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업무자료 사업평가 2012-16-037

Ex-Post Evaluation Report for the 3 Projects of the National Geodetic Control Point Installation in Cambodia

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This evaluation study was entrusted to Korean Association of Geographic Information Studies by KOICA for the purpose of independent evaluation research. The views expressed in this report do not necessarily reflect KOICA's position

Contents

List of Abbreviations

CIDA	Canadian International Development Agency
CORS	Continuously Operating Reference Stations
CPS	Country Partnership Strategy
DAC	Development Assistance Committee
EDM	Electromagnetic Distance Measurement
FLMA	Faculty of Land Management and Administration
GDCG	General Department of Cadaster and Geography
GD	Geography Department
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
GPS	Global Positioning System
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
LDCs	Least Developed Countries
LICs	Low Income Countries
LMAP	Land Management and Administration Project
MDGs	Millennium Development Goals
MLMUPC	Ministry of Land Management, Urban Planning, and Construction
NGCPIP	National Geodetic Control Point Installation Project
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
RUA	Royal University of Agriculture
TD	Technology Department
UN	United Nations
USAID	United States Agency for International Development

Abstract

Abstract

This evaluation aims at comprehensive follow-up evaluation based on the top five evaluation criteria of OECD/DAC, i.e., relevance, efficiency, effectiveness, impacts, and sustainability of assistance on Cambodia's national geodetic control point installation project (NGCPIP) implemented by KOICA from 2003 to 2009. Through this, this report seeks to evaluate the effects on NGCPIP under Korea's ODA, suggest measures for improvement, and reflect the lessons drawn on similar projects including future geodetic survey and GIS sectors and KOICA's national infrastructure support policy. Ultimately, the purpose of this evaluation is to contribute to the policy direction of KOICA's ODA strategies.

This evaluation carried out literature review and empirical analysis to achieve the evaluation purpose. The literature review used data on the relevant policies and plans of KOICA and Cambodia's national geodetic control points and interim and final outcome reports as basic data to analyze the relevance, efficiency, impacts, etc., on Cambodia's NGCPIP. For the empirical analysis, in-depth interview, questionnaire survey, and local geodetic survey were conducted, and empirical analysis was used as a means to verify the analysis results drawn through the literature review. The objects of in-depth interview and questionnaire survey included KOICA personnel, assistance-receiving country's project institution (Cambodia's MLMUPC), government officials of each province, local engineers, and local project participants. The local geodetic survey was carried out to verify the preciseness of the national geodetic control points installed as a result of project implementation.

The evaluation method and procedure were applied in the order of evaluation

criteria and items development, data collection, data analysis, and interpretation.

As the first stage of the evaluation, the top five evaluation criteria of DAC were applied to Cambodia's NGCPIP, and the evaluation indicators were developed from the project environment and system standpoint (micro level), project purpose and strategy standpoint (meso level), and policy and institutional standpoint (macro level).

At the second stage, data were collected through KOICA and Cambodia-related literature reviews, interviews with KOICA and Cambodia project-related personnel, and local engineers and project participants.

At the third stage, comprehensive follow-up evaluation results were drawn through data analyses and interpretation procedure based on the collected data.

As a result of the comprehensive evaluation, the project carried out in 3 phases to install national geodetic control points from 2003 to 2009 can be evaluated to be very excellent in evaluation items such as relevance, efficiency, effectiveness, impacts, and sustainability. Although training content and consideration of the relevant country's special attributes in the relevance item and specialized personnel training and achievement of training goals in the effectiveness and impacts items were good overall, there are some parts requiring improvement for the project's effect enhancement. The first- and second-phase projects were believed to have contributed to improving the feasibility and effectiveness of the project since regions with high potential for national territory development were selected and project priorities were decided to offer control points to LMAP. In particular, to enhance the project's effectiveness, geodetic datum should be installed at regular intervals for easier user accessibility. In this regard, Cambodia's NGCPIP realized uniform quality for the internal geodetic survey network and highly accurate outcome coordinates and offered a national geodetic network. All in all, NGCPIP is considered to have reflected effectively the ODA policy of KOICA.

Based on the foregoing evaluation results, the following are the policy implications on Korea's OECD/ODA projects to install national geodetic control points and Cambodia's NGCPIP:

First, a comprehensive evaluation method needs to be adopted for the comprehensive follow-up evaluation method. KOICA's unique evaluation system, i.e., the adoption of a comprehensive evaluation method combining internal and external evaluations, is necessary. The advantage of internal evaluation is that the personnel of the institution in charge of project implementation can identify the project's goals and details better and consequently monitor the project according to the evaluation items and indicators. Moreover, it is easier to draw problems and measures to improve them as required to enhance the effectiveness, impacts, and sustainability of the project. Meanwhile, the external evaluation carried out by experts can ensure objectivity in terms of the evaluation results, realize efficient evaluation using expertise, and provide new perspectives as to the project's direction and implementation. Consequently, KOICA's unique evaluation system, i.e., a comprehensive evaluation method that properly combines internal evaluation and external evaluation, is required.

Second, organizing an advisory group that can monitor the overall project is necessary. In the case of national infrastructure support projects such as NGCPIP, there is a need to organize an advisory group (tentative name) that can monitor the project from the project planning and execution stages to the completion stage and feed back the monitored results to the project to reflect flexibly the economic, policy, and environmental characteristics of the assistance-receiving country and enhance project effectiveness. Through the advisory group (proposal), the project's driving force can be secured, the problems can be identified, and the feedback function can be maximized, and the legitimacy of project implementation can be secured considering the detailed items in each project implementation stage, i.e., planning, implementation, and follow-up management stages. Therefore, the advisory group can offer an opportunity to secure the assistance-receiving country's ownership awareness including policy, legal, institutional, and administrative systems and technical advice and to foster capabilities to establish in-house planning, project implementation, and follow-up management.

Third, a strategy to foster personnel to secure the sustainability of NGCPIP is

required. Given the current situation wherein manpower having expertise in the geodetic control points of an assistance-receiving country is insufficient, there is a need to expand basic infrastructure such as setting up geodetic control points and to implement a project to develop capabilities, such as human resources development. Specifically, considering the fact that the paradigm of ODA projects is changing from simple technology transfer to capacity development, the input or transfer of advanced technologies to the assistance-receiving countries is judged to be burdensome.

Fourth, conversion into a results-based management system is required. The ultimate purpose of Korea's ODA project is to enhance the quality of life of the assistance-receiving countries' people and expand the friendly relationships between those countries and Korea beyond the drawing of results such as construction of hospitals and schools. In fulfilling more earnestly the purpose of the ODA project, there can be a limit through an implementation-focused management system wherein a project is carried out focusing on the resources inputted into the project and project outcomes. As an alternative, a measure to convert into a results-based management system that manages and measures the project's outcomes and impacts from the mid- and long-term perspectives should be presented.

Overview of Evaluation

Chapter

1 Overview of Evaluation

Section 1. Background

○ KOICA implemented Cambodia's NGCPIP as official development assistance (ODA) an assistance project carried out for free from 2003 to 2009 in 3 phases to restore and install Cambodia's survey control points, which were destroyed and devastated because of prolonged civil wars in Cambodia, so that national territory and regional development can be undertaken smoothly and for the project to contribute to Cambodia's economic development.

○ To enhance the smooth implementation and effectiveness of the ODA project, objective, reasonable evaluation is necessary during the project implementation process and even after the project is completed. Specifically, there is a need to draw problems in the project planning and implementation processes and results and measures to improve them, including a feedback system reflecting the measures on the ODA policy and project improvement.

○ In most cases, interim evaluation that monitors the project's progress and draws matters for improvement in the project implementation process is performed. Note, however, that comprehensive project evaluation is not carried out after the end of the project; thus measures to improve the relevant policy and project are not devised until the completion of evaluation.

○ Consequently, implementing the ODA project (free of charge) in line with its purpose and enhancing effectiveness require devising measures to improve the policy and project by carrying out integrated results evaluation after the end of the project. Therefore, this project was undertaken against such backdrop.

Section 2. Purpose

○ As comprehensive follow-up evaluation on Cambodia's NGCPIP, the effects of the project implemented in 3 phases are to be analyzed based on the evaluation criteria of the OECD/Development Assistance Committee ("DAC"). Specifically, the top five criteria are relevance, efficiency, effectiveness, impacts, and sustainability of assistance.

○ Through the comprehensive follow-up evaluation, the effects of NGCPIP are to be evaluated, and measures to address the problems, drawn. The evaluation results can be reflected on similar projects in geodetic survey and GIS areas and national infrastructure support policies and contribute to KOICA's establishment of policy direction for overseas assistance strategies. In particular, the evaluation aims to improve the recognition of Korean people with regard to KOICA's projects implemented by the government of Korea, an OECD member country, and to secure transparency through the sharing of evaluation information.

Section 3. Object and Scope of Evaluation

1. Object

○ The evaluation object includes Cambodia's NGCPIP implemented in 3 phases from 2003 to December 2009.

○ The aforesaid project is mainly aimed at establishing national geodetic infrastructure by installing 3 points for GPS Continuously Operating Reference Stations (CORS), 7 grade 0 control points, 155 grade 1 control points (including

60 control points for re-observation), and 92 grade 2 control points.

○ Through the local and invitational training of working-level personnel, the project seeks to support securing exclusive technology via the transfer of technology to install national geodetic control points on the basis of GPS and offer an opportunity to learn the information required for geodetic survey and spatial information policy establishment through the invitational training of decision makers.

○ **First-phase project**

- Project period: Dec. 2003 ~ Dec. 2004
- Target region: Kampong Chhnang Province and surrounding areas
- Budget spent: USD 972,000
- Control point installation: 15 grade 1 control points and 40 grade 2 control points (total of 55 control points)
- Invitational training: 8 working-level personnel, 3 decision makers
- Miscellaneous: 4-wheel drive jeeps and IT equipment including computers

○ **Second-phase project**

- Project period: Jan. ~ Dec. 2006
- Target region: Pursat and Koh Kong
- Budget spent: USD 1,000,000
- Control points setup: 16 grade 1 control points and 52 grade 2 control points (total of 68 control points)
- Invitational training: 6 working-level personnel and 3 decision makers
- Miscellaneous: GPS reception sets for geodetic survey, 4-wheel drive jeeps and IT equipment including computers

○ **Third-phase project**

- Project period: Dec. 2007 ~ Dec. 2009
- Target region: All across Cambodia
- Budget spent: USD 2,500,000
- Control points setup: 84 grade 1 control points f

- Re-observation of control points: 7 grade 0 points and 60 grade 1 points
- Installation of GPS CORS: 3 stations and Central Data Center
- Invitational training: 6 working-level personnel and 4 decision makers
- Miscellaneous: GPS reception sets for geodetic survey, 4-wheel drive jeeps and IT equipment including computers

<Table 1> Details of Cambodia's national geodetic control point installation project

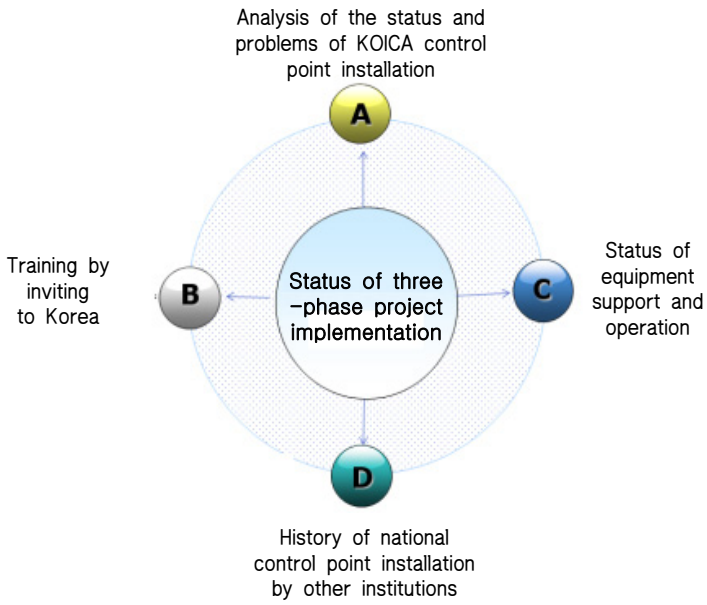
	First phase	Second phase	Third phase
Project period	2003.12～2005.1	2005.12～2006.12	2007.12～2009.12
Target region	Kampong Chhnang Province	Pursat and Koh Kong	All across Cambodia
Survey control points setup	15 grade 1 control points, 40 grade 2 control points	16 grade 1 control points, 52 grade 2 control points	7 grade 0 control points f (re-observation), 84 grade 1 control points (new installation/observation), 60 control points (re-observation) 3 GPS CORS
Domestic invitational training	8 working-level personnel 3 decision makers	6 working-level personnel 3 decision makers	6 working-level personnel 3 decision makers
Equipment support	Vehicle, computer, etc.	GPS, vehicle, computer, etc.	GPS equipment, vehicle, office supplies, etc.
Project cost	USD 1 million	USD 1.20 million	USD 2.50 million

2. Scope of evaluation in terms of content

○ To evaluate the status of Cambodia's national geodetic control point installation project implemented over the first to third phases, support for equipment and operation situation, and trainees invitation projects (training of working-level personnel and decision makers and local training)

○ To evaluate the implementation methods and procedures from the implementation process standpoint of the three-phase project and follow-up management

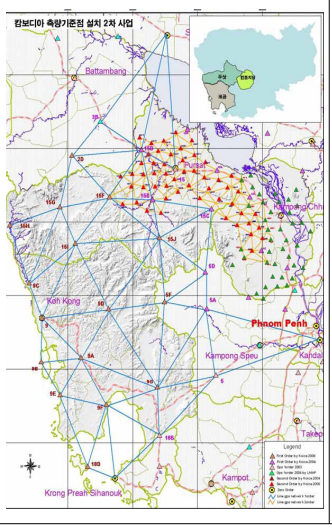
<Figure 1> Scope of Evaluation



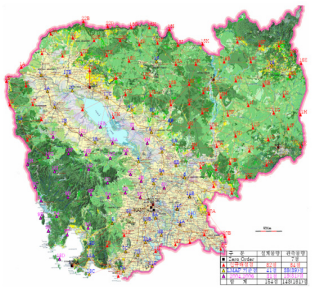
3. Scope of evaluation (in terms of region)

<Figure 2> First-phase project regions

<Figure 3> Second-phase project regions



<Figure 4> Third-phase project regions



Section 4. Characteristics of Evaluation

1. Inputting evaluation manpower equipped with expertise in the relevant field

- ○ Manpower with ample experience in Korea's national control points-related survey
- ○ Manpower with ample experience in national territory planning and international cooperation projects
- ○ Implementation of academic studies using evaluation experts
- ○ Manpower who are proficient in foreign languages, at the same time reflecting the project characteristics

2. Establishment of evaluation plans through ample pre-study

- ○ Collect similar cases in relation to domestic and international control point installation.
- ○ Carry out, implement, and reflect the pre-study of KOICA Cambodia's NGCPIP.
- ○ Reflect the opinions of project participants and Korean experts.

3. Enhancement of reliability and feasibility using triangulation

- ○ Simultaneously apply qualitative and quantitative research methods.
- ○ To enhance quantitative data analysis and improve the consistency of analysis results simultaneously using supplementary methods through questionnaire survey and in-depth interview

4. Simultaneous performance of qualitative and quantitative studies

○ Qualitative study: A qualitative study is carried out through literature review, data collection and analysis, and open questionnaire survey.

○ Quantitative study: Simultaneous conduct of questionnaire survey and in-depth interview

- After analyzing in the first phase by drawing up questionnaires by survey object in advance and distributing them, conduct in-depth interview focusing on the questionnaire survey object to supplement the analysis results.
- Conduct the local in-depth interview by group and collect various opinions effectively; individual interview should be conducted as necessary, however.

5. Use of standardized evaluation items of OECD/DAC

○ In line with DAC's top five evaluation items, develop evaluation indicators suitable for NGCPIP. Suitably correct and complement the various evaluation tools that have been applied to evaluation methodology study, and then perform evaluation.

○ By developing specific evaluation indicators by evaluation item, apply them to the evaluation of similar infrastructure establishment projects by other countries.

Evaluation Methodology

Chapter

2 Evaluation Methodology

Section 1. Evaluation Concept Framework

○ This evaluation study performed follow-up evaluation on NGCPIP that had been implemented from 2003 to 2009 and consequently attempted to evaluate the impacts and sustainability. The following are the limitations, however:

- Although the project began in 2003, it was completed in 2009; as such, there is a limitation in analyzing the impacts and sustainability of the project because the project duration was not that long.
- The project is a national infrastructure establishment project, which becomes the base of a country's geodetic survey and mapping; thus, the mid- and long-term effects can be identified by interviews with related personnel of the country, and there may be a limitation in quantifying the indicators.
- Survey control points were installed by classifying them into grade 1 to grade 4 based on the national geodetic survey starting point to link with the world's geodetic datum. The control points were only national grades 1 and 2 control points and 3 GPS CORS supported by KOICA through NGCPIP implemented in 3 phases.

