

India

FY2020 Ex-Post Evaluation Report of Japanese ODA Loan

“Kerala Water Supply Project (I)(II)(III)”<sup>1</sup>

External Evaluator: Shima Hayase, IC Net Limited

## 0. Summary

The Project was to provide a safe and stable water supply service to meet the growing demand for water by installing water supply facilities in three cities and two villages of the state of Kerala located in Southern India thereby contributing to improving the living conditions of the resident.

The Project has been consistent with the development plans and policies of the governments of India and Kerala’s development policies and development needs; by Japan’s policy for assistance to India at the time of the appraisal. Therefore, its relevance is high. Because the target area of the water supply included rural areas, the Project anticipated Sustainable Development Goals (hereafter referred to as SDGs) and the trends of the Government of India focusing dissemination of safe-water supply to a rural area. In project implementation, more attentive support to avoid delays should have been considered according to the experience of the Executing Agency.

Most of the Project’s original scope was implemented almost as planned, but some components were not completed. Construction of the remaining components has been continued using funds other than Japanese ODA Loan. Because the cost for the above-unfinished scope was not included in the construction cost, the project cost was within the plan. However, the project period was delayed significantly. Therefore, the efficiency is fair.

Regarding the effectiveness indicators, among the five project areas, one achieved the target of water supply amount, facility utilization rate, total population served, and percentage of population served. In the other areas, water treatment plants have not supplied the amount of water commensurate to the designed capacity because of incompleteness and defection in three areas, and lack of engineers in one area. On the other hand, the quality of the supplied water and the situation that water outage is extremely rare, it can be said that services have been provided stably.

The expected impact of the Project, improving living conditions of the residents, are some examples of contributions to the improvement of public health and water by water supply. No adverse impact on the natural environment due to the Project has been reported. Compensation to the damages during construction and land acquisition and resettlement were carried out by the regulations. Because expression of the project effects is limited extent, the Project’s effectiveness and impact are fair.

With regard to sustainability, some of the project areas are having difficulties allocating engineers with appropriate skills. In addition, some problems were observed with the status of

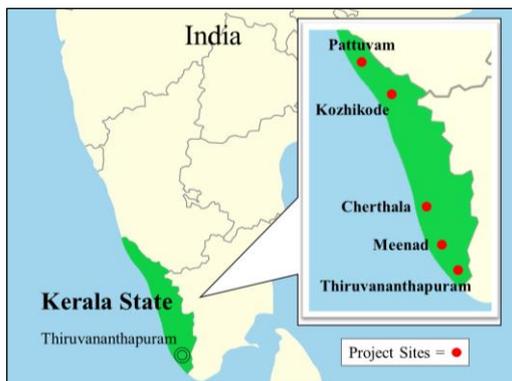
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<sup>1</sup> Because of the significant delay, the Project was examined twice. It was separated into three projects

operation and maintenance of the facilities, such as the application of automation systems, maintenance, and safety measures. However, since the water supply function has been in operation, and financial aspects of operation and maintenance are expected to be guaranteed by government subsidies. The sustainability of the Project effect is fair.

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

## 1. Project Description



Project Location



Water Treatment Plant in Thiruvananthapuram

### 1.1 Background

After the independence, the importance of the water supply was beginning to be recognized in India. Since *the First Five-Year Plan* (April 1951–March 1956) prepared after the independence, the budget was allocated to the water supply sector and the development across the country started with it. Since then, the budget allocation for the sector has increased in every Five-Year Plan, and the national government has been leading the effort to develop the sector. Much funding and technical assistance from international donors have also been provided to the sector. As the result, at the beginning of *the Eighth Five-year Plan* (April 1992-March 1997), access to safe water supply in India reached about 85% in the urban areas and about 78% in the rural areas.

In the state of Kerala, access to the safe water supply was below the national average, which was about 74% in urban areas and about 46% in rural areas as of March 1996. Moreover, in some parts of the state, there were many areas where safe water was not available because of groundwater pollution.

### 1.2 Project Outline

The objective of this project is to provide safe and stable water supply service to meet the growing demand for water by installing water supply facilities in the state of Kerala located in Southern India thereby contributing to improving the living conditions of the residents.

Loan Approved Amount/ Disbursed Amount	(I) 11,997 million Japanese yen / 11,833 million Japanese yen (II) 32,777 million Japanese yen / 29,634 million Japanese yen (III) 12,727 million Japanese yen / 5,662 million Japanese yen
Exchange of Notes Date/ Loan Agreement Signing Date	(I) January 1997 / February 1997 (II) March 2007 / March 2007 (III) March 2009 / March 2009
Terms and Conditions (I)	Interest Rate 2.1 % Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement General Untied
(II)	Interest Rate 1.30 % Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement General Untied
(III)	Interest Rate (Construction) 2.1 % (Consulting Services) 0.01% Repayment Period 30 years (Grace Period) (10 years) Conditions for Procurement General Untied
Borrower / Executing Agency	The President of India / Kerala Water Authority (KWA)
Project Completion	(I) June 2008, (II) April 2013, (III) July 2015 (Final Disbursement)
Target Area	Thiruvananthapuram city, Kozhikode city , Cherthala city, Meenad, Pattuvum, and adjoining villages
Main Contractor(s) (Over 1 billion yen)	Subhash Projects and Marketing Ltd. (India), Electrosteel Castings Ltd. (India), Degremont SA(France)/ Degremont Private Ltd. (formally Degremont Ltd.) (India), VA Tech Wabag GmbH(Austria) /VA Tech Wabag Ltd. (India) / Koya & Company Construction Ltd.(India) /Kirlokar Brothers Ltd. (India), Tokyo Engineering Consultants CO.,Ltd. (Japan), IVRCL Infrastructures and Projects Ltd. (India), Engineering Projects India Ltd. (India), Larsen & Toubro Ltd. (India), K. Ramakrishna Contractors (P) Ltd. (India), Shriram EPC Ltd. (India)
Main Consultant(s) (Over 100 million yen)	Tokyo Engineering Consultants CO., LTD. (Japan)
Related Studies (Feasibility Studies, etc.)	Thiruvananthapuram F/S (TATA Consulting Engineers Ltd. 1993), Kozhikode F/S (TATA Consulting Engineers Ltd. 1994), Cherthala Project Report (KWA 1993), Meenad Project Report (KWA 1994) , Pattuvam Project Report (KWA 1994)
Related Projects	【Technical Cooperation】 Project Formulation Survey for Water Leak Detection Services in India (October 2013-March 2014) 【Other International Agencies】 World Bank: Water Supply Project-Kerala (1985-1994), Kerala Rural Water Supply and Environmental Sanitation Project(2000-2008/ 2011-2019), Rural Water Supply and Sanitation Project for Low Income States (2013-2019) Asian Development Bank: Kerala Sustainable Urban Development (2005-2016)

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Shima Hayase, IC Net Limited

### 2.2 Duration of Evaluation Study

For this ex-post evaluation, study was carried out as follows:

Duration of the Study: October 2020-February 2022

Duration of the Field Studies<sup>2</sup>: July 19, 2021-September 23, 2021,

November 1, 2021-December 6, 2021

### 2.3 Constraints during the Evaluation Study

In this ex-post evaluation, the External Evaluator was unable to travel and conduct field studies because of travel restrictions induced by the COVID-19 pandemic. Discussions with the Executing Agency were conducted online, and the National Consultant visited the project facilities constructed by the Project. During the field studies, interviews and information collection by written documents were conducted intermittently. Moreover, as a COVID-19 preventive measure, in-person interviews with the beneficiaries were avoided as much as possible. Therefore, it was not possible to analyze the extent of achieving the impact through directly studying the situation at home and the lifestyle.

The Project was not completed although the final disbursement of ODA Loan was in July 2015. Because five years have passed since the final disbursement of the loan, the Project became subject to ex-post evaluation. However, due to such circumstances, the effectiveness cannot be confirmed with the actual data at the project completion. Instead, the evaluation is based on an analysis of the situation at the time of ex-post evaluation.

