



TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING IN THE WATER SECTOR

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Address
53113 Bonn, Germany
T +49 61 228 44 60-0
F +49 61 228 44 60-17 33

E svbb@giz.de
I www.giz.de

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Authors:

Dipl.-Ing. Rüdiger Heidebrecht (DWA) and Inke Hase (GFA)

Design:

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Abbreviations

ACWUA	Arab Countries Water Utilities Association
AQF	Arab Qualifications Framework
ASEAN	Association of Southeast Asian Nations
ATV	Abwassertechnische Vereinigung e.V. (German Association for Waster Water)
BIBB	Bundesinstitut für Berufsbildung (German Federal Institute for Vocational Education and Training)
BMBF	Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research)
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety)
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
BMWi	Bundesministerium für Wirtschaft und Energie (German Federal Ministry for Economic Affairs and Energy)
CEMEAU	Centre des Métiers de l'Eau (Training Centre of State Water Utility ONEA in Burkina Faso)
CEN	European Committee for Standardization
CVQ	Caribbean Vocational Qualifications Framework
DACUM	Developing a Curriculum (method of identifying and visualising occupational requirements)
DFID	Department for International Development, United Kingdom
DIN	Deutsches Institut für Normung (German Institute for Standardization)
DQR	Deutscher Qualitätsrahmen (German Qualifications Framework)
DVGW	Deutscher Verein des Gas- und Wasserfaches (German Technical and Scientific Association for Gas and Water)
DWA	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (German Association for Water, Wastewater and Waste)
EEA	European Environmental Agency
EU	European Union
EQF	European Qualifications Framework
FESTO	Festo AG & Co. KG (the group provides automation and control systems, while Festo Didactic provides technical training equipment)
GDP	Gross Domestic Product
GDVT	General Department of Vocational Training
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GLAAS	UN Water Global Analysis and Assessment of Sanitation and Drinking-Water
GOVET	German Office for International Cooperation in Vocational Education and Training

Abbreviations

GPS	Global Positioning System
GPPI	Global Public Policy Institute
GWP	German Water Partnership
HCD	Human Capacity Development
HCWW	Holding Company for Water and Wastewater, Egypt
HVCT	Ho Chi Minh Vocational College of Technology
IFAT	Internationale Fachmesse für Wasser – Abwasser – Abfall – Recycling (World's Leading Trade Fair for Water, Sewage, Waste and Raw Materials Management)
ILO	International Labour Organisation
iMove	International Marketing on Vocational Education (BMBF initiative to internationalise German vocational education and training)
ISO	International Organization for Standardization
IT	Information Technology
IWA	International Water Association
IWRM	Integrated Water Resource Management
KfW	KfW Entwicklungsbank (KfW Development Bank)
MDG	Millennium Development Goal
NGO	Non-Governmental Organisation
NWSC	National Water and Sewerage Corporation, Uganda
OECD	Organisation for Economic Co-operation and Development
ONEA	L'Office national de l'eau et de l'assainissement (State Water Supply Utility in Burkina Faso)
PE	Population Equivalent
PPP	Public-Private Partnership
SADCQF	Southern African Development of a Common Qualifications Framework
SDG	Sustainable Development Goal
SETA	Sector Education and Training Authority, South Africa
SEWERIN	Technology leader for gas and water leak detection
SETAs	Sector Education and Training Authorities
TC	Technical Cooperation
ToT	Training of Trainers
TVET	Technical and Vocational Education and Training
UN	United Nations

Abbreviations

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEVOC	United Nations International Centre for Technical and Vocational Education and Training
UNESCO-IHE	United Nations Institute for Water Education
UN HABITAT	United Nations Human Settlements Programme
UN WATER	The United Nations inter-agency mechanism on all related issues, including sanitation
UNW-DPC	United Nations Water Decade Programme on Capacity Development
USAID	United States Agency for International Development
VET	Vocational Education and Training
VETA	Vocational Education and Training Authority, Tanzania
VTC	Vocational Training Corporation
VWSA	Viet Nam Water Supply and Sewerage Association
WASH	Water, Sanitation and Hygiene
WDMI	Water Development and Management Institute, Tanzania
WHO	World Health Organization
ZVSHK	Zentralverband Heizung, Sanitär und Klima (German Central Association of Sanitation, Heating and Air-Conditioning)

Foreword

“One of the ten explicit objectives of the BMZ’s education strategy is to further expand vocational education and training (VET). These activities should not, however, be carried out in isolation. Rather, they should link up with other measures in the priority area of education or with other priority areas of development cooperation in order to further boost the effectiveness of German development cooperation for people in partner countries.” (BMZ 2012:7)

In a study published in September 2014 the International Water Association (IWA) writes:

“Shortages of human resources in the Water, Sanitation and Hygiene (WASH) sector will undermine the progress of many countries ... to increase access to water and sanitation.” In order to achieve the Millennium Development Goal (MDG) and nowadays the Sustainable Development Goal (SDG¹) target 6, to “ensure availability and sustainable management of water and sanitation for all” countries will have to double their current human resources and raise the level of training. (IWA 2014:3)

This study has been commissioned by the sector project Technical and Vocational Education and Training (TVET) of the *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*. It has been produced for Division 303 (Education and the digital world) and Division 312 (Water; urban development; mobility) of the German Federal Ministry for Economic Cooperation and Development (BMZ) in German language. The GIZ Competence Centres for “Education, Vocational Education and Labour Market”, and “Water, Wastewater and Waste Management” collaborated on the study. The aim is to generate recommendations for further development of the portfolio at the interface between the TVET and water sectors.

For the purposes of this study, technical and vocational education and training (TVET) is understood to embrace both initial vocational training in non-academic sectors and continuing vocational training, both of which are part of lifelong learning. The study concentrates primarily on water supply and sanitation for urban and rural households, commerce and industry. Over and above this it will look at household-level services and the informal sector, and assess their impact on employment. The study takes its lead from the BMZ position paper “Vocational education and training in German development policy” (BMZ 2012) and the “Water Sector Strategy” (BMZ 2006). It addresses BMZ officers, the staff of implementing organisations working in TVET and water projects and a professional audience inside Germany and at international level.

TVET experts and water sector experts have their own views, their own terminology and their own objectives. This study aims to help forge a common understanding shared by both sectors and to foster communication between the two. Water sector specialists should be in a position to recognise and evaluate the requirements of initial vocational training and continuing (lifelong) technical and vocational training, as well as appreciating the differences between them. Experts should be able to assess work processes, the demand for skilled workers and the occupational profiles needed in the water sector, as well as designing initial and continuing vocational training measures.

The study has taken the form of a desk study, supplemented by written surveys and interviews with experts (officers responsible for the commission and planning officers from eight development cooperation projects in Afghanistan, Burkina Faso, Jordan, Uganda, Tanzania, South Africa, Viet Nam and Peru). Investigations were complemented by meetings with staff members of the KfW Development Bank and stakeholders from the German Water Partnership.

Due to the increasing relevance of the topic and the great demand for an English version, we have translated the German study now into English. In this process, we have made few changes, such as alignment of SDGs, updating the projects or references. We wish you now an interesting reading!

Christoph Büdke, Jani Kitz, Dr Klaus-Dieter Meininger, Monika Soddemann and Anja Speicher
GIZ sector project Technical and Vocational Education and Training

¹ On 25 September 2015, the general assembly of the United Nations passed a new agenda: The 2030 agenda for sustainable development. Now, the so called sustainable development goals (SDGs) replace the millenium development goals (MDGs).

Abstract

Germany is one of the world's largest bilateral donors in the water sector. The United Nations (UN) Water for Life Decade (2005–2015) helped to bring about significant investments and make considerable progress around the globe. Yet challenges still exist in the international water sector. Adequately qualified professionals are needed to operate and maintain infrastructure in the long run. This represents a sizeable challenge for many developing countries since they already face considerable staff shortages and sufficiently qualified employees. Targets that have already been met are in jeopardy because of a lack of skilled workers. Many international donors have recognised water and jobs as priority issues. In this regard, data on the situation of the labour market was collected and solutions were developed thereupon.

The study focuses on drinking water supply and sanitation in households, in enterprises and the industry. For the purpose of this study, technical and vocational education and training (TVET) is considered to mean initial vocational training in the non-academic sector and professional development as a part of lifelong learning.

A large number of factors are hampering achievement of the Sustainable Development Goals (SDGs) in the water and TVET sectors. Natural disasters are occurring in greater frequency and the population in countries most affected by deficient water conditions is growing at a disproportionately fast rate, as is urbanisation. In many countries, young people are already largely decoupled from the formal labour market. In addition, workers often lack sufficient training to cope with growing requirements in the water sector caused by rapid technology change. Many people work in the informal economy, particularly those who provide household services. Their lack of skills frequently leads to high water losses and improper and environmentally harmful wastewater disposal.

Data on employment in the international water sector has only been gathered systematically since 2009. The International Water Association (IWA) published a profile of developing countries in September 2014. This study looked at 15 countries in two phases. With regard to ensuring universal supply, the study concluded that, for the ten countries evaluated in the second phase², there was a shortfall of 787,200 professionals. For example, Mozambique

would have to double the number of trained professionals to meet its goals. Ghana has a significant gap in the field of sanitation, while Bangladesh needs another 44,000 skilled workers. Despite major progress in this sector in recent decades the country was closed to achieving the MDGs.

According to the IWA study (2014), about 44% of the human resources required concern sector-related technical occupations, while 13% involve technical staff in the drinking water and wastewater sectors. The remaining 43% encompasses management and financial staff (37%) and personnel officers (6%). Another key finding is that only about 20% of the lacking capacity is in the area of drinking water supply, while the wastewater sector has 80% fewer staff than needed.

Alongside staff shortages, there are also qualitative concerns. In many instances, employees do not have the skills they require to operate systems productively. This is due to several factors, amongst the lack of practical elements in the respective TVET system.

On the whole, the water sector offers reliable jobs that are not sensitive to economic changes and it provides significant employment potential around the globe because of upcoming investments. However, inadequate public sector salaries and a poor image, especially in the sanitation sector, are hindering worker retention, particularly in rural areas.

Germany has an unparalleled 30-plus years of experience in training skilled workers in green technology. Experts in water supply and wastewater technology, industry and the waste sector ensure reliable water supply and wastewater disposal in households, enterprises and industry in Germany (GIZ 2013:113ff). This is one of the essential prerequisites for health, food production and economic activity in this country.

Challenges and opportunities lie in the coordination of the activities of the various national and international stakeholders active in TVET in the water sector. Several German ministries, such as the German Federal Ministry for Economic Cooperation and Development (BMZ) and the German Federal Ministry of Education and Research (BMBF), trade associations as well as the German Water Partnership (GWP) have recognised the importance of this issue and developed promising approaches. In addition, there are several international initiatives and

² First phase: Bangladesh, Mali, South Africa, Timor-Leste and Zambia. Second phase: Burkina Faso, Ghana, Laos, Mozambique, Niger, Papua-New Guinea, Philippines, Senegal, Sri Lanka and Tanzania.

Abstract

research approaches, associated for instance with the International Labour Organization (ILO), UN Water and IWA.

Development cooperation is faced with the major challenge of considering TVET and water as interconnected sectors and identifying suitable interventions in cooperation with partner countries. A potential model is the integrated approach to employment promotion, which compares the demand for labour (in the water sector) with the supply of labour (market for TVET). Supply and demand are balanced out through labour market policy, notably through the dialogue-oriented gathering of labour market information. The water sector must develop an understanding that investments in infrastructure have to go hand in hand with investments in human capital. Consequently, stakeholders in the water sector (for instance ministries and associations in each country) have the responsibility to keep this in mind and initiate dialogue with the ministries and institutions responsible for TVET. They should also become more involved in the financing, planning and practical implementation of training.

There are various options for promoting TVET – which can also be used in combination – depending on the number of water supply and sanitation systems in BMZ partner countries, the size of the population and the structure of the vocational training systems:³

- a) Independent training in specific water and wastewater occupations;
- b) Basic training in skilled occupations (electricians, fitters, plumbers, etc.) with advanced, modular qualifications in water supply and wastewater disposal;
- c) Modular further training.

Regardless of whether the focus is on complex approaches for initial vocational training or ‘smaller solutions’ in combination with further training, the requirements for adequate education and training systems apply to both approaches. An analysis of skills and needs has shown that overarching, flexible and standardised curricula should be developed or existing curricula adapted in cooperation

with social partners. These curricula are expected to be certified and compatible with each country’s educational system. Only comparable educational qualifications and certificates can bring about an increase in the acceptance of TVET and boost the mobility of professionals. Financing models must also be found. Lessons learned from vocational training in other sectors (such as the energy sector) in each country should be taken into account. Customised training approaches are needed for target groups in the informal economy and can be realised in cooperation with non-governmental organisations (NGOs).

The study examined a few GIZ projects at the interface between water and TVET. Content ranges from providing customised training for operators (Afghanistan) to introducing systematic vocational training approaches (Viet Nam, Jordan and Peru). In all projects, short-term training courses were conducted with operators, training modules were developed, trainers were trained, materials were created and descriptions of skills and jobs produced. This work was carried out with partners, often on an individual basis or at local level. Of course, many good approaches already exist in different projects. However, national vocational training approaches in the water sector are still in the early stages of development.

The study makes a few overarching recommendations based on its review of the labour market, approaches and lessons learned in development cooperation projects. The SDGs, which replaced the MDGs after 2015, offer guidance for designing new projects.

A higher priority should be given to making investments in infrastructure and strengthening vocational training at the same time. Construction planning and human resources planning should be systematically taken into account from the outset.

³ The integration of green skills into existing TVET courses has precedence over the creation of new professions (integration principle). By the time they finish their course, trainees must be in a position to contribute to the prevention of environmental damage caused by businesses in their professional sphere of influence. In accordance with the integration principle, green skills must always be kept in mind in formal and informal vocational training (GIZ 2013:35).

Abstract

When developing TVET approaches – whether initial vocational training or continuing training – the circumstances and needs in the partner country must be taken into consideration on a systematic basis. The five principles of German TVET can also offer important guidance when designing approaches (BMZ 2012:25):

1. Close cooperation between the state and the private sector;
2. On-the-job learning;
3. Social acceptance of standards;
4. Training of vocational teachers and instructors;
5. Institutionalised research and advice.

Germany looks back on a long tradition of cooperation with developing countries, both in the TVET and the water sector. It also has a strong apprenticeship tradition.

The study's authors recommend developing pilot measures in countries with a skills shortage to foster targeted cooperation between the TVET and water sector in development cooperation. Labour market data, such as the figures made available by IWA for 15 countries, may serve as a starting point here.

The positive experiences with past projects should be systematically reviewed in suitable forums (for instance sector networks of implementing organisations) and curricula and training materials should be made available across borders. Promising cooperative approaches among BMZ implementing organisations – between the GIZ Sector Project “Technical and Vocational Education and Training”, the GIZ Competence Centres for “Education, Vocational Education and Labour Market” and “Water, Wastewater and Waste Management” and KfW Development Bank – should be pursued in greater depth.

Significance



Significance

By 2025 two thirds of the world's population will live in water-poor regions. The people of Asia will be worst affected. The predicted rise in the global population to nine billion in 2050 will further exacerbate the problem of water availability. Agriculture accounts for about 70% of water consumption, followed by industry (20%) and households (10%).

“Clean water and sanitation can make or break human development. They are fundamental to what people can do and what they can become – to their capabilities. Access to water is not just a fundamental human right and an intrinsically important indicator for human progress. It also gives substance to other human rights and is a condition for attaining wider human development goals.”⁴ (BMZ 2006:5)

“2.5 billion people still lack basic sanitation and at least 1.8 billion people do not have access to safe drinking water. Water is key to food security for humankind. Agriculture requires the most water by some margin with a share of about 70%, followed by public water supply and industry. The Food and Agriculture Organization predicts that agricultural demand for water will increase by 40% to 60% by the year 2030. According to the OECD, global water consumption will see an increase of 55% by 2050, also driven by increased demand from manufacturing industries, thermal power plants and private households. The prognoses indicate that 2.3 billion people – 40% of the global population – will live in areas suffering from water shortages by then, especially in northern and southern Africa and southern and central Asia.”

(GIZ 2014:Water for All)

In developing countries and emerging economies in particular, contaminated water causes serious health problems. Every year 3.5 million people die because of water shortages or because they have consumed contaminated water. Every day 5,000 children die of diarrhoeal diseases and other diseases caused by contaminated water and the lack of sanitation.

Water is right at the top of the global agenda.⁵ Climate change and the necessary national adaptation strategies are linked to water. The close links between water, energy and agriculture are a focus of global discussion and are also emphasised by the BMZ.

Strategies are being implemented in numerous projects in developing countries, and the concomitant investment is being made. But at the end of the day, plants must be planned, built, operated and maintained by people. And this requires well trained skilled workers at all levels. Without properly qualified operators machinery will not work; plants do not maintain themselves, and if the skills are not available no plants will be built and no plans translated into practice. Drinking water supply and sanitation facilities must function without interruption, 24 hours a day, 365 days a year. This sets the water sector apart from other trades or branches of industry. Needs-driven vocational education and training is essential in the drinking water and sanitation sector to provide the skilled staff required.

Definition of the water sector for the purposes of this study

The water sector affects every aspect of our daily activities, food production and industry. The concept of the water-energy-food nexus is found increasingly in development discussions and in research circles, and will quite possibly supersede the concept of Integrated Water Resources Management (IWRM) currently used in German development cooperation in the years to come.

Water supply and sanitation services provide rural and urban households, trade and industry with water and dispose of the wastewater generated. Alongside this formal-sector businesses, the informal sector plays a vital part in providing household-level services like the water tanker drivers, septic tanker drivers and plumbers.

⁴ Source: Human Development Report 2006: Beyond scarcity: Power, poverty and the global water crisis, UNDP, 2006, page 27
BMZ Sector Strategy 2006: https://www.bmz.de/en/publications/archiv/type_of_publication/strategies/konzept152.pdf

⁵ <https://sustainabledevelopment.un.org/sdg6>: Ensure availability and sustainable management of water and sanitation for all

Significance

This study intentionally focuses on a sub-sector of the water industry, namely drinking water supply and sanitation, including household-level services. Within the framework of the MDGs and nowadays the SDGs this sub-sector is becoming increasingly important. This is reflected in the new BMZ Water Strategy 2017 – A key contribution to implementing the 2030 Agenda and the Paris Agreement. As well as in the increase in the volume of German development projects implemented (BMZ:2017).

Germany has been one of the biggest bilateral donors in the water sector for more than ten years. In 2016 alone, the Federal Ministry for Economic Cooperation and Development (BMZ) provided roughly 456 million euros to support water-related projects and programmes.⁶

Definition of TVET for the purposes of this study

For the purpose of this study, TVET is taken to mean initial vocational training in the non-academic sector and continuing vocational training and professional development as a part of lifelong learning. In Germany the term “dual vocational training” is also used, where training takes place both at a school and within industry. This concept gives Germany and a very few other countries⁷ a unique status in the world. The German system of TVET, with its own particular facets, cannot be directly transferred to other countries. The key features of this system (BMZ 2012:25) can, however, provide guidance and enable Germany’s development cooperation to devise customised solutions for and in partnership with each individual country in this field.

TVET generates employability and helps reduce poverty as laid out in the BMZ’s strategy papers (see foreword). Individuals successfully completing TVET courses have the knowledge, skills and abilities that provide a sound foundation for lifelong employment and lifelong income. In addition to initial vocational training, professional development with retraining, refresher courses and upgrading are vitally important fields of action.

Household-level services are often provided by the informal sector. In some countries vocational training does

exist in the informal sector in the form of traditional training schemes, although they rarely meet the standards required today. The capacities of those employed in the informal sector are often only very basic, and it is rare for technical or environmental and hygienic standards to be assured. This makes it important to devise specially adapted services for these target groups (non-formal vocational training, for instance), and to foster acceptance for their competencies within the formal education and training system.