○ Despite the aforesaid limitations, the conceptual framework of evaluation developed on the basis of the follow-up evaluation's purpose is presented in <Figure 5>.

○ The OECD/DAC evaluation criteria were applied to David Easton's system, i.e., to the model of input-process-output, and were comprehensively illustrated in <Figure 5>.

○ Stage of status identification and objective setting

- Whether the three-phase project was implemented considering national policies and demand and whether goals were established based on such are evaluated.
- In this stage, relevance is evaluated.

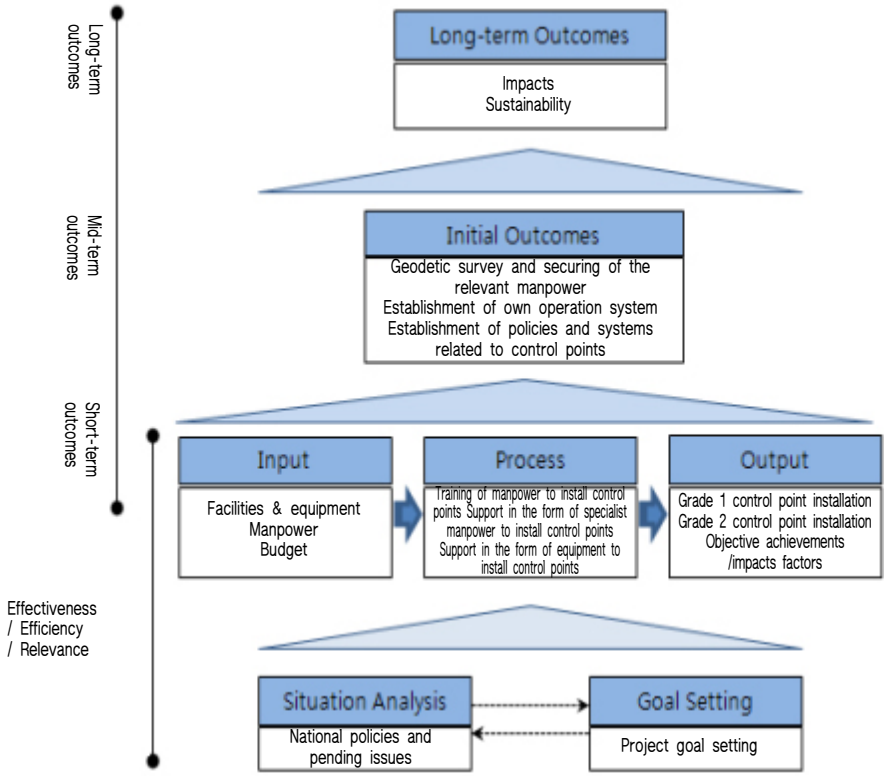
○ Stage of input-process-output

- Whether the input of facilities, equipment, manpower and budget and control point installation, equipment support, and training (working-level personnel, decision makers) were appropriate and efficient is evaluated.
- In the input and process stages, efficiency is evaluated; in the output stage, effectiveness is evaluated.

○ Stage of impacts and sustainability of project results

- Whether the project results including the preciseness of national geodetic control point installation, securing of the relevant experts, and establishment of control point management and operation system were effectively demonstrated and whether they wielded impacts at the current point in time including their sustainability are analyzed.
- This stage seeks to evaluate the impacts and sustainability that can be manifested as a result of the project. How the assistance-receiving country's efforts were reflected on the institution and policy is evaluated.

<Figure 5> Evaluation Concept Framework



Section 2. Status of Evaluation Team Composition

○ This evaluation consists of an evaluation team with four people organized by the Korean Association of Geographic Information Studies. Having majored in Public Administration, the head of this evaluation project supervised the study and evaluation methodology area and took charge of the project to install national survey control points.

○ The other three co-researchers and evaluation adviser are experts in civil engineering, spatial information system, and urban planning. They were in

charge of the technical areas including the preciseness of the geodetic control points, installation of GPS CORS, and follow-up management's relevance, input factors' pertinence, efficiency, etc.

<Table 2> Status of the Evaluation Team Composition

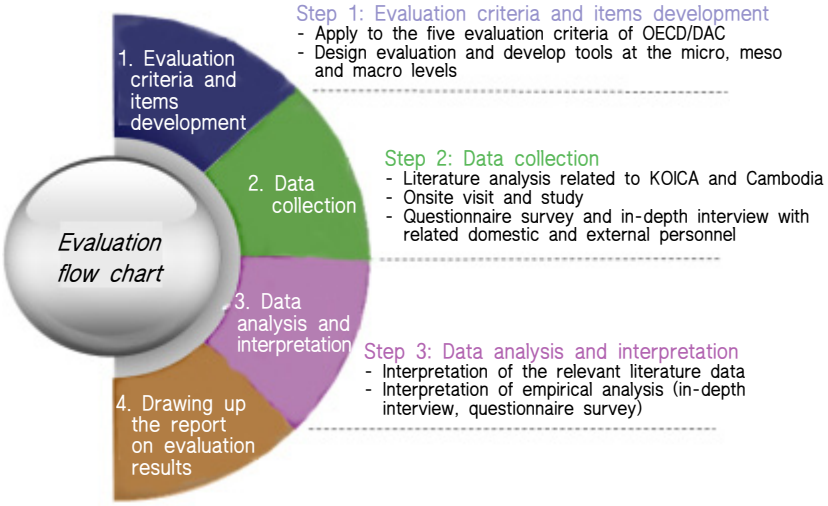
Area	Name	Position in this evaluation project	Organization	Duties
Head of the project/Public Administration	Kim Tae-jin	Head researcher	Prof. of the Dept. of Public Administration at Chungju National University	Research supervision, domestic study, onsite visit and study, questionnaire survey, in-depth interview, evaluation analysis
Engineering	Lee Hong-gyu	Co-researcher	Prof. of the Dept. of Civil Engineering at Changwon National University	Establishment of evaluation plans (survey), onsite survey and study plans establishment and analysis, onsite visit and study, analysis and report preparation
Urban planning	Cho Jin-chul	Co-researcher	Research committee member of KRIHS	Literature review, tools analysis, evaluation analysis, domestic study
Engineering	Seo Yong-chul	Evaluation advisory committee member	Prof. of the Dept. of Spatial Information System at Pukyoung National University	Domestic and external study, evaluation advisory

Section 3. Evaluation Details and Method

○ Evaluation flow chart

- The evaluation flow chart for the follow-up evaluation on NGCPIP was applied in the sequence of development of evaluation criteria and items, data analysis and interpretation, and drawing up of the report on the evaluation results as shown in <Figure 6>.

<Figure 6> Evaluation Flow Chart



○ Literature and data collection

- Data on KOICA and Cambodia's national control points-related policies and plans
- Collection and analysis of project-related data and analysis including assistance-receiving country's request, pre-study report, TOR, project plan, and interim and final reports on the project results.
- ODA-related government policy data collection and analysis
- Collection and analysis on data related to ODA including measures to advance international development and cooperation and comprehensive implementation plans by 2011 international development cooperation field
- Onsite survey and study: Onsite tour of control points/implementation of GPS observation

○ Questionnaire and in-depth analysis

- KOICA personnel
- Cambodia's project organizing institution (Cambodia's MLMUPC)
- Land Management and Urban Planning Bureaus of Kampong Chhnang and Pursat Provincial Governments
- Local engineers: Engineers for control point installation and observation,

participants of invitational training, and local business people using the project results

<Table 3> Details of Literature Review

Category	Details of data	Location of data
National policy data	Basic national survey plan, Basic plan of national spatial information, Cambodia's national development plan, etc.	MLMUPC (Spatial Information Policy Bureau) National Geographic Information Institute Cambodia's General Department of Cadaster and Geography
Business data	Assistance-receiving country's ODA project request (English version) Pre-study report Project implementation plan Project interim evaluation report Final project report, etc.	KOICA
ODA data	Millennium development goals Measures to foster international development and cooperation Comprehensive implementation plan by 2011 international development cooperation field	KOICA Prime Minister's Office, Ministry of Strategy and Finance, Ministry of Foreign Affairs
Study and evaluation data	Study methodology, Survey study method, etc.	

<Table 4> Details of Questionnaire Survey and In-Depth Interview

Category	Survey method	Survey object
Step 1 (Questionnaire survey)	■ The questionnaire survey targets institutions. ■ By devising the questionnaire, send it to each institution's representative. ■ Collecting the survey responses and analyze them.	■ Assistance-receiving country's relevant agencies and officials including Cambodia's General Department of Cadaster and Geography ■ Local government officials of Kampong Chhnang, Pursat, Koh Kong ■ Project participating agency (Samboo Engineering) ■ Project participant (Cambodian engineers) ■ Trainees ■ KOICA personnel

<Table 4> continued

Category	Survey method	Survey object
Step 2 (Group interview)	■ Conduct group interview by institution. ■ Ask questions related to evaluation. ■ Check and supplement the questionnaire analysis results. ■ Conduct the cross-check of the same details.	■ Cambodia's central and local government officials) ■ People with experience in using the project results (Cambodia) ■ Project participants (Cambodia) ■ Trainees (Cambodia) ■ KOICA personnel ■ Project participating company (Samboo Engineering) ■ Korean experts participating in the project
Step 3 (Individual in-depth interview)	■ After analyzing the step 1 and 2 surveys, implement in-depth interview by individual as necessary.	■ Officials of assistance-offering and assistance-receiving countries ■ Project participating institutions and personnel ■ Project results using businesses/personnel

1. Step 1: Evaluation criteria and items development

○ Concerning the evaluation items, the evaluation indicators were developed from the project implementation environment and system perspective (micro level), project purpose and strategic perspective (meso level), and policy and institutional perspective (macro level) by applying the concept of DAC's top five evaluation criteria to NGCPIP. Evaluation items and indicators were developed by field, based on the development cooperation project evaluation indicators presented by OECD/DAC Evaluating Development Co-operation: summary of key norms and standards (2010).

○ By developing key informant interview questions that are structured based on the evaluation indicators by field, semi-structured questionnaires that can be obtained through interviews on relevance, efficiency, impacts, and sustainability were devised.

<Table 5> Evaluation Indicators by Field

1) Relevance		
Policies and systems at the macro level	Relevance of Korea's ODA policies	■ Does the Cambodia project reflect Korea's ODA policies?
	Linkage with Cambodian survey policies	■ Does the national geodetic control point installation project match Cambodia's basic survey plan, national development plan, and basic plan for national spatial information policy?
Goals/ Strategies at the meso level	Linkage with MDGs	■ Are the set goals consistent with MDGs* to some degree?
	Integrity with the demand degree of the assistance-receiving country	■ Does the national geodetic control point installation project match the demand in Cambodia? ■ Were the regions where national geodetic control points are to be installed suitable?
	Relevance with the project purpose of injection factors	■ Was the project composed of suitable input factors to achieve the project purpose? - Was the project budget appropriate? - Was the manpower required for project implementation properly inputted? - Were the technology and equipment required for project implementation appropriate?
		■ Relevance of project equipment support - Were the types and quantity of equipment support to install national geodetic control points suitable to achieve the project purpose?
		■ Relevance of the invitation of trainees - Were the training period, programs, content, and lecturers appropriate?
		■ Relevance of dispatched experts - Were the dispatched manpower suitable to achieve the project purpose in terms of expertise and number of manpower?
Project implementation environment and system at the micro level	Consideration of peculiarity of the country concerned	■ Was the project implemented in consideration of the survey level of Cambodia? ■ Were the control points installed according to Cambodia's criteria?
	Relevance of the technology and infrastructure level of the country concerned	■ Was the technology support for the project suitable for Cambodia's technology and infrastructure level?
	Relevance of the implementation process	■ Was the process to coordinate the problems developed during the project implementation process? ■ Relevance of project starting time and duration ■ Relevance of local manpower utilization ■ Relevance of project schedule
Cross-cutting issues		■ Was there any consideration given to the environment when a project plan was drawn up and carried out?

<Table 5> continued

2) Efficiency		
Goals/Strategies at the meso level	Efficient linkage of project goals	■ Were the goals/strategies planned and executed to link organically with the NGCPIP of other institutions and Cambodia's NGCPIP of KOICA?
		■ What were the limiting factors in using more efficient strategies?
Project environment and system at the micro level	Efficiency of project input factors	■ Was input by project factor made efficiently? ■ Was the input cost by project factor efficient? ■ Was the geodetic control point installation ratio efficient within the project duration?
	Project management system	■ Was the monitoring of the project carried out in a timely manner? ■ Was communication in implementing the project efficient?
	Usefulness of project implementation technique	■ Usefulness of applied technologies
3) Effectiveness and impacts		
Policies/Systems at the macro level	KOICA purpose achievement	■ How much did NGCPIP achieve KOICA's development policies and purpose?
	Impacts on Cambodia's national territory plan and geodetic policies and system	■ What are the positive impacts of the project on the overall social, economic, regional, and environmental development outcomes including Cambodia's national territory plans and geodetic policies? ■ What are the negative impacts of the project on Cambodia's national territory plans and geodetic policies?
Goals/Strategies at the meso level	Project goals achievement	■ Were the goals concretely specified?
		■ Were the specified goals achieved? - To what extent were specialist manpower nurturing and training achieved? - To what extent was technology transfer achieved? - How precise is the geodetic control point survey? - How relevant were the geodetic control points? - What was the degree of satisfaction with the geodetic control point installation?
Project environment and system at the micro level	Impacts on national geodetic control point installation	■ Level of national geodetic control point use ■ National territory plan using the national geodetic control points ■ National information project using the national geodetic control points
	Impacts on project environment and system	■ What are the merits and demerits in comparison with the national geodetic control point installation supported by other countries/institutions?
	Effects of trainees invitation	■ Did the training through trainees invitation and by government officials help Cambodia's NGCPIP and practical national territory planning? ■ What is the trainees' degree of satisfaction?
Cross-cutting issues		■ Did this project contribute to environmental sustainability?

<Table 5> continued

4) Substantiality		
Policies/ Institutions at the macro level	Cambodia's policy/institutional support sustainability	■ Has the project contributed to establishing development strategies on Cambodia's policies and institutional national territory plans, national information policies, and geodetic survey projects? ■ Has Cambodia secured the legal and institutional bases related to national geodetic control point installation and management?
	Korea's technical and human resources support's sustainability	■ Has KOICA prepared for continual technical and HR support measures for the target project?
goals/ strategies at meso level	Cambodia's ownership awareness on the national geodetic control point installation project	■ Has Cambodia made efforts for the quantitative and qualitative improvement of the project? - Based on the geodetic control points, does Cambodia have a plan to expand the installation of grades 2, 3, and 4 geodetic control points? - Have the installed control points been used according to the original purpose?
Project environment and system at the micro level	Project's independence possibility	■ Ratio of trained people related to Cambodia's geodetic survey ■ Cambodia's decision makers' interest ■ Does Cambodia continually reinforce geodetic survey manpower? ■ Have organizations for geodetic survey, national territory plans, and spatial information been newly formed? ■ Does Cambodia have a plan to implement national development and regional development plans using the control points installed through this project? ■ To what extent is Cambodia equipped with capabilities to use the installation, management, and utilization of the geodetic control points in the future?
	Maintenance & repair and management & operation capabilities	■ Are there measures to maintain/repair the installed control points? ■ Under what levels do Cambodia's commitment to and capabilities for independent management and maintenance/repair of the national geodetic control points fall? ■ At what level is the equipment required for this project maintained and repaired?

2. Step 2: Data collection

1) Domestic interviews

○ Interviews with KOICA personnel

- To evaluate the relevance of Cambodia's NGCPIP with Korea's ODA policies and KOICA's purpose achievement, impacts of the project on other Korea- supported projects, and Korea's sustainability of technical and human resources support, interviews with the Cambodian Office Director and Assistant Director were conducted using a structured questionnaire.

○ Interviews with project officials dispatched to the site

- To evaluate the local activities, Cambodia's technical level on the geodetic control points, Cambodia's geodetic survey technology level and manpower status, consideration given to the environment, Cambodia's decision makers, and other related officials' interests in the national geodetic control points, interviews with the project participating institution (Samboo Engineering) dispatched to Cambodia were conducted using a structured questionnaire.

