

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
MINISTRY OF WATER RESOURCES, ETHIOPIA

Groundwater Development and Water Supply Training Project
in Ethiopia (Phase II)

Completion Report
of
Advanced Course for Water Supply Engineering

October 2006

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1. Outline of the Course

The Advanced Course for Water Supply Engineering assigned in Phase II of the Project for the year of 2006 was carried out in the following manner, after the Basic Course for this sector was completed by the EWTEC (Ethiopia Water Technology Center) in August 2006.

- 1) Name of JICA Expert dispatched for the course Mr. Tetsuji Niwano
- 2) Course Sector: Water works planning, designing and engineering
- 3) Period of dispatch From Sep. 13 to Oct. 25, 2006
- 4) Outline of the Course

The course intends mainly to provide training to senior engineers specialized in water supply engineering with practical knowledge and experience for planning and designing water supply schemes in Ethiopia, focusing on the detailed designs and functions of major components of the integrated water supply system from water resources, their intake, collection, transmission to distribution. Special attention is paid during the course to water treatment facilities of surface waters, which have growingly been installed in various parts of the country, although major sources for water supply systems in most part of the country still remain groundwater from drilled wells due to its overall natural conditions. In addition, several programs of computer software popular in the field of water supply engineering in Ethiopia are introduced into the training course to enhance the effect of training.

2. Contents of the Course

- 1) Field for Training Water supply planning and designing
- 2) Period of the Course From Sep. 20 to Oct. 13, 2006
- 3) List of Participants in the Course: Annex I

The participants in the course totaled 16 who gathered from 7 regions of the country. The administrative subdivisions of the country which failed to send participants were two chartered cities (Addis Ababa and Dire Dawa) and two regions (Harari and Afar). The list of participants is presented in Annex 1. In the official notice to

the respective regions for recruiting participants, EWTEC required the participation of personnel who have been engaged mainly in urban water supply engineering. The thus-recruited attendants in the class were found to have diverse backgrounds, with their experiences in the sector ranging from less than 1 year to 13 years and with diverse specialties such as hydraulic engineering, civil works, irrigation engineering, etc. A majority of them were field engineers who have been working at the regional water departments for designing, supervising and operating and maintaining water facilities.

4) Contents of the Course

The subjects that the course provided to them are summarized as follows:

- a. Water supply engineering in the system and for its components
 - i. Water sources (Rain water, groundwater, springs, surface water)
 - ii. Intake facility (Dams, subsurface dams, intake structures, deepwells, shallow wells, spring boxes, infiltration gallery, rain-harvesting, etc.)
 - iii. Water collection, transmission and distribution facilities
 - iv. Material and equipment for water supply system(Pumps, power units, etc.)

- b. Water treatment facilities
 - i. Water quality and water contamination
 - ii. Treatment facilities
 - Pre-treatment (settling tanks, sedimentation tanks, etc.)
 - Slow sand filtration
 - Rapid sand filtration
 - Advanced treatment(Activated carbon treatment, Ozonation, membrane filtration, etc.)

For the respective subjects in the list, the course tried to provide practical knowledge and information through the provision of texts, presentation with OHP slides and PowerPoint slide shows as well as explanation of Ethiopian and international guidelines, along with theoretical outlining. Copies of detailed designs for major facilities selected from various sites in Ethiopia were distributed to participants for their in-depth study, together with introduction of reference text books available in the country.

c. Tender practice in the country

Since the participants have chances from time to time to be involved in the tender

procedure in their regions, the standard format for public works tendering was reviewed and discussed. In Ethiopia, tender documents, international and governmental, are both based upon "FIDIC"'s Publication (Guidance for tendering issued by the International Federation of Consulting Engineers). Several examples of actual tender documents were presented to the participants.)

d. Practical training of application software programmes

i. Water CAD (program for water supply planning and designing)

After lessons for operating the programme, exercises were provided for its application in village water supply schemes as well as urban networks.

ii. SAP2000 (programme for civil work structure design)

