JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
ETHIOPIAN WATER TECHNOLOGY CENTER (EWTEC),
MINISTRY OF WATER RESOURCES (WoWR)

TECHNICAL COOPERATION PROJECT
ON
GROUNDWATER DEVELOPMENT
AND
WATER SUPPLY TRAINING PLAN PHASE 2
(REMOTE SENSING)
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

WORK COMPLETION REPORT

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KOKUSAI KOGYO CO., LTD.

WORK COMPLETION REPORT
CONTENTS

1. Outline of the work

1.1 Background

The rate of access to safe water in Ethiopia is extremely low at 24% compared to the average rate of 57% among Sub-Saharan African countries (UNDP: 2000). Many residents in rural areas have to spend a lot of time and energy to secure water for their daily lives, and this low water supply coverage is part of the reason why people are suffering from poverty. In 1994, the Government of Ethiopia established the Ministry of Water Resources and planned training for engineers and dissemination staff engaged in groundwater development and water supply activities covering planning and investigation, well construction, operation and maintenance of wells and equipment, and guidance on water supply management at the community level. In response to a request for assistance by the Government of Ethiopia, the Government of Japan implemented the "Groundwater Development and Water Supply Training Project (hereinafter referred to as "Phase 1")" for a period of seven years since January 1998.

Phase 1 included the establishment of the Addis Ababa Training Center, the development of three core training courses focusing on well construction techniques, trial implementation of core and ad-hoc courses, and practical training in the rural area. The staff from the regional governments currently participate in the core training courses carried out on a regularly basis, and the training center is recognized as playing a central role in capacity building concerning water resources development in Ethiopia.

Financial assistance and facility development to improve access to safe water is being implemented through the World Bank, UNICEF, NGOs, etc. However, due a lack of capacity to operate and maintain the wells and water supply facilities, there have been difficulties in improving water coverage.

Meanwhile, based on the decentralization policy implemented since 1994, responsibility for rural water supply management is being transferred to the regional government, and the need to develop the capacities of staff from the regional government has drastically increased. Issues concerning capacity building in this field are as follows:

(1) The demand for basic training of staff from district offices, which are responsible for water supply operations, has increased.
(2) Capacity building of the planning department for water resources development in both the

central and regional governments in the field of program formulation and technical analysis has become important.

(3) There is a demand for a variety of training not only in well drilling techniques but also in techniques for the operation and maintenance of wells, strengthening organizational control, etc.

In Phase 2 of the project, the role of the Addis Ababa Training Center established in Phase 1 is to be expanded to a Water Technology Center (WTC) with an added Research Section.

1.2 Objectives

Based on the background of the study mentioned above, the main objectives of the work of the short term expert were as follows:

(1) To launch a training course for practical training in remote sensing for groundwater management as part of the advanced course established in Phase 2. Specifically, a training curriculum and teaching materials for administrators in the planning section were prepared and a 4-week training course was implemented with the counterpart (C/P), the Ministry of Water Resources, in order to establish the foundation of this training course.

(2) To give advice on the work of the local consultant concerning the research in the Butajira – Ziway area during implementation of the project, based on the expertise of hydrogeologists.

1.3 Content of Implemented Work

The works conducted in Ethiopia were as follows:

- The work implementation plan was submitted to the C/P agency (Ministry of Water Resources), and explained the plan (draft) for activities and training guidance.
- Remote sensing training course was conducted The expert gave lectures on techniques for applying remote sensing to groundwater development and carried out technology transfer to the C/P agency through the training course.
- An evaluation of the training was executed with the C/P agency and revised the training curriculum and materials based on the feedback.
- The expert gave out comments as a hydrogeologist to the local consultant, participants and C/Ps through the field survey.

2. Implemented Training Course

2.1 Title

The First Training Course on Remote Sensing for Groundwater Management

2.2 Duration

The training course was conducted from January 25, 2006 to February 21, 2006.

2.3 Participants

There were twenty (20) from regional as well as agencies in Ethiopia, and participants were required to have the following qualifications:

- B. Sc. Degree in geology, hydrogeology or civil engineering
- Seven (7) years working experience in relevant field of groundwater management
- Knowledge of personal computer operation

2.4 Lecturer

The following lecturer was dispatched as the JICA short-term expert.