## 3. Results of the Evaluation (Overall Rating: C<sup>3</sup>)

### 3.1 Relevance (Rating:③<sup>4</sup>)

#### 3.1.1 Consistency with the Development Plan of India

The development plan of the Government of India at appraisal time was *the Eighth Five-Year Plan* (April 1992–March 1997), which aimed to raise the urban water supply ratio to 94% from 85%, and the rural water supply ratio to 100% from 78% by the end of the planned period. Access ratio to safe water<sup>5</sup>, which was 70% in the 1990s, was improved to 86% in 2006. It was close to

<sup>2</sup> Field studies were conducted by National Consultant visiting the project sites, and the external evaluator confirming the answers for the questionnaire and collecting information remotely.

<sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>4</sup> ③ High, ② Fair, ① Low

<sup>5</sup> The definition is the percentage of the population satisfying one of the conditions a-c, against the total population.

a. Household tap, public tap, and drinking water from well, b. Water source within 1 km from residence, c. Daily water supply more than 20 liters per capita (source: World Development Indicator).

attaining the target "to establish sustainable access to drinking water all over India" of the *Eleventh Five-Year Plan* (April 2007–March 2012), which was the development plan at the time of re-appraisal in 2007. However, the construction of water supply facilities has not kept up with the increase in water supply demand due to population growth and economic development, and there were many problems in the amount of water supply, quality, and services. Thus, the government's policy goal was to promote the construction of infrastructure to provide water supply, sewerage and sanitation facilities to the entire population by December 2011. In Kerala, the state's five-year plan also set a target in line with national policy. At the time of ex-post evaluation, in a relation to an SDGs goal "6: Safe Water", the government launched a new program called Jal Jeevan Mission ("Water for Life") in May 2019. The goal of the mission was that by 2024 all rural households are able to receive safe water from the tap at home. The Government of India has positioned this as a national flagship project. It was led by a new ministry named the Ministry of Jal Shakti to manage water resources and supply comprehensively and systematically, and the budget of 360 billion INR<sup>6</sup> ( about 525 billion JPY) has been allocated for the large-scale project carried out in collaboration of national and state governments. In the budget plan for the fiscal year of 2021 to 2022, urban areas were also added to its targets, and a budget of 500 billion INR (about 750 billion JPY), which is four times the previous year's budget, was presented.

In Kerala's Thirteenth Five-Year Plan (April 2017–March 2022), the state was to provide a roadmap for supplying safe water to all and the necessity of projects tailored to the development of each city.

As mentioned above, the Project is consistent with the development policies of the Government of India and the Government of Kerala from the time of appraisal to the ex-post evaluation.

### 3.1.2 Consistency with the Development Needs of India

The population coverage ratio of water supply at the time of appraisal was 54% for the entire state of Kerala (about 74% for the urban areas and about 46% for the rural areas) as of March 1996. In comparison with the national average of India (about 85% and about 78% as of March 1992), Kerala was behind.

Moreover, the average daily water supply per capita in the state capital of Thiruvananthapuram was about 90 liters, which was way lower than the appropriate volume for cities of similar size, 150 to 200 liters. In Kozhikode, the water supply per capita was only about 38 liters, which was more serious than in the capital. The two major cities had existing water supply facilities, but the supply volume was limited. In addition, the cities had a problem of unaccounted-for-water, as high as 30% due to leakage and else.

In Cherthala city, Pattuvam village, and Meenad village, there were few water supply facilities,

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<sup>6</sup> Indian Rupees

thus residents depended on groundwater. But there was a problem that water quality was deteriorated significantly due to the infiltration of seawater into the groundwater.

The main problems in Kerala were recognized as (1) absolute shortage of water supply to the demand, (2) deterioration of water quality due to brine penetration into groundwater, which was an existing water source, (3) inadequate maintenance and management by KWA including high un-accounted for water and information management.

The amount of water supply and demand at the time of appraisal and ex-post evaluation is shown in Table 1. At the time of ex-post evaluation (2021), the Thiruvananthapuram area was able to supply water more than the demand. This is because, in Thiruvananthapuram, a new water treatment facility of 75MLD<sup>7</sup> has been constructed with the state budget, and the capacity was to meet the expected demand by 2036. But in the other four areas, the supply was insufficient for the demand.

As of above, it can be said that the development needs for the construction of water supply facilities are continuously high from the appraisal to ex-post evaluation time.

Table 1 Water Supply and Demand Volumes in the Project Areas (unit: MLD)

	At the time of Appraisal of II/III (2006)			At the time of Ex-post Evaluation (2021)		
	Demand	Supply	Difference	Demand	Supply	Difference
(A) Thiruvananthapuram	246	190	-56	294	339	+45
(B) Kozhikode	209	72	-137	246	212	-34
(C) Cherthala	91	7	-84	98	66	-32
(D) Meenad	61	13	-48	66	58	-8
(E) Pattuvam	74	9	-65	84	63	-21

Source: Executing Agency's answer to questionnaire (November 30, 2021)

### 3.1.3 Consistency with Japan's ODA Policy

At the time of appraisal, the Economic Assistance Comprehensive Survey Team consisting of Japan's related ministries and agencies was dispatched in February 1989 and March 1995. Japan's assistance policy to India was formulated by the team through discussion with the Government of India. Economic infrastructure development, environmental protection, and poverty reduction were the three priority areas of the policy.<sup>8</sup>

The Project was to solve water shortages and dependence on groundwater by installing water supply facilities necessary for supplying safe tap water from surface water. Moreover, it was aiming to improve the living conditions of the residents and to mitigate environmental load. Thus, the Project was relevant to Japan's ODA policy at the time of appraisal.

<sup>7</sup> MLD is the abbreviation of Million Liter per Day. MLD= million liter/day

<sup>8</sup> Evaluation on the process to formulate Japan's ODA Policy to India

([https://www.mofa.go.jp/mofaj/gaiko/oda/shiryo/hyouka/kunibetu/gai/india/kuni03\\_01\\_0303.html](https://www.mofa.go.jp/mofaj/gaiko/oda/shiryo/hyouka/kunibetu/gai/india/kuni03_01_0303.html))

### 3.1.4 Appropriateness of the Project Plan and Approach

Since the Project's initial loan agreement in 1996, about a quarter of a century has passed till the time of ex-post evaluation. This section will trace the approaches taken during the time according to the issues.

#### (1) Selection of Project Areas

The Yen loan projects formulated around the same time included water and sewage projects in the four major cities in India (Delhi, Mumbai, Bangalore, and Chennai), all of which targeted the state capital. On the other hand, this Project was the first water supply facility project targeting multiple cities and even including adjoining villages. At the time of the appraisal (1996), there was no preparatory survey (Special Assistance for Project Formulation: SAPROF) or consultant procurement support scheme. therefore, based on the FS prepared by the Executing Agency, the employee of Overseas Economic Cooperation Fund (OECF), which was the predecessor of JBIC formulated the project plan.<sup>9</sup> Looking back at the time, the project plan was picking up the needs of the local government. At the same time, it can be said that the plan anticipated the trend such as SDGs "safe water supply for all" that is the current global issue, and the priority of the government such as the dissemination of tap water to the rural areas.

#### (2) Coordination with Donor Agencies

In the same sector, Dutch and Danish governments, and World Bank implemented water supply/public health projects at the local government level. The main components of the projects were the construction of water supply facilities and capacity building. The scale was not large, although it was as to supply water for several tens of households, the projects became popular because the benefits were direct and did not require advanced technology. Moreover, in Kerala, voluntary community works were active and the residents were highly motivated to participate in maintenance..<sup>10</sup>

For KWA, which is responsible for large-scale facilities, the Dutch and Danish governments implemented the *Operation and Maintenance Improvement Project* for three years from 1995. In the project's completion report<sup>11</sup>, following problems were recorded; the supply loss due to water leakage was 78% (there was a discrepancy with 40% according to KWA), the maintenance cost was high, and the tariff could not cover the cost. The report also mentioned that the recommendation to improve the problems were not accepted.

In the Project's appraisal, regarding the capacity of KWA, besides the high ratio of unaccounted-for-water, no other problem in KWA's technical level was pointed out because KWA had experience with other donor projects and facility construction. During the project

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<sup>9</sup> Interview with JICA staff (June 8, 2021)

<sup>10</sup> Domestic Water and Sanitation in Kerala, March 2014

<sup>11</sup> Operation and Maintenance of Rural Water Supply Schemes of KWA 1995

implementation, there was no donor coordination carried out because there was no duplication in the scopes, even during the project implementation. In reality, it was the first experience for KWA to implement a large-scale like this Project, and was unfamiliar with the preparation of bidding documents, consultant selection, and contracting procedures, etc. From the beginning of the Project in 1996, consultant selection was delayed by 6 years, and retender continue to be floated for selecting construction companies.