Before applying the programme, participants practiced the basic principle for analysis of structural design of civil works. Starting with a simple structure of buildings, the course provided lessons how to design reservoirs of standard cylindrical design in Ethiopia from the capacities of 50 m³ to 4,000 m³.

iii. Auto CAD (drawing software programme)

Auto CAD is a standard drawing software programme which has internationally been employed. Water CAD can incorporate drawings prepared by Auto CAD. The course provided lessons to cover major functions of the programme.

e. Site training

i. Water treatment plants

- Gaffarsa Treatment Plant (Addis Ababa, rapid sand filtration system for about 500,000), half-day course.
- Adama Water Intake Facilities(from the Awash River) • Treatment Plant(for Adama City in Oromia Region, rapid sand filtration system for about 250,000). Full day course was provided.

ii. Oromia Water Laboratory

- The laboratory is responsible for water analysis in the whole region of Oromia, where the methods of chemical analysis, coliform test, etc were demonstrated to the visitors. In addition, its technical service to various treatment plants in the region for jar-testing chemicals was shown. Half-day course was given.

The daily programme of the course from Sep. 20 to Oct. 13 is referred to the following list. The flow of the programme, however, is not consistent in part, due to the change of subjects on the way through the requests of participants or the adjustment of site visit schedule.

Date	Wk	a.m.	p.m.
9/20	Wed	Opening session, Glance at water sector in Ethiopia (PPoint)	Introduction of water sectors in other African countries and Japan (PPoint)
9/21	Thu	General procedure for survey to reporting for water projects. (Text)	Review of basic elements of Ethiopia's water supply planning(Text · Data)
9/22	Fri	Exercise for basic water supply planning	Site training, Gaffarsa Treatment Plant in Addis Ababa
9/25	Mon	Water quality criteria and contamination (PPoint/Text)	Water resources and use (Ethiopia and other African countries) (PPoint, OHP, Text)
9/26	Tue	Guidelines for various water intake facilities (sand dam, infiltration gallery, ponds, etc. in Ethiopia) (PPoint)	Presentation of Ethiopia's Integrated Water Development Programme (PPoint)
9/27	Wed	National holiday	
9/28	Thu	Guidelines for pre-treatment facilities (settling tanks, roughning filters, etc.) (PPoint)	Site training, Oromia Water Laboratory
9/29	Fri	Introduction and guidelines for advanced water treatment (PPoint)	Study on well design and evaluation of wells, based upon the pumping test (PPoint, Text)
10/02	Mon	Introduction of "SAP2000" for structural design and exercise	Study on design criteria of slow sand filtration and presentation of detailed design documents in Ethiopia (PPoint, data)
10/03	Tue	Study on design criteria of rapid sand filtration in Ethiopia and Japan (data, PPoint)	Introduction of Auto CAD programme together with exercises
10/04	Wed	Lessons on key points on the guidelines of transmission and distribution lines (Text)	Study on the tender process and documentation in Ethiopia (PPoint, Text · Data)
10/05	Thu	Site training (Adama water intake facilities and treatment plant)	Site training
10/06	Fri	Study of water treatment materials and equipment. (Text)	Exercise for water supply schemes (village supply system and urban networks, using Water CAD
10/09	Mon	Auto CAD drawing practice	Exercise for application of Auto CAD
10/10	Tue	Lessons for dam and weir structure (PPoint/Text)	Lessons for structural analysis of civil works
10/11	Wed	SAP2000 training(new version was introduced for further analysis of structural design)	SAP2000 training for architectural design
10/12	Thu	Lessons for structural design of reservoirs (cylindrical type)	Exercise with SAP2000 programme for designing reservoirs of various capacities
10/13	Fri	Closing ceremony	

Special remarks regarding the course are described as follows:

1) Since the Japanese expert is short of access to reality of present-day water sector of Ethiopia, support and assistance of local specialist(s) were inevitably required for the course management. Presentation by the local specialist, however, has revealed that there exists a wide difference in the technical levels of the two countries. For instance, the guidelines for major water facilities upon which Ethiopia have been dependent upon differed from those of Japanese criteria in various parts, (e.g. sand particle sizes in filters in treatment system; steel pipe strength criteria, etc). Ethiopia has no design criteria yet that can be applied across the country, due to various reasons. This situation raised difficulties to present standard examples commonly accepted in Japan. In this course, therefore, two cases were shown to participants in parallel, sometimes, to their confusion. The presentation of guidelines, therefore, needs to be adequately coordinated in advance between the Japanese expert and the local specialist.

