

People's Republic of China

FY 2017 Ex-Post Evaluation of Japanese ODA Loan

“Anhui Municipal Solid Waste Treatment Project”

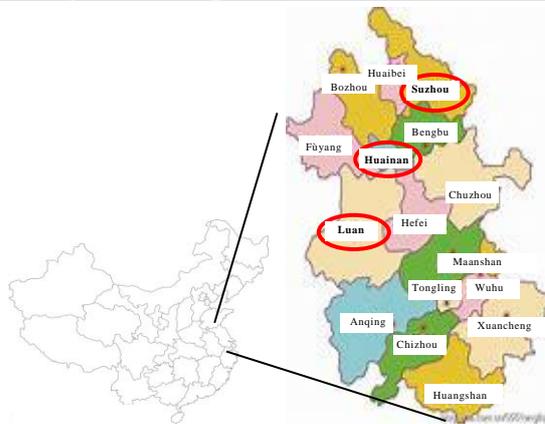
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1. Summary

The objective of this project is to promote the proper handling of the household solid waste generated in the regional cities of Anhui Province (7 prefectural cities and counties) by the construction of a solid waste treatment system, thereby contributing to environmental conservation and improvements in the living environments and sanitary conditions of local residents. The project conforms to the policies for household solid waste management of the Chinese Central Government and the Anhui Provincial Government. It is in line with China's developmental needs, such as the construction of an efficient solid waste treatment system and improvements in the sanitary conditions and living environments of regional cities in the province. It has been also relevant to Japan's ODA policy. Therefore, its relevance is high. Evaluation team assess the efficiency of the project as a whole to be fair, since the project cost was reduced commensurate to changes in project outputs, but the project period exceeded the planned duration due to newly required permits resulting from changed national standards for leachate treatment equipment. Additionally, as a result of setting up the basic facilities and equipment needed for municipal solid waste management, the operation and effect indicators (volume of sanitary landfill processed, post-treatment leachate BOD/COD concentration, harmless treatment rate of household solid waste, number of beneficiaries, etc.) at ex-post evaluation all achieved the target values set during the project appraisal. In addition, evaluation team verified a wide range of qualitative effects with respect to "promoting proper handling of the solid waste generated in target areas," such as (1) swift collection of household solid waste, (2) proper final disposal, (3) promoting higher-level treatment of household solid waste, (4) encouraging the management of household solid waste in rural areas, and (5) elevated solid waste management standards. There was also a remarkable impact with regard to "improvements in the living environments and sanitary conditions of residents in the target areas", consisting of (1) improvements in the residential environment and landscape, and (2) improvements in the water quality of rivers and water sources. Evaluation team also observed contributions by this project to the cultivation of industries related to municipal solid waste management, and increased employment opportunities in jobs related to municipal solid waste management. Therefore, Evaluation team believe the project has a high level of effectiveness and impact. Evaluation team also believe it to have high sustainability, given the excellent operation and maintenance of the equipment and

facilities, and the absence of problems from institutional, technical or financial aspects. In light of the above, this project is evaluated to be highly satisfactory.

2. Project Description



Project Locations



Transfer station set up for the current project (Yè jí)

2.1 Background

In the Tenth National Five-Year Plan for Environmental Protection (2001-2005), the Chinese government constructed an efficient waste management system (separated collection, storage/transportation, and treatment), prioritized the reduction and reuse/recycling of solid waste, and promoted the harmless treatment¹ of municipal solid waste (MSW) and centralized safe management of hazardous waste. However, the state of China's municipal solid waste was such that the treatment capacity could not keep up with the rate of waste generation. Although there has been growth in harmless treatment facilities such as sanitary landfills and incineration plants, with the number of locations increasing to 471 nationwide and the processing capacity to 256,300 tonnes/day (annual volume of harmless treatment at 80.51 million tonnes), the volume of collected and transported waste reached 156 million tonnes/year in 2005, while the harmless treatment rate for 2005 decreased from the previous year to 51.7%. Given these circumstances, The Outline of the Eleventh National Five-Year Plan for Economic & Social Development aimed to increase the construction of MSW treatment facilities as part of its environmental conservation efforts, and set targets to raise the harmless treatment rate above 60% by 2010.

Infrastructural development related to solid waste management in Anhui Province was delayed significantly, as initiatives for solid waste management started relatively late. The municipal solid waste generated in 2005 was 5.02 million tonnes annually. Even in urban

¹ Harmless treatment in China refers to the following 3 processes: sanitary landfill, composting, and incineration.

areas the harmless treatment rate stagnated at 17.6%, making it the third worst province after Shanxi and Gansu. The common practices in most areas of the province were treatment at simple landfill facilities which did not meet the national standards, open-air dumping and open-air burning among others, causing serious detrimental impacts on the soil, rivers, groundwater, air, etc. Therefore, there was great urgency to the construction of new sanitary landfill facilities and the improvement of sanitary conditions and living environments in the regional provincial cities.

2.2 Project Outline

The objective of this project is to promote the proper handling of the household solid waste generated in the regional cities of Anhui Province (7 prefectural cities and counties²) by constructing a solid waste treatment system, thereby contributing to environmental conservation and improvements in the living environments and sanitary conditions of local residents

Loan Approved Amount/Disbursed Amount	6.8 billion yen / 5.188 billion yen
Exchange of Notes Date/ Loan Agreement Signind Date	December 2007 / December 2007
Terms and Conditions	Interest rate 0.65% Repayment period 40 years (Grace period 10 years) Conditions for procurement General Untied
Borrower/ Executing Agency	The Government of People’s Republic of China / The People’s Government of Anhui Province
Project Completion	August 2015
Main Contractor	-
Main Consultant	-
Related Studies (Feasibility Studies, etc.)	F/S conducted by Shanghai Municipal Engineering Design General Institute (March 2007)
Related Projects	-

² Lu’an City, Huoshan County, Huo Qiu County, Yè jí Zone (Huoshan County, Huo Qiu County, and Yè jí Zone are administrative districts of the city of Lu’an), Huainan City, Suzhou City, and Tongling City.

3. Outline of the Evaluation Study

3.1 External Evaluators

Toshihiro Nishino and Miho Sakuma (International Development Center of Japan Inc.)

3.2 Duration of Evaluation Study

The ex-post evaluation study was conducted with the following schedule.

Duration of the Study: July, 2017 – March, 2019

Duration of the Field: October 29, 2017 – November 11, 2017; January 21-25, 2018

3.3 Constraints during the Evaluation Study

Evaluation team had planned to conduct interviews with beneficiaries of the project as well as residents who had been resettled due to the construction of the sanitary landfills, arbitrarily selecting residents from the directory to ensure objectivity. However, in China even government research institutes have not been able to use this sampling method to solicit opinions from ordinary citizens; neither did the executing agencies in the prefectural cities/counties have any experience implementing this method. Therefore, evaluation team designated place of residence, gender, age, and other requests (for example, ordinary citizens with no governmental affiliation), and allowed the executing agencies in each prefectural city/county to select the subjects.³ Therefore, the interview survey results may not entirely represent the opinions of all beneficiaries.

4. Results of the Evaluation (Overall Rating: A⁴)

4.1 Relevance (Rating: ③⁵)

4.1.1 Consistency with the Development Plan of People's Republic of China

As evidenced by *the Tenth National Five-Year Plan for Environmental Protection (2001–2005)* and the *Outline of the Eleventh National Five-Year Plan for Economic & Social Development (2006–2010)*, the Chinese Government's developmental plans have emphasized environmental issues (including waste management) as a priority policy while this project was at the time of appraisal. Given the shortage in the absolute number of municipal solid waste (MSW) treatment facilities, the plans stressed the increased construction of facilities and the efficient waste management system building (comprised of separated collection, and storage/transportation), and improvements in the harmless treatment rate of municipal solid waste as a result of the efficient waste management system. The subsequent National Five-Year Plans have also consistently

³ Interviews were conducted with about 10 resettled residents (roughly 40% women) in Lu'an City, Huoshan County, and Yè jí Zone.

⁴ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁵ ③: High, ②: Fair, ①: Low

focused on the construction of an efficient waste management system and improvements in the harmless treatment rate of municipal solid waste. However, given some progress in the construction of MSW treatment plants, the plans and policies during the ex-post evaluation period (such as *the Thirteenth National Five-Year Plan for Economic & Social Development (2016-2020)*) reveal stronger initiatives for a higher standard of MSW treatment, including further improvements in the harmless treatment rate (over 95%); technological development and facility improvements pertaining to incineration, biological treatment processing, waste-to-energy, and waste separation; achieving a high level of reduction, reuse, and recycling of resources; and disclosure of information pertaining to solid waste management.

Taking a cue from the central government’s policies, Anhui Province also stepped up its response to MSW treatment. *Anhui Province’s Thirteenth National Five-Year Plan (2016-2020) for Environmental Protection* outlines a plan to optimize the construction of MSW treatment facilities, strengthen their operation and management, and further improve harmless treatment rates.

Therefore, during both at the time of appraisal and ex-post evaluation periods, the objectives and details of this project aligned with China’s policies on household solid waste management, in that it aims for "environmental conservation and improvements in the living and sanitary conditions of local residents through the construction of an efficient MSW treatment system."

Table 1 Primary Objectives of the Development Plans Related to This Project

Type	During Project Examination	During Ex-Post Evaluation
Solid waste management policy / National development plan	<p><u>Tenth National Five-Year Plan for Environmental Protection (2001 – 2005):</u></p> <ul style="list-style-type: none"> Construct an efficient waste management system (separated collection, storage/transportation, and treatment); prioritize the reduction and reuse/recycling of solid waste; and promote the harmless treatment of municipal solid waste and focused centralized safe management of hazardous waste. <p><u>Outline of the Eleventh National Five-Year Plan for Economic & Social Development (2006 – 2010):</u></p> <ul style="list-style-type: none"> As part of environmental protection efforts, ramp up the construction of MSW treatment facilities, and collection of fees for MSW treatment, and aim for a harmless treatment rate of 60% or more by 2010. 	<p><u>Thirteenth National Five-Year Plan for Environmental Protection (2016 – 2020):</u></p> <ul style="list-style-type: none"> Reduce the amount of MSW processed, and increase the reuse/recycling of resources; raise the standard of harmless treatment; and raise the national rate for the harmless treatment of MSW to 95% or more. Build a collection, storage, and transportation system; promote full-scale, sealed waste collection and transportation in the municipality. Increase the management of waste leachate and ash emitted during incineration; increase methane use and odor management at landfills; and promote the social disclosure of pollutant emissions from waste processing plants. <p><u>Thirteenth National Five-Year Plan for Economic & Social Development (2016 – 2020):</u></p> <ul style="list-style-type: none"> Immediately start the construction of urban solid waste processing plants; build a collection and transportation system; improve the waste incineration rate; and complete a leachate treatment plants. Build waste management facilities and achieve standard targets.

