

Country Name	The Water Quality Monitoring Techniques Project (Phase II)
Republic of Panama	

I. Project Outline

Background	<p>In Panama, more than half of the country population concentrates in Panama City, the capital city of the country, and Province of Panama. The demographic pressure induced contamination of water quality of the rivers running in those areas and the contaminated waters were worsening the condition/quality of the Panama Bay. The National Authority of Environment (ANAM: Autoridad Nacional del Ambiente), currently Ministry of Environment (MiAMBIENTE: Ministerio de Ambiente) conducted monitoring of natural water to determine the water quality monitoring in pursuit of their mission of supervision, control and inspection on waste water. However, since their laboratory had only basic level of analytical accuracy and techniques, they were not able to provide information with high accuracy for ANAM's (currently MiAMBIENTE) environment administration, in particular, water management. Therefore, the government of Panama requested the government of Japan a technical cooperation project aiming at improvement of technical capacity for analysis with scientifically high accuracy and analytical capacity.</p>						
Objectives of the Project	<p>Through establishing of the Standard Operation Procedures (SOPs) for analytical works for water quality, training for the technical staffs of the ANAM (currently MiAMBIENTE) Environmental Quality¹ Laboratory on water quality analysis, interpretation, monitoring and supervision as well as internal audit, the project aimed at increasing the capacity of the ANAM (Environmental Quality Laboratory to provide reliable information through QA/QC (Quality Assurance and Quality Control) system, thereby contributing to strengthening management capacity to fulfilment of surface waters and effluent standards of Panama.</p> <ol style="list-style-type: none"> Overall Goal: The management capacity with respect to the fulfilment of surface waters and effluent standards of the Republic of Panama is strengthened. Project Purpose: The Environmental Quality Laboratory of ANAM is able to provide reliable information through the implementation of QA/QC to contribute to in the strengthening of the ANAM environmental management. 						
Activities of the project	<ol style="list-style-type: none"> Project site: Whole area of Panama Main activities: 1) development of SOPs for the selected parameters, 2) improvement of QA/QC system, 3) delivery of trainings for personnel of the ANAM Environmental Quality Laboratory in terms of SOPs, 4) delivery of trainings for personnel of the Directorate of Environmental Protection (DIPROCA: Dirección de Protección de la Calidad Ambiental) in terms of internal audit for the QA/QC (Quality Assurance and Quality Control) system supervision, 5) preparation of water quality monitoring plan for the pilot watershed area, etc. Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;"> Japanese Side <ol style="list-style-type: none"> Experts: 15 persons Acceptance of trainees in Japan: 3 persons Equipment: Analysis equipment including UV-VIS Spectrophotometer, autoclave, low temperature water circulator, ion chromatograph, etc. Local cost: cost for seminars, trainings etc. </td> <td style="width: 50%;"> Panamanian Side <ol style="list-style-type: none"> Staff allocated: 32 persons Land and Facilities: Office spaces for the Japanese experts in ANAM Environmental Quality Laboratory Local cost: cost for water quality sampling and analysis, utility, travel expenses, etc. </td> </tr> </table> 					Japanese Side <ol style="list-style-type: none"> Experts: 15 persons Acceptance of trainees in Japan: 3 persons Equipment: Analysis equipment including UV-VIS Spectrophotometer, autoclave, low temperature water circulator, ion chromatograph, etc. Local cost: cost for seminars, trainings etc. 	Panamanian Side <ol style="list-style-type: none"> Staff allocated: 32 persons Land and Facilities: Office spaces for the Japanese experts in ANAM Environmental Quality Laboratory Local cost: cost for water quality sampling and analysis, utility, travel expenses, etc.
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Ex-Ante Evaluation	2008	Project Period	November 2008 – November 2012	Project Cost	(Ex-ante) 310 million yen (Actual) 287 million yen		
Implementing Agency	National Environmental Authority (ANAM) (the current Ministry of Environment (MiAMBIENTE: Ministerio de Ambiente) since March, 2015)						
Cooperation Agency or Contract Agency in Japan	CTI Engineering International Co., Ltd.						

