India

FY2015 Ex-Post Evaluation of Japanese ODA Loan

"Yamuna Action Plan Project (II) "

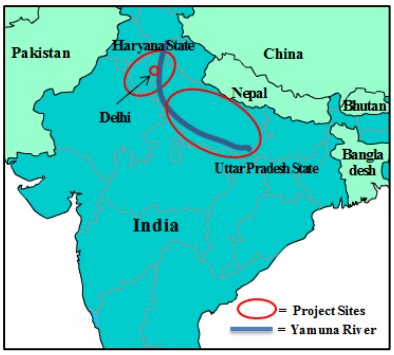
External Evaluator: Hisae Takahashi, Ernst & Young Sustainability Co., Ltd.

0. Summary

This project was conducted to increase the sewerage capacity by developing sewerage facilities and also aimed to promote water quality conservation and raise understanding of improving the living environment in the Yamuna River basin at Delhi, Uttar Pradesh (UP) State and Haryana State of India, through awareness and Public Relation (PR) activities to the local residents as well as strengthening the institutional capacity of executing agencies. It is consistent with the national development policy, which has highlighted water quality improvement of major rivers as a critical issue of the environment sector, and also with the Japanese policy of assistance to India. Development needs are also high considering the polluted condition of the Yamuna River and the hygiene situation of the river basin. Hence, the relevance of this project is high. The efficiency of the project is low, as the project cost slightly exceeded the plan due to the increased output and price escalation and the project period significantly exceeded the plan since more time was required to acquire land and obtain construction approval. Thanks to the project, effects such as an increase in the amount of wastewater treated and the improvement of effluent water quality were confirmed and the percentage of population served was also on target in the project areas. Since the Yamuna River basin covered a broad area, the effects on water conservation in terms of the whole Yamuna River through this project alone were limited. Compared with the situation before the project, however, a larger amount of wastewater treated with better water quality was discharged into Yamuna River, meaning that the project contributed to water conservation of the river to a certain extent. Therefore, the effectiveness and impact of the project is high. Operation and Maintenance (O&M) of sewerage systems developed under this project shows that they are in good condition and no major problems were observed in terms of institutional and technical aspects of O&M. The O&M cost required for the facilities has also been secured, thus the sustainability of the project effect is high.

In light of the above, this project is evaluated to be satisfactory.

1. Project Description



Project Locations


Sewerage Treatment Plant (Okhla)

1.1 Background

Yamuna River originates from the Yamunotri Glacier of Uttarakhand State in India, running through Delhi to the Ganges River in UP State. It is a tributary of the Ganges River and has a total length of about 1,400 km and a total catchment area of about 34,600 km. Many rivers, including Yamuna River, are used for bathing as sacred rivers and also provide drinking water, etc., making them intimate parts of resident's daily lives. However, more sewerage was being discharged into rivers than could be naturally purified due to the soaring population that accompanied rapid urbanization and industrialization. Consequently, the contaminated rivers caused health and sanitation problems for river basin residents. With this in mind, the Indian Government launched the "Yamuna Action Plan[1]" with the intention of reducing the pollution load on the Yamuna River. To support YAP, the "Yamuna Action Plan Project (I) (YAP (I))", developing the sewerage facilities, was implemented with the support of Japan International Cooperation Agency (JICA) and an ODA Loan to target 15 cities in the three states of Delhi, UP and Haryana, situated in the Yamuna River basin.

However, amid rapid industrialization, urbanization and population growth, at the time of appraisal of this project, the total volume of untreated wastewater released into the Yamuna River was about 3,600 million liters per day (MLD) in Delhi and about 147 MLD in Agra of UP State, which comprised 84% of the total 4,456 MLD pollution load generated in the 15 cities along the river[2]. Thus, YAP (II) was planned to maintain sewerage systems in Delhi and Agra as the most critical segment to reduce the pollution load in the Yamuna River. Moreover, as well as developing sewerage systems, this project included extending activities such as an awareness program to raise people's understanding of the importance of water quality preservation and living environment and capacity building among the implementing agencies of each state, which helps improve the project effectiveness.

[1] This is one of the projects shown in the "National River Conservation Plan" as explained hereinafter. This plan indicates "YAP" as a second national-level river purification plan behind "Ganga Rejuvenation Project" for the Ganges River.

[2] Source: Documents provided by JICA

1.2 Project Outline

The objective of this project was to improve the sewerage capacity to handle the water pollution of Yamuna River and raise residents' awareness to understand the importance of water quality preservation and improve the life environment by developing sewerage facilities, as well as conducting non-sewerage works, including public health activities and reforming the institutional capacity of the implementing agencies in each state, thereby helping to improve the hygienic environment and health condition of riverside residents.

Loan Approved Amount/ Disbursed Amount	JPY 13,333million / JPY 8,328 million
Exchange of Notes Date/ Loan Agreement Signing Date	March, 2003 / March, 2003
Terms and Conditions	Interest Rate 0.75% Repayment Period 40 years (Grace Period) (10 year) Conditions for Procurement: General Untied
Borrower / Executing Agency	President of India / National Mission for Clean Ganga (NMCG)
Final Disbursement Date	July, 2012
Main Contractor (Over 1 billion yen)	・Patel Engineering Limited. (India) / Michigan Engineering Pvt. Ltd. (India) (JV), Angerlehner (Austria) / Michel Bau Gmbh (Germany) (JV), Degremont SA (France) / Degremont Ltd. (India) (JV), Shriram Epc Ltd. (India) / KMG Pipe Rehabilitation Emirates Llc. (United Arab Emirates) (JV), VA Tech Wabag Gmbh (Austria) / VA Tech Wabag Ltd. (India) (JV)
Main Consultant (Over 100 million yen)	・RV Anderson Associates Ltd. (Canada) / Tce Consulting Engineers Limited (India) / Development Consulting Ltd. (India) / Price Waterhouse Coopers Pvt. Ltd. (India) / Tokyo Engineering Consultants, Co., Ltd. (Japan) (JV), CH2M Hill Construction Pvt. Ltd. (India), MDP Consultant Private Limited (India)
Feasibility Studies, etc.	Feasibility Study related to YAP (II)
Related Projects	・(Technical Cooperation) Integrated Pollution Abatement and River Basin Management Project for Ganga Basin(March, 2003) ・(ODA Loan) YAP (I) (December, 1992), YAP (III) (February, 2011) ・(Government of India) Ganga Action Pan (1985～) ・(World Bank) Delhi Water Supply and Sewerage Project (2005)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hisae Takahashi, Ernst & Young Sustainability Co., Ltd.