- Mr. Kazutoshi Masuda (Remote Sensing and GIS Specialist)

2.5 Materials

The following materials were prepared and used for the training:

(1) Hardware

- Desktop Personal Computer with 14 inches color monitor
- Color Plotter (up to A1 size)
- LCD Projector
- Whiteboard with markers
- Whiteboard marker

(2) Software

- TNTlite Ver.7.1

- ArcView 3.2 with its extensions
- Adobe Photoshop 6.0
- ASTER Data Opener
- Operation manual on TNTlite, ArcView 3.2, Photoshop 6.0 and ASTER Data Opener
- REMOTE SENSING NOTE, issued by Japan Association on Remote Sensing
- JICA-NET : CDs of Remote Sensing Course – Distance Education
- Satellite imagery data (LANDSAT, ASTER, SAR)

2.6 Curriculum

The curriculum covered basics and applications of remote sensing. In addition, practical training was conducted using state-of-the-art software. This remote sensing training course consisted of the following modules:

(1) Module 1 : Basics of Remote Sensing

- Fundamentals of remote sensing
- Remote sensors
- Platforms for remote sensing
- Data to be used in remote sensing

(2) Module 2 : Image Processing Systems

- Procedures of image processing
- Image processing systems
- Image input devices
- Image display systems
- Image processing software
- Image output systems
- Storage devices of image data

(3) Module 3 : Remote Sensing Applications

- Land cover / Land use
- Urban change
- Forestry
- Fishery
- Environment

- Disaster
- Topographic map

(4) Module 4 : Image Interpretation

- Concept of image interpretation
- Procedures of interpretation
- Interpretation elements
- Interpretation keys
- Applications of image interpretation

(5) Module 5 : Image Processing

- Image enhancement
- Geometric correction
- Image classification

(6) Module 6 : Data Storage in GIS

- Data types can be used in GIS
- Creation of GIS data
- Data conversion (Vector to Raster)

(7) Module 7 : Landform Analysis using Digital Elevation Model (DEM)

- Creation of DEM from contour lines and spot height data
- Creation of surface modeling data
- Creation of DEM, slope and aspect data

(8) Module 8 : Spatial Analysis with RS and GIS Data

- Query analysis
- Buffer analysis
- Reclassification analysis
- Overlay analysis
- Evaluation analysis

(9) Module 9 : Applications in Groundwater Management

- Merging of technologies (RS, GIS, GPS)
- Spatial analysis using various data
- Applications in groundwater development and management

2.7 Training Schedule

The duration of the remote sensing training course was from January 25th, 2006 to February 21st, 2006, and the daily program was scheduled according to the following time table.

Training Schedule

Date		Lecture Hour			
		09:30 - 10:30	**11:00 - 12: 00**	**14:00 - 15:00**	**15:30 - 16:30**
Jan. 25	Wed.	Arrival of Participants			
Jan. 26	Thu.	Training guidance	Preparation of training environment	Module 1	Module 1
Jan. 27	Fri.	Module 1	Module 1	Module 1	Module 1
Jan. 28	Sat.	---			
Jan. 29	Sun.	---			
Jan. 30	Mon.	Module 2	Module 2	Module 2	Module 2
Jan. 31	Tue.	Module 2	Module 2	Module 3	Module 3
Feb. 01	Wed.	Module 3	Module 3	Module 3	Module 3
Feb. 02	Thu.	Module 4	Module 4	Module 4	Module 4
Feb. 03	Fri.	Module 5	Module 5	Module 5	Module 5
Feb. 04	Sat.	---			
Feb. 05	Sun.	---			
Feb. 06	Mon.	Module 6	Module 6	Module 6	Module 6
Feb. 07	Tue.	Module 6	Module 6	Module 7	Module 7
Feb. 08	Wed.	Module 7	Module 7	Module 7	Module 7
Feb. 09	Thu.	Module 8	Module 8	Module 8	Module 8
Feb. 10	Fri.	Field Survey (Addis Ababa - Butajira - Ziway - Awassa)			
Feb. 11	Sat.	Field Survey (Addis Ababa - Butajira - Ziway - Awassa)			
Feb. 12	Sun.	---			
Feb. 13	Mon.	Module 8	Module 8	Module 8	Module 8
Feb. 14	Tue.	Module 9	Module 9	Module 9	Module 9
Feb. 15	Wed.	Module 9	Module 9	Module 9	Module 9
Feb. 16	Thu.	Review of the training			
Feb. 17	Fri.	Review of the training			
Feb. 18	Sat.	---			
Feb. 19	Sun.	---			
Feb. 20	Mon.	Examination on RS		Evaluation	
Feb. 21	Tue.		Closing Ceremony		

