Evaluation Results

I. Outline of the Project		
Country: Republic of Cuba		Project title: Capacity Development on Groundwater Development and Management for Climate Change Adaptation
Issue/sector: Water resources/disaster management		Cooperation scheme: Technical cooperation (services implementation type)
Division in charge: Global Environment Department		Total cost: approx. 289 million yen
Period of cooperation	From September 2008 to February 2012 (for three and a half years)	Partner country's implementing organization: National Water Resources Institute and Hydraulics Projects and Researches Enterprises Group
		Supporting Organization in Japan: None

1-1 Background of the Project

In the republic of Cuba (Cuba), about 80% of the annual rainfall is concentrated in the season from May to October. The amount of annual rainfall differs largely by region, from 400mm to 4,000mm. About 64% of the water used in 2000 was surface stream water. However, the amount of annual rainfall is declining recently, falling to a record low in 2004. Especially in the eastern five provinces, the decrease of rainfall is notable and the situation of water supply is showing severe deterioration. The causes of the deterioration of water supply in this region include the facts that the distribution of shallow aquifers are limited in the region, and that the reliance on surface stream water is as high as 90%. Under such a situation, the National Water Resources Institute (INRH) is considering the increased use of deep groundwater in order to cope with the extreme drought. However, the INRH and public corporations under it do not have sufficient geophysical prospecting technology to adequately implement the study, development and management of deep layer groundwater (200m underground or deeper), and technology for groundwater availability analysis.

JICA had dispatched experts and provided the transfer of technology for the understanding of aquifers and the acquisition of basic skills for electric prospecting in the past. However, in August 2006, a new request was submitted from Cuba for technical cooperation aiming for the improvement of geophysical prospecting skills including electromagnetic prospecting and the capacity to utilize the results of prospecting, as well as for the implementation of groundwater management according to groundwater models. In response to the request, a project was started from September 2008. This project, targeting the Institute and Hydraulics Projects and

Researches Enterprises Group (GEIPI), INRH, and the Managerial Group for the Hydraulic Resources Exploitation (GEARH), which are the organizations in charge of the research for groundwater development and the actual exploitation and management of groundwater, aims to improve the ability to implement geophysical prospecting and research, develop groundwater models, and establish GIS (Geographical Information Systems), as well as the ability to utilize these skills for the actual exploitation and management of groundwater.

1-2 Project Overview

This project aims to support the National Water Resources Institute (INRH) of the Republic of Cuba (Cuba) and the affiliated Institute and Hydraulics Projects and Researches Enterprises Group (GEIPI) and the Managerial Group for the Hydraulic Resources Exploitation (GEARH) to improve their ability to exploit and manage groundwater.

(1) Overall Goal: Groundwater is utilized appropriately within the use of water resources in the Eastern Region.

(2) Project Purpose: The ability of INRH (including GEIPI and GEARH) to exploit and manage groundwater is improved.

(3) Outputs:

1) The geophysical prospecting skills of GEIPI core technical personnel, who will become the training instructors, is improved.
2) The ability of GEIPI core technical personnel, who will become the training instructors, to construct groundwater models is improved.
3) The ability of GEIPI core technical personnel, who will become the training instructors, to establish GIS is improved.
4) The ability of GEARH and the Basin Management Department and Water Utilization Construction Department of INRH to utilize the results of the geophysical prospecting implemented and analyzed by GEIPI, the groundwater management model and the results of GIS, and to evaluate and manage groundwater, is improved.
5) Technologies related to geophysical prospecting, groundwater models and GIS are transferred to the relevant GEIPI technical personnel.

(4) Inputs

[Japanese side] Total cost: Approx. 289 million yen

1) Experts and personnel for work coordination: 9 persons (53.74MM, including the period of work in Japan)
2) Equipment: 19,791,000 yen
3) Local costs: 40,448,000 yen

4) Acceptance of trainees: 5 persons

[Cuban side]

1) Counterparts: 28 persons in total (project management: 9, core technical personnel: 19)
2) Lands and facilities: Offices for experts
3) Local costs: 456,862 CUC/MN and 27,320.73CUC

II. Evaluation Team

Members of the evaluation team	Leader: Katsuhito Yoshida, Senior Advisor, Global Environment Department, JICA Evaluation policy consultation/cooperation policy consultation: Yuki Inoue, Water Resources Management Division II, Global Environment Department, JICA Evaluation analysis: Keiko Asato, Foundation for Advanced Studies on International Development (FASID) Interpreter: Setsuko Otaki, Japan International Cooperation Center	
Period of evaluation	From June 3 to June 30, 2011	Type of evaluation: Terminal evaluation

III. Results of Evaluation

3-1 Achievements

3-1-1 Output 1: The geophysical prospecting skills of GEIPI core technical personnel, who will become the training instructors, is improved.