2.2 Duration of Evaluation Study

This ex-post evaluation was conducted with the following schedule:

Duration of the Study: August, 2015 – September, 2016

Duration of the Field Study: December 2 – December 19, 2015, February 28 – March 12, 2016

2.3 Constraints during the Evaluation Study

This project implemented support for awareness and PR activities for the local residents as well as enhancing the institutional capability of Project Implementing Agency (PIA) in each state. No indicators for these activities were established to confirm the effects, and it was difficult to analyze the extent to which the capability of PIAs and activities for residents were improved. And it was also difficult to assess them since awareness activities were conducted within only a limited area alongside the vast Yamuna River and many years had passed by the time of the ex-post evaluation. Accordingly, the effectiveness and impact were evaluated by weighting the effects generated from constructing the sewerage facility, comprising 88% of total funding. Awareness and PR activities and capacity building of PIA in each state were also analyzed by determining how these activities contributed to a smooth implementation and generated the effect and impact of this project.

3. Results of the Evaluation (Overall Rating: B[3])

3.1 Relevance (Rating: ③[4])

3.1.1 Relevance to the Development Plan of India

The development policy of India at the time of appraisal, "the 10th Five-Year Development Plan" (2002 – 2007), targeted 8% GDP growth per year to attain 13 numerical targets. One of the targets, "purification of major polluted rivers", was intended to improve the quality of major rivers by 2007. Furthermore, YAP, the basis for this project, was placed as the core program of each Five-Year Plan from the 8th through the 10th Five-Year Plan. The development policy at the time of ex-post evaluation, "the 12th Five-Year Plan"(2012-2017), emphasized "accelerated and sustainable inclusive growth" and specified environmental conservation needs for sustainable growth. In particular, an appropriate drainage plan was required, underlining the need to maintain a sewerage facility along the Yamuna River due to the

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[4] ③: High, ② Fair, ① Low

severely polluted condition of the Yamuna River tributary to the Ganges River[5].

Moreover, the national sector plan in the water area, "the National Water Policy" (2002) and its updated policy (2012), indicated the need to improve the quantity and quality of the water supply and hygienic environment by developing water sources and constructing water supply and sewerage facilities[6]. Furthermore, this project was also included, as a core project in the nationwide river water quality conservation program, "the National River Conservation Plan", targeting 29 rivers along with 151 cities of those basins in India[7]. This project aimed to help improve the water quality of the river by developing sewerage facilities in the city along Yamuna River and conducting various activities to improve residents' awareness of the need to preserve water quality. Therefore consistency with the sector policy is confirmed.

3.1.2 Relevance to the Development Needs of India

Many rivers in India are used for bathing as a sacred and intimate part of residents' daily lives. However, water pollution caused by coliform at the time of appraisal worsened considerably compared to the average from 1979 to 1985 (see Table 1). In particular, the water quality of Yamuna River worsened more than those of other rivers, which meant immediate maintenance of the sewerage facilities was required. Subsequently, the biochemical oxygen demand (BOD)[8] of Yamuna River remained high, despite some other major rivers showing improved values (see Table 2).

Table 1 Amount of Bacillus Colonies of the Major Rivers

River	Amount of Bacillus Colonies (MPN Note/100ml)	
	1979 - 1985	1999
Yamuna	440,000	19,000,000
Ganges	600,000	7,300,000
Subarnarekha	15,000	13,000
Bramhani	1,000	11,000

Source: Documents provided by JICA
Note: MPN stands for most probable numbers.

Table 2 Amount of BOD of the Major Rivers

River	BOD(mg/l)3	
	2002	2010
Yamuna	7.0	7.2
Ganges	2.5	3.1
Subarnarekha	2.0	1.4
Bramhani	2.7	1.8

Source: Central Pollution Control Board, "Annual Report 2011-2012"

The Yamuna River basin extends through three states, Delhi, UP and Haryana and its water quality worsened particularly in Delhi and Agra (See Table 3). At the time of ex-post evaluation, while the capacity of sewerage treatment facilities, alongside the Ganges River and including its tributary was about 35% of discharged sewerage, 65% of domestic and factory

[5] Source: Questionnaire responses from the NMCG and website of the Planning Commission, Government of India (http://planningcommission.nic.in/plans/planrel/fiveyr/12th/pdf/12fyp_vol1.pdf)
[6] Source: Questionnaire responses from the executing agency and website of Ministry of Water Resources (http://wrmin.nic.in/forms/list.aspx?lid=1190)
[7] Source: Documents provided by JICA
[8] This is also called biochemical oxygen consumption, one of the most common water quality indicators, showing the amount of oxygen needed by microorganisms for oxidative breakdown of the organic materials in water. Generally speaking, the higher the BOD value, the worse quality of the water.

sewerage was drained directly into rivers, which is a source of pollution[9]. Disposal of human waste and dumping into rivers also polluted the Yamuna River. Accordingly, the needs to develop sewerage facilities in Delhi and Agra and boost awareness and PR activities for residents to improve water quality are both high.

Table 3 Amount of BOD of Yamuna River Basin

Monitoring points	BOD(mg/l)[3]		
	1996	2002	2011
Hathnikund /Tajewala (Haryana, near the entrance)	1.2	1.0	0.8
Sonipat (Haryana)	3.0	2.0	2.5
Nizamuddin Bridge (Delhi)	25.0	34.0	21.3
Mathura Upper Stream (UP)	4.0	15.0	8.7
Agra Down Stream (UP)	9.0	20.0	9.5
Juthika / Auraiya (UP, near the exit)	5.0	9.0	2.0

Source: Documents provided by JICA and Delhi Water Board

3.1.3 Relevance to Japan's ODA Policy

JICA "Medium-Term Strategy for Overseas Economic Cooperation Operation" at the time of appraisal emphasized "poverty alleviation through development of agriculture and rural areas" and "improvement of severely deteriorated facilities for environment and hygiene condition in major cities" as priority areas of support for India. Also JICA Country-specific Programs set assistance priority in "environment conservation concentrating on securing quality water resources[10]. Japan's Country Assistance Program for India, which was being formulated at the time, showed a focus on improving the sewerage facility in urban areas to reduce environment deterioration caused by economic growth[11]. This project was to help improve the water quality of Yamuna River, which is a major water source for watershed cities and is relevant to Japan's assistance policy which emphasized improvement of the environment and the hygienic environment in major cities.