Department of Residential Construction policies / related ordinances	<u>Dept. of Construction: MSW management methods (2007):</u> <ul style="list-style-type: none"> Clearly indicate what fines will be imposed to those who generate municipal solid waste and fail to pay the waste management fees. Clarification and tightening of the licenses and requirements expected of the supervisory body (Department of Environmental Health) and private enterprises in relation to municipal solid waste management. 	<u>Proposal by departments such as Dept. of Residential/Urban Construction to boost the MSW incineration project (2016):</u> <ul style="list-style-type: none"> Strengthen the support system for collection, transportation, resource utilization, and end processing related to the separation of household trash. <u>Notice by the Office of the Secretary of the People's Government of Anhui Province on the enforcement of the household solid waste separation project (2017):</u> <ul style="list-style-type: none"> Strengthen on-site management of incineration facilities. Construction of a high-standard, waste-to-energy (“clean”) incineration project. Improvement of facility operations by boosting regulations.
Anhui Province development plan	<u>Anhui Province’s Eleventh Five-Year Plan for Environmental Protection (2006 – 2010):</u> <ul style="list-style-type: none"> By 2010, Achieve a harmless treatment rate in the municipality (chéngzhèn :cities and towns) of 40% or more and a harmless treatment rate of 60% or more in prefectural-level cities As a main project, plan the development of solid waste management plants in 31 cities including the urban areas of counties (county central towns). 	<u>Anhui Province’s Thirteenth Five-Year Plan for Environmental Protection (2016 – 2020):</u> <ul style="list-style-type: none"> Promote separated collection and sealed transportation of household solid waste. Complete a centralized waste management system. Scientifically and rationally select sites and further optimize the construction of municipal waste management facilities. Boost facility operation and management. In 2020, achieve implementation of harmless treatment of household solid waste across the entire province basically, achieve over 90% harmless treatment rate for household solid waste in the county, and achieve 95% waste management in Jiànzhì zhèn (towns, rural regions where commercial industry is developed to a certain extent and with a comparatively large concentration of non-agricultural population).

Source: Documents provided by JICA, plan documents.

4.1.2 Consistency with the Developmental Needs of People’s Republic of China

As mentioned above, at the project proposal (examination) there were significant delays in the infrastructural development for solid waste management in Anhui Province. Even in urban areas the harmless treatment rate stagnated at 17.6%, which is low even for Chinese domestic figures. In much of the province, citizens carried out waste management that did not meet national standards, such as the use of simple landfills, dumping, and burning of trash, seriously affecting the quality of soils, rivers, groundwater, and the atmosphere. Therefore, there was great urgency in building an efficient solid waste treatment system, through the construction of new sanitary landfill facilities, and improving the sanitary conditions and living environments of the local provincial cities. The project is therefore highly pertinent.

According to an interview with a representative of the executing agencies the harmless treatment rate in urban area of Anhui Province at the time of ex-post

evaluation had reached over 90%. On the other hand, the increases in urban population and municipal solid waste (MSW) per capita have also led to a significant increase in the volume of municipal solid waste generated, compared to levels during the project examination. In addition, because of the additional need to deal with solid waste discharged in rural areas, continuous enhancements are needed for solid waste management facilities in both urban and rural areas. The demand for MSW treatment has become more sophisticated given the certain progress in the construction of MSW treatment facilities. Demand for reuse/recycling and reduction has also increased, in addition to harmless treatment, from the viewpoint of the increased demand for effective utilization of treatment facilities and waste. The primary methods for reuse/recycling and reduction, incineration and food waste recycling, have advanced through the input of private capital. One important factor for the efficient incineration of solid waste to achieve a certain level of profitability is the removal of moisture through methods such as waste compaction, which results in a guaranteed incineration temperature. The transfer stations and the compressed container method (used by transport vehicles) developed with this project have contributed greatly to the elimination of moisture. These help to bring MSW treatment to the next level, in the target prefectural cities/counties, such as the construction of incineration plants and the (trial) introduction of separated solid waste collection. The construction of a basic MSW treatment system is also significant as a foundation to move to the next level of solid waste management.

Therefore, our opinion is that this project is in line with the developmental needs of Anhui Province, China, both during the project examination and ex-post evaluation.

4.1.3 Consistency with Japan's ODA Policy

During the examination of this project, Japan's *ODA Charter (2003)* emphasized initiatives to address global environmental problems, and *the Medium-Term Policy on ODA (2005)* focused on protecting individuals from the "fear" such as environmental destruction, from the angle of guaranteeing safety for humans. Countermeasures to environmental pollution (such as solid waste management) have been established as an area of focus. In addition, *the Economic Cooperation Program for China (2001, Ministry of Foreign Affairs)*, *the Medium Term Strategy for Overseas Economic Cooperation Operations (2002, JICA)*, and *the Country Assistance Strategy (2002, JICA)* all place an emphasis on environmental conservation. This project is therefore consistent with Japan's ODA policy.

From the aforementioned points, evaluation team can see that the implementation of

this project was fully compatible with China's developmental plans and developmental needs, both during project examination and ex-post evaluation, as well as with Japan's ODA policy during project examination. Therefore its relevance is high.

4.2 Efficiency (Rating: ②)

4.2.1 Project Outputs

From the initial project plan submitted for examination, the following initiatives have been canceled and rendered outside the scope of the current project: all projects in two city/county (Fēng tái County and the prefecture-level city of Huaibei); and projects related to the Tongling cement plant. Table 2 lists the reasons why these initiatives were regarded to be outside of the project's scope.

Table 2 Reasons for Revisions to the Project Plan

Projects rendered out of scope	Reason
All projects in Fēng tái County / Huaibei City	It became necessary to make further adjustments, along with affiliated organizations and stakeholders, with respect to the selection of the project implementation site. There was also a change in policy to urge the executing agencies and prefectural city governments to self-finance the construction.
Projects related to the incineration of household solid waste at the Tongling cement plant	After the start of the project, the executing agencies and city government adopted a policy of carrying out the projects sooner using their own funds, using a new building technology developed by the cement factory.

Source: Documents provided by JICA, and questionnaire responses by the executing agencies

Although circumstances in each region (described above) caused the exclusion of these initiatives from the current project, they had no impact on the achievement of the project objectives as the developmental needs remained the same.

The table below shows the project outputs at the following stages: (1) original plans at project examination, (2) post-revision plans, and (3) actual values. The table in the Appendix shows the project outputs broken down by the prefectural cities/counties targeted in this project.

The main outputs of this project include the following: 1) 5 locations of sanitary landfills and leachate treatment plants (volume of sanitary landfill: 43.1 thousand m³); 2) collection and transportation facilities (new transfer stations⁶ at 61 locations, and

⁶ In China, it is common for the following two methods to be used simultaneously: one where the transportation vehicles collect and directly transport household solid waste to the sanitary landfill facility or incineration plant, and the other where the household solid waste is first transported to an in-town transfer station, then usually brought to the sanitary landfill facility or incineration plant following a waste compaction process. The transfer station plays an important role in the efficient collection and transportation of household solid waste.

modified transfer stations at 62 locations); 3) access roads to the sanitary landfill facilities (8,276 m); 4) equipment related to solid waste management; 5) managed area building structures and parking for waste transportation vehicles; and 6) training sessions in Japan. There were no major changes to the project outputs other than the canceled initiatives described above. A portion of the surplus funds from the cancelled Tongling cement factory project was diverted into the development of collection and transport facilities and the construction of parking for waste transport vehicles. Similarly, the funds that were freed up by the cancellation of these initiatives have been used to set up some of the facilities and equipment originally planned to be financed from domestic funds in the project proposal. As Table 3 shows, when comparing the revised plans and the actual outputs⁷, evaluation team observe increases in some of the project outputs ('managed area building structures' and 'access roads to the sanitary landfill'), while others decrease to a certain degree ('sanitary landfill volume', 'collection and transport facilities', and 'parking for waste transport vehicles'). The sanitary landfill volume shrank due to decreased demand for landfills in Lu'an City, resulting from the construction of incineration plants for household solid waste. In addition, the project deployed higher quality equipment for leachate treatment, due to the increased national standards for post-treatment leachate. According to interviews with the executing agencies and other related documents, the changes to project outputs other than sanitary landfill volumes and leachate treatment equipment correspond to changes in demand within the scope of the current project, and thus pose no problems. These include (1) a portion of the equipment requiring urgent deployment, and therefore being self-funded; and (2) some of the equipment and tools planned either being changed to other equipment/tools or reduced in output during the project implementation.

⁷ Due to the circumstantial changes surrounding the project, and the formulation of a revised plan mutually agreed upon by Japan and China, the comparative analysis conducted during the ex-post evaluation to the comparison of actual results with the planned outcomes outlined in the revised plans.

Table 3 Planned and Actual Project Outputs

Details	Planned (as originally submitted for examination)	Planned (post-revision ⁸)	Actual
Sanitary landfill facility	7 locations Volume: Total 14.23 million m ³ (Fēng tái and Huaibei 675) Design: Improved anaerobic method Leachate pondage: Total 68,600 m ³ (Fēng tái and Huaibei 2.94)	5 locations Volume: 7.48 million m ³ Design: Improved anaerobic method Leachate pondage: Total 39,200 m ³	5 locations Volume: 6.967 million m ³ (93% of planned volume) Design: Improved anaerobic method Leachate pondage: Total 43,100 m ³ (110% of planned volume)
Leachate treatment equipment	7 locations Volume: Total 880 m ³ /day (Total of 5 prefectural cities/counties, as the planned volumes of Fēng tái and Huaibei are unknown)	5 locations Volume: Total 880 m ³ /day (Plans revised to deploy equipment with higher treatment capabilities than originally planned)	5 locations Volume: Total 880 m ³ /day (100% of planned volume) (Deployed equipment with higher treatment capabilities than originally planned)
Collection and transportation facility	New transfer stations: 87 locations Modified transfer stations: 74 locations Waste collection vehicles: 140	New transfer stations: 71 locations Modified transfer stations: 74 locations Waste collection vehicles: 189	New transfer stations: 61 locations (86% of number planned) Modified transfer stations: 62 locations (84% of number planned) Waste collection vehicles: 82 (43% of number planned)
Access roads to the sanitary landfill facility	7 locations 8,076 m (Total of 5 prefectural cities/counties, as the planned volumes of Fēng tái and Huaibei are unknown)	5 locations 8,076 m	5 locations 8,276 m (102% of length planned)
Equipment related to solid waste management	Treatment plant equipment: 59 Related vehicles: 47 Others: 9	Treatment plant equipment: 42 Related vehicles: 45 Others: 1	Treatment plant equipment: 31 (74% of number planned) Related vehicles: 48 (107% of number planned) Others: 1 (100% of number planned)
Cement plant facilities related to the	300 tonnes/day × 2 lines	None (outside of project scope)	None (outside of project scope)