⁶ <https://www.bmz.de/en/issues/klimaschutz/water-and-climate/germanys-commitment/index.html>

⁷ This is also the approach to vocational training in Austria, Switzerland and Liechtenstein.

2

International challenges



International challenges

Agenda 2030

The MDGs laid out major goals for drinking water and sanitation, on which significant progress has been made in recent years (MDG 7c). The MDG shifted over in 2015 to the Agenda 2030. It is recognized as a transformative, universal and integrated agenda with 17 Sustainable Development Goals (SDGs).

The situation still is that 780 million people have no access to safe drinking water. There are still 2.4 billion people worldwide without adequate sanitation with grave consequences for health and the environment (BMZ Water Strategy 2017:4). Water consumption is expected to rise by an estimated 55% by 2050, and by 2025 two people in three will live in countries suffering water shortages.

“SDG 6 aims to tackle challenges related to drinking water, sanitation and hygiene for populations, as well as to water-related ecosystems. Without quality, sustainable water resources and sanitation, progress in many other areas across the SDGs, including health, education and poverty reduction, will also be held back. In 2015, 5.2 billion people (71 per cent of the global population) used a “safely managed” drinking water service – an improved source located on premises, available when needed and free from contamination. In 2015, 2.9 billion people (39 per cent of the global population) used a “safely managed” sanitation service – a basic facility that safely disposed of human waste. Open defecation, practised by 892 million people (12 per cent of the global population) in 2015, continues to pose serious health risks. More than 2 billion people globally are living in countries with excess water stress. Northern Africa and Western Asia, as well as Central and Southern Asia, experience water stress levels above 60 per cent, indicating the strong probability of future water scarcity.”

(UN The Sustainable Development Goals Report 2017:6)

Although major progress has been made in the area of water supply as part of the MDGs. Still 1.8 billion women, men and children must drink contaminated and therefore health-threatening water (BMZ Water Strategy 2017:4).

For the post-2015 era, UN-countries adopted a set of SDGs in September 2015 as part of a new sustainable development agenda (2015-2030). The main difference between the old and the new goals is that while the MDGs applied

primarily to developing countries, the new SDGs are to be part of a universal global agenda that will apply to all states. Furthermore: The MDGs focuses on drinking water and sanitation. SDG 6 – Ensure availability and sustainable management of water and sanitation for all – covers the entire water cycle, including the management of water, wastewater and ecosystem.

These are in detail:

SDG 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

SDG 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

SDG 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

SDG 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

SDG 6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.

SDG 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

SDG 6.a By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

SDG 6.b Support and strengthen the participation of local communities in improving water and sanitation management.

SDG 6 has strong linkages to all the other SDGs, it also underpins them. Given the interdependent nature of sustainable development the targets of SDG 6 is also depending on developments in these other SDGs. In other words SDG 2 (food nutrition), SDG 3 (health), SDG 7 (energy), SDG 8 (work and economic growth), SDG 11

International challenges

(urban development), SDG 12 (consumption and production), SDG 13 (climate action), SDGs 14 and 15 (terrestrial and marine biodiversity), and SDG 16 (peaceful, just and inclusive societies) are all directly linked to the water links. The 2030 Agenda focuses on these links (BMZ Water Strategy 2017:6).

German development cooperation is pursuing four broad objectives in the water sector that build on the SDGs and German development cooperation's cross-sectoral objectives. These are:

1. Expand our engagement for water supply and sanitation, wastewater management and climate-smart water resources management, and align this with the needs of partner countries and particularly disadvantaged groups.
2. Increase our orientation towards results, and monitoring.
3. Further, develop our leading role in improving sanitation through international networks and partnerships such as the Sustainable Sanitation Alliance and our cooperation with the Bill & Melinda Gates Foundation.
4. Attach greater weight to the importance of water as a factor in global crisis and for achieving objectives in other sectors of German development cooperation. In line with partner country needs, we aim to increase our support for water security activities by a third.

(BMZ Water Strategy 2017:6)

Investment in the water sector has been significantly raised over the last ten years. The necessary initial and continuing vocational training measures, however, have not kept pace with investment, nor have job creation efforts. In future this will figure more prominently on the international agenda, however. The focus of World Water Day 2016 was on "Water and Jobs". Several studies have been conducted, some in cooperation with the ILO (UN Water 2014). This underlines the importance attached to this issue. If the staff do not have the skills required, there can be no reliable and affordable drinking water supply and sanitation.

Climate change and (natural) disasters

Climate change can already be seen today: drought in the United States of America, flooding in Pakistan. We will have to adapt to climate change, which is why it is important to take steps today in the field of drinking water supply and sanitation. In irrigation systems, for instance, more attention should be paid to re-using wastewater. Treated wastewater or surface run-off water can be helped to permeate the soil more effectively, thus recharging groundwater reserves, which can then be re-used. The 3R concept – Reduce Runoff – Recharge Groundwater – Reuse Water is already firmly established among experts in the field and is attracting a lot of attention, especially in countries suffering changed rainfall patterns.

Flood incidents can trigger problems in residential and industrial areas as a result of flooding, heavy rainfall and rapidly rising groundwater. Many built-up areas are located on river banks or sea coasts. Rising sea levels are a cause for concern in many regions. Dykes or mobile protection systems can mitigate flood damage. Modern urban planning already takes these developments into account, but the international discussion is still in its infancy.

Emergency flood plans must be prepared and tested. The same applies to long dry periods. Droughts and dry periods cause harvests to fail. Fertile land becomes desert, with dramatic impacts. This makes it important to work out and think through the worst-case scenarios. The water sector has a crucially important part to play in this. Clean drinking water must be made available in crisis-affected regions within a very short space of time. Drinking water supplies and sanitation are crucial to ensure the survival of people and livestock. In all these areas, existing operating staff must be trained at an early stage. Only then adaptation to climate change will be successful, and the necessary emergency measures prove effectiveness.

Rising urbanisation – infrastructure must be rapidly extended

Urbanisation is progressing apace. Today, about 50% of the population of the Earth live on around 2% of the planet's surface area. The number of megacities is rising; together these centres generate some 80% of gross domestic product (GDP). These activities account for between 60 and 80% of energy consumption and generate about

International challenges

75% of all CO₂ emissions (Vestner 2014). The trend is set to continue: the United Nations Human Settlements Programme (UN-HABITAT) predicts that 70% of the world's population will live in towns and cities in 2050.

How are these urban systems going to be supplied with the necessary drinking water supply and sanitation networks, and with the pertinent treatment and purification plants? How will the systems within buildings be efficiently maintained? What form will solid waste collection systems take in future? How will solid waste be sorted, re-used and disposed of? Qualified specialists will be needed for these essential tasks.

But alongside these specialists in urban areas, rural areas too will have difficulties to attract and retain the skills they need. Many employees find it more lucrative to work in towns and cities. The IWA and the Department for International Development (DFID) provide evidence of this, and recommend developing training and employment models specifically for rural areas (DFID and IWA 2011).

Fragile states

The number of fragile states is rising, and with it the engagement of development cooperation in these countries. When disasters hit, well trained international experts are flown in, but after a few weeks they return home leaving only their equipment. Responsibility for maintaining drinking water purification plants, for instance, is handed

over to local staff. In situations like this, the available staff are often poorly trained, as a result of which problems arise with the supply of drinking water and wastewater disposal.

Development cooperation has not yet developed a clear package of measures in conjunction with emergency assistance providers to address these difficulties. Short-term training courses and advisory services are needed, following the emergency deployment of international specialists. Worsening climate change means that flooding and droughts will become more frequent and more severe.

Youth unemployment

Rising youth unemployment is seen as a threat to economic stability, and even more crucially to social stability around the globe. According to the ILO (Global Employment Trends for Youth 2015), young people in industrialised and European Union states, in North Africa and the Arab world are worst affected (see Figure 1). Worldwide youth unemployment was put at 13.0% for the period 2012 to 2014 (ILO 2015:1). Only a few years after the 2008 financial crisis, it has thus once again reached an all-time high. Many experts see the widening gulf between the skills employers expect and the qualifications of applicants (known as the qualification mismatch) as one root cause of unemployment. The pursuit of academic education – followed by unemployment – on the one hand, and the lack of practical TVET on the other, means that the industry-side demand cannot be met by the labour market.

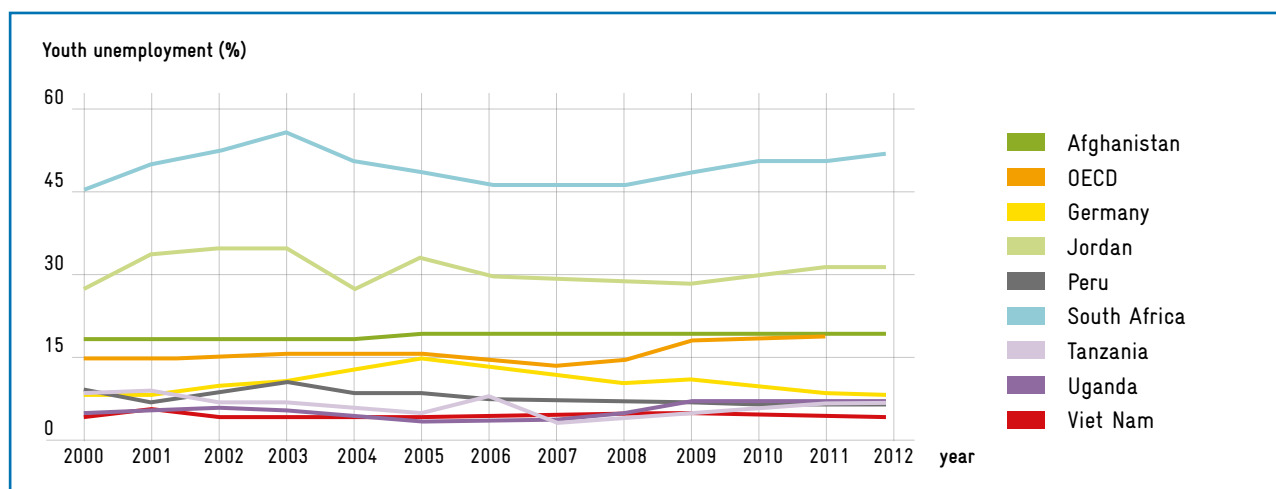


Figure 1: Youth unemployment – an international comparison (The Global Economy 2015)

International challenges

The infrastructure investments planned in the water sector offer significant employment potential for young people around the globe. But, in order to bridge the gap between demand and supply, it will not be enough to offer training places. It will also be essential to persuade young people and their parents that TVET offers genuine prospects, and to convince them that employment in the water sector is an attractive option (safe jobs, not vulnerable to economic swings and immensely important for society).

Technological innovation and need for new skills

Technical progress is advancing inexorably around the world, and requirements in terms of the knowledge, abilities and skills of employees are rising in line with it. Legal requirements are constantly changing, companies and service providers are developing new procedures. IT applications and the pertinent hardware and software are changing most rapidly. There is scarcely a single water treatment plant, system operator or wastewater treatment plant in Germany that still uses manual, paper-based steering and data management methods. Databases, simulations, global positioning systems (GPS) and geographic information systems are part of everyday work in many companies. These new technologies are very frequently used in developing countries too, especially when they invest in new systems.

An example: A few years ago the first wastewater treatment plants with a new membrane technology were built in Germany. Immediately there were calls to adapt the training of wastewater master technicians. Companies and operators called the DWA, and requested that the master technician training be extended to include the new technology. Today, 16 of Germany's 10,000 wastewater treatment plants use the new technology. Many of them are pilot plants. The technology has not yet made any greater impact.

The new technology is discussed within the framework of master technician training, but no need has yet been seen to change the curriculum.

(Heidebrecht, DWA)

Initial and continuing vocational training within the water branch must adapt to this constant change and to the rising demands of the sector. Often a high degree of flexibility

is called for, although this is not easy to achieve in most state structures. Flexibility is needed to ensure that curricula, examination standards and teaching materials are up to date, and they must take into account new – technical procedures, materials, IT applications and legal provisions. Contents often come from research, via standardisation, into everyday practical work. Flexibility is expected of the engineers and scientists who plan and build plants, and of the skilled tradesmen involved in construction work, including pipeline construction technicians, sewer builders, plant mechanics and plumbers.

New technologies are often introduced very swiftly in partner countries of development cooperation, thanks to new projects and investment. Different donors sometimes introduce different technologies and different technical standards.⁸ How should a training and education system respond? The entire curriculum does not have to be changed because of a few new plant types, of course. But curricula must remain flexible and mirror the market. The core question is often whether or not the technology in question will become the accepted industry standard. How many new staff needs to have the concomitant new knowledge to work competently? Curricula developed on the basis of actual needs make it possible to adapt flexibly to new technologies.

Fundamental concepts of hygiene in terms of dealing with water and protecting one's own health still pose a challenge in many countries. There are sound reasons why the WASH (Water, Sanitation and Hygiene) concept is widely used in development cooperation. Hygiene education, in schools for instance, is essential in many countries parallel to the introduction of public toilets.

⁸ The measures implemented are coordinated among the donor countries, but the suppliers and their technologies are often different.

International challenges

The figure below (Figure 2) illustrates changes in vocational and technical qualifications in Germany over the last 30 years, taking the example of a wastewater treatment plant. The level of training required has risen consistently in line with ongoing technological development.

Quality of TVET and further training

Some developing countries have training centres operated by the national water sector, but for the most part they have outdated equipment and teaching staff are not familiar with new technologies. In many cases there are no training manuals or consumables. Most training centres do not satisfactorily manage to bring together theory and practice, or to offer training that responds to the needs of industry. In general it can be stated that the water sector in developing countries does little to ensure a supply of well trained specialists for the future.

This is partly also a reflection of the lack of cooperation at strategic and political level. Ministries responsible for water, labour, education and industry rarely work together. It is often left to the ministry responsible for water to improve TVET in the water sector. These ministries do not, however, have the trained staff they would need or the financial resources that would allow them to devise and realise TVET for the sector. In Egypt, for example, the Holding Company for Water and Wastewater (HCWW)⁹ runs two

vocational schools and more than 20 regional training centres. The training programmes are devised and approved jointly by HCWW and the vocational schools, but they are still not sufficiently practice-oriented.

Working conditions and salary structures

Professional development measures for specialists in the drinking water supply and sanitation sectors often result in changes in the workforce. Some staff move to the private sector where they can earn more. Financial incentives, additional social benefits, promotion prospects and/or agreements that require staff to stay with the company for a minimum period following professional development measures can encourage trained staff to stay with the company. Overall, salaries in the public water sector are lower than in private industry or other sectors, including energy and telecommunications. The sanitation sector also has an image problem, meaning that it is not unusual for skilled staff to move to other sectors following professional development measures.

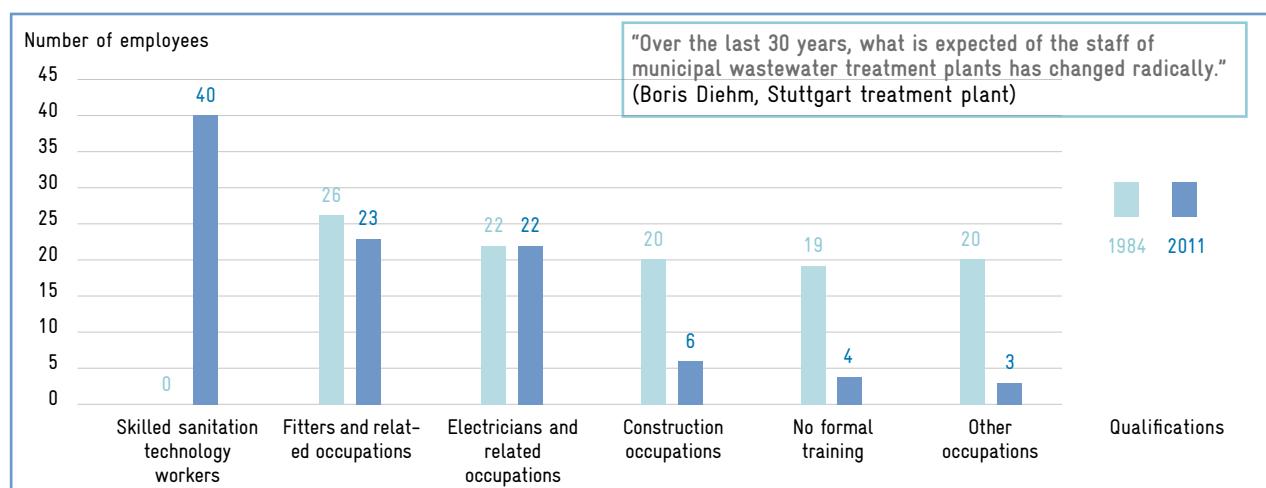


Figure 2: Changing technical and vocational qualifications in Germany, taking the example of a wastewater treatment plant (Diehm 2014:15)

⁹ Website of the GIZ project to establish the Holding: <https://www.giz.de/de/weltweit/16273.html>; website of the Holding: www.howw.com.eg.

The importance of standards and regulations for TVET

Standards lay out the “generally accepted technological rules” and “the state of the art in science and technology”. International standards are key in TVET. DIN¹⁰, the German Institute for Standardization, alone has over 35,000 standards. In Europe over the last 20 years 20,000 harmonised standards have been elaborated and published by CEN, the European Committee for Standardization. In the German water sector, the *Deutscher Verein des Gas- und Wasserfaches* (DVGW¹¹ German Technical and Scientific Association for Gas and Water) and the *Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.* (DWA¹² German Association for Water, Wastewater and Waste) have produced 600 rules and regulations.

The International Organization for Standardization (ISO) and CEN¹³ cooperate closely. European standards thus gain greater international significance.

At the latest when it comes to drawing up specific training materials, the question arises as to which standards should be adopted. Should a pipe be laid in line with European standards (DIN EN 1610) or should a different standard be adopted? Many partner countries do not yet have their own standards, but are supported by a number of different donors (including the USA and Japan), each of which have their own standards.

These matters are vitally important for TVET in technical subjects. Basically, training should build on the standards that apply in the country in question. Some countries (including Egypt, Jordan and Tunisia) have officially adopted the European system.

Informal sector

Informal employment is found in the water sector primarily in the field of household-level services. Plumbers install plumbing fixtures in buildings, repair leaky water pipes and taps and maintain household-level sanitation

and small wastewater treatment plants. In rural areas tanker drivers deliver drinking water for cisterns or water stations. Septic tanker vehicles empty small-scale wastewater treatment plants or septic tanks and dispose of the contents, often in an unregulated fashion.

Local, generally public utilities aim to ensure formal drinking water supplies and wastewater disposal for all people in the region. They recognise the importance of high standards on the part of the (informal) service providers with whom they work. For instance, the quality of drinking water in the water tankers should be checked regularly and there should be designated discharge points for emptying septic tankers. The lack of skills and knowledge among employees in the informal sector are often the cause of high water losses (through leakages) and of inappropriate and environmentally hazardous disposal of wastewater.

Since the informal sector will continue to play an important part in the water sector of many developing countries for the foreseeable future, it is important that it cooperates with the formal water sector. It is thus the common responsibility of vocational training experts and the water sector to develop approaches that raise the level of training of employees in the informal sector, as well as improving their working conditions, thus guaranteeing the quality of drinking water supplies and sanitation. One fundamental precondition is standardisation in many fields, and this should be incorporated in TVET. NGOs act as partners in many countries in moves to enhance the level of training of employees in the informal sector.

This is a highly complex and vitally important issue in developing countries, and has a huge socio-political dimension. The introduction of minimum staff qualifications as part of the licensing process for small businesses could be a first step in this direction. In Germany, for instance, the DWA certifies small businesses that maintain and empty small-scale wastewater treatment plants in rural areas. They are often farmers, who provide this additional service using their own agricultural machinery.

