

付 属 資 料

1. 要請書
2. 実施細則(S/W)
3. 協議議事録(M/M)
4. 面談記録
5. 事業事前評価表

Ministry of Mines & Energy



Project Proposal on

**Slope instability problems in the Abay River gorge:
Detail assessment of causes, extents and rate of
landslide along the main road from Gohatision to Dejen
and workout possible remedial measures**

November 2008

Addis Ababa

Project Title:

Slope instability problems in the Abay River gorge: Detail assessment of the causes, extents and rate of landslide along the main road from Gohatision to Dejen and workout for possible remedial measures.

Project life: five years (2009-2013)

Target area: The target area lies at the boundary between North Showa and East Gojam Zones of Oromiya and Amhara Regional States respectively. It extends from Gohatision to Dejen towns.

Location: the location of the study area is approximately 38° - $38^{\circ}18'$ E longitude and $9^{\circ}58'50''$ - $10^{\circ}15'00''$ N latitude (figure 1).

Background & Justification

Slope instability (Landslides, rock fall, toppling, subsidence) constitute a continuous series of events that rarely can be attributed to one definite cause. The causes that finally bring landslide and rock failures begin with the depositional environment of rocks. Subsequent topographical and geological adjustments, erosion, weathering, groundwater flow and the continuous pull of gravity all contribute to unstable situations just prior to land mass movements. The final event but not the sole cause may be triggered by such factors as heavy rainfall, earthquake or activities of human beings.

The mechanism of landslides also varies depending on the topography of the area and the degree of materials heterogeneity. Landslides along a planar surface are known as translational, whereas those occurring on a circular slip plane are called rotational.

A slump is a type of small rotational failure, which involves homogeneous rock and soil masses.

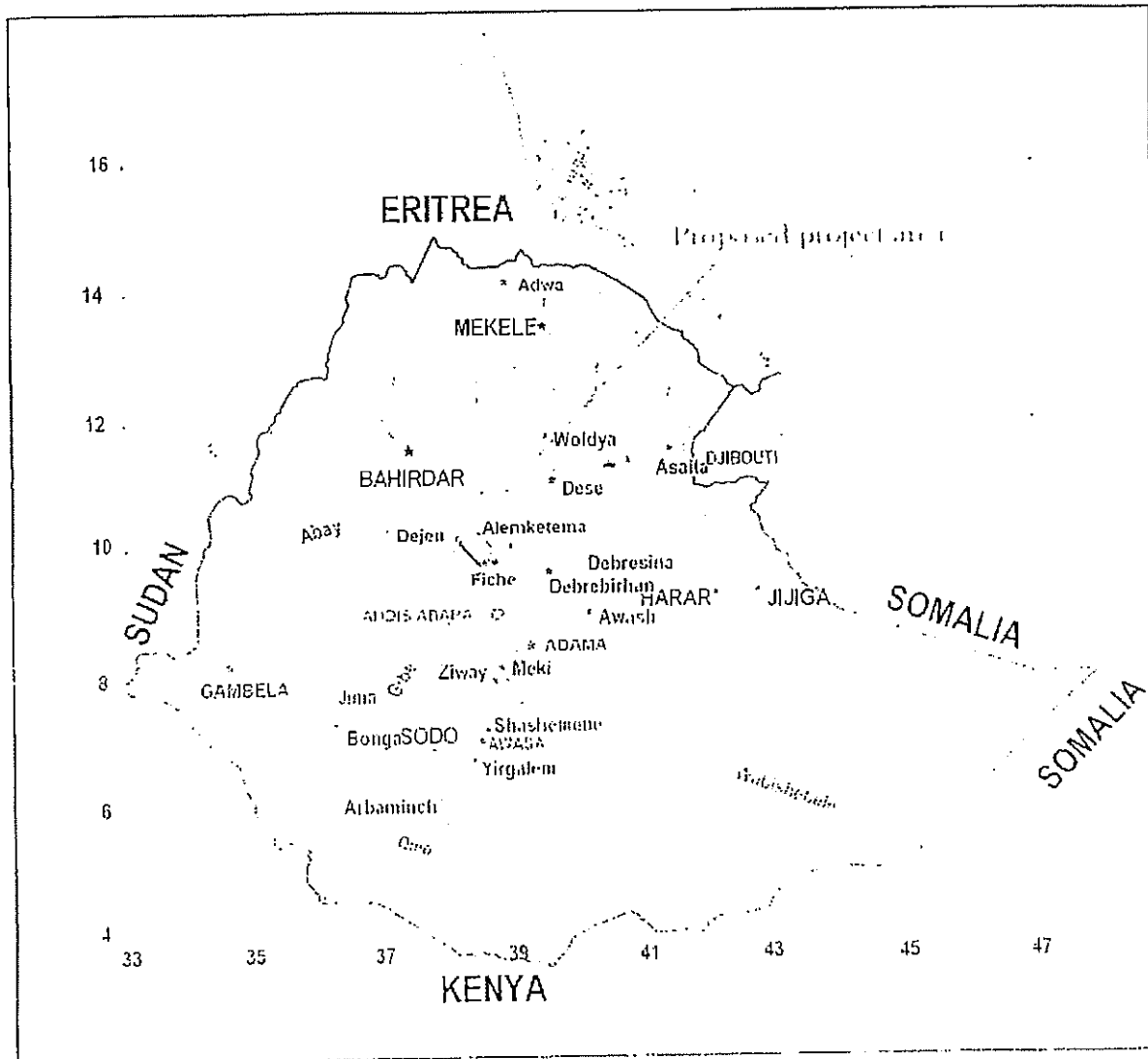


Figure 1. Location map of the proposed project area.

In Ethiopia landslide problems are common in the central, western, northern and southern highlands. Deforestation, overgrazing and improper land use favor soil erosion and landslides from steep to moderately steep slopes, especially during the rainy months of July and August.

The most landmass movement affected regions in the country are the Abay Gorge, Dessie area, different woredas of West Gojam, Gondar, Wolaita, Gofa, Gedio, Sidama,

Kefa and Western Tigray Zones. Besides, the Adigrat-Adwa, Lalibela-Sekota and Lemi-Alemketema roads, Semien highlands, Gelemso-Harar areas, highlands surrounding Ambassel and Woldia, Bonga town and surroundings, Gilgel-Gibe area, surroundings of Finchewa, Debre Libanos and Mughher valley are also affected by sever slope instability problems.

The landslide of Abay River gorge is relatively big and complex and encompasses a vast area, including the main road connecting the capital with the north and northwestern parts of the country. For the past many years the problem occurred in this gorge is causing devastating damages of infrastructure and farm land.

The contribution of geology to the process of landmass movement mainly comes from the variation in composition, type of deposition and degree of weathering. The presence of irregular landslide surfaces in the area and the occurrence of many isolated slumps indicate the presence of various rock layers of differing resistance.

Like any other place in Ethiopia, rainfall is the dominant triggering factor of landslides. Especially, anomalous high amounts of rainfalls following some dry periods have the potential to change previously formed small slides into rotational slumps of greater magnitude. Landslide could also be initiated by changes in groundwater storage. Groundwater flow paths within the landslide are thought to be controlled by hydraulic gradients in the rock mass. Because of the heterogeneity in hydraulic properties, groundwater flow is assumed to be complex and varies both in direction and velocity. Land clearing and cultivation in many parts of the mountain is among the activities of human beings related to landslide problems.

With these considerations, this project is proposed with an intention to contribute to the synthesis of data/information on geohazards and geo-environmental problems, particularly land sliding, rock fall and subsequent erosion. It is assumed that the

project will contribute to the national development plan and poverty reduction strategy.

This project proposal is submitted to the Japanese government for financial assistance under the "Cool Earth Promotion Program" whose implementation framework was worked out at the fourth *Tokyo International Conference on African Development (TICAD IV process)*.

The project is intended to deliver detail investigation and assessment of this land slide prone areas through engineering geological and geophysical investigation as well as core drilling to identify overburden thickness susceptible to sliding and establishment of monitoring stations.

Developmental Objective

In the Abay River gorge human activities such as random settlement, deforestation, poor agricultural practices along with the geologic and topographic factors are accelerating the landslide process and gully formation, which lead to severe slope instability problems.