⁸ JICA approved the adjustments to the implementation plan, based on the application submitted by the executing agencies, as follows: in September 2008, the sanitary landfill facility, leachate treatment equipment, access road to the sanitary landfill, building structures on the managed area, and parking for waste transportation vehicles; in September 2014, the collection and transportation equipment, and cement factory facilities related to the incineration of household solid waste. (Source: JICA internal document)

incineration of household solid waste			
Managed area building structures and parking for waste transportation vehicles	Managed area building structures: 11,991 m ² , 8 locations Parking for waste transportation vehicles: 2,360 m ² , 4 locations	Managed area building structures: 6,110 m ² , 6 locations Parking for waste transportation vehicles: 29,900 m ² , 3 locations	Managed area building structures: 6,483 m ² (106% of area planned), 5 locations Parking for waste transportation vehicles: 13,546 m ² (45% of area planned), 5 locations
Training in Japan	Management training: 30 persons (15 persons × 2 sessions) Technical training: 30 persons (15 persons × 2 sessions)	Management training: 30 persons (15 persons × 2 sessions) Technical training: 30 persons (15 persons × 2 sessions)	Management skill training: 43 persons (Total 3 sessions of 14 persons, 12 persons, and 17 persons) (72% of number planned)

Source: Documents provided by JICA, and questionnaire responses by executing agencies



Waste processing at the transfer station (Tongling)



Landfill constructed for the current project (Huoshan)

Table 4 shows the ratio of the facilities established by this project to all household solid waste management facilities owned by the target prefectural cities/counties involved in this project, at the time of ex-post evaluation (2017). This project has established one hundred percent of the sanitary landfill facilities (considering only phase 2 of the sanitary landfill facility where that is the only phase in operation), and the majority of leachate treatment equipment and transfer stations, and thus has made an extremely large contribution to the establishment of household solid waste management facilities in its target prefectural cities and counties.

If problems emerged the target prefectural cities/counties during the implementation of the project, JICA personnel visited the location to consult and take steps toward resolution, along with the representatives of the target prefectural cities/counties. The parties involved in the provincial executing agencies have rated this highly.

Table 4 Contribution of This Project to Overall Household Solid Waste Management Facilities in the Target Prefectural Cities/Counties

Facility	No. of prefectural cities/counties targeted by the current project	All household solid waste management facilities	Facilities equipped by the current project	Proportion equipped by the current project
1. Sanitary landfill facilities	5	Volume: 6,967,000 m ³	Volume: 6,967,000 m ³	100%
2. Leachate treatment equipment	5	Volume treated: 1,030 m ³ /day	Volume treated: 880 m ³ /day	85%
3. Transfer stations	7	197 locations	123 locations	62%
4. Collection vehicles for household solid waste	6	455 vehicles	82 vehicles	18%

Source: Questionnaire responses by executing agencies

4.2.2 Project Inputs

4.2.2.1 Project Cost

As Table 5 shows, the actual costs associated with this project, 8.103 billion yen, stayed within the planned (post-revision) budget of 11.333 billion yen (71% of the planned cost)⁹. Factors that caused the actual costs to dip below the planned costs were as follows: (1) changes in demand caused the project outputs for collection and transport facilities and parking for waste transportation vehicles to decline by a set amount; (2) reduction of land acquisition costs and administrative costs¹⁰ due to the availability of state-owned land for use in some prefectural cities/counties, and the budgeting of a higher amount during the feasibility study (FS) than what was generally incurred in practice; (3) tenders suppressing the cost of domestic public works, and (4) appreciation of the yen over the project period. If evaluation team consider the deployment of high-grade equipment for leachate treatment, due to changes in national standards¹¹, evaluation team regard the project costs to have been properly reduced as they have been conducted in line with the reduction in project output.

⁹ As mentioned above, the project cost (local currency) of the post-revision plan is significantly less than the original plan submitted for review, as revisions to the plan were primarily made to divert the Japanese ODA funding from the cancelled initiatives to cover a portion of the facilities/equipment originally planned with domestic funding.

¹⁰ Another reason for the low administrative expenses was the presence of some cases where it was difficult to calculate the administrative expenses separately; thus a portion of these expenses was lumped in with the costs for materials procurement / public works.

¹¹ The actual cost of setting up the leachate treatment equipment to meet the new benchmark was over roughly 1.54 times the planned amount.

Table 5 Planned vs Actual Project Costs

Units: in million yen

	Planned (as originally submitted for examination)			Planned (post-revision)			Actual		
	foreign currency portion	local currency portion	Total	foreign currency portion	local currency portion	Total	foreign currency portion	local currency portion	Total
Materials procurement /public works	6,335	5,365	11,700	6,343	2,669	9,012	5,150	2,331	7,481
Training	35	0	35	27	0	27	20	-	20
Inflation	396	0	396	396	0	396	-	-	-
Contingencies	338	268	606	17	0	17	-	-	-
Interest rate during construction	178	0	178	0	0	0	-	78	78
Commitment charge	0	0	0	17	0	17	17	35	52
Land acquisition costs	0	1,549	1,549	0	814	814	-	288	288
Administrative expenses, etc.	0	1,433	1,433	0	1,050	1,050	-	183	183
Total	7,282	8,615	15,897	6,800	4,533	11,333	5,188	2,915	8,103

Source: Documents provided by JICA, and questionnaire responses by executing agencies

Note: 1) The exchange rates are as follows: planned value (at project examination/revision), 1 yuan = 15.6 yen (June 2007); actual value, 1 yuan = 14.9 yen (average exchange rate for the period 2007-2015). 2) The exchange rate remained unchanged during the revision of the project plans (project cost). 3) The Japanese ODA loan covered 6.8 billion yen of the foreign currency portion in the original project plan submitted for examination; the Japanese ODA loan covered the entire foreign currency portion in the post-revision plan and actual execution of the project.

4.2.2.2 Project Period

The actual duration of the project was 93 months (December 2007 – August 2015), which was longer than the planned duration (post-revision) of 67 months (December 2007 – June 2013)¹², by 26 months (139% of the planned duration). Compared to the original plan submitted for examination (57 months), the actual duration went over by 36 months (163% of the planned duration at the time of appraisal). The fact that the project period was longer than expected is attributable to the following causes: (1) new designs and permits became necessary due to tightened national standards for leachate treatment equipment; (2) the time newly required for land acquisition and resettlement of the residents who lived within 500 m of the sanitary landfill (see 3.4.2 (2) below for details); (3) , and adjustments to the use of the Japanese ODA loan funds (including adjustments between prefectural cities and counties) became necessary as the result of changes in needs and construction of facilities by

¹² The revised project plan does not specify the duration for each project individually.

self-funding outside the current project; and (4) new designs and permits became necessary due to required route changes in a part of the road.

Table 6 Planned vs. Actual Project Period

	Planned (at project examination)	Planned (post-revision)	Actual
Date of Loan Agreement	December 2007	December 2007	December 2007
Entire project	January 2008 – September 2012 (Project period: 57 months)	December 2007 – June 2013 (Project period: 67 months)	December 2007 – August 2015 (Project period: 93 months)
Access roads	January 2008 – November 2010		January 2008 – March 2013
Transfer stations	January 2008 – March 2012		June 2008 – August 2015
Sanitary landfills	January 2008 – December 2008		March 2008 – August 2014
Land acquisition	January 2008 – December 2008		December 2007 – December 2009
Training	June, August 2008; May 2009		July 2009, September 2010, December 2011

Source: Documents provided by JICA, and questionnaire responses by executing agencies

4.2.3 Results of Calculations for Internal Rates of Return (Reference only)

Evaluation team did not calculate an Internal Rate of Return, since Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR) were not calculated at the project examination, and comparisons cannot be made at ex-post evaluation.

The project cost fell within the planned budget, but the project period exceeded the plan. Therefore, efficiency of the project is moderate

4.3 Effectiveness¹³ (Rating: ③)

4.3.1 Quantitative Effects (Operation and Effect Indicators)

Table 7 shows the operation and effect indicators, which had been set at the project examination and ex-post evaluation to show the quantitative impacts of this project.¹⁴ The Appendix shows the operation and effect indicators broken down by target prefectural city/county.

¹³ Sub-rating for Effectiveness is to be put with consideration of Impacts.

¹⁴ During revisions to the original plan, no changes were made to the operation and effect indicators that show quantitative impact.

Table 7 Changes in the Operation and Effect Indicators

Indicators	Target Value (2 years after completion of project)	Actual Value (2 years after completion of project: 2017)
【Operation indicator】		
Disposal volume of sanitary landfill	495,574 tonnes/year	514,772 tonnes/year
Post-treatment leachate BOD concentration	30-600 mg/l (simple average 396 mg/l)	2-30 mg/l (simple average 14 mg/l)
Post-treatment leachate COD concentration	100-1,000 mg/l (simple average 680 mg/l)	7-100 mg/l (simple average 49 mg/l)
Post-treatment ammoniacal nitrogen	-	0.5-20.0 mg/l (simple average 8.2 mg/l)
Treated leachate volume	-	705,425 m ³ /year
Municipal solid waste harmless treatment rate	50-100% (simple average 93%)	98-100% (simple average 100%)
Volume of collected municipal solid waste	-	885,225 tonnes/year
Proportion of collected municipal solid waste	-	96-100% (simple average 100%)
Volume of household solid waste disposed via transfer stations	-	1,011,895 tonnes/year
【Effect Indicator】		
Number of beneficiaries / target population for services	2.208 million people	5.31 million people
(out of which) beneficiaries of sanitary landfill	-	2.24 million people
(out of which) beneficiaries of transfer stations	-	4.57 million people
(out of which) beneficiaries of waste collection & transport vehicles	-	4.81 million people
Illegal dumping sites	-	0-9 locations (simple average: 1.3 locations)

Source: Questionnaire responses and field survey interviews

Note: The figures for BOD, COD, ammoniacal nitrogen, MSW collection rate, municipal solid waste harmless treatment rate, and illegal dumping sites represent the maximum and minimum figures in the target counties (the figures in parentheses represent the simple averages of the prefectural city/county values). In addition, the figures for BOD, COD, and ammoniacal nitrogen represent always achieved level following treatment.