2) Onsite visit study

○ Study period: July 10 ~ 21, 2011 (12 days and 11 nights)

<Table 6> Composition of the Local Study Group

Name	Organization/Position	Remarks
Kim Tae-jin	Prof. of Public Administration Dept., at Chungju National University	PM evaluation field
Lee Heung-gyu	Prof. of Civil Engineering Dept., at Changwon National University	Geodetic survey (control point) field
Seo Yong-chul	Prof. of Spatial Information Engineering Dept., at Pukyong National University	Evaluation advisory in the region (city) development field
Cho Jung-hyun	Evaluation Office of KOICA	Staff member

○ Status identification

- Identification of the policies and utilization fields of Cambodia's national geodetic control points
- Identification of the management and use status of control points as the results of KOICA's project
- Local GPS observation for the verification of the control points' preciseness

○ Questionnaire survey among key relevant officials and in-depth interviews

- Questionnaire survey and in-depth interview targeting Cambodia's central government public officials of MLMUPC and local governments' public officials including Kampong Chhnang, Pursat, and Koh Kong Provinces.
- To evaluate Cambodia's geodetic survey policies, technical level, project environment, training, impacts and use level of geodetic control point installation, management status of geodetic control points, and use sustainability, interviews were conducted using a semi-structured questionnaire.
- Interviews with the invited trainees in Korea on the relevance including training period, content, program, venue, and instructors
- Policy plan data collection of the central and local governments on the future geodetic survey development direction

<Table 7> Local Study Schedule

Date	Details of Activities	Remarks
July 10 (Sun.)	■ Departure from Incheon (18:40) ■ Arrival in Phnom Penh (22:05)	KE689
July 11 (Mon.)	■ Visit to KOICA's local office ■ Visit to MLMUPC's GDCG - Introduction to Local Study group's visit purpose, study details, and schedule - Delivery of requests related to the local study - Confirmation of study questions - Interviews with the GDGC Director, Technology Department Director, and Geography Department Director	Phnom Penh

<Table 7> continued

Date	Details of Activities	Remarks
July 12 (Tue.)	■ MLUMPC in Kandal - Interviews with the director and working-level personnel - Check on observation management issues ■ MLUMPC Technology Training Center - Interviews with the center personnel - Identification of the center's training status (geodetic survey and cadastral field) ■ MLUPC in Kampong Chhnang and Pursat - Interviews with the relevant personnel and trainees who completed the invitational training - Identification of control point use and management status ■ Move to Siem Reap	Kandal Siem Reap
July 13 (Wed.)	■ MLUPC in Siem Reap - Interviews with the director and working-level personnel - Identification of control point use and management status ■ Siem Reap GPS CORS - Check on the operation status of the observation station	Siem Reap
July 14 (Thu.)	■ Move to Kratie	Siem Reap Kratie
July 15 (Fri.)	■ MLUPC in Kratie - Interviews with the director and working-level personnel - Identification of control point use and management status - Check on the operation status of the observation station ■ Move to Phnom Penh	Kratie Phnom Penh
July 16 (Sat.)	■ Analysis and arrangement of study results	Phnom Penh
July 17 (Sun.)	■ Internal review meeting on the study details ■ Preparation for comprehensive meeting	
July 18 (Mon.)	■ Visit to FILMAP Office ■ Comprehensive meeting with GDCG	
July 19 (Tue.)	■ Geography Department of GDCG - Interview with the Geography Dept. Director - Collection of national control point systems and future policy data - Interviews with working-level personnel and trainees who completed the invitational training on control point installation ■ Local GPS observation of the first-phase project region	
July 20 (Wed.)	■ Technology Department of GDCG - Interview with the Technology Department Director - Collection of control point installation data with grade 3 and below ■ Local GPS observation of the second-phase project region ■ Departure from Phnom Penh	
July 21 (Thu.)	■ Arrival in Incheon (06:40) ■ Local GPS observation of the third-phase project region	KE690

3) Data collection list

<Table 8> Local Data Collection List

Serial No.	Collection Data	Remarks
1	Status of geodetic control point installation of grade 3 and below between 2003 and 2011	Technology Department
2	Status geodetic control point installation of grade 3 and below between Jan. and Jun. 2011	
3	Report of control point installation of grade 3 in Kampong in 2011 (partial)	
4	Control point installation plan of grades 2 and 3 in 2011	Geography Department
5	Control point installation plan of grades 2 and 3 in 2012	Geography Department
6	National strategic development plan update (2009~2013)	
7	National strategic development plan update (2006~2010)	
8	Official document to request the additional installation of control points of grades 1 and 2	
9	Official document to request for national geodetic control point maintenance/repair and protection	Hihanouk Governor
10	Data collection of 2009 MLUMPC project evaluation seminar (partial)	
11	Organization configuring the plan to maintain and repair GPS CORS	Minister of MLMUPC
12	Official document requesting the payment of the observation station's Internet connection expenses	
13	Draft of the Geodetic Survey Act	
14	National policy on spatial planning	Aug. 8, 2011
15	Sub-decree on the organization and function of MLMUPC	
16	Official document requesting cooperation on KOICA's control point installation project	Minister of MLMUPC
17	Report on the achievements of land reform implementation (2002-2009) and ways forward through the program-based approach (2003~2013)	
18	Land is Life (LASSP newsletter)	
19	Education curriculum of the Faculty of Land Management and Administration at the Royal University of Agriculture	

4) Local Geodetic Survey

○ Purpose

- Local geodetic survey to verify the preciseness of the national geodetic control point installed as a result of NGCPIP
- After processing GPS observation data, compare them with the estimated outcomes through NGCPIP.

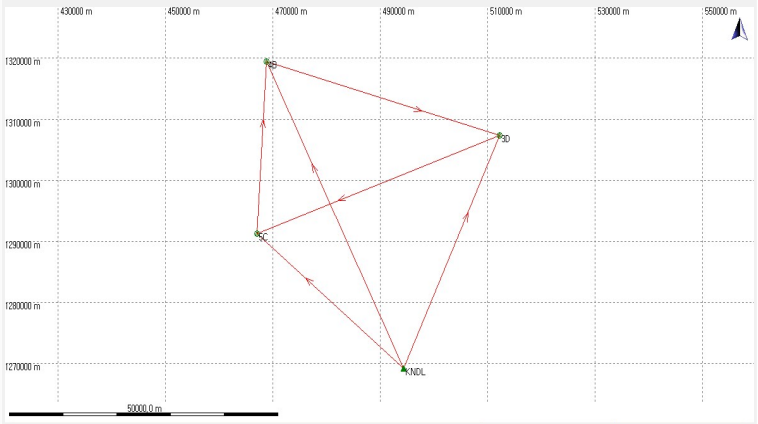
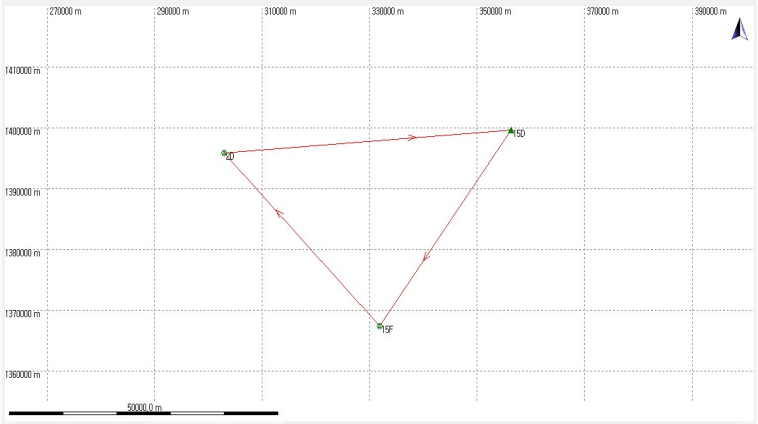
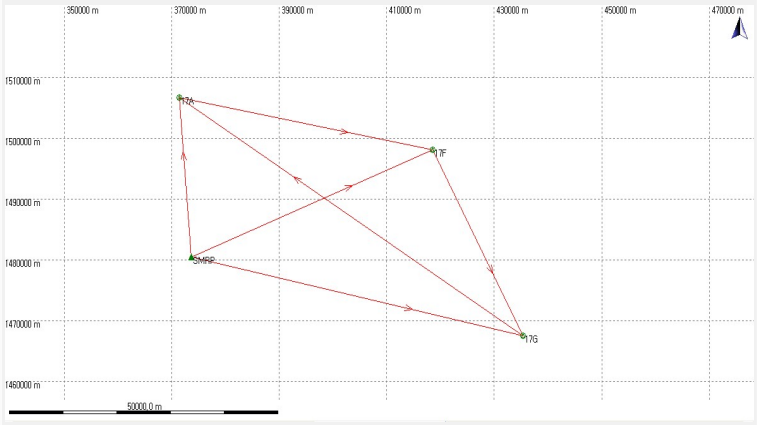
○ Method

- To verify the preciseness of the control points installed through NGCPIP, GPS observation was carried out by choosing a Cambodian geodetic surveyor, Heng Prime Construction, as local consultant.
- Comparison of the statistics of NGCPIP results after GPS observation data baseline interpretation and network adjustment

○ GPS observation

- GPS observation was carried out targeting 3 GPS CORS in each phase region of NGCPIP by minimizing the number of GPS CORS for verification of geodetic network adjustment in consideration of study period and budget.
- Observation period: July 19 ~ 21, 2011
- Observation duration: Minimum of 4 hours or more
- Data sampling interval: 20 seconds
- Observation equipment: GPS receptor and antenna with 2 frequencies (Trimble 5700, TRM41249.00)

<Table 9> GPS Local Observation Time and Network Chart

Project	Observation point/time	Observation and baseline interpretation network chart
First phase	KAND CORS 3D 4B 5C Jul. 19, 2011 09:30 ~ 13:30 (4h)	
Second phase	15D 15F 2D Jul. 20, 2011 09:10 ~ 13:50 (4h and 40 min)	
Third phase	SMRP 17A 17F 17G Jul. 21, 2011 08:30 ~ 13:30 (5h)	

<Figure 7> Local GPS observation

3D

15D

15F

17A

3. Step 3: Evaluation and mark distribution criteria

○ For the mark distribution criteria of OECD/DAC's top five evaluation items, assigning weight to each item, i.e., relevance, efficiency, effectiveness, impacts, and sustainability, is appropriate. When using a result-based management evaluation method, assigning higher weight to the effectiveness, diffusion effects, and sustainability items is only proper.

○ In this evaluation, however, the same weight is given considering the comprehensive aspects of NGCPIP, and not enough time has passed to measure the project's ripple effects.

○ This comprehensive follow-up evaluation was conducted using qualitative and quantitative study methods, but the qualitative study method was mainly used; the quantitative study method including questionnaire survey and in-depth interview was used as supplementary means.

- The reason the quantitative study method was used as supplementary means is that there is a limit in the generalization of the analysis results due to the insufficient numbers of the parent group.

○ The mark distribution criteria for the evaluation in this study are as follows:

- Very excellent: As a comprehensive evaluation, the details of data collection corresponding to the evaluation items are positively in line with the evaluation questions by more than 80%; this means a bit of improvement is needed for project effect enhancement, and the sign (o) was affixed.
- Excellent: As a comprehensive evaluation, the requirements of evaluation questions are met by 60%~less than 80%, and the evaluation results are good and were in line with each evaluation item. Note, however, that some improvement is required for project effect enhancement, and the sign (□) was affixed.
- Improvement needed: As a comprehensive evaluation, the requirements of evaluation questions are met by 40%~less than 60%. Nonetheless, faithfulness is insufficient, and many improvements are needed for project effectiveness enhancement; the sign (△) was affixed.
- Insufficient: As a comprehensive evaluation, the requirements of evaluation questions are met by less than 40%. Project implementation is insufficient, and large-scale improvement is necessary for project effectiveness enhancement; the sign (×) was affixed.

<Table 10> Mark Distribution Criteria of Comprehensive Follow-up Evaluation

Category	Mark Distribution	Mark Awarding Criteria
Very excellent	○	As a comprehensive evaluation, the details of data collection corresponding to the evaluation items are positively in line with the evaluation questions by more than 80%; this means there is a bit of improvement for project effect enhancement
Excellent	□	As a comprehensive evaluation, the requirements of evaluation questions are met by 60%~less than 80%, and the evaluation results are good and were in line with each evaluation item. Still, some improvement is required for project effect enhancement.
Improvement necessary	△	As a comprehensive evaluation, the requirements of evaluation questions are met by 40%~less than 60%. Note, however, that faithfulness is insufficient, and many improvements are needed for project effectiveness enhancement.
Insufficient	×	As a comprehensive evaluation, the requirements of evaluation questions are met by less than 40%. Project implementation is insufficient, and large-scale improvement is necessary for project effectiveness enhancement.

Section 4. Evaluation Schedule

Process / Details	No. of working days																		Report to be submitted
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	
Commencement of study and evaluation design																			
Commencement of report meeting																			Evaluation implementation plan
Domestic study/local study plan establishment																			
Local study																			Local study plan
Study results analysis and interim report preparation																			Local study implementation and result report
Interim report submission																			Interim report
Drawing up the final report																			
Final report meeting																			Draft of the final report
Report deliberation																			
Report correction and supplementation																			
Final report submission (Korean)																			Final report submission (Korean)
Final report submission (English)																			Final report submission (English)
Holding of advisory meeting																			

General Status of Cambodia

Chapter

3 General Status of Cambodia

Section 1. Status of ODA for Cambodia

○ The strategy of ODA for Cambodia is based on Cambodia's development strategies and is aimed at supporting the Cambodian government to achieve in a timely manner the national goals set by the Cambodian government. Toward this end, water resources, rural village development, health and medical service improvement, and industrial infrastructure establishment are intensively supported.

○ The ODA amount for Cambodia supported by Korea in 2008 was USD 33 million, ranking 6th in size next to Japan, China, US, and EU. Cumulative assistance for free from 1991 to 2009 was USD 52.73 million.

<Table 11> Korea's Yearly ODA Amount (1991~2009)

Year	Assistance amount (for free)	Year	Assistance amount (for free)
1991	2.9	2001	105.6
1992	-	2002	176.5
1993	3.0	2003	234.1
1994	0.8	2004	334.1
1995	3.1	2005	581.3
1996	24.7	2006	632.9
1997	183.4	2007	869
1998	30.1	2008	1,311.4
1999	29.7	2009	68.5 (tentative)
2000	65.3	Total	5,273.1

Data: Korea Institute for International Economic Policy (2010). Basic Study and Strategy Development Research to Establish ODA Policy for Cambodia, p.123

○ Among the ODA projects implemented by KOICA, relatively large-scale projects including the restoration of multi-purpose reservoirs, nurturing of goods and services and international trading capabilities, and construction of flood control embankment in the Batei area are heavily supported for rural village income increase in the economic sector.

○ The development study project focuses on infrastructure development including roads and water resources in terms of support size but also supports digital infrastructure construction such as the basic study of geodetic control point installation.

<Table 12> Details of ODA for Cambodia

Category	Details	Duration	Support amount (USD 10,000)
Details of project support	Support for multi-purpose reservoir restoration	2002~2004	136.9
	Nurturing of international trading of goods and services	2004~2005	87
	Modernization of National Children's Hospital	2005~2006	240
	Construction of Siem Reap Bypass	2008~2006	16
	Rural Village Comprehensive Development (Kampong Cham Province)	2006~2008	100
	Construction of flood control embankment in Batei	2007~2008	200
	Maintenance/Repair of Kampong Chhnang Regional Hospital	2007~2008	100
	Support for the national technical qualification system	2007~2009	120
	Pavement of Siem Reap Bypass	2008~2009	430
	Installation of national geodetic control points to shape the national territory management base	2007~2009	250
	Korea-Japan Joint Project for irrigation restoration and rural village development	2009	15.5

<Table 12> continued

Category	Details	Duration	Support amount (USD 10,000)
Details of development study support	Epidemic prevention and eradication support including Japanese encephalitis in 6 ASEAN countries	2002~2006	25
	Feasibility study and implementation of maintenance/ repair of Kampot and Trylanglofo Roads	2001~2002	57.4
	Feasibility study on multi-purpose water resources development in the Krang Ponley River Basin	2004~2005	74
	Basic study on geodetic control point installation	2003~2004	100
	Phase 2 project for geodetic control point installation	2005~2006	120
	Establishment of comprehensive plan for national water resources development	2006~2008	148.7
	Rural village development policy and strategy establishment	2007~2008	180
	Support for stock market establishment and operation	2007~2009	180

Data: Korea Institute for International Economic Policy (2010). Basic Study and Strategy Development Research to Establish ODA Policy for Cambodia, pp.125~126

Section 2. Other Assistance Institutions' Support for Cambodia's National Geodetic Control Point Installation Sector

1. History of national geodetic control point installation

- 1902-1950: The Indochina geodetic network based on the Hanoi System was started in Tonkin Delta and was carried out up to Pursat, but most control points were damaged or lost; thus, problems arose.
- 1993-1994: IGN France International installed 4 GPS control points in Phnom Penh and Siem Reap connecting Taiwan and installed 40 grades 1 and control points around Phnom Penh and 15 points around Siem Reap (IGN93).
- 1995-1997: The UHA project was implemented. Although Finnish mapping and observation company FINNMAP conducted a GPS survey from the Mekong

River up to Tonle Sap Lake and Bassac River, the outcomes were estimated by fixing the Laos control points.

○ 1997: Cambodia's GDCG installed 22 grade 1 control points in each province based on IGN93 using GPS supported by EU. In some provinces, secondary control point geodetic survey (EC97) was conducted.

○ 1998: Verification of EC97 outcomes was carried out by including 5 primary EC97 points in PCGIAP (PCGIAP1998).

○ 2003: CGD03 (Cambodia Geodetic Datum 2003) was connected based on ITRF96 and GRS80.

○ As mentioned above, Cambodia's national control points were installed through different geodetic datum according to supporting countries beginning 1902. Regional installation was carried out according to installation purpose.

○ In this context, the installed national control points' linkage is insufficient, and nationwide geodetic control point installation is required due to the limitation in nationwide geographic information establishment.