Therefore, the Ministry of Mines & Energy (MME), in consultation with the Ethiopian Roads Authority (ERA), has initiated a project proposal entitled "*Slope instability problems in the Abay River gorge: Detail assessment of causes, extents and rate of landslide along the main road from Gohatision to Dejen and workout for possible remedial measures*". The project's basic objective is to address geo-hazard issues and find out solutions to the existing problems through proper investigations and provisions of usable information. This will help to maintain safe and stable environment that ensures sustainable food security and reduces the prevalent absolute poverty in the country.

Geo-hazards investigation data are key elements for planning and decision making, which assist to work out mitigation measures and maintain sustainable development. Such data include, but not limited to, locations of specific objects (soils, rocks and water) and their properties, land cover and land use. The investigation results will help to identify factors affecting the locations, designs, constructions and operations of engineering structures for proper land use, workout and test mitigation measures to rehabilitate and maintain stable geo-environment in the selected area.

Immediate objectives of the project:

The immediate objectives of the project are:

1. Conduct detailed engineering geological and geophysical surveys over landslide prone areas between Gohatshion and Dejen towns at a scale 1:50,000 and produce geohazard zoning map. Based on the findings, carry out detail investigations in selected sites at scales larger than 1:10,000 to find out the trends and patterns of slope movement.
2. Understand the causes of land mass movement and identify factors that contribute to the problem;
3. Select sites for establishment of monitoring stations and study in detail the dynamicity (rate and magnitude) of land mass movement and thereby enable to predict land sliding at a regional scale and establish an early warning system.
4. Establish an engineering geological model of the Abay gorge and workout field methodologies that would be applicable in other parts of the country affected by geo-hazard problems.
5. Work out possible remedial measures (structural and non-structural measures, including communication and awareness creation) that avoid/reduce the risk and consequence of land sliding in the Abay Gorge.

6. Capacity building:

- a) Enhance the skill of conducting geo-hazard investigations in other parts of the country in the future through training of qualified personnel;
- b) Equip the organizations with technical facilities necessary for monitoring land mass movements and associated phenomenon.

Methodology

This project shall be implemented as per the following survey steps:

Step I: Desk study

The desk study covers evaluation of the existing both qualitative and quantitative data sets on the proposed project area and its surroundings. This includes aerial photo and satellite image interpretations as well as compilations of previous data using the state-of-the-art techniques. Besides, assessment of topographic changes before and after occurrences of landslides shall be carried out.

Step II: Field studies

Desk study is followed by site investigations, i.e., qualitative and quantitative data acquisition, including geological mapping, engineering geological mapping, geomorphological, hydrological, weathering profile, logging, discontinuity surveys, geophysical surveys, geotechnical engineering and sampling (rock, soil & water).

The specific tasks to be executed during this step are:

- Defining the aerial extent and volume of the landslide zone by assessing the geological, hydrogeological and hydrological conditions of the area to precisely determine their effects to the instability of land materials.

- Estimating the level of activity and direction of land mass movements using monitoring instruments to be installed within and/or outside the landslide prone area;
- Determining the location and configuration of slip surfaces using data from results of shallow core drilling, trial pitting, trenching and geophysical surveying (seismic refraction, electrical, magnetic and others);
- Determining the strength and index properties in the laboratory using representative rock and soil samples to be collected from the project area;
- Installing of monitoring instruments that deliver data necessary to examine the rate of movement/deformation and provide early warning information;

Step III: Post field desk studies

Post-fieldwork activities include analyses of laboratory test results and integrated interpretation of field and laboratory data and preparation of final maps and sections (2D & 3D) and compilation of final technical report. 3D sections are particularly important to indicate the depth of shear plane/sliding surface and thickness of superficial materials overlying the bedrock. Based on analysis of the studies possible remedial measures that help to rehabilitate the land slide affected localities will be worked out and implemented at a pilot test level on selected spots that are highly exposed to the problem.

Anticipated project inputs

The Ministry of Mines and Energy (MME) takes the responsibility for the execution of landslide and related geohazard investigations within the project area. Based on the findings of investigation the Ethiopian Road Authority will be responsible for the design and construction of remedial measures. Although the MME provide all necessary manpower, logistic, office and camping facilities, during the investigation

period, the project takes in to consideration the high-level technical assistance from the Japan government.

The Japan government shall cover salary, per diem, air tickets and other expenses of its experts involved in the project. Besides, equipment purchase and cost of training of local staff required for the performance of this project shall be covered by the donor. In order to fulfil the project objectives, the technical assistance of the donor is basically in form of expertise-technology transfer- training and provision of monitoring equipment. Hence, expertises in the following disciplines are considered to be essential during investigation, which is planned to be accomplished in two and half years.

- a) Geo-hazard expert (one month/year)
- b) Engineering geologist (one month/year)
- c) GIS and RS expert (one month/year)

In view of the fast changing technology, the need to upgrade even the high level professionals' knowledge through training is an essential and inevitable process and due to this the project includes a training component. The short term specially tailored in-house and on-the-job trainings are envisaged to build the human resource capacity in the field of geohazard mapping and data analyses (like engineering geology and geophysics, earthquake, land mass movement and subsidence), GIS and RS. It is planned that the training will be given by Japanese experts for a period of one month in two consecutive years.

Financial requirement

The necessary finance to implement and execute the project will be from the Japan government under TICAD IV framework of the *Cool Earth Promotion Program* is about **237,845,798 (Two hundred Thirty Seven Million Eight Hundred Forty Five Thousand Seven Hundred Ninety Eight USD)**. The financial expenditures proposed to be covered by donor government are shown in Tables 1, 2 & 3 below.

Table 1. Finance expenditures for detail investigations.

No	Item	Quantity	Total USD (x1000)
1.	High accuracy GPS	3	400
2.	Terrameter (Resistivity meter)	2	
3.	Magnetometer	2	
4.	Digital cameras	6	
5.	Permeability apparatus	4	
6.	Hand augers	4	
7.	pH meter (soil & water)	4	
8.	Shelby tubes	30	
9.	Digital deep-meter (water level indicator)	4	
10.	Dilatometer	4	
11.	Shear box apparatus	4	
12.	Different slope movement monitoring instruments		
13.	Geohazard modeling Software	2 licenses	
14.	Satellite images (high resolution)		50.0
15.	Orthophoto (large scale)		10.0
16.	One complete set 48 channel Seismograph with accessories (geophones & cables)	1 set	90.0
17.	Counter expertise expense	3 experts	112.5
18.	Staff training: <ul style="list-style-type: none"> ▪ Local training ▪ Foreign Training (at MSc Level) ▪ Foreign short-term training 	18 staff 2 staff 10 staff	36.0 83.2 450.0
19.	Perdiem (Technical staff & drivers)	23 staff	140.0
20.	Daily laborer	40	60.0
21.	Shallow core drilling (total 2000m)	40 bore holes each about 50m depth.	300.0
22.	Mobilization/demobilization of drilling machineries & accessories		30.0
23.	Drilling spare parts & related facilities		50.0
24.	Trenching (w2mxL5mxd3m)	20 trenches	18.0
25.	Pitting (each w1.5xL1.5xd3m)	40 pits	8.1
26.	Laboratory analyses (soil, rock & water samples)		50.0
27.	Purchase 4DW field vehicles	2	150.0
28.	Fuel & lubrication		100.0
29.	Planting fast growing trees (for slope rehabilitation)		100.0
30.	Office and field facilities		50.0
TOTAL			1,837.6
CONTINGENCY (12%)			220.512
TOTAL INVESTIGATION COST			2,058.112

Table 2. Finance expenditures for the construction.

No	Work item	Quantity	Total USD (x1000)
Direct Construction Cost			
1.	Soil removal (RHS & LHS)	320,000m ³	4,930.93
2.	Anchor work (L15@200 nos & @300 nos (Dia=150 mm))		4,800.0
3.	RC pile works (with different depth, interval & nos but @ Dia = 1000 mm)	100,800 m	48,988.8
4.	Caisson pile works	3,944 m	140,344.0
5.	Surface drainage ditches, including branches	20,100 m ³	1,883.4375
6.	Horizontal drainage boring (with L30 m@15, 50 & 60nos)	3,750	1,125.0
Total Direct Construction Cost			202,072.1675
Indirect Cost (12.1%)			24,450.7323
Total Construction Cost			226,522.8998
Consultant Fee (Design & SV – 4.09% of the construction cost)			9,264.7866
TOTAL SUM			235,787.6864

Table 3. Summary of Expenditures.