(1) Status of operation indicators

The actual values taken 2 years after project completion (2017) for the following operation indicators (set during project examination), all achieved their targets: (1) disposal volume of sanitary landfill, (2) harmless treatment rate for municipal solid waste, and (3) BOD/COD concentration of post-treatment leachate. The disposal volume of sanitary landfill represents the actual values of the four target prefectural cities/counties excluding Yè jí. This is because Jinzhai County, Yè jí's neighbor to the south, constructed a household solid waste incineration facility with a capacity of 300 tonnes/day in 2013. Because this incineration facility could not meet full capacity using

only Jinzhai County's municipal waste, it provisionally started incinerating Yè jí's household solid waste and processing the post-incineration waste in the county's sanitary landfill. Jinzhai County is outside the project scope, but is an administrative district falling under the jurisdiction of Lu'an City, similar to Yè jí Zone, Huoshan County, and Huo Qiu County, which are targets of this project. Yè jí's sanitary landfill facility was not being used at the time of ex-post evaluation, but according to interviews with the Lu'an executing agency, processing is expected to be resumed in 2018 following adjustments within Lu'an City. Apart from the sanitary landfill, the transfer stations and transport vehicles constructed and provided by this project continue to be used. Jinzhai County plans to collect and incinerate household solid waste not only from urban areas but also from rural areas; if this plan is implemented, the incineration plant will be at full operation using only the waste from Jinzhai County. In such a case, Yè jí will use the sanitary landfill facility constructed by the current project, since the county's household solid waste is collected and disposed of in Yè jí. Therefore, although Yè jí's sanitary landfill facility is not currently used, evaluation team judge that the actual processing volume exceeds the target. For the four target prefectural cities/counties excluding Yè jí, the actual value (514,772 tonnes/year) is 113% of the target value (453,753 tonnes/year). The deployment of incineration plants has progressed even in the four target prefectural cities/counties excluding Yè jí, in order to extend the longevity of the sanitary landfill. On the other hand, the volume of household solid waste requiring disposal via sanitary landfill has continually increased, due to increased household solid waste management in rural areas, higher-than-expected increases in the urban population, and increases in per-capita household solid waste due to improvements in living standards. The disposal volume of waste has therefore increased at a higher pace than planned.

Through the construction of sanitary landfills by this project, final waste disposal at a sanitary landfill facility has become the norm and the MSW harmless treatment rate has reached nearly 100% in the prefectural cities/counties targeted by this project, as mentioned above. In addition, the structure for municipal solid waste collection (made up of the equipment and systems for waste collection and transportation) has made a substantial contribution to achieving a 100% harmless treatment rate. The municipal solid waste collection rate has also reached nearly 100%. At transfer stations, which fill an important role in the collection and transportation of household solid waste, the volume of disposed household solid waste exceeds 1 million tonnes/year. These facts indicate the significant contributions made by the various facilities supplied by the project to improving the harmless treatment rate.

As mentioned above, the national standards for BOD/COD and ammoniacal nitrogen

concentrations in post-treatment leachate were further tightened in 2008, forcing the deployment of higher quality equipment than initially planned. As a result, the necessary treatments are executed at high standards, and all counties without exception have achieved targets in the indicators where target values had been set. The volume of treated leachate in the five target prefectural cities/counties have also reached 705,425 m³/year. Some indicators, such as COD levels, are constantly monitored at all sanitary landfill facilities using an on-line link with the environmental agency. The other indicators are also monitored regularly, and thus evaluation team consider that post-treatment leachate is sufficiently managed.

(2) Status of the Effect Indicators

"Number of beneficiaries/target population for services" is the only effect indicator that has a target value at the time of appraisal; the actual value of this indicator (5.31 million people) greatly exceeded the target, achieving 240% of target figures (2.208 million people). The reason for this is, as mentioned above, the unexpected increase in the urban population (the urban population of the seven target prefectural cities/counties is roughly 2.98 million people, which itself exceeds the target), in addition to the promotion of household solid waste management in rural areas. As a result, the target area for the sanitary landfill and the area of activity for the collection and transportation facilities and vehicles supplied by this project, largely shifted into rural areas. The number of beneficiaries and the target population for services are expected to increase in the future, as the target prefectural cities and counties will continue to emphasize household solid waste management in rural areas and plan to utilize the facilities and equipment supplied by this project, such as the sanitary landfill. Additionally, a target number had not been set for illegal dumping sites, nor was the actual figure known prior to the start of the project. However, this number came out close to zero when evaluation team excluded Yè jí.

4.3.2 Qualitative Effects

The qualitative effect assumed during the project proposal (examination) is the "promotion of the proper handling of waste generated in target areas." Evaluation team recognize the qualitative effects as shown in the figure below, classified according to the developmental strategy goals outlined in the "Solid Waste Management" section of JICA's issue-specific guidelines.

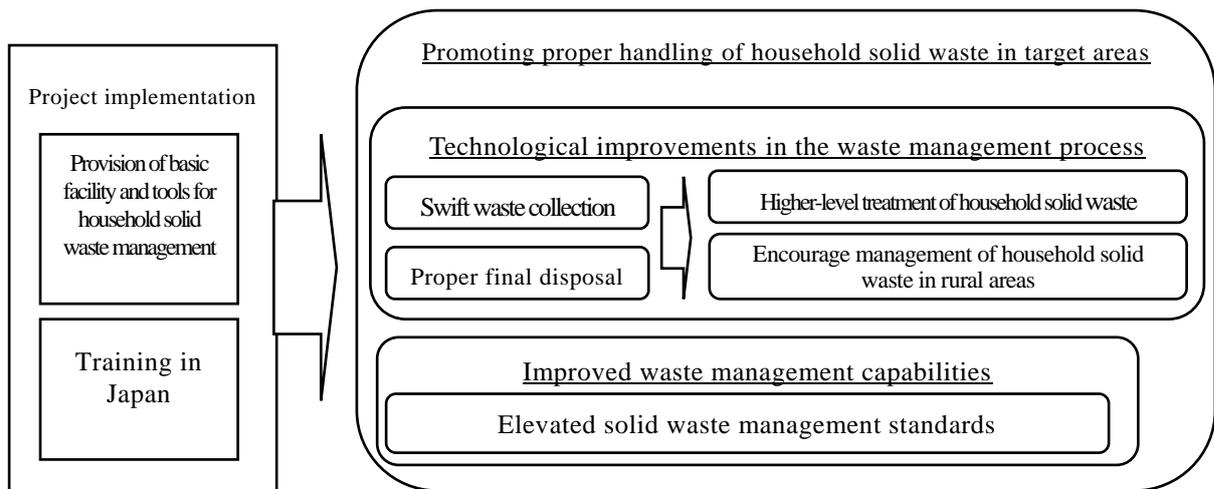


Figure 1 “Facilitation of Appropriate Treatment of Solid Waste Generated in the Target Area” of this Project

The qualitative outcome of this project, the "promotion of proper handling of household solid waste in target areas," can be classified as follows:

First, this project provided the related facilities and tools required by each process of municipal solid waste management (collection/transportation, final disposal). This paved the way for technological improvements in the waste management process (as originally anticipated) through the realization of the following 2 points: (1) swift waste collection and (2) proper final disposal (with no burden to the environment). Evaluation team can say that this project streamlined the flow of solid waste management through to final disposal, and thus built a foundation for MSW treatment. As mentioned above, open dumping and untreated landfills were commonly regarded as the final disposal method for waste in many prefectural cities and counties prior to the implementation of this project. However, the project was able to realize the harmless treatment of municipal solid waste using sanitary landfills. Swift MSW collection has been made possible through the establishment of a proper method for the final disposal of MSW, which is the nucleus of solid waste management, and the provision of collection and transport facilities/equipment to yield quantitative and qualitative outputs (that is, the efficient transportation of waste made possible through the enhanced functionality of waste compaction in transfer stations and collection/transportation vehicles). As a result, dramatic improvements can be observed in waste collection services; in the urban areas of the target prefectural cities/counties, garbage collection is conducted several times a day.

In addition, the provision by this project of basic MSW facilities and services has

yielded 2 effects: (1) achieving a higher standard of household solid waste management (due to the sophistication of treatments such as reduction, reuse/recycling, etc.), and (2) promoting household solid waste management in rural areas (through the expansion of the target areas). Through this project, the construction of a waste management system of a given standard encourages each prefectural city/county to step up to the next level of MSW treatment, such as reduction and reuse/recycling. Specifically, owing partly to the policy of the Chinese government, PPP (public-private partnership) projects have been carrying out the construction of incineration plants¹⁵ and the trial introduction of solid waste separation. Many incineration plants also generate power to guarantee profitability for the PPP. The transfer stations and collection/transportation vehicles supplied by this project which possess a waste compaction function have contributed to the removal of moisture from waste, a step necessary to ensure the incineration temperatures required for efficient power generation. In addition, each prefectural city/county has been utilizing their experiences of constructing solid waste treatment systems in urban areas to build similar systems in rural areas. In many cases the sanitary landfills constructed by this project also receive waste from rural areas. Evaluation team therefore observe direct contributions by this project to the promotion of solid waste management in rural areas. The project's large impact on household solid waste management has also promoted governmental understanding with respect to environmental actions, initiatives for solid waste management, and budget expenditures. Evaluation team also noted the effect the project had on facilitating the procurement of the necessary budgets for new developments.¹⁶

Next, this project elevated solid waste management standards and promoted improvements to waste management capabilities. The establishment of basic solid waste management facilities by this project led to the formulation of transfer stations management rules, and the collection and maintenance of waste disposal volume records in each prefectural city/county. Evaluation team observed improvements in solid waste management standards.

In addition, evaluation team observed the impact of the training in Japan, expressed in two qualitative effects: (1) technological improvements in line with waste management flow, and (2) improvements in waste management capacity. An interview with training participants revealed a wide range of ideas, such as "spirit/philosophy," "business development," and "individual applications" as embodied by the following example statements:

¹⁵ In many cases, supplementary payments are made according to treatment volume.

¹⁶ Evaluation team only obtained data from 4 cities with respect to government expenditures on environmental protection. However, each city's expenditure on environmental protection had more than doubled between 2011 and 2016, indicating rapid growth as compared to general government expenditures.

1. “I was inspired by a lecturer who stated, ‘Japan neglected the environment and paid a large price as a result. China needs to learn from Japan.’ These words helped me re-acknowledge the importance of solid waste management and simultaneously carry out conscious operational modifications and capacity enhancements so that the initiative is considerate of the environment.”
2. “Understanding the present situation of Japan helped me gain a long-term perspective and push for technological improvements from an early stage, such as the consideration of incineration plants.”
3. “I was able to recognize the importance of environmental consciousness among citizens, and so I promoted environmental education at schools while simultaneously employing examples from Japan to prepare posters for waste separation.”

4.4 Impact

4.4.1 Intended Impacts

(1) Reduction of Annual CO₂ Emissions

At the project examination, a reduction in annual CO₂ emissions was assumed to be a quantitative measure of impact. The annual target of 530,000 tonnes/year represents the reduction in annual CO₂ emissions originally assumed possible with the development of sanitary landfills in the seven target prefectural cities/counties in the sanitary landfill construction project. However, at ex-post evaluation, evaluation team have not been able to obtain target values (including calculation method) for each prefectural city/county’s reduction in annual CO₂ emissions, nor their actual values. However, evaluation team consider that reductions in annual CO₂ emissions have been achieved as planned, even though the specific amount of reduction for each prefectural city/county is unknown. Evaluation team believe this to be true because, as stated above, the sanitary landfill facilities were completed as planned in all five prefectural cities/counties targeted by this project. In addition, according to interviews with the executing agencies, even Fēng tái County and Huaibei City (which had originally been included in the project but were eventually deemed to be outside its scope) have self-funded the development of sanitary landfills. If evaluation team include these facilities, evaluation team believe that the actual value clears the annual target of 530,000 tonnes/year reduction in CO₂ emissions.