2. Status of survey assistance projects

○ Conducting cadastral survey and making drawings

- Cambodia's cadastral survey and land registration began through foreign capital including the World Bank, Germany, Finland, and France in 1993; currently, 1/40,000 topographical map scale is used.
- The project purpose is to produce land registration maps for land registration to secure tax resources, solve disputes on land boundary, and register these with the land information system.
- The equipment used for survey includes total stations, tapes, otheophoto interpretation, GPS, and airplane for aerial photograph shooting; plotters are also used.

- During the implementation of cadastral survey, control points were installed using GPS. Note, however, that a preciseness issue was raised because of the lack of linkage with the national control point network. Therefore, the nationwide geodetic control point installation project was implemented.
- Overall, Cambodia completed the digital map production in the main regions due to national interest in land use plan and development; it is currently preparing a master plan on national data infrastructure.

○ Land administration and system establishment

- Cambodia's land management sector began through international assistance, according to the Paris Peace Accords in 1993.
- Through assistance projects, Cambodia digitalized the land registration system, which is used in 15 cadastral survey offices.
- The digital land registration system began to be developed in 2002 with assistance from the World Bank, Finland, and Germany.
- In addition, land policy and regulations system development, land dispute solution mechanism, and land appraisal and trade market development were implemented.

○ National numerical value map production

- As a support project of KOICA, a 1/5,000 numerical value map was produced targeting the entire capital of Cambodia, Phnom Penh.
- A 1/25,000 scale map was produced targeting Siem Reap where the Angkor Wat historic site is located and the coastal resort area Sihanouk Ville.
- Cambodia's mid- and long-term master plan for national spatial information was established.

<Table 13> Status of Major Assistance Project Related to Cambodia's Survey

(unit: USD 1 million)

Project	Details	Duration	Project Amount
Land Management and Administration Project	■ Supported by Germany and World Bank ■ Development of land policies and regulations guidelines ■ Development of land registration system ■ Residents' safety increase and efficient real estate market enhancement	2002~2009	24.9
Land Allocation for Social and Economic Development	■ Supported by Germany and World Bank ■ Implemented to support social land transfer ■ Plan and management of land confirmation, land owner confirmation, and regional social land transfer	2007~2012	11.5
National Digital Map Production	■ KOICA's support ■ Establishment of national basic map database including cadastral map and topographical map	2010~2012	2.2
Land Administration Sub-Sector Program	■ Supported by the Finnish, German, and Canadian governments ■ Development of land policies and regulations system, education base, dispute solution mechanism, and land and land trading market	2011~2015	1404

Section 3. Features to be Considered in Implementing Cambodia's Geodetic Control Point Installation Project

○ Cambodia's MLMUPC recognizes that KOICA-assisted NGCPIP is one of the most important infrastructure among national infrastructures. The project is recognized as a very important means of establishing land management, policies and three-phase NGCPIP, and is deemed to contribute immensely to the establishment of administrative system including land management, urban planning, road construction, and land ownership protection from the mid- and long-term perspectives. Based on such recognition, Cambodia produced the Geodetic Survey Act (draft) by benchmarking Korea's Geodetic Survey

Act. Cambodia actually consolidates the geodetic survey policy through the maintenance/repair of geodetic control points and by using GPS CORS.

- The history of the Cambodian geodetic survey is short, and available financial resources are insufficient. In this situation, there is a limitation as to whether Cambodia can continuously implement geodetic survey-related projects with awareness of ownership. When continual partnership with OECD member countries is maintained in the future, Cambodia's geodetic survey technologies will develop further from the mid- and long-term perspectives.
- According to interviews with the Cambodian Geography Department directors, the direct effects are huge because projects supported by other institutions and countries were implemented in the form of individual project. Note, however, that the project assisted by KOICA is an infrastructure project; hence the small direct effects. If the national territory plan, land management, and policies are established, however, the effects will be significant. Cambodia rates the KOICA-assisted project's indirect effects to be high, considering the fact that Cambodia's various economic development projects (land management, dam construction, cadastral survey, road and railway construction, etc.) would have been difficult to implement without the national geodetic control points.
- Concerning the operation and maintenance/repair of geodetic control points, GPS CORS, the differences in understanding and recognition between the central and local government officials are deemed considerable. Moreover, between local governments, recognition differences in the use of geodetic control points and maintenance/repair of GPS CORS exist. Although NGCPIP was mainly implemented by the central government, it is believed to enhance the understanding of local government officials, since the actual use of NGCPIP is carried out by local governments' presentation of data.
- According to the major interviewees of the evaluation project, the satisfaction with the training is very high. In the case of working-level personnel who received training, they responded that the training was highly useful for the

geodetic survey project around the boundary with Vietnam. In the case of working-level personnel's local training, however, issues such as the short duration, need for realistic and practical training for them, and expectations of continuous conduct of training shall be considered in the future.

Comprehensive Follow-up Evaluation Results

Chapter

4 Comprehensive Follow-up Evaluation Results

Section 1. Relevance

○ To evaluate whether the three-phase NGCPIP was in line with the policies, institutions, goals, strategies, and project environment systems of KOICA and assistance-receiving country (Cambodia)

○ In view of comprehensive evaluation, the relevance was evaluated using the questionnaire survey and in-depth interview data with KOICA's personnel and Cambodia's decision makers and trainees along with the reports of results (pre-, interim, and final evaluation).

1. Policies and institutions

○ Concerning the relevance at the policy and institutional level of the three-phase NGCPIP, whether the project reflected Korea's ODA policies as well as consistency with Cambodia's land management, urban planning, construction strategies, and policies was evaluated.

<Table 14> Relevance: Policy and Institutional Level

Phase	Relevance with Korea's ODA policies	Linkage with Cambodian geodetic control point policies
First phase	○	○
Second phase	○	○
Third phase	○	○

1) Relevance with Korea's ODA policies

○ Korea improved international assistance for free in line with the international norm; it has focused on effectiveness enhancement after becoming a member of OECD/DAC. Under such plan, Korea presents high-level goals for ODA achievement such as supporting the sustainable economic and social development of developing countries, active contribution to UN's millennium development goals (MDGs) of international society, and contributing to international peace establishment through humanitarian assistance (KOICA, 2010).

○ The KOICA-assisted NGCPIP of Cambodia consists of the following to restore national geodetic survey and cadastral data that were destroyed or lost by prolonged civil wars: Support of grades 1 and 2 geodetic control points, dispatch of experts to install control points, training of Cambodians by inviting them to Korea for technology transfer, and support in the form of equipment such as GPS. This implies that Korea's ODA policy is based on key national infrastructure support contributing to UN's MDGs along with assisting in Cambodia's sustainable development.

○ In particular, concerning the basic facilities required for SOC, national territory, and urban planning, the use of geodetic control points becomes the basis. Thus, the offer of basic infrastructure that can support smooth national territory management and development not only contributes to the assistance-receiving country's national development plan (NDP) but also supports Cambodia's sustainable economic and social development. In this regard, NGCPIP is evaluated to be suitable for Korea's ODA policies.

○ Korea's ODA policies include ODA size expansion considering the poorest countries' demand and assistance-receiving countries' economic burden relief, simultaneous implementation of non-binding assistance policy, and expansion of international assistance procurement market. After such ODA policies were established, Cambodia's three-phase NGCPIP can be

deemed suitable for Korea's ODA policies (Ministry of Foreign Affairs and Trade, 2008).

2) Linkage with Cambodia's geodetic survey policies

○ Cambodia's national geodetic control points were installed based on the Hanoi System from 1902 to 1950, but the existing geodetic and cadastral data were almost destroyed or lost due to civil wars (85%). In this context, the installation of national geodetic criteria is very important for land management and development, becoming an urgent issue (KOICA, Development and Planning System Team, 2005).

○ Cambodia is currently drawing up the Geodetic Survey Act (draft) following NGCPIP, and the revision of the National Policy on Spatial Planning (enacted in April 2011) and the Act on Land Management, Urban Planning, and Construction (enacted in 1994) is underway. All these prove that their linkage with Cambodia's geodetic survey policies is high. Specifically, the geodetic control points present the criteria for national infrastructure's construction and management including various maps production, roads, airports, and dams and enable continual national territory development and management. Actually, NGCPIP is the key infrastructure and is evaluated to have close linkage with Cambodia's geodetic survey policies.

2. Goals and strategies

○ As for relevance at the goals and strategic level of NGCPIP, which is implemented in three phases, whether the goals of each phase of the project were in line with MDGs, whether they matched the demand of the regions concerned, and whether the project consisted of proper input factors in achieving the project goals were evaluated.

<Table 15> Relevance: Goals and Strategic Level

Phase	Linkage with MDGs	Integrity with assistance-receiving demand	Relevance with the project goals of input factors
First phase	○	○	□
Second phase	○	○	□
Third phase	○	○	□

1) Linkage with MDGs

- Implemented in 3 phases from 2003 to 2009, Cambodia's NGCPIP is considered to be linked with MDGs 7, "Securing sustainable environment," and MDGs 8, "Establishment of global partnership for development," among the 8 MDGs (http://www.unmillenniumproject.org/goals/index.htm).
- NGCPIP is considered to be linked with the "National policy integration of sustainable development principle" among the detailed objectives of MDGs 7 and "support for least developed countries" and "New technology benefit expansion including information and communications" among the detailed objectives of MDGs 8. NGCPIP is judged to contribute indirectly to the achievement of MDGs 7 and 8 among MDGs.
- The three-phase NGCPIP contributes to Cambodia's geodetic survey policy, but has also offered basic infrastructure that should not be omitted for Cambodia's national territory management and development plans. In this regard, there is direct linkage with the support for least developed countries.
- NGCPIP also has impacts on the realization of sustainable development in the economic and social fields, offers GPS CORS, and supports their use. All in all, the project is evaluated to offer new technology benefits diffusion.

2) Relevance with assistance-receiving country's demand

○ Carried out through KOICA's assistance between 2003 and 2009, Cambodia's NGCPIP began to be implemented at the request of Cambodia's Minister of MLMUPC, Mr. Im Chhun Lim.

- NGCPIP is a project with the highest priority in terms of national development plan and was implemented since it was deemed to contribute to Cambodia's industrial activity enhancement and regional economic activation. Confirmed as one of KOICA's project plans in August 2002, the project began to be implemented through the TOR agreement between Korea's KOICA and Cambodia's GDCG/General Department of Cadaster and Geog

<Table 16> Major Project Details by Project Region

Phase	Duration	Region	Budget (USD 10,000)	Project details		
				Installation of control points	Training	Equipment support
First phase	'03.12 ~'05.1	Kampong Chhnang	100	15 grade 1 points 40 grade 2 points	8 working-level personnel/3 decision makers	Vehicle, computer, etc.
Second phase	'05.12 ~'06.12	Pursat, Koh Kong	120	16 grade 1 points 52 grade 2 points	6 working-level personnel/3 decision makers	GPS, vehicle, computer, etc.
Third phase	'07.12 ~'09.12	All across Cambodia	250	7 grade 0 points (Re-observation) 84 grade 1 points (Install every day.) 60 points (Re-observation) 3 GPS CORS	6 working-level personnel/3 decision makers	GPS equipment, vehicle, office supplies, etc.

○ The Cambodian government was implementing the five-year plan of LMAP (land management and administration project) from 2002 through USD 33 million assistance from the World Bank, Germany, and Finland to

implement the cadastral information restoration project.

- LMAP included Cambodia's northeastern and southeastern areas. Therefore, when the geodetic control point installation project is implemented in the Kampong Chhnang area whose development potential is highest in terms of the national development plan in the midwest area, it can be linked with LMAP, contributing hugely to the comprehensive cadastral restoration project. In this context, this project is considered to respond properly to the assistance-receiving country.
- The first-phase project is deemed to have installed 15 grade 1 control points and 40 grade 2 control points in priority targeting Kampong Chhnang by reflecting the assistance-receiving country's demand.

○ NGCPIP in Cambodia was carried out simultaneously with LAMP, with regional installation carried out in the target regions; thus raising the need for geodetic survey network realization with uniform density and preciseness nationwide. Therefore, the geodetic datum (CGD2009: Cambodia Geodetic Datum 2002) was realized through the re-observation of 7 grade 0 control points via the third-phase project; 155 grade 1 control points were also installed.

3) Relevance of input factors in the project purpose

○ Most decision makers of the Cambodian central and local governments who participated in this evaluation and project participants and trainees who were invited to Korea as interviewees responded that most input factors, i.e., project budget, manpower injection, technology and equipment use, and dispatched experts were suitable for the project purpose. Note, however, that the need for some supplementation with regard to GPS CORS operation and management, training program duration, and content was cited.

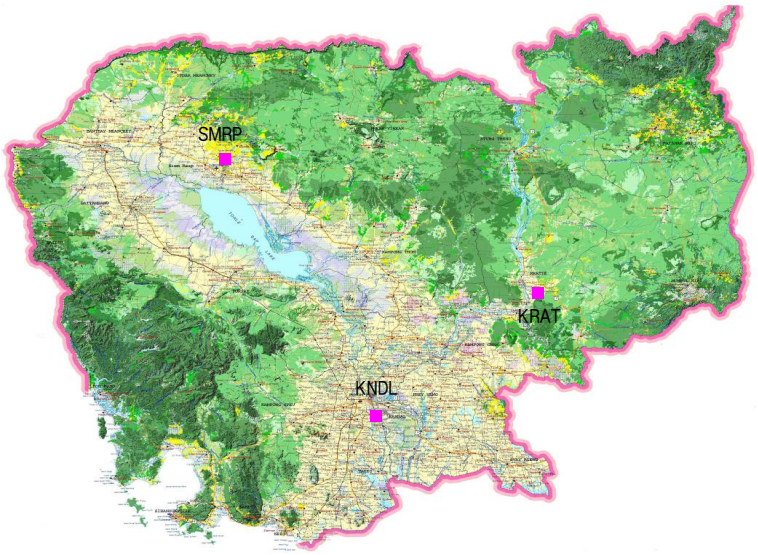
○ For the maintenance/repair of Cambodia's national geodetic datum, the GPS CORS installed in Kandal (KAND), Kratie (KRAT) and Siem Reap (SMRP) plays a role in the continuous storing of satellite observation data, but the solution to the following problems is necessary to increase utilization:

- Cambodia's national geodetic control points are currently composed of grades 0, 1, 2, and 3, but there is no grade classification for GPS CORS. In countries where geodetic datum is operated using GPS, most use CORS as the highest grade control point instead of providing marks (UK, Netherlands, New Zealand, Malaysia, Korea, etc.).
- Data accessibility is low, since the system for data provision is not realized in GPS CORS. Most local governments do not have GPS survey equipment; hence the difficulty in use.

○ As a result of the questionnaire survey and interviews targeting the training participants in the invitational training programs in Korea, technical satisfaction was very high. In the case of Cambodian engineers who received training, they use the educated/trained content in the national geodetic survey project around the boundary with Vietnam. Note, however, that continuous training is required at the short-, mid-, and long-term levels in the case of invitational training programs in Korea. Working-level personnel-centered training were deemed more urgent, however.

○ Concerning the local government invitational training program participants, actual geodetic survey work was mostly carried out by the total station as of July 2011, and GPS-centered training content was used limitedly in actual work. This is because the control points of grades 0 ~2 for the geodetic survey are managed by the Geography Department, and those of grades 3 and below, by the Technology Department within Cambodia's GDCG. Therefore, in the implementation of a similar project in the future, the selection of invitational trainees needs to consider the clear work field and roles of the government agencies.

<Figure 8> Composition of GPS CORS



○ The core of installation and operation of national geodetic control point by GPS is through estimation and updated outcomes via nationwide geodetic network adjustment, but there may be difficulties in carrying out such work through additional observation since systematic technology transfer was not properly carried out through NGCPIP.

3. Project environment and system

○ The relevance at the project implementation environment and system level of the 3-phase NGCPIP was evaluated in terms of whether the country's special attributes were considered, whether the assisted project was suitable for the country's technology and infrastructure level, and whether a process to address the problems occurring in the process of implementing the project existed.

<Table 17> Relevance: Social Environment and System Level

Phase	Consideration of the special attributes of the country concerned	Relevance of the technology and infrastructure level of the country concerned	Relevance of the implementation process
First phase	□	○	○
Second phase	□	○	○
Third phase	○	○	○

1) Consideration of the special attributes of the country concerned

○ To evaluate whether NGCPIP was implemented in consideration of Cambodia's special attributes, evaluation was made as to whether the project was suitable for Cambodia's geodetic survey level and whether the installation of control points was carried out in accordance with Cambodia's criteria.

○ As for NGCPIP, control point installation was carried out in the project regions along with the implementation of LMAP (Land Management and Administration Project) in 2002. Concerning LMAP, grades 1, 2, and 3 control points were installed through GPS observation based on 7 grade 0 control point coordinates (ITRF2000, Epoch 1998.90) whose outcome estimation was made by APRGP (Asia-Pacific Regional Geodetic Project). Such consideration of Cambodia's geodetic control point installation technology environment at the time of NGCPIP implementation and application of the most universal and efficient GPS (Global Positioning System) technology in terms of national control point installation and operation with regard to Universal Observation Instruments' technology is judged to be appropriate.