¹⁰ For further information see the DIN website: <http://www.din.de/de/>

¹¹ For further information see the DVGW website: <http://www.dvgw.de/>

¹² For further information see the DWA website: <http://de.dwa.de/>

¹³ For further information on the European Committee for Standardization see the CEN website: <https://www.cen.eu/Pages/default.aspx>



Current situation and prospects on the international labour market

Employees in the international water sector

In May 2014, the European Environmental Agency (EEA) published a report that provided facts and figures on drinking water supplies across Europe. If these are calculated in terms of the population of the respective states, it emerges that there are between 500 and 800 water sector employees for every million consumers with access to drinking water supplies. About 80% of these employees are classed as belonging to trades or commercial occupations.

This gives us a rule of thumb that about 500 skilled workers are required for every one million consumers with access to public water supplies (not counting household-level services). In addition to drinking water supplies, though, sanitation also has to be taken into account. For sanitation infrastructure, about the same number of skilled staff again will be required.

That gives us the benchmark that for one million people connected to central drinking water supply and sanitation facilities, utilities in European countries need about 1,000

skilled workers for the day-to-day operation and maintenance of the systems.

In the second half of 2014, the IWA published a study which laid out the employment situation and the numbers and qualifications of staff in the water supply and sanitation sector. Based on two-phase studies, the concomitant employment potential was analysed for a total of 15 Asian and African states, and this was documented (IWA 2014). The results of the study are shown in the graph below (Figure 3).

The IWA study

Within the scope of the IWA study, methodology was developed in conjunction with a number of international partners that enabled the authors to systematically identify human resources and the concomitant capacity gaps. The methodology made it possible to compare countries on the basis of relevant occupational categories in the drinking water supply and sanitation sectors. These categories include both academic and non-academic

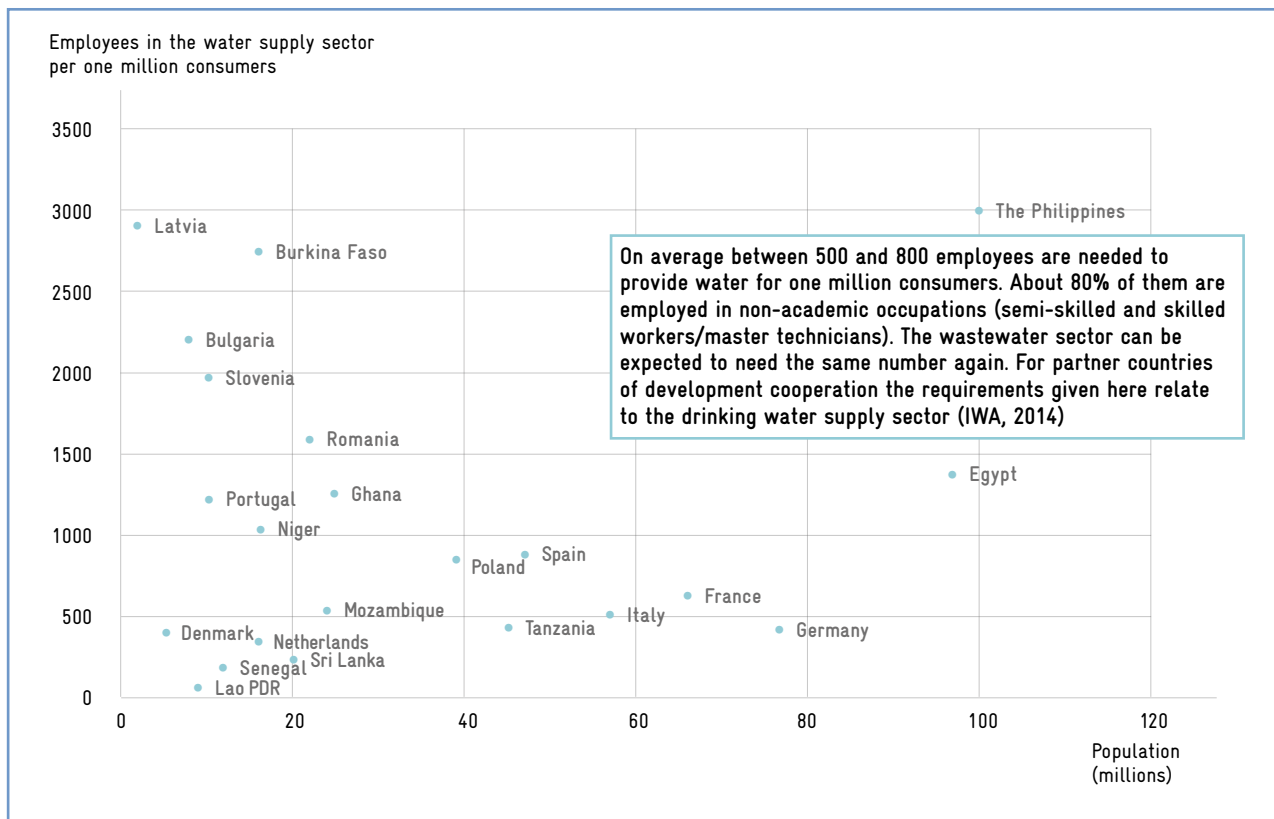


Figure 3: Employment in the water supply sector (EEA 2014)

Current situation and prospects on the international labour market

occupations. The study differentiates between the following occupational categories (IWA 2014:19):

- Technical occupations in drinking water supply and sanitation;
- General technical occupations;
- Management and finance;
- Occupations in the field of social development (as well as health and hygiene).

The methodology was tested in 2009 by DFID in a pilot study conducted in five states in Africa and Asia (Phase 1) (DFID 2011). During the second phase, the focus was on identifying gaps in the human resources available in terms of (i) absolute numbers and (ii) capacity shortfalls always with a view to achieving MDG 7c and nowadays the SDGs. The following analytical steps are those recommended by the group of IWA experts (IWA 2014:50):

1. Estimation of the projected population figures in the target year¹⁴ taking into account the rate of population growth;
2. Determination of current access to drinking water and sanitation services and calculation of the increase in services required to achieve the Sustainable Development Goals;
3. Quantitative estimation of the human resource required on the basis of type of services (per 10,000 people), and the qualifications required;
4. Determination of the current human resource capacities in the country in question, in terms of both numbers and qualifications;
5. Estimation of human resources development by the target year thanks to university and vocational education;
6. Calculation of the shortfall in human resources and assessment of deficits;
7. Recommendations for training institutions to help them address shortfalls and deficits and regarding alternative options to meet the identified needs.

The IWA study focused on a total of 15 countries during its first and second phases. A shortfall of 787,200 skilled

workers was identified for the 10 states last reviewed¹⁵ in terms of achieving universal coverage for the entire population (IWA 2014:18). Mozambique would have to double the number of skilled workers in order to achieve the targets set. Ghana has a massive shortfall in the sanitation sector, while Bangladesh needs an additional 44,000 skilled workers. Despite major progress in this sector in recent decades the country was closed to achieving the MDGs (IWA 2014:3).

According to the study, about 44% of the missing human resources can be classed as sector-related technical occupations, while 13% are classed directly as technical staff in the drinking water supply and sanitation sectors. The remaining 43% are accounted for by managerial and financial staff (37%) and social staff (6%) (IWA 2014:19).

One important outcome of the study is that only about 20% of the shortfall in capacities is accounted for by the drinking water supply sector, with the other 80% relating to capacities needed but not currently available in the sanitation sector (IWA 2014:19).

The following diagram shows the human resources needed in each of the two sub-sectors, broken down by occupational category (Figure 4 – see next page).

¹⁴ 2015 for Millennium Development Goal 7c, i.e. halving the proportion of people without sustainable access to safe drinking water and basic sanitation, and 2025 for the post-MDG goal of ensuring the availability of water and sanitation for all.

¹⁵ First phase: Bangladesh, Mali, South Africa, Timor Leste and Zambia. Second phase: Burkina Faso, Ghana, Lao People's Democratic Republic, Mozambique, Niger, Papua New Guinea, Philippines, Senegal, Sri Lanka and Tanzania

Current situation and prospects on the international labour market

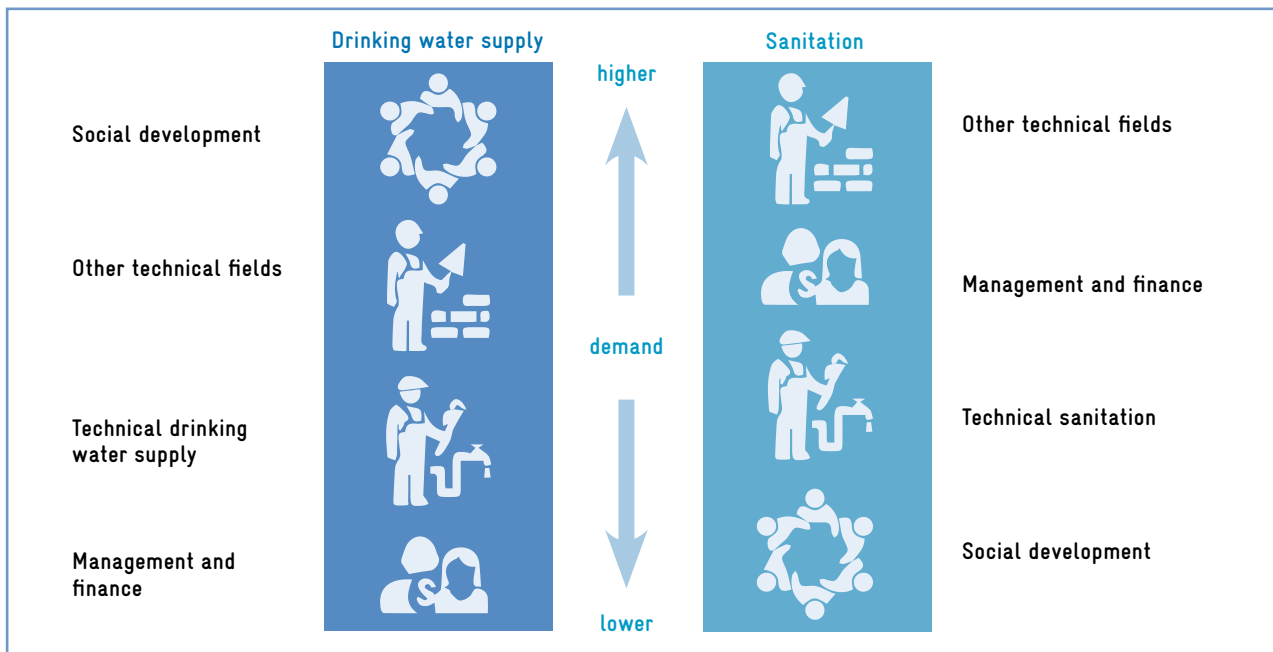


Figure 4: Trends in human resources required in different occupational categories (based on IWA 2014:19)

As well as differences between the drinking water supply and sanitation sub-sectors, there are significant gender differences in the sector. In both private- and public-sector water supply and sanitation companies, women are very much in the minority. According to the results of the study, women account for only about 17% of employees in the sector (IWA 2014:33).

The study shows that some parts of the sector are actually overstaffed, especially in managerial and financial posts, which slightly obscures the understaffing in technical fields

(IWA 2014:19). In rural, urban and peri-urban areas that are not adequately served by formal service-providers because of a shortfall of capacities, sanitation services are provided by the informal sector (including municipal-level organisations and NGOs). No relevant labour-market statistics are currently available (IWA 2014:31).

Figure 5 sums up the results for five partner countries of Germany’s development cooperation. South Africa and Zambia from the first phase, and Burkina Faso, the Lao People’s Democratic Republic and Tanzania from the

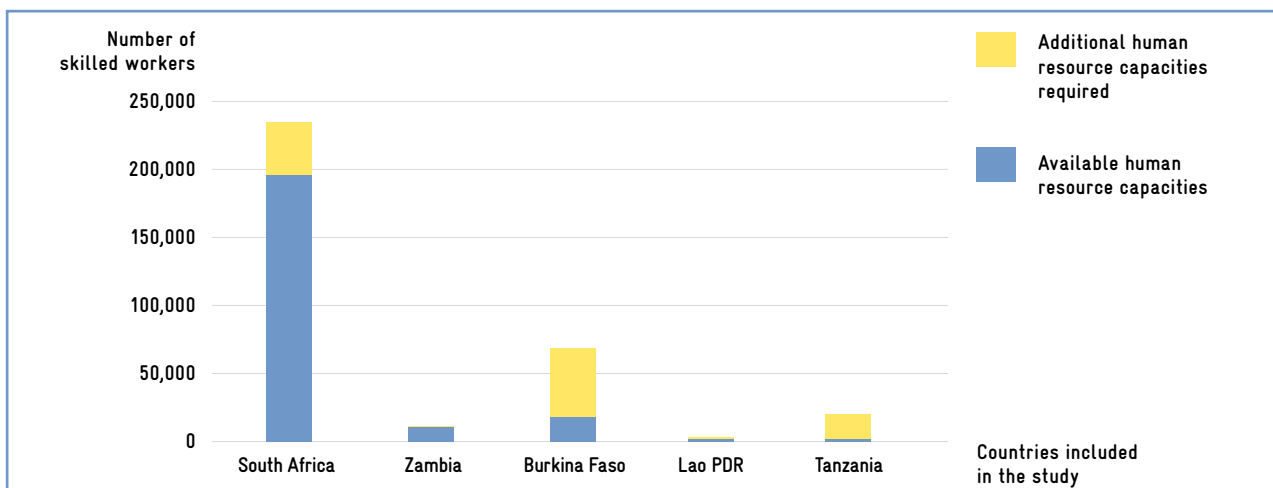


Figure 5: Employment situation and potential in the countries included in the study (IWA 2014:17f)

Current situation and prospects on the international labour market

second phase. The current employment situation and the employment potential that the coverage targets ought to generate are shown in the graph.¹⁶

The graph shows that a significant number of skilled workers will be needed in the years to come in order to meet the coverage targets. Even in South Africa, which already has more than 80% of the human resources it needs, there is an absolute shortfall of more than 40,000 skilled workers. In these five countries, the study calculates that more than 115,000 additional experts are needed, including water and sanitation technicians, technical staff in related occupations, tradespersons and general technicians, managerial and financial specialists and specialists on the social side. In all countries the study found the quality of training to be poor, in particular because of a lack of practical orientation (IWA 2014:17f).

Relevant occupational groups and employment potentials

Extending drinking water supply and sanitation systems will generate employment in the traditional construction occupations for a limited period. Water supply networks

and water tanks will have to be built, making work for pipe-layers, civil engineering and sewer construction specialists. Wells will have to be drilled and water sources tapped. Drinking water reservoirs and dams for hydro power and flood protection will be built. Sanitation systems will need to be installed in housing by plumbers. For wastewater disposal, sewage networks will be needed. Wastewater treatment plants will have to be built, while the disposal of sewage sludge will require more specialists in the relevant fields. Jobs will also be created along the value chain with suppliers (although some will be of a temporary nature) (Figure 6). This will include, for instance, pipe and water pump manufacturers, chemical companies, safety and security companies, cement producers and training providers.

Once this infrastructure is in place for the water sector, there will be a need for repair and renovation work. Construction work in the water sector is relatively immune to crisis or to major economic fluctuations.

At household level, repair and maintenance work must be performed even after the initial installation work.

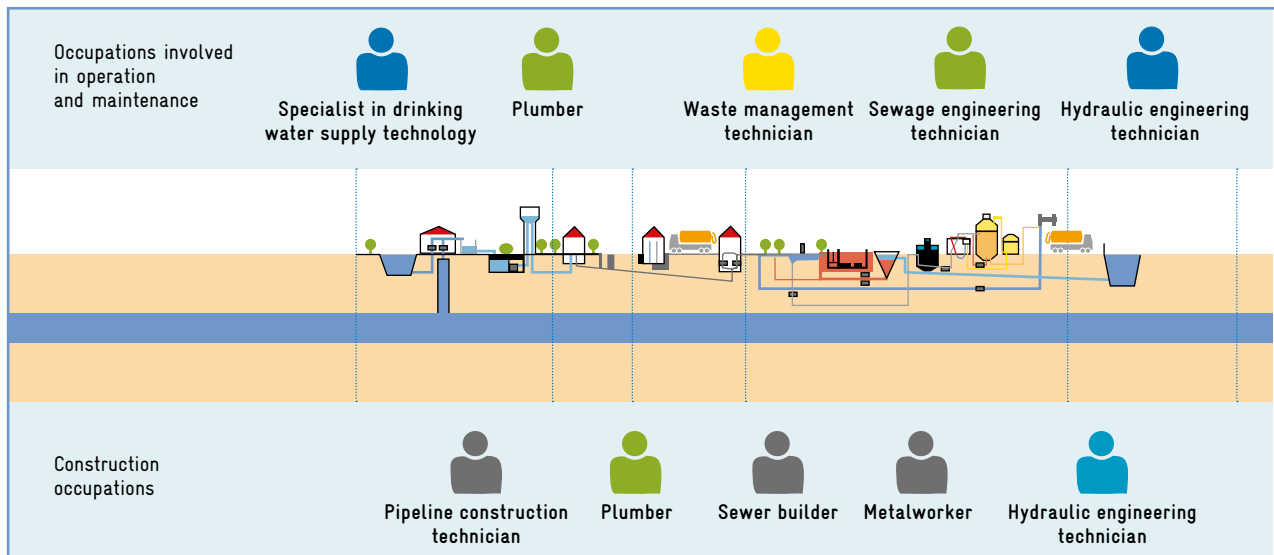


Figure 6: Technical occupations in drinking water supply and sanitation (© Heidebrecht/DWA 2013)

¹⁶ The first phase of the study investigated only the human resource capacities required to put in place the additional infrastructure required in order to achieve MDG 7c by 2015. The lack of human resource capacities to ensure the sustainable operation and maintenance of the infrastructure, so as to achieve the post-MDG goals by 2025, is only taken into account in phase 2 of the study.

Current situation and prospects on the international labour market

As indicated in Figure 7, numerous commercial and administrative occupations are also needed within a water utility. Laboratory staff monitor industrial discharge, raw water sources, water quality in rivers, and water and sludge quality. IT applications are developed and managed by IT specialists. Customer services and accounting lay the commercial foundations for the utility, and human resources development staff organise recruitment, in-company training and professional development. Staff are also needed in the fields of procurement, handling complaints and grievances, and providing emergency assistance (e.g. in the case of burst or blocked pipes) as well as installing new domestic connections.

In partner countries, many services in the water industry are provided by the informal sector. Water tanker drivers, water kiosk owners, septic tanker drivers and water sellers all work in the informal sector. Plumbers too are often self-employed or employed in the informal sector.

Household-level water stations also generate jobs. In many countries the central water supply utility cannot or is unwilling to provide the necessary quality of water for homes or companies. This has spawned a large market for small, decentralised water treatment plants, which have to be manufactured, installed and maintained. Consumables, such as ceramic membranes, must firstly be manufactured and later correctly disposed of. This is not

necessary in Europe, but the segment is booming in China and other Asian states, where jobs are being created (EEA 2014, UN Water 2014, Federal Statistical Office 2013).

Worldwide, only about 20% of wastewater produced is actually treated. Europe has 28,000 wastewater treatment plants for 800 million people. Germany alone is home to 10,000 plants. In developing countries, special efforts will have to be made in this field, meaning that there is a huge potential for employment (EEA 2014, UN Water 2014, Federal Statistical Office 2013).

In developing countries there is also potential for creating more employment in agricultural irrigation, but one cannot explore this field within the scope of the current study, which focuses on drinking water supply and sanitation.