II. Result of the Evaluation

< Special perspectives considered in the ex-post evaluation >

Verification of Achievement Level of the Overall Goal

The verifiable indicators for the Overall Goal defined by the Project Design Matriz (PDM) do not specify the target level or the target value. Therefore, the achievement level of each indicator for the Overall Goal were verified as follows:

- Indicator 1 was verified by the current performance of the verifiable indicators for the output 1 which specify the capacity required for the MiAMBIENTE Environmental Quality Laboratory to conduct water quality monitoring supplementarily
- Indicator 2 was verified by the current level of relevant skills/knowledge trained by the project to enhance the capacity required for the MiAMBIENTE Environmental Quality Laboratory to conduct water quality monitoring supplementarily.
- Indicator 3 was verified by comparison between the number of firms monitoring industrial effluent at the end of the project (20) as baseline and the ones at the time of ex-post evaluation.

¹ The following elements affect "Environmental Quality": Air quality, water quality, noise, vibration, geological conditions and geography, impacts on flora and fauna, and so on.

1 Relevance

<Consistency with the Development Policy of Panama at the time of ex-ante evaluation and project completion>

The project was consistent with the Panama's development policy of "the National Water Resource Policy (2007)" which aims at "establishment of integrated water resource management".

<Consistency with the Development Needs of Panama at the time of ex-ante evaluation and project completion >

The project was consistent with the Panama's development needs of capacity enhancement of the ANAM laboratory to conduct scientific analysis and to monitor compliance with environmental standards under the law and regulations.

<Consistency with Japan's ODA Policy at the time of ex-ante evaluation>

The project was consistent with the Japan's ODA policy to support environmental conservation, including support for improvement of environment management administration, one of the 3 priority areas confirmed by the policy dialogue between Panama and Japan in March, 2005.

<Evaluation Result>

In light of the above, the relevance of the project is high.

2 Effectiveness/Impact

<Status of Achievement for the Project Purpose at the time of Project Completion>

The Project Purpose was achieved by the project completion. In total, 24 parameters with SOPs were established by the project. Also, the technical capacity of the Environmental Quality Laboratory of MiAMBIENTE to provide water quality data was improved through preparation of SOPs for the 24 parameters and improvement of QA/QC. In addition, 4 water quality reports with scientific monitoring data were published as planned.

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

The project effects have been partially continued since the project completion. Although the number of parameters to be analyzed by the Laboratory decreased to 17 out of 24, the number of samples for water quality analysis increased from 2,700 in 2012 to 5,323 in 2015. Also, the accuracy of water quality analysis has been sustained within the margin of error of 10% since the project completion. The water quality monitoring reports have been continuously published. For internal use, monthly reports have been prepared since 2013, which are linked to the Annual Operation Plan elaborated each year. For public use through website and printed materials, one report related to water quality monitoring has been published each year since 2013. The monitoring activity for La Villa River watershed based on the monitoring plan has continued as well. After agrochemical contamination of the drinking water from La Villa River, the monitoring activity has been enhanced and the number of monitoring spots increased to 17 through technical trainings for the Regional Administration staffs on sample collection for water quality analysis by the Laboratory staff.

However, no internal audit based on QA/QC system was conducted by the internal auditors after the project completion because the 3 trained internal auditors, who remain working for MiAMBIENTE, have been fully engaged in their increased daily duties at the Laboratory due to resignation of 2 scientists, in their training activities for new personnel and others at the regional offices, and in their collaboration in the implementation of projects with other public organizations. Instead, audits have been performed by external auditors from the Analysis Specialized Laboratory under the Mexican National Water Commission (CONAGUA) and the US Environmental Protection Agency (EPA). The new administration of DIPROCA/MiAMBIENTE is planning to outsource the internal audit service to an accredited institution. In terms of maintenance of analytical equipment, although the Equipment Maintenance and Calibration Program has been implemented, some key analytical equipment, such as Atomic Absorption Spectrophotometer (ASS) and chromatographs have not been in use because of insufficient capacity of electrical system reflected in electrical fluctuation and blackouts in other areas of the Laboratory and lack of technical staff.