Although the activities could not be implemented as planned in the second year due to the delay in the procurement of equipment for geophysical prospecting, necessary activities were implemented in the third year and afterwards. The core technical personnel acquired the skill at the targeted level.

Indicator	Achievement
1-1 Training texts are formulated and revised.	The training texts are prepared and the Spanish translation is almost finished. In order to make the text geared to the reality of Cuba, core technical personnel started to replace charts and other materials with the examples of Cuba, which is scheduled to be finished by December.
1-2 Technical personnel who are able to carry out electric prospecting (tomography) and electromagnetic prospecting is developed (5 persons).	Comprehensively considering the lectures and practices implemented, answers to the assignments, and the results of tests so far, six core technical personnel acquired the targeted skills to carry out electric/electromagnetic prospecting.

1-3 The results of geophysical prospecting at the model site is presented.	The result of geophysical prospecting in the model site (Sola area) was presented in the groundwater seminar held in June. It is scheduled that the final result of the prospecting will be presented in December, after the fine adjustment of the study result is completed.

3-1-2 Output 2: The ability of GEIPI core technical personnel, who will become the training instructors, to construct groundwater models is improved.

The progress was behind the schedule because of the delay in geophysical prospecting training and the drilling of observation well, and because project covered the acquisition of new skills the parties needed time to understand and acquire the theory and familiarize themselves with new technologies. However, the groundwater model in the model site has already been constructed as of the time of terminal evaluation, and it is expected that the core technical personnel will acquire the skill of the targeted level by the end of the project.

Indicator	Achievement
2-1 Training texts are	The training texts are prepared and the Spanish translation is almost finished. In order to make the text geared to the reality of Cuba, core technical personnel will replace charts and other materials with the examples of Cuba, and the revision scheduled to be finished by December.
2-2 Technical personnel who are able to formulate groundwater model are developed (5 persons).	Japanese experts technically judged the understanding of theory, answers to the assignments, and the results of the tests so far. As a result, it is considered that the six core technical personnel who were the target of technology transfer will be able to forecast the acceptable pump yield by setting the conditions, using the groundwater model.
2-3 Based on the methodology acquired in 2-2, the groundwater mathematical model of the model site is constructed.	The structure of the model is almost completed as of March 2011. The groundwater model of the model site (Sola area) was constructed by revising the data on the hydraulic constant and pump yield based on the results of pumping tests and geophysical prospecting that were obtained in June 2011. In the training implemented in June, the forecasted figure was calculated using the model and the groundwater model to be used as a management tool in the future was provided.
2-4 The precision of the existing hydrogeological map of the model site is improved.	In the training implemented in June 2011, it is scheduled that data such as the result of pumping tests from observation wells and existing wells and geophysical prospecting results will be obtained, and the hydrogeological map and hydraulic constant distribution chart will be completed.

3-1-3 Output 3: The ability of GEIPI core technical personnel, who will become the training instructors, to establish GIS is improved.

Because there was an accumulation of basic knowledge in the area of GIS among the core technical personnel, technical training was implemented only twice. Thereafter, GIS DB was prepared in the eastern three provinces. Diffusion training targeted to GEIPI general technical personnel also started, and the core technical personnel acquired the skill of the targeted level.

indicator	Achievement
3-1 Training texts are formulated.	The training texts are prepared and the Spanish translation is almost finished. In order to make the text geared to the reality of Cuba, core technical personnel will replace charts and other materials with the examples of Cuba, and the revision is scheduled to be finished by December.
3-2 Technical personnel who are able to construct GIS related to water resources is developed (5 persons).	It is expected that the seven core technical personnel who participated the training will reach the level of being able to construct GIS.
3-3 GIS screen on the GIS construction site is prepared.	As of March 2011, GIS DBs for the eastern three provinces are already almost completed, and are currently being amended. The GIS screen is scheduled to be completed at the time of the dispatch of experts in September 2011.