(2) Promotion of Municipal Solid Waste Management in Anhui Province

In Anhui Province, as mentioned above, municipal solid waste management was at

low levels prior to this project. This project provided basic infrastructure and tools related to municipal solid waste management in multiple prefectural cities/counties (7 located in Anhui Province). Since then, MSW treatment has also been promoted in locations outside the target prefectural cities/counties in parallel with this project. Table 8 displays the current state of MSW treatment in the whole of Anhui Province, and the contributions by this project (2016).

Table 8 Current State of MSW Treatment in All of Anhui Province and the Contributions by this Project (2016)

	Volume of household solid waste disposed of in sanitary landfills	Volume of municipal solid waste collected	Number of municipal transfer stations
Entire province	4.6 million tonnes	8.61 million tonnes	687 locations
This project	510,000 tonnes	890,000 tonnes	123 locations
Percentage contribution of this project	11%	10%	18%

Source: Questionnaire responses

Evaluation team observe that this project has equipped or processed 10-odd % of the following in all of Anhui Province: volume of sanitary landfill processed, volume of municipal solid waste collected, and number of municipal transfer stations. In particular, less than 20% of the municipal transfer stations in the province were newly constructed or modified by this project. Therefore, evaluation team consider that this project has made a certain level of contribution to household solid waste management and the development of facilities in all of Anhui Province.

(3) Improvements in Residents' Living Environments and Sanitary Conditions in the Target Areas

A qualitative impact assumed at the project examination was an improvement in the living environments and sanitary conditions of the target areas. Evaluation team observed two aspects of this impact: (1) improvements in the residential environment and landscape, and (2) improvements in the water quality of rivers and water sources.

First, evaluation team will discuss the improvements in the residential environment and landscape. Waste collection sites existed in the urban areas of the target prefectural cities/counties prior to the implementation of this project, but collection was insufficient and it was common for these dumpsters to overflow with household solid waste for several days. Many people discarded their waste in city centres, and it was normal for garbage to be strewn all over the city. In the suburbs and rural areas, there were many areas where waste collection sites existed but were rarely emptied, or where residents burned or buried their accumulated trash due to their absence. In such areas, abandoned

garbage piled up in vacant lots, generating noxious odors and effluent, and attracting flies and mosquitoes severely. As a result, household solid waste had had deleterious effects on residential environments and landscapes in urban, suburban and rural areas.

As mentioned above, this project established the collection of household solid waste multiple times daily in urban areas, and set up cleaning crews to clean the city and pick up litter. As a result, the cities resolved their litter problem; the cities were beautified dramatically and relieved of foul odors and effluents. Sealed trash bins and waste collection/transport vehicles have also contributed to the improvements in residential environment and landscape, as the lids prevent the scattering of waste in city centres. There has been an extremely large impact with respect to improvements in the residential environment and landscape; the size of the impact is partly due to the poor condition of the residential environment prior to project implementation. In particular, there has been a remarkable effect on suburbs where no measures had been taken previously. Citizens have expressed a high level of satisfaction regarding the conspicuous improvements. Many citizens also say that the beautification of the city has made an impact on their environmental awareness and behavior, such as reduced littering, and disposing of waste found in the city into the installed trash cans.

Next, evaluation team discuss improvements in the water quality of rivers and water sources. Prior to this project, waste was often disposed in rivers; evaluation team observed negative impacts on river water quality where accumulated trash would remain floating in the river or emit effluent into the river. The implementation of this project improved the water quality in the rivers due to large reductions in the scattering of waste and subsequent emission/outflow of wastewater. Many residents are experiencing improvements in the condition and water quality of creeks near residential areas, and evaluation team also observed large rivers with improved water quality after project implementation. In particular, Pihe River, the main river in the Lu'an City region which provides water to big cities in Anhui Province, such as Hefei, and where the project constructed four sanitary landfill facilities, saw an improvement in water quality from Class IV (mainly general industrial use) to Class III (mainly daily use and drinking water) in the national environmental standard¹⁷.

(4) Cultivation of Industries Related to Municipal Solid Waste (MSW) Treatment

Use of private contractors has increased in tasks related to solid waste management,

¹⁷ In 1988, the State Environmental Protection Administration of China put into effect the "Environmental Quality Standard for Surface Water (GB 3838-1988)" to categorize the 30 indicators related to water quality, such as chemical oxygen demand (COD), into 5 grades (I, II, III, IV, V). Water quality decreases from Class I to Class V. The COD values of the 2002 revised standard, "GBIII 838-2002," are set as follows: Class I and II, 15 mg/l or less; Class III, 20 mg/l or less; Class IV, 30 mg/l or less; and Class V, 40 mg / l or less.

given the Chinese government's policy to actively promote the utilization of the private sector to operate the front-line work for public services so that government agencies can focus on administration. A private company even plays the key role in the solid waste management services required following project implementation; as a result, industries related to solid waste management have developed. Private companies have also increasingly taken over the operation of sanitary landfills and transfer stations, as well as accompanying businesses such as sanitation and garbage collection and transportation, which had been assumed at the project appraisal to be operated by the government or state-owned enterprises. In particular, the operation of all leachate treatment equipment for this project has been entrusted to private contractors. As mentioned in the section on Effectiveness, the project's development of a foundation for solid waste management has allowed advancements in higher-standard household solid waste management, such as incineration, power generation using methane gas, and food waste recycling (feed and fertilizer), and their market size has grown. However, a majority of these were developed through PPP projects, contributing greatly to the development of related industries,

(5) Expansion of Employment Opportunities in Jobs Related to MSW Treatment

The implementation of this project has enhanced the public services related to household solid waste management. In particular, the growing demand for the collection of household solid waste from garbage bins set up in homes and across the city has increased employment in related jobs. Table 9 shows the changes in employment for jobs related to household solid waste management between the pre-project time and ex-post evaluation time based on interviews with the executing agencies of each prefectural city/county. In most prefectural cities/counties, there was increased employment in jobs related to household solid waste management, and the employment figure in all seven of them increased roughly 1.5 times, from 6,286 to 9,622.¹⁸ It is notable that since many of these jobs are simple, they are a valuable source of employment particularly for unskilled seniors over the age of 50. Prior to the implementation of this project, waste pickers existed in small numbers in some waste disposal/dumping sites (mainly farmers living near the sites during their off-season), but evaluation team did not observe any waste pickers during the ex-post evaluation for the following reasons: (1) declining profitability due to increased income level and a slump in the price of valuables in recent years, and (2) employment in jobs related to solid waste management.

¹⁸ Even though there are no gender-specific data, women make up a certain ratio according to the executing agencies of each county.

Table 9 Changes in Employment Related to Solid Waste Management

Units: persons

	Lu'an	Huoshan	Huo Qiu	Yè jí	Huainan	Suzhou	Tongling	Total
Before project implementation	1,200	210	330	119	1,851	280	2,296	6,286
During ex-post evaluation	2,010	254	590	257	1,791	1,316	3,404	9,622

Source: Questionnaire responses by executing agencies, and interviews with the executing agencies in each prefectural city/county

4.4.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

Among the projects, there are concerns in particular about the burden that sanitary landfills have on the natural environment. Therefore, the environmental agencies of the prefectural cities/counties have carried out monitoring of factors such as air quality, noise, water quality, and dust during the construction period, according to national laws and regulations. As a result, no major problem has been reported in any prefectural city or county. There were cases where minor problems occurred in relation to dust and noise, but the situation was improved through discussions with project personnel.

There has been continued monitoring of the impacts on the natural environment even after the completion of the construction of the sanitary landfills, and based on national laws and regulations. Exuded water treatment, which is particularly important, is precisely managed by sending a portion of the data (COD, nitrogen/ammonia, etc.) wirelessly to the environmental agency for monitoring (as described above), and regularly monitoring other important indicators (BOD, suspended substance and suspended solids, etc.). Post-treatment leachate is often used as irrigation water. Monitoring has been carried out of impacts on the natural environment other than leachate; in addition to the periodic monitoring of the water quality of surrounding rivers and the atmosphere of surrounding areas, the environmental agencies of the prefectural cities/counties have carried out surprise inspections and guidance with respect to environmental considerations and the emission of odors. Leachate emitted from waste transfer stations is generally discharged as sewage; it is commonly monitored and treated with the rest of the sewage. However, some prefectural cities/counties collect transfer station leachate into a tank to treat with leachate treatment equipment.

As a result of these measures, no negative impact to the natural environment was observed at the time of ex-post evaluation; thus evaluation team determine the project to have no negative impact to the natural environment.

(2) Resettlement and Land Acquisition

Table 10 summarizes the resettlements and land acquisitions implemented during this project.

Table 10 Implementation of Resettlement and Land Acquisition

(Resettlement)

Prefectural city/County	Number of resettled individuals	Resettlement date	Resettlement format	Compensation status
Lu'an	119 households, 350 persons	Unknown	Procured residential community for resettled residents	Provision of farmland and funds for housing construction based on national standards. Construction of social infrastructure such as electricity, water, kindergartens.
Huoshan	32 households, 93 persons	2009	Procured residential community for resettled residents	Provision of funds for housing construction. Provision of financial compensation for farmland but not actual farmland.
Huo Qiu	None	-	-	-
Yè jí	43 households, 160 persons	2009, 2014	Resettlement in multiple community blocks	Provision of 45 m ² housing per person, compensation for farmland but not actual farmland. Provision of financial compensation based on building conditions.
Huainan	None	-	-	-
Suzhou	None	-	-	-
Tongling	None	-	-	-
Total	194 households, 603 persons			

(Land Acquisition)

Planned	Actual
73 ha	68 ha

Source: Documents provided by JICA, questionnaire responses by executing agencies and interviews with executing agencies in each prefectural city/county

Documents submitted during project examination stated that resettlement would not occur, but in actuality 603 persons from 194 households were relocated in 3 prefectural cities/counties. A majority of the resettlements were a result of the stricter enforcement after 2008 of the housing and construction agency's standards for sanitary landfill technology for household solid waste, which stipulated that residents living within 500 meters of the sanitary landfill facility must be relocated. During the resettlement process, executing agencies properly assisted with the necessary paperwork, compensation, and living assistance at the new relocation site, as outlined by JICA guidelines and the provincial laws of Anhui Province, China. Despite differences in format in each prefectural city/county, the resettled residents were provided with new Residential area

and housing or funds for residential construction (including land price) as shown in the table above. For farmlands and other lands, the resettlement provided substituted land or compensation funds in accordance with national standards. Evaluation team also observed some prefectural cities/counties that set up living infrastructure (water supply, roads, construction of a kindergarten, etc.) in the new residential community, or provided preferential job placement in treatment plants for resettled residents. Evaluation team have gathered from interviews with relocated residents and visits to resettlement sites that most of the resettled residents were relocated closer to urban areas and to areas where living infrastructure was supplied. Thus for most, the standard of living improved (income level either increased or remained the same), and all interviewed residents were satisfied. These resettlements were due to revised sanitary landfill volumes, following topographical examination during the stages of detailed design and construction.

