# Ex-Post Project Evaluation 2010: Package I-1
# (Pakistan, Bangladesh)

**November 2011**


## JAPAN INTERNATIONAL COOPERATION AGENCY

### FOUNDATION FOR ADVANCED STUDIES ON INTERNATIONAL DEVELOPMENT



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# Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2008, and Technical Cooperation projects and Grant Aid projects, most of which project cost exceeds 1 billion JPY, that were mainly completed in fiscal year 2007. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

November 2011

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Vice President
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Disclaimer

This volume of evaluations, the English translation of the original Japanese version, shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

Islamic Republic of Pakistan

Ex-Post Evaluation of Japanese ODA Grant Aid Project
"Establishment of Environmental Monitoring System in Islamic Republic of Pakistan"

External Evaluator: Nobuko Fujita,
Foundation for Advanced Studies on International Development

## 0. Summary

This project met the needs of Pakistan to monitor environmental degradation nationwide, thus its relevance was high. However, efficiency of the project was medium since a part of the planned output was unrealised. As for the project outcomes, nationwide ambient air monitoring is now conducted and the results are beginning to be used for environmental policy making. On the other hand, regarding industrial exhaust, wastewater and urban sewage, some of the parameters are still unable to be monitored. Although outcomes were realized to a certain extent at the time of evaluation since the Technical Cooperation Project (hereafter, the T/C project) is on-going, effectiveness of this project is also medium. As for the operation and maintenance system and the financial situation, there is a great deal of uncertainty at the time of evaluation. After completion of the federal project (this project's mother project) and the T/C project in January 2012, sustainability of the outcomes of this project is of particular concern.

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

## 1. Project Description


(Project Locations)


(CLEAN building, June 2011)

### 1.1 Background

Pakistan has a total land size of 796 thousand $km^2$ (2.2 times that of Japan) and a population of around 173 million (2010). There are growing concerns in major cities such as Karachi and Lahore where rapid urbanisation is observed, that deteriorating air and water quality will have adverse effect on people's health. Air pollution is mainly caused by the exhaust from vehicles and factories, while water pollution is caused

by untreated sewerage water.

Since prompt countermeasures were required, the Pakistan Environmental Protection Agency (hereafter, Pak-EPA)[1] and each provincial EPA had been conducting environmental monitoring. Monitoring, however, was only sporadic due to the lack of monitoring equipment and personnel, especially experienced laboratory staff.

In order to constantly monitor the status of environmental pollution and ensure that monitoring results are reflected in environmental administration and policy planning, the Government of Pakistan requested a grant aid from the Japanese Government, to construct a central laboratory and provide equipment (for air and water monitoring) for federal and provincial EPAs for the purpose of establishing a nationwide environmental monitoring system.

Since a T/C project seemed to be necessary to effectively utilise equipment provided to each EPA, the grant aid was approved on the condition that a T/C project would be implemented.

## 1.2 Project Outline

The objective of the grant project is to establish an environmental monitoring system (air and water) at federal and provincial EPAs by constructing a Central Laboratory for Environmental Analysis and Networking (hereafter, CLEAN) and providing monitoring and analysis equipment for CLEAN and provincial EPAs (Punjab, Sindh, KPK [2], Balochistan).

| | |
|---|---|
| Grant Limit / Actual Grant Amount | 1,238 million yen / 978 million yen |
| Exchange of Notes Date | August, 2005 |
| Implementing Agency | Environmental Protection Agency of Pakistan |
| Project Completion Date | March, 2007 |
| Main Contractors | Construction: Tobishima Corporation<br>Equipment: Mitsubishi Corporation, ITOCHU Corporation |
| Main Consultants | CTI Engineering International Co.,Ltd.,<br>Green Blue Corporation |
| Basic Design | "The Basic Design Study on the Project for Establishment of Environmental Monitoring System," CTI Engineering International Co.,Ltd., February to June 2005 |
| Detailed Design | October 2005-March 2006 |
| Related Projects | (1) Establishment of Environmental Monitoring System (Technical Cooperation Project, 2009～2011)<br>(2) Dispatch of an expert (Environmental Policy, 2003~2006) |

[1] Punjab EPA is under the Environmental Protection Department (EPD). However in this report, when the four provincial EPAs are discussed,"EPA" is used for Punjab EPD as well.

[2] Khyber Pakhtunkhwa (former North-West Frontier) Province

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Nobuko Fujita, Foundation for Advanced Studies on International Development

### 2.2 Duration of Evaluation Study

Duration of the Study: November, 2010 – October, 2011

Duration of the Field Study: February 18 –March 3, and June 27 to July 1, 2011

### 2.3 Constraints during the Evaluation Study

Due to a travel ban by JICA, the field surveys in two of the five targeted provinces, (KPK and Balochistan) were conducted by local consultants only[3].

## 3. Results of the Evaluation (Overall Rating: D[4])

### 3.1 Relevance (Rating: ③[5])

#### 3.1.1 Relevance with the Development Plan of Pakistan

The Pakistan Environmental Protection Act came into effect in 1997, in which new environmental monitoring system was pursued by Pak-EPA and provincial EPAs. The Pakistani Government's Planning Commission announced "The Mid-term Development Framework (2005-2010)" and listed concrete goals for environmental protection as well as a plan to establish a nationwide environment monitoring system. In addition, 111 projects concerning the improvement of the environment were also proposed in the framework. One of projects, the Establishment of Environment Monitoring System (2004-2010, hereafter, the "federal project"), is the mother project of this grant aid[6].

"Environmental conservation and countermeasures for climate change" is one of 14 pillars mentioned in the Approach Paper for the 10th Five Year Development Plan ((2010-2015) which follows the Mid-term Development Plan mentioned above). The plan proposed concrete strategies including the establishment of an effective monitoring system and the formulation and execution of national environmental standards.

Given the importance of environmental monitoring in stated development policies both before and after the project, this project is consistent with the development policies of Pakistan.

#### 3.1.2 Relevance with the Development Needs of Pakistan

In Pakistan, environment degradation is accelerated by the increase in population and in the number of vehicles. The main cause of air pollution in cities is the exhaust from vehicles and the total number of

[3] Hearings from staffs of those two EPAs were conducted in Islamabad.

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

[5] ③：High, ②：Fair, ①：Low

[6] Federal projects are implemented with development budget and by contracted staffs outside the routine work of the Ministries. This federal project was approved in October 2004 as a mother project of the grant aid and the T/C project. It will be completed along with the termination of the T/C project, and the activities were supposed to be operationalised (implemented with regular budget) thereafter.

vehicles increased from 2.7 million in 1990 to 6.8 million in 2010[7]. An increase in air pollution from traffic jams is also prominent. Air monitoring data prior to the project shows that SPM (dust) is particularly high in major cities (17 times higher than Japanese standards[8]). Surface water pollution is also a serious issue since most of the wastewater from food, textile, leather, and pulp processing industries, as well as urban sewage is released untreated into the rivers. Since it is important to have a nationwide environmental monitoring system to tackle such pollution, this project was consistent with Pakistan's development needs.

3.1.3 Relevance with Japan's ODA Policy

The Japanese Country Assistance Strategy for Pakistan (February 2005) states the overall goal of Japanese assistance as the establishment and development of sustainable society and lists the improvement of urban environments as an important cross-cutting issues. Japanese ODA Charter (2003) also states sustainable development and addressing environmental issues as important agendas.

This project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy; therefore its relevance is high.

3.2 Efficiency (Rating:②)

3.2.1 Project Outputs

The planned and actual output of the project was as follows (Table1).

Table 1：Summary of Outputs

| Planned | Actual |
|---|---|
| (1) Construction of CLEAN （2 stories） | ・ Change of design to one story[9] |
| (2) Installation of ambient air monitoring stations at Pak-EPA and provincial EPAs[10]<br>・7 fixed stations（one each for Pak-EPA, KPK・Balochistan EPAs, two each for Punjab and Sindh EPAs）<br>・3 mobile stations（one each for Pak-EPA , Punjab, and Sindh EPAs） | ・As planned. |

[7] including bikes and tricycles (Federal Bureau of Statistics).

[8] Compared with Japanese Ambient Air Standards. Data taken in 8 cities including 5 cities targeted in this project (Preparatory Study for the Project for the Establishment of Environmental Monitoring System in Islamic Republic of Pakistan 2004). Monitoring data of ambient air in 2010 (yearly average) shows that they are 1.6~3.1times higher than Pakistan Air Quality Standard, and 2.8~5.5times higher than that of the Japanese Standard (Data provided by Federal EPA).

[9] Initially it was planned that the laboratory would be on the first floor, and offices, training rooms, and the library would be on the second floor. The Federal EPA had a plan to add a third floor later for more office space.

[10] Ambient air monitoring stations measure CO, NOx, $O_3$, $SO_2$, HC, SPM, wind direction and speed, temperature, humidity and radiation unattended. Data is transmitted to CLEAN and provincial EPAs. For security reasons fixed air monitoring stations are placed on EPA's premises or on roof tops of public buildings. Mobile air monitoring stations use a generator for operating equipment and can be moved to locations such as busy intersections to monitor air for certain period of time. Due to scarcity of fuel for the generator, some EPAs, such as the Punjab EPA, use their mobile station on their own premises.

| | |
|---|---|
| (3) Installation of air and water monitoring equipment at Pak-EPA and provincial EPAs[11]<br>Air: stack gas monitoring equipment, gas analyser, monitoring vehicle, dust meter, etc.<br>Water: water sampler, sludge sampler, digital current meter, etc. | ・As planned[12] |
| (4) Installation of laboratory equipment at Pak-EPA and provincial EPAs[13]<br>・ atomic absorption spectrophotometer (for heavy metal analysis), UV/Vis spectrophotometer, gas chromatograph (for analysis of low molecular organic compound in air and water, ion chromatograph (for analysis of inorganic ion in a sample), pure water supply unit, waste water treatment equipment, draft chamber, etc. | ・As planned. |
| (5)Training for technicians and chemists（soft component）<br>・ Automatic monitoring of ambient air：operation of equipment, data analysis, maintenance of equipment, etc.（2 participants from each EPA, total of 10）<br>・ Stationary source monitoring: same as above（3 participants from each EPA, total of 15）<br>・ Water quality monitoring: water sampling, operation and maintenance of equipment, etc.（3 participants from each EPA, total of 15）<br>・ 21 days in each subject.<br>・ Newly recruited staff receives basic training by Pak-EPA. | ・ Location was moved from CLEAN to Sindh EPA[14].<br>・ Number of participants: 17 for automatic monitoring of ambient air, 12 for stationary monitoring, 11 for water quality monitoring, total of 40.<br>・ 21 days for each subject[15].<br>・ Basic training was cancelled[16]. |

(Source：Hearing from Pak-EPA and provincial EPAs, and document provided by JICA)

The modification of the design of the CLEAN building is explained as follows.