○ As for the geodetic control points, it is very important to provide by estimating the uniform quality of preciseness outcomes as well as improving accessibility by installing from upper grade to lower grade with a certain mark distribution density targeting a nationwide scale. In the case of

Cambodia, the control points were installed through linkage observation of the target areas as necessary in the LMAP implementation from grade 0 control points without complying with such geodetic control point installation's general procedure; hence the difficulties in securing the uniform quality of the internal preciseness of the installed geodetic control points and in offering high accessibility.

○ To overcome such limits of Cambodia's national geodetic control point installation, 87 grade 1 installation and re-observation of grade 1 control points are judged to be made in a timely manner with a certain mark distribution density in the third-phase project. Although Cambodia did not adopt official geodetic datum, the uniform preciseness of outcome estimation is considered possible through geodetic network adjustment using the data surveyed through the project, regardless of which type of geodetic datum is officially set in the future.

○ Moreover, whether control point installation complied with Cambodia's criteria and whether regional special attributes were reflected on the NGCPIP implementation process were reviewed. A geodetic survey expert, Andrew Dyson, diagnosed Cambodia's status of geodetic infrastructure from June 7 to June 22, 2003 to support LMAP and establish measures to reorganize national geodetic control points, published a report on future development strategy establishment, and implemented a geodetic review mission project[1]. In the report, he presented the control points' preciseness, distance, GPS observation time and method, and rough standard proposal of means to configure the observation network as well as future geodetic infrastructure establishment in Cambodia. Cambodia's NGCPIP is considered to have been implemented in accordance with the standard presented in the Geodetic Review Mission report, since there were no statutory regulations on control point installation at the time of

1) Land Management and Administration Report, Geodetic Review Mission. Ministry of Land Management, Urban Planning, and Construction (2003).

project implementation.

- ○ According to the standard above, 4 hours' observation was done by GPS stationary survey with distribution distance of 30~50km of grade 1 control points. For grade 2 control points, 3 hours' observation was carried out with regard to 7~15km distribution distance. Likewise, observation was undertaken to enhance the network's geometric strength through lots of observation data and to have many duplicate baselines, if possible, for significant error reduction after baseline interpretation.
- ○ For the GPS surveyed data's baseline interpretation and results check and observation network adjustment calculation, which are not specified in the Geodetic Mission Review report, Koreas' Control Point Observation Work Regulations by GPS were applied. The control points were buried based on grades 1 and 2 control point mark shapes designed by the Geography Department due to the LMAP implementation. Note, however, that this project has limitations in Cambodia's own establishing base to install and maintain/repair the geodetic control points in the future, since Cambodia did not have sufficient technology and know-how related to geodetic survey. This is because there was no standardization or manual for the control point installation procedure including burial, observation, adjustment, and calculation processes required for NGCPIP, which needs to reflect NGCPIP's characteristics.

2) Relevance of the technology and infrastructure level of the country concerned

- ○ National geodetic control points are the base (standard) of all national spatial information database positioning demonstrations. In the case of Cambodia, control points installation was carried out according to different purposes by different government agencies before the KOICA-assisted NGCPIP. In particular,

through LMAP implementation, with the need for unified national geodetic control points cited, control point installation was implemented using GSP technology, which is known to be the most universal and precise. Since the 1990s, GPS has been actively used for the geodetic survey for the installation of national geodetic control points in most countries. Therefore, NGCPIP is considered to have been carried out by applying the most recent GPS technology.

○ The Geodetic Mission Review report suggested installing grade 1 control points nationwide with a certain distribution mark density to improve uniform quality and accessibility nationwide for the implementation of LMAP. In the actual LMAP, however, control points were partially installed as necessary according to target areas, and there was a limit in installing control points with uniform preciseness and high accessibility. To address the problems in Cambodia's national geodetic infrastructure, installing grade 1 control points with a certain mark distribution density and uniform preciseness in the third-phase project was highly appropriate.

○ Reflecting the universal geodetic technology level, the establishment and operation of geodetic system in small and medium-sized countries are carried out by GPS CORS (Continuously Operating Reference Station). GPS CORS has the advantage of securing the observation data required for geodetic system operation (renewal) on a long-term basis. Likewise, the installation of GPS CORS is considered appropriate given Cambodia's technology and infrastructure level. Nonetheless, most of the observation is conducted by the total station except national control point installation in Cambodia, and there is a limitation in the direct use of GPS CORS.; hence the need for measures for additional TS.

3) Relevance of the implementation process

○ To evaluate whether the 3-phase NGCPIP implementation process was adequate, this follow-up evaluation evaluated the problem-solving process for the problems generated upon project plan establishment and execution, relevance of the project starting point and period, use of local personnel, and project schedule.

○ The problems are considered to be solved smoothly considering the following: In the first-phase project, control points were installed to support LMAP. In the second-phase project, the project was confirmed by the assistance-receiving country's request. In the third-phase project, proper communication was carried out between the assistance-receiving and assistance-offering countries in the implementation process of grade 0, 1, and 2 control points targeting the whole of Cambodia.

○ From the project starting point and duration perspective, the implementation starting point and target regions were evaluated to be appropriate.

- Cambodia carried out LMAP for cadastral restoration and registration from the northeastern and southeastern regions from 2002 before NGCPIP.
- For land registration, observation was essentially necessary for boundary determination and cadastral map production. LMAP was planned to be carried out all across Cambodia; thus, the commencement of NGCPIP in December 2003 was deemed appropriate.
- The period after 2000 saw the full-scale implementation of various national territorial projects including river development in Cambodia. Thus, the installation of geodetic control points to produce drawings for national territorial and urban planning, design, and construction was evaluated to be proper in terms of time.

○ From the local manpower utilization perspective, Korea inputted special and high-grade engineers and supported the plan, calculation, and inspection

of control point installation. Cambodia inputted local engineers for control point burial and observation. This is deemed to be aimed at implementing the project by properly separating the respective roles and was evaluated to use the local manpower properly.

- In particular, the dispatched and local engineers were organized into one team, and GPS observation was implemented. Observation plan, observation, and data arrangement were deemed to have been carried out, and adequate efforts to transfer onsite observation know-how were believed to have been made.
- As shown in <Table 18>, the reason the input ratio of local engineers in the second- and third-phase projects was higher compared with the first-phase project is that the use of local manpower increased through technology transfer and training through the project implementation.
- Note, however, that baseline interpretation and geodetic network adjustment through the most important process data processing via GPS national control point installation were mostly carried out by the dispatched engineers. This suggests that there will be a limitation in executing outcome renewal by Cambodian engineers in the future.

<Table 18> Number of Inputted Engineers (Unit: M/Day)

Category	First phase		Second phase		Third phase	
	Number	Technology grade	Number	Technology grade	Number	Technology grade
Korea	6,046.2	Special and high-grade	1,447	Special, high-, medium-grade	2,792	1～4 grades
Cambodia	5,132.1 (2,584.3)	Medium, beginner grades, technicians, laborers	4,074 (1,224)	High-, medium-grade, laborers	5,040 (1,680)	Medium-, beginner-grade, laborers

○ From the project schedule standpoint, the project implemented in three phases, which is implemented in 3 phases is judged to have been carried out properly by establishing detailed process plans including preparation, survey and plan, preemption and burial, observation, calculation and lighting, reflecting the NGCPIP characteristics.

- In particular, the observation plan was made by sufficiently reflecting the access road in the installation target areas; the process was deemed to have been executed without obstacles.

4. Cross-cutting issues

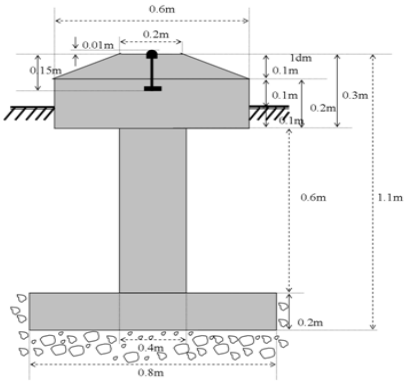
<Table 19> Relevance: Consideration of Environment upon Project Planning and Implementation

First phase	○
Second phase	○
Third phase	○

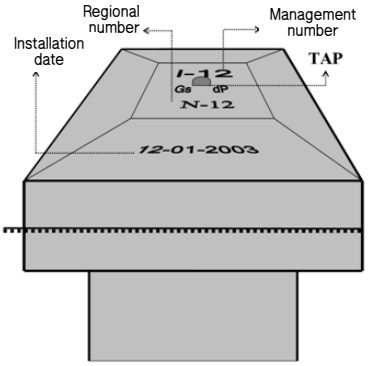
○ In evaluating whether consideration was given to the environment upon implementation of NGCPIP, consideration was deemed appropriate as a result of interviews with project participants and personnel from the participating company (Samboo Engineering) along with the project report review.

○ The outcome of NGCPIP is to bury the control points (burial marking stone) under the ground surface after observation, by looking into the control point installation cross section as shown in Figures 9 and 10. Actually, burying concrete with width and length of 0.6m was planned, which has very minimal adverse effect on the environment considering the project's characteristics.

<Figure 9> Control Point Installation Cross Section



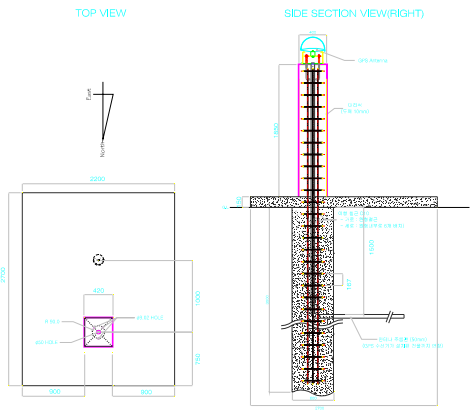
<Figure 10> Marks on the Top Part of the Control Point



○ When electric wave reception is hindered because of the structures and trees on the ground in relation to the control points, however, the obstacles (trees) were removed. The removal of 12 trees in the first-phase project is considered inevitable.

○ The GPS CORS selection criteria set up in three places Kandal, Siem Reap, and Kratie Provinces were easy to connect to the Internet (within 30km from the adjacent office, no hindrance in satellite reception). In this case, consideration on the project plan and environment was not problematic.

<Figure 11> GPS CORS Design Drawing



<Figure 12> View of Kratie GPS CORS

Section 2. Efficiency

1. Goals and strategies

○ As for efficiency at the project goal and strategic level of three-phase NGCPIP, which was carried out in 3 phases, evaluation was performed as to whether the goal of each phase of the project was planned and implemented by organically linking KOICA-Cambodia NGCPIP and what were the restrictive factors in using more efficient strategies.

<Table 20> Efficiency: Goal and Strategic Level

Phase	Efficient linkage of project goals
First phase	○
Second phase	○
Third phase	○

1) Efficient linkage with project goals

○ Carried out in three phases, NGCPIP gradually installed Cambodia's geodetic control points by establishing the goal of quality improvement for Cambodia's national territorial management and plan, urban planning, survey, and cadastral management. NGCPIP is believed to have been implemented to contribute to Cambodia's geodetic survey goal achievement.

○ The KOICA-assisted, first-phase NGCPIP was implemented by choosing the Kampong Chhnang region which has the highest development potential in terms of national development plan among the LMAP regions implemented as five-year plan from 2002 as the preferential project object area.

○ From this standpoint, for the KOICA-assisted project, NGCPIP is believed to

have been planned and executed to enhance linkage with the projects implemented with other institutions and countries. In particular, in the case of NGCPIP, which was carried out as first, second, and third-phase projects (31 national grade 1 control points and 92 grade 2 control points), it was considered to have been used for the survey to register land and produce cadastral maps in linkage with MMAP and is evaluated to have been carried out efficiently.

○ The 3 GPS CORS, 7 grade 0 control points, and 155 grade 1 control points installed in the third-phase project is judged to have been implemented efficiently in linkage with the project goals since the project established core infrastructure for national geodetic system realization. Nonetheless, the following are needed to enhance the accessibility and utilization of Cambodia's national geodetic control points in the future:

- Enhancement of geodetic network through the installation of national control points with uniform grade 2 and below nationwide
- Establishment of real-time survey position service offering system through the Web-based system via GPS CORS and installation of additional GPS CORS

○ Since Cambodia's geodetic survey technology level or reality is carried out mostly by the total station, the use of GPS CORS can be limited. Still, GPS CORS use is forecast to increase if GPS equipment is sufficiently spread.

2. Project environment and system

○ Evaluation of efficiency at the project environmental system level of three-phase NGCPIP was conducted as to whether the input of project factor was adequately implemented by each phase of the project, whether the project management system was efficient, and whether the project implementation technique was useful.

<Table 21> Efficiency: Project Environment and System Level

Phase	Efficiency of project input factors	Project management system	Usefulness of project implementation technique
First phase	○	○	○
Second phase	○	○	○
Third phase	○	○	○

1) Efficiency of input factors

○ NGCPIP consisted of the installation of geodetic control points, installation of GPS CORS, invitational training of decision makers and working-level personnel in Korea, and equipment support. To evaluate the input factors' efficiency, evaluation was performed with regard to personnel, budget, and geodetic control point installation ratio.

○ During the implementation of the project, from the efficiency standpoint on manpower and budget among input factors, there is no reason to believe that there was a problem in the input factors or size since no problems arose in terms of manpower and budget; neither was there any design change.

- In terms of manpower, a team was organized with Korea's medium- and higher-grade engineers, Cambodia's Geography Department and Technology Department engineers, and other local engineers, performing control point burial and observation work. In view of all this, local manpower is evaluated to have been used well.
- Experts were inputted by process step-by-step, and manpower was effectively operated by linking Korean experts with local engineers and public officials.
- From the aspect of professionalism of inputted manpower, the project was implemented by inputting Korean engineers possessing adequate qualification in each field. The engineers inputted in the project were experts with several years of control point observation experience in

Korea, and they are considered to have been implementing NGCPIP properly.

- During the third-phase project in particular, the project was carried out more efficiently by continuously inputting the same level of know-how and experts used in the previous-phase projects.

○ Based on the geodetic control point installation ratio during the project period, 155 grade 1 points with uniform density of 30~50km were deemed to have been installed 100% throughout the project for the first, second, and third phases.

- In the case of grade control points, however, partial installation was performed in Kampong Chhnang, Pursat, and Koh Kong where the national territory plan was established. Therefore, installation needs to be made by Cambodia itself.
- The 3 GPS CORS installed through the third-phase project collected surveyed data continuously; thus, it can be sufficient for the national geodetic system operation. Note, however, that additional installation is considered necessary in line with the reality for applied service offering such as control point observation and DGPS and RTK.

2) Project management system

○ As a result of the efficiency evaluation of the monitoring starting point and communication in the project implementation process, the project management system's efficiency was evaluated to be high.

○ From the monitoring aspect of the project, continuous monitoring was undertaken through interim and final evaluations during the project period. Interim evaluation was carried out at a time when the project was 50% implemented by dispatching geodetic survey experts from KOICA to project sites and through interviews with Cambodia's officials and onsite observation.

- Interim evaluation was conducted as to the rationality and relevance of geodetic survey, presentation of matters to be supplemented in the future survey, areas of improvement for efficient implementation, and assistance-receiving country's response and opinions and reflection of such.
- In the final evaluation, the interim evaluation results were reviewed as to whether they were reflected on the project; the feedback process was executed so that the monitoring results can be reflected on the project.

○ From the efficiency standpoint in communication upon project implementation, the Cambodian Geography Department Director and project head met two or three times a week to consult on work, and a close cooperative relationship was made with related personnel in the project regions. All in all, there was no problem in communication.

- The site office was located near Cambodia's Geography Department, and they frequently met and maintained smooth communication. Since Cambodia's engineers and project participating company's engineers stayed in the same accommodation, communication was carried out smoothly.

3) Usefulness of project implementation techniques

○ From the usefulness standpoint of the technologies applied during the project process, the GPS technology's usefulness was evaluated to be high in this project.

- Historically, national control points observation was carried out by triangulation, with a trilateration technique subsequently applied through the development of EDM (Electromagnetic Distance Measurement).
- Note, however, that the triangulation and trilateration technique had the disadvantage of lack of high efficiency of work because lots of supplementary works were necessary along with communication between the two techniques.
- The GPS technology that decides the location by receiving electromagnetic

signal on the ground does not need communication between the observation points; efficiency of observation is high, and securing preciseness is possible without major restrictions in the baseline field. Thus, GPS is used for geodetic control point installation and maintenance in most countries.

- The GPS technology used in NGCPIP can be said to use the most useful and efficient observation technology in the world.

Section 3. Effectiveness and Impacts

○ The purpose of this follow-up evaluation is to evaluate whether the effects of the NGCPIP goals are continuously demonstrated when a certain period of time passed after the project was completed.

1. Policies and institutions

○ NGCPIP was carried out with continuity from the first-phase project in 2003 to the third-phase project completed in 2009. Therefore, there is a limitation in evaluating the project's effects and impacts.

○ In particular, the KOICA-assisted national geodetic control points were grades 1 and 2. Therefore, to use them for national territory and urban planning and construction projects, Cambodia needs to install grades 3 and 4 control points so that more specific effectiveness and impacts can be evaluated.