At the time of planning, in order to understand the characteristics of the state and the needs of people, the Project should have collected information from other donors. Moreover, during project implementation, coordination with other donors such as information exchange should have been done.

After the completion of the ODA loan disbursement, JICA has been dispatching review mission and others to keep the discussion with KWA and the supervising organization, the Ministry of Water Resources. There are possibilities for JICA to have also communicated with other donors or state planning boards, so as to realize KWA's organizational efficiency and automation that the Project has implemented, countermeasure to water leak, raise awareness on the importance of maintenance, and safety management.

### (3) Difficulties in Bidding and Procurement

The main reason for the Project's delay was the difficulties in bidding and procurements. The longest time was spent on selecting the consultant. From the first Loan Agreement, about 6 years were spent until the selection of the consultant. Soon after the beginning of the project, the selection procedure has started, but when proposals were submitted and shortlisted, a third-party reported violations in the processes, and as the result, it was brought to state court for lawsuit. The lawsuit was found in favor of the government, but during the trial, the selection process was suspended. Consequently, the submitted proposals expired and the selection process was redone. The consultant contract was signed in March 2006, but the Yen loan agreement was also re-examined.

In addition, it was difficult to procure the contractors. According to JICA staff, the construction works were divided into packages for procurement for bidding, and the total number of the packages became 30 in total. One of the reasons was because of the large number of packages, the burden on the consultant who manages them became heavy too much. On the other hand, according to KWA engineers who undertook the construction, it was difficult to find a company with considerable capacity because the scale of the Project itself was large. Also, it was pointed out that there were several companies that could not complete the construction by the deadline because they have been awarded multiple packages, and the work exceeded their capacity. The unfinished portions ended up being completed by amending contracts or retendering but caused another delay.

Because it was the first time for KWA to implement a large-scale project such as this Project, KWA was unfamiliar with the preparation of bidding documents and selection procedure, and there were also points that the capacities of local construction companies were not predictable.

Since KWA had little experience in handling large-scale projects, it seems necessary for consultants and JICA to have provided closer support such as the preparation of bid documents through consulting services from the beginning of the project, the selection of capable contractors, contracting, and monitoring during implementation.

In light of the above, the Project is relevant to the development policies, development needs of the Indian Government and State of Kerala, and Japan's ODA policy at the time of the appraisal. Therefore, its relevance is high.

The Project was the first water sector project of JICA targeting multiple cities and villages in a state, and it can be said that the Project was anticipating the trends at ex-post evaluation time such as SDGs and India's priority to disseminate water supply to rural areas. On the other hand, considering the experience of Executing Agency, more attentive support for Executing Agency such as bidding support through consulting services and monitoring during the implementation should have been considered in order to prevent delays.

### 3.2 Efficiency (Rating: ②)

(For details, see the final page of the report "Comparison of the Original and Actual Scope of the Project")

#### 3.2.1 Project Outputs

Although there were some changes, the project was carried out almost as planned as shown in Table 2. The changes were as follows:

Table 2 shows comparisons of components that differed in the plan at appraisal and the actual. This project was to develop water supply facilities in three cities and two villages in Kerala state. The main components of (1) Water Supply Facilities were to construct (a) water treatment facility, (b) transmission facility, (c) distribution network, (d) service reservoirs. In the schemes of Thiruvananthapuram and Kozhikode cities, (e) rehabilitation of deteriorated water treatment plants was included.

Besides the main components, there were (2) Consulting Services, (3) Institutional Strengthening of Executing Agency. In the Appraisal of II/III following components were added to (3) Institutional Strengthening such as Enterprise Resource Planning<sup>12</sup> (hereafter referred as EPR) to build an information management system within the Executing Agency to automate

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<sup>12</sup> A plan to aim to maximize profits by centrally managing corporate management resources (people, goods, funds, and information) and making effective use across business organizations.

facilities and centralize information, Complaint Redressal system, Supervisory Control And Data Acquisition (hereafter referred to as SCADA) , and Central Control System.

Table 2 Plan and Actual of Outputs

Only the components that had a difference between the plan and the actual are listed. For details, see the final page of the report “Comparison of the Original and Actual Scope of the Project “

Plan	Actual
<b>(1) Water Supply Facilities (WSF)</b>	
* Only the components that have a difference between the plan and the actual result are listed.	
<b>(A) Thiruvananthapuram</b> (d) Service Reservoir 11 Locations 57 m <sup>3</sup> (e) Rehabilitation of Existing Scheme 2 Locations	<Commissioning of WSF May 2010 > (d) Service Reservoir 11 Locations 41 m <sup>3</sup> (e) Rehabilitation of Existing Scheme incomplete one scheme
<b>(B) Kozhikode</b> (c) Distribution Network 1865km (d) Service Reservoir 20 Locations	<Commissioning of WSF: February 2015 > (c)Distribution Network 204 km is incomplete (d) Service Reservoir were constructed, but 2 reservoirs have not connected to transmission / distribution network
<b>(C) Cherthala</b>	<Commissioning of WSF: January 2012 > Completed as planned
<b>(D) Meenad</b> (c)Distribution Network 920 km	<Commissioning of WSF: February 2011 > (c)Distribution Network 230 km is incomplete <sup>13</sup>
<b>(E) Pattuvum</b> (b) Transmission Main 92 km (d) Service Reservoir 13 Locations 29 m <sup>3</sup>	<Commissioning of WSF: March 2013 > (b) Transmission Main 82km (d) Service Reservoir 14 Locations 27 m <sup>3</sup>
<b>(2) Consulting Services</b>	
(a) Assistance in Review of Feasibility Reports, Detailed Engineering Designs, Tendering Assistance, (b) Supervision, procurements of equipment, (c) Institutional Strengthening	Finished in March 31, 2016
Trainings to develop capacity of Executing Agency: Organization Management, Overseas Trainings, O&M efficiency, System utilization	All domestic trainings completed. 14 participants dispatched in overseas training in Japan
<b>(3) Institutional Strengthening</b>	
Maintenance Vehicle: 128 units	Maintenance Vehicle: 61units, other procurement completed
Additional components in II/III appraisal	
Establishment of Information Management system: Complaint Redressal Software, Project Management Software ,Building Enterprise Resource Planning and Central Control Unit :	ERP system not introduced Complaint Redressal system software partially completed. Everything else have been completed

Source: Plan is from material provided by JICA, actual is from the Executing Agency’s answer to the questionnaire (November 30,2021 and December 10, 2021)

The differences between plan and actual are to be explained by component.

#### (1) Water Supply Facilities

All the components are completed almost as planned, but the following are incomplete at the time of the post-evaluation.

<sup>13</sup> According to KWA, after the final disbursement, KWA has been expanding the construction of distribution networks all over the city and surrounding areas with other funding sources.

Water Distribution Network<sup>14</sup>: There are some incomplete portions in Kozhikode city and Meenad village. In both cities, at the time of final disbursement of ODA Loan (final disbursement of July 2015, which was extended from July 2013 of the plan), the construction companies had not completed the contracted works and failed to fulfill the contracts. Unfinished portions remained. The bidding procedure was carried out again, and contracts with other companies were concluded, however, the construction has not been completed.

Service Reservoir: in Kozhikode city, 20 service reservoirs were constructed as planned, but two of them are not in use because land acquisition is not completed, and preventing the reservoirs to be connected to the transmission/distribution pipes.

Replacement of Distribution Pipes: In Thiruvananthapuram, Kozhikode, Cherthala cities, due to frequent rupture of pipes, replacement work was required. In Kozhikode city, water pipes ruptured in various locations after the commissioning, and when the cause was investigated, it was found that the strength of the pipes was insufficient, and replacement work was carried out.

For cities other than Kozhikode, Thiruvananthapuram city has found that it is necessary to redo the construction of three trunk lines, and Cherthala city found 33km of understrength pipes, however no tangible plans for when and how to execute the work has been shown.

Rehabilitation of Existing Water Treatment Plants: The contract was terminated halfway due to the contractor's breach of contract. Since the repairs included the replacement of transformers and pumps and the rebuilding of the chemical injection facility, the water supply function of the facility itself was not affected.

The differences between the service reservoir in the Thiruvananthapuram city and the transmission main and the service reservoirs in the Pattsvam village were due to the design change.

