



1. Project Data

Project ID P123323	Project Name CN-Ningbo Municipal Solid Waste Recyclin	
Country China	Practice Area(Lead) Urban, Resilience and Land	
L/C/TF Number(s) IBRD-82500	Closing Date (Original) 31-Mar-2019	Total Project Cost (USD) 80,000,000.00
Bank Approval Date 31-May-2013	Closing Date (Actual) 31-Mar-2020	
	IBRD/IDA (USD)	Grants (USD)
Original Commitment	80,000,000.00	0.00
Revised Commitment	80,000,000.00	0.00
Actual	80,000,000.00	0.00

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2. Project Objectives and Components

a. Objectives

The project development objective (PDO) was to assist selected districts in Ningbo Municipality to increase the volume and proportion of municipal solid waste recycled with processes for waste separation at source and recycling (Loan Agreement page 4 and PAD para 17).

b. Were the project objectives/key associated outcome targets revised during implementation?



No

c. Will a split evaluation be undertaken?

No

d. Components

The project comprised of four components (PAD para 20:

Component 1. Municipal Solid Waste Separation, Collection, Sorting and Transportation (appraisal cost US\$178.68 million; actual cost US\$166.50 million). This component aimed at strengthening the waste management system in six urban districts (Haishu, Jiangdong, Jiangbei, Beilun, Zhenhai, and Yinzhou, including the National Hi-tech Park and (Dongqian Lake Recreation Area). This component included four subcomponents:

(a) Residential waste separation through the provision of separation bins and bags;

(b) Public place waste separation through the provision of bins for recyclable and nonrecyclable waste, and recyclable material collection structures;

(c) Waste storage, transfer and sorting through: (i) the construction of about four medium to large and two small transfer stations (including a sorting facility for recyclable materials within one transfer station); and (ii) conversion of about 22 smaller transfer stations for parking space for smaller vehicles, rest areas for sanitation workers; and temporary storage space for compression equipment and bulk municipal wastes; and

(d) Waste collection and transportation through the provision of vehicles for produce market and household kitchen food waste, and bulk waste transfer trucks.

Component 2. Kitchen Waste Treatment (appraisal cost US\$41.86 million; actual cost US\$60.46 million). This component included the construction of a treatment plant in Yinzhou district to process kitchen waste from households and markets.

Component 3. Project Implementation Support (appraisal cost US\$24.21 million; actual cost US\$24.13 million). This component would provide technical advisory services and support for the introduction of:

(a) A citywide program for public and community mobilization, education, awareness-raising to encourage waste separation throughout the project period;

(b) Output-based Incentive Payments (OBIP) to Neighborhood Residents Committees (NRCs) to encourage waste separation;

(c) OBIP for restaurants that install and operate oil-water separators;

(d) Rules and regulations for solid waste separation;

(e) Municipal solid waste pricing policy;

(f) Assessment of bio-chemical characteristics of domestic solid waste and new treatment technologies; and



(g) Solid waste management information system (SW-MIS).

Revised component 3. The April 2017 restructuring dropped the OBIP for restaurants that install and operate oil-water separators because subsequent to project appraisal, Ningbo implemented regulations on treatment of wastewater discharges from restaurants, thus eliminating the need for this activity (ICR para 27).

Component 4. Capacity Building and Project Management Support (appraisal cost US\$1.41 million; actual cost US\$0.97 million). This component would provide technical advisory services for: (i) design review, advisory services, construction supervision, project management and monitoring; (ii) training in waste minimization and municipal solid waste management for staff at neighborhood, sub-district, district, and municipal levels; and (iii) external monitoring and evaluation of performance in waste separation.

e. Comments on Project Cost, Financing, Borrower Contribution, and Dates

Project Cost: The actual total project cost was US\$252.2 million, slightly higher than the appraisal estimate of US\$246.2 million. The ICR does not explain why the actual cost was slightly higher than the appraisal estimate. The project team clarified that there was no major cause and that this was a nominal increase of 3% (over a seven-year period) and was financed by the borrower.

