

Capability of the laboratories of universities to develop environmental studies

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1. INTRODUCTION

The growing demand for environmental studies including measurements of analytical parameters have prompted the need for identifying and promoting the development of new institutions to cope with this demand. In Latin America, the participation of universities in environmental monitoring programs is increasing, thus, it is necessary to know their capability to contribute to environmental studies based on accurate data to take informed decisions for the different realities of the countries of the Region.

The present study was conducted by CEPIS, at the request of the General Bureau of Environment of the Ministry of Energy and Mines of Peru (DGAA/MEM). The purpose was to evaluate the capability of 15 Peruvian universities in performing environmental studies and analysis of receptor bodies and water samples containing mining residues.

2. GENERAL OBJECTIVE

To evaluate the capability of the universities of the country to carry out environmental studies and measurements required by the energy and mining sector of Peru.

Specific objectives

1. To evaluate and to qualify the capability of each laboratory participating in the DGAA/MEM program.
2. To evaluate the performance of the laboratories of the universities in analyzing metal traces.
3. To qualify the aptitude of the laboratories of the universities to develop analysis programs, in accordance with the MEM protocol.
4. To evaluate the capability of the universities of the country to carry out environmental studies.

3. METHODOLOGY

Information was collected through questionnaires and technical visits. Data was submitted to a systematic indicator analysis that served as basis for the qualification of each laboratory.

The following variables and criteria used for the evaluation of the laboratories are shown in the result tables: personnel, parameters and methods, equipment and instruments, application of quality control, sampling capability, information management, installations and services, workload and application of standards.

To evaluate the performance, certified samples of the Environmental Protection Agency (EPA) were delivered with instructions and data report forms. The results were qualified as follows: accepted (with 5% of maximum error); within the limits of acceptance given by EPA; and rejected, when the results were outside the order of magnitude proposed by EPA.

To qualify the aptitude to fulfill the monitoring protocol of the Ministry of Energy and Mines, the capability of the laboratories, their performance, timely delivery of the information, accuracy, and information compatibility were considered.

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4. RESULTS

4.1 The three laboratories with the highest score showed a tendency to work in cooperation with faculties and had adequate communication within the university. Even so, only a maximum of 71% was reached from the total capability required.

Table 1 Capability of the laboratories to analyze water characteristics, expressed in percentages

No.	Personnel	Param. and methods	Eq. and instrum.	Quality control	Sampling	Inf. Management	Instal. and serv.	Workload and stand.	% Capability
1	10.38	5.06	1.91	5	5.5	8.33	3.10	1.00	40.28
2	8.68	4.63	1.74	2	3	7.50	4.70	1.00	33.25
3	13.10	9.98	5.74	9.5	12.5	9.44	6.70	2.50	69.46
4	10.04	7.89	4.17	7.75	11.5	9.17	5.30	2.00	57.82
5	10.10	9.20	4.96	12.5	14.5	11.11	7.90	0.50	70.77
6	13.15	11.59	5.83	7.5	7	10.28	5.90	3.50	64.75
7	11.08	9.45	3.57	11	13.5	12.22	8.40	0.50	32.06
8	7.62	5.11	2.87	5	0	1.11	3.60	0.00	25.31
9	7.21	8.43	4.96	11.5	13	7.22	5.90	1.00	59.22
10	7.15	5.65	1.65	2.5	7	6.11	1.50	0.50	32.06
11	6.46	2.48	2.70	7	12.5	7.64	3.10	1.50	43.38
12	8.42	2.19	1.74	7	6	7.78	0.70	0.50	34.33
13	8.08	5.60	2.26	0	0	6.39	5.30	0.00	27.63
14	8.88	6.19	2.61	5	9	11.39	5.00	1.50	49.57
15	8.88	6.48	3.13	6	5	10.56	5.70	3.50	49.25
16	10.62	5.94	3.91	9	4	10.28	7.90	1.00	52.65

The following table indicates the qualification reached by each university in the performance evaluation of their laboratories.