## (2) Consulting Services

Consulting services were to support the Executing Agency in the implementation of the Project, which included assistances mapping of the facilities, and installation of flow meters. Because the Executing Agency had not implemented these components by the final disbursement time, therefore no assistance was provided for these.

## (3) Institutional Strengthening

Among the components added at the time of II/III appraisals, ERP systems have not been introduced. Software for Complaint Redressal system was partially introduced and in use. Other functions related to automation and remote operation, such as SCADA were confirmed to be fully operational when handed over from the contractor after procurement and installation, but

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<sup>14</sup> In the project areas, other projects by the Executing Agency were carried out in parallel, and the distribution pipe networks include the part planned to be implemented by the Executing Agency.

afterward, it is no longer in used. At the time of ex-post evaluation, most measurements are done manually, including the flow meter of the water treatment plants. Details are to be explained in the sustainability section.

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The project cost of Japanese side at the time of each appraisal was (I) JPY 11,997million, (II) JPY 32,777 million, and (III) JPY 12,727 million. The total of planned project cost combining all was JPY 57,501million. The actual project cost of each became (I) JPY 11,833 million, (II) JPY 29,634 million, (III) JPY 5,662 million. The actual project cost in total was JPY 47,129 million, which was within the plan, 82% against the plan. The detailed information on the project cost borne by the Indian side was not provided by KWA.

The main reason for the reduction of about 20% project cost when comparing the actual with planned the cost of construction work for all facilities and consulting services from the time of the appraisals, is because of the cost for construction of water distribution network part of Kozhikode city and Meenad village. Because these parts were not completed before the final disbursement of Yen loan, and thus, have been excluded from the Project cost. The unfinished portion is being constructed with Kerala state's infrastructure development budget and the budget of Jal Jeevan Mission's at the time of ex-post evaluation.

Table 3 Planned Project Cost (unit: million JPY)

	I	II	III	total
Construction & Rehabilitation works	10,081	31,370	11,395	52,846
Consulting Services	1,569	374	1,239	3,182
Interest during construction	327	237	0	564
Contingency	20	796	93	909
Total	11,997	32,777	12,727	57,501

Table 4 Actual Project Cost (unit: million JPY)

	I	II	III	total	difference	Ratio to the plan
Construction & Rehabilitation works	10,083	29,031	4,476	43,591	-9,255	82%
Consulting Services	1,550	357	1,186	3,093	-89	97%
Interest during construction	200	237	0	437	-127	78%
Contingency	0	0	0	0	0	-
Extension	0	9	0	9	-9	1%
Total	11,833	29,634	5,662	47,129	-10,372	82%

Source: material provided by JICA

#### 3.2.2.2 Project Period

At the time of the appraisal, the project implementation period was scheduled from February 1997 (Loan Agreement I signing) to December 2010 (project completion of III, 13 years and 11

months, 167 months). The Project completion was set as the completion of all construction works and consulting services, but since construction of distribution pipes and rehabilitation works are incomplete at the time of ex-post evaluation, the project has not reached the completion according to the definition.

If the time of ex-post evaluation time is taken hypothetically as project completion, and compare with the planned period, the actual project period is from February 1997 (Loan Agreement I signing) to November 2021 (24 years and 10 months, 298 months), delay is already significant, making it 167% against the plan.

The reasons that the actual exceed the plan were, in addition to the influence of the change of government in the state, the selection of consultant took about 6 years from the start of the project in 1997. Because of this, the detailed design was delayed. Moreover, there were other large delays in the preparation of the bidding documents, the contract procedure and redoing, and interruption by the lawsuit.

Besides above, KWA pointed out that the negotiation of land acquisition and geological survey took longer time than planned, also the influence caused by natural disasters such as monsoon and floods deterred survey and construction works. In Kerala state, June to October is the monsoon season, and damages caused by heavy rains and floods are to be increased, so it is difficult to proceed with construction work as planned. The Executing Agency recalled the time of appraisal, that they should have had more discussion with JICA and made the plan considering the natural conditions.

Table 5 The Plan and the Actual of Project Period

items	Plan			Actual
	(I)	(II)	(III)	At the time of ex-post evaluation
Project Period	February 1997-December 2003 (70 Months)	March 2007-April 2009 (29 months)	March 2009-December 2010 (22months)	February 1997 -Incomplete
<b>1. Water Supply Facilities</b>				
Land Acquisition & Resettlement	April 1997-December 1999	April 1997-March 2007	April 1997-December 2008	August 1997-Incomplete
Detailed Design	July1997-June1999	November 2003-Sep2005	-	Jul1997-Sep2005
Tender procedure to Contract	April 1998-December 2001	February 1997-March 2007	May 2004-March 2009	February 2004-October 2018
Construction	April 2000-December 2003	April 2006-August 2009	April 2006-December 2010	April 2006-Incomplete
<b>2. Consulting Services</b>				
Selection of consultants	October 1996-June1997	May2002-August 2003	N/A	May 2002-August 2003
Consulting services	November 1997-December 2003	September 2003-August 2009	September 2003-December 2010	September 2003-March 2016
Domestic trainings	-	-	March 2006-December 2010	N/A

International trainings	-	-	2009-2010	September 3-15,2012
<b>3. Institutional Strengthening</b>				
Institutional Strengthening	-	June2006-December 2008	June 2006-December 2010	June 2006-January 2021

Source: Plan is from material provided by JICA, actual is from the Executing Agency's answer to the questionnaire (November 30,2021 and December 10, 2021)

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

Economic Internal Rate of Return (EIRR) were calculated for the Project at the time of the Project appraisal. EIRR could not be recalculated at the time of the ex-post evaluation because the data on entire project cost and willingness to pay was not available.

Table 6 EIRR at the time of Appraisal<sup>15</sup>

At the time of Appraisal (2009)	
IRR	EIRR: 8.7%
Cost	Project cost (excluding tax) operation and maintenance expenses
Benefit	Increase in willingness to pay for water tariff
Project Life	40 years

Source: material provided by JICA,

As mentioned above, the Yen loan disbursement period ended without completing some parts of the water distribution networks, rehabilitation work for the existing facility, and a part of the institutional strengthening component. The project cost was within the planned amount. The main reason for this was that the cost of the above incomplete construction was not included in the actual expenses after the final disbursement. The project period exceeded significantly, therefore, the efficiency is moderate.

## 3.3 Effectiveness and Impact<sup>16</sup> (Rating: ③)

### 3.3.1 Effectiveness

#### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

This project was aiming to provide safe and stable water supply service to meet the growing demand for water,“ and the following indicators were set to measure achievement; (a) Total Population Served (thousands), (b) Amount of Water Supplied (MLD), (c) Rate of Facility Utilization<sup>17</sup>, (d) Un-accounted for Water<sup>18</sup>, and (e) Percentage of Population Served<sup>19</sup>

<sup>15</sup> The EIRR calculated at the time of III appraisal

<sup>16</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

<sup>17</sup>Rate of Facility Utilization = average amount of water supply in a day / capacity of the facility\*100

<sup>18</sup> U-accounted for Water (%) = amount of water not for tariff collection/ amount of water served\*100

<sup>19</sup> A= number of household with tap connection, B= headcount in a household ( 5 people in Thiruvananthapuram, Kozhikode, and Cherthala city, 4 people in other areas), C=number of public tap, D=((A\*B)+(C\*25))/1000, E=population, F=Floating population (25 thousand in Thiruvananthapuram, 10thousand in Kozhikode, 5 thousand in Pattsuvam, and 2thousands in Cherthala and Meenad) calculated by applying the following formula, Population Served = D/(E+F)

The targets are based on the population forecast for 2036<sup>20</sup>, but since the project has not been completed and there is a discrepancy between the initial scenario and the current situation, the level of achievement cannot be shown by comparing the target and the actual result. Instead, the achievement status is analyzed from the actual data of four years preceding the ex-evaluation. For some components that are not completed, evaluation is to be taking consideration of the portion.

Regarding (d) unaccounted-for-water was excluded from the rating of effectiveness because it is not suitable to evaluate the project's quantitative effects since it is caused by not only water leak pointed out at the appraisal time, but also others outside of the project scopes such as insufficient water meters, illegal connection and insufficient tariff collection from the large number of public taps. However, in all the project areas, (d) unaccounted-for-water ratio tends to be worse than the baseline, and the target. The detail and Executing Agency's response will be dealt with not in this section but in the status of operation and maintenance in the sustainability section and will be taken into consideration in the evaluation.