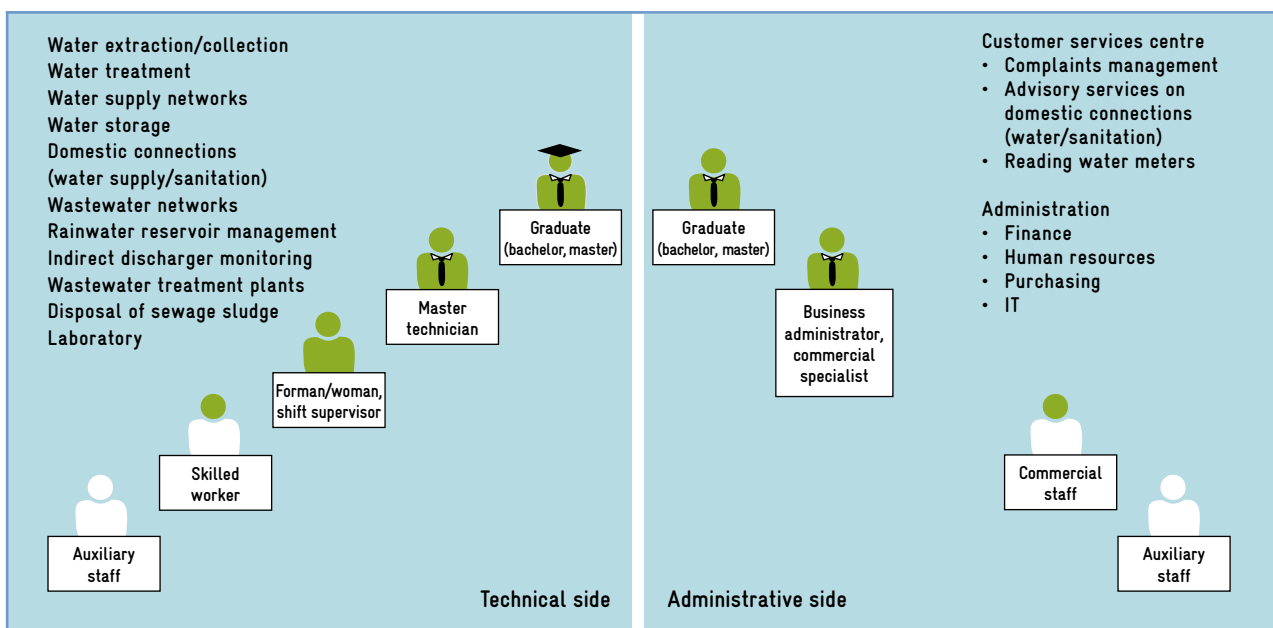


Figure 7: Fields of employment in drinking water supply and sanitation (operators) (© Heidebrecht/DWA 2014)

Germany: TVET for the water sector



Germany: TVET for the water sector

Workforce

Only a few of the 330 officially recognised occupations in Germany are directly classed as being part of the environmental sector. Several occupational groups are employed in drinking water supply and sanitation.

The DWA reckons that the water sector provides jobs for 250,000 people, plus the many skilled workers in plumbing who provide household-level services and perform installation work.

Operating staff work for the 10,000 water supply and sanitation utilities. They staff wastewater treatment plants, keep public sewage systems working, and operate water works, pipeline networks and water storage facilities. Some staff are employed by private-sector companies and service providers, but the majority work for public entities. This is what sets the water industry apart from other sectors.

A total of 80,000 people are employed by water supply companies (water extraction and collection, water treatment and water distribution) and by sanitation companies (drainage networks, wastewater treatment plants, recycling sewage sludge). Of this total, it is estimated that 60,000 are skilled workers or master technicians in various different occupations (Destatis 2014).

In addition to water supply and sanitation, the water sector offers employment in hydraulic engineering, in operating dams, pump storage plants and locks, and in maintaining waterways and dyke and coastal protection facilities.

Actors in Germany's water sector

99% of all households and commercial and industrial enterprises are connected to central drinking water supply systems. 96% have a connection to the public sewage system. All others are connected up to small-scale wastewater treatment plants.

Investment in wastewater technology totals 4.5 billion euros a year. The following are some of the actors involved in the sector:

Planning:	Engineering and consultancy offices
Construction:	Construction companies, civil engineering, pipeline network construction, plant construction companies, equipment and pump manufacturers
Operators:	Municipal, industrial and commercial network and plant operators
Research:	Universities and research facilities
Monitoring/supervision:	Supervisory authorities and ministries
Promotion:	Ministries (promotion programmes), foundations
Services:	Laboratories, service companies, consultants

The water sector is organised through two technical and scientific associations, the German Technical and Scientific Association for Gas and Water DVGW (founded in 1859) and the German Association for Water, Wastewater and Waste DWA (founded in 1948). The branch can thus look back on a long-tradition and a wealth of experience in self-management. At domestic level, the ZVSHK¹⁷ represents the crafts and trades sector. Along with the German Institute for Standardization (DIN) all three associations draw up standards and regulations for their respective members.

The DVGW is the association for the water supply side. It lays down standards and regulations, contributes to curriculum development and organises advanced training in and for the sector, working with its regional training partners. It certifies products and companies, and represents the industry at political level and vis-à-vis the science and research community and international standardisation bodies.

The DWA covers the rest of the water sector. It has drawn up about 350 sets of regulations within its 350 component bodies. Every year it trains 35,000 participants in Germany on more than 300 training courses, which makes it one of the leading providers of advanced training in its field. In the field of training it promotes environmental technology-related occupations, delivers advisory services, and produces learning and teaching materials. It certifies companies and represents the industry at political level and vis-à-vis the science and research community and international standardisation bodies.

¹⁷ For more information on the German Central Association of Sanitation, Heating and Air-Conditioning (ZVSHK) see: <https://www.zvshk.de/>

Germany: TVET for the water sector

Regional state training centres, private training providers, universities and institutes also offer additional special events and professional development measures.

Trade fairs are meeting points for industry, the science and research community, associations and policymakers. IFAT, the World's Leading Trade Fair for Water, Sewage, Waste and Raw Materials Management¹⁸, has grown steadily since 1966, and is today the world's leading trade fair for the water sector. When it is held, once every two years, it attracts more than 3,000 companies and 135,000 visitors. *Wasser Berlin International*, with some 600 exhibitors and more than 20,000 visitors, is comparable to trade fairs in the Netherlands, Italy, the USA and France.

The strongly international flavour of IFAT (China, India, Turkey, South Africa and the Arab Countries Water Utilities Association (ACWUA)) demonstrates the growing importance of this environmental engineering for industry and the environmental sector. Environmental engineering is fast becoming a strong driver of Germany's exports. To support the international engagement of German companies, the German Water Partnership (GWP) was founded in 2009 (see also section on German Water Partnership, p. 42f).

Occupations and what they involve

An industrial company will generally employ people qualified in between 10 and 20 different occupations, depending on the size of the company and the precise area in which it operates. Some of these occupations are listed below, classed by type of duties:

Planning:	Engineering and consultancy offices
Construction:	Construction companies, civil engineering, pipeline network construction, plant construction companies, equipment and pump manufacturers
Operators:	Municipal, industrial and commercial network and plant operators
Research:	Universities and research facilities
Monitoring/ supervision:	Supervisory authorities and ministries
Promotion:	Ministries (promotion programmes), foundations
Services:	Laboratories, service companies, consultants

Annex 1 provides more detailed information on these occupations. More information can also be found on the website of the German Federal Institute for Vocational Education and Training (BIBB).¹⁹

These specific occupations date back to the 1970s. On 23 July 1979 the *Abwassertechnische Vereinigung e.V.* (ATV, the precursor of the DWA), the DVGW and the *Kuratorium für Wasserwirtschaft* submitted a request to the German Federal Minister of the Interior for official regulations governing the training of the staff of wastewater treatment plants and water works.

On 30 May 1984 the training regulations for the occupation "supply and disposal specialist" was published, with three branches: water supply, wastewater disposal and solid waste. In 1987 this was supplemented by advanced training for master technicians in water, sanitation and urban cleansing. This was subsequently reorganised in the year 2000 (with the new title "specialist for environmental technology occupations") and in 2003 (with the advanced master technician training) with the publication of new ordinances regulating training.

Every five years a review is conducted to identify any need to modify regulations. BIBB, the sector associations, the *Kuratorium der Deutschen Wirtschaft* (coordinating association of German industry for vocational education) and the pertinent trade unions engage in consultations to this end.

¹⁸ For more information on IFAT, the World's Leading Trade Fair for Water, Sewage, Waste and Raw Materials Management, see: <http://www.ifat.de/>

¹⁹ For more information on the German Federal Institute for Vocational Education and Training (BIBB) see: <http://www.bibb.de/berufe>

Germany: TVET for the water sector

It must not be forgotten that in addition to the technical occupations, commercial, administrative and organisational (IT) occupations are needed.

Figure 8 shows how TVET has changed over the last 80 years in Germany as a result of investment in the construction of wastewater treatment plants. Initially weekend courses were sufficient. Later training courses lasting up to seven weeks were introduced. Finally state-regulated vocational training was introduced and regularly updated.

Skills competitions – a strong instrument

Skills competitions are an excellent way of creating public awareness, boosting motivation and showcasing both national and international training standards.

The organisation WorldSkills²⁰ was founded over 50 years ago in Spain and Portugal. These countries held the first competitions. Today the competition has become a veritable world championship in which representatives of 45 occupations test their skills as well as spawning the EuroSkills competition.²¹ (The 2013 WorldSkills in Leipzig attracted 200,000 visitors.)

The occupation “plant mechanic for sanitary, heating and air conditioning systems” has been a discipline at WorldSkills for many years, and is organised by ZVSHK. National, European and global skills competitions are firmly established in this field. The tasks set are coordinated at international level; descriptions and assessments are available in a number of languages and thus provide an excellent introduction to training as a plumber. Development cooperation projects can also help participants take part in skills competitions.

After Brazil 2015, the next WorldSkills have been held in Abu Dhabi 2017.

German skills competitions for sewage engineering technicians have been held since 2010. They are organised once every two years by the DWA at the IFAT trade fair. The first pilot skills competitions in pipe tapping are now being held by the DVGW.

In addition to skills competitions for young people, competitions of the same sort exist for established professionals. The USA already has more than 25 years of experience in this field. In Germany, the DWA has been organising the first skills competitions for experienced wastewater treatment plant and sewer specialists since 2010.

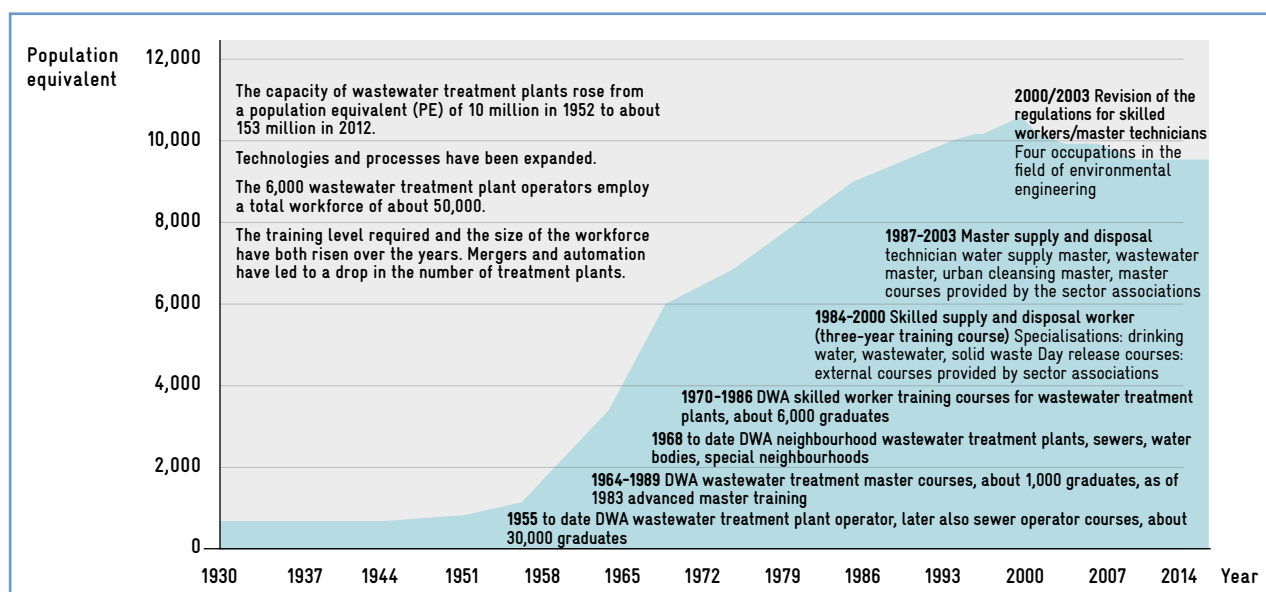


Figure 8: Wastewater treatment plants and the way TVET in the sanitation sector in Germany has changed over the years (© Heidebrecht/DWA 2014)

²⁰ For more information on WorldSkills see: <https://www.worldskills.org/>

²¹ For more information on EuroSkills see: <http://www.euroskills.org/>

Germany: TVET for the water sector

In 2014 three teams from a GIZ Water Supply and Sanitation Management project in Egypt took part.²² There had been an earlier national knock-out competition in 2013, which attracted eleven teams. The three Egyptian teams achieved very commendable rankings in the middle of the field. This shows that motivation, sound preparation and training can raise the level of international teams within a period of only one year.

Transfer potential – options for transferring German experience, and limitations

Germany's system of dual vocational training cannot simply be transferred in the same form to other countries. German development cooperation does, however, base its approach on the successful features of the dual approach to TVET (see Abstract). The combination of practical in-company experience and theoretical instruction at vocational schools is the great strength of the German training system.

One question that is frequently asked is “Do I need the same detailed training in other countries too? Is less specialised training not enough there?” A colleague from Viet Nam answered this question very simply and very succinctly in 2012. He showed me a piece of machinery his company had just purchased from Germany and said, “Same machine, same service is needed.”

(DWA, Heidebrecht)

Selected contents of German training courses and German standards can provide guidance for development cooperation. These must, however, be adapted to bring them into line with the needs of industry and be embedded in the respective TVET system in each partner country on a case by case basis. The examination system can be taken into account to a certain extent, but it too will have to be adapted.

The German water sector has two significant competitive advantages: firstly technology that seeks its equal worldwide in terms of transparency thanks to the many standards, rules and regulations that are regularly updated and readily available, and secondly thirty years' experience of organising training for occupations in the field of environmental engineering.

²² For more information on the project see: <https://www.giz.de/de/weltweit/16273.html>

Germany: TVET for the water sector

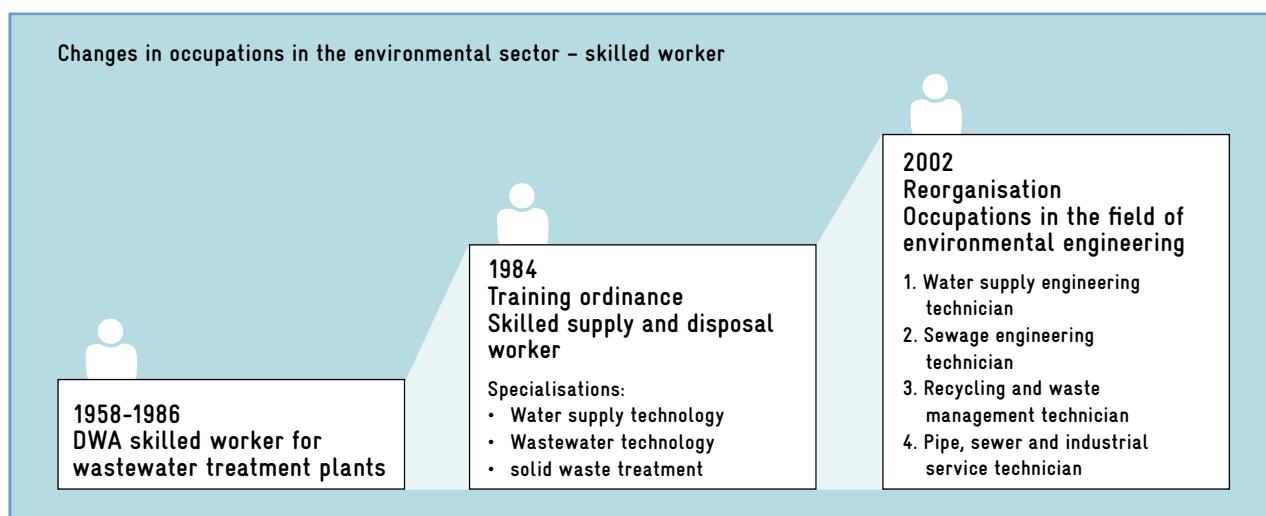


Figure 9: How professional development in the environmental sector have changed over time
(© Heidebrecht/DWA 2014)

German Water Partnership

The German Water Partnership (GWP) is a network that brings together about 350 stakeholders, including both private- and public-sector companies operating in the water sector, sector associations and industrial, academic and research institutions. The initiative is supported by five German federal ministries: the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUE), the Federal Ministry of Education and Research (BMBF), the Federal Ministry for Economic Cooperation and Development (BMZ), the Federal Ministry for Economic Affairs and Energy (BMWI) and the Federal Foreign Office. The partnership focuses the activities, information and innovations in the German water sector in order to strengthen the competitive position of German industry and research on international markets. The network improves the prevailing conditions for business segment development outside Germany, drives innovation, and, with appropriate, integrated and sustainable approaches helps resolve water-sector problems around the globe (GWA, 2014). A capacity development working group also looks at aspects of TVET and has published a first common assessment of the strengths and weaknesses of capacity development in the water sector in a brochure entitled “*Entwicklung braucht Wasser*” (Development needs water) (GWP 2012). Five federal ministries, the sector associations, universities, institutions and companies were involved. Another brochure entitled “Guideline – Skills

Development in the Water Sector” was published in October 2014. It uses concrete examples to explore capacity development in the water sector from a German viewpoint.

Approaches adopted by German development cooperation



Approaches adopted by German development cooperation

The integrated approach to employment in the water sector

The integrated approach to employment is an inclusive approach adopted by Germany’s development cooperation. It involves looking at the demand for skilled workers, underemployment and unemployment in developing countries before identifying appropriate solutions to ensure integrated promotion (BMZ 2012:26f.). Both the supply and the demand side of the labour market are taken into account, as is labour market policy, which acts as a sort of “hinge”, connecting the two.

The diagram below (Figure 10) illustrates the three dimensions of integrated employment promotion.

Demand for workers in the water sector

As laid out in Chapter 4, there is excellent potential for creating jobs in the water sector in the coming years. The potential numbers of skilled workers required in the ten countries included in the second phase of the IWA study are put at around 800,000 (see Chapter 3, p. 26). The widest gaps are seen in wastewater disposal (80%), as compared to 20% in drinking water supply.

Many developing countries have already looked at making extensive investments in extending coverage under their own water strategies, especially in urban areas. This would result in a strong rise in employment as new plants were built and later operated. New plants and replacement plants are built to the latest technological standard, which raises the level of skills required on the part of staff in all technical areas. The demands made of commercial employees too rise in line with the increasing complexity of information technology. Overall it can be assumed that there will be a strong increase in the number of secure jobs in the drinking water supply and sanitation sector, which will be linked to population growth (see Chapter 3, page 26).

In addition to the direct job creation impacts of building and operating plants, impacts can be expected above all at the end of the value chain where household-level services are found. The rate of house connections is still very low in many countries, particularly in rural areas. It can thus be expected that demand for services in the field of sanitation installation will rise significantly. In many countries these services are provided by small and medium-sized enterprises or by the informal sector.