Start of the construction by Japanese contractor was delayed by four months due to a delay in land preparation[17]. This delay shortened the construction period from the planned 11 months to 8 and half months and made completing a two-story building impossible during the remaining contract period. The plan, therefore, was changed to complete the first floor, and leave the second floor to be constructed by the Pakistan side later on.

After the first floor was completed, the Pakistan side had difficulty securing the necessary budget for adding a second floor, (due to further financial problems caused by the global economic crisis). The construction finally started in March 2010, then suspended due to a heavy flood in July. It restarted by June 2011, and the basic structure for the 2nd and 3rd floors was completed. It is planned to be completed by the

[11] Basically the same equipment was provided for the five EPAs.

[12] At Punjab EPA, although equipment was procured as planned, installation was delayed one year (March 2008) due to a delay in relocation of EPD office. It is reported that there was no inconvenience due to this delay(hearing from Punjab EPD)

[13] Except for the equipment already provided by World Bank and other institutions, basically same equipment was provided to five EPAs. Some equipment such as sulfur content analyzer in fuel and total organic carbon analyzer were provided only to CLEAN.

[14] Completion of the CLEAN building, original training site, was March 2007, right before the project term ended. Therefore the training was conducted at Sindh EPA where the equipment was already installed.

[15] From February 23 to March 15, 2007.

[16] The time for basic training ran out since recruitment of laboratory staffs took longer than planned and had to be waited until right before the soft component training.

[17] Since little waste water stream was running across the construction site, it took time to remove water and filling the land.

end of 2011[18]. However, delays caused some problems as follows.

① In the last 4 years, the administration division of Pak-EPA remained in the old EPA office, which is about 30 minutes by car from CLEAN, and only the laboratory staff members were stationed at CLEAN. Due to the absence of the management at CLEAN, there were disciplinary problems[19].

② The T/C project which was supposed to be stationed on the second floor of CLEAN had to stay in the Pak-EPA office as well, which caused a loss of commuting time to CLEAN and inefficiency in providing instructions.

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

Total project cost was 1,009.6 million yen (80% of planned cost), with 978 million yen from the Japan side (79％ of the planned cost), and 31.6 million yen (16.4 million Rs. 145% of the planned cost)[20] from the Pakistan side. The cost breakdown is shown in Table 2.

The reasons for the lower than planned cost for the Japan side are the reduction in the construction and management costs due to the design change of CLEAN, and the savings due to competitive bidding.

Table 2: Planned and actual project cost

| Japan side（million yen） | | | | |
|---|---|---|---|---|
| items | | plan | actual | difference |
| facility | Construction of CLEAN | 246 | 200 | 46 |
| equipment | Ambient air monitoring station | 508 | 333 | 175 |
| | Air and water monitoring equipment | 134 | 133 | 1 |
| | Equipment for laboratory analysis | 248 | 216 | 32 |
| Design and management cost | | 102 | 96 | 6 |
| Japan side total | | 1,238 | 979 | 259 |

| Pakistan side （million Rs.） | | | |
|---|---|---|---|
| items | plan | actual | difference |
| Construction cost | 8.0 | 9.7 | －1.7 |
| Others | 3.1 | 6.6 | －3.5 |
| Pakistan side total | 11.1 | 16.4 | －5.2 |

（Source. Plan: Basic Design Study, Actual: document provided by JICA and Pak- EPA.
Figures for Pakistan side are derived from expenditures during two fiscal year (July 2005～June 2007)

Regarding undertakings required of Pak-EPA, there were delays in securing an access road to the construction site, constructing exterior works, installing electricity and telephone lines[21]. In Sindh, KPK, and Balochistan EPAs, it was conducted as planned[22]. In Punjab EPA, there was a delay in installation of equipment as mentioned before.

[18] Federal EPA （June 28, 2011）
[19] Federal EPA. A senior chemist working as a laboratory manager was assigned in May 2011, although the basic situation has not changed.
[20] Rate at the time of project planning：1Rs.＝1.96 yen, and 1Rs.=1.93yen at the time of completion.
[21] Federal EPA.
[22] Moving existing equipment, securing utilities, etc.

3.2.2.2 Project Period

Project period was within the plan. The planned period was 18.5 months including detailed design and bidding and the actual period was 18 months (October 2005 to March 2007).

Although the project cost/period was within the plan, some of the project output was not realized; therefore efficiency of the project is fair.

3.3 Effectiveness (Rating:②)

3.3.1 Quantitative Effects

As for the outcome indicators set before the project, ambient air monitoring was accomplished for all possible target cities but in regards to air and water monitoring, many cities remained incomplete by the end of 2007 (the target year). However, after the Technical Cooperation Project started in 2009, there were improvements in monitoring techniques and operation and maintenance, and the target was mostly achieved by the time of the ex-post evaluation (Table 3).

Table 3 Outcome Indicators

| Indicator (unit) | Baseline (2005) | Target (2007) | Beginning of T/C project (Feb. – April, 2009) | Ex post evaluation (Feb.2011) |
|---|---|---|---|---|
| (1)Number of cities able to monitor ambient air | None (partially in Punjab EPA) | 5 cities including the capital city of each province | 4 cities excluding Balochistan | 5 cities including the capital city of each province (*3) |
| (2)Number of parameters in air monitoring (*1) | 4 | 15 parameters based on the National Environmental Standard | Pak-EPA：7<br>Punjab:8<br>Sindh:7<br>KPK:NA<br>Balochistan:NA | Pak- EPA：15<br>Punjab: 7<br>Sindh:14<br>KPK：13<br>Balochistan:15 |
| (3)Number of parameters in water monitoring (*2) | 6 | 31 parameters based on the National Environmental Standard | Pak-EPA:23<br>Punjab:27<br>Sindh:4<br>KPK:NA<br>Balochistan:NA | Pak- EPA:31<br>Punjab:14<br>Sindh:21<br>KPK:30<br>Balochistan:32 |

*1：Number of parameters to be monitored in industrial exhaust gas in 5 cities（Islamabad, Lahore, Karachi, Peshawar, and Quetta）

*2：Number of parameters to be monitored in urban sewerage and industrial waste water in the above 5 cities.

*3：At the time of ex post evaluation, it was not operational in Balochistan EPA due to a UPS problem, but it was repaired by the T/C project later.

（Source：Basic Design Study for baseline and target, Progress Report (1) 2009, JICA Expert Team for 2009, and hearings from EPAs for 2011）

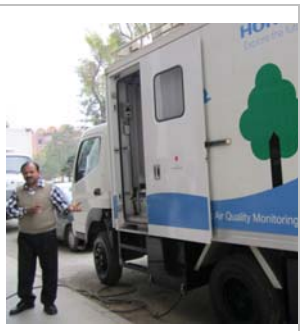
Detailed progress of each of the above three outcomes is explained below

(1) Number of cities able to monitor ambient air

In five cities, the automatic ambient air monitoring stations are installed and data is transmitted to its respective EPA. However, monitoring is sometimes interrupted due to power outages, UPS problems (uninterruptible power system) and other instruments (each parameter is analysed by its respective

instrument, therefore only some of the parameters are measured in some cases)[23]. Also, in Islamabad, Karachi, and Lahore, some instruments turn off automatically in order to avoid damage by heat when outside temperature reaches 45-50 degrees Celsius (inside temperatures become even higher)[24].

The number of days which air was monitored was 100% in 2007, 50% in 2008, 77% in 2009, and 93% in 2010[25]. Many of the equipment broken in 2008 were repaired after the technical cooperation started in 2009. Although the data transmission system had a problem in Punjab and Balochistan, the problem was fixed as a result of the T/C project's improvement to the transmission system.

| | | |
|---|---|---|
|  |  |  |
| Water analysis laboratory in CLEAN | A chemist changing parts in a fixed monitoring station (Sindh province) | Mobile air monitoring station(Punjab province) |

(2) Number of parameters in air monitoring, and (3) Number of parameters in water monitoring

The soft component training in March 2007 provided instructions for the operation and maintenance of equipment. However, due to a communication problem and constraints (considering participants' educational background and amount of knowledge and technique they had to absorb), the training could not sufficiently cover a wider scope to take appropriate measures in case of equipment problems[26].

Therefore, many parameters were unable to be monitored as of 2009 due to lack of technique and mechanical failures. By 2011, however, the goals were mostly reached (85% for air and 83% for water) thanks to technical transfer and repair works accomplished by the T/C project,. The accomplishment rate and reasons for non-attainment of each EPA are as follows (Table 4).

[23] THC meter, which contains hydrogen) needs to be manually restarted for safety reason after shutdowns caused by outages. Due to fuel shortages and the unavailability of vehicles, THC meters in the monitoring stations far away from an EPA office are often left turned off.

[24] Failure of the air conditioner inside one of the fixed monitoring stations in Punjab is making operations impossible in summer.

[25] Percentage was calculated from the number of days which data was sent from any of the stations in each EPA to CLEAN. It does not include the days which monitors were working but data was not sent due to transmission problems (data provided by Federal EPA).

[26] According to JICA experts and interviews with 21 soft component participants still with EPAs. (Out of the 40 soft component training participants, 27 still work for EPAs.)