No	Work Item	Cost (USD)	Remark
1	Total Investigation Cost	2,058,112.0	Work to be done by Ministry of Mines & Energy
2	Total Construction Cost	235,787,686.4	Work to be done by ERA
TOTAL PROJECT COST		237,845,798.4	

Expected outputs

The output of the proposed project will be very helpful for planning of development strategy, planner, environmentalists, agriculturalists, civil engineer, etc. They can understand easily the potential impacts of land slide, ground cracking and related geohazard problems on engineering projects and on communities living in the project areas.

Avoiding unfavorable sites based upon the information gathered from geohazard problems assessment studies would undoubtedly save the economy of the community and the country at large. The use of systematically studied and designed land resource will remarkably improve the economic development and environmental rehabilitation at a community and country level.

The following are the specific outputs of the project:

- √ Engineering geological and engineering geophysical maps with accompanying 2D and 3D models will be prepared that provide detail surface and subsurface information;
- √ Land slide and ground cracking monitoring stations shall be established that deliver continuous data necessary to provide early warnings;
- √ Possible remedial measures will be worked out that help to reduce risks on life, property and environment; develop methodology that helps to rehabilitate and protect natural environment as well as existing and future infrastructures;
- √ Geohazard management database will be established, which can be accessed by various governmental and non-governmental organizations;
- √ Institutional capacity building, in terms of human resource development (training) and supply of scientific equipment and logistics will be realized;
- √ Knowledge gained from this project area will be used in other areas of the country affected by slope degradation and land mass movement problems;

Expected Beneficiaries

- As the project is focused on landslide hazard reduction problems, the direct beneficiaries will be the communities vulnerable to these slope degradation and geo-hazards.

- The policy makers, planners, decision makers and i.e. the government will benefit because the focus will shift from the more expensive post disaster relief and rehabilitation to more economical and effective mitigation and preventive action.
- From the regional to woreda levels authorities will benefit by learning from the scientific approach to management of geo-disasters, as against crisis management which often turns out to be expensive and ineffective.
- Authorities concerned with maintaining, rehabilitating and managing slopes affected by geohazard problems.
- Professionals from regional bureaus, governmental agencies and NGOs involved in geo-environmental disaster mitigation and rehabilitation will be beneficiaries of the project since they get good lesson that can be effectively applied in areas with similar problems.
- Private investors.

Developmental Benefits

- ✓ Reduction in the loss of life, property damage of geo-environment.
- ✓ Capacity development for mitigation measures and preventive systems of landslide problems
- ✓ Protection of infrastructure from destruction.

Co-Benefits

- ✓ Reducing slope instability and degradation problems
- ✓ Reduction of soil erosion, draught and desertification
- ✓ Increase vegetation cover, especially plants and thus sequester carbon.

2. 実施細則 (S/W)

SCOPE OF WORK

FOR

THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST
LANDSLIDE IN THE ABAY RIVER GORGE

IN

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

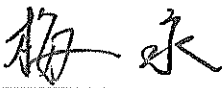
AGREED UPON BETWEEN

GEOLOGICAL SURVEY OF ETHIOPIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

ADDIS ABABA, December 16, 2009

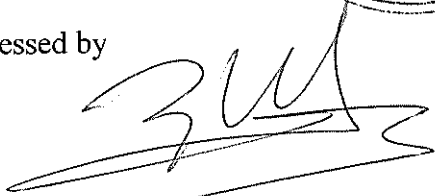


Satoshi Umenaga

*Leader of Detailed Planning Survey Team
Japan International Cooperation Agency
Japan*



Witnessed by



Tilahun Tadesse

*Bilateral Cooperation Sub Process Owner
Ministry of Finance and Economic Development
Federal Democratic Republic of Ethiopia*




Tolesa Shagi
Director General

Tolesa Shagi

*Director General
Geological Survey of Ethiopia
Federal Democratic Republic of Ethiopia*

Witnessed by



Zaid Wolde Gabriel

*Director General
Ethiopian Roads Authority
Federal Democratic Republic of Ethiopia*

I. INTRODUCTION

In response to the official request of the Government of the Federal Democratic Republic of Ethiopia (hereinafter referred to as "GOE"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, in consultation with the Government of Japan, decided to conduct the technical cooperation for development planning on "the Project for Developing Countermeasures against Landslide in the Abay River Gorge" (hereinafter referred to as "the Project") in accordance with the relevant laws and regulations in force in Japan. Accordingly, JICA will jointly undertake the Project with the authorities concerned of GOE.

On the part of GOE, Geological Survey of Ethiopia (hereinafter referred to as "GSE") shall act as the counterpart agency to the Japanese Project team (hereinafter referred to as "the Team") and as the coordinating body in relation to the other concerned organizations for the smooth implementation of the Project.

This document sets forth the Scope of Work of the Project.

II. OBJECTIVES OF THE PROJECT

The objectives of the Project are:

1. to figure out the mechanism for the landslide in Abay River Gorge
2. to transfer relevant skills and technologies to personnel concerned with the Project

III. STUDY AREA

The Project shall cover the Abay River Gorge shown in APPENDIX 1.

IV. SCOPE OF THE PROJECT

In order to achieve the objectives mentioned above, the Scope of Work for the Project shall cover the following items:

0. The project implementing system is established.
 - 0-1. To identify the personnel and equipment of GSE
 - 0-2. To establish the implementing system for GSE
 - 0-3. To set up monitoring equipment at identified sites
1. The situation of the landslide is identified.
 - 1-1. To conduct aerial photograph interpretation and develop topographic map for landslide
 - 1-2. To prioritize landslide sites at risk and develop hazard map
 - 1-3. To conduct hydrological investigation
 - 1-4. To develop database based on the analysis of hydrological investigation with GIS
2. The topography and geological condition of the landslide is identified.
 - 2-1. To conduct field survey for the topography and geological condition of the landslide
 - 2-2. To develop a implementation plan for landslide survey
 - 2-3. To conduct topographic survey by local on-the-spot surveying
 - 2-4. To conduct boring geological survey
 - 2-5. To conduct physicality and chemistry tests
 - 2-6. To conduct geophysical exploration
3. The landslide characteristics due to seasonal changes is identified.

- 3-1. To conduct the surface displacement observation
- 3-2. To investigate sliding surface
- 3-3. To monitor groundwater level
- 3-4. To conduct rainfall monitoring
- 3-5. To develop an early warning system

- 4. The landslide mechanism is figured out.
 - 4-1. To identify the coverage (lateral and vertical) of landslide and differentiate the blocks within it
 - 4-2. To figure out the natural causes of landslide
 - 4-3. To figure out the human causes of landslide
 - 4-4. To conduct landslide stability analysis
 - 4-5. To differentiate landslide blocks by degree of risks

- 5. The survey and analysis of disasters other than the landslide is conducted.
 - 5-1. To conduct survey and analysis of rock fall
 - 5-2. To conduct survey and analysis of debris flow

- 6. The technical skill for the survey and analysis for the landslide is developed.
 - 6-1. To develop a manual for landslide survey and analysis applicable for the case of the Project area and its surroundings
 - 6-2. To conduct on and off the training for landslide survey and analysis

V. SCHEDULE OF THE PROJECT

The Project is estimated twenty-one (21) months in accordance with the tentative schedule as attached in the APPENDIX 2. The schedule is tentative and subject to be modified when both parties agree upon any necessity of the modification that will arise in the course of the Project.

VI. PROJECT IMPLEMENTATION MECHANISM

- 1. Steering Committee
GSE will establish the Steering Committee to provide overall policy, and Technical Committee to provide technical advice for the Project and sort out technical problems, if any.

- 2. Collaboration between JICA Project Team and Counterpart Team of GSE
GSE will assign the counterpart personnel to work together with the Team on a daily basis.

- 3. Technical Committee
Technical Committee which consists of both GSE and the Team is to review the findings by the Project and provide comments for improvement of the Project from time to time. The comments and recommendations suggested by the Technical Committee shall be integrated into the Project.