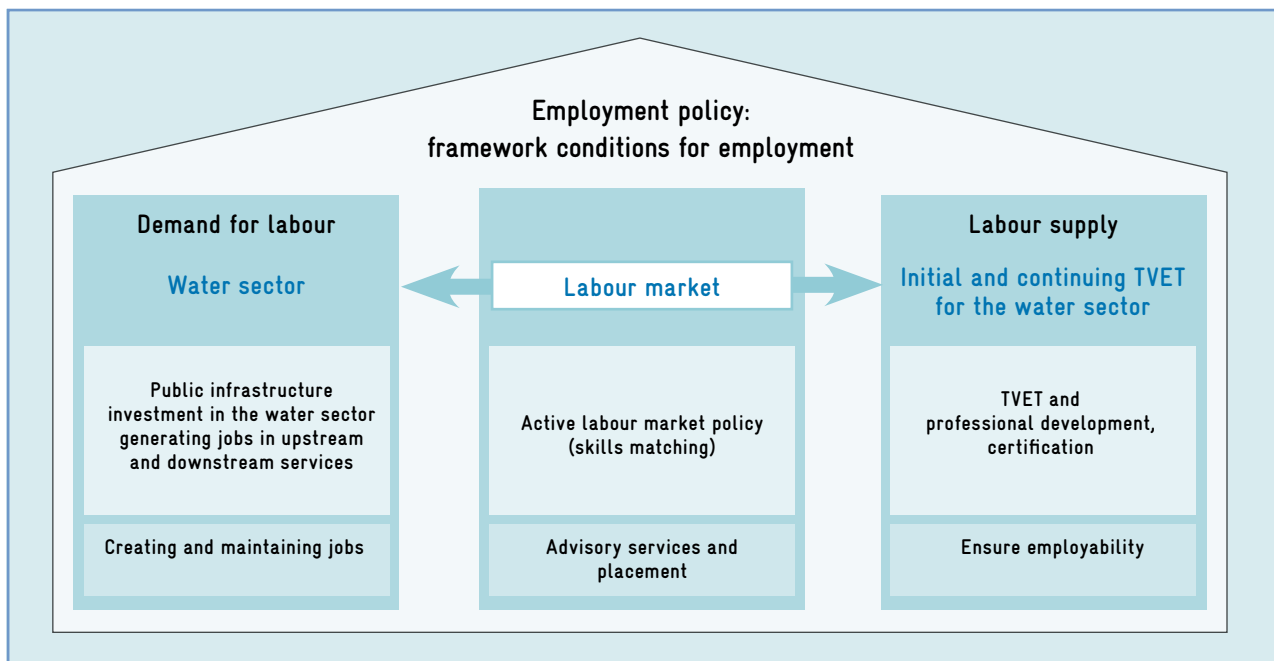


Figure 10: The integrated approach to employment promotion (GIZ 2010:81)

Approaches adopted by German development cooperation

The extent of household-level services in the water sector provided by the informal sector has not yet been recorded, even in more recent studies. Alongside sanitation, heating and air-conditioning services, some of which are provided by the informal sector, it seems safe to assume that demand for other services in the sector, such as operating water kiosks and transporting faecal matter, will dwindle in the medium term as the aim within the water sector is to move in the direction of formalisation so as to ensure universal access to safe drinking water and regulated wastewater disposal.

Investment in the water sector will also have indirect impacts on employment, thanks to the improved health of the population and thanks to the location remaining attractive or becoming more attractive for companies (KfW Development Bank 2013). Women in particular are directly affected by improved water supply, since they are often responsible for fetching water. There is also evidence that improved family health enhances the opportunities of women to undertake education or take up employment.²³

German development cooperation can support this rise in employment firstly by its involvement in more investment projects in partner countries. The KfW is currently financing projects in the water and sanitation sector to the tune of around 4.7 billion euros (KfW Development Bank 2015). The *Deutsche Gesellschaft für Internationale*

Zusammenarbeit (GIZ) GmbH supplements this extensive engagement on the part of the German government with the delivery of advisory services to 400 water supply and sanitation utilities to help them improve their own services, as well as advisory services provided at macro level. The leverage of German development cooperation in identifying the demand for skilled workers in the water sector is thus very high. It is important to identify the need for skilled workers when investment is first planned in infrastructure measures. At an early stage, discussions must be initiated on the measures that will be needed to train these skilled workers so that the workforce is available when the infrastructure measure is completed (see Figure 11). Operators must begin to see human resources costs, including the cost of training, as part of their operating costs, and must cost different productivity scenarios, depending on the level of training of staff. In 2013 the IWA determined for the Philippines that only one fifth of workers would be needed if productivity were higher (IWA 2013).

Private sector promotion measures for the water sector include start-up measures as well as the provision of business development services for companies operating in this sector. This applies in particular to the strengthening of household-level services. Over and above this, the sector associations for sanitation, heating and air-conditioning can act as an important link in the chain in the promotion of TVET. Sector associations for sanitation,

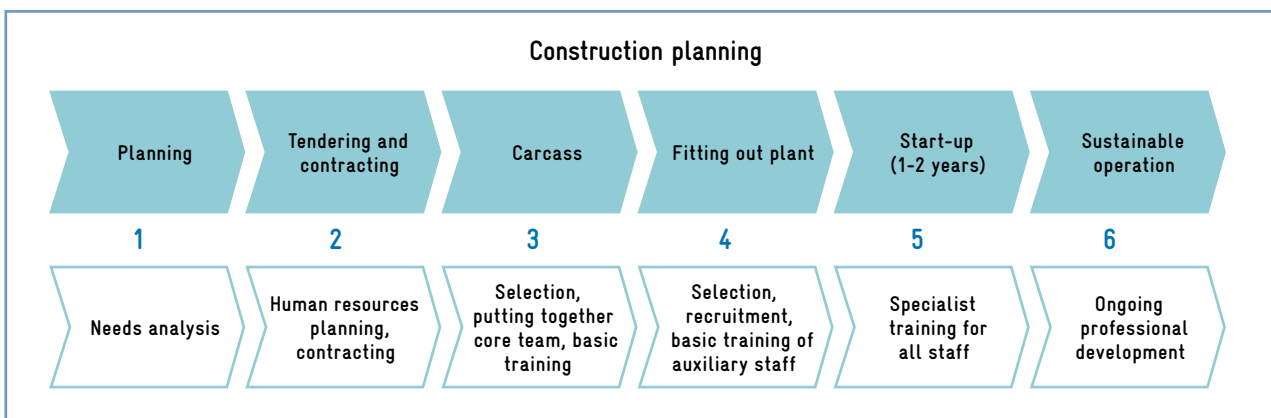


Figure 11: Human resources provision for construction and extension projects
(© Heidebrecht/Lenz/Salazar/DWA 2014)

²³ „Wirkungen von Bildung“ von M. Langthaler (ÖFSE/GIZ): http://www.oefse.at/fileadmin/content/Downloads/Publikationen/Policynote/PN4_Wirkungen_von_Bildung.pdf (last accessed on 20 November 2017)

Approaches adopted by German development cooperation

heating and air-conditioning already exist in many developing countries. They often provide access to the informal sector and can thus help achieve the desired standardisation of vocational capacities.

Labour market policy

Since it has become evident in the past that skills gaps in the water sector cannot be closed by market mechanisms alone, one must look at ways of steering the labour market. This includes gathering and updating data, inter-stakeholder coordination, systematic careers guidance and careers advice, and active labour market policy approaches.

The partner countries of German development cooperation rarely have fully functional labour market information systems. In some countries systems of this sort are being established, as is the case in South Africa, for instance. As mentioned above, some of the people employed in the downstream water sector services operate in the informal sector, for which few reliable statistics exist. The demand for workers in the formal sector, i.e. on the part of operators of water supply and sanitation utilities, can be estimated on the basis of the investment strategies of the individual countries (IWA 2014).

Relevant labour market information at regional level is a precondition for developing and implementing needs-driven measures in the field of active labour market policy. This information is to be gathered within the framework of dialogue-oriented approaches involving experts on both the supply and demand side of the labour market.

Since employment in the water sector leads something of a “niche existence”²⁴ in most countries when compared to the potential workforce, and since occupations in this industry, especially in the sanitation sector, are not generally seen as attractive, there is the additional challenge of promoting these occupations as attractive career options. It is important, for instance, to encourage the development of new staff in the immediate vicinity of the water utilities, since it is often impossible to attract town and city dwellers to rural areas, partly because the pay is lower there. It can be helpful to provide information on occupations and run recruitment campaigns under a dif-

ferent headline, such as “health and environment sector”. German water-sector occupations are also classified in this way. Financial incentives, such as trainee loans or voucher systems, can also stimulate demand for TVET in the water sector (see the project case study from Tanzania).

The crucial precondition for bringing training into line with the needs of the labour market is that the relevant institutions coordinate their actions. This need not take place only at central level, but can equally well take place at local level, as decentralisation moves forward. ILO studies, for instance, identify France and Spain as particularly good examples of how to coordinate environmental policy and national and local training policy (ILO 2011). Since the water sector alone is perhaps not large enough to justify the establishment of employment task forces and policy networks, it can be helpful to establish a link to the green economy, which would also include employment in water resources management.

In South Africa the sector dialogue is organised through the Sector Education and Training Authorities (SETAs), which identify the capacities required in the sector, and organise the pertinent training.

An approach devised by the World Health Organization (WHO) (Carefoot and Gibson 1984) to organising a stakeholder dialogue on skills development can be taken as the methodological approach, and is described in more detail below (see Figure 12):

- Firstly the current workforce in the sector should be estimated: occupations should be graded and classified, the breakdown by different institutions (central and regional/local), along with age distribution, to make it possible to forecast future needs for new staff.
- The current level of water supply and sanitation coverage should be determined.
- The coverage targets and the concomitant demand for workers must be estimated either with respect to the SDGs or to the already planned level of coverage.
- On this basis the priorities can be identified in terms of workers needed, and the concomitant skill gaps.
- In the summary the demand for workers should be contrasted with the training required.
- On the supply side an inventory should be drawn up of training institutions and their personnel in the water sector. These will include universities, specialist colleges, vocational schools and private training

²⁴ In Germany, the 250,000 or so employees in the water sector account for only 6% of the potential labour force.

Approaches adopted by German development cooperation

providers. The level of the capacities of vocational training staff must be analysed.

- The estimated supply of workers, adjusted to take account of probable fluctuation, will give an overview of the labour market.
- At national level an overall look at the supply of workers can supplement this information.
- A comparison of the forecast demand for well-trained skilled workers and the supply of workers at national level provides a basis for planning.
- Only then can the gaps in individual areas of employment be clearly defined and planning undertaken with a number of different stakeholders in order to specifically close these gaps.

Another intervention in the field of labour market policy involves advisory services and mediation. As mentioned above, employment in the water sector is not always considered attractive for a number of reasons. In a youth employment promotion programme in Egypt, GIZ is currently promoting the across-the board introduction of careers guidance at secondary schools as well as providing in-service training for teachers who can then act as multipliers in careers guidance and careers advice.

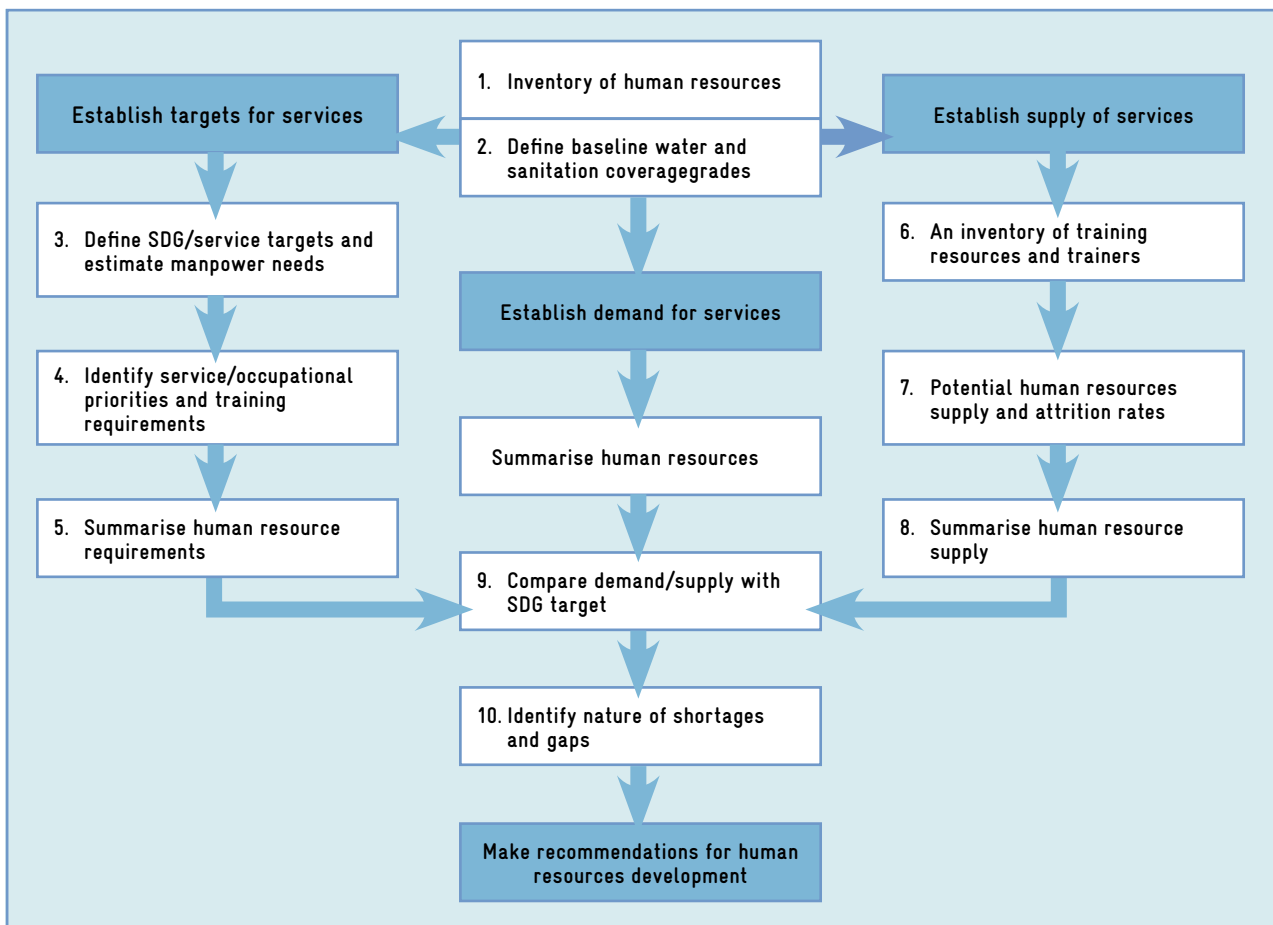


Figure 12: Methodology to assess human resource requirements in the water sector (DFID 2011:8)

Approaches adopted by German development cooperation

Employment programmes

In the field of water resources management, special note should be made of the public job creation programme in South Africa, the Working for Water Programme. Designed as a job creation measure for disadvantaged municipalities, it offers work to about 20,000 unemployed people a year, who remove invasive non-indigenous plant species from a water catchment area. The programme recruits primarily women (roughly 52%), young people and people with disabilities, who otherwise have little chance of finding work on the regular job market. The programme, introduced in 1995, has implemented more than 300 individual measures in all nine provinces of South Africa. Its achievements in the field of natural resource protection can be deemed a success. From an employment viewpoint, its achievements are more of a temporary nature, since it has not managed to help the marginalised target groups become established on the primary labour market or to generate permanent employment.

(Dept. of Environmental Affairs, South Africa, 2015)

Overall it can be said that the water sector makes very high demands of the educational background and training of staff, as a result of which it has little to offer workers from the informal sector and/or marginalised target groups. Because of the technical nature of the sector, women are still underrepresented. This can be addressed with the help of targeted interventions as described above.²⁵ There are also international approaches to active labour market policy, such as the “Working for Water Programme” in South Africa, which also offer potential for Germany’s development cooperation, and which specifically focus on marginalised groups (Department of Environmental Affairs, South Africa, 2015).

When devising advisory services on TVET in the water sector, it is important to focus on the development status of vocational training and labour market policy as a whole. It is easier to realise training in the water sector in countries which already have a well-developed TVET system. Positive experiences with sector dialogues in other industries can be transferred to the water sector. In countries with less developed TVET systems, it can be a good idea to use pilot approaches focusing on individual water utilities and vocational schools, which, if they prove successful, can then gradually be transferred to the TVET system.

²⁵ such as training women plumbers in Jordan

Market for technical and vocational education and training (TVET)

Unlike Germany, where formal state and private initial training institutes and certified continuing training institutes largely provide the training demanded by potential trainees, the initial and continuing training market in developing countries frequently does not meet the needs of industry. Firstly we must establish to what extent vocational training for the water sector is already anchored within the TVET and education systems of the BMZ’s partner countries, and to what extent it is perhaps already promoted by other donor institutions. Depending on this, and on the engagement of development cooperation in the TVET sector, we can identify the entry point for training support for the water sector.

Depending on the number of water supply and wastewater disposal plants in a country, and on the size of the population, different development paths and cooperation options beckon for development cooperation in the training sector:

- a) Independent training in specific water and wastewater occupations;
- b) Basic training in skilled occupations (electrician, fitter, plumber, etc.) with additional modular training in water supply or wastewater disposal;
- c) Modular further training.

Whether complex TVET approaches are to be taken with nationwide standards at initial training or continuing training level, or whether “smaller-scale solutions” are to be adopted with regional or industry-specific advanced training, it is crucially important that the approaches are developed precisely for the given context, that they meet the requirements of the target group, and that they are sustainable.

On the basis of the analysis of training levels required and the supply of labour available (Figure 4, page 28) and in line with the 2014 study performed by the IWA, it is important for decision-makers to deduce appropriate support measures in the field of TVET. Support measures should focus on the area in which the greatest shortfall of skilled workers is identified. Depending on the target groups (formal or informal sector), appropriate interventions must then be devised via a dialogue with all stakeholders (line ministries involved, associations and education and training providers).

Approaches adopted by German development cooperation

In Viet Nam for instance, which is home to 80 million people, the GIZ TVET project promotes the training of sewage engineering technicians. The first year group began training at the end of 2014. On the basis of skills profiles drawn up jointly with the water sector and the information obtained from a labour market analysis, a decision must be made on precise occupational profiles and on the development of standards (curricula and examination standards).

With the development of curricula and occupational standards for the water sector, the question also arises of certification and examinations for the occupations. Tanzania and South Africa have solved this problem by entrusting the job to their national certification bodies, while the water project in Peru has selected to go via the German-Peruvian Chamber of Commerce for trainer qualifications, while devising their own national standards. Burkina Faso too, with its national training centre *Centre des Métiers de l'Eau (CEMEAU)* intends to certify advanced training modules at national level. National certificates ensure that qualifications are recognised by the national education system, and mean that subsequent advanced training options (career options) for graduates can be taken into account from the outset.²⁶

For all training it is important to ensure that environmental protection is an integral part of the curricula. Whether it is a question of the correct handling of substances hazardous to water, the environmentally sound disposal of materials at the workplace, or energy- and water-saving working methods – all TVET must guide trainees and develop the appropriate capacities. The curricula for all occupations must include these issues that are important for the vocational field, and go into them in sufficient detail. The ILO describes this process in great detail in its publications on green skills (ILO/CEDEFOP 2011).

In some partner countries (for instance Tanzania and Burkina Faso), established training centres for the water sector already exist. They were originally planned as academic centres, and are only now being extended to embrace initial and continuing TVET. Advisory services for these providers to help them deliver sustainable, high quality training will focus on three main approaches: a) enhancing the centres' equipment and outfitting (via Financial Cooperation); b) providing pre- and in-service

training for teaching staff; c) organisational development and strengthening school management. When planning equipment and outfitting, one can draw on experience already gained with public-private partnerships (PPP). In South Africa, for instance, efforts are building on a cooperation arrangement with the private company FESTO (GIZ 2015). The water project in Peru is also cooperating with German equipment companies.