This project has been highly relevant to India's development policy and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

This project implemented the development of sewerage facilities, non-sewerage works (support for smooth implementation and sustaining the effects of the project) and consulting services. Table 4 shows the planned and actual outputs.

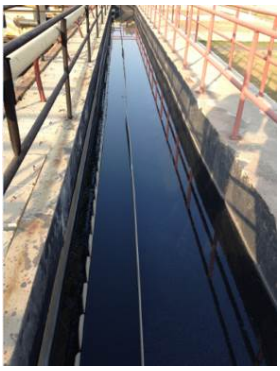
[9] Source: Questionnaire responses from NMCG
[10] Source: Documents provided by JICA
[11] Source: "Official Development Assistance (ODA) 2004, Japan's ODA data by Country", Ministry of Foreign Affairs of Japan

Table 4　Planned and Actual Outputs (Sewerage Component)

	Item	Area	Unit	Planned	Actual
Delhi	Sewerage treatment plant (Construction) (rehabilitation)	 Okhla Keshopur	m^3/day	135,000 54,000	As planned
	Sewer line (rehabilitation / replacement) (renewal) (new)	 Ring Road Bela Road Wazirabad	m	10,900 6,293 14,700	As planned 6,929 13,954
Agra	Sewerage treatment plant (construction)	Northern Area	m^3/day	10,000	14,000
	Sewer line (construction)		m	34,000	36,770
	Pumping station (construction)		m^3/day	10,000	14,000
	Rising main		m	6,100	5,370
	Sewerage treatment plant (construction)	Western Area	m^3/day	28,000	40,000
	Sewer line (construction)		m	39,200	34,960
	Pumping station (construction)		m^3/day	28,000	40,000
	Rising main		m	6,600	9,500

Source: Documents provided by JICA, NMCG, Delhi Water Board and Agra Water Board

The output for the sewerage component in Delhi was almost as planned, while the actual sewerage treatment plant (STP) capacities in the both Northern and Western areas of Agra were about 40% higher than planned. The main reason for the disparity was the miscalculation of capacity, due to citing the wrong standard year during the design stage, hence the capacity of STPs were increased based on the executing agency's proposal after commencing the project[12]. The outputs of the sewer line, pumping station and rising main were also modified based on the situation on the ground and changed capacities of STPs, accordingly. Each change was made based on a detailed survey and the situation on the ground, with changes deemed necessary to generate effect and was reasonable.



Sewerage Treatment Plant (Western area)

Sewerage Treatment Plant (Keshopur)

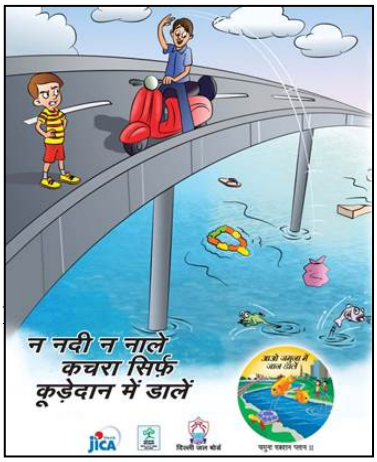
[12] The treatment capacity of STP is generally designed based on the time of completion as the standard year. In this project, 2002 data was mistaken as the standard year instead of the 2007 data. This mistake was recognized in 2003 and necessitated changes in treatment capacity along with the population forecast (11% difference between 2002 and 2007).

Each detailed activity of non-sewerage components was planned after the project started and the activities were conducted based on this plan. The main outputs are 1) Public Participation and Awareness activities (PPA) and PR activities to promote an understanding of the importance for improving the living environment of residents, 2) Capacity building activities for each state of PIA, 3) Improvement of the water quality management system of the National River Conservation Directorate (NRCD), 4) Feasibility Study (F/S) report preparation for the next phase. 5) Research related to preparing a guideline to redevelop the slums area was outside the scope because the intended riverside slums had already been forcibly relocated due to flooding when the project started.

Table 5 Planned and Actual Outputs (Non-sewerage Component, Consulting Services)

Item	Planned	Actual
1) PPA and PR activities	Workshops, short plays, seminars, meetings, etc.	Development of teaching material for public awareness (riverside residents, schoolchildren and media), school hygienic education with developed material, PR activities inducing workshops, short plays, meetings, rallies. Setting up a water and wastewater corner at the National Sciences Museum
2) Institutional capacity building of PIA	Enhancing technical capability and facility operation ability, improving the financial structure	Developing and implementing action plans (trainings for civil engineering work and maintenance) of a total of 15 local authorities)
3) Capacity building of NRCD	Improvement of the water quality management system and financial and information system	Introduction of a water quality management system (placement of server and hardware, instalment of software, training for water quality data management)
4) F/S report preparation for the next phase	Preparation of a detailed plan YAP (III)	Preparation of F/S for the next phase, Formulation and implementation of the Pilot projects (construction of laundry area, refurbishment of crematory)
5) Research related to formulating a guideline to redevelop slums	Research to prepare guideline	Not implemented at this project
Consulting services	Bidding documents review, bidding assistance, construction supervision, research assistance, preparation assistance of materials such as detailed F/S, staff training, etc.	As planned

Source: Documents provided by JICA, NMCG, NRCD, each PIA and interviews.