Baseline, target and actual of the indicators of each area is shown in Table 7.

Table 7 Quantitative Effects Indicators

\* achievement status of the indicators of each area is shown by changing the color of the cell  
If the actual achieved the target by 80% or more, the color of the cell is kept as it is.

The cell is colored if the achievement is more than 50% or less than 80% , less than 50%

(A) Thiruvananthapuram city Commissioning May 2010

Indicator / unit	Baseline		Target	Actual			
	I	II/III	II/III				
	1996	2006	2012	2018	2019	2020	2021
a. Total Population Served (thousands)	650	698	845	955	1,079	1,079	1,079
b. Amount of Water Supply (MLD)	108	190	264	264	264	264	264
c. Rate of facility utilization	-	-	95%	100%	100%	100%	100%
d. Un-accounted for Water	-	37%	29%	45%	40%	40%	40%
e. % of Population Served	53%	77%	90%	85%	90%	90%	90%

(B) Kozhikode city Commissioning February 2015

Indicator / unit	Baseline		Target	Actual			
	I	II/III	II/III				
	1996	2006	2012	2018	2019	2020	2021
a. Total Population Served (thousands)	145	560	1,011	962	739	796	825
b. Amount of Water Supply(MLD)	54	72	246	120	133	140	140
c. Rate of facility utilization	-	-	95 %	69%	76%	80%	80%
d. Un-accounted for Water	-	30 %	25 %	20%	41%	41%	N/A
e. % of Population Served	18 %	52 %	90 %	37%	64%	69%	72%

<sup>20</sup> According to materials at the time of appraisal

(C) Cherthala city Commissioning January 2012

Indicator / unit	Baseline		Target	Actual			
	I	II/III	II/III				
	1996	2006	2012	2018	2019	2020	2021
a. Total Population Served (thousands)	N/A	54	559	445	489	500	655
b. Amount of Water Supply(MLD)	-	7	111	55	60	67	71
c. Rate of facility utilization	-	-	85 %	51%	56%	63%	66%
d. Un-accounted for Water	-	-	19 %	25%	44%	44%	N/A
e. % of Population Served	-	99 %	100 %	86%	82%	84%	100%

(D) Meenad village Commissioning February 2011

Indicator / unit	Baseline		Target	Actual			
	I	II/III	II/III				
	1996	2006	2012	2018	2019	2020	2021
a. Total Population Served (thousands)	42	70	453	235	317	357	N/A
b. Amount of Water Supply(MLD)	-	13	73	36	48	55	58
c. Rate of facility utilization	-	-	85 %	51%	68%	75 %	79%
d. Un-accounted for Water	-	-	19 %	30%	33%	33 %	N/A
e. % of Population Served	11 %	16.3 %	100 %	43%	70%	80 %	80%

(E) Pattuvam village Commissioning March 2013

Indicator / unit	Baseline		Target	Actual			
	I	II/III	II/III				
	1996	2006	2012	2018	2019	2020	2021
a. Total Population Served (thousands)	49	69	405	151	330	246	388
b. Amount of Water Supply(MLD)	1.7	1.8	93	30	43	45	60
c. Rate of facility utilization	-	-	85 %	33%	48%	50%	67%
d. Un-accounted for Water	-	-	19 %	30%	40%	40%	N/A
e. % of Population Served	13 %	12.1 %	90 %	33%	71%	53%	83%

Source: baseline and target are from material provided by JICA, actual is from Executing Agency's answer to the questionnaire(November 30, 2021)

Note1 ) there was no target setting in I's appraisal

Note 2) 2021's data is the average of the beginning of the year to the ex-post evaluation (November 11) time

Only (A) Thiruvananthapuram city accomplished all the indicators. The scheme was providing (b) the designed amount of water, and the facility was fully used because (c) the facility utilization rate was 100%, and providing water to more than the targeted scale of the (a) population served.

Achievement of other four area have been improving year by year, but all the indicators has not reached 80% or more. According to the latest data (2021), (b) amount of water supply of Meenad was 79% to the designed water supply capacity, which was close to 80%. However, the latest data of other cities were only 57% for Kozhikode city, Cherthala city 63%, and Pattuvam 64%.

The reason for Kozhikode city and Meenad village was that because in these areas water distribution networks have not been completed, and unable to distribute the planned amount of water, the water treatment plants restrict their operation. Construction of the unfinished water distribution network is underway with other funds, thus once completed, it is expected that the

target of (b) the amount of water supply will attain the target.

In Cherthala city, the operation of water supply facility is reduced to less than 70% because of the problems of rupturing due to wrong specification of distribution pipes. Replacement works are needed, but it is unclear whether indicators of (b) amount of water supply and (c) facility utilization rate will achieve the target because there is no prospect of the replacement works. Numerically, (e) percentage of population served is accomplished, but in practice, it is presumed that the water may not have provided to some of the population

Details will be explained in the sustainability section, but in the Pattuvam village, facility has not been fully operational because the shortage of staff for operation and management. Since outsourcing contract is underway, and once appropriate contractor will oversee operation and maintenance, the problem will be solved, and it is presumed that (b) amount of water supply and (c) facility utilization ratio will be achieved the target.

#### 3.3.1.2 Qualitative Effects (Other Effects)

The qualitative effects are understood as the stable supply of water of a certain quality, and achievement of the effects is assessed from the situation at the time of ex-post evaluation.

In India, water quality is regulated by the national standard (IS10500-2012 CPHEEO guidelines). The executing agency has been inspecting water quality in their laboratories at each water treatment plant to ensure they are providing the water meeting the quality control regulation of the agency. In the field studies, no problem was observed in the quality of the supplied water.

Regarding the stability of supply, according to the Executing Agency, water outages rarely occur in each project area, and the water has been distributed almost 24 hours a day, 365 days a year. Therefore, it is assumed that the water supply service is provided stably.

Of the five project areas, Thiruvananthapuram accomplished the indicators' target of amount of water supply, facility utilization rate, water supply population and percentage of population served regarding the objective of the project "to provide safe and stable water supply service to meet the growing demand for water." Of the other four areas are having problems, such as 2 areas have not completed the construction, replacement of water distribution networks is needed, and one area is full operation is prevented by staff shortage. Thus, the designed capacity of the facilities is not fully utilized. However, it is expected that the effect will be achieved if the problems are solved. The quality of the supplied water is stable, and outage is rare. Therefore, at the time of ex-post evaluation, the effectiveness is judged to be fair.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

At the time of appraisal, "improvement of the local residents' living conditions" was set as the

impact of the Project. In particular, "improvement of public health by safe water supply" and "improvement of domestic water quality" were expected.

Regarding improvement of public health, there are no studies or data to examine the Project's effects specifically, but according to a statistical analysis report<sup>21</sup> on the data from the Directorate of Health Services Portal (from 2011 to 2019), most communicable disease cases was water-borne (95% to 99%), and vector and air-borne cases were rare.

Of the water-borne diseases, majority was due to diarrheal diseases (97%), and the number of the reports of diarrheal diseases has been increasing since 2011. Although, the degree of seriousness is low because no death case was reported.

On the other hand, the water-borne diseases that cause serious symptoms such as typhoid fever (-98.8%), hepatitis A (-64.6%), and cholera (-50%), are tended to decrease significantly.

In Kerala, more water-borne diseases have been reported in the rainy season than in winter. The outbreak of diarrheal infections overlaps with the monsoon times in the rainy season. The main cause is assumed to be contamination of well water, such as the inflow of water from the septic tank of the toilet into wells and the use of the water without proper chlorination.

The spread of tap water can reduce the chances of using contaminated water, thus it can be presumed that the Project has also contributed to the reduction of water-borne infectious diseases that cause serious symptoms and the improvement of the sanitary environment.



Sampling Points (Cherthala)



Water Testing Laboratory (Kozhikode)

According to the Executing Agency, the Project's contribution to improving the quality of domestic water is recognized as being able to provide tap water that meets water quality standards to a wide range of targets. For example, in the state's capital, Thiruvananthapuram, the population has increased significantly to 187% in 10 years since 2010. This Project supplies water to 80% of the population, and moreover, 24 hours water supply without outage was realized. Even in other major cities (Delhi, Bengaluru, Chennai, etc.), 24 hours water supply has not been achieved, and

<sup>21</sup> International Journal of Research in Medical Sciences vol 9 No.8 2021  
<https://www.msjonline.org/index.php/ijrms/article/view/9841> (retrieved on December 1, 2021)

it can be said that the realization of 24 hours water supply is a major impact of this project.