Table 4 The accomplishment rate and reasons for non-attainment

| | Air monitoring parameters | | | | Water monitoring parameters | | | |
|---|---|---|---|---|---|---|---|---|
| | Able to monitor | | Reason for non-attainment | | Able to monitor | | Reason for non-attainment | |
| | Number of parameters | Attainment rate（%） | Equipment related | Technique related | Number of parameters | Attainment rate（%） | Equipment related | Technique related |
| CLEAN | 15 | 100.0 | 0 | 0 | 31 | 100.0 | 0 | 1 (*1) |
| Punjab | 7 | 46.7 | 7 (*2) | 1 (*3) | 14 | 45.2 | 15 (*4) | 3 (*5) |
| Sindh | 14 | 93.3 | 0 | 1 (*6) | 21 | 67.7 | 5 (*7) | 6 (*8) |
| KPK | 13 | 86.7 | 1 | 1 (*9) | 30 | 96.8 | 0 | 2 (*10) |
| Balochisntan | 15 | 100.0 | 0 | 0 | 32 | 103.2 | 0 | 0 |
| Total | 64 | 85.3 | 8 | 3 | 128 | 82.6 | 20 | 12 |

Note: "equipment related" includes mechanical problems, shortage of parts and regent. (*1)The parameter unable to be monitored is Selenium.（*2）due to problems of AAS and pure water supply unit (repair scheduled). (*3)Hydrogen Chloride. (*4) due to AAS failure. (*5) the parameters unable to be monitored are Chlorine compound, Anionic surfactants, Pesticide (*6) Chlorine. (*7) due to AAS, and GC failure (repair scheduled) and expiration of regent. (*8）Fluorine compound, Total cyanide, Sulphite, Ammonia, Silver, Total toxic metals (9)Black smoke. (*10)Manganese, Sulphur compounds. Source : hearings from each EPA.

This project was planned assuming the T/C project would be implemented in parallel, therefore it could be said that the delay in the start of the T/C project (originally planned in March 2006 but actually started in February 2009) may have been one of the causes for delay in realizing the outcomes of this project[27]. On the other hand, the T/C project was meant to cover the planning of environmental monitoring and its implementation: instruction of staff on operation and maintenance of equipment and repair were not its main purpose.

### 3.3.2 Qualitative Effects

Ambient air monitoring data is sent from a data analyst at each EPA to the data processing room in CLEAN. After compiled according to parameters[28], daily and monthly averages are calculated and stored. Although there is some data deficiency as mentioned before, CLEAN has started making analysis by seasons and comparisons among cities. Data is simplified as "Air Quality Index" and posted on Pak-EPA's website.

### 3.3.3Statsus of equipment use

As mentioned before, ambient air monitoring stations are well used except during outages and mechanical problems (Table 5). Some of the air and monitoring equipment are not used often. As for laboratory equipment, some provinces rarely use certain equipment such as microwave digester and draft chamber. Laboratory technicians gave the lack of knowledge on how to use them as a reason for not using the equipment.

[27] The reason for the delay of T/C project was due to lagged hiring process of laboratory staffs, JICA considered the time was not right for starting the T/C project (hearing from JICA).
[28] Parameters are listed in foot note No.11.

Table 5: Statsus of equipment use

| | | | CLEAN | Punjab | Sindh | KPK | Balochistan |
|---|---|---|---|---|---|---|---|
| Air monitoring station | Fixed | ”Yes” if used well | Yes | No1：Yes<br>No2：Yes | No1：Yes<br>No2：Yes | Yes | Yes |
| | Mobile | | Yes | Yes | Yes | — | — |
| Air/water monitoring equipment | | Frequently used (number) | 6 | 4 | 3 | 6 | 6 |
| | | Often used (number) | 1 | 0 | 1 | 0 | 0 |
| | | Rarely used (number) | 0 | 1(*1) | 1(*5) | 1（*7） | 0 |
| | | Never used (number) | 0 | 0 | 0 | 0 | 0 |
| Laboratory analysis equipment | | Frequently used (number) | 5 | 4 | 3 | 8 | 6 |
| | | Often used (number) | 4 | 3 | 1 | 0 | 0 |
| | | Rarely used (number) | 0 | 1(*2) | 2(*6) | 0 | 0 |
| | | Never used (number) | 0 | 1(*3) | 0 | 0 | 2（*8） |
| Note | | | | *1: Low volume air sampler<br>*2: Atomic absorption spectrophotometer<br>*3: Draft chamber | *5: Low volume air sampler<br>*6: Microwave digester, draft chamber | *7: High volume air sampler<br>(1 of 3) | *8: Microwave digester, Waste water treatment equipment |

（For equipment more than CIF100 million yen and checked in field survey. Source：Federal and provincial EPAs）

This project has somewhat achieved its objectives, therefore its effectiveness is fair.

## 3.4 Impact

### 3.4.1 Intended Impacts

Realisation of expected impacts of this project is as follows.

(1) Contribution to environmental policy formulation

In Pakistan, the National Environmental Quality Standard for Ambient Air was long-awaited and it finally became effective in October 2010. Activities of ambient air monitoring and technical advice from experts in the T/C project contributed to the enactment of the standard[29].

The result of air monitoring found that, SPM was the most serious air pollution problem in Pakistan, far exceeding the standard. This led to countermeasures such as urban vegetation and raising the quality standard of fuels[30]. In Punjab province, the result of air monitoring is provided to the mayor’s office, the Lahore Development Authority, and the water works and sewerage department among others, and proposals are made to respective authorities regarding the promotion of interchanges and higher restriction on exhaust gas[31].

[29] Federal and provincial EPA hearing. Standards for industrial exhaust and wastewater became effective in 2000.

[30] For example, when Federal EPA conducts Environmental Impact Assessment of inter- provincial highways, they make it mandatory to cover shoulders of the road with vegetation or pebbles, and building road side ditches in order to prevent flying dust. As for fuel, EUROII standard, which has a higher restriction of CO and dust in its exhaust, is now applied to gasoline (from July 2009) and diesel (from July 2012). Also, the upper limit on the sulfur content of fuel was lowered from 1% to 0.5% (Federal EPA hearing).

[31] Punjab EPA hearing.

(2) Countermeasures for industrial exhaust and waste water

The project also contributed to issuing Environment Protection Orders (EPO) related to wastewater and factory exhaust, and Court Orders from the Environmental Tribunal that are more binding (Table 6) [32]. Especially in Punjab EPD, the number of EPOs and court orders increased substantially (Figure 1). However, since some monitoring activities were conducted before the project started, this cannot be solely attributed to the project.

Table 6: Number of Environmental Protection Order issuance

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|
| CLEAN | 5 | 8 | 33 | 4 | 30 | 20 |
| Punjab | 87 | 150 | 363 | 510 | 696 | 1600 |
| Sindh | NA | NA | 9 | NA | NA | 20 |
| KPK | 86 | NA | NA | NA | NA | 526 |
| Balochistan | NA | NA | NA | NA | NA | NA |

(Source: hearing from EPAs)

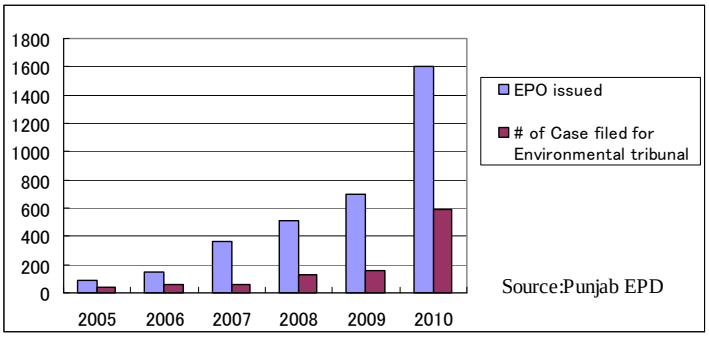



Figure1：Actions taken for pollutants (Punjab EPA)

(3) Enlightenment for citizens by information disclosure

The result of ambient air monitoring is posted on electronic sign boards along with an environmental protection message in Punjab and KPK provinces. Punjab EPD also provides the data for high school teaching materials.

According to the beneficiary survey (conducted in Punjab and Sindh provinces in February 2011 targeting 92 University students and researchers majoring in environmental studies), information disclosed on EPA website is well utilised by them. 52.0% of the respondents said they have used EPA website and 45.7% said EPA is disclosing enough information concerning environmental monitoring (this exceeds the 34.8% who said they did not). After the T/C project started ambient air monitoring, results have been posted on the web. Such posting is expected to increase environmental awareness among citizens, if the quality of the data is assured.

[32] Hearing from the EPAs. The EPO issues instructions for the installation of pollution reduction equipment and recovery of environment, and imposes fines if instructions are not followed. Court Orders can include: further fines, factory shutdowns or confiscation, imprisonment of persons responsible, and compensation for damages caused (Pakistan Environment Protection Act).

(4) Unified monitoring methods among provincial EPAs

Methods of the environmental monitoring before the project were different in each EPA. After this project and the T/C project, however, all provincial EPAs are now using the same methods making it easier to compile and compare monitoring data[33].

### 3.4.2 Other Impacts

(1) Impacts on the natural environment

There was no particular problem found in exhaust and waste water from the laboratories, however, many of the laboratories still have few opportunities to use draft chambers and waste water treatment facilities. Conventional Ph treatment is practiced in case there is ever a failure in the waste water treatment facility.

(2) Land Acquisition and Resettlement

There was no resettlement involved in this project, and no problem in land acquisition since the land for CLEAN was unused before its construction.

(3) Other Indirect Impact

All laboratories accept University students for research purposes. Punjab EPD accepted 50 University students in the last year, and even more students visit the laboratory. They are planning further collaboration in training and research with the environment-related faculties of Pakistani Universities[34].

At the time of the evaluation expected impacts had begun to be realised thanks to the T/C project.

## 3.5 Sustainability (Rating:①)

### 3.5.1 Structural Aspects of Operation and Maintenance

(1) Implementation system

It was originally planned that environmental monitoring activities would be continued under provincial budgets after the grant project ended in 2007. However, since the federal project was extended to December 2011, the federal budget was going to cover the cost till then. Therefore, starting from 2012, each province needs to take initiative in continuing monitoring activities.

Pak-EPA, the implementation agency of this project, used to be a part of Ministry of Environment, which was devolved to the provinces in June, 2011. Pak-EPA is now part of Capital Administration Development Division[35].

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[33] Hearing from provincial EPAs.

[34] Hearing from Punjab EPD.