3. Recommendations

The recommendations obtained through the remote sensing training course for groundwater development are as follows.

3.1 Participants

As this training course was an advanced course, the participants were required to have the following qualifications:

- B. Sc. Degree in geology, hydrogeology or civil engineering
- Seven (7) years working experience in relevant field of groundwater management
- Knowledge of personal computer operation

However, the actual participants included some with less than seven years working experience and some who lacked experience with personal computer operation. As a result, the level of the participants varied widely, which made it difficult for training to proceed smoothly.

Based on this experience, it is preferable that the participants of the next remote sensing training course have at least skills in computer operation. The C/P agency and the district offices should take the above into consideration when selecting participants.

3.2 Hardware

In remote sensing, very large satellite image data files are handled. Therefore, the hard disk should have a capacity of at least 30GB or more. The work folders of the personal computers at the training center only have a capacity of approximately 20GB so the capacity needs to be extended in the future.

Furthermore, as the display speed of satellite images depends on the memory of the computer, the computers should have at minimum 512MB of memory and if possible 1GB. Situations where remote sensing software and GIS software are handled simultaneously may increase, particularly in the future, and the use of high resolution satellites is also possible. Therefore, it is recommended that the computers have 1GB of memory or more.

In addition, in this training the participants were not able to output images, thematic maps, etc. through a network. However, since verification of the images produced by the participants is

extremely important in training, an A3 color printer and an A0 color plotter should be installed to enable the output of images through the network.

Finally, the light output of the projector used for presentations in the training was weak so the images were very dark. In order to conduct more effective presentations, a more up-to-date projector needs to be provided.

3.3 Software

The main software used in this training was TNTlite 7.1 (freeware) and ArcView 3.2 (3.3). In satellite image analysis using the freeware in particular, the image size that could be handled was limited, and the expected results concerning geometric correction, image classification, and data export could not be obtained. However, the purchase of professional software for 20 persons would not be possible in terms of budget.

Therefore, it is urgent to conduct studies focusing on freeware and low-priced software (academic version) for remote sensing that are currently being used in the world for future training courses. It is also necessary to examine the various analysis methods combining the wide variety of low-priced and/or free software.

3.4 Training Course

This training course was an advanced course on remote sensing, covering the basics of remote sensing, remote sensing applications, image processing systems, landform analysis, image processing, applications in groundwater development, and so on. However, currently in the field of remote sensing, various technologies and know-how such as GIS (geographic information system) techniques and GPS techniques are required. Therefore, GIS training should be incorporated in this remote sensing training course in the future. Also, although this was a one-month (four week) training course, it is recommended that the curriculum including GIS be reexamined, and a new 2-3 month GIS/remote sensing training course be started. This new course should conduct lectures and practical training in groundwater development and water supply.

In addition, in order to create an environment for the dissemination of technology, it is urgent that the responsible persons at EWTEC (the C/P agency) promptly acquire skills in remote sensing and GPS and independently provide training.

4. Conclusion

Through implementation of this training course, image processing techniques and GIS analysis techniques for groundwater development were transferred. Overall, most of the participants were able to acquire these skills and knowledge. However, it was unfortunate that due to the limited functions of the remote sensing software, the technology transfer could not be conducted as expected. In order to conduct more effective training in the future, the study and development of software is needed. In developing countries in particular, the diffusion of such software remains an important issue.