When training teaching staff it is essential to conduct an education needs analysis, and on that basis to familiarise teaching staff with occupational standards and give them the expertise they need through pre- and in-service training. In addition, they should be given special training in the use of modern teaching and learning approaches in TVET. A whole series of modules are already available from other vocational training projects and programmes, in particular focusing on enhancing the methodological and didactic skills of teaching staff. These can then be adapted to the specific context. Where cooperative approaches have already been used in vocational training in partner countries, the in-company trainers must also be trained parallel to the teaching staff at vocational schools on the basis of agreed standards.

Where education and training providers already have an effective organisational structure, they can be nominated as regional skills centres, which cooperate closely with the water sector and/or are partly funded by the sector. They could operate as a hub for initial and continuing TVET in water-related occupations, acting also as a point of contact for the private sector (including household-level services), and could advise companies on the introduction of new technologies, ways of establishing business contacts and managerial issues. If they play their part as effective intermediaries between utilities and upstream and downstream services, they can raise the quality of water supply and sanitation services. Over and above this, it would be possible to organise network-type exchanges among utilities for professional development purposes through these skills centres.²⁷

Financing TVET is still a crucial problem in many partner countries. Pledged funding is simply not provided on the scale envisaged, with the result that potential trainees decide not to undertake poor quality training that they

²⁶ see project case studies in Chapter 6, page 47 et seq.

²⁷ Along the lines of the "Klärwerksnachbarschaften" or wastewater treatment plant neighbourhoods established in Germany.

Approaches adopted by German development cooperation

even have to pay for themselves. Part of the multi-level approach adopted by many TVET projects is thus to deliver advisory services on the financing of TVET. In some countries, well established systems are in place to finance TVET. South Africa, for instance, raises a skills development levy on companies paying more than R 500,000 in salaries. The levy is equivalent to 1% of the total amount paid in salaries to employees. Fixed percentages of the skills development levy are paid to National Skills Fund and the Sector Education and Training Authorities (SETAs) respectively. In some countries, vocational schools are also production schools, which enables them to generate additional income. In the water project in Tanzania a training fund was put in place to finance TVET. Trainees are granted a loan from the fund, which they have to repay once they are qualified.²⁸ It is thus important to discuss with partners whether national solutions are adequate, or whether locally adapted financing mechanisms will have to be developed.

The labour market analysis should include employees in the informal sector as far as possible. Should the analysis show that workers in the informal sector account for a large percentage of the workforce in the water industry, and that their lack of training is a serious impediment to ensuring coverage, it is appropriate to make use of initial and continuing vocational training and possible support in the form of entrepreneurship education. Mechanisms to identify informally acquired skills can also be an important instrument in this sort of context. Overall, however, promotion of the fragmented informal sector involves a great many structural and financial preconditions (see GIZ toolkit “Learning and working in the informal economy – access, skills development and transition”, 2015).

Comparability, permeability and training standards

140 countries around the world have national qualification frameworks. They grade and categorise the qualifications offered by the education system in question so as to make different qualifications comparable, to allow people to move from one part of the education system to another, and to enhance the mobility options open to individuals. For university-level education, qualifications have now been largely harmonised in Europe thanks to the Bologna process. In TVET, however, harmonisation efforts are still in their infancy.

In 1986 the first national qualifications framework emerged in Scotland. In 1991 New Zealand produced a comparable framework, followed in 1995 by Australia and South Africa. Alongside national frameworks, we are increasingly also seeing regional, transnational frameworks:

- SADCQF – Southern African Development of a Common Qualifications Framework covering 11 countries
- ASEAN Framework Arrangement for the Mutual Recognition of Surveying Qualifications covering 15 countries
- CVQ – Caribbean Vocational Qualifications Framework covering 18 countries
- AQF – Arab Qualifications Framework covering 22 countries.

Since 2008, a European Qualifications Framework (EQF) has been in place, which was implemented in Germany in 2012 through the German Qualifications Framework (DQR). It embraces eight common European reference levels.

Against this background, development cooperation obviously takes into account the specific national features of existing qualifications frameworks. The number of reference levels in qualifications frameworks varies from five to twelve.

(Bohlinger 2013)

In many countries, neither employees nor employers in the informal sector consider the qualifications and training level of staff to be a crucial factor in their competitiveness. When asked where constraints lie, they tend to mention their lack of equipment, but not the skills level of their staff. Traditional training, in which an

²⁸ A manual for the fund is to be published shortly on the website of the Water Development and Management Institute (WDMI).

Approaches adopted by German development cooperation

experienced master passes on skills to apprentices, is the predominant form of training in many African countries. It thus makes sense to convince the informal sector that improved training will bring with it better employment and income opportunities. Sector associations should be taken as the starting point for awareness work of this sort. Many partner countries already have sector associations for sanitation, heating and air-conditioning.

The associations, which can be strengthened with the help of a TVET project, then act as intermediaries both in devising formal TVET offerings²⁹ and in non-formal training offers involving utilities and the private sector. As a general rule, non-formal advanced training measures in modular form prove to be better suited for the informal water sector, since they can be adapted to suit the financial and time-specific requirements of the target group. One example would be courses on the repair and maintenance of pumps. Business start-up measures can be a good add-on component to formal training courses, for instance, if the labour market analysis identifies a shortfall in the number of available skilled workers in the private sector offering household-level services. Business start-up measures cannot, however, be expected to have any short-term impact on the quality of services available in the water sector.

Frequently, NGOs operating in the sanitation sector are involved in the provision of advanced training for target groups in the informal sector. Close cooperation with experienced NGOs can generate added value in this context. Mobile vocational training can be used in order to ensure that target groups who often work in isolated areas can be addressed. In Kosovo, GIZ has already gained experience within the framework of training courses for green technologies (GIZ 2015). Mobile training units of this sort could, for instance, offer modularised training for standpipe attendants and drinking water tanker and septic tanker staff close to where they live and work.

To finance formal and non-formal advanced training in the informal sector, approaches as laid out above will be needed.

The success factors in effective initial and continuing training for the water sector can be summed up as follows: on the basis of close cooperation between the political level and the water sector, involving the private sector and sector associations, needs-driven solutions must be promoted that make it possible to close the skills gap in the short and medium term. Planning TVET, and developing occupational profiles, curricula and standards, is a process that presupposes a great many things, and generally takes at least one year. Sustainable solutions for one country can thus take a two-pronged approach: advisory services to devise initial vocational training on the one hand while developing modular continuing training concepts on the other. It is important in both cases to establish stronger links to practical application. The water sector should be involved in this as it is seeking suitably qualified labour. When devising and formulating occupational profiles it is also important to ensure from the outset that the profile can be fitted into the education system in place in the country, and to ensure that individuals can move from one part of the system to another. This is the only way to ensure that TVET can become established as an attractive alternative to academic education.

In general, the integrated approach to employment promotion can be seen as enabling a comprehensive overview of the water sector, workforce requirements and the necessary measures identified on this basis. The approach differs in this from the add-on training measures in financial cooperation measures and from the capacity development measures of current water projects. When designing programmes it is important to see to what extent each “pillar” is developed, and what contribution German development cooperation measures can make to further developing this. The authors of this study consider that impacts are most likely to be achieved in projects or programmes with both a strong TVET component and a water component, which thus address two major pillars of the integrated approach. This can be seen particularly clearly in countries with a dual focus (like Jordan, Peru and Viet Nam, for instance), where major elements of the approach have already been incorporated in programme design.

²⁹ In Ghana, advisory services have been provided to various sector associations since 2011 within the framework of the TVET project. In conjunction with these associations, skills standards have been devised for selected occupations. In cooperation with selected training providers (state and private vocational schools) modularised training courses for apprentices and masters are now being offered in the informal sector. A voucher system for financing has been devised and is implemented now.



Project case studies from development cooperation

As part of the study, several projects from BMZ partner countries were examined in greater detail. The surveyed projects were from Afghanistan, Burkina Faso, Jordan, Palestine, Peru, South Africa, Tanzania, Uganda and Viet Nam. The project from Palestine has been added. All in all they demonstrate a broad range of approaches of the water sector to TVET.

In Afghanistan, for example, employees of operators and authorities undergo preparation for their tasks in numerous individual interventions that focus on the basics. Training measures in the technical sphere were developed for skilled workers. The TVET project also trains plumbers and installers.

In Burkina Faso, responsibility for water supply and sanitation has gradually been shifting to local authorities since 2009. The current decentralisation process means that mobilising new actors (such as municipalities, consumer associations or private operators) and strengthening and training them is a key element in improving water supply and wastewater disposal across the country. Developing the *Centre des Métiers de l'Eau* (CEMEAU) into an efficient national centre for initial and continuing TVET enables the number of trained personnel to be increased.

In Jordan the water programme has included a TVET component since 2012, promoting training and business start-ups for plumbers. Development cooperation has been active in the water sector in Jordan for over 50 years. Jordan is one of the most water-scarce countries in the world. It guarantees its population a good drinking water supply and good wastewater disposal, but in some cases has to extract water from fossil aquifers and pump it over long distances. To date, no fundamental TVET measures have been initiated or offered. This is also true of the supply and disposal sector: waterworks, water networks and wastewater technology. The training centre at the Ministry of Water carries out individual training measures. Only a certain amount of practical work is possible with the trainees. The centre is not sufficiently equipped to meet the challenges, nor are the teaching staff sufficiently qualified. European Union (EU) education and training projects have been launched for various professions, for example in the tourism sector. In recent years the United States Agency for International Development (USAID) has tested and introduced an American certification system (ABCcert).³⁰



Figure 13: Examples of GIZ's TVET projects in the water sector (© Albrecht 2014; GIZ 2017)

³⁰ For further information about the Association of Boards of Certification, see http://www.abccert.org/certification_contacts/ last accessed on 20 November 2017

Project case studies from development cooperation

The Water Programme in Palestine aims to improve the capacities of the Palestinian water sector institutions. The intention is to improve planning steering and regulation of water supply and wastewater management services.

The project concentrates here on two fields of action:

- (1) Support of national institutions in the implementation of reform processes and
- (2) Improvement of the management capacities of the water and wastewater supply providers in line with the national strategy of the Palestinian Water Authority.

In Peru, vocational qualifications in the water sector were developed with state institutions and the private sector. Implementation and training are set. A dual training system and a certification scheme for water and wastewater technicians have been developed. To ensure that water companies have qualified staff in the future, the new training courses and certification programmes are being introduced in vocational training institutes and the participating water companies.

In South Africa a TVET project has been implemented under the title of “Skills for Green Jobs”. The focus was on improved opportunities for training and on developing curricula geared to hands-on practical work. An innovative public-private partnership component linked the water sector to a German company named FESTO.

Another interesting example is that of Tanzania, where support was mainly directed at the state-owned training centre, the Water Development and Management Institute (WDMI). After many years dedicated to theoretical training, it has shifted its focus to training skilled workers.

In Uganda, support is provided for the establishment of a training centre at the country’s largest state water provider. A new phase has now begun in which greater emphasis is placed on TVET with the development of curricula for plumbers and electricians and the development of four training standards.

The first training course culminating in qualification as a sewage engineering technician has begun in Viet Nam. Various German companies and ministries are actively involved in the country, engaging in research in industrial zone management, development cooperation measures relating to the construction and operation of supply facilities and disposal plants, and advisory services on flood

protection and river basin management. The GIZ TVET project promotes training for the water sector. German development cooperation has been active in Viet Nam for many years, and invests in the country’s water industry. Training measures have been successfully introduced at certain operating companies. Specialised training courses are already being run in the industrial wastewater sector. Lessons learned at the local level now need to be secured and scaled up for implementation at the national level.

In summary it can be stated that some of the GIZ projects studied here have responded to the emergence of a skills shortage. Training measures that were previously limited to individual companies are now being embedded nationwide and are being integrated into the TVET system.

Project case studies from development cooperation

Afghanistan

Title	Reform of the water sector
Term	2008–2018
Context	Few people in Afghanistan are connected to the public drinking water and wastewater system. One in three households in Kabul is connected, but only one in five in the provincial cities. In rural areas access to water is mostly obtained centrally via wells, streams or rivers, with all the associated risks to health. Furthermore, water resources in Afghanistan are scarce to start with. The public water industry has inadequate access to well-trained personnel.
Target group	Decision-makers in the water sector at local, regional and central level; the Afghan people by way of awareness-raising campaigns, and staff at the Ministry of Energy and Water;
Project objective	The institutional, organisational and legal frameworks for sustainable water management in Afghanistan have improved.
Method	The TC vocational training project provides training in the sanitation sector in Afghanistan. It also provides tailored courses for skilled workers at national, regional and local level and conducts campaigns to raise public awareness.
Result	Around 2,000 employees from all the institutions in the water sector attended management training courses. As a result, they are now better able to fulfil their tasks.

Afghanistan has a population of around 30 million people, some 80% of whom live in rural areas and only 20% in towns and cities. As noted in the context above, even in the cities the connection rate is sometimes as low as 20–30%. On the basis of these figures, a feasibility study conducted in 2004–2006 stated that one billion dollars' worth of investment was needed in the urban water sector by 2025. In parallel with this investment, the requirement for skilled labour (in mechanical, electrical, plumbing and other technical fields) in the urban water sector is estimated to rise from 1,000 in 2015 to 1,500. Because of the huge investment backlog, the rise in demand for labour in the water sector is expected to be slow over the coming decades.

The GIZ project has used a variety of customised individual measures to train employees in operating companies and in government bodies. The need for training was determined in consultation with the partners and the courses gradually developed. The training courses were very broad in scope. Basic skills needed to be learned in literacy, English and mathematics courses in order to establish an initial level of understanding. From 2013–2014 onwards around 70 employees at skilled worker level received training in technical disciplines such as leak detection or pump operation, partly in seminars but also in on-the-job schemes.

The project has not yet taken a close look at the informal sector, and therefore at plumbers, in particular. Similarly, no approaches have yet been adopted that institutionalise professional development in the water sector.

Project case studies from development cooperation

Burkina Faso

Title	Drinking water and sanitation programme in small and medium-sized towns
Term	2016–2018 (overall term of the programme: 2006–2018)
Context	<p>Since 2009, responsibility for water supply and sanitation has gradually been shifting to local authorities, but many of these are not yet in a position to face the new challenge. At municipal and regional level there is a shortage of skills and knowledge in water management, while at national level there is a lack of experience in steering and disseminating the complex reform process. Furthermore, meeting the constantly rising demand for clean drinking water and the requirement for good sanitation through the expansion and efficient operation of water supply and sanitation systems is proving to be impossible. All in all, capacities in the sector at individual, organisational and institutional level are not yet sufficiently developed to satisfy requirements or to ensure sustainable and equitable water supply and sanitation provision across the country. The current decentralisation process in the water sector means that mobilising and strengthening new actors (such as municipalities, consumer associations or private operators) is a key prerequisite for improving water supply and wastewater disposal in Burkina Faso as a whole. Raising individual skill levels through training and professional development is crucial to achieving sustainable development in the sector. Ensuring that the <i>Centre des Métiers de l'Eau</i> (CEMEAU) continues to make progress in becoming an efficient national centre for initial and continuing training for the entire water sector will increase the availability of skilled personnel needed to implement the reform process.</p>
Target group	The target group is the population of Burkina Faso via the multi-level approach but in particular through the support of the Ministry of Water and Wastewater through its regional directorates (Boucle du Mouhoun, Hauts-Bassins and Sud-Ouest).
Project objective	<p>Municipal and national capacity for operating and developing water supply and sanitation systems has been improved on a sustainable basis.</p> <p>Sub-objective: Services at the training centre for water professions have improved.</p>
Method	<p>The advisory services cover the strengthening and professionalization of management at CEMEAU with the aim of ensuring that the centre is managed independently and sustainably (including financial and business aspects). Curricula are also developed, and are adapted to the needs of new actors and of personnel at <i>L'Office national de l'eau et de l'assainissement</i> (ONEA). The principal activities comprise providing advice on institutional and organisational development, capacity building, analysing training requirements for all players in the sector, developing new curricula and identifying partnerships with other institutions in order to improve the provision of training and professional development.</p> <p>The strategic, technical and organisational capacities of experts and managers at ONEA and in the municipalities are strengthened at the meso level in order to implement the sector reform. To achieve this aim, the programme focuses on optimising the training and professional development of skilled workers through the CEMEAU training centre and on the provision of advisory services to experts and managers at ONEA and in the municipalities. It also includes:</p> <ul style="list-style-type: none"> • Institutional and organisational development, • capacity building, • analysis of training requirements for all players in the sector, • development of new curricula and identification of partnerships with other institutions in order to improve the provision of training and professional development.

Project case studies from development cooperation

Burkina Faso has a population of 17.8 million. The drinking water supply rate in urban areas is 86%, and in rural areas 64%. The figures in the wastewater sector are lower, with a connection rate of only 32% in towns and cities and a mere 9% elsewhere. The employment potential is therefore considerable. The 2014 IWA study forecasts that demand for skilled workers will reach 30,000 merely to achieve the SDGs.

CEMEAU is responsible for TVET, with some training also provided by the *Institut International d'Ingénierie de l'Eau et de l'Environnement* (International Institute for Water and Environmental Engineering).

The water sector has made the shortage of skilled workers the focus of its sector strategy. It has also been recognised that TVET has to be integrated into the national qualification system. The currently envisaged target groups comprise young people who have just completed secondary school and are intending to undergo basic training in the sector. In addition, a training scheme is being designed for qualified skilled workers who will perform municipal services.

The sector dialogue between the stakeholders has been initiated, and a round-table discussion on financing for TVET and for the provision of training for operators will take place in early 2015.

Seven training modules have been developed to train municipal operators, which 3,500 people are expected to attend over a period of six months.

Project case studies from development cooperation

Jordan

Title	Vocational Training and Skill Enhancement for Jordanians and Syrian Refugees in the Water Sector (VTW)
Term	2016–2019
Context	Water resources are not managed efficiently in Jordan. Water utilities, like the Water Authority of Jordan (WAJ), do not have adequately trained professionals who can efficiently operate and maintain the public water mains and technical infrastructure in the long term. The lack of trained sanitation professionals who can offer water supply and sanitation services at household level and the lack of trained staff at water utilities prevent water from being used efficiently. The capacities of sanitation professionals and experts on water utilities in Jordan are inadequate.
Target group	Jordanians, Syrian Refugees and technical operators in governmental authorities in the Jordanian water sector.
Project objective	The capacities of sanitation professionals and technical experts on water utilities in Jordan have improved.
Method	<ul style="list-style-type: none"> • Creating and conducting training for male and female Jordanians and Syrian Refugees in the field of sanitation • Sanitation professionals are receiving advice on improving their employment and income prospects • Advising WAJ on building capacity to implement a comprehensive programme of continuing professional development for technical staff
Result	<ul style="list-style-type: none"> • 460 Jordanians and Syrian Refugees have been trained in the field of sanitation • Three cooperatives with a total of 40 members offer their sanitation services on the market • 250 technical experts from water utilities have been trained in the fields of water supply and wastewater treatment

Jordan is ranked among the world's water-poorest countries. Its water needs are constantly rising because of the expansion of irrigation farming, increasing industrialisation and high population growth, due in part to the country accepting Syrian refugees. The groundwater level is falling. According to the United Nations High Commissioner of Refugees (UNHCR), about 657,000 registered Syrians were living in Jordan in April 2017. Estimates indicate that at least an equal number of unregistered refugees are residing in the country. The inadequate public utility services are now reaching their limits.