Financing: The project was financed by an IBRD loan of US\$80.0 million. The loan was fully disbursed.

Borrower Contribution: The actual Borrower Contribution was US\$172.2 million, slightly higher than the appraisal committed of US\$166.2 million.

Dates: The project was approved on May 31, 2013, became effective on September 3, 2013 and closed on March 31, 2020 after a delay of one year (see details below under restructuring).

Restructuring: The project underwent two level 2 restructurings, first on April 12, 2017 and second on March 13, 2019.

The **first restructuring** involved changes in: (i) implementing agency and institutional arrangements; (ii) results framework (the description of the PDO Indicator “Total amount of recycling materials separated at sorting centers” was amended to include collection through informal workers in addition to formal channels); and (iii) reallocation between disbursement categories.

The **second restructuring** extended the project by one year and revised the closing date from March 31, 2019 to March 31, 2020. The extension allowed time to: (a) fully operate the newly completed Kitchen Waste Treatment Facility (KWTP); (b) operationalize the six new transfer stations and sorting plant; (c) achieve the targets for quantities of separately collected kitchen waste and recyclables; (d) procure additional solid waste collection vehicles; (e) fine-tune the OBIP; (f) approve the draft solid waste regulations; and (g) complete resettlement (ICR para 28).

Split rating: This evaluation will not conduct split rating as neither the PDO nor the outcome targets were revised. As mentioned above, the description of the PDO Indicator “Total amount of recycling materials separated at sorting centers” was amended to include collection through informal workers in addition to formal channels. The target value for the intermediate indicator “Amount of hazardous waste delivered to



hazardous waste processing facilities” was revised from 950 ton/year to 175ton/year. These revisions do not require split rating.

3. Relevance of Objectives

Rationale

Country and Sector Context. All Chinese cities have been experiencing a rapid increase in solid waste generation and increasing pressure for solid waste management. The quantity of municipal solid waste collected and transported had increased more than five-fold nationwide from about 31 million tons in 1980 to about 157 million tons in 2009, and was projected to continue to rise exponentially, reaching 585 million tons in 2030 (PAD para 4). A large part of municipal solid waste was residential waste, with little separation at source. The collection and recycling of some valuable recycling materials was being carried out by the private sector, but residential waste disposed through incineration or landfill contained a large proportion of recyclable materials, which private recyclers was not collecting due to low profit margins. To combat this, China was exploring alternative approaches for solid waste management, such as promoting the concept of circular economy, through the adoption of “reduce, reuse, and recycle (3R)” strategy. Although several cities were attempting to implement source separation, none had succeeded owing to low public awareness and participation, and inadequate waste collection, transportation and treatment infrastructure (PAD para 6).

Local Ningbo Context. Ningbo city is an important port city on the southeastern coast of China. Ningbo City produced 1.19 million tons of total municipal solid waste in 2009 (about 3,260 tons/day). It has two incineration facilities with processing capacity of 1,600 tons/day and two sanitary landfills with a capacity of 1,300 tons/day. With the steady growth in Ningbo municipal solid waste, inadequate landfill and incineration capacity were becoming severe constraints. Without waste minimization efforts, the economic and financial burden of solid waste treatment would continue to be high and uneconomical. Moreover, 85% of households were not separating waste at home. For those who were separating waste, their separated waste was not been transported, transferred and treated separately due to lack of facilities for waste separation and treatment.

Alignment with the Government Strategy. At the national level, the National People’s Congress (NPC) passed the national Solid Waste Pollution Prevention and Control Law in 2004. The law focused on supervision, management and pollution prevention, and regulated dumping, collection, transport, reuse/recycling and disposal of municipal solid waste (PAD para 2). The China Circular Economy Promotion Law, promulgated by the NPC, became effective on January 1, 2009 to promote the 3R. The project objectives were fully aligned with the government’s Circular Economy Promotion Law.

The project was aligned with the developmental priorities of China’s 12th Five Year Plan for environment and natural resource efficiency, which explicitly required “establishing a sound collection and recycling system for separated waste, improving the systems for separated waste collection, enclosed transportation and centralized waste treatment, and promoting resource utilization and hazard free treatment of foods and other waste” (ICR para 8).