Table 2 Evaluation by factor and total qualification

No.	Personnel	Param. and method	Eq. and instrum.	Quality control	Sampling	Inf. Management	Instal. and serv.	Workload and stand.	Capability %
1	10.67	9.11	3.39	3.5	4.25	8.61	5.50	1.75	46.78
2	13.10	9.98	5.74	9.5	12.5	9.44	6.70	2.50	69.46
3	10.04	7.89	4.17	7.75	11.5	9.17	5.30	1.75	57.57
4	10.10	9.20	4.96	12.5	14.5	11.11	7.90	0.50	70.77
5	13.15	11.59	5.83	7.5	7	10.28	5.90	3.50	67.75
6	11.08	9.45	3.57	11	13.5	12.22	8.40	0.50	69.72
7	9.61	9.59	5.65	8.25	6.5	7.22	6.20	1.00	54.04
8	11.77	11.06	6.87	4.58	6.57	8.72	7.70	4.00	61.27
9	10.62	5.94	3.91	9	4	10.28	7.90	1.00	52.65

With regard to the performance, the following was observed:

Not all of the laboratories were able to measure metal traces. The highest scores for performance evaluation were 95.8%, 82.3%, and 68.9%. The following table presents the score of the performance evaluation, the analites analyzed, and the performance score affected by the analysis measurement capability.

Table 3 Performance evaluation

University	Percentage of measurements by qualification				Average score	No. of param. analyzed	Performance qualification
	% RM	% R	% A	% A+			
2	0.0	10.0	30.0	60.0	89.0	10	68.5
3	100.0	0.0	0.0	0.0	5.0	7	2.7
4	20.0	13.3	20.0	46.7	68.3	8	42.1
5	14.3	85.7	0.0	0.0	17.9	7	9.6
6	0.0	3.8	11.5	84.6	95.8	13	95.8
7	87.5	0.0	0.0	12.5	16.9	4	5.2
8	7.7	7.7	42.3	42.3	82.3	13	82.3
9	0.0	14.3	21.4	64.3	86.4	7	46.5

A+: Accepted with 5% of maximum error 5%; A: Within the acceptance limits; R: Outside the acceptance limits; RM: Rejected for being outside the order of magnitude set by EPA.

4.2 The best aptitude qualification to fulfil the monitoring protocol of the Ministry of Energy and Mines was 85%, followed by 72.68%, 59.4%, and 53.3%. The other universities obtained a qualification lower than 50%.

Table 4 Qualification of the laboratories

No.	Capability	Performance	Punctuality	Accuracy	Qualification
1	46.8	0	0	0	18.7
2	69.5	68.5	5	5	72.0
3	57.6	2.7	3	2	29.4
4	70.8	42.1	5	5	59.4
5	64.8	9.6	3	2	35.7
6	69.7	95.8	5	5	85.8
7	54.0	5.2	5	5	34.2
8	61.3	82.3	3	0	68.7
9	52.7	46.5	4	5	53.3

4.3 The capability of the universities considering the compiled information and the adopted qualification criteria, is shown in the following table.

Table 5 University capability to conduct environmental studies

No.	Services	Personnel	Instal. and serv.	Instrum. and field equip.	Capability
1	18.67	13.71	15	5	52.38
2	14.67	21.23	21.67	21.67	79.24
3	20	15.51	25	10	70.51
4					
5	8	11.92	15	5	39.92
6	19.33	20.62	21.67	16.67	78.29
7	16.67	9.63	21.67	20	67.97
8	18.67	15.54	25	16.67	75.88
9					

The total capability to carry out environmental studies is relatively low. The maximum score was 79.2 closely followed by 78.3%, 75.9% and 68%. Among the evaluated institutions, two of them do not offer environmental study services and did not participate in this component of the evaluation.

To qualify the measurement capability, the following factors made a positive contribution: offered services, experience in its execution, availability of multidisciplinary personnel, equipment and instruments of the laboratory, as well as the field equipment and instruments.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 It is necessary to improve the analytical capability of the universities of the country and, if they were going to offer services to third parties, it is important to design an operating plan to develop this component without affecting or being affected by the academic or research activities of the universities.

5.2 It is relevant to foster interdisciplinary work to deal with environmental issues. It has been noted that the universities with better coordination among its units obtained the highest scores and not necessarily those with better infrastructure, equipment or personnel.

5.3 It is vital to implement quality control and quality assurance programs to guarantee data accuracy and comparability. Regular evaluations are required to know the continuous improvement of each laboratory participating in analytical quality programs. The effectiveness of a regular qualification program may be enhanced if coordination is made with the institutions providing accreditation to environmental laboratories.

5.4 It is recommended that the institutions responsible for environmental studies promote a cooperative program for universities to develop their analytical capability and performance to carry out environmental studies since the future specialists are being educated in these centers.

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