VII. REPORTS

JICA shall prepare and submit the following reports in English to GSE.

- 1. Inception Report:
Thirty (30) copies, at the time of one month after commencement of the Project

- 2. Progress Report 1:
Thirty (30) copies will be submitted at the time of seven (7) months after the commencement of the Project.

- 3. Interim Report:

Thirty (30) copies, at the time of about ten (10) months after the commencement of the Project.

4. Progress Report 2 :

Thirty (30) copies, at the time of about fifteen (15) months after the commencement of the Project.

5. Draft Final Report:

Forty (40) copies, at the time of about nineteen (19) months after the commencement of the Project.
The GOE shall provide JICA with its written comments within one (1) month after the receipt of the Draft Final Report.

6. Final Report:

Fifty (50) copies, within one (1) month after the receipt of the written comments on the Draft Final Report.

VIII. UNDERTAKINGS OF JICA

For the implementation of the Project, JICA shall take the following measures;

1. to dispatch, as its own expense, the Team to Ethiopia and
2. to pursue technology transfer to the counterpart personnel in the course of the Project

IX. UNDERTAKINGS OF THE GOE

1. To facilitate the smooth conduct of the Project; the GOE shall take necessary measures:

- (1) To permit the members of the Team to enter, leave and sojourn in Ethiopia for the duration of their assignments therein and exempt them from foreign registration requirements and consular fees;
- (2) To exempt the members of the Team from taxes, duties and any other charges on equipment, machinery and other material brought into Ethiopia for the implementation of the Project;
- (3) To exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Project;
- (4) To provide necessary facilities to the Team for the remittance as well as utilization of the funds introduced into Ethiopia from Japan in connection with the implementation of the Study;

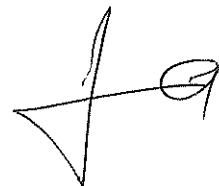
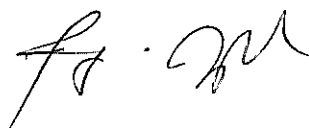
2. GOE shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Project, except when such claims arise from gross negligence or willful misconduct on the part of the Team.

3. GSE shall get approval for the aerial photography from related authority such as Ethiopian Mapping Agency and Military.

4. GSE shall act as a counterpart agency to the Team and also as a coordinating body with other relevant organizations for the smooth implementation of the Project, on behalf of the Ethiopian side.

5. GSE shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned:

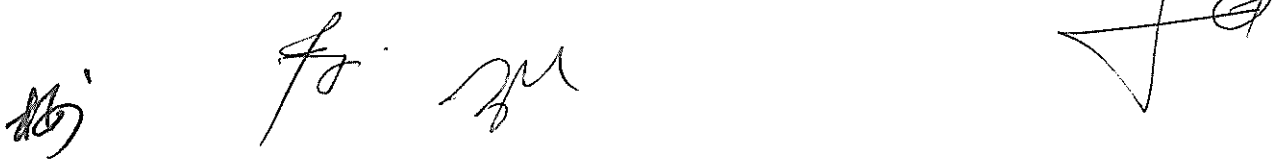
- (1) Security-related information on as well as measures to ensure the safety of the Team;
- (2) Information on as well as support in obtaining medical service;

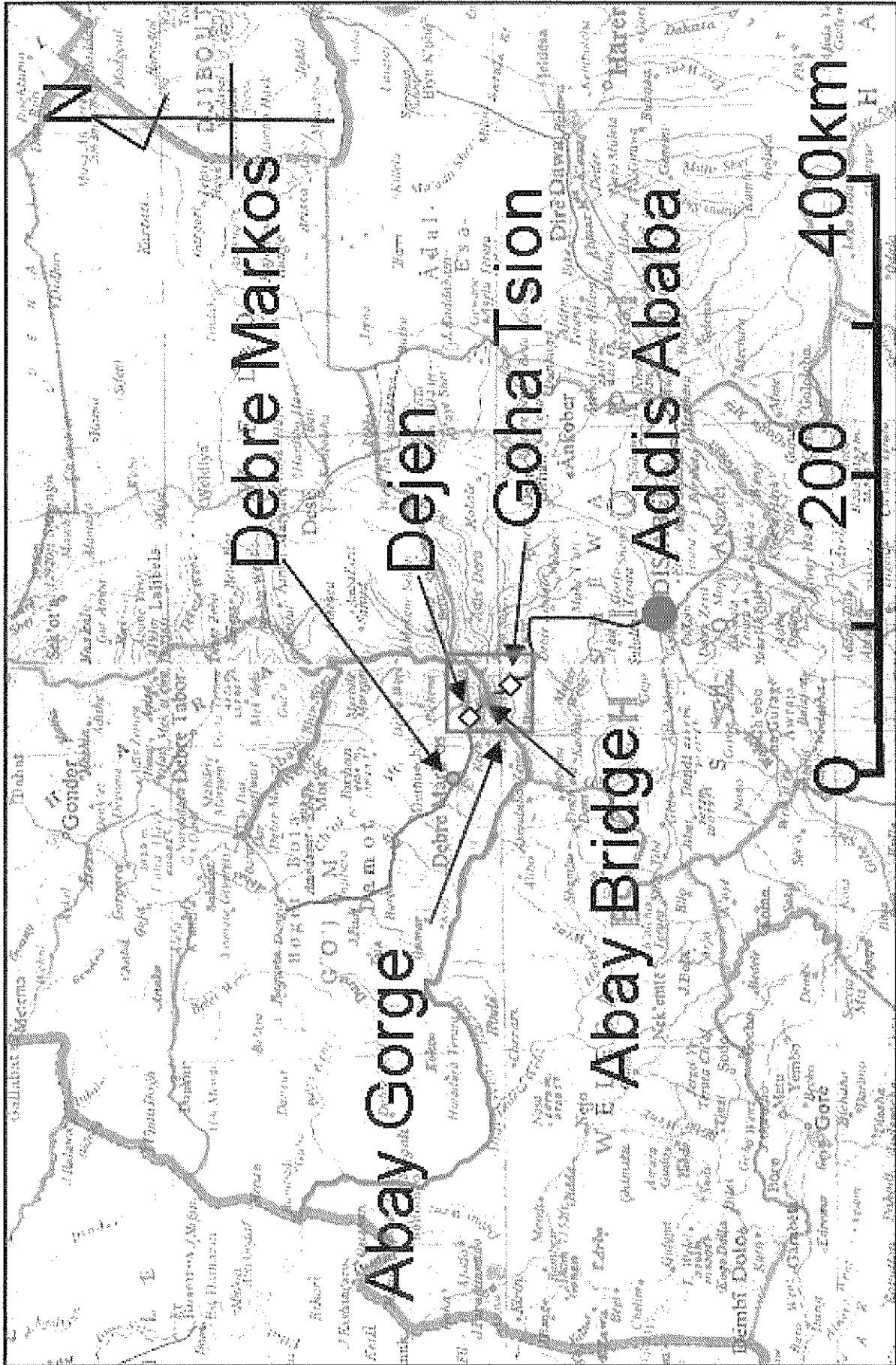


- (3) Available data (including maps and photographs) and information related to the Project;
- (4) Counterpart personnel;
- (5) Suitable office space with necessary equipment and facilities such as telephone line, internet, desks, etc. in Addis Ababa and Abay Gorge; and
- (6) Credentials or identification cards.

X. CONSULTATION

1. JICA and the GSE shall consult with each other in respect of any matter that may arise from or in connection with the Project.
2. The present document will become valid after authorization by JICA Headquarters and the GOE.

Four handwritten signatures in black ink are arranged horizontally. From left to right: the first is a stylized signature, the second is a signature starting with 'f', the third is a signature starting with 'm', and the fourth is a large, bold signature starting with 'f'.