Notwithstanding such difference, there is no doubt that the detailed design documents provided by the local specialist for slow and rapid filtration systems now in operation in the country are excellent data to the participants who had before little chance of directly accessing the complete information of treatment plants.

2) The application of software programmes for not only water supply schemes but also structural design analysis of civil works was incorporated into the course due to strong requirement of participants. The necessary programmes were procured in Ethiopia to meet their requirement since the initial plan did not assume their employment. The lack of regular versions of computer programmes in this country, however, caused some difficulties while they were in operation in the class. (e.g.SAP2000 for structure design). The programmes the course picked up were those widely used in this country, and were popular among the participants because they can create reports automatically, including computer graphic drawings. Depending heavily upon computer programmes, however, entails risks, since the detailed review of the results tends to be neglected. In the exercise using Water CAD for a village water supply scheme, a part of participants seemed to lack basic knowledge for hydraulic engineering and their data input resulted in incorrect design, although the system map was skillfully worked out. Prior to practicing any computer programme, therefore, the basic principle of engineering for which the programme is meant needs to be reminded to the participants in the class in order for them to effectively utilize software.

3) Site training in this course was exclusively devoted to the sites related with water treatment engineering. Although the initial plan included the training in water supply

scheme surveying and designing for a village in SNNPR, it was cancelled during the course for various reasons and was replaced with training in structure design analysis with SAP 2000. Site surveying and designing for a water supply scheme are, however, one of core subjects in this training course, having the first priority over other programmes. The key point in formulating a good plan for survey and design is in the selection of a suitable site. In the next opportunity, therefore, relevant preparation in advance for this part of site training is indispensable, including the recommendation by the Ethiopian side for candidate sites.

3. Evaluation of Participants (Technical level • Extent of Understanding and Achievement)

The participants in the course are divided into two groups in respect of their experiences; one group, 8 in number, has 5 or longer years of experience in water supply engineering, while the other's experience is limited to less than 1 year to 2 years. Experience is the essential element in water technology and engineering, and such a difference among them necessitated to present the course with details of basic principle of the respective subjects leading to the knowledge and understanding of the whole framework. The extent of their understanding and achievement was to be evaluated through the results from site training for a water supply scheme. Since this plan was cancelled during the course, the course is left with little objective material for judgment of the participants' performance in the course. The description in the following list, however, may suggest the results of the responses of the participants to the main subjects of the course.

	Subject	Method for confirmation	Results
1.	Basic elements for water supply planning and designing	Class discussions (participants' responses to questions.)	The basic elements for water supply planning such as served population, planned supply rates, etc., are designated by WSSMP(2001) of the country. The participants responded correctly, implying that the national standard for planning has been recognized and put into practice uniformly in all the regions of the country.
2	Planning and designing of water supply systems	Exercise (Village supply scheme and urban distribution networks, etc.)	The participants were grouped into 8 due to limitation in availability of computers for exercising. The results were submitted by 4 groups, all picking up the design for the village supply scheme. Among them, two groups utilized the computer programme, Water CAD for preparing the design map.