Prior to the Project, small-scale water supply facilities installed were geographically dispersed in rural areas, thus the coverage and volume of water supply were limited. The capacity of the facilities was not sufficient to meet the rapidly increasing population and the water demand, and the water quality was not too good. Once the Project constructed water distribution networks providing high-quality water to the target area for 24 hours a day without interruption, the previous small-scale supply facilities are no longer in use.

The project areas of Kozhikode are located along the coastline facing the Arabian Sea, and since the main water source was groundwater infiltrated by seawater, residents were using saline water from the wells. The Project started supplying high-quality tap water to the areas.

A hotel in Cherthala city had a sign saying "WE USE JICA WATER", recognizing the tap water by this project as a high-quality brand.<sup>22</sup>

Although there is no study to verify the impact of the Project, and quantitative data could not be obtained, from the information above it can be said that the expected impact was achieved to a certain degree.

### 3.3.2.2 Other Positive and Negative Impacts

#### (1) Impacts on the Natural Environment

At the time of the appraisal, no significant negative impact on the natural environment was expected. For this Project, *OECD Guideline for Environmental Consideration* (the first version) was applied. Accordingly, the Project was classified as category B of *the JBIC Guidelines for Confirmation of Environmental and Social Consideration* (April 2002) as it does not fall into sectors, characteristics, and the area that will impact the environment, nor is it in a sensitive area. Furthermore, it was determined that any adverse impact from the Project on the environment would not be significant.

Environmental Impact Assessment (EIA) was not conducted because it was not required by Indian law. During the construction period of the Project, environmental monitoring and measures were taken mainly to reduce dusts to the atmosphere by spraying water. In addition, noise levels, vibrations, soil pollution, air pollution, water quality in soil and waste treatment were monitored once a day.

According to the Executing Agency, during the construction work of Kozhikode city, there was a problem that the surrounding houses were damaged when the rock was blasted, and in Cherthala city, pipe-blast damaged surrounding houses during the construction of the water pipes. Both damages were covered by compensation.

In all the project sites, the water sources for treatment plant intakes are nearby rivers, so land

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<sup>22</sup> Field study report from National Consultant

subsidence has not occurred. In addition, sludge is chemically treated by using sludge thickeners in Thiruvananthapuram, Kozhikode, and Pattuvam. In Cherthala and Meenad, sludge is reused as fertilizer after dehydration. The quality of the water supplied from the water treatment plants also are satisfying the standards of India. Thus, there is no negative impact on the natural environment.

## (2) Resettlement and Land Acquisition

At the time of appraisal, the total area needed for the project was 131.14ha, and almost all the area were acquired following the India's domestic regulation. Also, 11 households were to be resettled due to land acquisition. According to the Executing Agency, after holding meetings to explain to the residents, the affected residents consented, and compensation was provided in accordance with national and state regulations.

Of the land acquisition plan, 2.28ha of the distribution reservoir site in Kozhikode City, although it does not require resettlement but has not been acquired due to ongoing disputes with the landowner.

The construction of reservoirs has completed, but two of the reservoirs could not be connected to the water transmission and distribution pipes, and thus not in use.

## (3) Unintended Positive/Negative Impacts

None.

Regarding the effectiveness of the Project, at the time of ex-post evaluation, facilities are not operated fully at designed capacity, because of the problems such as construction of the facility is partially underway, there are some parts needed to be repaired, and operation is limited due to shortage of personnel. However, in future if the problems are solved, the effect will be achieved. The quality of the supplied water is stable, and outage is rare.

Regarding the expected impact of the Project, there are examples of contributions to improving the living environment of residents, improving public health by supplying treated water, and improving the quality of domestic water. No negative impact on the natural environment has been reported, damages during construction have been compensated, and sludge generated in treatment plant is handled appropriately at each facility. Both land acquisition and resettlement cases have been handled in accordance with the regulations.

In the light of the above, this project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

### 3.4 Sustainability (Rating:②)

#### 3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

The Executing Agency, KWA is an organization under the jurisdiction of the state government, established in 1984. It is responsible for (1) planning, operation, promotion, maintenance, and financing of water supply and sewerage services in (2) services in supplying safe water and providing sufficient sewerage treatment in all the areas in Kerala, (3) formulation of state water and sewerage plans, (4) establishment of state standards for water and sewerage, and (5) research and studies for the efficient execution of the above.

At the time of the appraisal (as of March 2008), the number of KWA staff was 9,024, of which about half (4,735) were engineers. After the Project completion, 1,714 staff (including 568 engineers) were planned to be allocated. At that time, KWA was supposed to conduct operation and maintenance of the facility after the completion of the Project, and if necessary, part of the water pipe maintenance was to be outsourced.

At the time of the ex-post evaluation, due to restructuring of government ministries, supervisory bureau was changed from the Ministry of Irrigation to the Ministry of Water Resources, but no changes have occurred in the structure or mandate of the Executing Agency

The number of KWA staff (as of April 2021) was 6,735, of which engineering section was 4,845 including 745 engineers, of which administrative section was 1,890. Besides of these, outsource company's staff are estimated about 7,000, which was more than the number of KWA staff.

The number of KWA staff at each project site, is shown in Table8. Actual numbers of staff are about 12 to 16 % of the estimated number from the planning time. To cover for that shortage, a minimum number of KWA full-time staff is assigned for supervision, and the rest of the operation and maintenance work is outsourced. According to the field studies and interviews conducted during ex-post evaluation, the number of staff is sufficient for Thiruvananthapuram scheme, but for Kozhikode, Cherthala, Meenad, and Pattuvam schemes, while the number of regular staff was insufficient to carry out 24 hours duties of chlorine injection facility, control center, and remote-control area. In addition, because the outsourcing contract was still in progress in Pattuvam village, the facility could not be fully operated due to a shortage of personnel. These staff shortages for 24-hour operation, staff from other departments with different specialties have been covering concurrently.

Table 8 Headcount of Operation/Maintenance Staff

Job Title (unit : person)	Total	Engineer	Administration	Finance	Plan at appraisal	Total number/ plan
Total of project sites	241	149	75	18	1,714	14%
(A) Thiruvananthapuram	54	35	15	4	390	14%
(B) Kozhikode	62	44	15	3	465	13%
(C) Cherthala	38	20	15	3	311	12%
(D) Meenad	46	27	15	4	294	16%
(E) Pattuvam	41	23	15	4	254	16%

Source: Executing Agency's answer to questionnaire (November 30, 2021)

According to the Executing Agency, because of the influence of COVID-19, the headquarters was closed or working hours was shortened, but the water supply work was continued as usual during that closure period. However, the shortage of maintenance staff has become more prominent, and the response to customers' complaints such as water leaks has been delayed.

In addition, the State Planning Board<sup>23</sup> sought improvements in operations such as, (1) proper documentation, (2) collection and compilation of data and analysis, (3) technical and technological upgrading to identify and prevent leakages, (4) time bound execution of projects, and (5) improve operation with service-oriented approach. These are also the same issues found in the evaluation study, and the organization should work on improvements.

To sum the above, no issues have been observed in the institutional structure and the duties of KWA. In addition, KWA staff for operation and maintenance are outsourced, however, some sites are having difficulties allocating engineers with the necessary expertise and establishing sufficient operation management structure. Thus, there are some problems in institutional aspects of operation and maintenance.

### 3.4.2 Technical Aspects of Operation and Maintenance

At the time of the appraisal, technical and implementation capabilities of KWA were assessed, and that there was no problem because KWA had sufficient experience from accepting assistance from the World Bank, Denmark, and the Netherlands, and from constructing water supply facilities in Thiruvananthapuram and Kozhikode.

According to KWA, the facilities are properly managed by outsourcing to the contractors who have the necessary capabilities for operation and maintenance. Other than the water treatment plants that are maintained by full-time KWA employees, KWA is supervising the operation and maintenance work of the contractors. KWA considers there is no problem because all the staff of the contractors and KWA in charge of operation and maintenance are qualified and received appropriate training.