3-1-4 Output 4: The ability of GEARH and the Basin Management Department and Water Utilization construction Department of INRH to utilize the results of the geophysical prospecting implemented and analyzed by GEIPI, the groundwater management model and the results of GIS, and to evaluate and manage groundwater, is improved.

Although the progress of activities is behind the schedule, it is scheduled that technical trainings and seminars on the three areas targeted to the INRH and GEARH be held in the fourth year. If these trainings and seminars are participated in by the technical personnel of INRH and GEARH, it is expected that groundwater evaluation/management ability of the level targeted in the indicator will be acquired.

Indicator	Achievement
4-1 Two or more training courses targeting the technical personnel engaged in groundwater management of the Basin Management Department and Water Utilization Department of GEARH and INRH are implemented within the INRH training program.	During October and November 2011, Seminar on “What is Groundwater Management?” was implemented by the Japanese experts for six times, visiting all the provinces the core technical personnel belong to. There were 94 participants in total, including technical personnel from the provincial level INRH, provincial Managerial Group for the Hydraulic Resources Exploitation (EARH) and Provincial Institute and Hydraulics Projects and Researches Enterprises Group (EIPH/EIPI). Also, a groundwater management seminar was held in Camagüey

	in June, participated in by INRH and GEARH. A similar seminar is planned for Havana in December. It is scheduled that training for INRH, GEARH, EIPH/EIPI and GEILH will be held for eight times from July to November 2011, with the core technical personnel who were instructed in this project serving as the lecturer.
4-2 Of the total participants in the training course (approx. 45 people), 90% acquire what is conveyed in the training (a test is conducted at the end of the course).	When the seminars and trainings explained above are implemented, it is scheduled to conduct questionnaires or tests to check the level of understanding of participants.

3-1-5 Output 5: Technologies related to geophysical prospecting, groundwater model and GIS are transferred to relevant GEIPI technical personnel.

Although the progress of activities is behind the schedule, it is scheduled that technical trainings and seminars on three areas also targeted to the general technical personnel of GEIPI be held in the fourth year. It is expected that groundwater evaluation/management ability of the level targeted in the indicator will be acquired by participating in these trainings and seminars. For the general technical personnel of EIPH/EIPI, which are the subsidiary organizations of GEIPI, the level required in terms of the specific understanding of individual skills differs from that required for technical personnel of GEARH, which manages the water usage and budget plan, or of INRH, which is in charge of the management of the water source as a whole. Therefore, it is important that specific skills necessary for work will be continuously instructed even after the termination of this project.

In some cases, technical personnel of EIPH/EIPI of the ordering provinces are also engaged in conducting the groundwater research accepted by the core technical personnel. Thus, an opportunity for general technical personnel of GEIPI experiencing the new technology is being provided in the form of on-the-job training (OJT).

Indicator	Achievement
5-1 Two or more training courses targeting the technical personnel engaged in groundwater exploitation and management of the GEIPI are implemented within the INRH training program.	The visiting training program scheduled in Output 4 will be implemented for eight times, and is to be participated by at least 30 general technical personnel of GEIPI. As for GIS, training for general technical personnel was already held twice under this project (in June 2010 and March 2011).
5-2 Of the total participants in the training course (approx. 30 people), 90% acquire what is conveyed in the training.	It is scheduled to conduct tests at the end of the training to check the level of understanding of participants.

3-1-6 Expectation of the achievement of the project purpose (the ability of INRH [including GEIPI and GEARH] to exploit and manage groundwater is improved).

The degree of the achievement of indicators at the time of evaluation is as shown in the table

below. It is expected that the project purpose will be achieved.

Considering the duration of the project and the original activity plan, it is considered to be difficult to obtain any specific "result" of groundwater management within the project period. Thus, the evaluation here is implemented by interpreting the indicator as the "implementation of groundwater evaluation and management."