The project supports the Vocational Training Corporation (VTC) as it creates training courses for skilled and semi-skilled sanitation professionals. These courses target male and female Jordanians and refugees in the governorates of Amman and Irbid. The sanitation professionals also receive advice on improving their employment and income prospects. This allows households to have access to better services, in terms of quality and quantity, that would help them reduce water losses and conserve water.

Furthermore, the project advises WAJ on building capacity to implement a comprehensive programme of continuing professional development for technical staff. It thus makes a contribution to reducing annual water losses and to safeguarding investments in infrastructure in the long run, as envisaged in the National Water Strategy.

Project case studies from development cooperation

Palestine

Title	Water Programme Palestine
Term	2013-2018
Context	<p>The development of the water sector in Palestine is hampered by the political situation and a fragile institutional framework. This leads to inadequate water supply and sanitation services and limited access to water resources for large parts of the growing Palestinian population. 96% of the roughly 2.4 million inhabitants of the West Bank are connected to the public water supply networks which is quite high on an international comparison. However, the provision of the population with potable water continues to be limited due to internal problems in the water and wastewater service providers and difficulties with water availability. About 61% of the population in the Palestinian Territories are connected to sewage networks. Because of the lack of treatment plants, the majority of wastewater in the West Bank (79%) continues to be discharged untreated into valleys or drained underground. In the Gaza Strip, this percentage was 28% before the recent conflict in 2014, in which a substantial part of the infrastructure was destroyed.</p> <p>Numerous water and wastewater service providers struggle with high water losses, inefficiency in the operation of existing facilities, partly also critical revenue collection rates and lack of professional staff in particular for wastewater management. With the adoption of the Water Law in 2014, the establishment of the regulator and numerous bylaws, the framework conditions for a far-reaching reform of the sector have been improved. However, institutions on the national level as well as the approximate 300 water service providers do not have the required capacities for efficient planning, management and regulation of water provision and wastewater management.</p>
Target group	The target group of the project is the population of the Palestinian Territories (West Bank and Gaza) including around 15.000 households in East Jerusalem, as they are beneficiaries of all consumer-oriented improvements in the potable water and sewage services.
Project objective	<p>The GIZ Water Programme Palestine aims to improve the capacities of the Palestinian water sector institutions with regard to planning, steering and regulation of water supply and wastewater management services.</p> <p>The project concentrates on two fields of action: (1) Support of national institutions in the implementation of reform processes and (2) Improvement of the management capacities of the water and wastewater supply providers in line with the national strategy of the Palestinian Water Authority.</p>
Method	<p>In general, the HCD³¹ and training measures of the GIZ Water Programme Palestine shall contribute to the enhancement of the human capacities in the Palestinian water sector and to the achievement of the National Human Capacity Development targets. Specifically, they shall:</p> <ul style="list-style-type: none"> • Provide flexible, demand oriented and efficient procedures for preparation and delivery of HCD and training activities • Create and test a delivery mechanism for HCD measures including the Palestinian Water Authority (PWA), (Union of Palestinian Water Service Providers (UPWSP) and Water Service Providers with regard to self-sustainability • Strengthen the UPWSP role in participating in sector management planning, especially building up its trainings capacities

³¹ Since 2011, GIZ has been developing goals and innovations for the GIZ service Human Capacity Development in a process of change in the last years. The HCD strategy provides a target model for the management of HCD processes within the company and links to personnel development.

Project case studies from development cooperation

Method	<ul style="list-style-type: none"> • Develop of an “Overall Training Plan” for the use by the UPWSP beyond the project • Support the activities of the other components (such as benchmarking, performance monitoring and tariff setting)
Result	<p>The overall evaluation shows, that the HCD project has been successful by all means and further continuation is requested. Furthermore, these results were achieved:</p> <ul style="list-style-type: none"> • More than 100 HCD measures and trainings were delivered with around 1,500 participants from the water and wastewater sector • The UPWSP raised the number of members from 9 to 65 Water Service Providers and improved its capacities in delivering training programs and in providing a platform for knowledge exchange on the national level. • Development of an “Overall Training Plan” for the use by the UPWSP beyond the project • International cooperation’s established to water sector institutions in Jordan, Balkan region, Turkey, Portugal, Italy, Kenia and Germany

The Union of Palestinian Water Service Providers (UPWSP) was reestablished in 2014 and is committed to a) the development of sustainable, resilient and economic water and waste water service providers, b) the facilitation of knowledge exchange between its members, c) the achievement of an efficient and cost-effective operational environment of its members by technical qualification such as operation and maintenance trainings. So far, UPWSP has 65 members including the biggest water service providers in Gaza and the West Bank.

GIZ has been supporting the UPWSP since its establishment through its Water Programme. UPWSP has developed a strategic plan 2015 – 2017 with the following objectives:

- Institutional development of the union and ensuring its financial sustainability
- Capacity and institution building of the union members
- Contribute to the development of the regulatory framework of the water sector
- Contribute to incorporating members’ priorities in the national sectorial development plans

The UPWSP is conducting technical working groups in order to strengthen the linkage between the members by exchanging knowledge on common water issues (GIS, Water Awareness, Leakage, Non-Revenue Water, Wastewater, Energy, Research) and to define mutual strategies and operational plans in order to develop the sector. The technical working groups can be defined as a core process of the Union.

In order to strengthen the technical, managerial and financial capacities of the members, the UPWSP offers tailored consultancy services aiming to improve the performance. Local short-term consultants or employees of members are trainers for the technical working groups and offer services in particular small and medium size Water Service Providers. These services are a flexible tool to the UPWSP in order to answer the needs of the members and contribute to the overall goal of a sustainable self-financed UPWSP.

The yearly annual Water Conference aims to present “Best practices” in the water sector and to reflect on the output of the trainings. National and international water experts are invited to exchange their knowledge and build business relationships.

Project case studies from development cooperation

Peru

Title	Modernization and strengthening in water supply and sanitation Program (PROAGUA II)
Term	2015–2019
Context	Three and a half million Peruvians do not have access to drinking water and more than twice of that amount does not have adequate sanitation facilities. Poor families in peri-urban areas and rural areas are the most likely to suffer this situation. Public water services often can not provide basic services because their employees are not adequately trained and managed. In many regions, water utilities are too small, financial management is poor, water charges are too low and operations are often determined by political influence.
Target group	Water and sanitation facilities and as a result the users of sanitation services.
Project objective	Water utilities in Peru provide better drinking water supply and sanitation services. The drinking water supply and sanitation services have improved and also having as a political counterpart the Ministerio de Vivienda, Contrucción y Saneamiento (MVCS) of Peru.
Method	<ul style="list-style-type: none"> • Dual technical training • Certification of labour competencies • Sustainability mechanisms
Result	<p>Dual training: Design of two technical careers:</p> <ol style="list-style-type: none"> 1. Water Treatment Technician: “National Training Service in Industrial Work” – SENATI (private), 3 years. 2. Technician in “Drinking Water and Wastewater Networks” National Training Service in the Construction Industry – SENCICO (state-owned), 3 years. <ul style="list-style-type: none"> • 153 apprentices in training processes (107 in SENATI and 46 in SENCICO). • 17 training companies are participating: 15 private and 2 public companies. <p>Certification of labor competences:</p> <ul style="list-style-type: none"> • A functional map approved by the Ministry of Labor and Employment Promotion (MTPE). • Four profiles of labor competencies, including their respective evaluation instruments and listings of minimum equipment approved by the MTPE (Production, Distribution, Collection and Treatment). • SENCICO accredited as “Certification Center of Labor Competencies” for three profiles of labor competences (production, distribution and collection). • 115 employees of companies in Piura, and 39 of Peruvian Water and Sewage Service (SEDAPAR), in Arequipa, received certifications. <p>Sustainability mechanisms:</p> <ul style="list-style-type: none"> • Two companies fund the training of their apprentices • Creation of the “Labor Competencies Committee of the Sanitation Sector”.

Project case studies from development cooperation

A 2011 study on human capital in sanitation service companies established 9,585 permanent employees working in drinking water and sanitation services in urban areas in Peru. This represents 0.005% of the 16 millions of workers in the country and does not include personnel working in subcontracted companies.

In 2014, the Ministry of Labor and Employment (MTPE) and the Ministry of Housing, Construction and Sanitation (MVCS) commissioned a study on the estimated supply and demand by 2025 of the operational technical staff of companies providing sanitary facilities. It has found that, on average, in the 19 largest water and sanitation companies in Peru, by the year 2025, about 350 technical and operational workers are needed every 2 years.

Two training centers, SENATI (private) and SENCICO (state-owned), were selected to be the providers of professional technical careers. The companies providing sanitation services are actively involved in the design of educational instruments for technical careers but above all in the implementation of training in the company. The training centers have been equipped with technology from German companies such as FESTO, Herman SEWERIN GmbH and DAS Environmental Expert GmbH. This has been achieved because of the German Peruvian alliances.

Furthermore, the certification of labour competencies is currently in the implementation process. In the last months, 153 workers have been certified and by 2018, it is planned to certify 1,000 workers from approximately 20 sanitation service companies.

Both subjects, both the dual technical professional training and the certification of labor competencies, are led by the MVCS, which coordinates the action of implementation of the “Work Competencies Committee” of the sanitation sector.

Project case studies from development cooperation

South Africa

Title	Invest in the future – vocational education and training for the climate and the environment – capacity development PPP with Festo Didactic GmbH
Term	2011–2016
Context	<p>The green economy is becoming increasingly important in South Africa. By 2020, some 300,000 new jobs related to climate change and the environment are expected to be created. These include jobs in the public sector, for example in relation to drinking water supply and wastewater disposal.</p> <p>In order to meet an employment target like this the country needs new technologies, and it has to establish new training programmes and corresponding career paths. Above all business and industry – including public service providers – are faced with the problem of a lack of coherent strategies and coordinated training programmes for systematic initial and continuing training.</p>
Target group	Public and private enterprises and their current and potential workforce in the (drinking) water supply and wastewater disposal sector;
Project objective	Current and potential workers in (drinking) water supply and wastewater disposal have been trained in accordance with the requirements of a green economy.
Method	<ul style="list-style-type: none"> • Support for training institutions with the development of modular curricula, and their subject-specific and methodological conversion into training materials • ToT • Feedback of development work and lessons learned into the ongoing processes of the development of occupational profiles in the water sector

It is estimated that 34,000 people are employed in the water sector in South Africa. The demand for engineers is put at 3,000, and that for skilled workers at a further 4,000. The shortfall in technical occupations and trades, in particular, will be impossible to make up for in the medium term because there are no adequate training programmes in place and only an insufficient number of training places available. Modernising the overly academic system in South Africa and making the theoretical training more practically oriented also poses a challenge.

Festo Didactic GmbH is a leading international provider of customised training solutions for industry. Together with the University of Stuttgart, Festo has developed training modules and a modular training system (Edukit PA). As part of the project, the University of Pretoria (UP) and the Water Academy in Knysna are receiving support to help improve initial and continuing training for municipal water utilities in South Africa and to make it more practice-oriented. The training is to be placed at the level of water plant operators. The modules that are developed are trialled and adapted to South African conditions in ToT measures with lecturers from the UP and the Water Academy. These two institutions incorporate these adapted modules – including the associated training materials – in their teaching and learning programmes. In order to ensure the systemic fit of this training content, the UP maintains close contact with the Quality Council for Trade and Occupations (QCTO), which safeguards the quality of vocational qualifications.

This project is closely related to the Skills for Green Jobs (S4GJ) project promoted by the BMZ, the strategic focus of which is directed at support measures to improve coordination between ministries, vocational training institutions, technology transfer facilities and businesses. As a result, lessons learned with the development of the modules and integration into teaching and learning activities will not only be presented for discussion in the context of a regional conference, they will be continuously supported by S4GJ and will be taken into account in the design of subsequent training and technology transfer projects for the water sector.

Project case studies from development cooperation

Tanzania

Title	Supporting water sector development – institutional development for water and wastewater companies
Term	2004–2016
Context	The process of reforming the Tanzanian water sector is moving at a slow pace. Although new political and legal frameworks have been established, government institutions, water and sanitation companies, and water management authorities often lack the capacity to implement adopted reforms. Demand from the Tanzanian partners for advisory services on capacity development and vocational education and training has increased. One of the main partners is the Water Development and Management Institute (WDMI), which has the role of meeting training requirements for the water sector across the country.
Target group	Students, employees of utility companies and staff of the WDMI.
Project objective	The institutional and human resource capacities of commercial water and wastewater companies are improved.
Method	<ul style="list-style-type: none"> Needs-driven training measures are introduced at the water supply and wastewater disposal companies and the public agencies responsible for water quality and protecting catchment areas Advisory services are provided to the WDMI on the designing of new curricula and training courses
Result	A comprehensive range of courses is on offer and the number of trainees completing training has risen.

One priority area of the institutional development for water and wastewater companies' component is cooperation with the WDMI. The Institute was founded in 1974, and makes vital contributions to development of the water sector in Tanzania through its three fields of work: training, advice and research. The Institute has a monopoly on initial and continuing vocational training. In 2011 the GIZ project supported the WDMI in developing a management tool for market assessment of training needs and demands. The tool was tested and revised, and is now used to gather data from the future employers of the trainees and to evaluate it on a national basis. There have been estimates that the water sector will require at least 4,000 technicians over the next five years. For the WDMI, this means that roughly an additional 600 workers will have to be trained each year.

The Institute originally focused solely on training the next generation of technically oriented academic recruits. Starting in the coming academic year, it will take on a further two training courses. Training will be offered at skilled-worker level in the following occupations, in five one-year certificate courses: (i) water supply and sanitation engineer, (ii) hydrology and meteorology, (iii) hydrogeology and well construction, (iv) water laboratory technology, and (v) irrigation engineer. In addition, a modular programme has been designed that likewise from next year onwards will offer training for skilled trades at levels one to three of the National Qualification Framework, covering the occupations of water protection management, hydraulic engineering (specifically well construction), monitoring of new customer connections, and pump operation.

The curricula for both new programmes were developed in close cooperation with the future employers, and they have also been closely involved in adapting the existing courses. The cross-sectoral dialogue with the National Council of Technical Education (NACTE) and the Vocational Education and Training Authority (VETA) proved successful in the development of the certificate and training programme. The good relations between the WDMI and all relevant stakeholders can be rated a particular success.

Project case studies from development cooperation

Uganda

Title	Reform of the urban water and sanitation sector
Term	2014–2018 (overall term of the programme: 2008-2019)
Context	Over the last decade, Uganda has made enormous improvements to the water supply and sanitation provisions for its population. However, although more than 70% of urban residents now have access to water and sanitation services, the high rate of population growth and increasing urbanisation mean that the access is still inadequate, especially in the poorer areas of towns and cities. This, combined with the growing pollution of the water resources, poses one of the biggest barriers to development in the country.
Target group	Poor city dwellers in Uganda.
Project objective	The preconditions for a pro-poor urban water supply and sanitation system that functions efficiently over the long term have been improved.
Method (of this field of activity)	<ul style="list-style-type: none"> • Twin-tracked consultancy for the responsible Ministry of Water and the largest water utility • Policy and strategy development • Development of curricula and organisational development for training centres • Establishment of partnerships and networks, including with the private sector • Public relations work to arouse an interest among women for technical occupations
Result	The following results have already been achieved in this field of activity in the current phase (2014–17): the training materials/curricula for the Industrial Plumbing and Electromechanical Technician training courses have been or are being revised (Water Quality Management) and have been brought up to date. The capacities and the quality of training at the training centre for the National Water and Sewerage Corporation (NWSC) have been analysed, and on that basis TVET has already been made more practice oriented. The Ministry of Water's current capacity development plans have likewise been geared more towards practical training.

In light of the steadily rising demand for skilled labour in the Ugandan water sector, which even now cannot be met by existing training institutions, the NWSC, the parastatal water utility company in Kampala and about another 100 towns and cities, has established its own training centre for water-sector occupations with support from GIZ. Another training centre in northern Uganda is at the planning stage. Although considerable importance is attached to TVET nationwide, in terms of quality it is significantly below academic education.

Since 2012, curricula for the professions of industrial plumber, electrician and pump mechanic have been developed at the NWSC in cooperation with the Directorate of Industrial Training (DIT) with support from GIZ.

The curricula have been used by the NWSC in training courses at the training centre since 2014. In the ongoing project the intention is to continue to expand the range of training courses on offer and to provide advice on the operation, financing and commercial expansion of the centre. In addition the project aims to identify more national and international partners from the private sector, for example to provide training materials or samples for demonstration.

The Ugandan government has made gender balance a priority. The programme actively supports the mobilisation of women in the sector, who have, until now, occupied 18% of the key positions.

Project case studies from development cooperation

Viet Nam

Title	Reforming technical and vocational education and training in Viet Nam
Term	2015–2017 (overall term of the programme: 2006–2019)
Context	The rapid developments and structural changes in Viet Nam's economy are presenting the TVET system with huge challenges. The demand for competent skilled workers in the economically dynamic industrial and service sectors, in particular, is extremely high; if economic trends remain the same, demand will continue to rise. At present, however, there are insufficient resources or capacity to transform and expand the TVET system in accordance with needs.
Target group	<ul style="list-style-type: none"> • Secondary school leavers • Employees of private companies • The unemployed • The underemployed or young people and adults under threat of unemployment • Intermediaries are school teaching staff and in-company trainers, as well as overarching structures such as the General Department of Vocational Training (GDVT) and the Vietnam Water Supply and Sewerage Association (VWSA)
Project objective	<p>The supply of workers trained in accordance with needs for green and sustainable economic development has improved.</p> <p>The preconditions for needs-oriented training in the wastewater sector, in terms of content, human resources, design and organisation, have been created in a selected vocational training institution.</p>
Method	<p>Priority areas:</p> <ul style="list-style-type: none"> • Capacity development for experts and managers at the authority responsible for TVET and subordinate teaching and management staff posts at the promoted vocational training institutions • Provision of advisory services on reform processes for TVET at systemic and institutional level • Piloting of needs-oriented initial and continuing training courses based on the German standard • Strengthening of cooperation with the private sector in TVET
Result	<ul style="list-style-type: none"> • The capacities of teaching and management staff at the Ho Chi Minh Vocational College of Technology (HVCT) and skilled workers from companies have been developed. • Occupational standard, training programme and training modules have been developed and have been approved by the GDVT for piloting. • Four training companies have been identified as partners for cooperative training.

Project case studies from development cooperation

The field of activity covering the initial and continuing training of skilled workers in the wastewater sector within the programme “Reforming technical and vocational education and training in Viet Nam” has been implemented since the beginning of 2014. The Ho Chi Minh Vocational College of Technology, which was selected according to specific criteria, is receiving support to implement needs-driven training in the wastewater sector. The College has already been offering a course for the profession of industrial wastewater treatment for seven years. As part of this field of activity, a cooperative, practice-oriented training model is being piloted for training skilled workers specialising in wastewater technology, with in-company and in-school training phases.

During the preparations the programme joined the water supply and sewerage association VWSA to identify companies as training partners. Teaching staff from the HVCT and (future) trainers from the companies improved their skills and knowledge in practice-oriented professional development courses. The occupational standard, which was devised in collaboration with the VWSA and wastewater companies, formed the basis for the curriculum and training modules drawn up by the HVCT. An examination and certification system involving the state and the private sector is currently in preparation. In addition, image campaigns are being conducted with companies and associations in order to introduce the occupational profile and to improve the social recognition of TVET in the wastewater sector.

To conclude this section, the diagram below shows the qualification levels at which TVET in the water sector is placed in the respective countries. The European Qualifications Framework (EQF) is used as the reference for the classification of the training in the diagram. The development of infrastructure varies from country to country, and the vocational training systems in the water sector have also reached different stages of development.