However, at the time of field studies, some project sites answered that there are some

<sup>23</sup> Working Group on Drinking Water and Sewerage on the preparation of Kerala state's 13th Five-Year Plan for Kerala (2017-2022)

components that cannot be maintained because there is no local company to outsource with technical capabilities for maintenance, electrical system, or electrical installation technology.

In addition, regarding KWA's operation and maintenance technical skills, the above mentioned working group on Drinking Water and Sewerage of the Kerala State Planning Board pointed out problems such that there is a shortage of experienced engineers, there is a large gap between water production and supplied amount, the needs for facility maintenance work is not recognized, poor supervision of chlorine treatment techniques to satisfy water quality standards, in addition, no staff has comprehensive information on production and supply issues, and data is not managed or accumulated as an organization. These also overlap with the problems identified in the field studies of this evaluation.

From the above, some issues have been observed in the technical aspects of operation and maintenance.

### 3.4.3 Financial Aspects of Operation and Maintenance

The balance of KWA's income and expenditure for the last five years is shown in below Table 9. The expenses required for operation and maintenance cannot be covered by revenue from water tariff, instead the operation cost is covered by national and state subsidies. Since KWA is the organization in the state that supplies water and sewerage, it is unlikely that subsidies will be stopped.

Table 9 Income and Expenses of KWA (unit: INR)

FY	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
<b>Income</b>	<b>11,001,791,613</b>	<b>11,659,035,588</b>	<b>12,290,292,442</b>	<b>12,853,461,717</b>	<b>13,755,640,460</b>
Water Supply (households)	5,842,571,055	6,223,282,041	6,532,922,793	7,117,605,758	8,359,583,042
Water Supply (others)	11,408,878	32,016,667	91,801,376	51,093,273	281,609,395
Contribution & Grants from Government of Kerala	2,651,069,000	2,965,575,000	2,809,747,800	3,590,231,800	2,735,311,300
Contribution & Grants from Government of India	81,393,000	104,652,000	36,569,000	-	320,429,705
Others	2,077,584,680	2,333,509,880	2,819,251,473	2,094,530,886	2,058,707,018
<b>Expenses</b>	<b>14,561,184,943</b>	<b>16,600,372,068</b>	<b>15,477,407,323</b>	<b>18,069,399,684</b>	<b>18,088,160,023</b>
O&M	3,353,469,906	3,702,503,084	4,084,894,725	4,654,306,066	4,407,696,875
Administration	7,340,861,414	8,235,403,725	8,950,467,922	9,044,815,286	150,730,415
Others	3,866,853,623	4,662,465,259	2,442,044,676	4,370,278,332	13,529,732,733
<b>Income-Expenses</b>	<b>-3,559,393,330</b>	<b>-4,941,336,480</b>	<b>-3,187,114,881</b>	<b>-5,215,937,967</b>	<b>-4,332,519,563</b>

Source: KWA Annual Account Report FY2017-2021 versions

Note) Data for 2020-2021 are provisional

KWA has been enforcing to reduce un-accounted for water. In 2019, a Revenue Monitoring Cell was formulated in the Administration Section of the KWA headquarters, and the section is

making efforts to reduce arrears by awareness campaigns through the media and using IT tools.

One of the challenges is establishing a GIS system that locate water supply facilities and owners, which also includes information on the locations of households and public taps and billing address of the owners. At the time of ex-post evaluation (as of April 2021), half of all the facilities in the state (242 water treatment plants, 692 pump stations, 75,000 km of pipelines, 1,486 service reservoirs, 2,600,000 household taps, and 200,000 public taps) were registered to the GIS system.

In addition, policy on water meter was formulated, and rules such as installation of meter, management, and reading were stipulated as state regulations.<sup>24</sup>

Water tariffs have been deferred since the revision in September 2014. The price setting was not at a level that could cover operation and maintenance costs. The Government of Kerala has issued a document<sup>25</sup> that will start increasing prices by 5% every year from 2022.

Regarding financial aspects of sustainability, the income from water tariff has not been able to cover the costs for operation and maintenance, and tariff revision and countermeasure for unaccounted-for-water are still in progress. However, the costs for operation and managements are expected to be secured because national and state subsidies are supporting the operation.

#### 3.4.4 Current Status of Operation and Maintenance

Regarding the status of the operation and maintenance at the time of ex-post evaluation, the main facilities such as water intake, water treatment, distribution system are working normally, and water supply has been continuing. However, the field studies found following issues.

##### (1) Automation System

The project was aiming to automate monitoring and control by centralized system by installing SCADA, Central Control Unit, and flow meters at the time of II/III appraisal. At the time of ex-post evaluation, the field studies found that some attempts have been made to use the system in the facility of Thiruvananthapuram City, however, the automation system in all of the project facilities were not used, and even some service reservoirs are un-connected to the system. For the reason, KWA is facing difficulties to know the accurate amount of water flow at each facility, and to detect the locations and the situation of the leak. Because the operation and measurement are done manually, the operation requires more staff. The input of chlorine for disinfection is a work that can be automated, in Pattuvam village, out of 13 service reservoirs, five are understaffed, and re-input of chlorine has not carried out appropriately, which is an issue that may affect to safe water supply. According to the field study report by the National Consultant, the automation functions are not in use because the importance and advantages of automation system in measuring water treatment, production and supply amount, and SCADA and remote system in

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<sup>24</sup> KWA Implementation of Meter Policy (March 15, 2021)

<sup>25</sup> Government circular G.O.(Ms) No.9/2021/WRD dated February 10, 2021

operation are not fully understood.<sup>26</sup> Furthermore, without using the new system, KWA can operate water supply facility manually. Also, technical transfer from the construction company that installed the system was not sufficient, and operation and manage support plan were not materialized.<sup>27</sup> Moreover, when the system was installed, 2G was the communication band, at the time of ex-post evaluation it was upgraded to 3G/4G. But the facilities by the Project were not updated, and this was another reason that system are not used.

## (2) Repair and Maintenance

After the commissioning, no repaint work was done at all the pumping stations, water treatment plants, and service reservoirs, which is violation of the Central Public Works Department Maintenance Manual.<sup>28</sup> Painting of metal part is necessary maintenance work to prevent corrosion and keep the facility in good condition. Especially, the brake pressure tanks in water treatment plants required immediate maintenance work. Because the tanks may explode if they corrode.

In Kozhikode's high metal percentage of manganese, iron, and magnesium were detected in transmission pumps and reservoir tank in the water treatment plant. It is a serious issue that requires immediate attention. One of the service reservoirs in Cherthala, and two in Kozhikode were not in use. In Pattuvam only a part of the capacity of service reservoirs was used.

While water leaks have been pressing on KWA's business and causing customers' dissatisfaction,<sup>29</sup> KWA has been responding water leakage after the problem occurred, and in all the project area, no detection and inspection works have been carried out in advance to prevent leaks.

As indicated in the effectiveness section, ratio of un-accounted for water tends to deteriorate. Regarding the maintenance of the installed equipment, according to the engineers of the Executing Agency, they were installed more than 10 years ago, and there is no domestic company that manufactures spare parts, while procuring spare parts for foreign made facilities are difficult.

## (3) Safety Management

In all the facilities, excepting one contracting company, safety measures (helmets, safety shoes) and security measures (uniforms and name tags) of staff working in pumping stations and water treatment plants were not worn by the KWA staff and the staff of outsourced companies. The

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<sup>26</sup> According to the JICA India Office, SCADA is not functioning because the contractor does not repair the faulty part even if KWA requests it, and the O & M contract is not properly concluded.

<sup>27</sup> According to the JICA India Office, even after the final loan disbursement they have appealed the necessity of functionalization of SCADA repeatedly and requested improvement, but KWA did not accept it.

<sup>28</sup> In India, repainting every 10 years is mandatory according to the Central Public Works Department Maintenance Manual

<sup>29</sup> KWA's customers complained in a week (September 18 to 24 in 2021) out of 4,519 cases, about 91% (4,110) were claims related to water leaks.

measures are needed to be mandatory to prevent accident of staff, and to prevent invasion of outsiders, and to maintain the sense of professionalism.

As above, regarding the situation of operation and maintenance at the time of ex-post evaluation, the automation system were installed in all the project areas, however, they are not being in use in actual operation. The field studies found problems such as regular maintenance works were not carried out, and safety management was not sufficiently provided.