(5)

F

M

T

物

TENTATIVE SCHEDULE

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Work in Ethiopia																						
Work in Japan																						
Reports	△						△			△					△				△			△
	IC/R						PR/R1			IT/R					PR/R2				DF/R			F/R

物

物

- IC/R: Inception Report
- PR/R: Progress Report
- IT/R: Interim Report
- DF/R: Draft Final Report
- F/R: Final Report

物

3. 協議議事録 (M/M)

MINUTES OF MEETING

ON

SCOPE OF WORK

FOR

THE PROJECT FOR DEVELOPING COUNTERMEASURES AGAINST
LANDSLIDE IN THE ABAY RIVER GORGE

IN

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

AGREED UPON BETWEEN

GEOLOGICAL SURVEY OF ETHIOPIA

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

ADDIS ABABA, December 16, 2009




Satoshi Umenaga
Leader of Detailed Planning Survey Team
Japan International Cooperation Agency
Japan



Tolesa Shagi
Director General

Tolesa Shagi
Director General
Geological Survey of Ethiopia
Federal Democratic Republic of Ethiopia

Witnessed by



Zaid Wolde Gabriel
Director General
Ethiopian Roads Authority
Federal Democratic Republic of Ethiopia

In Response to the official request of the Government of the Federal Democratic Republic of Ethiopia (hereinafter referred to as “GOE”), Japan International Cooperation Agency (hereinafter referred to as “JICA”) , in consultation with the Government of Japan, dispatched the detailed planning survey team headed by Mr. Satoshi Umenaga (hereinafter referred to as “the Team”) from 11th to 18th December, 2009 to discuss the scope of work for “the Project for Developing Countermeasures against Landslide in the Abay River Gorge” (hereinafter referred to as “the Project”).

During the stay in Ethiopia, a series of discussions were held with Geological Survey of Ethiopia (hereinafter referred to as “GSE”) and other organizations related to the Project. The list of participants of the meetings is shown in Annex 1.

This document summarizes major items discussed between both sides and is intended to supplement the Scope of Work for smooth implementation of the Project.

1. Project Title

Both sides agreed that the title of the Project is “The Project for Developing Countermeasures against Landslide in the Abay River Gorge”.

2. Basic Stance of the Project

2-1 Both sides agreed that the duration of the Project shall include at least two rainy reasons (between June and September) to enhance the quality of the analysis and transfer the techniques.

2-2 In order to achieve the project objective which is to figure out the mechanism of the landslide in Abay River Gorge as early as possible, both sides agreed that the six (6) monitoring sites are the preferential monitoring project sites for the Project, which were selected as the highest-priority by “the Preparatory Survey for The Project on Countermeasure Works for Landslide in Abay Gorge” dispatched from 4th June to 22nd October, 2009. These monitoring sites are at the stations of 0+700~0+800, 0+800~1+100, 4+800~5+200, 5+200~5+500, 20+400~20+600 and 21+850~22+100. Although there are at least other eight (8) sites to be pointed out as a second priority, their study during the Project’s life will be decided by the Steering Committee taking into consideration the work progress of first selected six preferential sites and the conditions in Abay Gorge.

3. Cooperation among the related authority

3-1 The expected output of the Project is to reveal the mechanism of the landslide in Abay River Gorge, and the substantive countermeasure works for road disaster shall not contain in the Project. The output must be utilized by Ethiopian Roads Authority (hereinafter referred to as “ERA”), which is the responsible agency of maintenance of the road in Ethiopia, for the countermeasures against the road disaster. Therefore, the mutual cooperation between GSE and ERA is requested.

3-2 Since the aerial photography is essential for the Project, GSE shall arrange the approval from related authority before the commencement of the Project.

4. Steering Committee

Both sides agreed that a Steering Committee (hereinafter referred to as “the Committee”) will be set up for effective and efficient implementation of the Project under the chair of GSE. The Committee will decide on important matters to promote the output of the Project. The Committee will comprise representatives from the following related organizations.

- (1) Geological Survey of Ethiopia
- (2) Ethiopian Roads Authority
- (3) JICA Project Team
- (4) JICA Ethiopia Office

GSE shall inform JICA Ethiopia Office of the members of the Committee before the commencement of the Project.

5. Transfer of Technology

5-1 The Project team will make an effort to transfer skills and technology through on and off the training. GSE is the main authority for this transfer, however the staff from ERA will be also included as an entity for the technical transfer.

5-2 With regard to the counterpart training in Japan for technology transfer, the Team will convey it to JICA headquarters. After approval of the request, the number, field and duration of the training shall be discussed after the commencement of the Project.

6. Counterpart and Project team

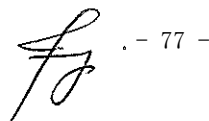
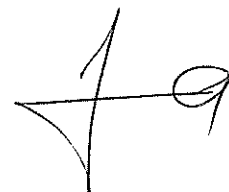
Both sides agreed that the Project should be conducted in close collaboration between the Ethiopian side and the Japanese side. In this context, GSE will establish the project team, which is a main implementation body of the Project along with the Project team, by the commencement of the Project. The leader of the Project team will be the focal point of the Ethiopian side.

7. Equipment for the Project

7-1 Both sides agreed that all equipment owned by GSE is available for the Project.

7-2 Both sides agreed that equipment for the Project is listed as follows.

- Automatic Waterlevel Recorder (25 units)
- Rain Gauge (2 units)
- Extensometer (10 units)



- Borehole Extensometer (20 units)
- Groundwater Resistivity Logging Equipment (1 unit)
- Engineering Seismograph (2 units)
- Software for Seismograph (1 unit)
- Pickup Truck (2)
- Slope Stability Analysis Software

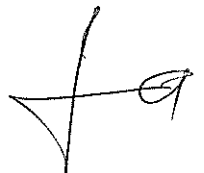
7-3 Equipment required for the Project, including Physical Laboratory Equipment and others than listed in 7-2 will be identified at the Technical Committee and be requested to JICA by the Ethiopian side.

8. Others

8-1 The Ethiopian side requested that the satellite image of high resolution would be required for the Project. The necessity and the level of the resolution would be discussed in the course of the Project.

8-2 The Ethiopian side requested that the trip allowance for the field survey would not be possible to provide from their own budget because of the budgetary constraint. The Team recognized the request and would convey it to the JICA headquarters. Also, the Team mentioned that this matter would be dealt with under the JICA regulation.

8-3 The Team notified that they would estimate to start discussion of the Inception Report in April or May, 2010, subject to JICA's internal procedures.



The List of Participants in the Meeting

ETHIOPIAN SIDE

Geological Survey of Ethiopia

Mr. Tolesa Shagi, Director General
Dr. Getnet Mewa, Head, Geo-hazards Investigation Core Process
Mr. Tadesse Dessie, Engineering Geologist

Ethiopian Roads Authority

Mr. Zaid Wolde Gabriel, Director General
Mr. Haddis Tesfaye, Road Network Management Division Manager