The Ningbo City's Five Year Plan emphasizes waste separation and minimization, material recycling, and environmental management of recycling materials processing, and institutional and capacity strengthening (PAD para 12). The project objectives are aligned with this plan.

Alignment with the Bank Strategy. The PDOs are well-aligned with the first strategic theme of the Bank's China Country Partnership Strategy (CPS) for FY13-16 "Supporting Greener Growth" and Outcome 1.2: Enhancing Urban Environmental Services, which sought to improve sanitation, solid waste, and other basic urban services in selected second-tier cities. The project's objectives are consistent with the current Country Partnership Framework (CPF) (FY2020-2025), which identified solid waste management as a significant challenge for local and national authorities and a source of pollution. The CPF, under its Engagement Area Two: Promoting Greener Development, Objective 2.2: Reducing Air, Soil, Water, and Marine Plastic Pollution, envisages that the Bank will support efforts to tackle land-based sources of marine plastic pollution, i.e., predominantly residential solid waste and refers to China's Waste Free Cities initiative aimed at reduction and recycling of solid waste.

Development Problem. To control the large and growing problem of municipal solid waste, China needs to move from the traditional waste management to minimize the amount of waste that needs to be disposed by promoting 3R (reduce, reuse, and recycle). The project objectives are therefore pitched at a level that adequately reflect a potential solution to a development problem - proper municipal solid waste management will generate substantial economic benefits, such as improving the environment and the quality of life, reducing emissions of pollutants, and improving the livelihoods of those employed in the material recycling sector. Without waste minimization efforts, the economic and financial burden of solid waste treatment would continue to be high and uneconomical.

The project addresses the critical municipal solid waste management issues and there is a clear alignment between the project's development objectives and the country, city level and World Bank strategies. The relevance of the objectives is rated **high**.

Rating

High

4. Achievement of Objectives (Efficacy)

OBJECTIVE 1

Objective

To assist selected districts in Ningbo Municipality to increase the volume and proportion of municipal solid waste recycled with processes for waste separation at source and recycling.

Rationale

Theory of Change (ToC).



The project's ToC was based on the premise that a more efficient waste separation will make more recycling material readily available for collection and recycling and would lead to waste minimization. The project **activities** included kitchen waste treatment facility (KWTF), provision of municipal solid waste residential separation and collection equipment, transferring/sorting stations, collection vehicles, the implementation of incentive based municipal solid waste program for Neighborhood Resident Committees (NRCs) roll out of public awareness programs on separation and recycling, training programs on waste minimization for municipal solid waste management staff, development of solid waste management information system (SW-MIS), and development of municipal solid waste pricing and separation rules/policies. These activities were expected to result in **outputs** and **intermediate outcomes** such as increased awareness of separation and recycling, an operational kitchen waste treatment facility; collection, transfer and sorting facilities; and capacity building of government staff in municipal solid waste management through: (a) municipal solid waste pricing policies and rules for waste separation, and (b) a solid waste information management system that would assist the staff to monitor and manage waste separation. The project activities were directly linked to **outcomes** such as increased municipal solid waste (residential) separation at source, as well as collection, sorting, and transfer of separated waste and improved government capacity and enabling environment for municipal solid waste management. These outcomes were in turn expected to contribute to the overall PDO of increased volume and proportion of municipal solid waste recycled in selected districts in Ningbo Municipality.

The achievement of the project outcomes was underpinned by the following **assumptions**: (i) separated residential solid waste is collected and then transferred to recycling facilities in a timely manner, (ii) the recycling facilities recycle the delivered residential solid waste, (iii) separated kitchen waste is collected and transferred to the KWTF, (iv) the kitchen waste delivered to the KWTF is treated, (v) communication and incentive programs are effective in increasing the willingness of households and restaurants to participate in source separation programs; (vi) there is a sustained leadership and institutional capacity to develop, establish, and sustain the new collection, transportation, and treatment systems.