<Status of Achievement for Overall Goal at the time of Ex-post Evaluation>

The Overall Goal has been partially achieved. The current staffs of the MiAMBIENTE Environment Quality Laboratory have been qualified to carry out water quality sampling and water quality analyses for 35 of 52 watersheds in Panama. However, only 17 out of the 24 parameters with SOPs developed by the project have been analyzed by the Laboratory staffs. Since the staff trained by the project who had skills and knowledge for analysis of the other 7 parameters² resigned and some key analytical equipment cannot be used because of the electrical problems; therefore, analysis for those parameters cannot be conducted. In addition, for 10 out of the 17 parameters only one primary staff is in charge to carry out their analysis and no assistant has been assigned to each of them, as recommended by the project. On the other hand, the areas to be monitored have been expanded since the project completion. As mentioned above, 35 of 52 watersheds in the country, including 100 rivers, have been monitored by the MiAMBIENTE Environment Quality Laboratory. Also, the monitoring spots, such as factories and rivers/pollution complaints, increased from 118 in 2012 to 166 spots in 2015 and expected to be increased to 170 in 2016 though decreasing to 103 spots in 2014 due to the reduction in the Laboratory's budget and complex administrative paperwork. These monitoring activities by the Laboratory have been based on the monitoring plan to verify environmental quality of surface waters for recreational use, water supply, agricultural and industrial use as well as preservation source for aquatic lives. Also, the regional offices of MiAMBIENTE have conducted the water quality monitoring at over 12 rivers other than La Villa River in the watersheds of Los Santos and Herrera provinces.

<Other Impacts at the time of Ex-post Evaluation>

Some positive impacts of the project have been observed at the time of ex-post evaluation. The data of water quality analysis have been utilized by other government or public institutions. 3,383 points have been monitored nationwide by the Ministry of Environment (MiAMBIENTE) under collaboration with the Ministry of Health (MINSAL: Ministerio de Salud) and the National Water and Sewerage Institute (IDAAN: Instituto de Acueductos y Alcantarillados Nacionales). Also, monthly monitoring of Chiriqui Viejo River Basin has been conducted by the Laboratory together with the Ministry of Agriculture (MIDA: Ministerio de Desarrollo Agropecuario), the Aquatic Resource Authority (ARAP: Autoridad de Recursos Acuática de Panamá) and the Gorgas Memorial Institute. In addition, the Panama Canal Authority (ACP: Autoridad del Canal de Panamá) utilized the data collected by MiAMBIENTE for their monitoring of the Panama Canal Watershed. Furthermore, the universities, such as University of Panama, can utilize the monitoring data for research works by their

² Br⁻, F⁻, CN⁻, Hg, Cr⁶⁺, HC and Pb

students. No negative impact on natural environment has been reported and no resettlement and land acquisition has been required by the project.

<Evaluation Result>

In light of the above, the project achieved the Project Purpose and partially achieved the Overall Goal through expansion of water quality monitoring activities by the MiAMBIENTE Environmental Quality Laboratory despite of the constraints on water quality analyses by the less number of parameters, no internal audit conducted and the limited utilization of analytical equipment. Therefore, the effectiveness/impact of the project is fair.

