



2012

# Skills Challenges in the Water and Wastewater Industry



## Contemporary Issues and Practical Approaches in TVET



United Nations  
Educational, Scientific and  
Cultural Organization



International Centre  
for Technical and Vocational  
Education and Training



German Association for Water,  
Wastewater and Waste

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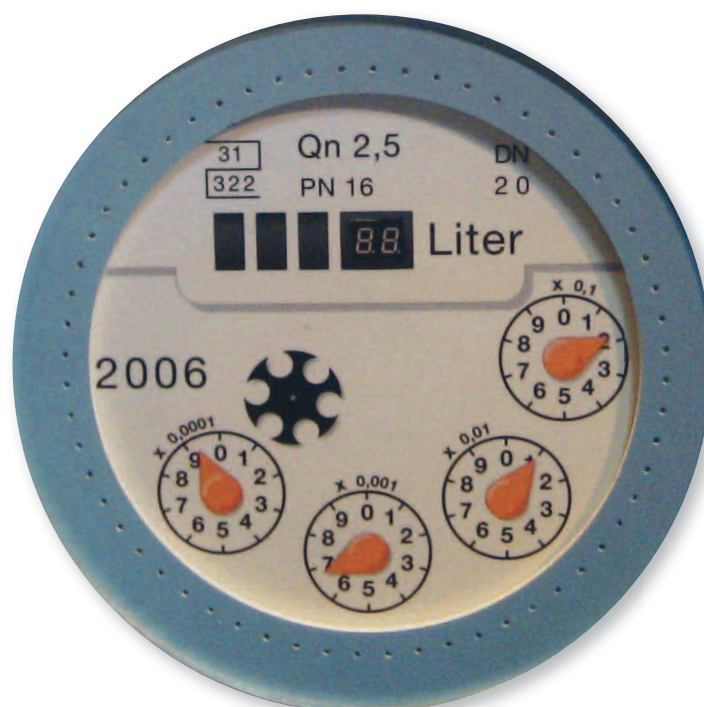
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# Table of Contents

Table of Contents.....	3
Acronyms.....	4
Acknowledgements .....	5
Foreword.....	6
Why this Publication? .....	7
Chapter 1 TVET and the Water and Wastewater Industry Challenges .....	8
Chapter 2 Regional Overview and Approaches in TVET .....	11
Chapter 3 Skills Challenges and Demands by the Industry .....	16
Chapter 4 Capacity Development in TVET for Water .....	21
Chapter 5 Country Practices.....	22
Chapter 6 Recommendations: From Policy to Practice in TVET.....	26
Resources .....	31



## Acronyms

ACWUA	..... Arab Countries Water Utility Association
BiBB	..... Federal Institute for Vocational Education and Training
BMZ	..... Federal Ministry for Economic Cooperation and Development
BMBF	..... Federal Ministry for Education and Research
BMU	..... Federal Ministry for Environment, Nature Conservation and Nuclear Safety
BVS	..... Bavarian Administrative School
CD	..... Capacity Development
CEN	..... European Committee for Standardisation
DIN	..... German Institute for Standardization
DVGW	..... German Technical and Scientific Association for Gas and Water
DVWK	..... German Association for Water Resources and Land Improvement
DWA	..... German Association for Water, Wastewater and Waste
EU	..... European Union
EQF	..... European Qualification Framework
GIS	..... Geographical Information System
GIZ	..... German Society for International Cooperation
GWP	..... German Water Partnership e. V.
GPS	..... Global Position System
ISO	..... International Organization for Standardization
IWRM	..... Integrated Water Resources Management
NGO	..... Non Government Organisation
NuR	..... Standards and Rules
ToT	..... Training of Trainers
TVET	..... Technical and Vocational Education and Training
UN	..... United Nations
UNDP	..... United Nations Development Programme
UNEP	..... United Nations Environment Programme
UNESCO	..... United Nations Educational, Scientific and Cultural Organization
UNW-DPC	..... UN-Water Decade Programme on Capacity Development
VET	..... Vocational Education and Training
VKU	..... German Association of Local Utilities

# Acknowledgements

This booklet is the product of a joint effort by UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training (TVET), UNEVOC Network members, and the German Association for Water, Wastewater and Waste e. V. (DWA). This booklet will become a resource for UNESCO-UNEVOC's mission of building knowledge and capacity necessary to meet today's water resource challenges. The technical expertise provided by the DWA has ensured that readers will gain the required knowledge regarding the demands, competencies and skills needed in the water and wastewater industry.

This booklet is the first of its kind to build links and promote cooperation between TVET and the water and wastewater industry. The development of "Skills Challenges in the Water and Wastewater Industry: Contemporary Issues and Practical Approaches in TVET," began after a joint effort was made by all parties involved. Attaining substantial results would not have been possible without successful collaboration and dedication. Therefore, all contributors are credited for accomplishing this effort.

A sincere thank you is conveyed to every individual who remained committed to supporting the development and ensuring the successful completion of this booklet. A special thank you to Professor John W. Simiyu (Department of Technology Education, Chepkoilel University College, Kenya), Rector Professor Dr. Mya Mya Oo (Mandalay Technological University, Myanmar), Dr. Jorge Arturo Casados Prior (The Mexican Institute for Water Technology) and Dr. Mahmoud Abdel Fattah Elkady (Technical Education Sector, Ministry of Education, Egypt) for providing ideas and valuable information on regional mapping of TVET in support of water and wastewater industry.

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# Foreword

## Dear Reader,

Within UNESCO's strategy for Technical and Vocational Education and Training (TVET), one of our roles is to serve as a clearing house for TVET and a source of information sharing and cooperation. Our unique role lies in its ability to reach out and make information accessible to a wide audience around the world, especially in developing countries and through our UNEVOC Global Network. Our publications seek to create a bridge between research, policy and practice, with the intention to reach a wide and diverse audience of policy-makers, educators, researchers and practitioners.

In this booklet, we aim to communicate the importance of developing appropriate and relevant skills for the water and wastewater industry and informing TVET educators and practitioners about the labour market needs associated with the introduction of new technologies, trades and competencies. UNESCO's continuous work in promoting sustainable development in education forms as the basis for this initiative. The development of this booklet springs from a collective understanding that the water sector is a vital area for initiating sustainable development not only from an educational perspective but also from social, environment and economic fronts.

Water is fundamental in greening the economy and the transition to social sustainability. Understanding the relationship between water and poverty, food security and health is vital. Similarly, knowledge of how industries could make or break the ecosystem through water, wastes and technology investments is needed. Through our collaboration with DWA and our Network members, we hope to build the necessary foundations for the TVET sector to meet today's water resources challenges and harness their potential to respond to them.

Shyamal Majumdar  
Head of the UNESCO-UNEVOC International Centre



## Dear Reader,

As President of the DWA, I am extremely pleased with the long-standing, successful collaboration with the UNESCO-UNEVOC International Centre. For many decades the DWA has advocated for the qualification of specialists and managers and annually welcomes ca. 35,000 individuals in more than 200 specialist events in Germany.

We are very happy to share our experiences with those involved in the water industry in other countries. Each year we receive visits from specialist colleagues from close at home and far abroad. They come to the large trade fairs: IFAT in Munich or WASSER BERLIN INTERNATIONAL in Germany's capital city. Many take part in our range of international English language seminars.

In Germany, more than 80 percent of the water and waste industrial facilities are operated and maintained by skilled technicians and master technicians. Through this, we guarantee that the high demands placed on keeping our bodies of water clean are also met permanently. Our experiences show quite clearly that the satisfactory operation of the facilities on a continuous basis is not possible without qualified specialists. As the person responsible for, and Chief Executive Officer of, the Stadtentwässerungsbetriebe [Group of Municipal Drainage Operations] in Cologne, I see this necessity every day.

Solid basic training, lifelong advancement and further training, for example in the form of wastewater treatment plant neighbourhoods, ensure the high level of knowledge and the activity-orientation of our operating personnel in Germany. We are very happy to provide our skills in this field.

With this reading material I wish readers a true gain in information concerning the subject of training and further training. The DWA will, at any time, gladly provide further cooperation and information.

Dipl.-Ing. Otto Schaaf  
DWA President



# Why this Publication?

Most developing countries are experiencing a rising gap between labour-market demand in key sectors and the supply of adequately trained and qualified professionals. The UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training (TVET) plays a key role in bridging this skills gap and in meeting new labour-market demands through its network of over 280 UNEVOC Centres across UNESCO Member States. As UNESCO's lead agency for worldwide service in TVET development, UNESCO-UNEVOC promotes and supports the development of skills, technical and institutional capacities needed to strengthen the labour force, particularly in the water supply and sanitation sectors.