The ToC is convincing and the stated assumptions were logical.

Outputs

- A kitchen waste treatment facility (KWTF), with a capacity of 400 ton/day was constructed and is operational. The facility includes pretreatment workshop, dry fermentation facility, biogas purification facility, wastewater treatment facility, biogas residual composting workshop, boiler rooms, public educational center and supporting installations including water supply and drainage, roads and greeneries, administrative facilities. The biogas produced by the anaerobic digestion process is transported to the Yinzhou Landfill Gas Power Plant for utilization. The GHG emissions reduction through the KWTF is estimated around 50,404 ton/year. The biogas produced at the KWTF was 29,000 cubic meters compared to a target of 30,000 cubic meters.
- Six large transfer stations were built and fully operational (Dongqian lake, 220 ton/day capacity; Jiangbei District Municipal Solid Waste Separation and Transfer Station with 790 ton/day capacity including the sorting center with 150 ton/day capacity; Zhenhai District Transfer Station, 750 ton/day capacity; Yinzhou District Municipal Solid Waste Separation and Transfer Station, 680 ton/day capacity; Jiangdong District Municipal Solid Waste Separation and Transfer Station, 610 ton/day capacity; and Haishu Transfer Station, 300 ton/day capacity.



- The original small transfer stations were transformed into large waste storage sites and parking for environmental sanitation vehicles.
- 357 waste separation and collection vehicles were procured and deployed.
- The project deployed 955,700 separate waste bins to residents, exceeding the target of 636,000. About 7.3 million specialized waste bags were also provided. This aided the households in practicing waste separation at source - the number of households were 905,000, exceeding the target of 636,000.
- The number of separate containers deployed in public places were 104,800, far exceeding the target of 20,000.
- The project rolled out 868 recycling collection points throughout the project districts, achieving the target of 862. The project team clarified that these points had automated/reporting system, and containers were emptied when they were full.
- The waste sorting center was constructed and fully functional. However, the facility is not processing waste due to the success of the segregated campaign. Materials collected through this campaign are of high quality and not in need of further segregation (ICR para 42). Ningbo municipality has plans to relocate it to another section of the city where incoming mixed recyclables need further separation.
- The amount of hazardous waste delivered to hazardous waste processing facilities at project closure was 187 tons/year, compared to a revised target of 175 tons/year (original target was 950 tons/year). The target value of this intermediate indicators was reduced during the April 2017 project restructuring due to: (a) overestimation of hazardous waste quantities at appraisal, (b) adoption of subsequent policies which reduced the generation of such waste (for instance policies which reduced the use of mercury containing batteries), and (c) service agreements entered between individual districts and licensed operators for hazardous waste which reduced the volumes captured at communal points (ICR para 29).
- The project assisted in the development of municipal solid waste management regulations for Ningbo Municipality. They became effective in 2019.
- Output-based incentive program system to neighborhoods was established and operational. The program rewards communities that separate well their wastes and the funds are used for community projects.
- An extensive public outreach campaign was carried out to promote separation at source, inform the public about waste management and increase its environmental awareness. This included large-scale public communication campaign via multiple channels (schools, radio, TV, community groups, and promotion conferences). More than 1.2 million promotional material were produced and more than 87,000 publicity posters were erected around Ningbo to support a city-wide event called "I influence" and "Correct action".
- A Smart Sanitation Information system was established. The system is internet based and includes data related to waste collection, transfer vehicles and transfer stations. it is used for monitoring: (a) the



number of household kitchen waste bags distributed; (b) the quality of kitchen waste separation; and (c) volume collected and transported, etc.

- Capacity building trainings for the city government officials and the municipal solid waste separation-related personnel were carried out. This included 5800 domestic trainings, 21 domestic survey trips, and 4 overseas survey trips.
- A tariff study was carried under the project and a charging mechanism was devised applying elements of a charge-by-volume approach. Charges are expected to be attached to the water bill identified as a suitable mechanism by the study.