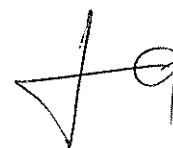
JAPANESE SIDE

The Detailed Planning Survey team, JICA

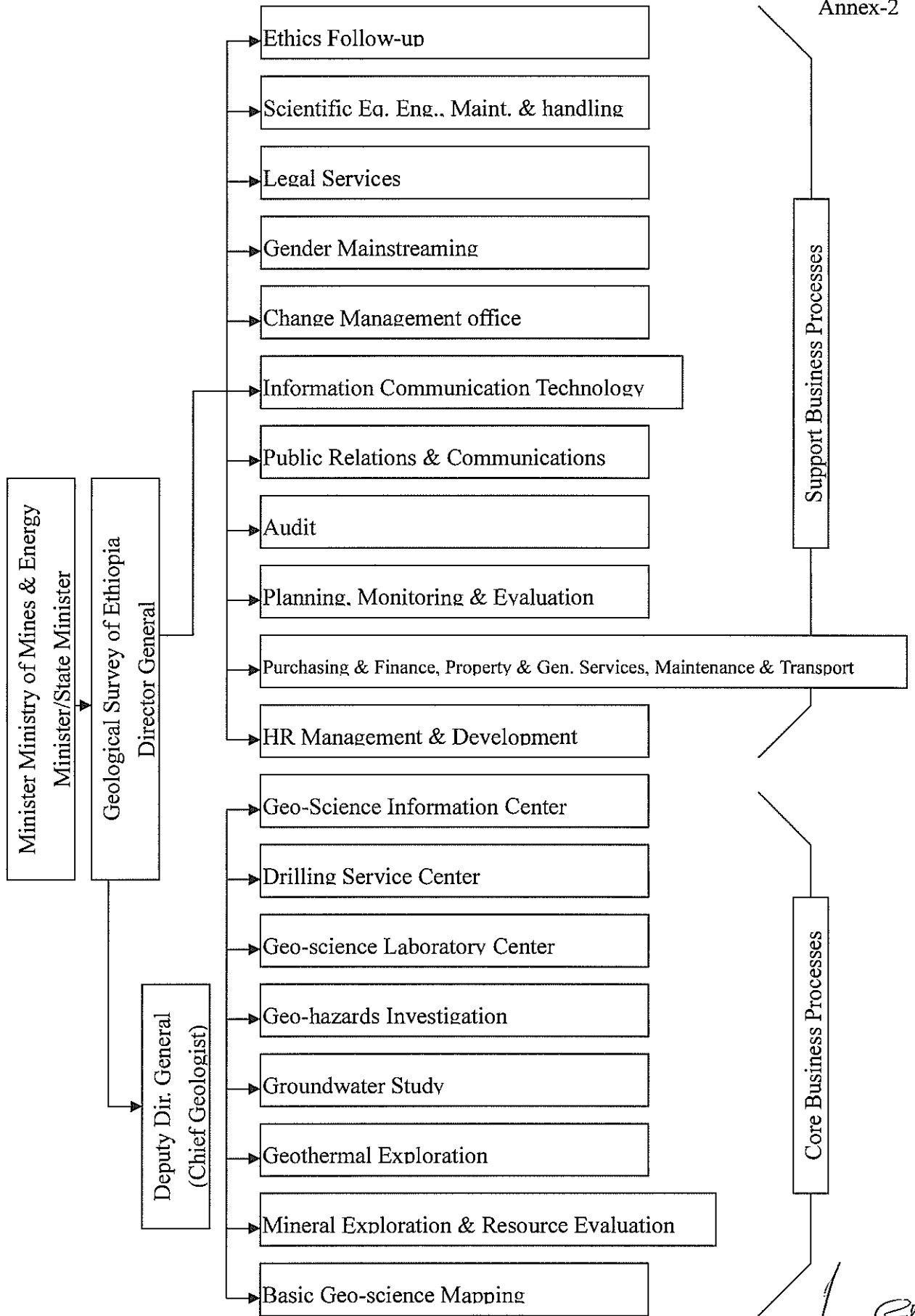
Mr. Satoshi Umenaga, Leader
Mr. Hiroyuki Yokoi, Project Coordinator

JICA Ethiopia Office

Ms. Momoko Suzuki, Representative



Organizations Chart of Geological Survey of Ethiopia



Annex-2

[Handwritten mark]

[Handwritten signature]

[Handwritten signature]

4. 面談記録

面談記録

日時	2009年12月7日(月) 14:05-15:50
場所	ERA
面談相手	Mr. Gleso Borie (D/Deputy Director General, Human Resources & Finance, ERA) Mr. Haddis Tespaye (Road Network Management Division Manager, ERA) Mr. Girma Worku (Bridge Management, ERA) Mr. Demelash Glmavism (Alemgena DED Manager, ERA) Mr. Nebyou Endale (Alemgena DRMC Manager, ERA) Mr. Daniel Nebro (Design and Technical Support Bureau, ERA)
面談者	調査団 (梅永団長、横井) JICA エチオピア事務所 晋川次長、鈴木所員 在エチオピア日本国大使館 舛田書記官

概要

- プロジェクトの成果として地すべりメカニズムの解明が主たるものであるが、その後の対策工の計画・実施は ERA が実施すべきものである。プロジェクトのカウンターパートは GSE であるものの、ERA からの協力も極めて重要である。Steering Committee を作る予定であるため、その中に ERA から参加するようお願いしたい。(調査団) ⇒ 了解した。(ERA)

面談記録

日時	2009年12月9日(水) 14:15-15:00
場所	JICA エチオピア事務所
面談相手	晋川次長、鈴木所員
面談者	梅永団長、横井

概要

<ul style="list-style-type: none"> ・ MME は、他省庁等からの業務受注により地質調査を行うことが多く、独自の計画により地質調査を行うような予算はないものと考えたほうがよい。(晋川次長) ・ スペアパーツ等の消耗品などについてはプロジェクト経費に含めることは可能かと考えられるが、人件費についてはプロジェクト経費に含めるのは困難であるという認識。(梅永団長) ・ MME の職員の人件費を支払うのは実施機関の通常経費を JICA がカバーすることになるため、不可能である。ただし、日雇い労働者等契約ベースの人件費についてはプロジェクト経費としてカバーすることは可能。ただし、先方との協議時には、なるべく先方負担事項として整理されるよう協議し、協議が割れた場合に、MME の人件費以外をプロジェクトでカバーするということが妥協点と考える。(晋川次長) ・ 地すべりについては、ERA は地質調査を MME に発注し、MME が調査を行い、調査の結果に基づき、ERA が対策工を行うというのが全体のフローである。今回の MME へのプロジェクトの中で、ERA の発注者側としての能力を高めるようなキャパシティ・ビルディングが必要。(晋川次長) ・ 現在の計画では 2010 年の 4 月ころに現地調査入りし、2 ヶ月間観測機器等の設置を行い、1 回目の雨季を経て、2010 年 9 月以降の乾季でさらに詳細な調査を行い、2 回目の雨季を迎える。1 回目の雨季では観測機器の設置を早急に行う必要があることから、ERA の発注を待ってプロジェクトを開始させることは困難であるが、2 回目の雨季には十分時間があることから、この点を検討したい。(梅永団長) ・ ERA を効果的に巻き込むには、以下の役職・部局を巻き込む必要がある。 <ul style="list-style-type: none"> ✓ Engineer & Regulatory Department, Deputy Director General ✓ Network Management Division ✓ Design & Technical Support Branch, Eng. Serv. Proc., Des. & Tech. Sup. Division ✓ District Engineering Division
--

面談記録

日時	2009年12月11日(金) 10:45-12:30
場所	Geological Survey of Ethiopia (GSE)
面談相手	Mr. Tolesa Shagi (Director General, GSE) Dr. Getnet Mewa (Deputy Head, Geo-hazards Investigation Core Process, GSE) Mr. Tadesse Dessie (Engineering Geologist, GSE)
面談者	梅永団長、鈴木所員、横井