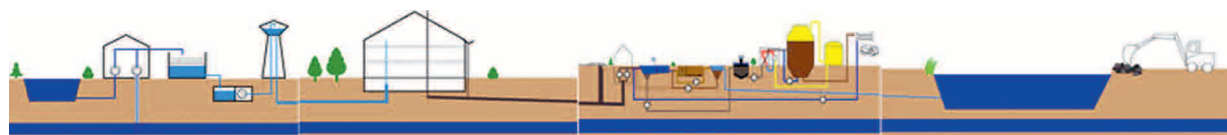
The booklet serves as an educational-informational-reference for TVET educators and practitioners in the area of emerging skills development demanded by the water and wastewater industry. In particular, the booklet explores labour market needs associated with the introduction of new technologies, trades and competencies. Innovation and collaboration has been thus taken as the broad theme in order to promote appropriate approaches and innovative practices, to cater linkages and configure cooperation between TVET and the water industry, and to foster the development of emerging skills needed in the water sector.

This initiative has been taken as a response to recommendations made by decision makers and educators during the UNESCO-UNEVOC International consultation meetings held in Berlin (2009), in Munich (2010) and the International Experts meeting in Bonn (October 2011). Participants from over thirty UNESCO Member States identified that there is a need for staying abreast of current advances in water and wastewater treatment products and services. To this end, the development of practical guidelines including industrial-based learning materials particularly for TVET teachers and trainers was recommended.



*Team Stuttgart, winner Skills Competition, IFAT Munich 2010*

This booklet thus provides an overview of approaches and practices in current TVET policy and programme at regional, national and local levels in response to the changing patterns of the water and wastewater services. Drawing on worldwide knowledge and experience, regional priorities and challenges faced in TVET, particularly for the water and wastewater industry, are summarized in this booklet. Emphasis is given to the capacity development in relation to policy implementation, institutions and human resources from a practical perspective. With the technical expertise provided by DWA, a specialist, technical and scientific organization, the booklet discusses what is currently known about the different types of occupations and jobs in the water and wastewater industry and provides a variety of resources to help educators in understanding, planning and configuring their approaches for the development of emerging skills needed for the green transition of the water and wastewater industry.



*Water supply, house installations, wastewater treatment and river constructions, DWA 2012*



# Chapter 1

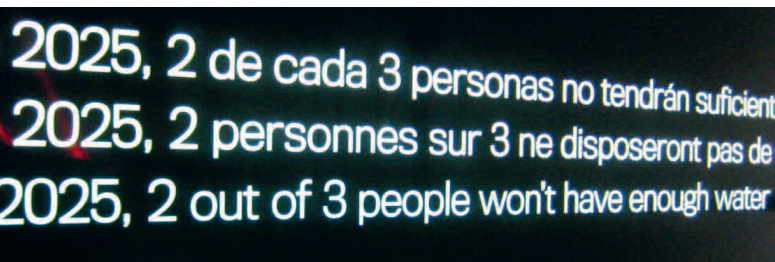
## TVET and the Water and Wastewater Industry Challenges

Promoting education and training for water technicians and professionals has been a source of challenge, innovation and advancement for societies for sustainable development for decades. TVET is thus critical for providing youth and adults with the required skills and competences which help to cope with the labour market demands and rapid development, particularly in the water and wastewater industry. However, TVET in many countries remains a mere supplier of skilled labour to the industrial sector and is thereby unable to respond effectively to the needs of sustainable development strategies. In addition, there have been few serious attempts to inform TVET teachers and trainers about the links between TVET and the water sector. Under such circumstances, TVET institutions must strive to explore and exchange information about innovative teaching and learning methods, such as programmes on clean energy, clean water and clean technology, reorientation of TVET curricula, sustainable campus management programmes and examples of innovative approaches to integrating learning in TVET for sustainable development. It is also increasingly acknowledged that sustainable solutions for water challenges strongly depend on the availability of adequately trained human resources, from high-level experts to communities and stakeholders. TVET should be promoted to build knowledge and expertise necessary in meeting today's water resource challenges through bridging linkages and ensuring cooperation between TVET and the water and wastewater industry. Overall, TVET should be a provider for ensuring that the world of work contributes to social cohesion and promotes environmentally sound sustainable development.

In addition to these challenges, many countries seem to have insufficient resources to meet the Millennium Development Goal (MDG) target for sanitation and drinking-water. The 2012 report of the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (WHO/UN WATER, 2012) has summarized the efforts and approaches of seventy-four low and middle income countries and twenty-four external support agencies. The report states that although some countries are reporting strong progress towards national sustainable water, sanitation and hygiene (WASH) targets, for the majority of countries, human and financial resource constraints, especially for sanitation, are significantly impeding progress. Challenges remain and are discussed as follows:



*Gas Storage Tank from Wastewater Treatment Plant, Croatia 2012*



*EXPO 2008, Zaragoza, Spain*

## Necessary Infrastructure

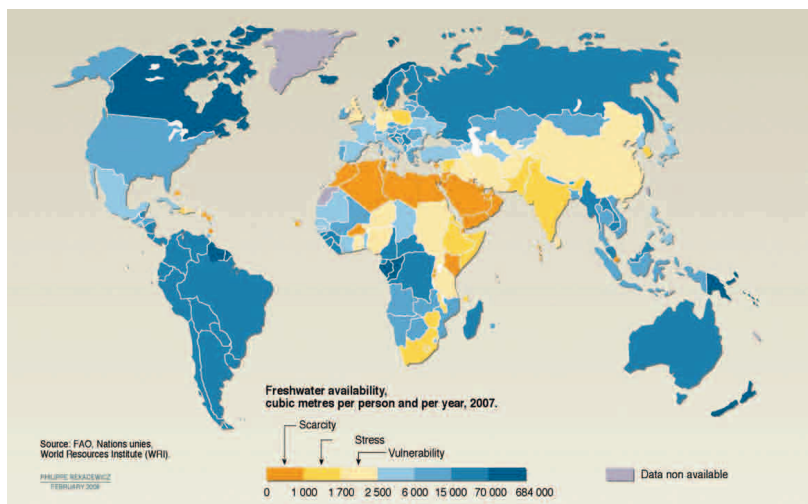
The 2012 Monitoring Programme for Water Supply and Sanitation Progress Report (UNICEF/WHO, 2012) describes the success of many countries in improving access to clean drinking-water sources and sanitation facilities. A number of countries in Latin America, Northern Africa and Western Asia report that they are on track in meeting national targets and surpassing the harmonized global criteria for improved water and sanitation, such as universal access to a piped sewerage system. The report noted that at the national level, progress frequently exceeds that required to meet the MDG targets. Despite the progress that is required to meet the MDG targets, a functioning infrastructure in the water and wastewater sectors at the local level has come into questions due to an upward trend in urbanisation. For example, how will these urban systems supply themselves with the necessary water, disposal networks and the corresponding processing facilities? How will the waste collection systems of the future look? How will the waste be sorted, recycled and disposed of? How can TVET ensure the promotion of technically qualified operating personnel in the light of the rapidly changing skill needs for now and the future?



*Training in Palestine (GIZ 2005)*

### Did you know?

- Around 700 million people in 43 countries suffer today from water scarcity.
  - By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water stressed conditions.
  - With the existing climate change scenario, almost half the world's population will be living in areas of high water stress by 2030, including between 75 million and 250 million people in Africa. In addition, water scarcity in some arid and semi-arid places will displace between 24 million and 700 million people.
  - Sub-Saharan Africa has the largest number of water-stressed countries of any region.
- (Source: [www.un.org/waterforlifedecade/scarcity.shtml](http://www.un.org/waterforlifedecade/scarcity.shtml))



*Water security map  
(Source: Vital Water Graphics,  
UNEP 2008)*

## Water scarcity and contamination in the world

Water scarcity is among the main problems facing many societies and the world in the 21st century. Water use has been growing at more than twice the rate of the population in the last century, and although there is no global water scarcity, an increasing number of regions are chronically short of water. The United Nations projects that by 2025, half of the countries worldwide will face water stress or outright shortages. By 2050, as many as three out of four people around the globe could be affected by water scarcity.

There is also increasing evidence of pollution of surface, ground and coastal waters in many developing countries. In particular, downstream sections of major rivers, most lakes and canals in certain countries suffer from deteriorating water quality. With economic development, wastewater discharges, from industrial and municipal sources, have grown rapidly in many countries, where water pollution is leading to the build-up of many areas with accumulated environmental contaminants.

### **Water & poverty, an issue of life & livelihoods**

Unsafe water and a lack of basic sanitation in the world causes nearly 80 percent of all sicknesses and diseases. Relevant UN studies indicate that there is a clear link between poverty and access to water; those individuals who lack adequate water resources are far more likely to be poor, and those who are poor are far more likely to lack adequate water resources. Today, infrastructure development projects such as dams and mines are diverting essential water resources from farmers and fishers, threatening their lives and livelihoods, and plunging them into poverty (<http://www.oxfamamerica.org/issues/water>).