[35] The 18th amendment of the Constitution (June, 2011) devolved 17 Ministries including the Ministry of Environment. Responsibility and budget of environmental administration were transferred to each Province, and federal issues such as ratification and implementation of international treaty, was transferred to the Planning and Development Division under the Ministry of Finance, Revenue, Planning and Development. The Capital

By this administration reform, Pak-EPA will be in charge of environmental administration only in the area covering the capital city. Although, in substance, it is not much different from the previous status, CLEAN's role in the future is unclear. After the Ministry of Environment is devolved, each provincial EPA will, under the provincial government, enact environmental protection acts, and be responsible for the formulation and implementation of environmental policies. In order to continue activities covered in the current federal project, provincial EPAs have to secure necessary personnel and budget starting from 2012. In Punjab, Sindh, and KPK EPAs, follow-up projects are planned and their budgets have been secured. Balochistan EPA is in the process of planning a follow-up project as well[36].

(2) Personnel assignment

Originally, the Ministry of Environment intended to hire an additional 101 contract staff (including 75 technical staff)[37] for the federal project, and assign staff to each provincial EPA who would continue working in their assigned province after the federal project was over. However, constitutionally, provincial governments are not obliged to employ anyone hired by the federal government; in fact, they have to follow their own provincial hiring process. Moreover, the original hiring plan was not welcome due to strong local autonomy and ethnic sentiment in Pakistan. On top of that, the Ministry of Environment had a shortage of funds leading to the recruitment of a total of only 30 staff (including only 16 technical staff) as of March 2007. Later, 7 more staff (including 5 technical staff) were hired and some staff left, so that at the time of the evaluation only 23 staff (including 19 technical staff) were remaining (Table 7)[38].

Table 7: Number of staff at each EPA

| | Contracted project staff | | Regular staff |
|---|---|---|---|
| | Planned | Actual | |
| Federal EPA | 25(16) | 10(9) | 74(46) |
| Punjab EPD | 20(16) | 5(3) | 234(171) |
| Sindh EPA | 20(16) | 5(4) | 81(37) |
| KPK EPA | 18(14) | 3(3) | 66(16) |
| Balochistan EPA | 18(14) | 0(0) | 59(17) |
| Total | 101(75) | 23(19) | 514(287) |

( ( )indicates technical staff. Others are support staff such as drivers. Source: Basic Design Study, Revised PC1, hearing from EPAs and documents provided by T/C project)

All EPAs experienced difficulties in monitoring activities because the actual recruitment numbers did not meet the original plan. Also, the utilisation of monitoring results in environmental policy and urban planning was delayed due to the fact that a senior chemist who was supposed to play a central role at CLEAN in data analysis and utilisation was not hired till 2011.

The contracts for the remaining 23 staff expire in November 2011. Even though regular EPA staff have received the training with the contracted staff, in order to sustain current monitoring activities, it's

Administration Development Department is under the Cabinet Division of the Prime Minister Secretariat, and responsible for works related to capital which used to be under the devolved Ministries

[36] Hearing from Ministry of Environment

[37] Numbers taken from revised PC-1 (federal project plan). It was 120 according to the Basic Design Study.

[38] After hiring the first 30 staff, repeated requests from the federal EPA to recruit additional staff were denied by the Ministry of Environment on the grounds that there was a budget shortage. Hiring restarted in 2011.

necessary to extend the contracts of the contracted staff who accumulated knowledge and skill and also undertake additional recruitment.

As mentioned before, although provincial EPAs have plans to increase staff, realisation of those plans was not yet foreseeable as of the time of the evaluation.

### 3.5.2 Technical Aspects of Operation and Maintenance

Before the T/C project started, many of the parameters were not able to be monitored due to a lack of techniques in measurement and maintenance. A deteriorating security situation prohibited Japanese Experts to visit KPK and Balochistan to directly instruct their laboratory staff on even the T/C project[39].

However, by the time of the evaluation, technical capabilities were greatly improved thanks to the closely supervised training and the on-the-job training of the T/C project. Some technicians mastered not only the operation of the equipment but simple maintenance such as changing parts[40]. If some of these technicians stay at each EPA, a certain level of equipment use, operation and maintenance can be expected. However, currently the activities are conducted under the supervision of Japanese Experts. Whether or not scheduled monitoring continues after the completion of the T/C project in December 2011 will remain to be seen.

### 3.5.3 Financial Aspects of Operation and Maintenance

(1) Status up to ex-post evaluation

Since 2007, budget for the federal project was tight due to a distressed national budget. Actual disbursement compared to the planned budget was 22.8% in fiscal year 2007-2008, and 58.0% in 2008-2009. The global financial crisis in 2008-2010 and floods in 2010-2011 made the situation even worse and only part of the approved budget had actually been disbursed (Table 8). Shortage of budget led to insufficient maintenance and arrears in salary payments.

Table 8：Planned and disbursed budget of EPA for the project (million Rs.)

| | planned | approved | disburse | disbursed/ planned (%) |
|---|---|---|---|---|
| FY2006-2007 | NA | 50.0 | 24. 8 | NA |
| FY2007-2008 | 47.0 | 10.8 | 10.7 | 22.8 |
| FY2008-2009 | 51.7 | 97.0 | 30.0 | 58.0 |
| FY2009-2010 | NA | 113.1 | 12.0 | NA |

(The amount includes salary of contracted staff. Source: Federal EPA)

Since it is a federal project till the end of 2011, provincial EPAs waited for the disbursement from the Pak-EPA, consequently their operation and maintenance were insufficient. KPK, however, managed to secure some funds from the provincial budget for operation and maintenance.

[39] Business trip to these two provinces have been suspended since August 2007.

[40] However, there is difference among them in capability, basic knowledge in math and chemistry, and motivation (hearing from laboratory staffs and Experts of T/C project).

(2) Perspectives after 2012

Since Pak-EPA and each provincial EPA will start their own activities to continue environmental monitoring after 2012, the situation will differ according to the province. As for the prospects of securing sufficient budget for environmental monitoring at each EPA: Pak-EPA,[41] Punjab[42] and KPK[43] EPAs have managed to already secure it until FY2011-2012. Sindh EPA acquired the necessary budget; however, it is for the amount needed for the enlargement of local laboratories and it is not clear if budgets will be used for the EPA laboratory.[44] Balochistan EPA has submitted a request to the provincial government for budget appropriation.

Starting FY 2012/2013, all EPAs will try to shift the budget necessary for environmental monitoring from the development to the non-development side(opeartionalisation). However, at the moment, it is unclear if it will actually be realised at all the provinces, and necessary budget will be secured in the future.

### 3.5.4 Current Status of Operation and Maintenance

As mentioned before, there are considerable uncertainties whether or not equipment provided for CLEAN and provincial EPAs will be properly maintained and utilised. Frequent power outages and unstable voltage are causing mechanical troubles. At the time of the evaluation, rolling blackouts are carried out in all 5 cities.[45]

In 2010, supply of electricity was 77.6% of the total demand. Future power outlook also tells us this ratio will be 74.6% in 2015 and 73.3% in 2015, and power shedding will continue at least until 2018.[46] For equipment, the current surge which occurs after the power comes back is more serious than power outages itself. For precision instruments in general, voltage fluctuation is assumed to be within 10%. However, actual fluctuations from 230V to 360 V, or 57% were observed in Islamabad and current surges happened 300 times between April and December 2009.[47] The cost of operation and maintenance is estimated at 10 million Rs. in case of Punjab (which is 3 times the amount estimated at the time of planning). The difference is partially due to the devaluation of the Rs. against the yen, which raises the procurement cost of parts of Japanese products, but the main reason is the failure of precision instrument due to outages and unstable voltage.[48]

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[41] It has secured 25 mil.Rs for the fiscal year 2011-2012 to complete the construction of CLEAN, extend contract of laboratory staff, and maintain equipment (Letter from Director General of Pak-EPA, dated October 21, 2011).

[42] 100 million Rs. is already approved by the Provincial Government as a cost for environmental monitoring (hearing from Punjab EPA)

[43] Also, renewal of laboratory building is under way.(hearing from Balochistan EPA)

[44] 38.5 million Rs. is expected to be approved by the Provincial Government to take over Federal project (hearing from Sindh EPA)

[45] Hours of power shedding per day in each city is 4~5h in Islamabad, 6~8h in Lahore, 6~7 h in Karachi, 1~8h in Peshawar, and 10h in Quetta. It is even longer in summer (hearing from EPAs and The Quetta Electric Supply Company.

[46] Pakistan Water and Power Development Authority（http://www.wapda.gov.pk/htmls/power-index.html）, and Nation, June 30,2011.

[47] Hearing from T/C project experts.

[48] 1.96 yen/Rs. (Basic Design Study 2005), and 1.00 yen/Rs. (April, 2011)

As for automatic air monitoring stations, the probability of their continued use is high if operation and maintenance cost is provided. However, maintenance cost per station is estimated at 1 million Rs. a year. Although repaired by the T/C project, UPS's durable year is said to be 1-2 years, and even with proper maintenance, periodical replacement will be necessary in the future.[49] Currently, consumables such as filters and spare parts are mostly provided by the T/C project budget. The possibility of procuring substitutes from India and Dubai is being examined to avoid airfreight from Japan (taking the higher yen value into consideration)[50].

As for air and monitoring equipment, among the ones over 100 million yen CIF, 58.9%broke down in less than 4 years after completion of the grant project. However, due to repair support by the T/C project, 85% of all equipment is in operation as of now (Table 9).

Table 9: Equipment failure rate

| | equipment checked | equipment failed in the last 4years | | equipment out of order at the time of evaluation | |
|---|---|---|---|---|---|
| | number | number | % | number | % |
| CLEAN | 30 | 16 | 53.3 | 3 | 10.0 |
| Punjab | 38 | 19 | 50.0 | 6 | 15.8 |
| Sindh | 34 | 26 | 76.5 | 8 | 23.5 |
| KPK | 23 | 16 | 69.6 | 2 | 8.7 |
| Balochistan | 21 | 9 | 42.9 | 3 | 14.3 |
| Total | 146 | 86 | 58.9 | 22 | 15.1 |

(Note: equipment over CIF 100 million yen and checked during field survey. Source: hearing from EPAs)

The equipment is used mostly in activities of the T/C project. After the T/C project is over, it will probably be used in Punjab and KPK EPAs for routine environmental monitoring, while it will be rarely used in Balochistan EPA if today's staff shortage continues. For Pak- EPA, it will depend on securing budget for recruitment of laboratory staff and maintenance. In Sindh, it will depend on if they focus more on central laboratory instead of enhancing local laboratories.