Outcomes

Collection of Separated Waste

With the support of project activities, the proportion of solid waste separated at project closure was 17.5% compared to the target of 15%. As discussed below under 'recycling', in absolute terms the achievement is very significant. The total amount of recycling materials separated at sorting centers was 71,600 tons/year (March 2020) compared to the target 39,000 tons/year. This was achieved by having 905,000 households participating in waste separation; the waste separation rate of government institutions, state-owned enterprises and schools had reached 100%. This achievement is by far the most impressive in the relevant Bank portfolio for any city.

The total amount of separated kitchen waste collected was 193,200 tons/year (March 2020) compared to the target 150,000 tons/year. The separated kitchen waste was transported to the KWTF (constructed under the project). This was achieved due to the deployment of separation collection bins and rolling out recycling collection points. The ICR reports that the quality of separated kitchen waste improved over time, from 55% in November 2019 to 60% in March 2020. The ICR notes that not all separated kitchen waste was processed at the kitchen facility, the volumes processed at the kitchen facility as of July 2020 was 90% of target due to issues with the discharge limits into the sewer network, which have been resolved. The receiving waste water treatment plant was undergoing renovation and had been delayed due to Covid-19.

Recycling

Prior to the project, all generated municipal waste in Ningbo municipality either ended up in the landfills or was incinerated (with the exception of small volumes of recyclables sold directly by households to traders). The project resulted in increased material to be recycled. The total amount of recycling materials separated at sorting centers was 71,600 tons/year (March 2020) compared to the target 39,000 tons/year (these figures do not include recyclables captured through the informal sector even though the definition of this indicator was revised at the time of the first restructuring because the client could not guarantee the accuracy of reporting). The separated recycling material constituted dry residential material such as paper, cardboard, plastic, metal, glass, and textile, which was sorted by residents using the project-financed waste separation equipment and facilities, and collected and transferred to the sorting centers by project-financed transfer stations and vehicles. A client satisfaction survey carried out in November 2019 by the Ningbo Municipal Statistics Bureau showed increase in the awareness on waste separation from 35% in 2015 to 94%.



Rating
Substantial

OVERALL EFFICACY

Rationale

The project financed the development of a comprehensive waste separation, collection, transportation and recycling system, and raised public awareness and participation in separation at source. As a result, the share of recycling within the overall waste treatment mix has increased. By March 2020, 905,000 households had started participating in waste separation. The waste separation rate of government institutions, state-owned enterprises and schools had reached 100%.

Overall Efficacy Rating

Substantial

5. Efficiency

Economic Analysis.

At appraisal, the main benefits included: (i) avoided transportation and disposal costs, including land resource saving and pollution reduction, due to waste reduction through waste separation at source and recycling; (ii) value generated by recycling materials separated from solid waste; (iii) global environmental benefits of CO₂ reduction due to solid waste minimization; and (iv) value of energy (biogas) generated from kitchen food waste treatment. Economic costs included capital investment for equipment and facilities for solid waste separation, transportation and treatment, and operation and maintenance costs.

A cost-benefit analysis was carried out, which yielded an Economic Rate of Return (ERR) of 13.98% and NPV of US\$64.5 million. Sensitivity analysis showed that the ERR would be 9.23% under the assumptions of 10% decrease in economic benefits and 10% increase in total costs; hence the investment was economically robust (PAD para 36).

The appraisal methodology was applied at completion. The ex-post ERR was 17.58%, higher than the ex-ante estimate of 13.98%. This was due to: (i) higher project coverage among households; and (ii) higher productivity of the project-financed platform (the solid waste collection, separation and recycling platform established under the project managed to operate at higher productivity, collecting and recycling more residential wastes than estimated at appraisal, thus raising the economic value generated from recycling materials, and more savings in transportation cost.

At completion, the total CO₂ emission reduction attributable to the project was estimated at 1.94 mmtCO₂, 7.2% higher than the estimated 1.81 mmtCO₂ at appraisal.