At ex-post evaluation, evaluation team did not observe any negative impact from resettlement and land acquisition, and thus evaluation team determine that there is no negative impact related to resettlement and land acquisition caused by this project.



Housing for displaced residents (Lu'an)



Development of apartment buildings along the road constructed for this project (Lu'an)

(3) Regional Social Development Near the Road Developed by this Project

Japanese ODA loan funds financed the construction of a 4.5 km road leading to the sanitary landfill in Lu'an City. But because the newly constructed road makes up not only the access road to the sanitary landfill but also a part of the route leading to other regions, it is used all day long by many general vehicles and not only waste collection and transportation vehicles. Although the exact vehicular traffic is unknown, there is high usage. Also, the construction of the road has advanced the development of apartment buildings and housing developments in neighboring areas; numbers of

residents have also increased. Therefore, evaluation team determine that the construction of the road contributed to the regional social development to a certain degree.

(4) Promotion of Household Solid Waste Management Modeled after Japan

Through the implementation of this project and training in Japan, key personnel in Anhui Province have been able to learn the philosophy, approach, technique, and methodology of household solid waste management in Japan, and were able to introduce these concepts within Anhui Province. The province rated the training opportunity and content highly, and has modeled its household solid waste management projects and their administration after Japan. This is a notable impact of this project. Specifically, Anhui Province continues to regularly send provincial staff to training sessions in Japan using its own funds and routes even after the completion of this project. The training participants are expected to learn about the Japanese philosophy/approach pertaining to household solid waste management, as well as initiatives to address the challenges Anhui Province will face in the future, such as waste separation, and to facilitate the Japanese model of household solid waste management taking root in the province.

From the aforementioned points, evaluation team determine effectiveness to be high, as all quantitative indicators are at levels that achieve their target values, and evaluation team observe qualitative effects such as improvements in technology/service and waste management capacity. As far as the impacts of this project are concerned, positive impacts have emerged, including the promotion of household waste treatment using a Japanese method as the model for Anhui Province in addition to those presumed quantitative and qualitative impacts of this project. Therefore, evaluation team evaluates this project has a high level of effectiveness and impact.

BOX: Improvements in the Solid Waste Management Project based on Knowledge
Gained from the Training in Japan

This project conducted 3 training sessions in Japan, which combined lectures at Hokkaido University on solid waste management policies and technologies, and visits to solid waste management facilities. A total of 42 people attended including managers and engineers of waste management facilities from the target regions.

Training participants from Lu'an City mentioned that understanding the current state of Japanese household solid waste management, clearing up the long-term vision for solid waste management and administration, as well as what issues need to be addressed going forward to achieve this vision, have made it possible to develop business with

confidence and with the future in mind. As a specific example, securing land to construct sanitary landfills for household solid waste had not always been recognized as a big problem in China. However, upon hearing that “urbanization will make it difficult to secure the land needed to construct sanitary landfills,” the participants returned and promoted the incineration of household solid waste ahead of Chinese policies. As a result, a waste-to-energy plant was completed in 2013 as a BOT project, the earliest endeavor among medium-sized cities in Anhui Province. A project is planned in the future to tackle the conversion of food waste into fertilizer/feed.



Collection of household solid waste by waste collection and transport vehicle (garbage truck)



The newly-built household solid waste incineration plant

In addition, many participants in the training in Japan said that they learned a lot from viewing the current state of waste sorting at home and environmental education at school. Training participants from Huoshan County stated, "Based on what we learned in the Japan training, we started an environmental education initiative here for elementary school students, once a month at the solid waste management facility, and have taken on initiatives to improve waste management, such as signs that admonish littering or illustrated displays for trash receptacles in the city. We also introduced trials to separate garbage, but so far it has not succeeded." On the other hand, Tongling City was designated as a model city for waste sorting in 2015, and launched trials to separate waste in ordinary households (30 target communities, approximately 20,000 people) and government agencies. Training participants from Tongling City witnessed the current state of waste sorting in Japan and realized the important role that municipalities play. Therefore, Tongling City involves housing management companies and committees in addition to solid waste management and recycling companies in order to promote waste sorting. In addition, utilizing the knowledge gained from the Japan training, the training participants put efforts into educational activities for residents, such as starting to invite elementary schools to create environmental posters, and incorporating environmental

education for students and teachers at a pilot junior high school. The separation of waste is slowly becoming accepted by the community, but raising the awareness of the residents remains a task for the future. They state that in order to promote waste sorting, they need to consider action such as warning or announcing the names of communities or agencies that do not comply with guidelines, or other compulsory measures.

4.5 Sustainability (Rating: ③)

4.5.1 Institutional / Organizational Aspect of Operation and Maintenance

In China, municipal solid waste (household solid waste) treatment falls under the jurisdiction of the housing and construction agency, and is managed in the target prefectural cities/counties of this project by urban management agencies (the names of which may vary slightly depending on prefectural city/county). Among sanitary landfills, leachate treatment equipment, and waste collection and transportation facilities (waste transfer stations, waste transport vehicles, etc.), only the maintenance and operation of leachate treatment equipment is contracted to business specialists in all prefectural cities/counties. The operation and maintenance of sanitary landfill facilities and collection and transport facilities vary by prefectural city/county; some are directly operated and managed by government (the sanitation office of the urban management agency, or a state-owned enterprise), while others are outsourced to private companies. The table below shows the administrating entity by prefectural city/county. In the case of private contractors, companies with sufficient experience are selected periodically through a bidding process, and the urban management agency of each prefectural city/county provides management guidance to the contracted company. The number of private contractors is expected to rise in the future as policies exist on a national/provincial level promoting the outsourcing of solid waste management operations to private enterprises. The staff sizes of sanitary landfills and leachate treatment facilities are small, with about 10 persons or less in each, but both are operated smoothly. For waste collection and transport facilities, the size of the staff involved in maintenance, and operations varies according to the size of the prefectural city/county, but several hundred staff (including waste collection operatives) are currently employed and work either for the government or contractors.

At the time of the project examination, the operation of sanitary landfills was assumed to be carried out by governmental organizations or state-owned enterprises. Despite some changes from the original plan, such as the increased roles of private contractors in the operation of the sanitary landfill facilities, due to China's policies, evaluation team see no problem as this is a structure consistent for solid waste management throughout China. In addition, according to interviews with stakeholders in

each target prefectural city/county, the future expansion of household solid waste management into rural areas will require further growth of the organizational system. But presently there is no shortage of staff, and so there have not been any institutional problems.

Table 11 Operating Entities of the Household Solid Waste Management Businesses in the Prefectural Cities/Counties Targeted by the Current Project

Prefectural city/county	Sanitary landfill	Leachate treatment	Transfer station operation	Collection/transport of waste
Lu'an	government	private contractor	government	government
Huoshan	government	private contractor	private contractor	private contractor
Huo Qiu	government	private contractor	private contractor	private contractor
Yè jí	government	private contractor	government	government
Huainan	private contractor	private contractor	government	government
Suzhou	government	private contractor	government	government
Tongling	private contractor	private contractor	government	government

Source: Questionnaire responses by executing agencies

4.5.2 Technical Aspect of Operation and Maintenance

The table below summarizes the technologies related to operation and maintenance, broken down by facility/operation.

Table 12 Technologies Related to Operation and Maintenance, by Facility/Operation

Facility/ Operation	Current state of technology
Sanitary landfill facility and leachate treatment	<ul style="list-style-type: none"> • The operation of the facilities conforms to Chinese domestic standards and manuals, regardless of whether the administrating entity is governmental or private. Periodic training is carried out several times a year by the provincial housing and construction agencies / business groups. • The private contractors entrusted with operating the sanitary landfill and leachate treatment have received authorization to operate domestic facilities related to household solid waste management in China, and possess experience in operating and maintaining numerous facilities of a similar nature in addition to those set up by this project. In addition, the companies periodically conduct technical training internally. Prior experience and areas of technical expertise are taken fully into consideration during the selection of contractors. • Even for sanitary landfills operated by the government, technical training is conducted for the acquisition of skills related to household solid waste management.
Collection and transport	<ul style="list-style-type: none"> • Collection and transport may not be thought to require particularly advanced technology, but the public offering of private contracts often attracts bids from more than 10 companies. The contractors are chosen based on past achievements and quality of service. Private contractors have improved service levels, with methods such as the installation of cameras in waste transfer stations, or the introduction of new compact vehicles. • Even in cases where the government runs operations, service improvements have been made, such as the creation of new management regulations for waste transfer stations, or bulletins showing hours of operation.

Source: Questionnaire responses by executing agencies, and interviews with concerned parties in the target prefectural cities/counties and private contracting companies

Operations were carried out in line with Chinese domestic standards for sanitary landfill facilities and leachate treatment, for which the operation and maintenance require technical skill. The government (provincial housing and construction agency) and business groups conducted training for workers several times a year to improve technical capabilities. The improved anaerobic method adopted in the project's sanitary landfills is a common technique used in China, and no technical problems have occurred. With regards to outsourcing to private enterprises, the prefectural city/county selects the contractor on the premise that they possess sufficient technical expertise, based on achievements in similar past projects and the creation of manuals; they are selected from companies authorized to operate household solid waste management-related facilities in China. Companies taking on contract work have experience operating and maintaining numerous similar facilities and technologies outside of the facilities set up by this project. As a result, both government and contractor firms possess the technology necessary for operation and maintenance. Equipment maintenance and issue management are properly carried out, and no problems have occurred since the start of operation. Collection and transport may not be thought to require advanced technology,

but operators have improved the level of management and service following the development of facilities, through the creation of management regulations and the installation of automatic disinfectant/deodorizing equipment. There are many cases where bids are received from more than 10 companies during the selection of a private contractor, in which case the contracting firm is selected based on past achievements and quality of service. Evaluation team even observed cases where the private contracting firm improved operations and management through the installation of cameras in the waste transfer stations, and improved the efficiency of collection work through the introduction of compact collection vehicles. From the aforementioned points, evaluation team determine there are no problems with the technical aspects of operation and maintenance.

4.5.3 Financial Aspect of Operation and Maintenance

At the project examination, the proposal assumed a monthly waste management fee of 4-6 yuan per household in order to secure a budget for solid waste management. However, only 5 of the 7 target prefectural cities/counties collect waste management fees from ordinary citizens (3-5 yuan/month per household).¹⁹ Evaluation team observed the presence of prefectural cities/counties (Huo Qiu, Yè jí), which were unable to collect waste management fees due to a lack of understanding by the public, signifying that securing of revenue necessary to stably advance municipal solid waste management is not necessarily underway. Information could be obtained only from 4 prefectural cities/counties (Huoshan, Yè jí, Huainan, Suzhou) regarding fiscal expenditures on municipal solid waste management, but the expenditures vary according to the size of each area (roughly 10-80 million yuan). Even the prefectural cities/counties that receive income from waste management fees receive less than half the value of the expenditure related to MSW treatment; some prefectural cities/counties receive about 10% of the expenditure. The shortage is expended and compensated from the general budget.