Poster Prepared for
the Awareness Activities

Water Preservation and
Hygienic Education at School

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost was set at 15,808 million yen (13,333 million yen from Japanese ODA loan) and the actual project cost totaled 17,120 million yen (8,323 million yen from Japanese ODA loan), 108% of the original plan, which was higher than planned. This increased cost was due to the increased construction cost from changes of output for STPs in Agra[13] as well as the affect from inflation. Besides, the substantially lower Japanese ODA loan disbursement than what was planned was due to the sharp rise in the yen when the civil works began. Despite the fact that there was an unused balance in the Japanese ODA loan[14], the Government of India only allowed disbursements up to the amount approved for the project cost in rupee, including the Japanese ODA loan portion. Therefore, the remaining balance was not utilized.

3.2.2.2 Project Period

The planned project period[15] at the time of appraisal was 63 months in total (January 2003 – March 2008) and the actual period was 127 months (March 2003 – September 2013), significantly longer than planned (202% of the planned period). The major factors behind this delay were longer duration for land acquisition and necessary approvals for construction from each related authorities. Table 6 shows the detailed factors behind the delay.

[13] The increased amount by extending capacities of STPs in Agra was covered by the Indian side.
[14] For instance, the exchange rate at the time of appraisal was 2.45 Japanese Yen (JPY) to the Indian rupee and the average rate during the project was 2.19 JPY to the Indian rupee. During the full-scale engineering work in 2010, 2011 and 2012, the exchange rates were 1.92 JPY, 1.71 JPY and 1.50 JPY, respectively (quoted from the IMF rate).
[15] The project term is defined from the time of Loan Agreement (L/A) signing to the time of completion of the facility construction.

Table 6 Major Sites Delayed and Factors behind the Delay

Situation of delay	Major factors
The delay in starting construction of the STP (Okhla)	Approval had to be obtained for the start of construction at the planned site from the Municipality Corporation of Delhi (MCD) and related authorities. However, insufficient information sharing for this project meant a delay in obtaining approval. Moreover, an unexpected rocky area on site also delayed the work.
The delay in starting rehabilitation work for the STP (Keshopur)	When rehabilitating the existing facility, the inflow to the existing facility has to be connected to the other facility before the work can start. This connection process took longer, delaying the start.
The delay in constructing the sewer line (Bela Road)	The laying location of the sewer line was near the Kashmir Gate metro station, surrounded by historical buildings. Accordingly, it took time to obtain approval from the Delhi Metro Rail Corporation (DMRC) and the Archaeological Survey of India (ASI).
The delay in constructing the sewer line (Wazirabad)	The planned construction site was located in a crowded area in Delhi, so the construction method was changed to the Micro Tunneling Method, which allows sewers to be constructed, even in confined spaces. This change required more time to obtain approval from the MCD. Unexpected ground water from subterranean formation also delayed construction.
The delay in constructing the sewer line (Ring Road)	The construction was planned near Delhi castle (Red Fort), a tourist site, which meant obtaining approval from the ASI took longer. It was also difficult to continue the construction as planned in the area crowded with tourists, which delayed the work.
The delay in constructing the sewer line (Western area)	The construction site was surrounded by a national road and two stations. Accordingly, it took time to obtain approvals from the National Highways Authority of India (NHAI) and Indian Railways.
The delay in constructing the pumping station (Northern and Western areas)	Part of the construction site was owned by farmers and owners who opposed the project in the early stage, which meant time was required to acquire the land. There was no resettlement in this case.
The delay in constructing the STP (Northern and Western areas)	It took time to secure the construction site. Moreover, the construction did not proceed as planned due to unexpected thickness of the sand layer.

Source: Interviews with Delhi Water Board and Agra Water Board

Approval is always required from each of the related authorities when planning to construct sewerage facilities near stations, national roads or historical buildings in the city. However, the duration required to obtain such approval depends on the authorities or other circumstances and is beyond the control of the executing agencies, which meant delays at many project sites. In this project, proper information sharing, preparations of a proper plan in a timely manner and coordination with related authorities[16] for implementation were not sufficiently promoted before and at the start of the project[17], which was considered to trigger a critical situation.

[16] For this project, the authorities indicate the MCD, DMRC, ASI, NHAI, Indian Railways and Police, etc.
[17] Source: Interview with the civil works department at the Delhi Water Board

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

Financial Internal Rate of Return (FIRR) was recalculated based on the assumption[18] at the time of appraisal. FIRR was estimated as 3.5% against the preliminary calculation of 9.6%. The differences were due to the seven and a half years delay in the project period and water charges being raised less than the level assumed at the time of appraisal, resulting in a lower benefit.

While the project cost slightly exceeded the plan, the project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness[19] (Rating: ③)

3.3.1 Quantitative Effects (Operation Indicators)

3.3.1.1 Amount of Wastewater Treated at the STP

Table 7 shows the amount of wastewater treated at STPs developed under this project. Except for the Western area, approximately 80% of the targeted volume was achieved in the Okhla, Keshopur and Northern areas. Although the target amount of each facility was set at the design capacity of the STPs, this does not necessarily mean that the STP capacity will meet 100% of the targeted amount within the few years after project completion, because connection to sewers or weather affects the amount of sewerage inflow to the STPs. Given this factor, the wastewater treated amount of STPs in all sites except the Western area mostly met targeted values. Accordingly, the effectiveness of this project was confirmed.

Table 7 Amount of Wastewater Treated of Targeted Plants

(Unit: m^3/day)

	Baseline 2002/03 Baseline Year	Target 2010/11 2 Years After Completion	Actual 2012/13 Completion Year	Actual 2013/14 1 Year After Completion	Actual 2014/15 2 Year After Completion	Achievement Status (%)
Okhla (Extension)	682,000	773,000[Note1]	545,640	577,469	613,845	79%
Keshopur (Rehabilitation)	327,000	327,000	218.256	250,085	309,196	95%
Northern area (Construction)	—	10,000 (14,000)[Note2]	12,250	12,250	12,250	88%
Western area (Construction)	—	28,000 (40,000)[Note 2]	4,590	6,700	11,870	30%

Source: Documents provided by JICA and each STP

Note 1: The target amount shows the total capacity of existing STP and that of constructed STP in Okhla. Considering the fact that the dilapidated old STP constructed in 1937 with a capacity of 136,400m^3/day was demolished in Okhla, Delhi Water Board recognizes that the total capacity of STPs in Ohkla can be calculated as 636,600m^3/day, meaning 96% of the target value was achieved.