Achievement of project purpose and overall goal

Aim	Indicators	Results								
(Project Purpose) The Environmental Quality laboratory of ANAM (currently MiAMBIENTE) is able to provide reliable information through the implementation of QA/QC to contribute to in the strengthening of the ANAM (currently MiAMBIENTE) environment management.	(Indicator 1) At least 20 parameters with SOPs are established.	<u>Status of the achievement: Achieved</u> (Project Completion) ● 24 parameters were established. (Ex-post evaluation) Mostly continued. ● 24 parameters have been sustained for water quality analysis at the Laboratory but only 17 parameters have actually been analyzed. ● The water quality analyses based on SOPs have been continuously conducted by the Laboratory. ● The number of samples increased from 2,700 in 2012 to 5,323 in 2015.								
	(Indicator 2) Capacity to provide water quality data based on the established QA/QC procedure for 20 parameters.	<u>Status of the achievement: Achieved</u> (Project completion) ● Skills to develop SOPs for 24 parameters were obtained by the trained Laboratory staffs.. ● Capacity to conduct QA/QC of the Laboratory was improved through technical support in order to provide reliable water quality data. (Ex-post Evaluation) Partially continued ● The accuracy of water quality analysis has been sustained within the margin of error of 10%. ● No audit by the internal auditors was conducted after the project completion but the current DIPROCA administration is planning to outsource the internal audit to an external accredited institution. ● The Equipment Maintenance and Calibration Program has been under implementation but priority has been given to frequently-used equipment and according to the requirements, such as autoclaves, scales, and incubators. AAS and chromatographs have not been in use due to the insufficient capacity of electrical system and the lack of technical staffs.								
	(Indicator 3) 4 water quality reports with scientifically analyzed monitoring data published.* *”Published” refers to the following two different aspects: 1) internal management; 2) general public use.	<u>Status of the achievement: Achieved</u> (Project completion) ● The following reports were prepared and revised based on the improved monitoring data with scientific knowledge: ➤ Internal report for MiAMBIENTE (internal) ➤ Water quality monitoring report on river water (public) ➤ Water quality monitoring report on industrial effluent (public) ➤ Annual report disclosed to the public on the website (public) (Ex-post Evaluation) Continued ● The following reports for internal use and public use have been developed: ➤ 2013: monthly reports (internal), Water Quality Conditions of River in Panama (public) ➤ 2014: monthly reports (internal), Research on Macroinvertebrates in the Latin American Region (public) ➤ 2015: monthly reports, Annual Operation Plan (internal), Condition of Water, Soil and Biological Indicators of Chiriqui Viejo River Watershed (public) ➤ 2016: monthly reports (internal)								
(Overall goal) The management capacity with respect to the fulfilment of surface waters and effluent standards of the Republic of Panama is strengthened.	(Indicator 1) ANAM Environmental Quality Laboratory personnel are qualified to carry out water quality sampling.	<u>Status of achievement: Achieved</u> (Ex-post Evaluation) ● The number of samples for water quality analysis based on the SOPs continuously increased after the project completion except 2014. <table border="1" data-bbox="791 1883 1390 1995"> <tr> <td>2013</td> <td>2014</td> <td>2015</td> <td>2016 (plan)</td> </tr> <tr> <td>4,669</td> <td>3,933</td> <td>5,323</td> <td>(7,000) 3,635*</td> </tr> </table> *as of July, 2016 ● The staffs of the Laboratory have carried out water quality sampling to monitor different spots of the 35 watersheds throughout the country.	2013	2014	2015	2016 (plan)	4,669	3,933	5,323	(7,000) 3,635*
2013	2014	2015	2016 (plan)							
4,669	3,933	5,323	(7,000) 3,635*							
	(Indicator 2) ANAM Environmental Quality Laboratory personnel are qualified to carry out water	<u>Status of the achievement: Partially achieved</u> (Ex-post Evaluation) ● 7 of 8 scientists of the Laboratory have carried out water quality analysis for the 17 out of the 24 parameters with SOPs.								