Administrative Efficiency. The project experience delays due to: (i) land acquisition issues for the transfer stations and the KWTF during the first two year of implementation; and (ii) the design-build-operate (DBO) contract approach for the anaerobic digestion processing facility was replaced by a PPP arrangement. The project closing date was extended by one year. However, the administrative costs were less than planned (ICR para 55). The ICR does not provide data to support this.

Overall, efficiency is rated **substantial**.

Efficiency Rating

Substantial

a. If available, enter the Economic Rate of Return (ERR) and/or Financial Rate of Return (FRR) at appraisal and the re-estimated value at evaluation:

	Rate Available?	Point value (%)	*Coverage/Scope (%)
Appraisal	✓	13.98	89.00 <input type="checkbox"/> Not Applicable
ICR Estimate	✓	17.58	90.00 <input type="checkbox"/> Not Applicable

* Refers to percent of total project cost for which ERR/FRR was calculated.

6. Outcome

The project development objective was highly relevant to the China and Ningbo Municipality priorities and was aligned with the Chinese and Bank strategies. Efficacy is rated substantial; the project supported the development of a comprehensive waste separation, collection, transportation and recycling system, and raised public awareness and participation in separation at source, and as a result, the share of recycling within the overall waste treatment mix has increased. By March 2020, 905,000 households had started participating in waste separation. The waste separation rate of government institutions, state-owned enterprises and schools has reached 100%. Project efficiency is also rated substantial. The overall outcome is **satisfactory**.

a. Outcome Rating

Satisfactory

7. Risk to Development Outcome

The risks to the development outcome can be classified into the following broad categories:

Financial Risk. The user fees in Ningbo are being subsidized by tax revenue and governmental transfers. The financial risk is modest because Ningbo is the transitioning towards full cost recovery of operating costs.



The project supported a tariff study for residential users and developed pricing mechanism to attach solid waste user charges to the water bill. This was delayed but is expected in 2021. At the national level, NDRC issued a policy guidance on fees for recurrent costs in 2018 (ICR para 91).

Also, Ningbo plans to continue to finance the Output-based Incentive Payments (OBIP) through its own resources. It will likely be phased out in the medium-run as the population internalizes fully the requirements of the new system.

Government Ownership/Commitment Risk. The Government's 13th Five-Year Plan explicitly requires improvement of solid waste management and development of circular economy measures. Several policy, sectoral documents, and national laws have been issued to support these goals. The experience of waste separation in Ningbo is being studied by other provinces. The Government commitment risk is assessed as low.

Ningbo Municipality Ownership Risk. This risk is low as the Ningbo Municipality had developed a comprehensive regulatory environment in support of the separate collection and recycling system in place and instituted municipal ordinances and regulatory instruments to govern the sector.

Social Risk. The social risk is assessed as low because the Ningbo Municipality has continued public information campaign to encourage residents to participate in waste separation.

8. Assessment of Bank Performance

a. Quality-at-Entry

The project was informed by high quality analytical work. The project design benefited from three studies carried out by the Bank during preparation: (i) an Overview of China's Regulatory and Institutional Framework and Development Plans for Municipal Solid Waste Management, (ii) Ningbo Solid Waste Situational Analysis, and (iii) E-waste in China (ICR para 64). The technical design emphasized the importance of integrated planning, enabling institutional and regulatory environment, and public awareness and participation, which are key elements of an effective solid waste management system (ICR para 86).

The overall implementation risk was assessed as substantial. The main risk identified at appraisal was effectively mobilizing about 3 million residents in Ningbo to adopt waste separation at source. To mitigate this risk, project design includes a sustained community education and awareness-raising campaign to promote waste separation throughout the project period. However, the risk associated with the time required for land acquisition was not assessed. The M&E design and safeguards identification were appropriate.

Overall, the quality at entry was **satisfactory**.

Quality-at-Entry Rating



Satisfactory

b. Quality of supervision

The ICR reports (para 88) that the project team comprised of an appropriate mix of technical and operational experts who provided consistent technical and operational inputs; adequate implementation support; capacity building; and maintained a broader policy dialogue. The project team proactively supported Ningbo Municipality's decision to establish a PPP for the development and operation of the KWTP and restructured the project accordingly. The Bank agreed to extend the closing date of the project to allow sufficient time for the KWTF to start functioning smoothly. As a result of continued dialogue, the Ningbo Municipality has expressed interest in a possible new project in waste management, recycling, and improved resource efficiency.