Note 2: Data in parentheses of the lower line shows the capacity after changing output. Achievement status indicates the rate of actual capacity value after changing output.

[18] Cost: Initial investment cost, O&M cost, Benefit: Revenue from sewerage charges, Project life: 30 years after the project completion

[19] Sub-rating for Effectiveness is to be put with consideration of Impact.

The reasons why the achievement status showed 30% of the targeted value in the Western area were that the construction works were delayed due to an undistributed budget for sewer line connections until March 2016[20] and that the connection works were underway, even at the time of ex-post evaluation, under the original plan to be fully operated by 2022. Furthermore, most residents in this area were poor compared to those of Agra in the North and not very interested in connecting to sewer lines, which also affected the progress[21]. The amount of wastewater treated of this area comprised only 3% of the total in this project, and besides, the total amount of wastewater treated of the STPs developed in this project reached 82% of the target. Accordingly, it can be judged that the amount of wastewater treated in the targeted STPs met the targeted value of the project.

3.3.1.2 Population Treated

The population treated in each area where the project constructed STPs is shown in Table 8. Targets were achieved in the Okhla, Keshopur and Northern area[22], while that at the Western area was 38% of the planned value, since the sewer connection works remains ongoing as explained above. However, the actual population treated by the project as a whole (population treated by STPs which were developed under the project) achieved 99% of the target value.

Table 8 Population Treated

(Unit: thousands people)

	Baseline	Target	Actual		
	2002/03	2010/11	2012/13	2013/14	2014/15
	Baseline Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Year After Completion
Okhla (extension)	3,000	3,400	3,400	3,400	3,400
Keshopur (rehabilitation)	2,500	2,500	2,500	2,500	2,500
Northern area (construction)	-	55	N.A	N.A	97
Western area (construction)	-	152	N.A	N.A	57
Total[Note1]	5,500	6,107	-	-	6,054

Source: Documents provided by JICA and each STP

Note1: Total number of population treated; covered by all STPs developed under this project.

3.3.1.3 Improvement of Effluent Quality

BOD (effluent) concentration and BOD reduction rate largely achieved the target level at all STPs as shown in Table 9. Moreover, all satisfied the standard level set by each State Pollution Control Board (below 30mg/l for BOD), which meant improved effluent water

[20] Civil works restarted from March 2016 and an improvement in the situation is expected.

[21] Connecting to the sewers and each house requires 5,000 Indian rupees as the initial cost, which is a large sum and a big burden for poor households.

[22] The target value of the population treated remained unchanged though the capacity of STPs in the northern and western areas increased as explained in footnote 12. Because the changes in the STP capacity were made due to errors in setting the baseline year, this did not affect the prediction of the population as explained.

quality discharged from developed STPs was confirmed. The reduction rate has been decreasing in the STP of the western area because part of the inlet (inflow parts) was damaged, and maintenance works were implemented from June to December 2015[23]. Thus the rate decrease was temporary.

Table 9 BOD Concentration of STPs

		Baseline	Target	Actual		
		2002/03	2010/11	2012/13	2013/14	2014/15
		Baseline Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Year After Completion
Okhla	Inflow (mg/l)	196.0	200.0	182.8	177.5	175.3
	Outflow(mg/l)	22.7	10.0	5.0	8.0	9.3
	Reduction Rate (%)	88.4	95.0	97.3	95.5	94.9
Keshopur	Inflow (mg/l)	250.0	250.0	209.0	210.0	175.0
	Outflow(mg/l)	44.0	10.0	19.0	5.0	6.0
	Reduction Rate (%)	82.4	96.0	90.9	97.6	96.6
Northern area	Inflow (mg/l)		225.0	205.0	207.0	204.0
	Outflow(mg/l)	-	30.0	29.8	29.1	28.8
	Reduction Rate (%)		87.0	85.5	85.9	85.9
Western area	Inflow (mg/l)		225.0	87.5	87.5	95.0
	Outflow(mg/l)	-	30.0	11.5	16.8	29.7
	Reduction Rate (%)		87.0	86.9	80.8	68.7

Source: Documents provided by JICA and each STP

3.3.2 Quantitative Effects (Effect Indicators)

3.3.2.1 Percentage of Population Served

The Percentage of Population Served achieved the target value at all sites (See Table 10). Those at the Okhla, Keshopur and Northern area are very high thanks to the contribution of this project by expanding the capacity of wastewater treated through developing sewerage facilities. While that in the western area was 30%, which is relatively low, it achieved the target value, meaning the planned effect of the whole project was confirmed.

Table 10 Percentage of Population Served

(Unit: %)

	Baseline	Target	Actual		
	2002/03	2010/11	2012/13	2013/14	2014/15
	Baseline Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Year After Completion
Okhla	80	90	90	90	90
Keshopur	25	25	100	100	100
Northern area	-	21	88	88	95
Western area	-	22	11	17	30

Source: Documents provided by JICA and each STP

Note: Percentage of population served is defined as (population treated)/(target population treated) x100.

[23] Source: Interview with Agra Water Board

3.3.2.2 Reduction Rate of the Pollution Loading Amount[24]

Table 11 shows the pollution loading amount before the project and the planned and actual reduction rates in the pollution loading amount. The reduction rate in the pollution loading amount was 44%, which exceeded the target rate of 28% in Agra, while necessary data was not available from the Delhi Water Board. The pollution loading amount itself worsened after the project, but the effluent water quality improved and the treated wastewater amount also increased by constructing sewerage treatment facilities, as explained in "3.3.1.3 Improvement of Effluent Quality". Accordingly, the implementation of this project is also considered to have helped reduce the pollution loading amount.

Table 11 Reduction Rate of Pollution Loading Amount

(Unit: kg/day)

	Baseline	Target			Actual		
	2002/03	2012/13			2014/15		
	Baseline year	Completion year			2 years after completion		
	—	Without project	With project	**Reduction rate**	Without project	With project	**Reduction rate**
Delhi	208,915	365,297	188,528	**48%**	N.A	N.A	**N.A**
Agra	14,068	22,667	16,164	**28%**	81,000	45,000	**44%**

Source: Documents provided by JICA and Agra Water Board

Note: Pollution Loading Amount shows the amount (kg) of BOD per day and is calculated as water quality (concentration of pollution) × water volume (discharged flow). This evaluation compared the situation with/without the project using actual and predicted degrees of pollution loading, as calculated and estimated by the Agra Water Board.