### **Staff qualification differs from country to country – lack of skills**

The operators of water supply and wastewater facilities employ approximately 80 percent of the workers in the water industry. These technical operating personnel are trained very differently and are very differently further qualified. Continuous training systems do not exist in many countries. Unfortunately, poorly qualified personnel are often employed. In particular with wastewater and waste disposal, these branches also have to deal with image problems. These occupations, in various societies, receive minimal appreciation.

The water and wastewater industry has been in decline in certain regions for several decades. The industry has also experienced restructuring involving the introduction of sustainable practices, energy and resource efficiency, new green technologies, and clean water, which are all changes that require upgrading significant skills.

### **Knowledge is increasing – Technology is running**

Technical progress and the accompanying knowledge grow inexorably. The legal requirements in various countries are subject to continuous development. Companies and service providers are forever developing new processes. The application of computers, and the corresponding hard- and software, are the developments which change the most. There is hardly any wastewater treatment plant in which the control and data management are still carried out manually on paper.

Today in many businesses, databases, analyses, simulations, GPS systems and GIS applications belong to the daily tools for operating personnel. The development of new skills, occupations and the greening of water and wastewater industry are closely related to the ability of TVET to promote and develop the right pool of talent and skills, support green know-how and the right labour market conditions. Innovative support and mechanisms are required, particularly for transition to a low-pollution, low-carbon and resource-efficient water sector.

### **Climate change**

Climate change is already being experienced today, such as droughts in the USA and floods in Pakistan. Adjustments to the change will have to take place. For this there is a need for further research and observation of the changes. Climate change, increasing drought frequency and intensity, and high demand of water are increasing scarcity in certain countries. High agricultural consumption, increased salinity and underdeveloped conservation technologies compound the pressures on the nation's water supply. Ultimately, climate change is likely to have a negative impact on countries and make them increasingly difficult to meet urban and agricultural water needs.

Among the challenges ahead, measures are already being taken for the mitigation of climate change with water supply and disposal. The recycling of wastewater can promote employment within irrigation systems. Treated wastewater and also surface runoffs can be deliberately percolated (groundwater replenishment) and then used again later. Flooding events can be mitigated through dykes or mobile flood protection systems. Emergency systems for droughts must be tested and prepared. Operating personnel must be trained in advanced for these tasks. Only then are the adjustments to climate change successful and the required emergency measures correctly targeted.

# Chapter 2

## Regional Overview and Approaches in TVET

### Europe and North America

In the regions of Europe and North America, drinking water and wastewater networks have already been in use for over 100 years. The system and processing of drinking water and treatment of wastewater operate at a high level. Within Europe the collecting, sorting and recycling of waste varies from country to country, however, these processes no longer harm humans or the environment. Building knowledge for repairing old facilities is increasingly becoming a part of the training.

Vocational training systems in individual countries have developed and evolved in diverse ways. Countries such as Austria, Germany, Switzerland and France have their own official qualification standards for the water and waste sectors. Other countries have developed their own endorsement agencies. In the new EU Member States such as Romania and Bulgaria, specific vocational training has not yet been established and is currently being debated.

Recent initiatives have aimed at harmonizing training and certification. The recent European Qualification Framework (EQF) will harmonize the vocational certification within Europe. Common European Standards are being created and help facilitate high technical standard, which in the long-term, enables common teaching materials.

The responsibility for official vocational training in many European countries is created by the state. Therefore training can vary across Europe. For example, certain countries institute a dual training program, which emphasizes developing skills and knowledge within a company or organization where the firm shares the responsibility of training with the state. This is especially seen in Germany; certain companies and organizations have taken the responsibility of training individuals and are supervised by the vocational training school as well as responsible authorities. Intercompany training centres supplement the training and provide additional teaching material (such as good laboratory equipment for practical purposes). Trainees are often hired as full-time employees by the firm.

In many countries in the region, training takes place completely under academic conditions through training workshops and in the classroom. Short practical apprenticeships provide an insight into the vocation in the water sector. The trainees first submit applications to an employer following the acquiring of the vocational certification.

Often within European countries, personnel are employed from related vocations. Electricians, fitters, vehicle mechanics, plumbers or chemical laboratory assistants are enthusiastically accepted. Employees then become further qualified through courses and these particular courses transform into the necessary qualifications of the national specialist associations. Qualification and approval agencies are used to some countries for the comparability of theoretical and practical expertise.

Training and the knowledge acquired in vocational institutes must run parallel to the challenges of the fast growing industries in the region. Therefore it is necessary to regularly examine curricula as well as develop innovative and relevant teaching tools.

Vocational teaching possibilities are becoming ever more multifaceted and flexible for students. For example in Germany, there are about 350 training vocations students can focus on. In Germany, about 60 percent of all school leavers select a vocational education path. Vocational training is not only a lifelong path but is supported by society. 40 percent of school leavers attend a university and strive for a bachelor or master degree.



*Competition Team Canada at WEFTEC, New Orleans 2012 – Operators Challenge*

### Africa

One of the greatest challenges we face in the world today includes delivering, growing and securing affordable natural resources including water for every citizen. The United Nations has recently confirmed that the world must meet certain targets regarding access to clean water. For example, in order for Nigeria to provide portable water to 75 percent of its citizens, the government requires about 2.5 billion dollars in financing. Overall, Africa is facing greater challenges in water-related fields such as achieving high drinking water quality, water efficiency and freshwater sustainability, filling in skill gaps and increasing industrial linkage to TVET.

In developing countries, as high as 80 percent of illnesses are linked to poor water and sanitation conditions. Approximately 884 million people do not have access to clean and safe water; 37 percent of those people live in Sub-Saharan Africa (WHO/UNICEF, 2012). The United Nations estimates that Sub-Saharan Africa alone loses 40 billion hours per year collecting water; which is the same as a whole year's worth of labour by the entire workforce in France (UNDP, 2009). "Water can make an immense difference in Africa's development if it is managed well and used wisely. Given clear policies, skills development and capacity building, real commitments to implementation, we can use water to help eradicate poverty, reduce water-related diseases and achieve sustainable development" (African Water Vision, 2001).

In African regions, TVET systems (e.g. The Gambian TVET system) forward all of its efforts in instilling the awareness to environmental protection. This is especially through the promotion and integration of the aspects of green practices in TVET, with focus on water conservation and resource use. TVET provides knowledge and skill development in operating and maintaining public and private water treatment plants, water distribution systems, wastewater treatment plants and wastewater collection systems. TVET teaches pupils how to meet the demand for acceptable quality and quantity of water for municipal, industrial, agricultural and recreational use. TVET also teaches how to collect and treat wastewater to an acceptable level for discharge into receiving waters.

The lack of capacity and of skilled professionals for effective water management, especially educational, scientific, technological and institutional, is a key factor that contributes to the global water crises. Technical and vocational education and training (TVET) has been neglected in the national and international education policy agenda for many years in Africa, for a variety of reasons, including: the mismatch between training and labour market needs, high training cost and poor quality of training. Policymakers in many African countries and the donor community have been acknowledging the critical role that TVET can play in national development.

TVET systems in Africa are diverse; by trying to generalize them, they may not accurately reflect the realities of each country. In order to understand some common issues and the general overview of the TVET systems in Africa, we refer to the African Union's situational analysis. Over all in many countries in Africa, TVET is delivered at different levels and institutions, including technical and vocational schools, polytechnics, enterprises and apprenticeship training centres (UNESCO IIC-BA Newsletter Vol. 13 No.2 December, 2011).



*Festo/GIZ Water Training in South Africa 2011*

## Asia and Pacific

Water problems in Asia today are severe. 20 per cent of people, about 700 million, do not have access to safe drinking water, and half of the region's population, 1.8 billion people, lack access to basic sanitation. As population growth and urbanization rates in the region rise, the stress on Asia's water resources is rapidly intensifying. Climate change is expected to worsen the situation. According to the Intergovernmental Panel on Climate Change, by 2050, more than one billion people in Asia alone are projected to experience negative impacts on water resources as a result of climate change. Experts project that reduced access to fresh water will lead to a range of consequences, including impaired food production, the loss of livelihood security, large-scale migration within and across borders, and increased geopolitical tensions and instabilities. Over time, these effects will have a profound impact on security throughout the region (<http://asiasociety.org/files/pdf/Water-SecurityReport.pdf>).



*Sewer cleaning in Vietnam, Hanoi 2011*

Under the condition of global economic downturn, most countries in Asia have continued to invest heavily on technical vocational education and training (TVET) to help achieve economic growth with quality jobs. In times of progress and crisis, TVET has proven to be a strategic option because it is rapid, flexible, jobs-oriented, and competency-based and will lead people to jobs.

