.) are separated and recovered prior to final disposal. In several countries of Western Europe (Belgium, Denmark, Germany, Netherlands, Norway, Sweden, Switzerland), over 90 percent of solid waste is recycled or reused, vastly reducing the need for disposing of waste in landfills. Such an approach may not be feasible or appropriate for cities in developing countries due to lack of funds, particularly since waste charges are not matched with the costs of moving away fully from landfilling. Approximately 45 percent of middle income countries have landfills, though in many instances they are poorly operated and could be classified as controlled dumping sites. (box 1.1)

Box 7.1. Landfills and Dumpsites

Landfills are areas that have been treated to receive residues; have bottom-lining systems to protect the underground and groundwater; and are covered and have a drainage system to collect and treat leachate (rainwater and seepage water from organic waste) and a gas collection and treatment system. On the other hand, an open dump is defined as a land-based waste disposal site, without suitable environmental control measures and operations. Controlled landfills are an intermediate solution between landfills and the open dump, they are covered, but do not have soil sealing or gas collection systems. A sanitary landfill that is not properly designed or maintained can rapidly turn into a dump with adverse health and environmental impacts associated with it.

In developed or high-income countries, thermal treatment of waste, specifically waste-to-energy, is a primary method of treatment and disposal.²⁸ Waste-to-energy projects are absent or less prevalent in low- and middle-income countries because they are capital intensive, may not receive remunerative pricing for energy, require greater technical capacity than is readily available, or cannot easily find technology that works for the local composition of waste, which is generally different (wetter, lower calorific value) from the composition of waste in developed countries.

National Solid Waste Policy: Status and Issues in Implementation

SWM Plans: By 2015, 2,325 out of Brazil's 5,570 municipalities (about 40 percent) had submitted their plans, against the NSWP target of full coverage by 2012. The lagging municipalities face constraints in capacity for developing such plans or resources for hiring private consultants for the task. This is of concern because access to federal funds earmarked for SWM is conditional on submission of plans. Several municipalities turn to private consultants to prepare SWM plans. However, some respondents told the IEG mission that the quality of SWM plans varies widely across private consultants, with some reported to be copying and pasting from previous output, without customizing them sufficiently. The Ministry of Cities, together with Ministry of Environment and the German Cooperation Agency (GIZ), are discussing a capacity-building program for municipalities, focused on solid waste and climate change. The Ministry of Cities has been giving training to municipalities in different sectors, which includes solid waste management. One of the courses helps cities to design their SWM plans.²⁹ ABRELPE,³⁰ the Brazilian association of waste companies, informed the IEG mission that it has provided numerous training activities to prepare master plans for SWM.

Closure of dumpsites and use of landfills: A big challenge in the Brazilian context is to find the proper destination for the waste in the country. Land is expensive and in big centers increasingly rare. Insufficient funding for investment and upkeep is a big constraint for several municipalities. The IEG mission was told that in several cases where municipalities have received funds for landfills, the landfills soon degenerate into dumpsites because of lack of continued funding or capacity to manage them. According to ABRELPE, despite the NSWP target of closing all dumps by 2014, there are 3,000 dumps still open in Brazil, mostly in the North, Northeast and Midwest regions. The Brazilian experience in this regard is common across developing countries, where investment money is pumped into systems that do not have the revenue basis to run upgraded systems with higher operating costs.

Reduce recyclables directed to landfills: While the main concerns with SWM in developed countries are to reduce waste, and recycle the energy recovery to drastically decrease the residues sent to a landfill, for developing countries the targets on waste management are more basic. At this stage, the expectations for ‘reverse logistics’ (producers of goods taking responsibility for their products or packaging materials used at the end of their life-cycle, also called Extended Producer Responsibility or EPR) as set out in the NSWP, are quite ambitious. Sorting is very expensive; and there is no ready market for recycled material, while their price is volatile. For such reasons, companies that have reverse logistics obligations have been postponing action. So far, there are three signed sectoral agreements for (i) oil packaging; (ii) lamps; (iii) general packaging. Other sectors for which sectoral agreements are being discussed are medicines and electronics. A successful business model of reverse logistics can be seen in pesticides packaging. The industry formed an entity to coordinate the entire process. Companies pay this entity to operate the entire logistics. One option is for landfill owners to build sorting facilities. At the same time, the amount of recycling that is already taking place through formal and informal means should not be underestimated. A case to point is that Brazil is a global leader in recycling of aluminum cans.