3.3.3 Qualitative Effects (Other Effects)

3.3.3.1 Promoting the Understanding of the People through Awareness and PR Activities

Table 12 shows the result of the beneficiary survey[25] conducted during the ex-post evaluation. It was confirmed that 93% of the respondents changed their understanding on minimizing open defecation through awareness and PR activities of the project. Before this project, community toilets were constructed with the support of YAP (I) and activities to promote awareness of usage and O&M of community toilets were conducted. Continued activities to convey these priorities, even in this project, can be said to have impacted and changed the people's understanding.

[24] Total amount of substances polluting the river water

[25] A beneficiary survey was conducted as follows. Method: Structured interview, Number of valid responses: 100 in total, target beneficiaries: residents of Delhi (25 in Ohkla, 25 in Keshopur) and Agra (8 in Moti Kunj, 8 in New Rajamandi Colony, 10 in Tota ka Teela, 8 in Jagpura, 8 in Lohamandi, 8 in Sonth ki Mandi) nearby the Yamuna River basin (50 from each), Sex: 72% for male and 28% for female, ages: 18－30 (12%), 31－40 (30%), 41－50 (26%), 51－60 (14%), over 60 (18%).

Table 12 Improvement of Local People's Understanding on Living Environment

	Greatly improved	Improved	No change	Worse	Much worse
Minimizing open defecation	40%	53%	6%	1%	0%
Reducing the disposals into water bodies	0%	3%	95%	1%	1%
Reducing the wasteful usage of water	0%	25%	74%	0%	0%
Keeping good hygiene condition	1%	27%	71%	0%	1%

Source: Result of beneficiary survey

On the other hand, 95% of them explained no change in understanding for "reducing the disposal into water bodies." Regarding "keeping good hygiene condition" and "reducing the wasteful usage of water," less than 30% answered as "improved" and 70% cited "no change." As for these results, it can be explained that awareness and PR activities were conducted in 2009, so the people did not clearly remember those activities at the time of ex-post evaluation unlike toilets, which are actually still visible in the area. Also one project could cover only a limited number of beneficiaries within the huge area of Yamuna River basin. Moreover, various awareness activities have been conducted in this area after project completion, making it difficult for the people to discern activities between this project and others.

It is generally considered that the effects of awareness activities, such as changes of awareness, must be confirmed before and right after the project. Afterwards, they become second nature and will then be reflected in actual actions by implementing continued activities. Accordingly, also in YAP (III), which will be conducted, reviewing the changes before and right after the project and continued awareness and PR activities based on the result of the reviews is expected to sustain the effects from YAP (I) and YAP (II).

3.3.3.2 Improvement in the Institutional Capacity of each PIA

In this project, support to prepare and implement action plans to construct sewer lines was provided to 15 local authorities of UP and Haryana States with the aim of improving the O&M capacity for sewerage facilities. When confirming changes in institutional capacity to PIA, thanks to the support, "smooth implementation of project activities" as well as "improved O&M for sewerage facilities" were confirmed.

The project assisted bidding for a smooth project implementation. In particular, since some PIAs lacked sufficient experience to work with NGOs, the support through this project can be said to have contributed toward smooth implementation. Moreover, it was also mentioned that conducting training in the O&M of sewerage facilities has contributed toward O&M activities of facilities developed under YAP (I) and YAP (II) after commissioning the facilities. Considering the fact that actual O&M conditions of the facilities are good as mentioned in "3.5.4 Current Status of O&M", it can be said that the knowledge and

experience acquired in the trainings have been utilized. F/S for the following phase of the project (YAP(III)) was conducted and a draft project plan was prepared as part of the non-sewerage component (to improve the foundation of project activities). However, the commencement of YAP (III) is delayed[26], hence there is concern that the F/S plan would not be in line with the actual situation over time.

3.3.3.3 Strengthening the Institutional Capacity of NRCD

NRCD is an institution which controls and supervises the water preservation of rivers in India. This project supported efforts to improve the water quality management system. For example, a server was set and the necessary hardware and software for data processing was installed so that NRCD could receive monitoring information on water quality by data. Training on data management methods for the NRCD staff was also conducted. Following this support, a foundation for sending water quality monitoring data from each state to NRCD by data was developed, although it was submitted by paper before implementing the project. Due to this change, the data is submitted from states on a monthly basis, as opposed to quarterly as before. Furthermore issues such as delays in submitting reports, which were frequently seen before the project, have since improved[27].

3.4 Impacts

3.4.1 Intended Impacts

3.4.1.1 Water Preservation of Yamuna River

The “Water preservation of Yamuna River” was expected as an impact of the project. However, despite a significant contribution toward generating this impact, expecting this impact to come from the support of a single project is unrealistic, since the Yamuna River basin covers a huge area and various other factors also affect water quality. Conversely, if the effluent water quality and volume from the developed STPs of this project to Yamuna River improved and increased, it can be said that “the project helped preserve water.” As described in Table 13, both effluent water quality and volume from target STPs improved and met the requirement of the State Pollution Control Board. Accordingly, it can be judged that the larger volume of effluent and better water quality contributed toward the water conservation of Yamuna River.

[26] The executing agency of YAP (III) was shifted from NRCD to NMCG in line with the change of government in 2014. This required changes including the approval process and coordination with the project which NMCG was conducting apart from YAP (III) at the time and delayed in YAP (III). After the field survey of this evaluation survey, however, a bidding of a part of project was announced.

[27] Interviews with the staff of NRCD

Table 13 Water Quality and Quantity Discharged into Yamuna River from STPs

	Effluent water quality (BOD mg/l) Before project → After project	Amount of wastewater treated
Okhla	22.7 → 9.3	Increased by extending the existed plant
Keshopur	44.0 → 6.0	No change as rehabilitation of existed plant
Northern area	No data due to new construction→ 28.8	Increased by constructing new plants
Western area	No data due to new construction → 29.7	Increased by constructing new plants

Source: As STPs in the Northern and Western area were newly constructed, the data before the project implementation was not existed.