			<p>(In comparison of ordinary calculation method and the application of computer programme, errors were more in the latter. It may have been due to the limitation in time for practice in the class.).</p> <p>The participants who submitted the results consisted mostly of members with longer experience. Most of younger members could not respond, and their understanding are feared to have remained in poor level.</p>
3.	Water treatment engineering	Practice at the sites	<p>The water treatment was one of the main subjects in this course, including site training in two plants. At the first site of Gaffarsa treatment plant, most participants seemed to lack basic knowledge of the process, while during the second visit to Adama plant, their response changed, reflecting the results of concentrated class lessons. In addition, the provision of detailed design documents for treatment plants now in service in various parts of the country enhanced the effect. All of them are in need of further study for mastering the subject. However many participants promised to continue it in their regions</p>
4.	Utilization of computer software programme	Practice in the programme operation and application	<p>This course picked up 3 software programmes popular in various sectors of the country. Each programme, particularly Water CAD, was not allowed adequate period for its mastering. The results from insufficient practice of Water CAD appeared in the exercise for design of village water supply scheme, in which the computer calculation of water flow for distribution turned out inconsistent, while the graphic map for the system looked sound. calculation practiced in a limited period of 2 hours only. Insufficient practice seemed to have left the participants</p> <p>Most participants concentrated their efforts on computer operation even after the daily course was closed. They believed those programmes would greatly help their jobs after they returned to their office. The course provided the best opportunity for them to make access to the most popular programmes in the country's water sector.</p>

4. Questionnaires to the Participants

On September 22, soon after the opening of the course, a questionnaire was distributed to the participants, asking for their specific interests and requests to the course. Its results are summarized as follows:

Participants' interests and requests to the course

(Attendants on the day were 15. Most of them listed their requests more than one.)

1.	Water supply planning and designing with computer programme such as Water CAD	10
2.	Water treatment engineering in detail	7
3.	Structure design analysis with computer programme SAP 2000	6
4.	Design criteria of water supply facilities	4
5.	Water tariff criteria	3

In addition, the studies on the design criteria of surface water intake system, water well design, pump selection method and water quality were respectively requested from 2 of them. The results were analyzed in consultation with the responsible official of the EWTEC. As a whole, their request were focused upon utilizing the computer programmes for the advance course. Consequently, the introduction of computer programmes such as were decided and soon put into practice, although the initial plan did not assume such a trend, and the programme of the course was revised to that effect.

The results of the thus revised program and attainment of computer programme mastering was not surveyed, however, due to difficulties in the target setting of the achievement under various constraints such as limitation in time period allowed for practicing and availability of computer units.

5. Proposed Improvement and Recommendations

1) Improvement for the next opportunity

- a. The course decided to employ various computer programmes for planning and designing water facilities during the progress of the course. The abrupt change of the policy pressured the ordinary lessons for the respective subjects, posing difficulty in balancing them with computer programme practicing. Given strong

appetite of the participants for the latter, an integrated presentation of theoretical parts and computer application in major subjects is expected to encourage their continued interest and willingness to study in the course. Site training could be incorporated into part of this new programme. Since the use of computer programmes is so strong a trend in the country's water sector that it will become a major premise for the next course, and improved presentation integrating the theory and tools is sure to be required to enhance the effect of the course study.

Water CAD is reportedly becoming one of official tools for reporting and presentation in the Ministry of Water Resources, where the advanced application of this programme in combination with GIS has now become popular, although the course this time could not spare sufficient time for practicing it. On the other hand, more course time was allotted to the practice of SAP 2000 for structural design analysis, along with preliminary lessons for the basic principle of structure engineering, and eventually the exercise in the analysis of the country's standard structure of cylindrical reservoirs with their capacities ranging from 50 m³ to 4,000 m³. Although the exercise was interrupted at the analysis of a reservoir of 100m³ capacity due to time limit, the approach and method practiced in the class could further be tried by the respective participants thereafter. Based upon the experience this time in the employment of computer programmes for system and facility designing, it deems necessary to improve the course programme as a whole effectively combining the computer software programmes, along with relevant assignment of class hours for the respective subjects.