○ Note, however, that this follow-up evaluation evaluated how effectively Cambodia can use such project under such restrictive conditions and which activity content was indirect. In this manner, effectiveness and impacts were to be evaluated.

<Table 22> Effectiveness and Impacts: Policy and Institutional Level

Phase	KOICA goal achievement	Impacts on Cambodian geodetic survey policies and institutions
First phase	○	○
Second phase	○	○
Third phase	○	○

1) Achievement of KOICA goals

○ The basic philosophy of international cooperation by Korea in the 1990s was to actively share its experiences and technologies as a leading developing country based on South-South cooperation[2] and to help latecomer developing countries achieve autonomy and ease poverty. In addition, it aimed at supporting developing countries' social and economic development by specializing the field having relative advantage compared with advanced assistance-offering countries.

○ In 2000, Korea's international cooperation sought to participate actively in international society's poverty elimination efforts including UN MDGs, and enable supporting continuous development based on the harmony of economy and environment between cooperation target countries.

○ From this standpoint, the KOICA-assisted NGCPIP of Cambodia was evaluated to have high relevance with KOICA's development policy and goal achievement in terms of the following: installed geodetic control points that can be SOC as essential for Cambodia's national territory plan and management,

2) In a broad sense, South-South cooperation can be defined as mutual cooperation activities aiming at independence in terms of economy, social development, and collective independence between developing countries. UNDP, UNESCO, and JICA actually define South-South cooperation as follows:
First, UNDP defines it as a means to promote effective development through learning and sharing best practices and technologies between developing countries. Second, UNESCO defines it as a process to pursue each or common development through the mutual exchange of knowledge, function, financial resource, and technical know-how between developing countries. Third, JICA defines it as mutual cooperation accompanied by technological and economic cooperation between developing countries in promoting continuous development.

land management, and construction; provided support in the form of observation equipment and invitational training, and; assisted in Cambodia's independent development of geodetic survey policies and consequently supported Cambodia's economic development and plans indirectly.

2) Impacts on Cambodia's national territory plans, geodetic survey policies, and institutions

- ○ Thanks to the KOICA-assisted NGCPIP, the Cambodian government makes an effort to prepare its geodetic policy and system by devising the Geodetic Survey Act (draft). NGCPIP was evaluated to have contributed immensely to the Cambodian geodetic survey policy.
- ○ The Cambodian government devised the National Policy on Spatial Planning regarding spatial planning in April 2011; the Act on Land Management, Urban Planning, and Construction enacted in 1994 is being amended. Moreover, Cambodia is currently pushing for the enactment of the sub-law on Regional and Provincial Spatial Planning at the regional and provincial levels and the Law on Navigation and Port Management.
- ○ In a situation wherein data on geodetic survey policy essential for national territorial plan and management were almost destroyed or lost following prolonged civil wars, NGCPIP, which began with the assistance of KOICA, was evaluated to contribute immensely to supporting Cambodia's geodetic control points and land policy development and administrative system.

2. Goals and strategies

- ○ As for the effectiveness and impacts at the goal and strategic level of Cambodia's NGCPIP, evaluation was performed as to whether each project's goals were achieved and whether the success or failure factors of goal achievement were identified.

<Table 23> Effectiveness and Impacts: Goal and Strategic Level

	Comprehensive project goal	Nurturing and training of specialist manpower	Technology transfer	Preciseness of geodetic control point measurement
First phase	○	□	○	○
Second phase	○	□	○	○
Third phase	○	□	□	○

1) Comprehensive project goal achievement

○ The goals of three-phase NGCPIP consist of direct and indirect goals:

○ The direct project goal is to install geodetic control points step-by-step, which are the basic information required for Cambodia's cadastral observation, national map production, and SOC development projects and national territory and urban planning in a nearly impossible situation since land information was nearly destroyed or lost because of prolonged civil wars.

○ The first-phase project's scope was to install 15 national grade 1 control points and 40 grade 2 control points in Kampong Chhnang Province, which is an important site of transportation and with huge potential in terms of national development plan and where 40,000 people resided, and in the adjacent regions (Pursat, Kampong Thom, Kampong Cham). Although 15 national grade 1 and grade 2 control points were installed only in Kampong Chhnang Province, and the project target regions were consequently reduced, the project's target quantity was evaluated to have been achieved.

○ The second-phase project's scope was the 3 northwestern regions including Pursat Province, which are adjacent regions with Thailand and with huge economic power and are regions belonging to national development's strategic axis. The three provinces including the two provinces (Kampong

Chhnang, Koh Kong) were excluded from the World Bank's LMAP (Land Management and Administration Project). Therefore, the installation of control points in the same regions for the establishment of a broad geographical network including the northwest part, reflected such control points installation in the same region. The second-phase project's target quantity was to install 16 national grade 1 control points and 52 grade 2 control points; thus, the project's goal was deemed to have been achieved.

○ As for the scope of the third-phase project, geodetic control points were installed to establish a broad geographic information network targeting the whole of Cambodia including Kampong Chhnang and Pursat and Koh Kong, which were the first- and second-phase project regions among 24 provinces nationwide.

- During the third-phase project, the 3 GPS CORS, Cambodia's starting point of longitude and latitude, were installed; 7 grade 0 control points were also installed and surveyed, with 155 national grade 1 control points surveyed and installed nationwide.
- The project targeted the whole of Cambodia and installed national grade 1 geodetic control point network densely in terms of geodesy. Although the goal was to cause no difficulties in design despite the absence of geodetic control points in the installation of grades 2 and 3 geodetic control points, various national territory management policy implementation and construction efforts were made. The goal was evaluated to have been achieved.

○ The indirect project goal is to contribute to social development by increasing the SOC base, enhancing economic development, and efficiently using resources in all regions by providing a spatial framework that supports national development and plan establishment.

○ Although not much time has passed since NGCPIP was completed, the following indirect effects were evaluated to have been generated through

questionnaire survey and interview results:

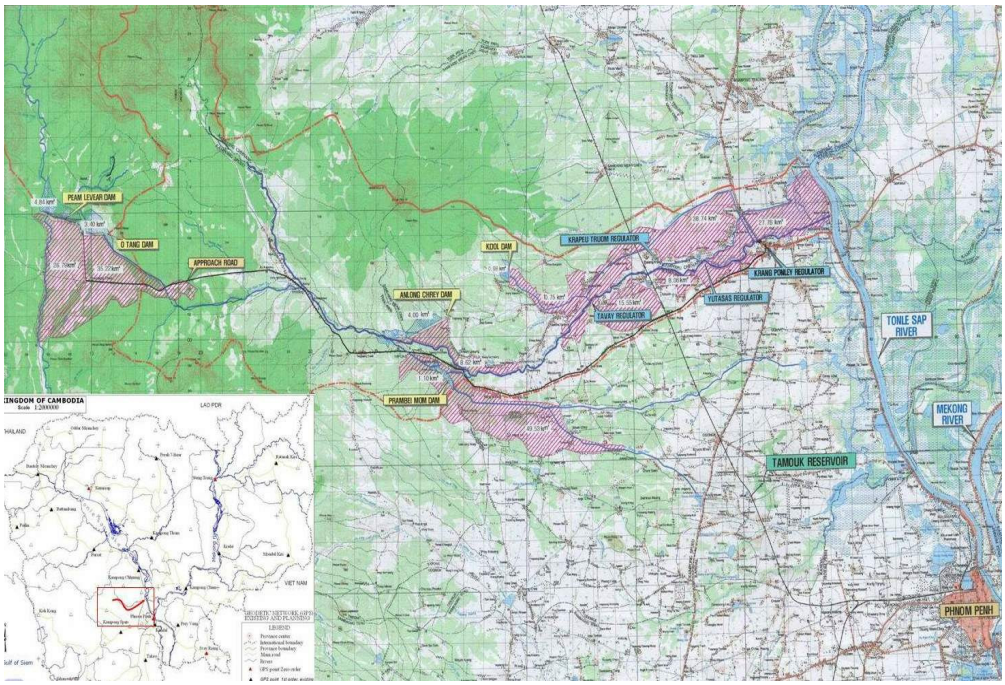
○ The typical outcomes of Cambodia's NGCPIP are as follows:

- Offering of control points for the 2004 cadastral restoration project in Kampong Chhnang supported by CIDA (Canadian International Development Agency), offering of control points for 2004~2011 (LMAP), offering of reference coordinates for 2004~2011 topographical map production, water resources development and housing shaping, etc., offering of reference coordinates for the multi-purpose water resources development project of Cambodia's Krang Ponley River during June 2007 and June 2010, offering of reference coordinates of the national basic map of three major cities (Phnom Penh, Siem Reap, Sihanouk Ville) between 2010 and 2011, etc.

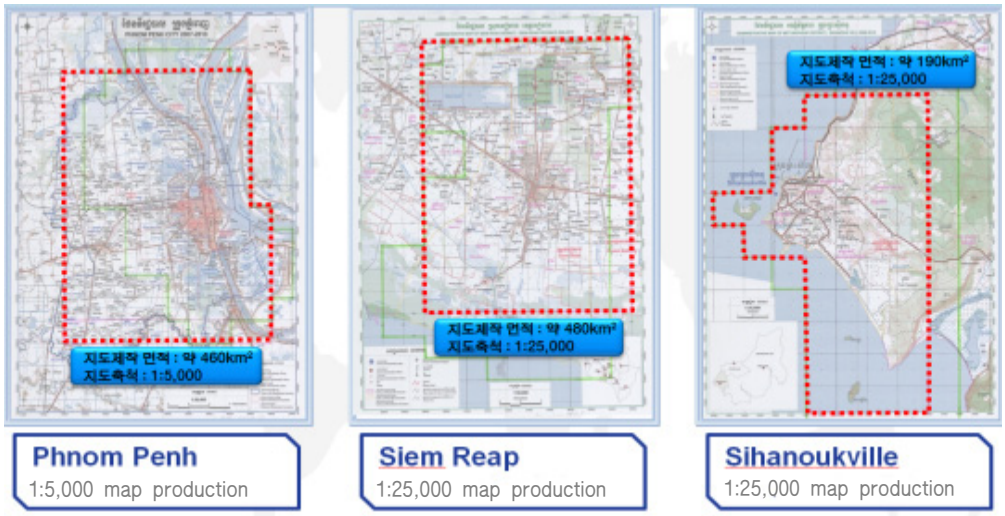
<Table 24> Major Activities of Cambodia's Geodetic Control Points

Year	Use outcomes of Cambodia's Geodetic Control Points
2004	■ Offering of cadastral restoration project's control points in Kampong Chhnang area (Canadian International Development Agency's (CIDA) support)
2004 ~2011	■ Offering of control points of LMAP (Land Management and Administration Project) ■ Offering of reference coordinates of land projects around Cambodia (topographical map production, water resources development, housing site development, etc.)
2007 ~2010	■ Offering of reference coordinates system for the multi-purpose water resources development of Krang Ponley River in Cambodia
2010 ~2011	■ Offering of national basic coordinates for Cambodia's three major cities (Phnom Penh, Siem Reap, and Sihanouk Ville)

<Figure 13> Utilization for the Krang Ponley Multi-purpose Water Resources Development Project



<Figure 14> Utilization for the Basic National Mapping of Phnom Penh, Siem Reap, and Sihanouk Ville



2) Nurturing specialist manpower and training achievement

○ The goal of nurturing specialist manpower and technology transfer was classified into local technology training, working-level personnel invitational training, and invitational training for Cambodia's decision makers and was analyzed to have unique goals by target group. Actually, it was evaluated as training in line with the group's characteristics.

- Local technology training seeks to introduce and increase understanding of NGCPIP and nurture excellent manpower by adopting recent technologies on geodetic survey. For outstanding human resources among the trainees, they can consolidate the observation theory, basic GIS theory, GPS theory, and field practice through invitational training in Korea. For decision makers' invitational training, it focused on enhancing assistance and support upon implementing NGCPIP, instead of training on geodetic survey technology.

<Table 25> Training Details of Specialist Manpower

Phase	Details of local technical training	Details of training by inviting working-level personnel	Details of training for decision makers in Korea
First phase	■ Introduction of recent technology ■ Topographical map production and various applied surveys ■ Basic GPS theory and calculation program ■ General matters related to GPS gauge ■ Trend in up-to-date technologies	■ World coordinates and national coordinates systems ■ Basic GIS theory ■ General survey education ■ GPS processing program ■ Visit to the National Geographic Information Institute ■ Cultural experience	■ Introduction to Korea's geodetic survey industry ■ Operation situation of geodetic control points ■ Visit to survey site ■ Cultural experience
Second phase	■ Survey of control points ■ Control point plan and installation theory ■ Basic GPS theory ■ Introduction to GPS processing S/W ■ Trend of up-to-date technologies ■ Future direction of Cambodia's GIS project	■ Basic geodetic survey theory ■ Basic details of GPS ■ Site practice using GPS equipment ■ GPS data processing	■ Visit to the geodetic control point installation site ■ Visit to the relevant institutions (KOICA, National Geographic Information Institute) ■ Touring of industrial facilities (Hyundai Motors, Samsung Electronics) ■ Cultural exploration

<Table 25> continued

Phase	Details of local technical training	Details of training by inviting working-level personnel	Details of training for decision makers in Korea
Third phase	■ National control point management method ■ RTK theory and practice ■ GPS CORS and operation technology	■ Basic geodetic survey theory ■ Basic GPS details ■ Site practice of GPS equipment ■ GPS data processing ■ GPS CORS operation ■ GPS data processing education	■ Status of national control points and geographic information establishment ■ Deliberation of the surveyed results ■ Geographic information field engineers' management methods ■ GPS CORS system ■ Education and site tour of GPS operation

○ In the case of local training in Cambodia and invitational training of working-level personnel, they were carried out in the initial stages of the project, and efforts to enhance the goal achievement of training by inducing them to participate in the project were made.

○ Concerning the content of training for specialized manpower, the training programs were finally decided through consulting with Cambodia's GDCG; the training fields and content were deemed to have been decided via the examination of Cambodian demand.

- As a result of analyzing the limitations of specialist manpower training through interviews, however, no sufficient consideration was given regarding Cambodia's technical level. Moreover, the manpower could not use the GPS training content, after they returned to Cambodia because of the lack of GPS instruments.
- In comparing the invitational training of working-level personnel and local training programs, there is a question on the need for invitational training owing to the lack of sufficient differentiation between them.
- As for the training on GIS (Geographic Information System), which is a very important training, there was insufficient linkage with geodetic survey

technology. Moreover, it was analyzed not to have considered sufficiently Cambodia's technical level. In the training for local governments' working-level personnel, field practice and data processing using GPS apparatus and training on GPS CORS operation and data processing did not take into account Cambodia's lack of equipment.

3) Achievement of technology transfer goal

○ The technology transfer goal of Cambodia's NGCPIP is control point installation via GPS technology and operation and use technology of GPS CORS.

○ As for the installation of geodetic control points via GPS technology, 5,878 control points with grade 3 and below have been installed by Cambodia's Technology Department since 2003. The Geography Department plans to install 16 grade 2 control points and 18 grade 3 control points in 2011 and 75 grade 2 control points and 100 grade 3 control points in 2012. All in all, the technology transfer was evaluated to have achieved the goal.[3)]

○ As a result of examining the technical level of Cambodia's Geography Department, which was in charge of control point installation, Cambodia was identified to have the ability to estimate the outcomes in the observation target areas along with the baseline interpretation of GPS observation data, but there was a limitation in estimating the uniform quality of outcomes after adjusting the geodetic network nationwide by configuring each layer of the national geodetic control point network with a single geodetic network.[4)]

○ As of July 2011, GPS CORS played the role of collecting and storing

3) Interviews with Cambodia's GD Director and TD Director during the period July 11 ~ 19, 2011.

4) Interviews with Cambodia's Geography Department Director (So Vanna) and working-level personnel, July 19, 2011.

continuous satellite data only; hence the limitation in evaluating technology transfer goal achievement. Following the planned training of GPS CORS, and after maintenance and repair support were carried out in August 2011, re-evaluation needs to be conducted.

4) Preciseness of measuring the geodetic control points

○ The preciseness of control point coordinates as estimated through the adjustment of the geodetic network can be expressed with the size of the error ellipse's long axis (horizontal) and error bar's size (vertical) calculated through the variance-covariance matrix. To do so, the variance-covariance matrix that can indicate the preciseness close to the actual 3D base matrix corresponding to input data in the GPS network adjustment should be used. Generally, because the preciseness of the variance-covariance matrix provided as the processing results of GPS baseline interpretation software is evaluated to be higher than the actual preciseness, an empirical statistical modeling technique is applied (Rizos, 1996; Lee, et al, 2007).

○ In Cambodia's NGCPIP report, the details of the preciseness expressions of the control point coordinates that were calculated by applying such procedure were not included. Moreover, the results were confirmed to have been estimated by comparing with the additional inspection observation results and with the reprocessing results using heterogeneous software.

○ To evaluate quantitatively the preciseness of the control point coordinates estimated through NGCPIP by applying the geodetic network adjustment theory, the follow-up evaluation readjusted the grade 1 control points using the geodetic adjustment software Geolab 2001, which is used most widely in the world. In this case, the results were analyzed, and the newly calculated coordinates and those acquired by the project outcomes were statistically compared (see Section 1 of the Attachment).