quality analysis.		<ul style="list-style-type: none"> ● 10 out of the 17 parameters to be analyzed currently have been analyzed by only one primary scientist and no assistant. ● Analyses of the 7 parameters which cannot be analyzed by the scientists of the Laboratory have been outsourced. 																								
	(Indicator 3) Expanded area monitored by ANAM (currently MiAMBIENTE) Environmental Quality Laboratory.	<p><u>Status of the achievement: Mostly achieved</u> (Ex-post Evaluation)</p> <ul style="list-style-type: none"> ● The monitored areas increased to 166 spots in 2015. ● 35 watershed including 100 rivers out of 52 watersheds in the country have been monitored. ● The monitoring plan for the 35 watersheds have been prepared and implemented. ● 12 rivers other than La Villa River in Los Santos and Herrera provinces have been monitored by the regional offices of MiAMBIENTE ● 3,383 points have been monitored nationwide under collaboration among MiAMBIENTE, MINSA and IDAAN. ● Monitoring of Chiriqui Viejo River basin has been under implementation with collaboration among MiAMBIENTE, MIDA, ARAP and the Gorgas Memorial Institute. <p>[Number of areas monitored by the MiAMBIENTE Quality Laboratory]</p> <table border="1" data-bbox="759 562 1541 815"> <thead> <tr> <th>Type</th> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> <th>2016 as of June (Plan)</th> </tr> </thead> <tbody> <tr> <td>Factories/plants</td> <td>20</td> <td>36</td> <td>25</td> <td>44</td> <td>22 (+12)</td> </tr> <tr> <td>Other areas (rivers / pollution complaints)</td> <td>98</td> <td>89</td> <td>78</td> <td>122</td> <td>96 (+50)</td> </tr> <tr> <td>Total</td> <td>118</td> <td>125</td> <td>103</td> <td>166</td> <td>108 (+62)</td> </tr> </tbody> </table>	Type	2012	2013	2014	2015	2016 as of June (Plan)	Factories/plants	20	36	25	44	22 (+12)	Other areas (rivers / pollution complaints)	98	89	78	122	96 (+50)	Total	118	125	103	166	108 (+62)
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Total	118	125	103	166	108 (+62)																					

Source : Project completion report, Questionnaire and interview surveys with the Environmental Quality Laboratory, DIPROCA, the Regional Administration Offices in Herrera and Los Santos provinces (MiAMBIENTE)

3 Efficiency

Both the project cost and the project period were within the plan (ratios against the plan: 92.5% and 100%, respectively). Therefore, efficiency of the project is high.

4 Sustainability

<Policy Aspect>

There has been no change in the government policy on water quality management at the time of ex-post evaluation since the project completion. The Government Strategic Plan 2015-2019, promulgated by the current government since 2014, prioritizes environment management including water resource management. In addition, the National Plan for Water Security 2015-2050 and laws and regulations including the Water Law (the Decree Law 35 of 1966) and the Water Quality Law have endorsed the water quality monitoring activities by MiAMBIENTE.