Indicator	Prospect of achievement
The potential and problems of groundwater development (including the forecast based on hydrogeology, groundwater availability, water quality and groundwater model) in the model site is summarized and presented.	The result of the summarized potential and problems of groundwater development in the Sola area was presented in the groundwater seminar held in June. It is scheduled that case simulation will be implemented from this point on based on the information on the current situation of groundwater, including hydrogeological conditions, groundwater availability and water quality, to clarify changes in groundwater level, groundwater flow and substances transport. The final summary of the potential and problems of groundwater development (points to keep in mind at the time of development) will be presented in the seminar held in December.
The result of the groundwater analysis and management based on the groundwater model and GIS DB is reflected in the annual report of GEARH.	It is scheduled that the annual report of GEARH issued in February 2012 refers to the instruction for GEARH scheduled to be made from late in the third year to the fourth year, and the introduction of the groundwater analysis and management method.
The result of the groundwater analysis and management based on the groundwater model and GIS DB is reflected in the annual report of INRH.	As of the time of evaluation, it is not reflected in the publications of INRH. However, it is scheduled that the case of the Sola area (or the case of other areas based on the experience in the Sola area) is explained as an example of groundwater analysis and management method based on the groundwater model and GIS DB in "Voluntad HIDRAULICA," the official paper published by INRH.

3-1-7 Prospect of the achievement of the overall goal (groundwater is utilized appropriately within the use of water resources in the Eastern Region)

INRH is announcing the policy of forecasting the amount of available groundwater in order to cope with the impact of climate change. Although the budgetary trend could not be confirmed, it is thought that a study of at least of the present level will be continued and the skills necessary for implementing such a study have been developed. On the other hand, in order to secure alternative water sources, it is necessary to secure operating expenses for the development of water sources, and budgets should be also allocated to GEAAL (Representatives of the Public Company of Aqueducts and Sewer Systems) for reducing the number of people who are being supplied of water from water trucks. Because no information on the possibility of these budgets was obtained in this survey, no judgment can be made on the prospect of the achievement of these indicators.

Although there remain some indicators that cannot be judged due to lack of information, concerning the indicators that can be judged, it is possible that the overall goal is achieved.

Indicator	Prospect of achievement
Periodic and ongoing studies on the availability of groundwater in the eastern provinces are implemented (in at least three provinces).	It is expected that skills necessary for implementing studies on the availability of groundwater will be acquired during the project period. Although budget is necessary to implement studies, there is no information that there will be a reduction of the budget necessary to carry out the study continuously and periodically in the future, so it is considered that the studies will be continued at least at the current frequency.
5-2 An alternative source of water at the time of drought is secured in the eastern provinces (at least in three provinces, the ratio of people being supplied of water from water trucks is reduced in 2007).	The prospect of the achievement of this indicator cannot be judged.

3-2 Summary of Evaluation Results

(1) Relevance (high)

Cuba has set five prioritized items in the National Development Plan with the target year set at 2010, and water resources development is one of them. INRH, which is in charge of the development and management related to water resources, gives “taking measures to reduce the damage of abnormal situations (extreme drought/flood) through the comprehensive and effective management of water” as one of the prioritized strategies in the Water Resources Strategy Plan 2007-2009. Thus, the improvement of the ability for the research and management related to groundwater development corresponds with the water resources policy of Cuba. In addition, there are also increasing needs for exploiting groundwater as a source of water in the time of drought. On the other hand, support for groundwater exploitation and management matches the assistance policy for Cuba formulated in 2000, and Japan also has the technical superiority in this area.

Consequently, the relevance of implementing this project is “high.”

(2) Effectiveness (high)

Although the development of core technical personnel in terms of geophysical prospecting skills, construction of groundwater models and the construction of GIS is being achieved as planned (Outputs 1-3), due to the delay in the training on geophysical prospecting skills and the digging of observation wells, the implementation of training on the method of the study and management of the development of groundwater provided by the core technical personnel to INRH (including GEIPI and GEARH), and the implementation of training to general technical personnel in GEIPI (Outputs 4-5) are behind the schedule of the original plan. However, the potential and problems of groundwater development in the model site are already summarized and presented. As for the delayed training, implementation is

specifically planned for the fourth year, and if these trainings are implemented, it is considered highly probable that the case example of the utilization of skills acquired in this project as a method for groundwater analysis and management is explained in GEARH and INRH reports.