In light of the high maintenance cost required for precision instruments due to unstable power supply and voltage delivery, sustainability of the project will depend on the commitment by each EPA toward environmental monitoring. If Pak- EPA and provincial EPAs can stably acquire budget and staff, equipment especially air monitoring stations will be continually utilised. However this is uncertain considering the implementation system as well as the financial situation, and the operation and maintenance situation.

Major problems are observed in terms of the structural and financial aspects of operation and maintenance, therefore sustainability of the project effect is low.

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

This project met the needs of Pakistan to monitor environmental degradation nationwide, thus its

[49] 500,000-600,000Rs./unit
[50] Hearing from EPAs

relevance was high. However, efficiency of the project was medium since a part of the planned output was unrealised. As for the project outcomes, nationwide ambient air monitoring is now conducted and its result is beginning to be used for environmental policy making. On the other hand, regarding industrial exhaust, wastewater and urban sewage, some of the parameters are unable to be monitored. Although outcomes were realized to a certain extent at the time of evaluation (in light of the ongoing T/C project), effectiveness of this project is also medium. As for the operation and maintenance system and the financial situation, there is a great deal of uncertainty at the time of evaluation. After completion of the federal project (mother project of this project) and the T/C project in January 2012, the sustainability of the outcomes of this project is of particular concern.
In light of the above, this project is evaluated to be unsatisfactory.

## 4.2 Recommendations

### 4.2.1 Recommendations to the Executing Agency

Pak-EPA and CLEAN, which are now part of the Capital Administration Development Department, will play an important role as a monitoring institution of air and water quality in Islamabad and an institution for training and source of information dissemination of environmental monitoring. In order to play these roles, they need to secure budget to hire competent and experienced staff. The know-how and resources built up by the efforts of both the Pakistan and the Japan sides should be maintained and further developed.
Provincial EPAs need to steadily implement successive federal projects by securing personnel and budget for activities, and maintenance. In consideration of the importance of environmental monitoring, monitoring activities should be operationalised in the medium-term so that budgets can be secured without disruption.

### 4.2.2 Recommendations to JICA

After the T/C project is completed, periodical monitoring by JICA Pakistan office should be conducted to check the environmental monitoring activities of Pak-EPA and the provincial EPAs as well as their budget situations. If stagnated EPA is found, they should be encouraged to pursue environmental monitoring. Also, in case of training conducted by EPAs, cooperation such as dispatching Japanese instructors should be considered.

## 4.3 Lessons Learned

（1） Formulation of a project

This project had an implementation problem since it was formulated based on the assumption that Pak-EPA would lead the project while decentralisation was in progress. Hiring of staff by the central government was much-debated among the Pakistan side and some people questioned if it was realistic[51]. Even if a partner country officially agrees on a project design and minutes are signed, its operability should be carefully examined beforehand.

[51] Autonomy of the Provinces was guaranteed in the 1973 Constitution.

（2） Compatibility of equipment to the infrastructure situation of a partner country

Outages were already frequent at the time of the Basic Design Study[52]. For providing precision equipment to a country or area with power supply and voltage fluctuation problems, equipment should be selected carefully only after examining the long term power supply outlook.[53]

[52] Basic Design Study for the Project of Establishment of Environment Monitoring System in the Islamic Republic of Pakistan(2005)

[53] Similar problems are pointed out in the terminal evaluations for the Project for Capacity Development of Environmental Monitoring in People's Democratic Republic of Algeria and the Project for Capacity Development of Environmental Monitoring at the Directorates for Environmental Affairs in Governorates in the Syrian Arab Republic.

People's Republic of Bangladesh

Ex-Post Evaluation of Japanese Grant Aid Project
"The Project for Improvement of Meteorological Radar System at Cox's Bazar and Khepupara"

Rie Fusamae
Foundation for Advanced Studies on International Development

## 0. Summary

This project is well aligned with the Government of Bangladesh policies that give high priority to disaster management as well as the development needs of a country that has suffered tremendously from cyclones. The project was efficiently implemented with inputs executed and outputs produced almost as planned.

One of the project's targets for a 300km radius radar detection range for a precipitation intensity of 1mm/h, or more, has been met. Although the annual operation target hours of the meteorological radars fell well below the target for FY 2009/10, the prospects for the extension of operation hours are good. Findings of the evaluation study suggest that it has largely generated intended impacts including improved cyclone information and warnings and better quality forecasts for the Cox's Bazar District in addition to contributing to the reduction in damage caused by cyclones. The implementing agency that has operated and maintained all of Bangladesh's meteorological radars over the past two decades is competent enough to continue to generate these project effects and therefore the sustainability of the project is high.

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

## 1. Project Description


Project Locations

Cox's Bazar Radar Station

Khepupara Radar Station

### 1.1 Background

Bangladesh is prone to various types of natural disasters and in particular has been devastated a number of times by tropical cyclones. According to official records, over the four decades up to 2004, Bangladesh has been struck by 52 major cyclones which left more than 700,000 dead or missing: this accounts for nearly 70% of the total number of dead and missing due to natural disasters.

The previous meteorological radar systems (with two S-band weather radars mainly for storm monitoring purposes) were installed in Cox's Bazar and Khepupara in 1988 with Japan's grant

assistance. The radar systems failed irreparably in 2004 after 16 years of use: 16 years exceeds the 10 to 12 year recommended period of use. Since the radar observations stopped, the Bangladesh Meteorological Department (BMD), the sole national meteorological service provider, was unable to obtain timely cyclone information (such as intensity, location of the centre, and direction of movement), and consequently the quality and accuracy of cyclone warnings and advisories issued by the BMD deteriorated.

The Government of Bangladesh (GoB) recognized the critical importance of cyclone monitoring and warning in disaster management and the urgent need to replace and improve its radar systems. Due to their financial constraints, the GoB requested assistance from Japan.

### 1.2 Project Outline

The objective of this project is to enhance the cyclone monitoring capability of the BMD by: replacing the existing Cox's Bazar and Khepupara Meteorological Radar Systems; establishing data communication systems; and introducing a meteorological satellite data receiving system.

| | |
|---|---|
| Grant Limit / Actual Grant Amount | Phase 1: 866 million yen / 865 million yen<br>Phase 2: 803 million yen / 791 million yen |
| Exchange of Notes Date | Phase 1: July 2005<br>Phase 2: June 2006 |
| Implementing Agency | Bangladesh Meteorological Department |
| Project Completion Date | February 2008 |
| Main Contractors | Mitsubishi Corporation<br>Shimizu Corporation |
| Main Consultant | Japan Weather Association (JWA) |
| Basic Design | "Basic design study on the project for improvement of the meteorological radar systems at Cox's Bazar and Khepupara in the People's Republic", JICA and Japan Weather Association, October 2004 - March 2005 and April 2005 - May 2005. |
| Detailed Design | Phase 1: August 2005 - October 2005<br>Phase 2: August 2006 – October 2006 |
| Related Projects (if any) | [Technical Cooperation]<br>"The Project on Human Capacity on Operation of Weather Analysis and Forecasting " (2009-12)<br>[Grant Aid]<br>"The Project for Replacement of Weather Surveillance Radars" (1986-88)<br>"The Project for Microwave Link for Meteorology" (1992-94)<br>"The Project for Improvement of Weather Warning Services related to Natural Disasters" (1997-99)<br>"Follow-up Cooperation for the Project of Weather Warning Services Related to Natural Disasters" (2005)<br>"The Project for the Establishment of the Meteorological Radar System at Moulvibazar" (2007-2009) |

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Rie Fusamae, Foundation for Advanced Studies on International Development

### 2.2 Duration of Evaluation Study

Duration of the Study: October 2010 - October 2011
Duration of the Field Study: February 6, 2011 - February 21, 2011
June 10, 2011 - June 16, 2011

## 3. Results of the Evaluation (Overall Rating: A[1])

### 3.1 Relevance (Rating: ③[2])

#### 3.1.1 Relevance with the Development Plan of Bangladesh

At the time of the basic design study, the project plan was included in the Three Years Rolling Investment Programme 2004-2006 of the GoB as a project requiring urgent implementation.

The project remains in line with the GoB's development policy. The current GoB policy is manifested in the Poverty Reduction Strategy Paper (PRSP), "Steps towards Change: National Strategy for Accelerated Poverty Reduction II (Revised), FY 2009-11," in which priority is given to disaster management particularly in terms of social protection for the vulnerable and also in order to tackle climate change. The PRSP identifies enhancement of disaster management and risk reduction capacity and knowledge management on disaster risk reduction as the major strategic goals. The policy agenda set towards that end include capacity development in disaster warning and forecasting with a focus on the BMD, and the project aims to contribute to the BMD.

#### 3.1.2 Relevance with the Development Needs of Bangladesh

The restoration and improvement of BMD's cyclone monitoring capacity was of pressing importance for the country, which has been heavily affected by cyclones. The Disaster Management Bureau (DMB)[3] of the Ministry of Food and Disaster Management and the Cyclone Preparedness Programme (CPP)[4], which takes a leading role in the cyclone warning and evacuation system, as well as the media depends on information and warnings provided by the BMD based on radar data from Cox's Bazar and Khepupara, the only two meteorological radars in the country located in coastal areas. The two radar systems ceased to function in 2004 and the BMD was unable to deliver accurate information on cyclone: intensity, direction and the location of its centre.

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

[2] ③: High, ②:Fair, ①:Low

[3] DMB is responsible for disaster risk reduction and disaster management from the warning stage to the recovery stage. Its responsibilities include proposing disaster-related legislation, awareness-raising for disaster risk reduction, coordination of concerned organizations in disaster management, monitoring of delivery of warnings, and evacuation and relief activities. (Ministry of Food and Disaster Management, "Standing Orders on Disaster," April 2010.)

[4] The CPP was launched, following the cyclone of 1970, by the International Federation of Red Cross and Red Crescent Societies (IFRC) and the Bangladesh Red Crescent Society (BDRCS) in order to establish a warning delivery system. Since 1973, it has been a joint programme between the BDRCS and the GoB. The CPP has engaged mainly in the dissemination of cyclone warnings, evacuation assistance, assistance in relief and rehabilitation operations, covering 37 Upazilas in coastal areas of 11 Districts. (Interview with CPP)

Since the planning stage of the project, seven major cyclones have made landfall on Bangladeshi soil or its coastline including one of the most powerful cyclones in Bangladeshi history, (Cyclone Sidr of November 2007) which left 3,363 people dead and 871 missing[5]. Though the early warning system is improving, cyclones have continued to have serious impact on the country's economy and society, and the need for accurate information and early warning remains great.