3.4.1.2 Improved Hygiene Environment and Health Condition

In the beneficiary survey, 24% of the respondents replied that the hygiene environment had "improved", 44% cited "no change" and 22% responded that it had "worsened." Many explained the reasons for the improvement as cleaner condition are kept since the number of over flow of untreated wastewater from drainage is becoming less. This happened because wastewater was formerly discharged directly to drainages but now flows into developed STPs. For the same reason, 37% of responses stated that the odor had improved. For health issues, 32% of them cited improvement, particularly on diarrhea and stomach issues. As such, the improvement was not drastic and there is a limitation on water preservation in Yamuna River, which covered a broad area by one project as explained above. 32% of respondents answered that the hygiene environment had "worsened or largely worsened" in the survey, but considering the population growth in Delhi and Agra and economic development in India, this project is thought to have helped prevent worsening of the situation to a certain extent, since 68% of respondents answered that hygiene conditions had "improved or not changed."

Table 14 Improvement of Hygiene Environment

	Largely improved	Improved	No change	Worsen	Largely worsen
Hygiene environment	2%	22%	44%	22%	10%
Odor	4%	33%	33%	23%	7%
Health condition	1%	31%	40%	22%	6%

Source: Beneficiary survey result

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

Interviews with each water board and residents and a site survey confirmed that no complaints such as noises and odors had arisen from implementing this project. Sludge generated from STPs was appropriately treated and the quality of discharged water from STPs also met the water quality standard, thus no negative impact on the natural environment was confirmed.

3.4.2.2 Land Acquisition and Resettlement

71 hectare of land to construct STPs and a pumping station in Agra were acquired through this project. The land was acquired in line with regulations set by the state government. However, it took longer than expected, which was one of the factors delaying the project period. Similar issues related to land acquisition occur frequently in this country and avoiding those issues can be considered very difficult[28]. No resettlement took place for implementing the project[29].

3.4.2.3 Effect of Improving the Quality of Irrigation Water

According to the beneficiary survey, 57% of respondents engaged in farming answered that agricultural activities had improved when treated water was used as irrigation water. Before the project, the water which the farmers used for irrigation were the water from rivers and drainage where untreated water were discharged. Even when interviewing farmers of nearby STPs developed in this project, at the time of ex-post evaluation, many explained that using treated water with better quality for irrigation increased the yield. Accordingly, it can be said that developing STPs in this project contributed to agricultural activities nearby the STPs to a certain extent.

This project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance (O&M)

The executing agency of this project was shifted from NRCD to NMCG in line with the change of government administration in 2014 (after project completion). However, this shift did not affect the O&M structure, since O&M activities for sewerage facilities were managed by the Delhi and Agra Water Boards. The total number of staff in the Delhi Water Board is 19,152, where 7,435 of whom are technical staff and 3,500 are engaged in O&M; while the total staff at the Agra Water Board is 202 people, where 125 of whom are technical staffs and 157 of whom are engaged in O&M works at the time of ex-post evaluation. Sufficient staff are assigned considering the fact that both water boards outsourced O&M of the facilities to private contractors and are giving actual positive O&M condition in the field. The responsibilities for each role; daily O&M works by private contractors, supervisory work by staff of the Water Boards, are also clear. Accordingly, no problems have been seen in the O&M structure.

[28] Interview with Agra Water Board
[29] Interview with each PIA

Awareness and PR activities have also been continued, primarily by each Water Board and the public health department of each state, which has helped prevent issues from arising.

3.5.2 Technical Aspects of Operation and Maintenance

The Delhi and Agra Water Board are institutions which have overseen O&M for water supply and sewerage facilities, thus they have sufficient knowledge and experience for O&M of sewerage facilities. They are also familiar with water quality control at STPs and have worked on preventive maintenance. Furthermore, management of contact with contractors and monitoring of O&M activities done by contractors have been made without any issues. During the site survey, it was confirmed that manuals for O&M provided to each facility through this project were properly kept and utilized at the time of ex-post evaluation. O&M for each project facility was assigned to contractors, which constructed the facility, for three years after the operation started. Following that contract period, contractors are selected through a bidding process and conclude contracts every three years. Eligible contractors who have passed the pre-qualification are only allowed to participate in bidding, which means contractors have sufficient technical skills for daily O&M activities.

In addition, each PIA utilizes experience gained from the component of institutional capacity building in the project for daily O&M sewer activities and so on. The information system for monitoring water quality introduced under this project was also operated and maintained without issues by NRCD staff.

3.5.3 Financial Aspects of Operation and Maintenance

According to the staff of the Delhi and Agra Water Boards, the O&M budget for sewerage facilities has been properly secured. The balance of current transactions in the Delhi Water Board shows a surplus for the past few years, as indicated on Table 15, so no serious financial issues are likely[30]. Regarding the Agra Water Board, the required budget for O&M is allocated each year by the Water Board of UP State and no budget issues have arisen.

Table 15 Delhi Water Board's Income and Expenditure

(Unit: million Indian Rupees (INR))

	2012/13	2013/14	2014/15
Income	**21,553**	**20,045**	**19,098**
Water charges	13,379	13,221	14,359
Other income	8,174	6,824	4,739
Expenditure	**16,721**	**19,405**	**18,912**
Establishment	10,286	11,028	11,680
Power	4,492	4,913	5,400
Repair and maintenance	1,566	3,187	1,517

[30] Although the Delhi Water Board is basically an autonomous entity, part of the project cost for investing in facilities is allocated as subsidies from central government or municipal government.

Raw water	302	173	219
Taxes	75	104	97

Source: Documents provided by financial department of Delhi Water Board

Table 16 O&M Cost of the Agra Water Board

(Unit: million INR)

	2012/13	2013/14	2014/15
O&M Cost	145	167	180

Source: Documents provided by Agra Water Board

3.5.4 Current Status of Operation and Maintenance

It was confirmed that the facilities developed under this project were in good condition at the time of ex-post evaluation through interviews with the Delhi Water Board, Agra Water Board and private contractors and through site surveys. Although the utilization rate of the Western area was low, it was within the plan as explained and connections from sewers to STPs will increase hereafter.