Reduce organic waste directed to landfills: Fifty percent of Brazilian garbage is organic, which is a feedstock for composting. However, 95 percent of the waste goes to landfills in the country. Bio-digesting is not a significant activity in Brazil. Over the past five years, the Ministry of Environment has been trying to evolve a strategy for dealing with organic waste. One option being considered is mechanical-biological treatment,³¹ which is considered better and cheaper than segregating at source.

Waste to energy: There are about 15 waste-to-energy plants in Brazil that generate about 118 MW, of which seven plants are in the state of São Paulo, and the others are in Santa Catarina, Rio de Janeiro, and Paraná provinces. This is seen to be far below that potential for waste-to-energy projects in the country. Economic instruments to foster landfill gas extraction, biogas production or energy solutions have not yet been designed in Brazil. Waste-to-energy projects face some political opposition, especially from those who fear that these facilities will cause waste-pickers to lose their livelihood. Waste incineration and energy recovery is deemed too expensive for Brazil’s market. However, increased energy prices, end-of-life sanitary landfills, and lack of room for new sanitary landfills could make incineration economically feasible in the future. A case to point is a waste-to-energy plant promoted by the private company Haztec with International Finance Corporation (IFC) support, which is currently under construction in Barueri, São Paulo. This facility will include solid waste incineration technology and energy recovery. Haztec executives noted that waste-to-energy projects in general face the following barriers: the need for public long-term power purchase agreements with appropriate prices to ensure viability of waste-to-energy projects; learning curve for the technology; lack of tax incentives on par with other renewable energy sources; low tipping fees; and need for strong guarantees for payments by public partners.

Waste pickers: There are 800,000 waste pickers active in Brazil, of whom about 50 percent operate informally, and the others are organized into about 20,000 cooperatives. Out of 5,570 municipalities, fewer than 100 municipalities have contracts with waste-pickers’ cooperatives. Cooperatives vary widely in working conditions and safety, and nature of contracts. In many cases, the scale of activities in the cooperatives is not sufficient to meet the needs of prospective

buyers of recycled material. Also, inside the cooperatives opinions differ on the way that the cooperative should be managed. Some people argue that waste-pickers should be phased out gradually, and trained or assisted to take up other work. Many universities and NGOs are involved in studying waste-pickers' issues.

²⁴ According to OECD, municipal solid waste covers waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, yard and garden, street sweepings, contents of litter containers, and market cleansing. Waste from municipal sewage networks and treatment, as well as municipal construction and demolition is excluded. (World Bank 2012).

²⁵ Sujauddin et al. 2008

²⁶ Guerrero et al 2013

²⁷ Sharholy et al 2008

²⁸ World Bank 2012

²⁹ www.capacidades.gov.br

³⁰ ABRELPE (Brazilian Association of Public Cleaning and Special Waste Companies) is a non-profit NGO created in 1976 to represent, develop, and promote the professional sector in Brazil. ABRELPE also supports science through research and publishes reports such as "Panorama of solid waste in Brazil" which includes a detailed presentation of waste management in Brazil and comparative benchmarking year by year. has 45 associates that cover 70% of the country. http://www.abrelpe.org.br/abrelpe_quemsomos.cfm

³¹ A mechanical biological treatment (MBT) system is a type of waste processing facility that combines a sorting facility with a form of biological treatment such as composting or anaerobic digestion. MBT plants are designed to process mixed household waste as well as commercial and industrial wastes.

Appendix D. Solid Waste Management and Carbon Finance

Carbon finance is the generic name for the revenue streams generated by projects from the sale of their greenhouse gas (GHG) reductions, or from trading in carbon permits. It is part of the larger response to leverage existing development finance, and complements other financial instruments focused on mitigating and adapting to the impacts of climate change. The Clean Development Mechanism (CDM) was one of the Flexible Mechanisms defined in the Kyoto Protocol³² (IPCC, 2007) that provides for emissions reduction projects that generate Certified Emission Reduction units (CERs), which may be purchased or traded in emissions trading schemes.

Additionality for Carbon Finance: To qualify for carbon finance under the CDM, a project should demonstrate additionality, that is, provide evidence that the project's emission reductions are additional to what would occur without carbon finance. Projects that capture or flare landfill gas³³, which is a mix of methane and CO₂, are among those that have the least difficulties in demonstrating additionality (for example, in comparison with energy efficiency, transport, or forestry projects)³⁴ GHG emission reductions are achieved through capturing and flaring the landfill gas; or capturing and using it as a fuel or for electricity production that displaces a more GHG-intensive energy source. Global estimates suggest that 50 million tons of methane are generated annually from landfills.³⁵

Additionality does not come into the picture where regulation requires landfill gases to be collected and flared. The EU landfill directive³⁶ makes gas capture mandatory for its members, candidate countries, and other countries in the EU periphery that have adopted this legislation. Landfill gas capture in ECA is not considered 'additional' in CDM terms, hence there is hardly any of this kind of CDM schemes in ECA.