In interviews with the executing agencies, there is no system to provide special financial assistance from the national/provincial government to subsidize the cost of urban household waste treatment. However, fiscal authorities have a deep understanding of the need to budget household solid waste management, for the following reasons: (1) environmental issues, including living environments, have been emphasized in recent years, and (2) municipal solid waste management has yielded large, visible results. Thus,

¹⁹ The garbage disposal fee does not present a heavy burden for the general public. There is a high collection rate for the waste treatment fee from the general public, as it is added to the water bill. Also, Huainan City separately collects a waste treatment fee from enterprises. The proceeds are accounted for as revenues of the prefectural city/county government (Finance Agency).

even while expenditures are on the rise with household solid waste management expanding into rural areas, the budget necessary for the operation and maintenance has been secured. In prefectural cities/counties where data was available (Yè jí, Huainan), about 1-2% of fiscal expenditure was allocated to the budget for solid waste management. As the solid waste management-related budget has grown over 10% annually in one prefectural city/county (Lu'an), the annual growth rate of the solid waste management budget has exceeded the growth rate of the overall fiscal expenditure. Therefore, at ex-post evaluation, finances had not caused problems with operation and maintenance. Even from interviews with executing agencies and stakeholders in target prefectural cities/counties, MSW treatment is expected to continue securing the necessary budgets in the future, as fiscal revenues in each target prefectural city/county steadily rise, and since the "stagnation of MSW treatment will directly affect citizens' lives." However, there is concern that the financial burden will increase long-term, as considerable investment capital will be needed to continue building waste management facilities, if the volume of household solid waste requiring treatment continues to increase in the future; for example due to the increased management of household solid waste in rural areas, as mentioned previously. Therefore, from the viewpoint of financial sustainability, it is important to minimize reduce volume of waste by ingraining the 'Three Rs' (reduce, reuse, recycle) – including the current endeavor of waste sorting – and to optimize waste management fees for reliable collection.

When outsourcing municipal solid waste management to a private firm, payment is made taking into consideration the firm's experience with other similar work and corresponding to the amount of ordinary solid waste and leachate water processed (base amount per unit treated × volume treated); thus a certain level of profit is guaranteed.

From the above, evaluation team observe that (1) despite the presence of prefectural cities/counties with insufficient collection of waste management fees, fiscal expenditures are supported without problems, and (2) measures are being taken to counteract long-term issues. Thus evaluation team do not note any problems with the financial aspects of operation and maintenance.

4.5.4 Status of Operation and Maintenance

The equipment supplied by this project is properly monitored, maintained, and periodically inspected by the urban management agency of each prefectural city/county and contracting firms, in line with Chinese standards and management regulations. The leachate treatment equipment in particular is managed by a system that automatically detects issues. Some contracting firms also possess systems through which they can monitor the operational status of the facilities from their headquarters and respond

immediately when problems arise. Maintenance and inspection are also conducted regularly, conforming to domestic standards (and the more stringent standards of each company). No major problems have occurred for any facility, from the start of operations through to ex-post evaluation. Evaluation team also have not observed any problems obtaining spare parts. Even during ex-post evaluation, evaluation team confirmed the following during the field survey: (1) the equipment is generally well organized and maintained in a sanitary condition, (2) various bulletins are displayed for smooth operation and maintenance, proactively providing guidance and raising awareness among stakeholders, and (3) proper record-keeping practices exist at many transfer stations regarding MSW transportation. According to a person involved in facility operations, malfunctions and damage to equipment are also handled smoothly in cooperation with the contracting firm. The condition of the main facilities and equipment are generally very good. Additionally, as described above, the operating rate of the facility has increased with urbanization and the promotion of household solid waste management in rural areas.

As mentioned in Section 3.3.1 (1), the solid waste management facility in Yè jí is expected to restart in 2018, and is properly maintained to return to use at any time; waste transfer stations and transport vehicles continue to be used, and no problems have emerged. The incineration plant in Lu'an City is currently in full operation, and its sanitary landfill facility has no extra capacity. The zone bordering Yè jí to the east may start using Yè jí's solid waste management facility in the future, as they lack their own. Lu'an City plans to expand the collection and treatment of household solid waste to rural areas given the situation in the city; as the plan progresses, the operating rate of Yè jí's solid waste management facility is also expected to rise.

No major problems have been observed in the institutional, technical, financial aspects and current status of the operation and maintenance system. Therefore sustainability of the project effects is high.

5. Conclusion, Lessons Learned and Recommendations

5.1 Conclusion

The objective of this project is to promote the proper handling of the household solid waste generated in the regional cities of Anhui Province (7 prefectural cities and counties) by the construction of a solid waste treatment system, thereby contributing to environmental conservation and improvements in the living environments and sanitary conditions of local residents. The project conforms to the policies for household solid waste management of the Chinese Central Government and the Anhui Provincial

Government. It is in line with China's developmental needs, such as the construction of an efficient solid waste treatment system and improvements in the sanitary conditions and living environments of regional cities in the province. It has been also relevant to Japan's ODA policy. Therefore, its relevance is high. Evaluation team assess the efficiency of the project as a whole to be fair, since the project cost was reduced commensurate to changes in project outputs, but the project period exceeded the planned duration due to newly required permits resulting from changed national standards for leachate treatment equipment. Additionally, as a result of setting up the basic facilities and equipment needed for municipal solid waste management, the operation and effect indicators (volume of sanitary landfill processed, post-treatment leachate BOD/COD concentration, harmless treatment rate of household solid waste, number of beneficiaries, etc.) at ex-post evaluation all achieved the target values set during the project appraisal. In addition, evaluation team verified a wide range of qualitative effects with respect to "promoting proper handling of the solid waste generated in target areas," such as (1) swift collection of household solid waste, (2) proper final disposal, (3) promoting higher-level treatment of household solid waste, (4) encouraging the management of household solid waste in rural areas, and (5) elevated solid waste management standards. There was also a remarkable impact with regard to "improvements in the living environments and sanitary conditions of residents in the target areas", consisting of (1) improvements in the residential environment and landscape, and (2) improvements in the water quality of rivers and water sources. Evaluation team also observed contributions by this project to the cultivation of industries related to municipal solid waste management, and increased employment opportunities in jobs related to municipal solid waste management. Therefore, Evaluation team believe the project has a high level of effectiveness and impact. Evaluation team also believe it to have high sustainability, given the excellent operation and maintenance of the equipment and facilities, and the absence of problems from institutional, technical or financial aspects. In light of the above, this project is evaluated to be highly satisfactory.

5.2 Recommendations

5.2.1 Recommendations to the Executing Agency

None.

5.2.2 Recommendations to JICA

None.

5.3 Lessons Learned

Training Sessions in Japan as a Guideline of Problem Solving Tailored to Regional Characteristics and Needs

Participants in the training sessions in Japan use the skills and knowledge gained from the training as a model and apply them to each region according to its characteristics and needs. Thus the training plays a large role in improving solid waste management in the target regions of this project. A factor in this success is that the project implementation period coincided with the transition period for waste management. Due to the sharp increase in MSW volume in Anhui Province, the method of disposal shifted from a landfill-centric one to the deployment of incineration plants; waste sorting had been introduced and was becoming full-scale. The training participants themselves were facing various challenges and questions about the technologies and operation management structures for solid waste management. In such a situation, the experiences gained in the training program, learning about Japanese policies and techniques in solid waste management and observing current programs of environmental education and garbage separation, became a large asset to the returning trainees to use while tackling the challenges of solid waste management in each target area. However, there are regional differences, even within the same province, with respect to population, solid waste volume, and residents' willingness to sort their waste. Therefore, when implementing future training sessions in Japan, it will be necessary to incorporate content such as case studies that show how different Japanese local governments arrived at different responses to the same issues (e.g. methods of waste disposal, methods of waste sorting), or reasons why a certain measure was effective. In this way, the content will aid the trainees in considering the measures suited to their own municipality from among multiple options upon their return.

Comparison of the Original and Actual Scope of the Project

Item	Plan (post-revision)	Actual
1. Project Outputs	1) Sanitary landfill facility: 7.48 million m ³ 2) Leachate treatment equipment: 880 m ³ /day 3) Collection and transport facilities: <ul style="list-style-type: none"> • new transfer stations: 68 +3 • modified transfer stations : 69 +5 • Waste collection vehicles: 115+74 4) Access road to sanitary landfill facility: 8,076 m 5) Equipment related to solid waste management <ul style="list-style-type: none"> • Equipment for treatment: 42 • Related vehicles: 45 • Others: 1 6) Managed area building structures and parking for waste transportation vehicles: <ul style="list-style-type: none"> • Managed area building structures: 6,110 m² • Parking for waste transportation vehicles: 29,900 m² 7) Training in Japan <ul style="list-style-type: none"> • Management training: 30 persons (15 persons × 2 sessions) • Technical training: 30 persons (15 persons × 2 sessions) 	1) Sanitary landfill facility: 6.97 million m ³ 2) As planned 3) Collection and transport facilities: <ul style="list-style-type: none"> • New transfer stations: 61 • Modified transfer stations: 62 • Waste collection vehicles: 82 4) Access road to sanitary landfill facility: 8,276 m 5) Equipment related to solid waste management <ul style="list-style-type: none"> • Equipment for treatment: 31 • Related vehicles: 48 • Others: 1 6) Managed area building structures and parking for waste transportation vehicles: <ul style="list-style-type: none"> • Managed area building structures: 6,483m² • Parking for waste transportation vehicles: 13,546m² 7) Training in Japan <ul style="list-style-type: none"> • Management skill training: 43 persons
2. Project Period	January 2008 – September 2012 (57 months)	December 2007 – August 2015 (93 months)
3. Project Cost Amount Paid in	6.8 billion yen	5.188 billion yen

Foreign Currency Amount Paid in Local Currency Total ODA Loan (Yen Loan) Portion Exchange Rate	4.598 billion yen (295 million yuan) 11.398 billion yen 6.8 billion yen 1 yuan = 15.6 yen (as of June 2007)	2.915 billion yen (196 million yuan) 8.103 billion yen 5.188 billion yen 1 yuan = 14.9 yen (average 2007-2015)
4. Final Disbursement	September 2015	