Maintenance works at each facility are conducted for set items based on the daily and regular maintenance system. It was also confirmed that each facility has kept records on preventive maintenance sheets and formats to complete information on parts which are problematic. Spare parts of facilities and equipment are all available within the country and no problems were confirmed since the installation up to the time of ex-post evaluation. Furthermore, since the actual O&M condition is good, no issues were confirmed concerning the current O&M status.

No major problems have been observed in the institutional, technical and financial aspects of the O&M system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was conducted to increase the sewerage capacity by developing sewerage facilities and also aimed to promote water quality conservation and raise understanding of improving the living environment in the Yamuna River basin at Delhi, UP State and Haryana State of India, through awareness and PR activities to the local residents as well as strengthening the institutional capacity of executing agencies. It is consistent with the national development policy, which has highlighted water quality improvement of major rivers as a critical issue of the environment sector, and also with the Japanese policy of assistance to India. Development needs are also high considering the polluted condition of the Yamuna River and the hygiene situation of the river basin. Hence, the relevance of this project is high. The efficiency of the project is low, as the project cost slightly exceeded the plan due to the

increased output and price escalation and the project period significantly exceeded the plan since more time was required to acquire land and obtain construction approval. Thanks to the project, effects such as an increase in the amount of wastewater treated and the improvement of effluent water quality were confirmed and the percentage of population served was also on target in the project areas. Since the Yamuna River basin covered a broad area, the effects on water conservation in terms of the whole Yamuna River through this project alone were limited. Compared with the situation before the project, however, a larger amount of wastewater treated with better water quality was discharged into Yamuna River, meaning that the project contributed to water conservation of the river to a certain extent. Therefore, the effectiveness and impact of the project is high. O&M of sewerage systems developed under this project shows that they are in good condition and no major problems were observed in terms of institutional and technical aspects of O&M. The O&M cost required for the facilities has also been secured, thus the sustainability of the project effect is high.

In light of the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency and JICA

- This project prepared detailed F/S for YAP (III), the project following YAP (II). L/A for YAP (III) was signed in 2011, but activities have not fully commenced since then and the progress is delayed, though bidding was announced for a part of the project. Accordingly, there is a concern that the contents of the F/S would not match the real condition and not be utilized if things continued to be unchanged. The executing agency and JICA need to work on resolving problems which have disturbed the start of the activities and provide support to commence YAP (III).
- While the effectiveness and impact of YAP(I) and YAP(II) were high, continued actions, including developing sewerage facilities, awareness and PR activities would be required for further water preservation of the broad Yamuna River basin.

4.3 Lessons Learned

- <u>Setting up a place for sharing information with related authorities</u>

The period of this project was much longer than planned (202% of the plan). One of the major reasons, as explained, was the longer time required to obtain approval to construct sewerage facilities from the related institution. Although such issues occurred frequently in the projects for sewerage sectors, insufficient information sharing and coordination before and on commencement of construction could be considered to compound the situation considerably. For similar projects, the executing agency must share information thoroughly with related agencies (for example, the DMR, AIS, National Highway Authority of India, Railway Agency,

each municipalities, polices etc., in case of this project) at the time of project commencement to avoid similar problems. There are possibilities that project plans at the time of the planning stage could change according to the progress of construction works. Therefore, as well as sharing information with related institutions, it would be also effective to avoid delays in projects by planning and implementing modified plans, stating by whom it will be conducted and the orders of actions.

・To include a monitoring system by reviewing effects of awareness and PR activities to promote the sustainability of the project effect

This project conducted awareness and PR activities to promote changes in people's understanding of water preservation and the hygiene environment. The effect of these activities should be reviewed both before and right after the project and then continue activities based on the reviewed result, which will help sustain the effect of the activities. In future, for projects including activities such as awareness-raising and PR (for example in the case of YAP (III) which is a project following this one), a monitoring system to understand the situation before and right after the project should be included for reviewing the effect of activities at the time of project completion and then continuing activities to promote the sustainability of the effects.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs		
1) Sewerage component		
Delhi: STP (Construction)	135,000m^3/day (Okhla)	As planned
(Rehabilitation)	54,000m^3/day (Keshopur)	As planned
Sewer line (Rehabilitation/replacement)	10,900km (Ring Road)	As planned
(Renewal)	6,293m (Bela Road)	6,929m
(New)	14,700m (Wazirabad)	13,954m
Agra: STP (Construction)	10,000m^3/day (Northern area)	14,000m^3/day
Sewer line (Construction)	34,000m	36,770m
Pumping station (Construction)	10,000m^3/day	14,000m^3/day
Raising main	6,100m	5,370m
STP (Construction)	28,000 m^3/day(Western area)	40,000 m^3/day
Sewer line (Construction)	39,200m	34,960m
Pumping station (Construction)	28,000 m^3/day	40,000 m^3/day
Raising main	6,600m	9,500m
2) Non-sewerage component		
① PPA and PR activities	Workshops, short plays, seminars, meetings, etc.	Development of teaching material for public awareness, hygienic education, awareness for water quality preservation, PR, Setting up a water corner at the National Science Museum
② Capacity building of PIA	Enhancing technical capability and facility operation ability and improving financial structure	Developing and implementing action plans
③ Capacity building of NRCD	Improving the water quality management system and financial and information system	Introducing a water quality management system
④ F/S report preparation for the following phase	Preparation of a detailed plan YAP (III)	Preparation of F/S for the next phase pilot project
⑤ Research related to formulating a guideline to redevelop slums	Research to prepare guideline	Not implemented at this project
3) Consulting services	Bidding documents review, bidding assistance, construction supervision, research assistance, preparation assistance of materials such as detailed F/S. staff trainings, etc.	As planned
2.Project Period	January 2003 – March 2008 (63 months)	March 2003 – September 2013 (127 months)
3.Project Cost		
Amount Paid in Foreign Currency	1,861million yen	Unknown
Amount Paid in Local currency	13,948million yen (5,693 million INR)	Unknown
Total	15,808million yen	17,120million yen
Japanese ODA Loan Portion	13,333million yen	8,328million yen
Exchange Rate	1INR = 2.45 yen (As of September 2002)	1INR = 2.23 yen (Average between March, 2003 and September, 2013)