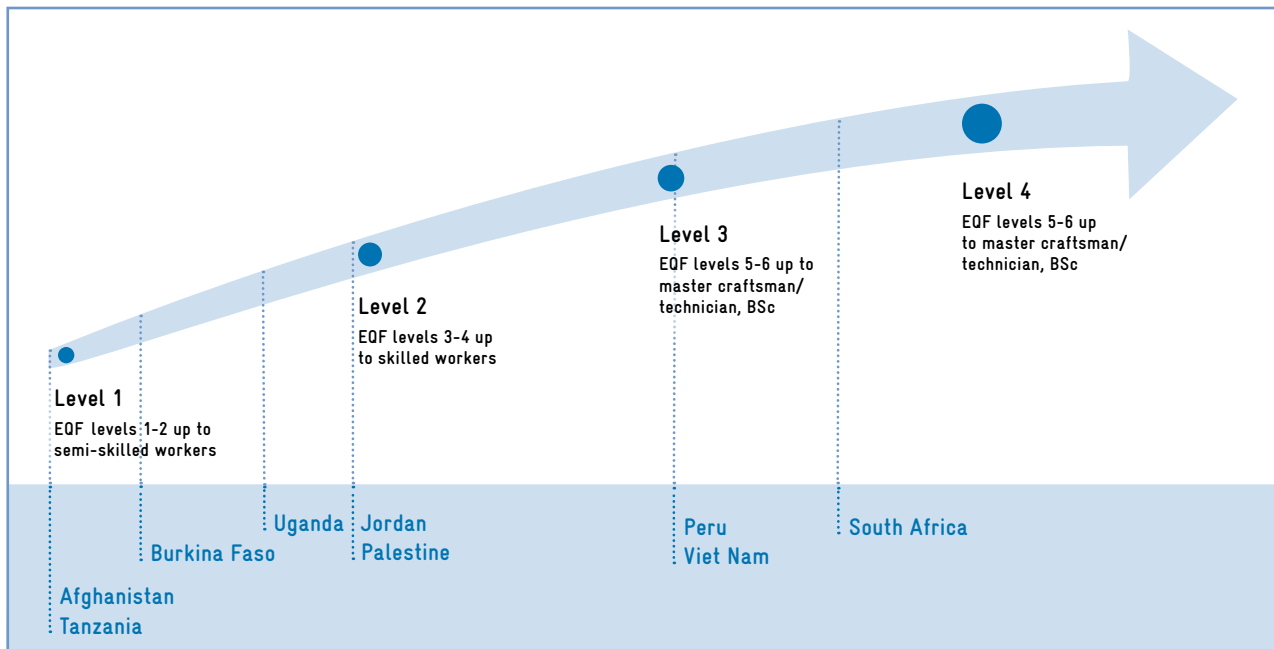


Figure 14: Classification of countries according to possible qualification levels within the education system
(© Heidebrecht/DWA 2014)

Project case studies from development cooperation

The four qualification levels are explained below, using Figure 14 as a basis. The EQF provides guidance regarding the various levels. Requirements may differ, depending on the partner and country.

Level 1 EQF, level 1–2 to semi-skilled workers. Basic courses, because only a small number of simple plants are built. Electricians, fitters, plumbers, construction workers, etc. obtain additional basic qualifications.

Level 2 EQF, level 3–4 to skilled workers. Courses lasting several weeks are conducted because significantly more plants and more complex systems are operated. Electricians, fitters, plumbers, construction workers, etc. obtain extensive additional qualifications.

Level 3 EQF, level 5–6 to master craftsman/master technician/Bachelor of Science. A standardised nationwide certification system is in place, training providers use coordinated examination regulations, questions and procedures. Modular or block courses lasting several months are in place. Electricians, fitters, plumbers, construction workers, etc. obtain extensive additional qualifications.

Level 4 EQF, level 5–6 to master craftsman/master technician/Bachelor of Science. State-approved qualifications are in place, vocational schools offer practice-oriented initial training for the next generation of young talent. Training providers offer in-service courses for electricians, fitters, plumbers, construction workers, etc. for post-qualification.



Recommendations for action and prospects

Recommendations for action at the political and strategic level

Use global sustainability goals as an important guide

The SDGs set out indicators for vocational training in the water sector and provide key policy guidance till 2030. They should be taken into account in the bilateral negotiations with the BMZ partner countries.

Be guided by demand for skilled workers – examine development cooperation engagement on TVET in the water sector

In partner countries where there is a need for skilled workers in the water sector, the possibility of strengthening TVET for the sector should be examined and proposals drawn up. Experience can be drawn from the examples of good practice from ongoing projects. Systemically effective approaches to TVET contribute to safeguarding investment in the water sector over the long term and to providing a lasting solution to shortages of skilled workers.

Create employment by expanding infrastructure

Further investment, especially in urban water supply and wastewater treatment plants, brings with it the creation of jobs. Construction and equipment companies receive orders and recruit staff. Operators take over new facilities and need appropriately trained personnel. This creates employment opportunities for the next generation of junior employees, which can help to reduce youth unemployment.

However, when orienting development cooperation measures towards the achievement of employment effects, contrary trends in the international water sector must be taken into account: greater use of telecontrol and improvements to instrumentation and control engineering can lead to a reduction in the number of jobs, with a simultaneous growth in the skill requirements of the employees. Changes are also likely to occur for workers in the informal economy. It can be assumed that as the quality and reliability of services improve, the share of work for the informal sector in water supply will decline.

No investment in infrastructure without strengthening initial and continuing vocational training

Building water works, wastewater treatment plants and their networks without developing appropriate TVET measures for the operating personnel is not sustainable. Besides expert planning in technical matters, vocational qualification planning must be included in new projects

and programmes. This should be established as an integral part of every project in parallel with detailed construction supervision planning (GWP 2012). Task-sharing between Financial Cooperation and Technical Cooperation, and complementary collaboration between the two, must therefore be clarified before measures are implemented.

If training is provided for staff members who are already employed, some may leave to join the private sector, where the pay is usually better. It must therefore be ensured that the incentive systems developed make it attractive to remain in the water sector.

Create conditions for the systematic use of labour market information

An absence of labour market information in developing countries has meant that the problem of the skills gap has been kept hidden for a long time. It was only the study begun by DFID and IWA in 2009, which looked at 15 countries in the water sector up until 2014, that presented transnational analyses of demand for skilled workers for the water sector. German development cooperation could participate in this process at international level by supporting the ongoing initiatives by ILO and UN Water on Water and Jobs and carrying out further country studies together with the IWA. An internationally coordinated approach promotes synergies and produces a better planning basis for TVET projects in the water sector.

When it comes to implementing TVET projects in the water sector, on the other hand, a qualitative approach is advisable. Establishing wide-ranging labour marking information systems usually proves to be very difficult in developing countries. Therefore it is recommended using dialogue-oriented approaches at local or regional level with experts on the supply and demand side of the labour market, to explore current and future requirements for skilled workers, training and qualifications and to jointly identify gaps and/or qualitative weaknesses in the TVET programmes on offer. This information then serves as a foundation for planning the development of initial and continuing training provision in the region.

Recommendations for action and prospects

Make German experience more visible and strengthen cooperation with German actors

The theme of the UN World Water Day 2016 was Water and Jobs. German experience and contributions in this field can become more internationally visible, and be presented at trade fairs and conferences, for example. Germany has over 60 years of TVET-related experience in the water and wastewater sector. There have been state-recognised professional qualifications in the environment sector for 30 years.

The BMZ has been promoting cooperation between development cooperation and the private sector for many years now. The private sector meets at trade fairs, where German development cooperation has had virtually no presence to date. Greater interaction could therefore be achieved by communicating development cooperation themes – including those relating to TVET in the water sector – at trade fairs, for example by development cooperation scouts financed by the BMZ.

There has been a marked improvement in cooperation within Germany on international TVET for the water sector in recent years. The GWP has played an important part in this. Efforts still need to be made, however, to coordinate different measures more closely with each other. Development cooperation could make greater use of experience gathered by the GWP.

It also makes sense to further encourage cross-ministerial cooperation in TVET in the water sector. The BMZ finances extensive bilateral projects and programmes within the framework of development cooperation. The BMBF promotes the internationalisation of TVET with its initiatives iMOVE (International Marketing of Vocational Training)³² and VETnet³³. The BMZ should endeavour to ensure that when new TVET projects are initiated in partner countries there is consultation and coordination with other ministries on existing development cooperation projects to ensure that the projects complement each other on the ground.

Fragile states

If TVET is to be implemented successfully in fragile states, the following four recommendations can be made (GPPI 2013):

- a) Comprehensive yet informal analyses of fragile and socio-economic institutions are key;
- b) TVET projects are effective if they pursue a holistic approach;
- c) The timing and duration of the measures must be correctly chosen; and
- d) The partner must be chosen systematically and following proper reflection.

A change in cooperation partners can be expected more frequently in fragile states than in other partner countries, which makes cooperation more difficult. Projects in these countries therefore need greater perseverance and the flexibility to deal with setbacks. The lessons learned from cooperation with fragile states have not been sufficiently processed to date and further applied research is required.

Development cooperation measures following on from disaster relief

The number of disasters and crisis around the world is increasing. In the wake of natural disasters and political crises it is often the case that refugee camps are set up, which have to be supplied with drinking water and sanitary facilities. Experience shows that refugees on average remain in a refugee situation for 20 years, and spend most of that time in refugee camps (BMZ 2015, refugee research 2015). In the water sector, development cooperation has not yet developed a clear package of measures in conjunction with emergency assistance providers to address these difficulties. Short-term training courses and advisory services are needed which follow on from the emergency deployment. The emergency responders leave behind technical equipment and apparatus that has to be serviced and maintained. German development cooperation and disaster relief organisations should pool their experience and develop appropriate approaches to vocational training.

³² For more information on iMOVE: http://www.imove-germany.de/cps/rde/xchg/imove_projekt_international/hs.xsl/prepage.htm?rdeLocaleAttr=en

³³ A Chamber of Industry and Commerce (AHK) project that targets the implementation of dual elements in vocational training systems at eleven AHK locations.

Recommendations for action and prospects

Recommendations for implementing organisations

Align approaches to TVET in the water sector with the key features of the German dual vocational education and training system

In its 2013 strategy paper for one-stop international cooperation in vocational education and training³⁴ and its position paper “Vocational education and training in German development policy” (BMZ 2012:8), the Federal German Government identifies five key features of the German TVET system. These key features serve as crucial guidance for cooperation with international partners on TVET:

1. Close cooperation between the state and the private sector;
2. On-the-job learning;
3. Social acceptance of standards;
4. Training of vocational teachers and instructors;
5. Institutionalised research and advice.

Although the key features are an important guide, a one-to-one transfer of German TVET concepts to partner countries is not a promising recipe for success. In fact it is necessary to devise demand-led training courses that are appropriate to the vocational training systems in the respective country and that actively involve the local water industry.

Bear in mind the size of the country – new qualifications in the water sector can build on existing professions

Introducing specific environmental technology occupations (initial vocational training) in a country presupposes that there are a sufficient number of drinking water supply and wastewater disposal plants at which there will be demand for skilled workers over the medium and long term. If this is not the case, developing specific occupations and carrying out training for them is not an efficient way to proceed.

Relatively small countries with fewer than 10 million inhabitants are generally able to meet their manageable demand for skilled workers for water works, wastewater treatment plants and their networks by conducting further training measures that build on other commercial or

technical trade occupations. In Austria, for instance, the associations offer courses lasting several weeks for electricians and fitters. In Switzerland, too, there is a state-regulated training scheme for target groups from among the skilled trades.

Develop career concepts and strengthen lifelong learning

The bedrock for the proper functioning of supply and disposal facilities is high-quality initial vocational training and continuing training for all employees. Around 80% of the technical staff working at companies in the water sector are engaged in trade or commercial occupations. In addition to these, the household-level craftspeople (plumbers) and others working in the informal sector (such as water tanker and septic tanker drives) are also important target groups who should have access to systematic training opportunities.

In the partner countries awareness should be raised of the need for a permeable TVET system that is geared to the requirements of the water industry and draws the target groups' attention to career paths and development opportunities in their careers.

Cooperation between the state and the private sector on TVET

Development cooperation's tried-and-tested multi-level approach provides the set of instruments needed to advise the various actors at political level (line ministries, e.g. ministries of water and education) and at meso level (water industry associations, sector associations, vocational training agencies) and micro level (training providers, companies), with the aim of jointly planning and implementing TVET. The water sector should initiate the dialogue, for example in the form of round tables or Sector Skills Councils.

The themes to be addressed are the needs-driven development of occupational standards, curricula and the examination system. Skill descriptions, learning goals for the training modules, syllabuses, learning materials and technical standards must be clearly defined for each target group. In the course of this dialogue, public and private enterprises must be persuaded that greater involvement in the financing, planning and implementation of TVET courses is worthwhile for them. When it comes to implementation, pilot approaches could be used to introduce the increased focus on practical work that is often called

³⁴ “Strategiepapier zur internationalen Berufsbildungszusammenarbeit aus einer Hand” – Drucksache 17/14352, Deutscher Bundestag [in German]

Recommendations for action and prospects

for, through in-company phases within the TVET courses. If these prove successful they can be expanded.

Sector associations have an important role to play in defining demand in the partner countries. There are about 80 countries where associations provide a good platform for the stakeholder dialogue. They are organised via the IWA, but in many cases they are only marginally involved in TVET, if at all. The GIZ has gathered experience in the provision of support to sector associations in the Wave project (education and technology partnership) in East Africa, for example, and with the Arab Countries Water Utilities Association (ACWUA) in the MENA region. This experience can be utilised for TVET, and sector associations can be involved in cooperation more closely than they have been up to now.

TVET requires viable financing models. These have already been developed in many countries and form the basis for their vocational training systems. In South Africa, for example, there is the payroll levy that companies have to pay. Development cooperation measures that work with stakeholders in the water sector and in TVET must build on these models.

Embed standards and regulations in TVET

It is essential to apply relevant standards and regulations when drawing up curricula, examination standards and teaching materials. This includes technical specifications, concerning laboratory analysis and instrumentation and control technology, for example, pipe standards, material standards, system standards and standards for the operation and maintenance of motors, devices and test equipment. As a general rule the standards and rules of each individual country should be used. If these are not available, European and German standards and regulations can be used, but of course only after taking account of other donor activities, following consultation with the donors.

One final, important factor in success is training employees of the implementing organisations and forming teams.

The roughly 550 GIZ staff members in the water sector mostly started out on their career paths from university. They should be made more aware of commercial and technical training. Internal training measures and guidelines can help to improve understanding in this regard. The same applies to employees of KfW Development

Bank, other implementing organisations and partner organisations that are mainly concerned with technology. The “technicians” have to become more like “vocational training experts”, and the vocational trainers have to improve their understanding of water technology. The competence centres involved in this study should increase the cooperation between them in order to achieve this. In many water projects, close cooperation with vocational training centres is already everyday routine, or is to be boosted in future. As technical experts often have little or no experience with TVET, it is essential to have interdisciplinary project teams.

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Water supply engineering technician

Water supply engineering technicians work at municipal and industrial water supply companies. They carry out their work independently in accordance with technical documents and regulations as well as legal requirements. They collect information and plan and coordinate their work. They document their work and adopt measures to ensure quality and safety and ensure that people's health and the environment are protected as they work. They are electrotechnically 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;
- lay pipelines, assemble and dismantle relevant facilities;
- examine customer facilities;
- carry out a limited scope of switching operations and repairs to electrical facilities at waterworks;
- take samples to conduct own monitoring of drinking water, and determine and evaluate quality parameters to a limited degree;
- document and evaluate work procedures and operational processes;
- identify operational faults and respond independently;
- work in a cost-effective and environmentally sustainable manner while remaining aware of hygiene;
- apply relevant legal provisions, technical regulations and health and safety at work provisions while observing quality management guidelines;
- act in a customer-oriented manner and make use of information and communication technologies.

Water supply engineering technicians can fulfil their tasks in the following functional entities. The focus here is on drinking water treatment plants:

- management (waterworks plant manager, often academically educated or qualified as water technician at small waterworks)
- analysis and operations monitoring (examination of water quality and sludge)
- process control (control room)
- operation and maintenance of facilities (machines, plant and filter technology)
- disinfection
- management of protected zones
- data management and documentation
- safety management
- quality management

For drinking water distribution networks, skilled workers are to be assigned to the following functional entities:

- management (plant manager, often academically educated or qualified as water technician)
- work planning (e.g. resource planning, logistics)
- water storage
- operation and maintenance of water distribution networks
- leak location and repair
- illegal tapping
- water meter management
- domestic connection management
- operation and maintenance of pumping facilities
- mobile water distribution (e.g. tanker vehicles)
- data management (GIS)
- safety management, quality and hygiene management

Further sources and annexes

Plant mechanic for sanitary, heating and air conditioning systems

Plant mechanics for sanitary, heating and air conditioning systems install and maintain complex plants 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 activities.

Plant mechanics for sanitary, heating and air conditioning systems:

- plan and control work procedures, monitor and assess results and apply quality management 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, optimise and maintain supply engineering plant and systems;
- put supply engineering plant and systems into operation;
- hand over supply engineering plants and systems to customers and instruct customers in the operation of such equipment;
- inspect, maintain and repair supply engineering plants and systems;
- advise and support customers with regard to products and services offered by their company, taking into account environmental and economic aspects;
- 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. The focus here is on domestic water supply and disposal facilities:

- customer management and preparation of offers
- operation and maintenance of pumping facilities
- planning and construction of sanitary engineering facilities
- operation and maintenance of sanitary engineering facilities
- use of rainwater, process water and grey water
- new types of sanitary systems (e.g. separation toilets)
- interceptor technology
- customer information and advice

Sewage engineering technician

Sewage engineering technicians work in the fields of drainage systems and the treatment of sewage and sewage sludge at government-owned and industrial sewage treatment plants. They carry out their work independently on the basis of technical documents and regulations as well as legal requirements. They collect information and plan and coordinate their work. They document their work and adopt measures to ensure quality and safety and ensure that their work does not pose a risk to human health or the environment. They are electrotechnically qualified personnel.

Sewage engineering technicians:

- plan, monitor, control and document process sequences;
- identify malfunctions within the process sequence and initiate measures to eliminate faults;
- identify risks within the work sequence and carry out protective measures;
- take measurements and conduct analyses for the purposes of process and quality control;
- operate plants and equipment;
- inspect, maintain and carry out routine repairs to machines, equipment, pipe systems and building structures;
- recognise the danger of dealing with electricity, assess malfunctions and carry out electrical work;
- collect and evaluate data and apply process optimisation;

Further sources and annexes

- monitor and document compliance with statutory requirements;
- work in a cost-effective and environmentally sustainable manner while remaining aware of hygiene.

Sewage engineering technicians can fulfil their tasks in the following functional entities. The focus here is on municipal and industrial wastewater discharge facilities:

- management (plant manager, often academically educated or qualified as wastewater technicians)
- work planning (e.g. resource planning and logistics)
- operation and maintenance of drainage systems (sewer technician)
- sewer cleaner
- sewer inspector
- sewer maintainer
- private property drainage, cesspits/small wastewater treatment plants
- operation and maintenance of pumping facilities
- monitoring of industrial dischargers
- data management (GIS)
- safety management
- quality management

For municipal and industrial wastewater treatment, skilled workers are to be assigned to the following functional entities:

- management (wastewater treatment plant manager, often academically educated or qualified as wastewater technicians)
- analysis and operations monitoring (examination wastewater and sludge)
- process control (control room)
- operation and maintenance of wastewater treatment facilities (mechanical and plant engineering)
- sewage sludge treatment and utilisation of wastes from wastewater facilities
- data management and documentation
- safety management
- quality management

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn

Friedrich-Ebert-Allee 36 + 40
53113 Bonn, Germany
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de

On behalf of



Federal Ministry
for Economic Cooperation
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