This option also highlights how skills development can be an important tool for reducing poverty and enhancing competitiveness and employability during a period of economic recession. In improving the quality and availability of TVET, this fuels innovation, investment, technological change, enterprise development, economic diversification and competitiveness that the Asian economy needs to accelerate the creation of better jobs and improve living conditions.

In many countries', such as in the Philippines, TVET systems have implemented the following training programs:

- a) Pre-Employment training programs.
- b) Retooling/Retraining programs
- c) Upgrading training programs

(Source: Implementing Public TVET Programs in the Midst of the Financial Crisis, by IMELDA B. TAGANAS)

Countries should forge a regional approach in which governments and other key stakeholders, including non-governmental organizations, civil society groups and businesses, work together to clarify responsibilities and coordination mechanisms to address water security concerns. As the Asian Water Development Outlook 2007, an assessment of Asia's possible water future, pointed out, the majority of Asia's water problems are not attributable to an actual shortage, but rather are the result of poor water governance. The report recommended that they are solvable through more effective governance and better management practices.

## Latin America and Caribbean

77 million people within Latin America region lack access to safe and clean water; about 51 million rural residents and about 26 million urban residents. Although conditions are still in need of assistance, this has drastically increased, from 33 percent of the population in 1960 to about 85 percent in 2000. With regard to sanitation waste, less than 14 percent of houses are treated by sanitation plants which can have dire ecological effects.

Compared with the other regions of the world, the water supply, disposal and the waste industry sector in Latin America and in the Caribbean are very heterogeneous. Within the region, Brazil has more infrastructural facilities than other countries. Approximately 90 percent of the services are provided by public facilities. The wastewater disposal and the regulated treatment of waste are still very unsatisfactorily developed and, with this, demand further efforts to expand them. Vocational training for the water and waste sectors is extensively not developed. There are one or two countries in which regular short-term courses are offered.

CEHI is a technical institute of the Caribbean Community (CARICOM) and an inter-governmental organisation of Caribbean countries working towards, among other things, improving the standards of living and working for Caribbean citizens and improving sustainable economic development of the region. CEHI was established in 1979 by Governments of the Caribbean, to address environmental concerns and further the sustainable development of the region. The Institute's environmental health mandate focuses on the impacts of human activity on the environment and the consequent effects on human health and the socio-economic development of CARICOM States.

CEHI is headquartered in St. Lucia and works throughout the Caribbean region providing technical and advisory services to its sixteen Member States. The Institute works with the public sector, private sector, development agencies and civil society and remains dedicated to finding cost effective solutions to environmental problems in the Caribbean. Since its inception, CEHI has provided environmental management training to environmental professionals, public and private sector employees. The Institute conducts national and regional workshops, as well as in-country training for Ministry and state agency facilities. Additionally, one-on-one training is provided through attachments, associate and internship programmes at CEHI headquarters in St. Lucia. CEHI also develops training manuals to support workshop training and post-workshop needs.



*Students viewing a primary clarifier that has been emptied for renovations, Jamaica 2010*

## Arab States

The expansion of vocational training schools with the Arab region is gaining in importance. For example, the Egyptian Holding Company, in the water supply and disposal industry, is operating four of its own vocational training schools. Vocational training school projects are being initiated in Jordan, financed by the European Union.

Despite the increase in vocational training, studying and acquiring an academic title from a highly reputable university has greater significance in Arab society. In many Arab states, attending a vocational school is not seen as attractive as university, and is not sufficiently recognized. For example in many countries in the region, it is therefore rare to find a highly trained electrician. Unfortunately the problem also affects university graduate; despite gaining a degree from a university, numerous graduates are without employment.

Although this problem has already been noted by authorities, it may take many years before attractive professions, recognized by society, can be created for non-academics. In many countries vocational school projects have already started in order to improve the quality of the vocational training school and the industrial training centre. Vocations must be elaborated together with the actors in the market, the employers and, if necessary, where available the unions. Through this cooperation with outside actors, a link with the needs of the labour market can be established.

Many countries in the region have founded large state enterprises for water supply, wastewater and for the disposal of waste. Most of these facilities have their own training centres however these qualifications cannot be transferred to other facilities. Often these training centres offer only short-term training sessions. Collaboration with vocational training schools/establishments is seldom found. Officially recognized vocations for the water and waste sectors do not exist.

Technical standards, which are the basis for the training manuals, are seldom found in Arabic countries. Technical standardisation has no tradition in the economic systems, which is aimed mainly at agricultural products. With this, a rethinking has now started. Countries such as Egypt, Jordan and Tunisia have joined the European standardisation system as affiliated members and therefore have access to European standards.

Another problem prohibiting the development of a vocational training is that the Arabic language has no official, prescribed vocational terminology. A project initiated by the BMZ (German Federal Ministry for Economic Cooperation and Development) with the name "Arabterm" is producing dictionaries in German, English, French and Arabic for up to ten vocational training centres and to be available online. Approximately 7,000 terms, from the area of the water industry, are now available. The database also provides further training, information and visual aids, which can be used by vocational teachers and instructors for teaching purposes.

The common Arabic language allows for easier exchange of documents, curricula and experiences. The collaboration in the water sector is promoted through a new regional specialist association ([www.ACWUA.org](http://www.ACWUA.org)) in which seventeen countries have come together and have intensified the exchange of information. There is now the possibility in bringing together the training managers of the region to further intensify exchange. A first meeting of working groups has taken place in Morocco.

Vocational training will continue to gain significance and with this the water and waste sectors will be of central importance in a region where water is becoming scarcer.



*Wastewater treatment plant in Palestine, Ramallah 2005*



# Chapter 3

## Skills Challenges and Demands by the Industry

Industry is more than a partner in the TVET system; in fact, it is the key driver. Industry plays the major role in the setting of occupational and competency standards. Learning about industries is needed to better understand skills, challenges and demands by the industry. Learning about occupations will provide insight about activities that serve as workers' regular source of livelihood, profession and vocation.

Frequently updated occupational employment projections are needed to influence curricula and continue education, training and degree program development throughout the education and workforce system. This can also help determine the gap in talent many countries are facing, especially with regard to the demands of highly trained professionals. This report demonstrates that there are very few direct occupational matches for workers in traditional industries with declining employment. The education and workforce development system must have a more detailed understanding of occupational skills so gaps can be identified to design and implement strategies that quickly transition workers.

Acknowledging that demand for qualified skilled staff in the Water and Wastewater Industry is high while qualification pathways are diverse and complex, the following are short descriptions of a selection of the hitherto training occupations including basic information on individual training occupations prepared by The Federal Institute for Vocational Education and Training.

### Water Supply Engineering Technicians (BIBB, Germany)

Water Supply Engineering Technicians work in municipal and industrial water supply companies. They carry out their work independently on the basis of technical documents and rules as well as on a legal bases. Water Supply Engineering Technicians procure information, plan and coordinate their work. They document their services and take measures to ensure quality assurance, safety, health and environmental protection at work. They are electro-technically qualified personnel.

#### Water Supply Engineering Technicians

- Manage and control technical processes;
- Operate, monitor, inspect, maintain and repair water extraction, treatment, delivery, storage and distribution facilities;
- Install pipelines, assemble and dismantle the facilities;
- Examine customer facilities;
- Carry out, to a limited extent, switching operations and repairs to the electrical facilities in waterworks;
- Take samples of drinking water for self-monitoring, and determine and evaluate quality parameters to a limited degree;
- Document and evaluate work procedure and operational processes;
- Recognise fault and react independently;
- Work in a cost effective, environmental and hygiene-conscious manner;
- Apply relevant legal provisions, technical regulations and work safety regulations and observe quality management guidelines;
- Act in a customer-oriented manner and make use of information and communication technologies.

#### Activities

Water Supply Engineering Technicians can fulfil their tasks in the following functional entities:

#### Drinking water processing facilities

1. Management (waterworks plant manager, frequently academically educated or, with small waterworks, qualified as Water Technician);
2. Analysis and operation supervision (examination of water quality and sludge);
3. Process control (control room);
4. Operation and maintenance of facilities (machines, plant and filter technology);
5. Disinfection;
6. Management of protective zones;



*Municipal wastewater treatment plant in St. Augustin, Germany 2010*

7. Data management and documentation;
8. Safety management;
9. Quality management.

### Drinking water distribution networks

1. Management (plant manager, frequently academically educated or, with small waterworks, qualified as Water Technician);
2. Work planning (e.g. resource planning, logistics);
3. Water storage;
4. Operation and maintenance of water distribution networks;
5. Leak location and repair;
6. Illegal tapping;
7. Water meter management;
8. Domestic connection management;
9. Operation and maintenance of pumping facilities;
10. Mobile water distribution (e.g. tanker vehicles);
11. Data management (GIS);
12. Safety management;
13. Quality and hygiene management.