Regarding sustainability, in terms of the institutional and organizational aspects, the operation and maintenance system has been established by using outsourcing. Sufficient number of staff was not allocated in some area, but outsourcing contract is underway, and the shortage will be solved. About the technical aspects, KWA has training and qualification regulation, an engineer with appropriate skills were allocated, but in some sites shortage of skilled staff was covered by other sections' staff with other specialties.

In addition, some problems were observed with the status of operation and maintenance of the facilities, such as the application of automation systems, maintenance, and safety measures. The financial aspects of operation and maintenance are expected to be guaranteed by government subsidies. As of above, the sustainability of the Project effect is fair.

## **4. Conclusion, Lessons Learned, and Recommendations**

### 4.1 Conclusion

The Project has been consistent with the development plans and policies of the governments of India and Kerala's development policies and development needs; by Japan's policy for assistance to India at the time of the appraisal. Therefore, its relevance is high. Because the target area of the water supply included rural areas, the Project anticipated Sustainable Development Goals (hereafter referred to as SDGs) and the trends of the Government of India focusing dissemination of safe-water supply to a rural area. In project implementation, more attentive support to avoid delays should have been considered according to the experience of the Executing Agency.

Most of the Project's original scope was implemented almost as planned, but some components were not completed. Construction of the remaining components has been continued using funds other than Japanese ODA Loan. Because the cost for the above-unfinished scope was not included in the construction cost, the project cost was within the plan. However, the project period was delayed significantly. Therefore, the efficiency is fair.

Regarding the effectiveness indicators, among the five project areas, one achieved the target of water supply amount, facility utilization rate, total population served, and percentage of population served. In the other areas, water treatment plants have not supplied the amount of water commensurate to the designed capacity because of incompleteness and defection in three areas, and lack of engineers in one area. On the other hand, the quality of the supplied water and the situation that water outage is extremely rare, it can be said that services have been provided stably.

The expected impact of the Project, improving living conditions of the residents, are some examples of contributions to the improvement of public health and water by water supply. No adverse impact on the natural environment due to the Project has been reported. Compensation to the damages during construction and land acquisition and resettlement were carried out by the regulations. Because expression of the project effects is limited extent, the Project's effectiveness and impact are fair.

Regarding sustainability, some of the project areas are having difficulties allocating engineers with appropriate skills. In addition, some problems were observed with the status of operation and maintenance of the facilities, such as the application of automation systems, maintenance, and safety measures. However, since the water supply function has been in operation, and financial aspects of operation and maintenance are expected to be guaranteed by government subsidies. The sustainability of the Project effect is fair.

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

### 4.2 Recommendations

#### 4.2.1 Recommendation to the Executing Agency

In the field studies, some problems regarding the operation and maintenance of facilities

constructed in the Project were found. Since the following two problems are serious ones, immediate countermeasures should be taken.

- ◆ Maintenance of pressure tank in water treatment facility
- ◆ Water quality improvement of transmission system, and water treatment plant in Kozhikode

As for the following, it is desirable that the chief engineer and engineers of the project areas should examine the regulations and operation. According to the examination, entire organization should secure budget and to implement the measure by the end of next fiscal year.

- ◆ Maintenance and repair plan and safety management.
- ◆ updating the automation system, and operation and management trainings to use the system in operation.

In addition, the working group on Drinking Water and Sewerage of the Kerala State Planning Board sought improvements in operations such as, (1) proper documentation, (2) collection and compilation of data and analysis, (3) technical and technological upgrading to identify and prevent leakages, (4) time bound execution of projects, and (5) improve operation with service-oriented approach. These are also the same issues found in the evaluation study, and the organization should work on improvements.

#### 4.2.2 Recommendation to JICA

When the project was re-appraised, introduction of automation system was added. The system was constructed as planned, but at the time of ex-post evaluation, it is not used in all the project areas. These system is expected to contribute to measuring accurate water flow. Moreover, the system will help the Executing Agency to detect leaks which are adversely affecting the management of the Executing Agency, and to solve personnel shortages. It is desirable for JICA to promote the engineers of the Executing Agency to understand the advantages of the system, and to provide support such as additional training and on-the-job guidance so that the constructed system can be used for water supply routine.

Even after the completion of disbursement of the Yen Loan, the JICA India Office has been reminding the necessity of these systems to KWA, but in reality, there is a gap with the notion of KWA. Although it is possible to supply treated water without the automation system, to encourage KWA to implement the system for their efficient and sustainable water supply business operation, it is necessary to promote understanding of KWA to the benefit through trainings or introducing practices of other cities.

#### 4.3 Lessons Learned

##### Closer support for inexperienced Executing Agencies

Among the main causes of delay in the Project, the one related to the experience of the Executing Agency was the delay in selecting consultant and contracting. Although the Executing

Agency had experiences in implementing international donor projects, it was the first time to implement a large-scale project such as this one, and was unfamiliar with the preparation of bidding documents, selection and contracting procedures.

They had difficulties in planning bidding package in appropriate size and in evaluating the capacity of the construction companies, as a result companies that did not have the capabilities ended up handling more packages than they could handle. Consequently, there were cases that the contract term ended before completion of facility, time was wasted while repeating bidding processes.

When an inexperienced organization becomes the Executing Agency of a large-scale project, to prevent delays in the project, consultants and JICA should provide support in the preparation of bidding documents through consulting services immediately after the start of the project. In examining the contents of bidding, in particular, it is important to tighten the bidding qualifications so as to select contractors with appropriate scale and capability, and to clarify the conditions to eliminate the insufficient contractors prior to the bidding process.

Regarding project monitoring, it is effective to implement closer monitoring, for example, holding meetings promptly with executing agency, and establishing mechanisms to find and solve issues in the early stage. The above is considered to be effective in conducting bidding smoothly and avoiding the delay of the project.

#### Consideration and approach according to local characteristics

At the time of the appraisal, the Executing Agency and JICA should have discussed consideration and approach according to the uniqueness of the target areas. Every June-October, Kerala is hit by a monsoon, and it is also a difficult time to proceed with construction works as scheduled. Project schedule should have been formulated taking these points into consideration.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
<b>1. Project Outputs : Water Supply Facilities</b>		
(A) Thiruvananthapuram	Water Treatment Plant 74MLD, Transmission system, Distribution Network 410 km, Service Reservoirs 11, Rehabilitation of 2 Plants	Almost as Planned Except Rehabilitation of 1 Plant
(B) Kozhikode	Water Treatment Plant 174MLD, Transmission system, Distribution Network 1,865km, Service Reservoirs 20, Rehabilitation of 1 Plant	Almost as Planned Except about 304 km of distribution network
(C) Cherthala	Water Treatment Plant 107MLD, Transmission system, Distribution Network 659 km, Service Reservoirs 18	Almost as Planned
(D) Meenad	Water Treatment Plant 71MLD, Transmission system, Distribution Network 960 km, Service Reservoirs 14	Almost as Planned Except about 230 km of distribution network
(E) Pattuvam	Water Treatment Plant 90MLD, Transmission system, Distribution Network 625 km, Service Reservoirs 13	Almost as Planned
Consulting Services	Assistance in Review of Feasibility Reports, Detailed Engineering Design, Tendering Assistance, Supervision, procurement of equipment, and Institutional Strengthening	Completed 31 March, 2016
	Trainings for the staff of Executing Agency	All the domestic trainings have completed. Overseas training: 14 staffs have participated training in Japan
Institutional Strengthening	Maintenance Vehicle: 128 units, Office Supply, O&M Equipment	Maintenance Vehicle: 61units, completed other procurement
Additional components in Phase II/III	Establishment of Information Management system: Complaint Redressal Software, Project Management Software , Building Enterprise Resource Planning and Central Control Unit :	ERP System has not built, Complaint Redressal Software partially completed. Completed other items
<b>2. Project Period</b>		
	February 1997 to December 2010 (167 months)	February 1997 to Incomplete at the time of Ex-post Evaluation
<b>3. Project Cost</b>		
Amount paid in Foreign Currency	1,772 million Japanese JPY	1,947 million Japanese JPY
Amount paid in Local Currency	65,271million Japanese JPY (162,524 million INR)	45,183 million Japanese JPY (102,113 million INR)
Total	67,043 million Japanese JPY	47,129 million JPY
Exchange Rate	1INR =2.49 JPY (as of November 2008)	1INR =2.26 JPY (Average of February 1996 to July 2015 average)
<b>4.Final Disbursement Date</b>	July 2015	