Consequently, it is likely that the aim of this project will be achieved and it is judged that the effectiveness is high.

(3) Efficiency: (moderate)

Although the quality, amount and timing of input from both Japan and Cuba were appropriate for the most part, some delay of input (procurement of electromagnetic prospecting equipment and the digging of an observation well) resulted in the delay of activities, and eventually the delay of the achievement of some outputs. In addition, because of the replacement of project administrators on three occasions and insufficient handover of work to support the replacement, as well as the lack of personnel in charge of the practical operation of assisting the project administrator, it became difficult to efficiently implement the project for some time.

Consequently, the efficiency is judges as moderate.

(4) Impact (high)

It is considered that the overall goal of the project is partly achieved. In addition, there are many more positive impacts of the project being confirmed. For example, core technical personnel trained in this project implemented study on the water resources development in other provinces, resulting in the improvement of the accuracy of groundwater study in provinces where technical personnel have not been trained. In some provinces, not only the data of GEIPI but also the data of INRH and GEARH are being streamlined using GIS. Technical personnel of CITA, who were not the direct beneficiaries of the project, are implementing GIS diffusion training. There is also a plan being considered for the land usage utilizing the hydrogeological map of the Sola area (the model site) formulated in the project. On the other hand, no negative impact was found in particular.

Consequently, it is considered that the impact is high.

(5) Sustainability (moderate)

In terms of policy and framework, INRH is expressing its intention to forecast the amount of available groundwater as a part of countermeasures against climate changes, so it is considered that the study, exploitation and management of groundwater will continue to remain important in the future. A group of core technical personnel in the areas of

geophysical prospecting skills, the construction of groundwater models, and the construction of GIS have been developed through the implementation of this project. It is also considered that skills necessary to improve the accuracy of groundwater studies and to provide technical instructions to the general technical personnel of INRH/GEARH/GEIPI have been developed.

On the other hand, the framework remains fragile, as GEIPI, the organization in charge of directing the core technical personnel and utilizing/maintaining the outputs of this project, still has not appointed any personnel in charge of practical operation even at the time of terminal evaluation. As for funding, although a certain amount of training budget is being secured, it is difficult to secure budget for the maintenance of equipment and materials, so whether the sustainability can be supported in the future is unclear.

Consequently, the sustainability of the project is moderate.

3-3 Factors that promoted the realization of effects

(1) Details of the plan

This project employed a method similar to development studies. The accuracy of the hydrogeological map of the model site was improved jointly with the counterparts. At the same time, the simulation of groundwater development was implemented by using the model site as a case example. Through these measures, better understanding was promoted regarding the implementation method of groundwater studies, acquisition of skills in the three areas, the utilization method of the results of the groundwater study and groundwater management method; including the points to keep in mind when putting them into practice.

In addition, because it was expected that the procurement of equipment in Cuba may take time due to import restrictions and complicated procedures, the procurement of equipment was started first, and the plan for implementing individual activities was set forth thereafter. Also due to the effort of the project administrators at that time, much of the equipment could be obtained before the start of activities and the technology transfer was started as planned.

(2) Implementation process

Core technical personnel all have the expertise and working experiences in the area in question, and they possessed fundamental technical experience such as being accustomed to operating PCs. They also had the basic skills in the area and space recognition such as the conversion of coordinate systems and the understanding of three-dimensional maps. In addition to these basic skills, they also had strong enthusiasm

for acquiring new knowledge and information. They acquired the targeted skill level by going through the training while also being engaged in busy ordinary work.

3-4 Problematic issues and factors that caused such issues

(1) Details of the plan

Regarding the project operation system, no personnel in charge of the clerical work to support the decided policy were appointed, and the excessive burden on project administrators and the delay of communication made it difficult to smoothly operate the project. However, persons in charge of practical operation were appointed after the terminal evaluation and the situation improved.

(2) Implementation process

With the delay of the procurement of geophysical prospecting equipment and the digging of the observation well, some of the activities were delayed, and as a result the achievement of some outputs and the start of related activities were also delayed.

3-5 Conclusion

In this project, the achievement of some outputs was delayed due to the delay of some inputs, which also affected the achievement of other outputs. However, it is judged that INRH (including GEIPI and GEARH) can acquire knowledge to improve the ability to exploit and manage groundwater before the termination of the project. With a high degree of the probability of the project purpose being achieved, it is considered as reasonable to terminate the project as planned.