- b. In connection with the first proposal for improvement, it is proposed to provide computers to each participant. (In the course for this year, one unit was jointly used by two members on the same desk due to the limit in availability during the course period.)
- c. Site training this year in water treatment plants was completed with excellent results for the participants who had little knowledge in this field, thanks to the appropriate selection of candidate sites. On the other hand, the cancel of training for planning and designing of the water scheme for community in SNNPR caused a lack of an essential element in the course. Since the site training in the actual field is the most effective experience for learning water works engineering in general, chances to visit various sites should be increased to as many as possible within the time schedule of the whole course. In addition, the selection of sites to visit is important as well. As the treatment plants visited during this course

were decided after the opening of the course, the instructor as well as the participants had little information on the sites to visit. Earlier decision of the candidate sites prior to the opening of the course and preliminary visit by instructors, if possible, can increase information and knowledge of the sites, eventually resulting in the in-depth observation and understanding by the participant.

2) Recommendations

- a. To supplement the shortage of experience in this country of the dispatched Japanese expert, this course depended upon support and cooperation of local specialists in the diverse subjects. Through the experience this time, it is recommended to follow a similar setup for the course management in the next opportunity. However, the difference in technical level and design criteria must be reviewed beforehand jointly by the Japanese expert and the local specialist. Through such a coordination, presentation to the participants should be prepared in consistent style to avoid confusion and misleading.
- b. Site training is proposed to be carried out in the following manner:
 - The sites to visit for training should include the candidates as follows:
 - Treatment plants (slow sand filtration plant x 1
rapid sand filtration plants x 1 or 2)
 - Existing town water supply system for the community having a population of more than 10,000 comprised of intake, collecting, transmitting and distribution facilities, together with administration of water service and management to citizens
 - Community in which the course is allowed to provide training to participants for water supply planning/designing or rehabilitation (preferably middle sized town)
 - The candidate sites should be selected by the tripartite discussions among the EWTEC, the Japanese expert and the local specialist, followed by the preliminary survey, if possible, for their final agreement and decision prior to the opening of the course.

Annex I

Water Supply Engineering Course (Advanced)

From Sept. 20 - October 13/ 2006 (Meskerem 10 - *Tikemet 3/1998*)

No.	NAME	REGION	JOB TITLE	QUALIFICATION	WORK EXPERIENCE
1	Fanta Daba Debela	Oromia	Expert in Water Res	Bsc in Hydraulic Eng	6 Years
2	Tsegaye Teklu Melcuria	Oromia	Water Res. Engineer	Bsc in Irrigation Engineering	2 Years
3	Abdella Gelgelu Duke	Oromia	Water Res. Engineer	Bsc in Hydraulic Eng	2 Years
4	Lelissa Likassa Dugassa	Oromia	Water Res. Engineer	Bsc in Irrigation Engineering	6 Years
5	Getachew Abebe Gonfa	Oromia	Head, Arsi Zone Water Resource	Bsc in Civil Engineering	13 Years
6	Asrat Kassie Desta	Amhara	Water & Sanitary Engineering	Bsc in Hydraulic Eng	5 Years
7	Degarege Eyassn Alemu	Amhara	Rehab & Expansion Expert	Adv.Diploma in Civil Engineering	3 Years
8	Bantemlak Yseigat Gelagay	Amhara	Water Operation & Maintenance	Adv.Diploma in Water R. Eng	11 Months
9	Tadessa Desta Rada	Tigray	Head, Dept. of Mekele Water Sup Ser Office	Bsc in Hydraulic Eng	12 Years
10	Leake Tadesse Bahta	Tigray	General Manager	Bsc in Irrigation Engineering	8 Years
11	Glyohannes Glegziabher Hagos	Tigray			
12	Ephrem Alemu Worku	Benishan-gule	Team Leader	Bsc in Irrigation Engineering	4 Years
13	Dinku Arega Shimbulo	SNNP	Water. Res. Engineer	Bsc in Hydraulic Eng	10 Years
14	Terwodros S. Dilvessa	SNNP	Water Quality Control	Adv. Diploma in Hydraulic Eng	1 Year
15	Abolla Odange Othow	Gambela	Project Monitoring & Evaluation Expert	Adv. Diploma in Hydraulic Eng	1 Year
16	Abdihakim Tahir Muhammed	Somali	Senior Expert Eng. Dept	Adv. Diploma in Hydraulic Eng	2 Years