### 3.1.3 Relevance with Japan's ODA Policy

The project aims to reduce damage from cyclones by improving cyclone monitoring functions. It is fully consistent with Japan's ODA Charter, which gives priority to addressing global issues including natural disasters. Disaster management was also one of the four priority areas identified in the Country Assistance Plan for Bangladesh at the project planning stage.

Thus this project has been highly relevant with the country's development plan and development needs, as well as Japan's ODA policy: therefore its relevance is high.

## 3.2 Efficiency (Rating: ③)

### 3.2.1 Project Outputs

Planned outputs of the project were produced as planned. Details are shown in the table below.

Table 1 Planned and Actual Outputs

| Planned | | | Actual |
|---|---|---|---|
| System / Facilities | Site | Main Equipment | |
| Meteorological Radar System | 1) Cox's Bazar Radar Station<br>2) Khepupara Radar Station | Radome, Antenna, Antenna controller, Transmitter, Amplifier Tube Unit (ATU), Digital Receiver and Signal Processor (DRSP), Dehydrator, Wave-Guide Configuration, Radar Task Controller, Data & Protocol Converter, Isolation Transformer, Radar AVR, Flywheel Power Backup Unit, Test instruments & materials | As planned |
| Meteorological Radar Data Display System | 1) Cox's Bazar Radar Station<br>2) Khepupara Radar Station | Severe Storm & Doppler Velocity Indicator, Severe Storm & Doppler Velocity Indicator, Data Analyzing Unit | As planned |
| | Storm Warning Centre (SWC) | CCU, Southern Composite Processor, Accumulated Rainfall Processor, Cyclone Tracking Monitor, Product Retrieval Unit, Radar Web Server, Doppler Velocity Indicator, Meteorological Data Archiving Unit | As planned |
| | Cox's Bazar Meteorological Office | Radar Image Access Unit | As planned |
| Meteorological Data Communication System | 1) Cox's Bazar Radar Station<br>2) Khepupara Radar Station | VoIP Gateway, Spread Spectrum Transceiver with ODU, Antenna, VoIP Gateway, VoIP Exchanger | As planned |
| | Cox's Bazar Meteorological Office | VoIP Gateway, Spread Spectrum Transceiver with ODU, Antenna | As planned |
| | SWC | VoIP Gateway, VoIP Exchanger | As planned |

[5] BMD

| | | | |
|---|---|---|---|
| Meteorological Data Satellite Communication System | 1) Cox's Bazar Radar Station<br>2) Khepupara Radar Station | VSAT Out-door Unit (ODU/Transmitter), VSAT Out-door Unit (ODU/LNB), VSAT Antenna, VSAT In-door Unit (IDU), Test instruments & materials | As planned |
| | SWC | HUB Out-door Unit (ODU/Transmitter), HUB Out-door Unit (ODU/LNB), HUB Antenna, HUB In-door Unit (IDU), Test instruments & materials | As planned |
| Meteorological Satellite Data Receiving System | SWC | MTSAT Receiver, MTSAT Acquisition Workstation, Satellite Data Processor | As planned |
| Meteorological Radar Tower Building | 1) Cox's Bazar Radar Station<br>2) Khepupara Radar Station | | As planned |

Source: Basic Design Study Report (2005), Project Completion Reports (2007, 2008)

It was assumed at the project planning stage that the BMD would conduct technical training for its meteorologists and engineers. Although not provisioned as part of the project, internal training was provided in the form of on-the-job training as needed and also by internally sharing knowledge within the BMD that was gained by some staff members who participated in overseas training including the counterpart training held in Japan.

The Bangladeshi side undertook all its required work as specified in the Minutes of Discussion of the Basic Design Study, including: securing land and legal rights for the construction of the radar towers, clearing land, providing facilities for electricity distribution, water supply and communications, obtaining frequency allocation, and providing space segments for a satellite communications system.

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The actual cost of the project was mostly as planned: amounting to 1,664 million yen, equivalent to 99% of the estimated cost of 1,676 million yen. Of the total capital cost, 1,657 million yen was borne by the Japanese side and 7 million yen by the Bangladeshi side (planned amounts were 1,669 million yen (Japanese grant ceiling) and 7 million yen for the Bangladeshi side)[6].

#### 3.2.2.2 Project Period

The project period (from the detailed design up to the project's completion) was 31 months: shorter than the planned 32 months.

Both the project cost and the project period were within the plan; therefore efficiency of the project is high.

[6] Converted at the exchange rates used in the basic design study (1BDT=1.822yen) and at the time of the project completion (1BDT=1.55yen), respectively.

### 3.3 Effectiveness (Rating: ②)

#### 3.3.1 Quantitative Effects

##### 3.3.3.1 Improvement of Cyclone Monitoring Capacity

The radar system's reliable detection range for a precipitation intensity of 1mm/h or more is 300km radius as targeted. This is broader than the 200km radius of Cox's Bazar's and Khepupara's old systems before their failure in 2004. The maximum detection range covers a 440km radius.

##### 3.3.3.2 Operation Hours of Meteorological Radars

Annual operation hours of both radars fall below the 4,000 hour target set at the time of the project planning. While operation hours of the Cox's Bazar radar reached 88% of its target, the Khepupara radar operated at only 589 hours (or 15% of its target) in the expected achievement year of 2009/10 (See Table 2).

Table 2 Planned and Actual Operation Hours of the Meteorological Radars

| | Baseline | Target | Actual (2009/10) |
|---|---|---|---|
| Cox's Bazar Radar Station | Non-operational (Approx. 2,000 hours before the failure of the system) | Approx. 4,000 hours/year | 3,529 hours/year |
| Khepupara Radar Station | Non-operational (Approx. 2,000 hours before the failure of the system) | Approx. 4,000 hours/year | 589 hours/year |

Source: BMD

The main reasons for the low operation rate of the Khepupara radar were that it was affected by frequent power outages and insufficient fuel supplies for the generator. In response to the situation, the BMD secured a budget for fuel for Fiscal Year (FY) 2010/11[7]. Indeed, the Khepupara radar operated 589 hours in the pre-monsoon season (March – May) in the year, more than triple the previous year's 142 hours. In May alone, the month that precipitation sharply increases, the operation hours increased 78 hours from the previous year to 319 hours. The BMD intends to keep the same operation level in Khepupara until November when the post-monsoon season ends and also plans to operate it for more than 3,000 hours annually in the coming years.

Although the Cox's Bazar radar did not reach its operation hour target of 4,000 hours, some questions exist as to whether this target was reasonable. The BMD considers 4,000 hours to be the maximum operation hours and recognizes that actual operation time depends on meteorological conditions and therefore varies from year to year. Since reducing operation time when there are no precipitation phenomena does not pose serious problems itself, it is not appropriate to jump to the conclusion that the operation time of the Cox's Bazar radar was not sufficient[8].

It is also debatable whether using operation hours as an indicator was appropriate to assess the effectiveness of radar operation. Operation hours do not include the time spent on inspections as well as the time that radar operations are deliberately stopped while there are no precipitation phenomena. Therefore, it may have been more appropriate to use an indicator such as: 1) the total time of operation hours and planned/deliberate outage hours, or 2) unplanned outage hours

[7] It is covered by the budget of the Head Office.
[8] Comments from a meteorological expert in Japan

due to power outages and mechanical/system failures[9]. A target could then be set based on past operational records.

It should be noted that understaffing in the two radar stations has to some extent affected operation rates of both radars in the monsoon seasons. The BMD is trying to improve the situation and has proposed a new organizational structure to the Ministry of Establishment which includes an increase in the number of staff. It is currently under consideration in the Ministry.

Based on the above findings, it can be said that the project enhanced the cyclone monitoring capacity of the BMD. On the other hand, the full benefit of the project has not been realised due to the low operation rates of the radars, though it should be kept in mind that the target may not have been appropriate.

### 3.3.2 Qualitative Effects

#### 3.3.2.1 Development of Monitoring Capacity on Cyclonic Wind Velocity

The new meteorological radar systems are equipped with a Doppler function to monitor wind, which enabled the BMD to obtain data on precipitation intensity in a broader range also in addition to information on cyclonic wind velocity distribution. The old radar systems installed in 1988 did not have such a function even though storm surges caused by cyclonic wind have often resulted in tremendous damage.

#### 3.3.2.2 Early Monitoring of Cyclones

As part of the project, a meteorological satellite data receiving system was set up in the Storm Warning Centre (SWC) of the BMD. Though the BMD had had a satellite data receiving system compliant to the Japanese Geostationary Meteorological Satellite (GMS-5), it had been unable to receive satellite data since the GMS-5 was taken over by the Geostationary Operational Environmental Satellite-9 (GOES-9) of the United States in May 2003. A new satellite data receiving system installed under the project made available to the BMD satellite imagery provided by the Japanese Multi-functional Transport Satellite (MTSAT), which succeeded GOES-9. By analyzing MTSAT data along with radar data, the BMD is able to monitor cyclones in the Bay of Bengal and the Indian Ocean at an early stage. (Note: The system crashed early this year and is expected to be restored soon (See 3.5.4 Current Status of Operation and Maintenance)).

#### 3.3.2.3 Quick Dissemination of Cyclone Information and Warnings

The BMD had been unable to provide cyclone information based on the latest radar observation data since the failure of the radar systems in Cox's Bazar and Khepupara in 2004. With the replacement of the systems, the SWC currently receives radar data every 30 to 60 minutes when a cyclone develops. In addition, a satellite data communication system was newly installed in the SWC and the two radar stations for stable and swift transmission of radar data to the SWC, and now receives data in an average transmission time of 15 minutes and promptly prepares special weather bulletins that can be distributed to disaster management agencies and the media through such means as a microwave link.

Thus, this project has somewhat achieved its objectives, therefore its effectiveness is fair.

[9] Comments from a meteorological expert in Japan. By not including planned and deliberate outage hours into "non-operating hours", effectiveness of operation can be assessed independently of meteorological conditions.