However, it cannot be said that GEIPI has sufficient organizational and financial powers to continuously implement the training and study. Measures should be taken on items recommended in 3-6 in order to ensure the sustainability after the termination of the project.

3-6 Recommendations

The following six items are recommended to be implemented before the termination of the project.

(1) Seminars and trainings on groundwater exploitation and management targeted to technical personnel including those in INRH and GEARH are planned to be held after June 2011. It must be ensured that technical personnel of INRH and GEARH actively participate in these trainings and seminars.

(2) GEIPI should consider a mechanism to make the maximum use of the outputs of this project (including the core technical personnel, equipments and materials, various types of

software, GIS DBs and the hydrogeological map of the model site) throughout the country, and Japanese experts should give advice thereof.

(3) Core technical personnel should clarify the specific content and implementation method of the technical instruction training, that is to be provided by the core technical personnel to the general technical personnel of GEIPI after the termination of the project, and Japanese experts should give advice thereof. GEIPI should also share the content of the information with INRH and GEARH.

(4) A mechanism to appoint personnel in charge of practical operation within GEIPI and ensure smooth operation of the project should be established.

(5) A system to maintain the equipment supplied by the project (places to be allocated, administrators, source of maintenance budget, etc.) should be clarified and the transfer procedure should be completed based on the agreement with JICA before the termination of the project.

(6) With regard to the maintenance of equipment, because the procurement of spare parts and equipment for replacement is difficult in Cuba, manuals should be made on the method of handling the equipment in order to delay the wear and degradation of consumables as much as possible and on the method of maintenance necessary to prevent the malfunction of the equipment, and the contents should be thoroughly informed to those who handle the equipment. A list of where the parts and equipment can be obtained in Cuba and abroad should also be compiled and shared among the relevant parties.

The following four items are the recommendations after the termination of the project.

(1) INRH should continuously implement groundwater studies. Upon implementation, a study method utilizing the skills acquired in the project (geophysical prospecting skills, groundwater model, GIS, etc.) should be employed, the skills and equipment acquired in the project should be utilized, the accuracy of the study should be improved and the level of skills maintained.

(2) INRH should consider a mechanism to streamline the data that were collected periodically up to now into a unified format in order to be shared among relevant parties in Cuba, and to manage and utilize them appropriately.

(3) Since many of the core technical personnel to which the technology was transferred in this project were in their 40s and 50s, GEIPI should consider a way to develop young technical personnel having skills of the same level.

(4) INRH should utilize the information from each organization in order to ensure the smooth sharing of information among public corporations, and ensure that each organization can utilize the information to operate the enterprise efficiently and effectively.

3-7 Lessons learned

Lessons learned from this project are as follows.

(1) Although the decision-makers and core technical personnel to which the technology was transferred were set as CPs of this project, no personnel in charge of the practical operation of the project were appointed, impeding the smooth operation of the project. When formulating a project, it is necessary to clarify the operational framework of the project including the appointment of personnel in charge of practical operation, and allocate a sufficient number of counterparts.

(2) The plan of this project was to simultaneously implement the technology transfer in the three areas of geophysical prospecting, groundwater model and GIS. However, because the geophysical prospecting and the creation of groundwater model are implemented by utilizing the GIS database, it is thought that it would have been more efficient if the technology on GIS was transferred first. Based on this experience, in cases where an output is achieved based on the effect derived from the achievement of other outputs, it is desirable to formulate the project considering the temporal sequence of the outputs.

(3) As for activities that strongly rely on the procurement of equipment, an activity plan should be set that sufficiently considers the time required for procurement so that the delay of procurement does not seriously affect the implementation of the activity.

(4) In some countries, available parts and peripheral equipment may be limited. Set the bidding conditions by considering not only the price but also the situation of distribution and the market of the country when procuring equipment and materials.

(5) In this project, instructions were provided also for the usage of free software that does not require licensing. The Cuban side does not need to purchase software that requires licenses on their own, which contributes to the sustainability of the project. When the diffusion of technology within a country utilizing software is planned, explanations and usage instructions should not just be provided for software that requires licensing, but also for free software, to support the promotion of technology diffusion.