*Process control in a water supply plant, Germany 2010*

## Plant mechanics for sanitary, heating and air conditioning systems (BIBB, Germany)

Plant mechanics for sanitary, heating and air conditioning systems install and maintain complex plant and systems in supply engineering. They are assigned to different sites, primarily building sites, residential and factory buildings and workshops. Services for customers are an additional focus. They carry out their work independently in accordance with documents and instructions, observing the relevant rules and safety regulations. They often work as part of a team. They coordinate their work with the preceding and following building activities.

### Plant mechanics for sanitary, heating and air conditioning systems

- Plan and control work procedures, monitor and assess results and apply quality assurance systems;
- Install, dismantle, transport and secure conduits and piping, ducts and components for supply and disposal plant;
- Install and test electrical subassemblies and components;
- Install, set index values for and test control, safety and monitoring equipment;
- Test the functionality of, adjust, optimize and maintain supply engineering plant and systems;
- Implement supply engineering plant and systems into operation;
- Hand over supply engineering plant and systems to customers and instruct customers in the operation of such equipment;
- Inspect, maintain and repair supply engineering plant and systems;
- Advise customers with regard to products and services offered by their company, taking into account environmental and economic aspects;
- Also work with English language documents and use English technical terms.

Plant mechanics for sanitary, heating and air conditioning systems can fulfil their tasks in the following functional entities:

### Domestic water supply and disposal facilities:

1. Customer management and production of offers;
2. Operation and maintenance of pumping facilities;
3. Planning and construction of sanitary engineering facilities;
4. Operation and maintenance of sanitary engineering facilities;
5. Use of storm water, process and grey water;
6. New types of sanitary systems (e.g. separation toilets);
7. Interceptor technology;
8. Customer information and advice.

## Wastewater Engineering Technicians (BIBB, Germany)

Wastewater Engineering Technicians work in the area of drainage networks as well as in wastewater and sewage sludge treatment in municipal and industrial wastewater treatment plants. They carry out their work independently on the basis of technical documents and regulations as well as legal requirements. They acquire information, plan and coordinate their work. With this they document their services and take measures to ensure quality assurance, safety, health and environmental protection at work. They are electro-technically qualified personnel.

### Wastewater Engineering Technician

- Plan, monitor, control and document operational processes;
- Recognise faults in the operational process and initiate measures to eliminate the fault;
- Recognise dangers in the operational process and carry out safety measures;
- Operate plant and machinery, inspects, service and maintain; machines, equipment, piping systems and structural facilities;
- Recognise the dangers in dealing with electricity; assess faults; and carry out electrical engineering tasks;
- Collect and evaluate data and optimise processes;
- Monitor and document compliance with legal requirements;
- Work in costs-, environmental and hygiene-conscious manner.

#### Activities

Wastewater Engineering Technicians can fulfil their tasks in the following functional entities:

#### Municipal and industrial wastewater discharges facilities:

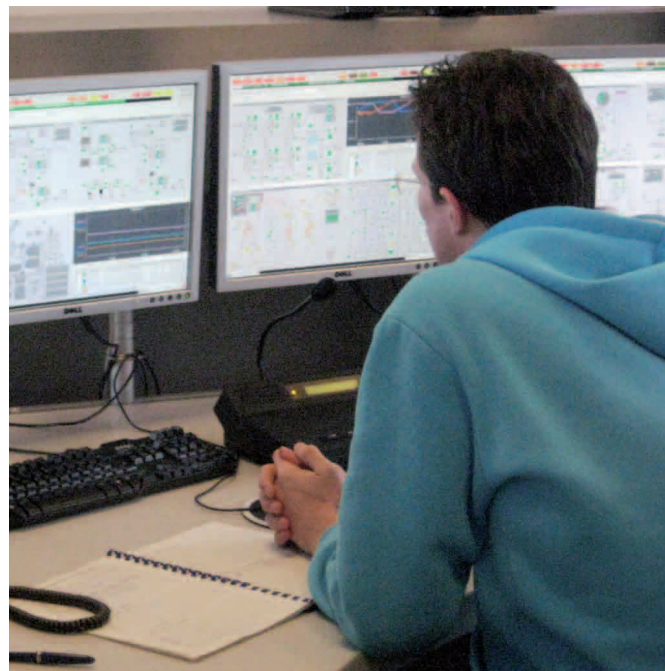
1. Management (plant manager, frequently academically educated or Wastewater Technician);
2. Work planning (e.g. resource planning, logistics);
3. Operation and maintenance of drainage systems (sewer technician);
4. Sewer cleaning;
5. Sewer inspector (CCTV);
6. Sewer maintainer;
7. Private property drainage, cesspits/small wastewater treatment plants;
8. Operation and maintenance of pumping facilities;
9. Monitoring of industrial dischargers;
10. Data management (GIS);
11. Safety management;
12. Quality management.

#### Municipal and industrial wastewater treatment facilities:

1. Management (wastewater treatment plant manager, frequently academically educated or Wastewater Technician);
2. Analysis and operational supervision (examination of wastewater and sludge);
3. Process control (control room);
4. Operation and maintenance of wastewater treatment facilities (mechanical and plant engineering);
5. Treatment and utilisation of wastes from wastewater facilities;
6. Data management and documentation;
7. Safety management;
8. Quality management.



Wastewater treatment, plant work, Germany 2010



Wastewater treatment plant operators work place, Germany 2011

## River Water Maintenance Technicians

(BIBB, Germany)

In Germany these hydraulic technicians work specifically on facilities, structures and other objects on and in bodies of water as well as on floating vehicles and in the workshop. They:

- Produce, monitor and maintain structures and bodies of water;
- Produce, monitor and maintain water's edge security;
- Carry out measures for the maintenance and development of bodies of water;
- Produce structures for coastal and island protection, monitor and maintain these;
- Carry out construction supervision tasks;
- Carry out measures for the maintenance and monitoring of the beds of bodies of water and sign navigation channels and navigable waters;
- Carry out measures for flood and ice protection and defense;
- Control floating vehicles and operate floating equipment;
- Operate and maintain barrages, reservoirs and holding tanks;
- Take measurements and produce work documents;
- Erect, maintain and dismantle scaffolding, employ transport equipment;
- Plan and control work processes, prepare and coordinate processes with other trades;
- Carry out teamwork;
- Hold talks with tasked firms;
- Check and document their work for faultless execution, and carry out quality assurance measures;
- Record quantity and time expenditure and calculate the services carried out;
- Take measures for safety and protection of health with tasks and also for the environment.

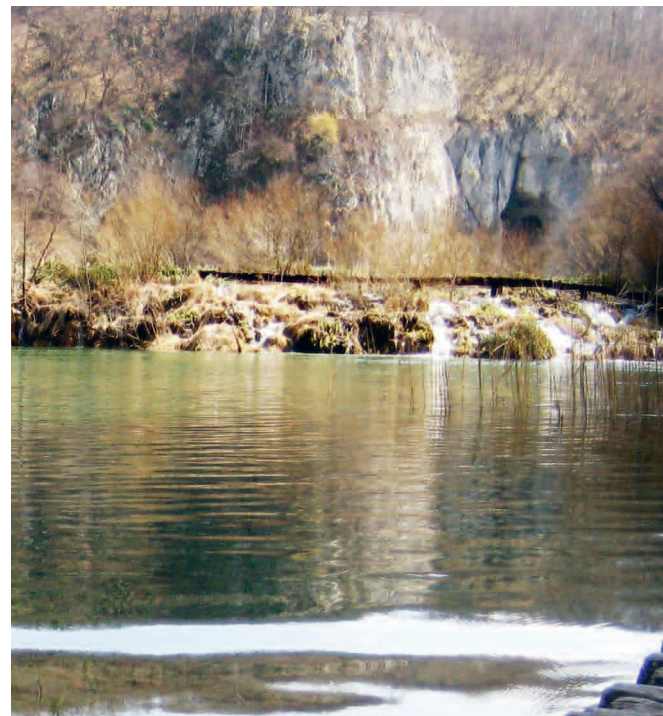
### Activities

River Water Maintenance Technicians can fulfil the following tasks.

1. Management (plant manager, frequently academically educated or Hydraulic Master Technician);
2. Work planning (e.g. resource planning, logistics);
3. Operation and maintenance of bodies of water;
4. Maintenance of structures;
5. Security of water edges and paths;
6. Examination of the bed of bodies of water;
7. Flood protection measures;
8. Control and operation of floating equipment;
9. Operate and maintain barrages;
10. Data management (GIS);
11. Safety management;
12. Quality management.