<Institutional Aspect>

While ANAM (currently MiAMBIENTE) was leveled up to MiAMBIENTE, there was no change in the organizational structure or setting of DIPROCA and the Environment Quality Laboratory. The responsibility of the MiAMBIENTE Environment Quality Laboratory expanded to monitor 34 watersheds at the time of ex-ante evaluation to 35 watersheds at the time of ex-post evaluation. In addition, it is expected that the new organizational structure of MiAMBIENTE, including a change of the name and structure of DIPROCA, will be effective in 2017 after approval by the Ministry of Economy and Finance (MEF: Ministerio de Economía y Finanzas) in order to enhance their functions but no detail information was available at the time of ex-post evaluation. In terms of the personnel of the Laboratory, there were 8 scientists as of July, 2016. The number of scientists engaged in water quality analysis has not been sufficient to meet increasing demand for water quality analysis and monitoring throughout the country. 4 of the 8 counterpart staffs trained by the project resigned though one of them is currently working for the Los Santos regional office of MiAMBIENTE and is engaged in the water quality monitoring activity for La Villa River. The lack of personnel has also constrained coverage of parameters to be analyzed and development of SOPs. However, in a short run, DIPROCA is planning to fill the vacant position of chemical Laboratory technician and created two new positions for Chemical Regent and Quality Regent. Also, although the high turnover of the personnel for the Laboratory has impeded enhancement of analytical capacity of the Laboratory because of low competitive salaries and non-permanent employment status, the current DIPROCA administration has given a permanent status to all the Laboratory technical staff and is planning to increase their salaries in order to make employment conditions of the Laboratory more competitive. The Laboratory has not been accredited for ISO/IEC 17025 because of the lack of a Quality Regent or Manager required by the ISO/IEC 17025 as well as the limited procurement of goods and services. In order to get accreditation of the ISO/IEC 17025, the National Investment Programme for the Restoration of Priority Watersheds ("PROCUENCAS": Programa de Inversión para la Restauración de Cuencas Hidrográficas Prioritarias), including a component to improve the quality system of the Laboratory, is under implementation (2015-2019) with a financial support of the Development Bank of Latin America (CAF: Banco de Desarrollo de América Latina). For maintenance of analytical equipment, the problems of electrical capacity as mentioned above have constrained utilization and maintenance of the key analytical equipment such as AAS, chromatograph and large incubators in despite of the Equipment Maintenance and Calibration Program. It is expected that those problems will be solved by the installation of new electrical wiring through the above-mentioned loan program supported by CAF. In terms of internal audit, although 3 counterpart staffs of DIPROCA trained by the project have still been engaged in the analytical and monitoring activities for the Laboratory, they have not been engaged in the internal audit anymore.. Other 7 staffs trained by the project left MiAMBIENTE. As mentioned above, the internal audit will be outsourced to external auditors from an accredited institution.

<Technical Aspect>

In terms of water quality analysis, all the 8 scientists working for the Laboratory have the skills and knowledge for water quality sampling according to the SOPs, industrial effluent monitoring, water quality interpretation, and evaluation on contaminant behavior in

water environment. 6 of them have sufficient skills and knowledge for calibration of analytical equipment. For uncertainty analysis calculation, only 3 scientists are able to conduct it. Since very few training opportunities are offered by MiAMBIENTE in the particular areas required by the Lab staff, the newly recruited scientists for the Laboratory have acquired necessary skills and knowledge through the on-the-job trainings by the experienced staffs. In addition, by virtue of a collaboration agreement, the Gorgas Institute is going to appoint a biologist for the macro-invertebrate area to train the Lab staffs. In terms of the internal audit, the 3 remaining staffs trained by the project have not utilized their skills and knowledge about the internal audit because they are working for the Laboratory. In addition, the current staffs of DIPROCA have not been transferred the skills and knowledge about the internal audit by the 3 remaining staffs..

<Financial Aspect>

The sufficient budget has been allocated for the MiAMBIENTE Environment Quality Laboratory to cover cost of water quality analysis and monitoring activities, including purchase of equipment, maintenance of equipment, reagents, consumables and parts and fuel for vehicles. However, the amount of budget allocated to the Laboratory has been fluctuating year by year due to changes in its main budget sources. The budget for the Laboratory decreased from 564,900 USD in 2011 to 104,461 USD in 2013 and increased to 504,523 USD in 2015. The allocated budget in 2016 is 302,000 USD. For the years of 2011 and 2012, the external funds provided on a project basis were the main sources. Since 2013 after the project completion, the main sources of budget have been own revenue of the Laboratory and contributions from the national government to cover the necessary costs. In particular, the government subsidies to the Laboratory dramatically increased from 37,560 USD in 2014 to 339,853 USD in 2015 because the current government has confirmed importance of the environmental sector. Besides the allocated budget, MEF allocated 3 million USD for the Project of Monitoring of Water for Human Consumption³ under the initiative of the President of Panama. On the other hand, there was an issue of the budget execution. The proportion of budget execution against the allocated budget was only 51% in 2013 though it improved to 85% in 2014 and 89% in 2015. The limited budget execution constrained procurement of necessary equipment and reagents for water quality analysis at the Laboratory as mentioned above. The budget execution system requiring approval by the General Controller's Office for any procurement affects the water quality monitoring activities. However, this problem has been mitigated to a certain extent by the allocation of a Petty Cash Fund, which allow them to procure very urgent inputs. Since the delivery quality and supplier management is a requirement for the ISO/IEC17025 certification, DIPROCA plans to implement supplier management system for timely deliveries.