Overall, the quality of supervision was **satisfactory**.

Quality of Supervision Rating

Satisfactory

Overall Bank Performance Rating

Satisfactory

9. M&E Design, Implementation, & Utilization

a. M&E Design

The outcome of the project was to increase the volume and proportion of municipal solid waste recycled. The three outcome indicators: (i) proportion of waste separated; (ii) total amount of separated kitchen waste collected; and (iii) total amount of recycling materials separated at sorting centers, were appropriate for monitoring the achievement of the PDO. Targets were set for the three indicators, but no baselines were provided as there was no waste separation in Ningbo. An indicator related to gender was also included as one of the result-based indicators, to measure the satisfaction rate of women and men with solid waste separation and collection (PAD para 58).

The PAD (para 26) specified that the data for monitoring would come from the participating districts and the waste treatment facility. The project also included a subcomponent to develop a solid waste management information system (SW-MIS) for the City Administration Bureau (CAB). The SW-MIS would also capture additional information related to truck routing, the utilization rate of equipment, and residual volumes. The incremental cost of the project M&E arrangements would be assumed by the CAB, with financial support from Ningbo Municipality (PAD 52).

b. M&E Implementation



The ICR reports (para 75) that most data collection was computerized (as planned), i.e., electronically collected from the various points of entry to a centralized system. One exception was the collection of kitchen waste separation at source. This resulted in some errors in reporting. The ICR suggests the option for including optical sensors at receiving points to distinguish the quality of material and link it to the incentive system in place but acknowledges that this is a highly sophisticated system and challenging internationally and in China.

Overall, the collected data was properly and timely analyzed and included in progress reports.

c. M&E Utilization

The ICR reports (para 76) that the data generated by the M&E system was utilized to capture implementation issues and propose adjustments and restructurings. For example, during implementation the M&E system found that the informal sector was involved in collecting material to recycle. Therefore, the definition of the relevant indicator was revised. It also captured issues related to the quality of separation, resulting in the allocation of more supervisors and an increase of communication activities. The Ningbo authorities used the M&E system for planning and management.

M&E Quality Rating

Substantial

10. Other Issues

a. Safeguards

The project was assigned Environmental Category "B" and the following two safeguards policies were triggered: Environmental Assessment OP/BP 4.01 and Involuntary Resettlement OP/BP 4.12.

Environmental Safeguards. An Environmental Impact Assessment (EIA) was carried out and an associated environmental management plan (EMP) was prepared to determine the mitigation measures, environmental monitoring program and necessary institutional arrangements, as well as capacity building (PAD para 59). The EIA and EMP were disclosed locally and in the World Bank's InfoShop on November 19, 2012. During implementation, the EMPs were included in the bidding documents and monitored for compliance (ICR para 79). No additional information is provided in the ICR.

Social Safeguards. According to the PAD (para 54), the negative social impacts were mainly related to land acquisition. The project would involve 187.1 mu (12.5 ha) of permanent land acquisition, 42 mu (2.8 ha) of temporary land use, and demolition of 5360 square meters of houses and 55,300 square meters of business buildings. The project would affect 683 persons. A Resettlement Action Plan (RAP) was prepared in compliance with the relevant government policies and the Bank Policy on Involuntary Resettlement. The summary of RAP was disclosed through the Bank InfoShop on November 19, 2012 and its full document was disclosed on November 23, 2013. A community participation manual was prepared at appraisal and updated and followed through during implementation (ICR para 81).