Without the revenue stream from carbon finance, a landfill project proponent would have little economic incentive to capture the waste gas³⁷ Therefore, collection and flaring of landfill gas is not common practice in developing countries without the incentive of carbon finance. However, the capture and use of landfill gas as an energy source may be feasible if there are renewable portfolio standards or feed-in tariffs that enable projects to cover costs and provide capital investment for methane collection systems.

As of July 1, 2015, there were 364 landfill projects registered worldwide with the United Nations Framework Convention on Climate Change (UNFCCC). Predominantly these are large-scale projects located in Latin America and Asia/Pacific regions, though there are also projects in Africa and the Middle East. In Brazil, landfill gas projects (World Bank-supported and others) account for 12 percent of all Emission Reduction Purchase Agreements (ERPAs) and about 25 percent of planned emission reductions in the country.

Recent Developments in Carbon Finance: With the adoption of the Paris Agreement,³⁸ which establishes a mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development (Article 6.4), it appears that the Clean Development Mechanism (CDM) as a mechanism of the Kyoto Protocol will end. However, in terms of its standards, procedures and institutional arrangements, the CDM certainly forms an important basis for the elaboration and design of future international crediting mechanisms. The actual CER supply depends on

various conditions of the global carbon market and particularly on price expectations. However, even under normal market conditions, price forecasts are very uncertain. Under post-2012 market conditions, prices are even more uncertain. A recent study notes that landfill gas flaring is among the few project types identified that have a high likelihood of ensuring environmental integrity and will continue to be attractive to potential CER buyers.³⁹

World Bank Support for SWM and Carbon Finance in Brazil

Prior to Brazil's Integrated Solid Waste Management and Carbon Finance Project (assessed in this report), the World Bank implemented two Carbon Offset projects for landfill gas viz. Nova Gerar Landfill Rio de Janeiro Project (2005–17) under the Prototype Carbon Fund and the Nova Gerar Carbon Finance and Solid Waste Management Project II (2007–15) under the Spanish Carbon Fund.

The first project aimed to put in place a methane gas collection system on two landfills – an old waste dump located in Marambaia and a new state-of-the-art sanitary landfill in Adrianopolis, in the larger metropolitan area of Rio de Janeiro. The second project was an umbrella operation for three landfill gas sub-projects: (i) the Itaoca landfill (Rio de Janeiro); (ii) the Candeias landfill (Recife); and (iii) the Santa Rosa landfill (Rio de Janeiro). For this project, carbon credits generated from captured landfill gas emissions were covered in two ERPAs financed by the Spanish Carbon Fund, one for the Itaoca and Candeias landfills and another for the Santa Rosa landfill. The Candeias landfill was registered as a CDM project on December 30, 2011, and concluded an ERPA with the Spanish Carbon Fund, which was terminated in 2013, owing to lack of activity. The Santa Rosa ERPA was transferred to an ERPA between the Carbon Finance Facility and CAIXA's program of activities that was registered with the UNFCCC.

³² IPCC, 2007

³³ 1.20 Decomposition of solid waste in landfills generates CO₂ and methane in roughly equal proportions. This landfill gas can be captured and flared or captured and used for electricity production or as a fuel. GHG emission reductions are achieved through the destruction of methane, and in the case of energy production, displacement of a more GHG-intensive energy sources. Global estimates suggest that 50 Mt of methane are generated annually from landfills.

³⁴ For example, in comparison with energy efficiency, transport, and forestry projects.

³⁵ UIPC 2014 [[note: this is the reference at the link in endnote 41]]

³⁶ http://ec.europa.eu/environment/waste/landfill_index.htm

³⁷ Sometimes referred to as the “methane kick”, given the higher GWP (global warming potential) of methane (the landfill gas) compared to CO₂, the CDM provides a value to capturing landfill gas. The captured landfill gas, which would otherwise be vented into the atmosphere, can instead be flared and transformed into CO₂ (with much reduced GHG impact on the atmosphere) or used for power generation.

³⁸ http://unfccc.int/paris_agreement/items/9485.php

³⁹ Cames, Martin, Ralph O. Harthan, Jürg Füssler, Michael Lazarus, Carrie Lee, Peter Erickson, and Randall Spalding-Fecher. 2016. “How Additional is the Clean Development Mechanism? Analysis of the Application of Current Tools and Proposed Alternatives. Study prepared for DG CLIMA.. . 10.13140/RG.2.2.23258.54728.

Appendix E. Borrower Comments

No comments were received from the Borrower.