<Evaluation Result>

In light of the above, slight problems have been observed in terms of the institutional/technical/financial aspects of the implementing agency. Therefore, the sustainability of the effectiveness through the project is fair.

5 Summary of the Evaluation

The project achieved the Project Purpose and partially achieved the Overall Goal for enhancement of capacity of the MiAMBIENTE Environment Quality Laboratory for water quality analysis and monitoring. Although the Laboratory has improved and sustained its analytical and monitoring capacity on water quality, it is necessary to further improve the management of analytical equipment and internal audit in order to be certified ISO/IEC 17025.. As for sustainability, the government of Panama has prioritized improvement of water quality in the watershed in the country through the monitoring activities by DIPROCA/MiAMBIENTE and MINSAs. The scientists of the Laboratory have sustained their skills and knowledge to continuously conduct monitoring and analytical activities. On the other hand, there are issues of the insufficiency of the number of scientists for the Laboratory,, the limited capacity of the internal audit as well as the limited budget execution hampering timely procurement of necessary analytical equipment and reagents.

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

III. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

[DIPROCA/MiAMBIENTE]

- In order to enhance the capacity of the Laboratory for attaining the overall goal of the Project and obtaining the ISO/IEC 17025 accreditation, DIPROCA should continue their efforts to improve the Lab budget execution through the implementation of a good supplier management system for timely procurement of necessary reagents and other inputs, and adequate equipment maintenance. The planned installation of the new electrical wiring must also be conducted as soon as possible in order to make good use of the Lab equipment and devices, and to prevent further deterioration or damages thereof.
- As for equipment maintenance concerned, it is necessary to appoint a person to be in charge of equipment maintenance within the Laboratory, to select and contract good-service maintenance companies, to establish a maintenance and calibrations program for all equipment (not only for frequently used), to avoid further deterioration, and to strengthen the record keeping for operation, maintenance/calibrations, and inspection of key analytical equipment, including name of persons that use, maintain, or calibrate them, date and time.
- DIPROCA should establish a formal training system for the Lab technical and administrative personnel, including technical visits on internationally accredited laboratories outside of the country, so as to learn good practices that can be implemented in MiAMBIENTE Environmental Quality Laboratory. It should also explore the possibility of obtaining technical advice or training from foreign experts for the Lab technical personnel in some priority areas, such as required analysis of some parameters, the elaboration of necessary additional SOPs, equipment maintenance and calibrations, internal audit, etc.
- The possibility of establishing a formal internship program (“professional practice” program) for outstanding graduate students from recognized local universities should be explored in order to get professional help for the Lab scientists in the record keeping and other mechanic, repetitive activities, and also to train them in sampling and analytical activities for creating a database of trained scientists who can be eventually recruited.

³ The project consists of collection and analysis of 3,383 samples of water for human consumption under collaboration with MINSAs, IDAAN, and external laboratories certified in 25 parameters.

Lessons learned for JICA:

- This project provided analytical equipment such as AAS and chromatograph which require stable electrical system in order to enhance analytical capacity of laboratory scientists. However, due to the electrical problems of fluctuation and lack of capacity constrained the utilization of those equipment, the counterparts trained by the project were not able to conduct analytical works on some parameters with SOPs developed by the project. It was necessary to assess conditions of the laboratory before installation of those equipment and to provide necessary devices to improve the electrical system for utilization of necessary equipment in order to ensure effectiveness of the project and its sustainability.



Water Quality Sampling at La Villa River



Environmental Quality Laboratory equipped by the Project