### 3.4 Impact

#### 3.4.1 Intended Impacts

##### 3.4.1.1 Improvement of Cyclone Information and Warnings

(1) Accuracy

According to the results of the beneficiary surveys conducted by the ex-post evaluation team, the majority of the respondents recognized improvement in the accuracy of cyclone information and warnings. The CPP and the Disaster Management Committee (DCC) formed under each Union Parishad (Committee), which is the lowest administrative body in the county, play a central role in dissemination of warnings to communities and evacuation support[10], while citizens receive cyclone information and warnings mainly through the media such as radio and television[11]. The beneficiary survey mainly targeted DCC members that include Union Parishad members. A total of 155 respondents[12] from 10 Union Parishads[13] indicated that the accuracy of cyclone information has improved (Figure 1).

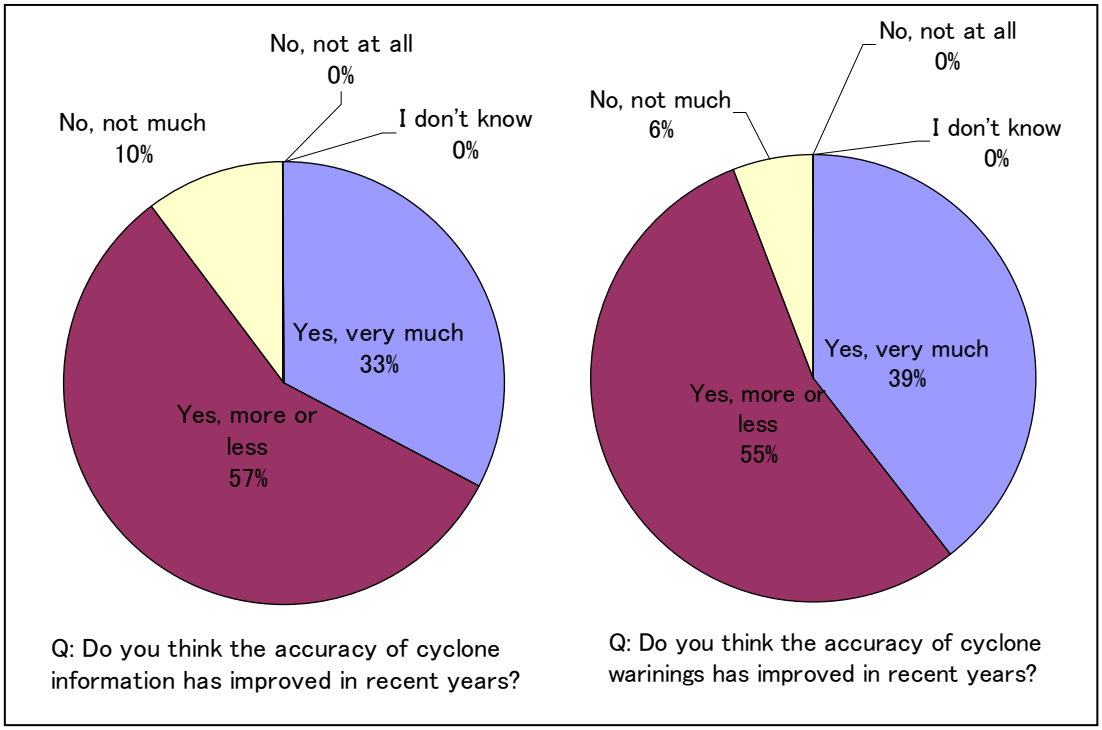


Figure 1 Results of Beneficiary Surveys on Accuracy of Cyclone Information and Warnings

The DMB and the CPP also recognize the improvement of accuracy of cyclone information and warnings issued by the BMD. The level of satisfaction of the CPP is particularly high[14].

[10] Tools such as megaphones and warning signal flags have proven to be effective. (Interview with DMB)

[11] Cyclone information that citizens receive include: centre position, direction of movement, maximum wind speed, height of tidal surge, areas likely to be affected and warning signal level numbers.

[12] Of 155 respondents, 115 are Union DCC members including Union Parishad members and 40 are those involved in administration of Union Parishads. 22 out of the 155 are women.

[13] The administrative structure of rural Bangladesh consists of Divisions, Districts, Upazilas and Unions. For the survey, 10 Upazilas heavily affected by any cyclone hit after the completion of the Cox's Bazar Radar Station (February 2007) were selected from 4 districts (Barguna, Patuakhali, Khulna, Cox's Bazar). One Union is chosen from each of the 10 selected Upazila making the total number of surveyed Unions 10.

[14] Interview with DMB and CPP. CPP commented that 95% of warnings issued in the last few years were

(2) Timing of warning issuance

Though the Standing Orders on Disaster of the GoB stipulates that the BMD should issue danger signals at least 10 hours before an expected landfall[15], in case of super cyclones, the BMD is supposed to issue danger signals 24 hours in advance. The table below shows the lead times for evacuation, which indicates a period of time from the first issuance of a danger signal until landfall, by super cyclone (more than 200km/h in intensity) that hit Bangladesh after the first replacement of meteorological radar systems in Cox's Bazar and Khepupara in March 1988.

Table 3 Lead Time for Evacuation

| Year | 1991 | 1994 | 1997 | 2007 |
|---|---|---|---|---|
| Lead Time | 32 hours* | 21 hours | 25 hours | 27 hours |

*It took a long time due to slow pace of the cyclone
Source: BMD

Cyclone Sidr of 2007 is the only super cyclone that hit the country since the completion of one of the two radar systems under the project. The BMD issued danger signals earlier than usual based on conclusions drawn from radar data and other information that left no doubt about the intensity of the cyclone.

Results of the beneficiary surveys also indicate an improvement in the timing of warning issuance. 139 people (90%) of those surveyed answered that they receive warnings earlier than before.

#### 3.4.1.2 Improvement of Quality of Weather Forecasts for Cox's Bazar District

As part of the project, a meteorological data display system and a meteorological data communication system were installed in the Cox's Bazar Meteorological Office, which prepares forecasts for the Cox's Bazar District. Through the system, the Meteorological Office receives radar data from the Cox's Bazar radar including data on the movement of clouds and storms. This data had not been available before the project and they now use such detailed data to prepare forecasts[16].

#### 3.4.1.3 Reduction of Cyclone Damage

Historically cyclones have caused extensive damage to the coastal areas of Bangladesh. Table 4 shows the scale of and number of victims of major cyclones that struck Bangladesh after March 1988.

Table 4 Scale and Number of Victims of Major Cyclones

| Year | Landfall Area (Name of Cyclone) | Max. Wind Speed (km/h) | Tidal Surge (ft) | No. of Dead & Missing | No. of Affected Districts | No. of Affected People |
|---|---|---|---|---|---|---|
| 1988 | Khulna | 160 | 2-14.5 | 12,133* | ― | ― |
| 1991 | Chittagong | 225 | 12-22 | 138,882 | 19 | 10,798,275 |
| 1994 | Cox's Bazar - Teknaf Coast | 278 | 5-6 | 188 | ― | 416,000 |
| 1997 | Sitakundu | 232 | 15 | 155 | 10 | 2,835,472 |
| 1997 | Sitakundu | 150 | 10-15 | 300 | ― | 2,015,669 |
| 1998 | Chittagong Coast | 173 | 3 | 114 | ― | ― |

accurate.

[15] Ministry of Food and Disaster Management, "Standing Orders on Disaster," April 2010.

[16] Interview with the Cox's Bazar Meteorological Office

| | | | | | | |
|---|---|---|---|---|---|---|
| 2000 | Sundarban Coast | 50-60 | 2-4 | 253 | — | — |
| 2002 | Sundarban Coast | 65-85 | 5-7 | 182 | — | — |
| 2004 | Cox's Bazar - Akyab (Myanmar) Coast | 65-90 | 2-4 | 30 | — | — |
| 2007 | Khulna - Barishal Coast (Sidr) | 223 | 15 | 4,234 | 30 | 8,923,259 |
| 2008 | Khulna – Barishal Coast (Rashmi) | 83 | 5-7 | 11 | 17 | 321,831 |
| 2009 | Chittagong – Cox's Bazar Coast (Bijli) | 60-80 | — | 5 | 15 | 92,558 |
| 2009 | Khulna Coast (Aila) | 92 | 6-8 | 1,278 | 11 | 4,826,630 |

* Including deaths in India
Source: BMD and DMB website

Since a number of factors determine the amount of damage caused by a cyclone, it is difficult to verify whether the damage relative to the scale of the cyclone has been reduced. However, when the two biggest cyclones in terms of maximum wind speed, height of tidal surge and number of affected people, namely the 1991 cyclone and Sidr of 2007[17], are compared, it can be said that the number of dead and missing from the latter is substantially lower.

The GoB acknowledges that the number of deaths from cyclones has been lower than in the past and identifies the improved early warning system as a primary factor[18]. An improvement in the quality of cyclone warnings issued by the BMD has also been acknowledged by: DMB officials, a leading government agency for disaster prevention and response, and the staff of the CPP that delivers cyclone warnings to residents in high-risk areas[19]. The CPP appreciates the early issuance of warnings by the BMD for all recent cyclones that have allowed communities sufficient time for evacuation after receiving warnings from the CPP[20]. Although the death toll from Cyclone Sidr is high (exceeding 3,000), the number of those killed on land was about 1,000 and the CPP estimates that most of the victims were fishermen that ignored warnings.

In the above-mentioned beneficiary survey, 92% of the 155 respondents answered that residents in their unions are better prepared for cyclones than before. As the main reasons for the better-preparedness, 41% answered that people have sufficient time for evacuation as a result of early receipt of warnings, and 35% noted an increased awareness from past experience about the disastrous effects of cyclones. To the question about assumed reasons why some people lost their lives due to recent cyclones, the top answer (51%) was that they did not evacuate despite warnings.

### 3.4.2 Other Impacts

No negative impact such as environmental impact has been observed. Resettlement and land acquisition were not required for the project.

As seen above, the project has generated positive impacts. Findings suggest that it has contributed to the improvement of cyclone information and warnings, increasing the quality of forecasts for Cox's Bazar District, and reducing damage from cyclones.

[17] Sidr hit the country after the completion of Cox's Bazar radar replacement.
[18] Government of Bangladesh, "Steps towards Change: National Strategy for Accelerated Poverty Reduction II (Revised) FY 2009-11," December 2009.
[19] The CPP transfers warnings provided by the BMD from the CPP Headquarters to communities through CPP regional offices, Upazila offices, CPP Union teams, and CPP Unit teams and CPP volunteers.
[20] Interview with CPP.