*Reservoir in France 2012*



*River in Croatia 2012*

### Competence Profiles

Expertise profiles are a tool in order to fill new positions and to determine objectively the best-suited candidates. Employees' competence profiles highlight the need for further training. Competent profiles have become accepted in personnel development and are also employed in the water and waste sectors.

Below is a simple example for the employment in sewer inspection (CCTV-Inspector). The ideal profile is compared with the expertise of the applicants. Candidates who are nearest to the ideal image are the most suitable for the activity. Differences between the planned and actual line indicate the requirement for training.



Practical Training, Germany 2010

Competence CCTV Inspection	A Novice to know	B Practioner to understand	C Professional to solve	D Expert to innovate
Health and Safety		X		
Geoinformation	X			
Sewer Technology		X		
Legal Acting	X			
IT Applications		X		
Standards and Rules		X		
CCTV Technic		X		
Work Organisation		X		
Problem Solving	X			
Systematic Acting		X		
Communication	X			
Working in Teams	X			
Service Orientation		X		

# Chapter 4

## Capacity Development in TVET for Water

Capacity Development, a new favourable way of managing water resources as well as a new economy, can be achieved through a process of learning, transferring, acquiring and using new abilities to replace the old way of doing things. Capacity Development means that knowledge has been created, shared, anchored and is available in an effective way by a variety of stakeholder groups (OECD; 2006).

The term “Capacity Development” embraces three levels: the level of the System, the level of the Organisation and the level of the Individual. These three levels must, like in a gearbox, engage with each other in order that the “vehicle of vocational training for the water and waste sector” is set in motion. If the wheel does not turn, or is in fact blocked, the complete system is endangered.

The level of the system includes the legal conditions, vocational training laws or water and waste laws. Social, quality assurance and technical standard specifications and sets of standards for the operating process and maintenance underpin these legal conditions and thus



*New wastewater treatment plant, Croatia 2012, Karlovac*

create the framework in which capacities can develop.

At the level of the organization, implementation takes place in the practice of the water and waste industries. This takes place in that the individuals come together in organizational units of the operating organization and work there in teams.

The individual level emphasizes expertise and knowledge that each individual learns and gathers during his or her lifetime. This can occur formally via deliberate advanced and further training measures and also informally, for example within organizations through emulation, role model effect or individual exchange of experience.

Overall, the booklet demonstrates that the broader development of technical capacity for the design and operation of water infrastructure and wastewater treatment systems is essential in greening the economy and transition to social sustainability. Promoting adequate technical capacity to support water and wastewater management is thus an important part of the policy package for addressing water challenges in many countries. In addition, the booklet advocates for capacity development of policymakers to encourage governmental accountability as well as to foster innovative approaches and greener technologies.



*Training of trainers in Jordan, DWA 2010*

# Chapter 5

## Country Practices

### Germany

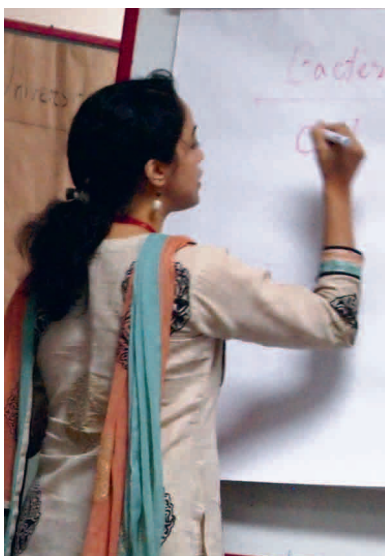
In Germany, professions in the water supply, wastewater and waste sector were officially prescribed in 1984. Employers and union representatives developed the professional contents and the curricula over three years together with vocational school teachers. The experts then wrote both instruction manuals and test manuals for exercises.

The significant driving forces were the specialist associations DWA, Wastewater treatment plant Munich, Germany VKU and DVWK. They provided important expertise and disseminated the information within the branch. Precursors of the professions were six week association courses with corresponding association examinations and qualifications. These experiences have been used for the development of professions and for further development.

Processing was coordinated centrally through the BiBB. The BMBF was the ordinance provider. In 2002, the teaching content for the technicians was updated.

Today professionals are accepted within the branch. Annually 2,000 employees are employed for a three-year occupation education as technicians. Parallel to this, specialist associations offer courses for several weeks for career changers. About 500 career changers take the technician examination.

Building on the technician qualification there is a possibility of joining a Master Technician course and becoming qualified, for example, as a Wastewater Master Technician. The DWA offers these courses together with its partners, for example, the BVS. Technicians for wastewater engineering can independently run wastewater treatment plants with up to 30,000 connected inhabitants and master technicians those up to 80,000 inhabitants. Technicians for water supply technology and technicians for waste and recycling management complete the professional opportunities on offer in Germany.



*Training of Trainers in Bangladesh 2012*



*Wastewater treatment plant Munich, Germany 2010*

With these professions Germany has created a professional foundation for an intact infrastructure within the environmental sector.

### Bangladesh

Bangladesh is a very densely populated country rich in water. The textile industry is extremely extensive and uses the resource of water intensively. The industrial use of water is therefore a central theme in this country.

Regulated municipal and industrial wastewater treatment facilities are only recently being developed along with environmentally sound practices. There are industrial wastewater treatment plants, however, there is a lack of qualified operating personnel for these plants.

Aid projects were initiated for the qualification of wastewater treatment plant personnel in the textile industry. Local trainers, defined curriculum and institutions have been successfully established. Trainers have been qualified and training materials have already been produced.

Following the implementation of training, the experiences are to be evaluated and, if necessary, prepared in a further phase of dissemination of results.

## Jordan

The engineering company ENGICON in Amman, Jordan, founded an operating and maintenance company for water supply and wastewater facilities several years ago. Cooperation agreements have been made in the area of training with the German specialist association DWA and the regional umbrella organisation ACWUA. The ENGICON training manager has been qualified in Germany. The curriculum has been produced in collaboration and the trainers are going through a “training of trainers” programme.

Within a year more than ten short-term training measures have been carried out in Jordan, and the regions over 200 participants have been qualified. The ACWUA has communicated this training opportunity to its members in more than seventeen Arabic countries.

## Egypt

The Egyptian vocational training reform programme (TVET Reform Programme) started in 2004 and is aimed at the areas of textile production, tourism and the building and construction industry. Approximately thirty vocations in these areas were developed (occupational standards developed). Egypt is making great efforts to build up these areas.

The area of water supply and wastewater is looked after by four vocation training schools, which lie within the responsibility of the Holding Company for Water and Wastewater. Typical task profiles have been produced and the required expertise determined. These serve as a basis, in order to further qualify those employed within the twenty-three regions and to practically train students in the regional training centres. With more than 100,000 employees and over 600 water supply and disposal facilities, this is a long-term task.

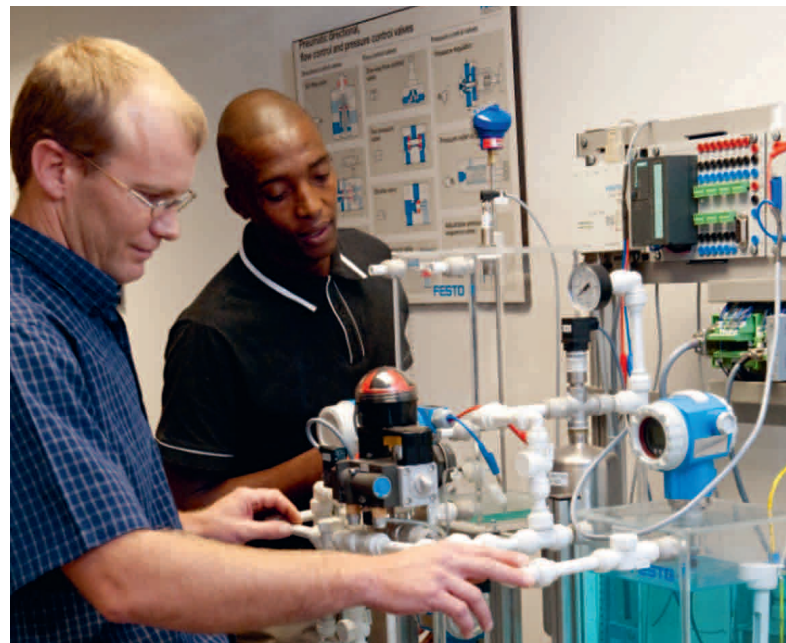
## Romania

A trust collaboration was founded in 2006 between the Municipal Drainage Services in Munich, Germany and the Water Concern Timisoara, Romania. The main purpose of the cooperation is the transfer of knowledge in the field of water supply and wastewater industry. This is especially pertinent to the training of the staff in Timisoara and the surrounding region. In 2011, over twenty short training sessions were carried out with over 400 participants. Educators and staff members were trained in Germany by the Municipal Drainage services in Munich and the DWA. A vocation basic training centre is planned.