○ Consequently, concerning the preciseness of the control points estimated through readjustment, the preciseness of grade 0 control points can be evaluated as 6.3mm and 12.5mm from the horizontal and vertical directions at confidence level of 95% and as 0.164PPM of internal relative preciseness of the geodetic network at confidence level of 95%.

○ As a result of comparing the readjustment of 155 control points and the project results coordinates, considering $\sigma = \pm 6mm$ in the horizontal direction and $\sigma = \pm 7mm$ in the vertical direction, they statistically matched. This scope is within the preciseness scope of the control point coordinates estimated through adjustment. Thus, the readjustment results can be said to have the same preciseness as the project results coordinates' preciseness.

3. Project environment and system

○ The effectiveness and impacts at the implementation environment and system level of NGCPIP, which was carried out in 3 phases, were evaluated by the impacts arising from national geodetic control point installation, impacts on the project environment and system, and effects of trainees' invitation.

<Table 26> Effectiveness and Impacts: Project Environment and System

	Impacts on control point installation	Impacts on the project environment and system	Effects of trainees' invitation
First phase	○	○	○
Second phase	○	○	○
Third phase	○	○	○

1) Impacts on national geodetic control point installation

○ The national geodetic control points have a hierarchical structure, and the control points of subgrade were linked with the next higher-grade control points. In this manner, the outcomes were estimated.

○ Because grade 3 must be linked with grade 2 control points, the control points installed through this project can be evaluated to have been used for control point installation in the Kampong Chhnang, Pursat, and Koh Kong regions. Such fact was confirmed through interviews with the officials of the regional MLMUPC in Kampong Chhnang and Pursat.

○ <Table 27> summarizes the status of control points with grade 3 and below installed by Cambodia's GDCG after 2003.

<Table 27> Status of Geodetic Control Point Installation of GDCG with Grade 3 and Below after 2003

Grade	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Grade 3	24	164	150	34	13	65	76	54	40	620
Supplementary control point	276	863	896	481	315	368	441	448	289	4,377
GCP	91	235	170	21	0	108	74	101	81	881
Total	391	1,262	1,216	536	328	541	591	603	410	5,878

* Source: Cambodian Technology Department of GDCG

○ Through interviews with GDCG's Geography Department official, Mr. So Vanna, and a local process performer, Eo Soo-chang (Samboo Engineering), the control points were found to have been used for the Krang Ponley River multi-purpose water resources development project design during the period June 2007 ~ June 2010, and the national basic map production of three major cities (Phnom Penh, Siem Reap, and Sihanouk Ville) was carried out with the assistance of KOICA.

○ Although the control points installed through Cambodia's NGCPIP have been used for LAMP's survey for land boundary and registration and some development projects for some regions to date, the use is forecast to increase dramatically, if full-scale national territory development projects are implemented in the future.

○ As of September 2011, Cambodia was not perfectly equipped with national geodetic control points classified as 0, 1, 2, and 3 grades. Therefore, the use of grade 1 control points established nationwide is expected to be inevitable for the implementation of high-density projects of geodetic control points.

○ 3 GPS CORS have been continuously collecting satellite observation data since their installation, and they are forecast to serve as basic data that can be used for future national geodetic system operation and renewal.

○ To enhance the utilization of GPS CORS, however, system upgrade is required so that an observation data offering system through the Internet and DGPS (Differential GPS) and RTK (Real-Time Kinematic) services can be provided.

○ In interviews with the directors and working-level personnel at the regional MLMUPC in Kandal, Siem Reap, and Kratie, which operates GPS CORS, they recognized the importance of GPS CORS but questioned the utilization, since the applied services mentioned above were not offered.

2) Impacts on the project environment and system

○ As a result of interviews with Cambodian government officials, people in charge of NGCPIP, and KOICA personnel, the satisfaction with the KOICA-assisted NGCPIP of Cambodia was evaluated to be higher than the control points installed by other countries and institutions. In particular,

the control points were installed nationwide through NGCPIP, and their usefulness were evaluated to be high.

- The national geodetic control points should be offered by estimating the uniform quality of highly precise outcomes (coordinates) on a single geodetic datum with a certain interval, if possible, for easier user accessibility.
- France installed 40 and 50 grade 1 control points in Phnom Penh and Siem Reap, respectively, during the period 1993～1994, Finland, 50 grade control points to develop water resources around the Mekong River, Tonle Sap Lake, and Bassac River during the period 1995～1996 as well as 22 grade 1 control points all across Cambodia in 1997 with the support of EU.
- The control points installed with the support of other institutions did not have the basic requirements of the national geodetic control points mentioned above. Although they were installed in some regions and nationwide, the number was insufficient; hence the limitation in securing high accessibility.
- In the first- and second-phase projects, although grades 1 and 2 control points were partially installed in 3 provinces where the control points were not duplicated with LAMP, the third-phase project secured national geodetic datum through grade 0 control points beyond the simple installation of control points, additionally installed grade 1 control points, and carried out the re-observation of the existing control points. Furthermore, the third-phase project actualized the single grade 1 geodetic network, which becomes the foundation of the national geodetic network.
- As evaluated in the geodetic network readjustment for preciseness verification, the grade 1 control points had absolute preciseness of 6.2mm and 12.5mm in the horizontal and vertical directions, and relative preciseness of 0.164PPM. They were installed with very uniform quality and high preciseness.
- Grade 1 control points are expected to play the role of enhancing the density of additional grades 2 and 3 control point installation in

Cambodia. Likewise, GPS CORS is forecast to play the role of core infrastructure for various observation location services as well as maintenance/repair and renewal of the geodetic system in the future.

3) Effects of trainees' invitation

○ As for the trainees' invitational training, it was divided into training for working-level personnel and decision makers targeting 30 people in the 3-phase project. The training was carried out as shown in <Table 28> for central public officials (GDCG) and regional MLMUPC public officials. The working-level personnel invitational training was conducted for 20 trainees including 14 central public officials and 6 local government officials. For decision makers, 10 including 5 central government directors and 5 local government directors received the training. Therefore, the total number of trainees was 30.

○ As a result of examining the departments in charge of national geodetic control point installation, GDCG's Geography Department was in charge of grades 1 and 2 control points, and the Geography Department was in charge of grade 3 control points. Local offices are performing cadastral observation work for land registration including supplementary control point installation.

<Table 28> Status of Invitational Training Participants

Phase	Working-level personnel (people)			Decision maker (people)			Total
	Central	Local	Duration (days)	Central (GDCG)	Local (director)	Duration (days)	
First phase	6	2	15	2	1	6	11 people
Second phase	4	2	7	2	1	7	9 people
Third phase	4	2	16	1	3	7	10 people
Total	20 people			10 people			30 people

○ To analyze the effectiveness of invitational training, status analysis of the participants and in-depth interviews and questionnaire surveys were performed focusing on the trainees; the results can be summarized as follows:

- The working-level personnel invitational training included control points observation and data processing by GPS and GPS CORS management (third-phase project). The working-level personnel of GDCG's Geographic and Technology Departments are in charge of the installation and outcome management of grades 1~3 control points; thus, the training was greatly helpful to their actual work. Nonetheless, they responded that there was a limitation in acquiring the GPS theory and practical work for 7~16 days.
- Since the local government officials' main duties were observation work by the total station, they responded that they had no opportunities to apply their learnings to actual work. Nonetheless, they said that understanding of the GPS work carried out by GDCG in the relevant province improved.
- As for the invitational training of decision makers, it was conducted focusing on Korea's observation and spatial information-related agencies touring, and trainees' understanding of the related industry increased. Through recognition of the relevant industry's importance, the trainees responded that the training was helpful to policy establishment and system improvement.

4. Cross-cutting issues

<Table 29> Effectiveness and Impacts: Contribution to Environmental Preservation

First phase	○
Second phase	○
Third phase	○

- ○ Cambodia's NGCPIP which was carried out in 3 phases was evaluated not to cause factors impacting the environment from the project planning stage to the execution stage in step-by-step geodetic control point installation, which can serve as the basic data required for cadastral observation, national map production, and SOC development including roads and national territory and urban planning.
- ○ The criteria deciding the installation location of national geodetic control points include areas that can secure more than 15° with aerial vision. Moreover, the obstacles need to be removed in case electromagnetic wave reception is hindered by structures or trees. When removal is difficult, the location needs to be moved to the point where observation is good. Therefore, the control points were evaluated to have been selected in an area where impacts on the environment were minimal.

Section 4. Sustainability

- ○ The KOICA-assisted NGCPIP of Cambodia, which is judged to have been implemented according to the project's goals, is considered to make efforts toward sustainability including the expansion of the utilization scope of the surveyed control points, supplementation of survey acts and systems, implementation of own training, and installation of grades 3 and 4 control points.

1. Policies and institutions

○ The sustainability evaluation at the policy and institutional level of NGCPIP was conducted as to whether the Cambodian government made policy and institutional efforts and whether Korea's continuous support means were prepared for technical and manpower assistance for Cambodia's observation system development in partnership with Cambodia.

<Table 30> Sustainability: Policy and Institutional Level

	Sustainability of Cambodia's policy and institutional support	Sustainability of Korea's technical and human resources support
First phase	○	○
Second phase	○	○
Third phase	○	○

1) Sustainability of Cambodia's policy and institutional support

○ The Cambodian government's policy and institutional efforts are sufficiently manifested in the proposal of the Geodetic Survey Act (draft) and National Strategic Development Plan (2006-2010).

○ As for specific outcomes under such policy and institutional base, Cambodian local governments' installation of grade 3 control points and supplementary control points and aviation control points was continuously implemented. In this regard, the policy, institutions, and execution plans have been well-linked together.

○ The Cambodian government was found to have installed national grade 3 control points, 4,377 supplementary control points, and 881 aerial photograph control points from 2003 to 2011. As a result of analyzing the control points of national grade 3 and below from January to June 2011, 40

grade 3 control points, 289 supplementary control points, and 410 aerial photography positioning control points were installed in 9 provinces, 11 districts, and 34 communes, respectively. In this context, the geodetic survey policy was well-linked with detailed execution plans, and efforts at the policy level with regard to the geodetic control points are expected to continue.

○ In the Cambodian government's National Strategic Development Plan Update (2009~2013), the expansion of horizontal and vertical national geodetic datum network and GPS CORS are specified; thus, continuous supplementary efforts on the geodetic survey system has been made since the KOICA-assisted NGCPIP.

○ As a result of confirmation through Cambodian central government officials (GDCG of MLMUPC, personnel in various local governments), continuous interest and plans are demonstrated on the central government dimension; these interests are demonstrated as policy and institutional outcomes.

2) Sustainability of Korea's technical and human resources support

○ Through interviews with Cambodian government officials (GDCG of MLUMPC, local government officials) and KOICA personnel, the sustainability of Korea's technical and human resources support can be evaluated as follows: When Cambodia's Geodetic Survey Act draft was drawn up, Korea's Geodetic Survey Act was benchmarked; thus, law enactment of survey criteria and standardization was supported. Equipment support for the operation activation of GPS CORS was also planned.

○ In particular, the basic national map support and national geographic information system master plan carried out at the request of Cambodia from 2010 is a project expanded from NGCPIP; KOICA's technical and human resources assistance was evaluated to expand and continue.

2. Goals and strategies

○ As for the sustainability of NGCPIP at the goal and strategic level, the ownership awareness of Cambodia with regard to the project was evaluated, and contributing factors and hindering factors in the project's use and expansion were also identified.

<Table 31> Sustainability: Goal and Strategic Level

	Cambodian awareness of ownership with regard to the project
First phase	○
Second phase	○
Third phase	○

1) Cambodia's ownership awareness with regard to NGCPIP

○ To evaluate Cambodia's ownership awareness with regard to NGCPIP, the evaluation can be made centering on responsibility awareness and interest. Analysis was performed through interviews with Cambodian government officials (public officials of GDCG of MLMUPC, local governments' officials).

○ To enhance the utilization of the KOICA-assisted NGCPIP, the Cambodian government needs to install grades 3 and 4 control points with ownership awareness. The Cambodian government secured 620 grade 3 control points, 4,377 supplementary control points, and 881 aerial photography positioning control points from 2003 to 2011 to enhance the national geodetic control points' use. Therefore, their responsibility and use awareness with regard to the project was evaluated to be high.

○ In Cambodia's National Strategic Development Plan (2006~2010), nationwide vertical and horizontal geodetic datum network installation and photography map production were specified; thus, an effort to maximize the use of project results was identified as well.

3. Project environment and system

○ As for the sustainability of the 3-phase project at the project environment and system level, it was evaluated with regard to the project's independence possibility and maintenance/repair and management capabilities.

<Table 32> Sustainability: Project Environment and System Level

	Project's independence possibility	Maintenance/Repair and management/operation capabilities
First phase	○	○
Second phase	○	○
Third phase	○	○

1) Project's independence possibility

○ The independence possibility of the geodetic survey-related systems and project was evaluated from Cambodia's training level, interest, and decision makers' support and interest standpoints.

○ From the perspective of Cambodia's geodetic survey training, since LAMP was implemented in full swing from 2002, FLMA (Faculty of Land Management and Administration) was established in 2003 at RUA (Royal University of Agriculture) based on an agreement with MLMUPC.[5)]

- FLMA offers the only four-year regular bachelor's and master's degrees programs related to geodetic survey and spatial information in Cambodia.
- FLMA has five majors: Land Management, Land Policy, Land Administration, Geomatics, and Geodesy.
- FLMA continues collaboration with overseas colleges and experts to consolidate the Geomatics Dept., and Geodesy Dept., based on the importance

5) Sopha S. Mund and J.P. Setha V. (2006). Professional education program for land management and land administration in Cambodia, XXIII FIG Congress, Munich, Germany, October 8-16.

recognition of geodetic survey and geomatics industry and technologies.

- MLMUPC established a Professional Training Center on March 9, 2011 for the practical training of its personnel and opened the cadastral survey program. The program offers Geodetic Survey, Cadastral Survey, GIS CAD, and GPS education.
- Through the nurturing of new manpower who completed the regular college education programs by FLMA, geodetic survey and geomatics manpower equipped with geodetic survey and geomatics through MLMUPC's Professional Training Center can be said to be reinforced continuously in the relevant industries.

○ To evaluate Cambodian decision makers' support and interest with regard to NGCPIP, interviews with Cambodian GDCG's policy decision maker, Sar Sovan (July 11 and July 18, 2011), and Assistant Director and Geography Dept. Director Ith Sotha (July 11 and July 19, 2011) and Technology Dept. Director Lor Davuth (July 11, 18, and 19, 2011) were conducted.

- They sufficiently recognized the importance of geodetic control points, which become the standard for the location expression of national spatial information; they have plans to implement high-density enhancement of the control point network through the installation of lower-grade control points based on grade 1 control points observation data nationwide as installed via the third-phase project.
- Although NGCPIP has been mainly used for geodetic survey for LMAP until recently, the use fields and frequency are forecast to increase when Cambodia's national territory development is implemented in full swing in the future.
- They showed high interest in GPS CORS installed through the third-phase project and indicated that they plan to implement policies toward the direction of raising the utilization of GPS technology by reflecting the GPS observation location technology.
- In summarizing the interviews with decision makers and middle managers

of Cambodia, they can be said to have high interest in the meaning, importance, and use of the national geodetic survey control points.

○ To evaluate whether Cambodia is equipped with capabilities to install, manage, and use geodetic control points in the future, this follow-up evaluation analyzed the departments and project status of NGCPIP.

- The Geography Dept. of GDCG is in charge of geodetic survey and national geodetic control points work of Cambodia, and the Technology Dept. is in charge of cadastral survey work.[6].
- Cambodia's national geodetic control points consist of grades 0, 1, 2, and 3, and the installation work should be performed by the Geography Dept.. Note, however, that grade 3 control point installation is carried out by the Technology Dept., due to the implementation of LMAP and LASSP.
- Cambodia's grade 2 control points consisted of 416 points as of May 2010, with 92 control points and 324 control points installed by the KOICA-assisted project and LAMP after that. Likewise, the Technology Dept. installed 5,878 control points with grade 3 and below after 2003.
- In addition, 16 grade 2 and 18 grade 3 control points are currently being installed in 2011; 75 grade 2 and 100 grade 3 control points are planned to be installed in 2012.
- The Geography Dept., and Technology Dept., can be evaluated as having sufficient capabilities to install control points according to the GPS geodetic survey method. Note, however, that they are considered to have no capabilities to calculate outcomes by carrying out geodetic network adjustment that includes the newly installed control points in the nationwide single network.[7]

6) Sub-decree on the organization and function of the ministry of land management, urban planning, and construction (1994)

7) Interview with Geography Dept. Director So Vanna on July 19, 2011

2) Maintenance/Repair and management capabilities

○ The installed geodetic control points need maintenance/repair and management on the survey marks and outcomes (coordinates). To evaluate maintenance/repair and management capabilities, analysis was conducted focusing on the government's commitment to institutions, control point management capabilities, commitment to geodetic network density enhancement, operation of GPS CORS, and collected data analyzing capabilities.