【Appendix】

Table Main Project Outputs by Target Prefectural City/County

			Planned (at project examination)	Planned (post-revision)	Actual
1. Sanitary landfill facility	1-1 Processing volume	Lu'an	1,200,000 m ³	1,200,000 m ³	600,000 m ³
		Huoshan	1,400,000 m ³	1,400,000 m ³	1,400,000 m ³
		Huo Qiu	2,030,000 m ³	2,030,000 m ³	2,030,000 m ³
		Yè jí	1,050,000 m ³	1,050,000 m ³	1,137,000 m ³
		Huainan	None	None	None
		Suzhou	1,800,000 m ³	1,800,000 m ³	1,800,000 m ³
		Tongling	None	None	None
	1-2 Leachate pondage volume	Lu'an	None	None	None
		Huoshan	5,800 m ³	5,800 m ³	9,700 m ³
		Huo Qiu	10,400 m ³	10,400 m ³	10,400 m ³
		Yè jí	3,000 m ³	3,000 m ³	3,000 m ³
		Huainan	None	None	None
		Suzhou	20,000 m ³	20,000 m ³	20,000 m ³
		Tongling	None	None	None
2. Leachate treatment equipment	2-1 Volume	Lu'an	300 m ³ /day	300 m ³ /day	300 m ³ /day
		Huoshan	100 m ³ /day	100 m ³ /day	100 m ³ /day
		Huo Qiu	100 m ³ /day	100 m ³ /day	100 m ³ /day
		Yè jí	80 m ³ /day	80 m ³ /day	80 m ³ /day
		Huainan	None	None	None
		Suzhou	300 m ³ /day	300 m ³ /day	300 m ³ /day
		Tongling	None	None	None
3. Collection and transportation facilities	3-1 Construction of new transfer station	Lu'an	16	16	16
		Huoshan	8	8	11
		Huo Qiu	8	8	6
		Yè jí	6	6	6
		Huainan	10	10	10
		Suzhou	8	8	3
		Tongling	12	3	3
	3-2 Modification of transfer station	Lu'an	8	8	8
		Huoshan	8	8	0
		Huo Qiu	0	0	0
		Yè jí	0	0	0
		Huainan	30	30	23
		Suzhou	3	8	8
		Tongling	20	6	6
	3-3 Solid waste collection vehicles	Lu'an	30	30	18
		Huoshan	0	0	0
		Huo Qiu	4	4	6
Yè jí		7	7	9	
Huainan		22	22	43	
Suzhou		12	12	6	
Tongling		40	74	74	
4. Access road to sanitary landfill facility		Lu'an	4,300 m	4,300 m	4,500 m
		Huoshan	340 m	340 m	340 m
		Huo Qiu	1,286 m	1,286 m	1,286 m
		Yè jí	950 m	950 m	950 m
		Huainan	None	None	None

		Suzhou	1,200 m	1,200 m	1,200 m
		Tongling	None	None	None
5. Equipment related to solid waste management	Treatment equipment	All prefectural cities/counties	4 Refuse compactors 9 Excavators 15 Bulldozers 9 Loaders 2 Light buses 6 Cars for project management 4 Dump trucks 4 Spraying vehicles 4 Small maintenance vehicles 2 Cargo buses	2 Refuse compactors 6 Excavators 11 Bulldozers 7 Loaders 1 Light bus 6 Cars for project management 2 Dump trucks 2 Spraying vehicles 4 Little tool vehicles 1 Cargo bus	0 Refuse compactors 5 Excavators 6 Bulldozers 5 Loaders 1 Light bus 7 Cars for project management 0 Dump trucks 2 Spraying vehicles 5 Little tool vehicles
	Collection vehicles	All prefectural cities/counties	2 Cargo trucks 16 Road sweepers 15 Garbage-compacting trucks 5 Road sweepers 5 Road washing machines 2 Large water trucks 2 Hydraulic turbines	0 Cargo trucks 16 Road sweepers 15 Garbage-compacting trucks 5 Road sweepers 5 Road washing machines 2 Large water trucks 2 Hydraulic turbines	2 Cargo trucks 19 Road sweepers 15 Garbage-compacting trucks 5 Large water trucks 7 Street sweepers
	Others	All prefectural cities/counties	2 lightweight bridges 1 car wash equipment 1 maintenance equipment 1 fuel supply equipment 1 electrical equipment 1 communication equipment 1 control device 1 set of furniture equipment	1 set of furniture equipment	1 set of furniture equipment
6. Managed area building structures and parking for waste transportation vehicles:	6-1 Managed area building structures	Lu'an	1,550 m ²	1,550 m ²	1,600 m ²
		Huoshan	1,250 m ²	1,250 m ²	1,751 m ²
		Huo Qiu	300 m ²	300 m ²	None
		Yè jí	650 m ²	650 m ²	800 m ²
		Huainan	None	None	None
		Suzhou	1,400 m ²	1,400 m ²	1,019 m ²
	6-2 Parking for waste transportation	Tongling	960 m ²	960 m ²	1,313 m ²
		Lu'an	None	None	3,600 m ²
		Huoshan	150 m ²	150 m ²	1,080 m ²
	Huo Qiu	None	None	None	

	vehicles:	Yè jí	None	None	200 m ²
		Huainan	None	None	None
		Suzhou	450 m ²	450 m ²	441 m ²
		Tongling	None	29,300 m ²	8,225 m ²
7.Training in Japan		All counties	60 persons	60 persons	43 persons

Source: Questionnaire responses by Eexecuting companies

Note: “Planned (at project examination)” excludes all projects in Fēng tái and Huaibei, as well as the incineration facilities related to household solid waste at the Tongling cement plant.

Table Operation and Effect Indicators by Target Prefectural City/County

Prefectural city/county	Lu'an		Huoshan		Huo Qiu		Yè jí	
Indicator	Target Value	Actual Value	Target Value	Actual Value	Target Value	Actual Value	Target Value	Actual Value
(Operation indicator)								
Processed volume of sanitary landfill (tonnes/year)	153,335	195,625	57,753	57,600	66,430	66,430	41,821	0
Post-treatment leachate BOD concentration (mg/l)	600	4	30	2	600	30	150	2
Post-treatment leachate COD concentration (mg/l)	1,000	30	100	7	1,000	100	300	10
Post-treatment ammoniacal nitrogen (mg/l)	-	0.5	-	2.0	-	8.5	-	10.1
Treated leachate volume (m ³ /year)	-	60,825	-	36,000	-	525,600	-	18,000
Harmless treatment rate of municipal solid waste (%)	100	98	100	100	100	100	100	100
Collection rate of municipal solid waste (tonnes/year)	-	195,625	-	57,600	-	73,811	-	41,040
Collection rate of municipal solid waste (%)	-	100	-	96	-	100	-	100
Volume of household solid waste disposed of via transfer stations (tonnes/year)	-	176,550	-	57,600	-	82,125	-	10,900
(Effect Indicator)								
Number of beneficiaries / target population for services (in units of 10,000 people)	46.8	70.0	17.6	36.0	20.3	50.0	12.8	27.8
(out of which) beneficiaries of sanitary landfill (in units of 10,000 people)		70.0 (Entire city)		24.0 (Urban areas + some rural areas)		50.0 (Urban areas + town center)		12.0
(out of which) beneficiaries of transfer station (in		70.0 (Entire		12.0 (Urban		20.0 (Urban		8.0 (Urban

units of 10,000 people)		city)		areas)		areas)		areas)
(out of which) beneficiaries of waste collection & transport vehicle (in units of 10,000 people)		70.0 (Entire city)		36.0 (Entire county)		20.0 (Urban areas)		8.0 (Urban areas)
Illegal dumping sites		0		0		0		0
Prefectural city/county	Huainan		Suzhou		Tongling		Total	
(Operation indicator)								
Volume processed at sanitary landfill facility (tonnes/year)	-	-	176,235	195,117	-	-	495,574	514,772
Post-treatment leachate BOD concentration (mg/l)	-	-	600	30	-	-	30-600	2-30
Post-treatment leachate COD concentration (mg/l)	-	-	1000	100	-	-	100-1,000	7-100
Post-treatment ammoniacal nitrogen (mg/l)			-	20.0			-	0.5-20.0
Treated leachate volume (m ³ /year)				65,000			-	705,425
Municipal solid waste harmless treatment rate (%)	50	100	-	100	100	100	93	100
Volume of collected municipal solid waste (tonnes/year)				244,800				885,225
Collection rate of municipal solid waste (%)	-	100		100				100
Volume of household solid waste disposed of via transfer stations (tonnes/year)	-	365,800	-	195,117	-	131,303	-	1,011,895
(Effect Indicator)								
Number of beneficiaries / target population for services (in units of 10,000 people)	14.3	115.0	53.8	80.0	55.2	172.0	220.8	531.0
(out of which) beneficiaries of sanitary landfill (in units of 10,000 people)				80.0 (Urban areas + some rural areas)				224.0
(out of which) beneficiaries of transfer station (in units of 10,000 people)		115.0 (Urban areas)		60.0 (Urban areas)		172.0 (Entire city)		457.0
(out of which) beneficiaries of waste collection &		115.0 (Urban		60.0 (Urban		172.0 (Entire		481.0

transport vehicle (in units of 10,000 people)		areas)		areas)		city)		
Illegal dumping sites		9		0		0		1.3

Source: Questionnaire responses by executing companies

Note: The target and actual values reflect 2 years after project completion (actual values are from 2017). Collection rate of municipal solid waste = collected MSW volume / generated MSW volume. The shaded boxes reflect indicators that are outside the scope of this evaluation.

Table The Number of Beneficiaries of Project Facilities in Target Prefectural City/County

	Sanitary landfill/leachate treatment		Transfer stations		Collection and transport		Total
	Region	Beneficiaries	Region	Beneficiaries	Region	Beneficiaries	
Lu'an	Entire city	700,000	Entire city	700,000	Entire city	700,000	700,000
Huoshan	Urban area + some rural areas	240,000	Urban areas	120,000	Entire county	360,000	360,000
Huo Qiu	Urban area + some rural areas	500,000	Urban areas	200,000	Entire county	200,000	500,000
Yè jí	-	-	Urban areas	80,000	Entire county	80,000	80,000
Huainan	-	-	Urban areas	1,150,000	Entire county	1,150,000	1,150,000
Suzhou	Urban area + some rural areas	800,000	Urban areas	600,000	Entire county	600,000	800,000
Tongling	-	-	Entire city	1,720,000	Entire city	1,720,000	1,720,000
Total	-	2,240,000	-	4,570,000	-	4,810,000	5,310,000

Source: Questionnaire responses by executing companies

Note: Total figure excludes duplicates.

Table Operating Entities of the Household Solid Waste Management Businesses in the Prefectural Cities/Countries Targeted by the Current Project

Prefectural city/county	Sanitary landfill	Leachate treatment	Transfer station operation	Collection/ transport of waste
Lu'an	government	private contractor	government	government
Huoshan	government	private contractor	private contractor	private contractor
Huo Qiu	government	private contractor	private contractor	private contractor
Yè jí	government	private contractor	government	government
Huainan	private contractor	private contractor	government	government
Suzhou	government	private contractor	government	government
Tongling	private contractor	private contractor	government	government

Source: Questionnaire responses by executing agencies