概要

<ul style="list-style-type: none"> ・ 冒頭梅永団長よりプロジェクトの概要を説明。 ・ 今回プロジェクトを具現化すると聞き非常にありがたく思う。エチオピアにはアバイ渓谷の他にも地質的に調査を行わなければいけないところが多くあり、今回のプロジェクトでアバイ渓谷をモデルサイトとし、GSE の能力を高め、プロジェクト終了後には、独力で調査を展開していけるようにしたい。(Mr. Tolesa) ・ 空中写真判読が今回のプロジェクトの開始段階で極めて重要になるが、空中写真を撮ることのできる業者の存在や国防省等との許可などが必要か？(梅永団長)⇒業者については2つ程度あるように認識している。今回のプロジェクトはエチオピア政府として実施することとしており、手続き的な障害はないとの認識であるが、Mapping Authority 等に通常必要な手続きと業者の有無を確認する。(GSE) ・ Geo-hazards Investigation Core Process が本プロジェクトのカウンターパートと認識しているが、組織上どこに位置づけられているのか？(梅永団長)⇒Geo-hazards Investigation と Geo-hazards Investigation Core Process は同じと理解していただいてよい。よって、組織表では Geo-hazards Investigation のことである。(GSE) ・ Geo-hazards Investigation には公式では33名(うち30名がエンジニア)が配置されることになっているが、現状は16名である。うち12名がエンジニアである。(GSE)⇒現状のスタッフの役職、経歴、また Geo-hazards Investigation の組織上の TOR につき情報を提供してほしい。(調査団)⇒調査団帰国前までに提供する。(GSE) ・ 本プロジェクトにおいて GSE で所有しているボーリング機等を活用することは可能か？その際、機材にかかる費用(燃料、維持費他)、またカウンターパートの現地への国内出張旅費等もエチオピア側で負担することは可能か？(梅永団長)⇒GSE 職員の給料については当然 GSE で支払うものの、オペレーションコストについては極めて難しく、日本側に負担をお願いしたい。エチオピアの会計年度は7月から開始されることから、少なくとも年度途中にあたるプロジェクト開始当初(2010年4月)に予算(Matching Fund)を計上することはすでに不可能である。また現時点では財務省に予算確保のための明確な業務を提示することはできないことから、この点からも困難である。(GSE)⇒状況は了解した。別途検討したい。(梅永団長) ・ GSE は通常の業務として、クライアント(ERA 等)から依頼されて調査を行うとのことだが、調査計画は GSE が行っているのか？(調査団)⇒通常、クライアントは調査の大雑把な内容を GSE に提示するのみであり、調査計画は GSE が立案し、調査を実施することとなる。クライアントからの依頼なしに、GSE が独自に調査を実施することもある。(GSE)⇒年間の業務内容に関する情報提供をお願いする。(調査団) ・ 先方負担事項に関し、免税措置をお願いしたい。特に機材は雨季前にタイミングよく投入する必要があるため、円滑な通関が必要である。(梅永団長)⇒了解した。MOFED と協議したい。(GSE) ・ プロジェクト開始前までに電話線、インターネット、机、椅子、コピー機を備えた執務室をアジスアベバに用意してほしい。(梅永団長)⇒了解した。インターネットやコピー機についてはできる範囲で用意したい。すでに場所は用意してある。(GSE)(なお、執務室スペースを実際に確認したところ、GSE の施設内の約 40 m²弱の執務室があることを確認した) ・ アバイ渓谷周辺にプロジェクトオフィスを構えることは可能か？(梅永団長)⇒GSE では困難である。通常他の調査ではキャンプを行っており、それでよいのであれば可能である。(GSE)⇒ERA 等と調整して確保が可能であれば GSE に知らせたい。(調査団) ・ ボーリング機関係の機材について情報を入手しているが、今回の機材との関係性はどうか。(GSE)⇒非常に専門的な部分であり、専門家によってもやり方が異なることから、プロジェクト開始後に詳細を検討し、追加投入する形としたい。現状提示している機材は特に初期段階で必要になるモニタリング機を中心に選んでいる。(調査団)⇒了解した。(GSE) ・ プロジェクトにおいて Steering Committee (S/C) と Technical Committee (T/C) を設置する。S/C では GSE が議長を務め、ERA からも総裁や副総裁レベルの人員も含めて構成し、その他にプロジェクトチーム、JICA エチオピア事務所により構成してほしい。T/C については GSE サイドとプロジェクトチームで技術的な内容を議論する機関である。(梅永団長)⇒了解した。(GSE)
--

面談記録

日時	2009年12月15日(火) 09:00-12:00
場所	GSE
面談相手	Mr. Tolesa Shagi (Director General, GSE) Dr. Getnet Mewa (Deputy Head, Geo-hazards Investigation Core Process, GSE) Mr. Haddis Tesfaye (Road Network Management Division Manager, ERA)
面談者	梅永団長、鈴木所員、横井

概要

- ・ プロジェクト概要に基づき、主要な以下の点に関し確認・修正を行い、SW 及び MM の内容に合意した。
- ✓ 活動項目 0 の実施体制の確立に関し以下の修正を行った。
 - 【変更前】
 - 0-3.モニタリングサイトを設定する
 - 0-4.観測資機材設置ポイントを設定する
 - 【変更後】
 - 0-3.認識されたサイトでモニタリング機器を設置する (To set up monitoring equipment at identified sites)
- ✓ 活動項目 5 の地すべり以外の災害 (土石流・落石) の調査・分析の実施についても、GSE がこの業務の所掌範囲として担っていることを確認した。
- ✓ プロジェクトの基本方針に関し、6 つの優先的なサイト以外のサイトについても、活動の進捗とサイト状況に応じ、モニタリングサイトの設定をステアリングコミティーで決定することを確認した。
- ✓ GSE 側でプロジェクトチームを設置し、プロジェクトチームのリーダーはプロジェクトにおけるエチオピア側の調整窓口であることを確認した。
- ✓ 機材に関し以下の点を確認・合意した。
 - GSE 所有の機材で利用可能なものは本プロジェクトでも活用できることを確認した。
 - 本プロジェクトで供与する機材は次のものであることを確認した。
 - 自記水位計 (25 ユニット)
 - 雨量計 (2 ユニット)
 - 地表伸縮計 (10 ユニット)
 - 孔内伸縮計
 - 地下水検層機材 (1 ユニット)
 - サイスマグラフィ (2 ユニット)
 - サイスマグラフィソフトウェア (1 ユニット)
 - ピックアップトラック (2 台)
 - 安定解析ソフト
 - 上記に含まれていない機材 (実験室用機材を含む) の必要性についてはテクニカルコミティーで判断し、エチオピア側から JICA に対し要請することに双方合意した。
- ✓ エチオピア側は高解像度の衛星画像が本プロジェクトにおいて必要であると要請した。衛星画像の必要性と解像度の程度は本格プロジェクトの中で検討することを確認した。
- ✓ エチオピア側は現地調査に必要な出張旅費は、予算措置が困難であることから独自で支出できず、日本側に支出を願いたい旨要請した。調査団はその要請を確認し、JICA 本部において JICA の規程に基づき検討することを説明した。
- ・ なお、現在 GSE に対して、活動を行っている他ドナー等は存在していないことを確認した。GSE に対するこれまでの他ドナーによる協力は以下表のとおりである。

プロジェクト名	実施機関	実施年
Training Project for Mineral Exploration and Geological Mapping	UNDP	1985-1989
Airborne Geophysical Project Western Ethiopia	NORAD	1996
The Ethionor Mineral Resource Program	NORAD	1996-2001
Water Resources Management and Environmental Protection studies of the Temma Basin	The Czech Republic	2006-2009

5. 事業事前評価表

事業事前評価表（開発計画調査型技術協力）

作成日：平成21年1月5日

担当部署：経済基盤開発部

1. 案件名
<p>国名：エチオピア連邦民主国 案件名：アバイ渓谷地すべり対策調査プロジェクト Project for Developing Countermeasures against Landslide in the Abay River Gorge</p>
2. 協力概要
<p>(1) 事業の目的 国道3号線沿いのアバイ渓谷（ゴハチオンーデジェン間）における地すべり発生メカニズムが解明され、先方協力機関に地すべり調査・解析の業務の技術移転を行う。</p> <p>(2) 調査期間 2010年4月～2011年12月（計21ヶ月）</p> <p>(3) 総調査費用 3.0 億円</p> <p>(4) 協力相手先機関 主管官庁：鉱山・エネルギー省（Ministry of Mines and Energy） 実施機関：エチオピア地質調査研究所（Geological Survey of Ethiopia）</p> <p>(5) 計画の対象（対象分野、対象規模等） 1) 対象分野：公共・公益事業（河川・砂防） 2) 対象地域：エチオピア国 国道3号線 ゴハチオンーデジェン間 40.45 キロの地すべり地帯 3) 技術移転の対象：エチオピア地質調査研究所、エチオピア道路公社</p>
3. 協力の必要性・位置付け
<p>(1) 現状及び問題点 エチオピア連邦民主共和国（以下、「エ」国）の道路分野の課題には舗装道路比率の低さ（国土面積110万km²に対して舗装道路延長は42,429km）と道路状態の悪さ（道路総延長の51%がコンディション不良）がある。この10年間、「エ」国はドナーの協力を得つつ、幹線道路の改修、州道路の建設、リング道路の建設等を実施してきたが、道路密度の向上には幹線道路の整備を進めつつも、さらに農村道路の拡大を行っていく必要がある。</p> <p>主要幹線道路の一つである国道3号線は、首都アディスアベバとスーダンを結ぶアフリカ縦断回廊の一部であり、かつ、「エ」国の食糧生産量の約40%を占め、穀倉地であるアムハラ州を縦断する重要な路線である。加えて、産油国スーダンから「エ」国へ輸入される原油燃料の約8割は、同路線を通じて重量車輛により首都アディスアベバへ陸送されていることから「エ」国の生活・経済にとって不可欠な路線である。</p> <p>国道3号線上のアバイ渓谷を通過する区間は、40kmの道路延長の間に約1500m標高差のある険しい渓谷であり、同区間では雨季（6月から9月）に地すべりが繰り返し発生している。地すべり幅2kmに及ぶ大規模なものもあり、道路機能そのものを脅かしている。JICA専門家の指導や「エ」国見返り資金を利用し、地すべり発生時の対策や予防策を行ってきたものの、根本的な解決のためには、当該区間の地すべり発生要因を解明した上で、適切な地すべり対策工を行う必要がある、地すべりメカニズムの解明の必要性は高いと考えられる。</p> <p>一方、「エ」国では各地で地すべりの現象が見られるにもかかわらず、これまで同国政府内に地すべりの現象調査等を担当する部門がなかったが、2009年4月に鉱山・エネルギー省内の地質調査研究所（Geological Survey of Ethiopia：以下、GSE）内に、ジオハザード調査業務プロセ</p>