During implementation, annual resettlement monitoring reports were prepared. In total, 1,249 persons were affected due to the construction of the transfer stations, the KWTF, the Ningbo municipal waste disposal center and Reconstruction of Dongqiao Town, Xuanpei Village. The project team clarified that Dongqiao Town was demolished due to KWTF and had to be rebuilt at a new site. The ICR notes (para 80) that by project closure all land acquisition and resettlement related compensatory activities were completed. The ICR reports (para 82) that the grievance redress mechanism on resettlement was appropriate, and the complaints that were received were recorded and addressed properly. The ICR does not discuss the magnitude of land acquisition.

The project team provided following information on land acquisition: *the actual resettlement impacts included 650 mu (43 ha) of permanent land acquisition with impact on 478 farmers' and 370 workers' livelihood, and relocation of 167 households with 395 persons, among which 51 households moved into their replacement apartments and 116 households got cash compensation. The final external monitoring report in June 2020 concluded that all the resettlement task was fully completed, including the allocation of the replacement house, in consistent with the prepared resettlement plans, and that all implemented resettlement exactly followed the RPs. Its survey of 40 sampled household indicates that their income and housing are fully restored and the affected are satisfied with the relocation result without no pending issue or complaints.*

b. Fiduciary Compliance

Financial Management. The financial management of the project was satisfactory throughout implementation. The Interim Financial Reports (IFRs) and the annual audit reports were submitted to the World Bank on time. The annual external project audits were unqualified (ICR para 83).

Procurement. The procurement performance was largely satisfactory during implementation except for one year (mid-2015 to mid-2016) due to procurement delays related to land acquisition issues. For the Kitchen Waste Treatment Facility and some transfer stations, new locations or changes in plots required securing of land availability, which was a lengthy process and significantly delayed procurement. The procurement complied with the World Bank's procurement guidelines (ICR para 84).

c. Unintended impacts (Positive or Negative)

d. Other

11. Ratings

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Satisfactory	Satisfactory	



Bank Performance	Satisfactory	Satisfactory
Quality of M&E	Substantial	Substantial
Quality of ICR	---	Substantial

12. Lessons

The ICR provides a number of useful lessons (paras 93 to 97). The following are highlighted by IEG with some modification to the language:

- **Separation at source can be introduced at a large scale over a relatively short time but requires right conditions.** The project experience shows that these conditions are: (i) strong government commitment, (ii) capacity to roll out an integrated waste management system that supports separation at source, and (iii) effective public outreach. In Ningbo, while the higher levels of government were engaged with planning, securing resources and addressing implementation difficulties, the neighborhood committees were working on explaining the separation process and requirements and guiding households how to best comply with the new program. The Bank project helped to establish a well-integrated infrastructure and system including: equipment at the front end where the waste is separated; the separate containers are serviced timely; separated waste is handled as a separate stream and not mixed; the cleanliness and appeal around the disposal areas - all of which contributes to the willingness of households to comply with the new separation program. The community awareness and engagement campaign was far-reaching and intensive.
- **A public-private partnership (PPP) arrangement for solid waste treatment can be promoted through a two-staged procurement process which allowed inputs from prospective bidders to shape the design of the technical solution and explore what contractual arrangements could be supported by the market.** The PPP for Kitchen Waste Treatment Facility used this approach and was successful and is been studied for replication within China. The experience confirmed that a market test could inform both the design, the aptitude and willingness of the market to share the risk with the public sector within a PPP arrangement.
- **Ningbo's kitchen waste treatment facility has proven the viability of treating household kitchen waste through anaerobic digestion processes at scale and can be used as a reference for other projects.** Anaerobic digestors for municipal/household kitchen waste might be challenging to operate due to fluctuating composition of the feedstock. Ningbo's experience shows that large capacity digestors for less homogeneous household kitchen waste can be successful.

13. Assessment Recommended?



No

14. Comments on Quality of ICR

The ICR provided an adequate overview of project preparation and implementation, was internally consistent and concise. The ICR was outcome driven and included a good discussion on the theory of change and economic analysis. The ICR provides relevant lessons learned from the project experience. The ICR does not discuss though the magnitude of land acquisition.

Overall, the ICR provides a good basis for assessing the project's outcome. The quality of the ICR is rated **substantial**.

a. Quality of ICR Rating
Substantial