## South Africa

South Africa’s current status quo, with regard to the demand and supply of environmental skills, provides the best available information on scarce and critical skills presently in the sector at present from a supply and demand perspective. It also identifies new trends to further develop skill needs in the sector, for example new socio-ecological issues and directions, such as climate change; mainstreaming of environment into development; new science and technology directions in South Africa; and the green economy. It further provides guidance on improving environmental sector skills development planning and implementation within the national education, training and skills development system. It sets objectives for Human Capital Development Strategic Planning for the Environmental Sector, and provides guidelines for Human Capital Development Planning.

Women are under-represented in the water industry, as careers and training in the water management sector are dominated by men. If water management is to be democratic and transparent, both men and women must be equally represented. Recent initiatives have been made



*Festo/GIZ water training in South Africa 2011*



to increase the number of women serving as ministers of water and environment, but the empowerment of women as water managers must also be felt at the grassroots level. In South Africa, women have found their voices and have now been trained to locate water sources in villages, to decide on the location of facilities and to repair pumps. Since these changes were implemented, the incidence of pump breakdown has decreased considerably.

There is a great demand to further improve and propagate existing training units for the personnel of water supply and wastewater facilities. The GIZ, in cooperation with the firm Festo Didactic, is developing five practical oriented training packets in 2011-2013. These packets consist of the modules Transport and Distribution, Water Processing, Monitoring, Energy Optimisation and General Systems. The objective is to improve the practical oriented handling capacity of the participants. More than 450 plant engineers, technicians and specialists will attend these practical oriented courses.

### Jamaica

For almost 20 years, the Ministry of Health and the Technical University in Jamaica have offered a six-week course for operators of water supply and disposal facilities. Participants come from large hotel plants, hospitals, from the National Water Commission and Public Health Inspectors from the Ministry of Health.

The aim of this basic training is to improve the knowledge of the operators of waterworks and wastewater treatment plants; to reinforce an understanding of the hygienic principles; to provide information on new technologies; and to raise the general level of knowledge. Excursions to facilities supplement the theoretical contents. Tests are given after each module. In 2005 the curriculum on anaerobic technology was expanded. In 2010 membrane technology was taken up in the curricular. Financing was assured through participant fees.

### Peru

According to reports, six million Peruvians have no access to acceptable drinking water; over 40 percent are without adequate sanitary provisions. Poor families in the outskirts of cities and in rural areas are particularly affected. Often municipal water supply companies (WSC) cannot guarantee basic supply of water as their personnel are insufficiently qualified and management skills are weak. The sector has neither a systematic training of technicians, nor an adequate framework to keep competent personnel.

Progress has been made with the “National System for Capacity Development” (SFC). Peru, with the assistance of the project, has established a system of supply and demand for further training, technical assistance and technology transfer. Results can be seen on the GIZ website. Measures for “Capacity Development” in Peru have been introduced in order to improve the situation in the water sector. National institutions of vocational training and operator organisations have worked closely together with these measures. The necessary individual training and further training must be directed within the context of the existing framework conditions at the technical level.



*Zaragoza, Spain 2008*

## Korea

The International Expert's Workshop on, "Green TVET and Education for Sustainable Development," September 13 to 17, 2010 in Germany, was organized by the UNESCO-UNEVOC International Centre, in partnership with InWent Capacity Building International, Colombo Plan Staff College (CPSC) and the German Association for Water, Wastewater and Waste (DWA). During the workshop, Ms. Hee Jung Son, Water Resources Training Team, K-Water Academy, Korea Water Resources Corporation, in her presentation stated that the tapping of water resources has been a vital aspect of the Korean economic boom. The provision of water for the agricultural, industrial and household use is being supervised by the central government officials and the Korea Water Resources Corporation (K-Water). Water resource management is also heavily supported by laws pertaining to conservation, protection and preservation of the water supply.

Currently, K-Water has embarked on several projects through their training programs in order to increase awareness towards water resource conservation on TVET. This includes water training programs for local officials, K-Water expert program, CRP (Competency Reinforcement Plan) and water training courses for foreign officials. These programs aim to boost the development of TVET for water sustainability and to provide support to the laws and policies mandated by the government which target workers in the water industry to upgrade Korea's overall water technology level. Continuous upgrades of the training programs, as well as innovations in education, are required to meet the self-evolving demands of the customer.



Source of picture: [http://www.unevoc.unesco.org/fileadmin/user\\_upload/docs/2010-09\\_WaterEducationMunichMagdeburg\\_Finalreport.pdf](http://www.unevoc.unesco.org/fileadmin/user_upload/docs/2010-09_WaterEducationMunichMagdeburg_Finalreport.pdf)

# Chapter 6

## Recommendations: From Policy to Practice in TVET

### Greening TVET for Water

According to new employment trends, formal, non-formal or informal training must reflect these trends in order to train the workers with new and emerging operating techniques and technologies, raise their skills performance and prepare them for lifelong learning. Broadening the debate over raising skills, revisiting qualification targets, encouraging institutional reforms and increasing industry participation, are few of the examples of restructuring the agenda of TVET. Green economy stimulates these efforts and should be closely linked with environmentally-sound practices (Majumdar, 2012).

For TVET to be engaged and carefully aligned with the changing landscape, analysing and understanding the occupational landscape and changes brought by green economic activities would be useful. A holistic framework is needed to transform TVET institution in a comprehensive manner to support green society and green economy. This cannot be achieved by piecemeal or ad hoc approach. As presented in the table below the five dimensions of greening TVET at the institutional level can be highlighted here for further consideration in the context of promoting TVET for the water and wastewater industry.



Figure 2:  
Five Dimensions  
of Greening TVET  
(Majumdar, 2012)

A suggested framework that builds upon the five dimensions to anchor sustainable development principles in TVET institutions is necessary for a smooth transition to a sustainable and low-carbon world through the TVET sector. In this context, supporting sustainable practices and scope of the initiatives, TVET for the water and wastewater industry can be identified for each dimension. The vibrant integration of sustainability into TVET is most effective having both enablers and drivers working in synergy. Institutional value statements, penetration of sustainability principles in administrative and pedagogical systems, community involvement, participation and ownership, will lead to clear educational content restructuring and professional development, that are needed for the water and wastewater industry.

### Demand driven Curriculum

Urgent measures are needed to carry out analyses of labour market requirements, support the development of TVET, employment legislation, professional standards, new curricula, modern teaching methods and examination requirements. These analyses should not be restricted to mere figures, but also provide awareness of the actual state, up-to-date developments, problems and perspectives of TVET in the water sector. Knowledge about the history of the vocational field, standards and qualifications should be considered in curriculum development which will enable the students to develop a critical view on how the characteristics of work in the occupational domain are interlinked with changes in economy and technology. It is important to emphasize that the curriculum should be designed together with enterprises offering qualifications that are geared to professional practice and the requirements of the water sector.

## Training of Trainers

An engineer or scientist understands technical procedures while a teacher or a vocational trainer has knowledge and skills needed for education and the didactics. However, teachers or trainers seldom lack the experience and knowledge about not only the technologies but also legal and labour protection processes in using water and waste engineering facilities.

Both professional groups must acquire missing knowledge of the technology and expertise. Engineers and scientists have to be better trained to use various learning and teaching methods. On the other hand, vocational school teachers must get to know the practices of the water and waste industries and the professional environment and activities involved as well as to bring these into the classroom. Vocational school teachers have to learn about practice and technique and stay "fresh", while engineers and scientists have to develop pedagogic and didactic expertise.

Young beginners in the water supply and wastewater industries are taught by vocational school teachers. Those already employed must also have a chance to acquire this new profession through training measures parallel to their normal vocation. Use of these training measures requires both qualified measures and teachers. Trained and motivated vocational school teachers pass on these measures to subject matters and further to their students.



*Training with DWA Training Box, Bangladesh 2012*

## Project based Learning

In order to introduce new professions into the water supply and wastewater industries, selected vocational training schools can carry out pilot projects. Short courses, new teaching manuals and well-qualified and motivated young vocational school teachers, supported by practitioners from the branch, create a context where a new profession can be introduced and tested. Parallel to this, courses need to be offered and tested for people who are already employed. This should be carried out primarily by practitioners while vocational school teachers can sit in and get to know the branch in more detail.

These pilot projects must be evaluated and made known within the branch. Evaluation of pilot projects creates the basis for the formulation of longer-term project phases. The introduction of new professions into the water and waste industries needs a long-term planning and project phase. However, pilot projects can be "light-houses" and provide the new direction of the professions in the field.