ス (Geo-hazards Investigation Business Process) としてジオハザード調査部 (Geo-hazards Investigation) という専門部門が設けられた。しかしながら、新設して間もないため、同省より地質調査、地図作成等から地すべりの原因、メカニズムを究明し、地すべり対策工に役立てることを意図し、これらの技術及び人材育成を目的とした要請が我が国政府に対してなされた。

(2) 相手国政府国家政策上の位置づけ

「エ」国では 2005 年から 2009 年の 5 年間の計画としてジオハザード調査コアプロセス (Geohazards Investigation Core Process ; 以下 GHICP) として、地すべり、斜面崩壊、地盤沈下、地質環境、火山及び地震リスク等につき調査を行ってきた。現在「エ」国では GHICP の第 2 フェーズ (2010 年～2015 年) を策定中であり、これによれば各種地質調査図の策定、地質調査能力の向上、政府実施プロジェクトに対する地質技術及び地質環境に関する助言、国家ジオハザードデータベースの構築等が計画されている。これらの計画に基づき、第 2 フェーズが終わる 2015 年までにジオハザード地図の策定範囲を現在の 8% から 16% に向上させることが目標とされている。

本プロジェクトでは、ジオハザード地図の作成に加え、調査・解析技術の向上も目的とされていることから、上記の GHICP を補完するものとして位置づけられる。

(3) 他国機関の関連事業との整合性

他国機関で地すべり対策に特化したプロジェクトを展開している機関はない。しかし、他国機関が実施する道路改修区間でも地すべり等の地質的問題が発生しており、本プロジェクトで技術移転される技術を用い、これらへの対策を行うことにより、他国機関の道路整備等のプロジェクトに対する貢献が期待される。

(4) 我が国援助政策との関連、JICA 国別事業実施計画上の位置づけ

我が国の対エチオピア国別援助計画 (2008 年 7 月承認) と JICA 国別事業実施計画 (2008 年 10 月改訂) ではともに、貧困削減・人間の安全保障 (特に食糧安全保障) の観点から、農産物および農業投入財の流通の円滑化を目的とした社会経済インフラの確立を重点分野としているおり、本案件もこれに整合するものである。

4. 協力の枠組み

(1) 調査項目

0. 調査実施体制を整備する

- 0-1 GSE の人員・資機材の状況を把握する
- 0-2 GSE の調査実施体制 (人員配置、予算確保、活用機材の配置等) を整備する
- 0-3 地すべり発生サイト (6 サイトを想定) にモニタリング機器を設置する

1. 地すべり状況を把握する

- 1-1 空中写真撮影 (約 200km²) 及び判読による地形解析を行い、地すべり地形分布図を作成する
- 1-2 危険箇所の優先順位付けを行い、ハザードマップを作成する
- 1-3 水文調査を行う
- 1-4 解析結果を GIS を利用してデータベース化する

2. 地すべりの地形・地質状況を把握する

- 2-1 地形・地質踏査を行う
- 2-2 地すべり調査の計画立案を行う
- 2-3 現地測量による地形調査 (平面測量 300m²～700m²程度、横断測量約 10 断面程度) を行う
- 2-4 ボーリング地質調査を行う (約 10 測線、30 本程度)

- 2-5 ボーリングコアの物性・化学試験を行う
- 2-6 物理探査を行う

- 3. 地すべりの季節的変化の特徴を把握する
 - 3-1 地表の移動量観測を行う
 - 3-2 すべり面調査を行う
 - 3-3 地下水位のモニタリングを行う
 - 3-4 雨量モニタリングを行う
 - 3-5 早期警戒体制の立案を行う

- 4. 地すべりのメカニズムを解明する
 - 4-1 地すべりの範囲（水平・垂直）とその中のブロック区分を行う
 - 4-2 地すべりの素因を究明する
 - 4-3 地すべりの発生誘因を究明する
 - 4-4 地すべり斜面の安定解析を行う
 - 4-5 地すべりブロックを危険度により区分する

- 5. 地すべり以外の災害調査・解析を行う
 - 5-1 落石調査・解析を行う
 - 5-2 土石流調査・解析を行う

- 6. 地すべり調査・解析業務を相手国関係機関に定着させる
 - 6-1 プロジェクトサイト及び周辺地域に適用可能な地すべり調査・解析に係わるマニュアルを作成する
 - 6-2 地すべり調査・解析に係わる業務の OJT と研修を行う

- (2) アウトプット（成果）
 - 1) 調査結果：以下の内容に基づきアバイ渓谷における地すべりメカニズムが解明される。
 - ア. 地すべり地形分布図、ハザードマップ、データベース
 - イ. 柱状図、地質断面図
 - ウ. 各種グラフ(地表・地下移動量、地下水位、すべり面深度推定、雨量-地下水位相関)、警戒体制クライテリア
 - エ. 地すべりブロック区分図
 - 2) 技術移転：エチオピア地質調査研究所に対する地すべり調査・解析技術

- (3) インプット（投入）：以下の投入による調査の実施
 - (a) コンサルタント（各分野1名）
 - 業務主任
 - 地形解析（1）/ハザードマップ作成
 - 地形解析（2）
 - GIS/データベース作成
 - 地質調査/解析（1）
 - 地質調査/解析（2）
 - 水文調査/解析
 - 物理探査/解析
 - 地すべりモニタリング/警戒態勢
 - 地すべり安定解析

<ul style="list-style-type: none"> ● 地すべり総合解析 ● ボーリング技術 ● 落石・土石流調査/解析 <p>(b) 供与機材 地すべり調査/解析に係る機材/ソフトウェア</p> <p>(c) その他 研修員受け入れ、現地でのワークショップ/セミナーの実施</p>
<p>5. 協力終了後に達成が期待される目標</p> <p>(1) 提案計画の活用目標</p> <ul style="list-style-type: none"> ・アバイ渓谷の地すべり調査結果を用い、地すべり対策工の実施機関であるエチオピア道路公社により地すべり対策工が実施される。 ・「エ」国の需要にそった地すべり調査・解析が他地域で実施される。 <p>(2) 活用による達成目標</p> <ul style="list-style-type: none"> ・「エ」国における地すべり災害に伴う交通遮断が緩和され、円滑な交通網が確保される。
<p>6. 外部要因</p> <p>(1) 協力相手国内の事情</p> <ol style="list-style-type: none"> 1) 行政的要因：エチオピア地質調査研究所の職員の異動・退職等 2) 物理的要因：調査工程に影響を与えるほどの地すべりの発生、活用予定機材の故障等 <p>(2) 関連プロジェクトの遅れ 特になし</p>
<p>7. 貧困・ジェンダー・環境等への配慮（注）</p> <p>特になし</p>
<p>8. 過去の類似案件からの教訓の活用（注）</p> <p>特になし</p>
<p>9. 今後の評価計画</p> <p>(1) 事後評価に用いる指標</p> <p>(a) 活用の進捗度 エチオピア政府が本調査により技術移転された地すべり調査・解析方法を用い、地すべり対策をどの程度実施したか。</p> <p>(b) 活用による達成目標の指標</p> <ul style="list-style-type: none"> ・地すべりハザードマップの作成数 ・地質調査図の作成数 ・地すべり調査・解析実施数 <p>(2) 上記（a）および（b）を評価する方法および時期</p> <ul style="list-style-type: none"> ・フォローアップ調査によるモニタリング ・必要に応じ、調査終了後5年目以降に事後評価を実施

（注）調査にあたっての配慮事項