○ The key to survey marks is to preserve them so that they are not damaged; when they are damaged, they need to be reinstalled promptly, and outcomes should be calculated through observation.

- The commitment of the Cambodian government to preserve the survey marks can be confirmed through the statutory Land Law, which specifies the penalty of 500,000～3,000,000 Riels when a person damages them deliberately. Moreover, as shown in the <Attachment>, Cambodia's local governments make an effort to enhance the importance of survey marks by sending official documents.

○ Cambodia's institutional efforts for geodetic control points' maintenance/repair are considered to be made simultaneously. In the case of Kampong Chhnang, official documents under the name of the governor are cyclically sent to the public offices adjacent to the places where geodetic control points were installed. Likewise, the importance of preservation is recognized, and reporting is requested when a problem arises.[8)]

○ As of July 2011, the most urgent problem of Cambodia's national geodetic control points is realizing density enhancement through the installation of lower grades, i.e., grades 2 and 3 control points, based on the grade 1 control point network installed nationwide via the KOICA-assisted NGCPIP.

- The urgency and importance of density enhancement of the geodetic

8) Interview with officials of MLMUPC in Kampong Chhnang Province on July 12, 2011

survey network were sufficiently recognized by the directors of the Geography and Technology Departments according to interviews with them.

- To do so, Cambodia continuously implements the installation of lower-grade control points as shown in <Table ?>. Moreover, the commitment was confirmed through the plan to install grades 2 and 3 control points in 2011 and 2012 by the Geography Dept., as shown in <Attachment ?>.

○ According to the Geography Dept., in charge of control point installation, however, they have capabilities to estimate outcomes through the baseline interpretation of GPS survey data and network adjustment of observation target areas. Moreover, it was found that there was a limitation in estimating the uniform quality of outcomes through nationwide geodetic network adjustment by composing each layer of the national geodetic control point network with a single national geodetic network.[9)]

○ Most countries use GPS CORS for geodetic system establishment and operation, but as infrastructure to offer various applied positioning services. As of July 2011, however, the three Cambodian GPS CORS collect only GPS survey data to cope with future geodetic datum upgrade. Furthermore, Cambodia is considered to lack capabilities related to geodetic datum management through the interpretation of highly sophisticated GPS data processing software (i.e., Bernese, GAMIT, GYPSY) for science and technology use.

9) Interviews with Geography Dept. Director (So Vanna) and working-level personnel on July 19, 2011

Conclusion and Suggestions

Chapter

5 Conclusion and Suggestions

○ As a result of comprehensive follow-up evaluation, Cambodia's NGCPIP which was carried out in 3 phases from 2003 to 2009 can be evaluated as very excellent in the relevance, efficiency, effectiveness, impacts, and sustainability evaluation items. Meanwhile, specialist manpower nurturing and training goal achievement are good overall in the training content, including consideration of special attributes of the country concerned in the effectiveness and impacts items. Nonetheless, there are some parts that need improvement for the project's effect enhancement.

○ In the first- and second-phase projects, they are evaluated to contribute to the enhancement of NGCPIP's feasibility and effectiveness since regions with high potential for national territory development were selected, and the project's priorities were decided to offer control points to LMAP. In particular, to enhance NGCPIP's effects, single geodetic datum needs to be installed at a certain interval for easier user accessibility. From this point of view, Cambodia's NGCPIP realized uniform quality and high preciseness of outcome coordinates within the geodetic survey network and provided the base for the national geodetic survey network. In this regard, the project effectively reflected KOICA's ODA support policy.

Section 1. Strengths and Areas of Improvement

1. Strengths

1) Cambodia's policy priorities and coherence enhancement

○ Enhancing the effects of NGCPIP requires estimating and offering the high preciseness of outcomes (coordinates) with uniform quality within the geodetic survey network on the single geodetic datum at a certain interval for easier user accessibility. From this standpoint, Cambodia's NGCPIP has strength since grades 2 and 3 control points were installed in 3 phases and national geodetic datum was realized through grade 0 control points; the base of national geodetic network was also offered through re-observation of the existing installed control points.

- France installed 40 and 50 grade 1 control points around Phnom Penh and Siem Reap in 1993 and 1994, respectively; Finland installed control points around the Mekong River, Tonle Sap Lake, and Bassac River for water resource development and 22 grade 1 control points across Cambodia in 1997 with the support of EU.
- The control points installed with other institutions' assistance did not have the basic requirements of national geodetic control points. Even though the control points were installed in some regions or nationwide, the number of control points were insufficient; hence the limitation in securing high accessibility.

2) Enhancement of linkage with other assistance-offering countries' projects

○ In the first- and second-phase projects, grade 1 and 2 control points were partially installed in 3 provinces with high national territory development potential and which were not duplicate with LAMP. To provide control points to LMAP, their priority was decided. In this regard, NGCPIP was a project that sufficiently reflects Cambodia's requests and is evaluated to be in line with Korea's ODA policy direction.

3) Securing of preciseness and uniformity of Cambodia's national geodetic control points

○ As a result of evaluating the preciseness of NGCPIP which was carried out in 3 phases it was evaluated to have very uniform quality and high preciseness.

- As evaluated in the geodetic network readjustment for preciseness verification, grade 1 control points had absolute preciseness of 6.2mm and 12.5mm in the horizontal and vertical directions, respectively, and relative preciseness of 0.164PPM with very uniform quality and high preciseness.

4) Offering core infrastructure of Cambodia's positioning services

○ The grade 1 control points are forecast to play a role in enhancing the density of the geodetic network through additional grades 2 and 3 control point installation in the future. GPS CORS is also projected to play a role in maintaining/repairing and renewing the geodetic datum in the future including serving as core infrastructure to offer various positioning services.

2. Areas of improvement

○ Although NGCPIP's plan establishment and implementation process was evaluated to be carried out properly, its effects could be enhanced further if Cambodia's social, economic, and technical level had been considered in implementing NGCPIP.

- The national geodetic control points are one of the most important infrastructure of a nation's spatial information data location expression (reference); thus, the preciseness of the national control points' coordinates should be maintained at a very high level. Toward this end, institutionalization through the standardization of control point installation and observation, data processing, and geodetic network adjustment calculation process should be essentially conducted. Note, however, that Cambodia's Geography Dept., which is in charge of control points have difficulties since they do not have manpower capable of implementing the standardization. In particular, when different procedures are applied to additional control points installation in the future, problems in securing control point coordinates' preciseness may arise. Therefore, when a project similar to NGCPIP is carried out in the future, there is a need to perform standardization and institutionalization as the priority, secure process quality, and support technical independence from the short-term perspective.
- In the case of GPS CORS carried out in the third-phase project, it is a very important and core infrastructure project to realize national geodetic datum. Note, however, that Cambodia's geodetic survey is mostly conducted focusing on the total station; hence the possibly limited utilization before GPS equipment is diffused sufficiently.

○ From the project results utilization perspective, areas of improvement can be presented in two aspects: use of national geodetic control points and GPS CORS.

- LMAP is a tentative body organized to establish the land policy and legal

system, organizational development and training, land registration and registry, and land dispute solution for Cambodia's land management. This body needs to implement work in close cooperation with the existing MLMUPC's Geography Dept. Likewise, the master plan for the entire country and the work should be executed through a sequence of priorities.

- The most basic data tasks to implement NGCPIP are to acquire precise location values from the national control point network and make cadastral maps. In a situation where there is no national control points network, however, Cambodia produces cadastral maps using independent geodetic survey and digital orthophotos by region. Thus, confusion is expected after the national control point network is established because of the differences in coordinate values. As such, the Cambodian government needs to execute national control point network establishment with the highest priority.
- Considering the fact that the data of three GPS CORS are not shared, only individual data are received by GPS CORS, and there is no GPS receptor, including the huge burden of the Internet use fee, improvement to remove these problems is considered necessary.

○ With the completion of NGCPIP, the following are the limitations from the standpoint of maintenance/repair of control points and GPS CORS:

- When trees exist around GPS CORS, GPS signal can be reduced or refraction can be triggered; thus, the trees around the receptor need to be removed. Around the Siem Reap GPS CORS, however, trees exist. Therefore, understanding of the GPS and of relative observation is judged to be insufficient. In this context, practical training on the maintenance/repair of GPS CORS is considered necessary.

○ Although training was carried out diversely including invitational training in Korea for working-level personnel and decision makers, local training, and dispatch of experts, the mutual learning process among trainees after the invitational training was insufficient; hence the limitation in the dissemination

of training effects.

- Although the types of training are appropriate, the content and duration of training need to be differentiated into short-, mid- and long-term among the trainees. Thus, differentiated training is required.
- In the domestic invitational training, basic GPS theory, GPS equipment's general matters, and practice were implemented. In the case of local government, however, public officials mainly use the total station for geodetic survey, and only central government public officials use the training content in their work. In this regard, the training outcomes can be limited.
- Differences seem to exist in the recognition and use level of geodetic control points among provinces where NGCPIP was implemented. Continuous training needs to be enhanced for PR and recognition enhancement and use of the national geodetic control points.

Section 2. Policy Suggestions

1. Adoption of comprehensive evaluation type for comprehensive follow-up evaluation

○ In the case of OECD/ODA projects, external evaluation is mandatory. Nonetheless, the adoption of a comprehensive evaluation mode that appropriately combines internal and external evaluations is required.

○ As one of the advantages of internal evaluation, the personnel of an institution in charge of project implementation can identify the goals or content of the project better than others; thus, the project can be monitored according to the evaluation items and indicators. As such, it is easy to identify issues to raise the projects' effectiveness, impacts, and sustainability and draw measures

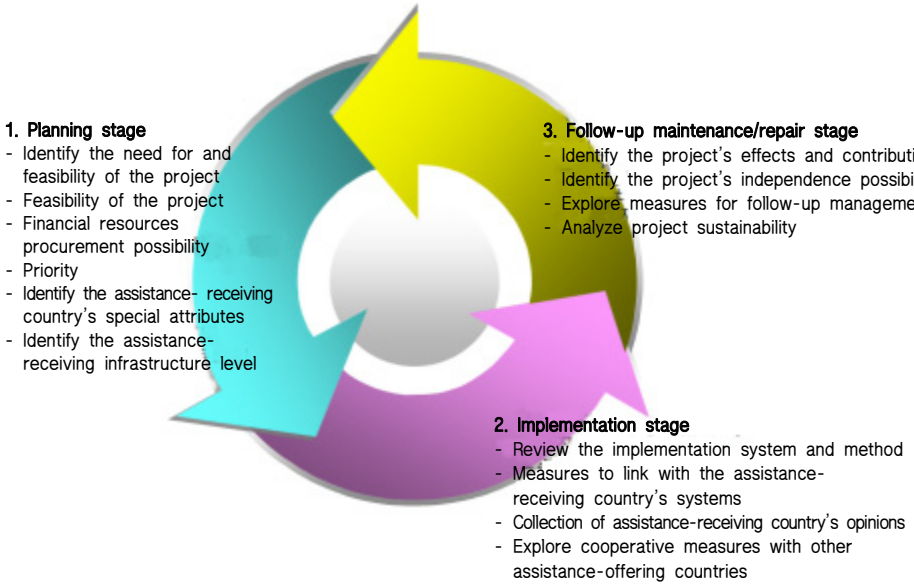
to improve them. On the other hand, external evaluation by experts can be objective in terms of evaluation results, and effective evaluation can be realized using expertise. A new vision can also be offered with regard to the project's direction and operation.

○ Although the selective application of evaluation type is possible considering the available resources required for the evaluation results' use purpose and evaluation (manpower, budget, expertise, etc.), linkage between macro situations such as assistance-receiving country's financial, administrative, legal and institutional, and structural changes and micro situations such as specific goals and content by identifying them adequately can contribute to enhancing the project's effectiveness and sustainability. All in all, the comprehensive evaluation mode that sufficiently combines the advantages of internal and external evaluations is considered to be appropriate.

2. Consolidation of advisory group's role for overall project monitoring

○ In the case of the national infrastructure support project such as NGCPIP, there is a need to consolidate the currently operating advisory group's role so that it can perform the monitoring of the project from the planning and execution and completion stages to the feedback of the results to the project to reflect flexibly the assistance-receiving country's economic, policy, and environmental characteristics and enhance project effectiveness.

<Figure 15> Roles of the Advisory Committee Group



○ The advisory group (proposal) can review the detailed items to consider in each project implementation stage, i.e., planning, implementation, and follow-up maintenance and management stages, and can secure the project's driving force, identify problems, and carry out feedback and secure the project's legitimacy. Therefore, all these make for an opportunity to secure the assistance-receiving country's ownership awareness including policy, legal and institutional, and administrative systems and technical advice and expand the capabilities to make plans, execute the project, and carry out follow-up management.

○ KOICA's comprehensive follow-up evaluation conducts evaluation by collecting data in a cross-sectional manner at a specific point in time after the longitudinal project is completed. For this reason, if the advisory group can refer to the measured details by project phase and participate in the external evaluation following the final follow-up evaluation, the reliability and feasibility of the project evaluation results can be enhanced.

3. Strategy of manpower nurturing for securing the sustainability of the national geodetic control point installation project

○ In view of manpower with expertise in the assistance-receiving country's geodetic control points, there is a need to undertake simultaneously the expansion of basic infrastructure such as geodetic control point installation and a capability development project such as human resources development.

○ By actively considering the technologies and infrastructure that are insufficient in an assistance-receiving country, training opportunities can be expanded, and training programs can be consolidated for the least developed countries such as Cambodia using a measure to implement technology cooperation in the direction of directly linking such country's problem solving.

○ In particular, given the fact that OECD/ODA project's paradigm is shifting from simple technology transfer to capacity development, the existing method to input into or transfer advanced technologies to an assistance-receiving country seems to be somewhat unreasonable.

○ From the mid- and long-term perspectives, there is a need to consider a realistic, sustainable, and long-term training method in the case of trainees' invitational training and local training on a short-term basis.

○ There is a need to select and train actively the object that can use the national geodetic control points of each local government of Cambodia by diversifying the trainee selection criteria in the case of operating training programs. As presented in the analysis results, there were huge differences in the understanding and recognition of geodetic control points and GPS CORS between the central and local governments' public officials. The understanding of local governments' public officials was also analyzed to be lower than that of the central government's public officials.

4. Conversion into a results-based management system

○ The ultimate purpose of Korea's ODA project is to improve the quality of life of the assistance-receiving country people and enhance amicable relations with Korea in addition to drawing the outcomes including hospital and school establishment.

○ In implementing more faithfully what ODA pursues, the implementation-focused management system wherein the inputted resources and direct outcomes are the focus has a limitation.

○ As an alternative, a means should be presented on shifting to a results-based management system wherein the project's outcomes and impacts are managed and measured from the mid- and long-term perspectives. The results-based management can be effectively used for the implemented projects to be equipped with technical and organizational capabilities for a long time such as NGCPIP, including projects carried out under comprehensive programs or projects whose effects are demonstrated quite later after a project is finished.

○ Especially, such management system can be helpful in establishing goals to demonstrate sustainable outcomes instead of focusing on outcomes through linear input and output and in designing a project direction to have hopes and visions for both assistance-offering and -receiving countries with regard to development cooperation outcomes.

Section 3. Limitations of Evaluation

1. Limitations of quantitative evaluation through satisfaction survey

○ Although this follow-up evaluation attempted to carry out literature study and empirical analysis simultaneously as study methods, in the case of the satisfaction survey, the number of samples is not sufficient. Thus, the quantitative evaluation results were reflected at the level of supplementing the qualitative analysis results due to difficulties in securing statistical significance. In other words, follow-up evaluation was conducted through literature study and content analysis of the collected data, with the satisfaction survey results reflected at the level of confirming or supplementing the analysis content.

2. Limitations of follow-up evaluation's impacts and sustainability

○ NGCPIP can be a national infrastructure establishment project with the characteristics of interim outputs that become the base of national geodetic survey and map production. NGCPIP plays an important role in designing and constructing SOC as an infrastructure establishment project. In this context, there is a limitation in analyzing the direct effects based only on the installed national geodetic control points; therefore, only the indirect effects were measured using a method to explore the Cambodian government's projects and policies using those control points. Accordingly, this follow-up evaluation identified the Cambodian government's laws, institutions, instructions, official documents, and national projects utilizing the control points derived from NGCPIP in terms of the method to measure the project's impacts. In addition, the comprehensive follow-up evaluation evaluated the assistance-receiving country's sustainable efforts and awareness of ownership with regard to

the project, based on the Cambodian government's administrative system efforts for NGCPIP.

3. Limitations of analyses through in-depth interview and focus group

○ After conducting in-depth interviews with the local training participants, previously invited trainees to Korea, and project implementing institutions, opinion collection on the problems, effects, and impacts generated in the input, process, and output process of NGCPIP by focus group was done. Instead of individual in-depth interviews, in the interviews with focus groups, the demand of the assistance-receiving country's officials including the problems and areas of improvement in NGCPIP was drawn a lot. In the problems found in all the focus groups, however, they were not clearly demonstrated, i.e., unarticulated customers' needs were found. To address this kind of problems, this follow-up evaluation attempted to enhance the feasibility and reliability of the analyses in the mode of checking through the data (official documents) received from the assistance-receiving country.

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