## Capacity Development through Networking

In view of the diverse needs and approaches for capacity development by different levels of stakeholders, including students, educators, employers and others, specifically identifying capacity development needs for each cluster are necessary. It is well-recognized that the transfer or learning new technologies appears as a common need for all the segments. Towards this end, international, regional, national and industry-based networking is needed, while institutional networking would benefit the process of building capacity in thematic areas. Suggestions for expanding activities to sensitize concerned sectors, scale up efforts, build commitment, establish cooperation and transfer technology would add value to this direction. There is a continuous need for developing the capacity of water educators and institutions as well as establishing key partnerships to enable a proper assessment of water challenges and develop suitable educational programmes and curricula (UNW-DPC, 2011).

### Learning Environments

The vocational training must match the necessary expertise of the graduates to the requirements which derive from the demands of the market and services. Professions are subject to permanent change. The developments in IT over the last 20 years have radically changed complete jobs, for example in the printing trade, and new jobs have been created in the fields of robotics and services. New technologies have increasingly been applied also in water supply and wastewater industry.

It takes a decade to qualify those already employed and the new entrants, to convince all employers about a new profession and to match the corresponding wage plan to the changed qualifications. Frequently updated occupational employment projections are needed to influence curricula, continuing education, training, and degree program development throughout the education and workforce system. This will help to determine the level of talent gap a state is facing (i.e., there are not enough high skilled workers to meet demand). The changing learning environment requires new resources and activities.

First of all, for the introduction of a new vocation, there is a need for sufficient financial resources. Vocational training schools need good equipment in order to demonstrate new technologies and developments in step with actual practice. Vocational school teachers have to work themselves into a new profession and must learn to understand the working place. They require good instruction manuals as well as teaching materials such as videos, imagery, E-learning material, YouTube tutorials etc., all of which must be in the form that is easily understandable both for the trainees and the teacher. Training manuals, tests, skill level surveys, practical exercises, videos, imagery etc., must be prepared by experts, which requires time and a coordinated procedure. The material must be made available to all teachers and trainers.

The branch must be informed as soon as the professions have been drawn up and enacted. Websites, brochures, specialist articles and presentations must be found for wide dissemination in order for the new professions to be accepted by potential employees and sought after by employers. Teachers and students also need this information for the selection of a profession. Information material for publication of the new vocation, websites and videos have to be produced. In addition, new professions need the support of the regional professional institutions, the operators and the specialist technical institutions such as associations, professional institutions, and NGOs.

### Environmental Awareness

An environmentally aware and forward-looking vocational training policy creates the framework for professions with good prospects. Forward-looking political thinking vocational training experts have the opportunity of creating a national vocational training in which environmental awareness can play a new role in all professions.

In each vocational training session the concept of environmental protection must be a component part of the curricular. Trainees must structure their approach so that it is environmentally sound. Whether it is the correct handling of water-hazardous substances, the environmentally friendly disposal of materials in the working place or an energy-saving mode of operation, each vocational training session must guide the students appropriately and promote the necessary expertise.

For professions, which are concerned with water, waste, wind or energy, the relaying of the environmental protection concept should be executed with a separate course within the training. Vocational training school teachers must be appropriately trained to transfer environmental awareness to students. Curricula of all the professions in water and wastewater industry must adopt and appropriately draft the professional activity descriptions. In this context, basic hygienic terms with regard to the handling of water and students own health protection should not be forgotten.



*Training WWTP, Germany 2010*

## Training Delivery

### Legal setting

Vocational training schools need the following settings:

- Legal enforcement as an institute,
- Occupation law,
- Sufficient budgets,
- Support (network) from the water industry,
- Curriculum.

### Teaching Infrastructure

Technical training schools should have available the following items:

- Well lit classrooms,
- Equipment (boards, flip charts, pin boards, beamers etc.),
- Laboratories,
- Workshops, work and training rooms,
- Sufficient sanitary facilities and overnight accommodation and catering possibilities,
- Charts and models to help the visualization of the subject,
- Good facilities and possibilities for practical exercise should be, guaranteed for each participant,
- Expense material and exercise areas are to be provided in the practical workshops and exercise areas.

### Training Material

Training material, based on the curriculum, must be available. The following items are needed:

- Technical books for participants,
- Teacher books,
- Exercise books,
- Examination questions for exercise.

### Implementation of Training

Training should be delivered through different methods:

- Group work,
- Presentations by students,
- Viewing of videos,
- YouTube offers,
- Excursions,
- Technical talks and discussions,
- New media, e-lectures, e-classes and blended learning materials.

### Tests

Tests must be evaluated jointly by practitioners and educators. To create good questions requires a great deal of expert knowledge and experience.

A number of question types are given as examples:

- Course work: problem cases from the water and waste industries are described,
- Technical reports: consideration of a work step, e.g. BOD5 analysis,
- Multiple choice questions: specified answers are marked,
- Reorganisation tasks: new combinations are to be arranged,
- Arithmetical problems,
- Open answer problems.



*Testing Teaching Material, UNESCO UNEVOC, Bonn 2012*

### Modular Wastewater Training System

This building set contains magnetic cards for work using a magnetic board. These cards represent component parts of a wastewater treatment plant and can be combined together as desired. Supplementary to this a paper card set can then be handed out to each participant. These paper cards indicate an object, for example a grit chamber, on one side and on the reverse side the explanations are listed and the most important operating data noted. Supplementary to this, for each card there are examination questions prepared. These can be used directly by the teacher ([www.dwa.de](http://www.dwa.de)).

## WorldSkills International

WorldSkills International is a non-profit membership association promoting vocational education and training in their respective countries/regions.

Up until now WorldSkills has had a competition for plumbers. Further competitions in the water sector will be shown for the first time at WorldSkill Leipzig in July 2013.



## Life-long learning systems

Life-long learning has become a fixed term. Technology, laws and constraints are changing all the time. Every employee must keep up-to-date and track the changes.

## Short-term training as refresher

In the course of time technologies change. In recent years for example, membrane technology has made a very strong entry into water supply sector and this technology has been partially applied also in industrial wastewater treatment plants and municipal plants.

## Neighbourhood system

In Germany, there have been wastewater treatment plant neighbourhoods since 1968. In 320 regional neighbourhoods with each fifteen to twenty plants, the operating personnel meet twice a year and exchange experiences. Since 1999 there has also been the Lake Constance (Bodensee) neighbourhood. There, eleven German, eleven Swiss and three Austrian wastewater treatment plant operators meet once a year for their exchange of experiences.

## Skills competition

Over recent years the significance of vocational training has been reinforced internationally through politics and the economic system.

Professional competitions motivate, inform and train and are a very good means of public relations and training.

## Exchange of experience and sharing knowledge

There is a need to provide a platform for exchange of experience, sharing of knowledge and contestation of ideas between TVET and the Water and Wastewater Industry.

## Operators Challenges / WEFTEC/ USA professional competitions

Every year, five competitions are held: a collections event; a laboratory event; a pump maintenance event; a process control event; and a safety event.

These competitions, which have already been in existence for 25 years, motivate, inform and train the competitors from the various states of the USA.



## IFAT/Germany – DWA Open German Championship in Wastewater Engineering

Since 2010 DWA has organized a professional competition for specialists in wastewater engineering at the biannual environmental trade fair IFAT Munich. More than thirty teams from various German towns and cities came together in 2012 and competed for the medals. Teams from Vienna and Romania also took part.

Motivate, inform and train – in the training period and also as a professional. Trainees and professionals competed for the championship title in three disciplines: entry into a manhole, working in a traffic area and the control of a wastewater treatment plant.



Professional competition, IFAT, Munich 2012

# Resources

## Background papers prepared to underpin development of this Booklet

Final meeting report on "Green TVET and Education for Sustainable Development", (Germany, 2010)  
[www.unevoc.unesco.org/fileadmin/user\\_upload/docs/2010-09\\_WaterEducationMunichMagdeburg\\_Finalreport.pdf](http://www.unevoc.unesco.org/fileadmin/user_upload/docs/2010-09_WaterEducationMunichMagdeburg_Finalreport.pdf)

Final meeting report on "Transforming TVET for Meeting the Challenges of the Green Economy" (Germany, 2011)  
[www.unevoc.unesco.org/fileadmin/user\\_upload/docs/GreeningTVET\\_Meeting\\_ReportBonn2011FINAL.pdf](http://www.unevoc.unesco.org/fileadmin/user_upload/docs/GreeningTVET_Meeting_ReportBonn2011FINAL.pdf)

BIBB Bundesinstitut für Berufsbildung. Explanatory notes to and practical assistance for the nationally recognised vocational training regulations. Environmental Engineering Occupations. Volume 1. Water Supply Engineering Technician. Publisher: Federal Institute for Vocational Education and Training. W. Bertelsmann Verlag GmbH & Co. KG, Bielefeld, Germany. 1st reproduction 2008. Order-No.: E035, ISBN 978-3-7639-3736-3 (German original)

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