### 3.5 Sustainability (Rating: ③)

#### 3.5.1 Structural Aspects of Operation and Maintenance

Since the time of the project planning, the observation setup and the total number of staff involved in observation in both radar stations have not been changed[21]. Normally, a team consisting of an electronic assistant and a mechanic work in two shifts for a total of 12 hours. When a cyclone approaches, however, the radars operate around the clock on three shifts for special observation. In addition to the team members, an (assistant) electronic engineer(s), electronic assistants, a foreman/mechanics and an assistant meteorologist supervise observations.

Both stations receive backup from the BMD Head Office during the development of a cyclone. However, the number of electronic assistants has decreased by 1 in both stations despite the recommendation by the basic design study team for more staff allocation to certain posts including electronic assistant to extend observation time in the monsoon seasons (See Table 5). This has resulted from a change in GoB recruitment rules that do not fit with BMD's organizational setup. Due to the change, it has become difficult for the BMD to recruit electronic assistants and consequently the BMD cannot even fill positions left vacant by retirements. In order to increase manpower and enhance observations, the BMD has proposed a new organogram along with its proposed staff numbers for each post to the Ministry of Establishment.

Table 5 Number of Personnel in Cox's Bazar and Khepupara Radar Stations

| Posts | Cox's Bazar | | | Khepupara | | |
|---|---|---|---|---|---|---|
| | 2005 | | 2011 | 2005 | | 2011 |
| | Actual | Proposed increase | Actual | Actual | Proposed increase | Actual |
| Electronic Engineer / Assistant Electronic Engineer | 1 | 1 | 2 | 1 | 1 | 1 |
| Electronic Assistant | 4 | 1 | 3 | 4 | 1 | 3 |
| Assistant Meteorologist | 1 | ― | 1 | 1 | ― | 1 |
| Foreman / Mechanic | 5 | ― | 5 | 4 | 1 | 5 |
| Radio Mechanic | 0 | ― | 1 | 0 | ― | 0 |
| Balloon Maker | 0 | ― | 0 | 0 | ― | 3 |
| Other | 5 | 2 | 3 | 3 | 2 | 5 |
| Total | 16 | ― | 15 | 13 | ― | 18 |

Source: BMD

With regard to the maintenance of equipment procured under the project, through decades of experience, the BMD has developed a well-established system in both radar stations for routine maintenance under the supervision of an assistant electronic engineer.

#### 3.5.2 Technical Aspects of Operation and Maintenance

There is little concern about BMD's technical capacity since many of BMD's technical personnel have long engaged in operation and maintenance of meteorological radars and

[21] The two radar stations have almost the same number of observation staff despite the fact that the operation rate of the Khepupara radar is far lower than that of the Cox's Bazar radar. This is due to a gap in the technical capacity of the two radar stations.

received training when new equipment was installed under the project. Newly recruited or transferred staff acquired sufficient skills to manage routine operation and maintenance through on-the-job training under the guidance of experienced personnel. In addition, under JICA's technical cooperation project on Human Capacity on Operation of Weather Analysis and Forecasting, they have received further training on operation and maintenance of the radar systems[22] in order to use the equipment procured under the project more effectively and longer. JICA experts from the technical cooperation project[23] as well as BMD officials did not identify any problems with the routine operation and maintenance of the equipment. Though the BMD does not provide regular training for technical personnel, internal training is conducted in which personnel who have participated in overseas training share their knowledge as appropriate.

Technical personnel themselves in the Cox's Bazar and Khepupara radar stations also find little difficulty in operation and maintenance of the radars. However, since the software based system was introduced to the BMD for the first time, they feel the need to learn more about the Linux operating system and circuit analysis so as to deal with troubles properly when they arise.

### 3.5.3 Financial Aspects of Operation and Maintenance

Budgets for the BMD Head Office, the two radar stations and the SWC have increased steadily securing sufficient funds for usual operation and maintenance (See Table 6). Satellite communication fees, which were not required before the introduction of the satellite data communication system under the project, are covered by Head Office budget.

Table 6 Annual Budget of BMD Head Office and Radar Stations

(BDT1,000)

| Item | 2008/09 | 2009/10 | 2010/11 | 2011/12 (Prospect) |
|---|---|---|---|---|
| **BMD Head Office** | | | | |
| Personnel Expenses | 42,500 | 45,000 | 46,000 | 50,000 |
| Consumable Cost | 3,000 | 3,500 | 4,000 | 5,500 |
| Electricity & Water Utilization Cost | 3,800 | 4,000 | 4,100 | 4,500 |
| Cost of Spare Parts | 35,090 | 37,000 | 41,000 | 65,000 |
| Telecommunication Cost | 8,500 | 9,000 | 9,500 | 10,000 |
| Space Segment | 1,200 | 1,500 | 1,700 | 2,500 |
| Total | 94,090 | 100,000 | 106,300 | 137,500 |
| **Cox's Bazar Radar Station** | | | | |
| Personnel Expenses | 3,500 | 3600 | 3,700 | 3,900 |
| Consumable Cost | 820 | 920 | 1,120 | 1,320 |
| Electricity & Water Utilization Cost | 700 | 800 | 910 | 1,110 |
| Radar Maintenance Cost | 810 | 910 | 1,110 | 1,310 |
| Total | 5,830 | 6,230 | 6,840 | 7,640 |
| **Khepupara Radar Station** | | | | |
| Personnel Expenses | 3,580 | 3,680 | 3,780 | 3,860 |
| Consumable Cost | 400 | 500 | 600 | 710 |

[22] Under the technical cooperation project, the BMD is working on estimating rainfall through calibration analysis of radar data from the Cox's Bazar and Khepupara radars in order to increase the impact of a series of Japan's grant aid projects to develop meteorological radar systems including the Cox's Bazar and Khepupara project.

[23] Those experts include consultants from the Japan Weather Association (JWA): the main consultant for this project.

| | | | | |
|---|---|---|---|---|
| Electricity & Water Utilization Cost | 500 | 600 | 750 | 910 |
| Radar Maintenance Cost | 1,000 | 1,100 | 1,200 | 1,330 |
| Total | 5,480 | 5,880 | 6,330 | 6,810 |

Source: BMD

Though the operation of the radar systems, particularly in Khepupara, has been affected by frequent power outages especially during the period from 2007 to 2009 and subsequent lack of funds for generator fuel, the BMD claims that it has managed to secure sufficient budget for fuel since FY 2010/11. Although the electricity and water budget of the Head Office for 2010/11 that covers the fuel cost does not indicate a significant increase (See Table 6), recent operation records in Khepupara show a substantial extension of radar operation hours (See 3.3.1 Quantitative Effects). It is therefore unlikely that financial issues will significantly affect the sustainability of the project's effects.

### 3.5.4 Current Status of Operation and Maintenance

The equipment in the two radar stations have managed to be maintained very well: all equipment is currently functioning properly and even looking as good as new. Both stations have kept complete maintenance records using daily, weekly, monthly and semi-annual check sheets. Uses of spare parts and the replacement of parts and components have also been recorded in detail. Mechanical troubles have been dealt with properly; however, it sometimes took a few months to change parts or components because these systems were the first digital radar systems introduced in Bangladesh.

The condition of the radar tower building is also good. The interior of the building has been thoroughly cleaned. The BMD arranges for maintenance and repair work on any radar tower buildings when problems are identified and therefore the inspection and maintenance of the Cox's Bazar and Khapupara radar tower buildings (walls, roof, doors, etc.) have been done only once when the warrantee period was ending a year after the completion of the construction. The BMD has encountered no serious problems with regard to maintenance of the radar tower buildings.

The project equipped the SWC with a meteorological radar data display system, a meteorological data communication system, a meteorological data satellite communication system and a meteorological satellite data receiving system. Of the four systems, the satellite data receiving system has been non-operational for more than 10 months. The prolonged response is partly due to the fact that a hard disk change did not work and partly because it is not required for observation activities. The problem is expected to be solved very soon now that the JWA, the main consultant of the project, diagnosed the problem, and the procurement of necessary parts is underway. The Japan Meteorological Agency is providing the BMD with access to meteorological satellite data on the Internet until the restoration of the data receiving system.

Based on the above findings, it is concluded that, no major problems have been observed in the operation and maintenance system, therefore sustainability of the project effect is high.

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

This project is well aligned with the policy of the GoB that gives priority to disaster management as well as the development needs of a country that has suffered tremendously from cyclones. The project was efficiently implemented with inputs executed and outputs produced

almost as planned.

One of the targets set for the project, the radars' detection range of 300km radius for precipitation intensity of 1mm/h or more, has been met. On the other hand, though annual operation hours of the meteorological radars fell well below the target in FY 2009/10, prospects for extension of operation hours are good. Findings of the evaluation study suggest that it has largely generated intended impacts such as improved cyclone information and warnings, better quality of forecasts for Cox's Bazar District and contribution to the reduction of damage from cyclones. The implementing agency that has operated and maintained all meteorological radars in Bangladesh for over two decades is competent enough to continue to generate such project effects and therefore the sustainability of the project is high.

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

### 4.2 Recommendations

#### 4.2.1 Recommendations to the Executing Agency

Although operation and maintenance of the radar systems have been properly undertaken owing to skilled technical personnel, in order to maximize the project effects as well as to benefit more from the project, it is necessary to extend observation hours (particularly in the monsoon seasons). In this regard, the current observation setup of the two radar stations in the monsoon seasons in particular should be enhanced. It is recommended that the BMD make further efforts to obtain government approval of the proposed new organizational structure and increase personnel for observations.

As far as the meteorological satellite data receiving system set up in the SWC, the BMD should restore it as soon as possible, giving serious consideration to the fact that it remained non-functional during this year's entire monsoon season. In addition, developing an effective reporting and coping system that works without relying on the JWA ( the main consultant of the project) is recommended.

#### 4.2.2 Recommendations to JICA

There is no particular recommendation to JICA.

### 4.3 Lessons Learned

Indicators that measure the direct effects of a project, "project effect indicators", are important and therefore need to be set based on sufficient discussion among concerned parties. In setting such targets, the past performance records of the executing agency need to be taken into consideration.