der Bundeswehr
Universität München

Developing and Testing Benchmarking System for Water Utilities in Jordan

Mustafa Nasereddin

Vollständiger Abdruck der von der Fakultät für Bauingenieurwesen und Umweltwissenschaften der Universität der Bundeswehr München zur Erlangung des akademischen Grades eines

Doktors der Ingenieurwissenschaften

genehmigten Dissertation.

Gutachter/Gutachterin:

1. Vorsitz: Prof. Dr. - Ing. Christian Jacoby
2. Prüfer: Prof. Dr. - Ing. F. Wolfgang Günthert
3. Prüfer: Prof. Dr. - Ing. Andreas Schulz

Die Dissertation wurde am 12 Mai 2017 bei der Universität der Bundeswehr München eingereicht und durch die Fakultät für Bauingenieurwesen und Umweltwissenschaften am 01 September 2017 angenommen. Die mündliche Prüfung fand am 22 September statt.

Universität der Bundeswehr München

Institut für Wasserwesen

Developing and Testing Benchmarking System for Water Utilities in Jordan

Mustafa Nasereddin

May 2017

Acknowledgment

Great thanks to my supervisor Prof. Wolfgang Günthert and co-supervisor Prof. Andreas Schulz. Your guidance and mentorship enlightened my research and formulated my thinking, thank you for your support and patience through the past years and supporting me till the end of my Ph.D. research. Also, I would like to my co-advisors from the CNRD program; Prof. Manar Fayyad and Prof. Lars Ribbe who believed in my abilities and gave me this opportunity and encouraged me to pursue my applied research tenure. Thanks to DAAD for granting me 3 years (part-time) scholarship and supporting my higher education in Germany.

Big thanks and appreciation goes to H.E Iyad Dahiyat from Ministry of Water & Irrigation, and to Nodira Mansurova and to Esther Griffies Weld from EBRD which financed the benchmarking program and permitted me to use and analyze the data of the project in my PhD thesis. Also, thanks to ACWUA team members who supported my research through the past years.

Not forget to mention the great support I got from my friends Filip Bertzbach and Daniel Zipperer from aquabench GmbH who inspired me and shared with me their solid (hands-on) experiences and rich resources. Special thanks to my friend Rüdiger Heidebrecht for his encouragement and knowledge sharing.

I'm grateful to my friends who have been always next me and boosted my energy and endured the long stories through the past years (Rana, Feras, Rami, Anas, Azmi and Mohammed).

Special thanks to the special person to my heart, who graced my life and lifted me up and walked with me step by step until the completion of my thesis work. Thank you heaps my love Maram Sha'ban!

Last but not the least, I would like to thank my family (Salem, Hanan, Yara, Dema, Yousef and Dana) for supporting me spiritually throughout writing this thesis and my lifetime. Your prayer for me was what sustained me thus far. You supported me in writing, and strengthened me always to strive towards my goal.

Abstrakt

Der Wassersektor in Jordanien leidet unter gemeinsamen Problemen und steht vor zahlreichen Herausforderungen im Bereich Wasserversorgung und Abwasserentsorgung. Diese Herausforderungen bestehen im Wesentlichen im Wassermangel, steigender Nachfrage aufgrund wachsender Populationen und Konflikten von Wasserverbrauchern, schnelle Urbanisierung, Wasserverschmutzung, Fragen der Wasserqualität, begrenztem Zugang zu Trinkwasser und sanitären Einrichtungen in ländlichen Gebieten. Dieses widerspiegelt sich als Herausforderungen für die Wassversorgungsunternehmen in schlechten Betriebs- und Wartungspraktiken, steigenden Wasserentnahmen, schwacher Kostendeckung und schlechtem Asset Management, geringer Energieeffizienz, mangelnder Personalentwicklung und mangelndem Management und technischen Kapazitäten.

Infolgedessen sind die Wasserversorgungsunternehmen in Jordanien bei der Erreichung der Ziele der 6 Sustainable Development Goal noch zurückgeblieben, weshalb die Umsetzung guter Bewirtschaftungsmethoden unter Verwendung von integrierten Wasserressourcenmanagementsystemen (IWRM) erforderlich ist. um die begrenzten Ressourcen effizient zu nutzen und Wasser- und Sanitärdienstleistungen wirtschaftlich anzubieten. Benchmarking gilt als eines der IWRM-Tools für die Leistungssteigerung durch systematische Suche und Anpassung von führenden Praktiken und Lernen von den Besten. Diese Dissertation sich mit dem aktuellen Stand der Leistungsbewertungsmethoden für die Wasserversorger in Jordanien und untersuchte die Gründe, warum Benchmarking im jordanischen Wassersektor nicht angewandt wird.

Diese Untersuchung entwickelt und testet ein Benchmarking-System für Wasserversorger in Jordanien. In Jordanien wurde erstmals ein Benchmarking-System für 9 Wasserversorger in Jordanien nach internationaler Benchmarking-Praxis angewandt, mit dem Online-Datenerfassungsinstrument Daten gesammelt und Leistungsindikatoren der beteiligten Versorgungsunternehmen berechnet. Workshops und Leistungsbeurteilungssitzungen wurden durchgeführt und Leistungspläne für die teilnehmenden Versorgungsunternehmen festgelegt. Die Datenzuverlässigkeit wurde bewertet und Datenquellen-Lücken wurden bei jedem Wasserversorger identifiziert, und Leistungsindikatoren, die sich auf Wasserverluste, Energieeffizienz, Kostendeckung und Personalresourcen beziehen, untersucht und analysiert.

In der Untersuchung, die auf den Ergebnissen des Pilot-Benchmarking-Programms aufbaut, werden wissenschaftliche Arbeiten zu Korrelationen der Leistungsindikatoren durchführt. Die Methode, auf Basis des deutschen Benchmarking-System, wurde für das Jordan-Benchmarking-Projekt ubertragen. Die Durchschnittswerte der Kenzahlen für den jordanischen Wassersektor im Jahr 2014 wurden bewertet und mit internationalen Benchmarks (regional und international) anhand des fünf Säulen Models des deutschen Benchmarking-Systems verglichen.

Die Ergebnisse dieser Untersuchungen sind ein sehr nützlicher Einstieg, um Wasserversorgungsunternehmen zu helfen, ihre Herausforderungen in Jordanien zu bewältigen, und die Methode kann für ähnliche Wasserversorgungsunternehmen in der arabischen Region übertragen werden.

Abstract

The water sector in Jordan suffers from common problems and face many challenges in terms of water supply and sanitation service provision. These challenges are summarized in water scarcity; increasing demand due to growing populations and conflicts of water users; rapid urbanization; water pollution; water quality issues; limited access to drinking water & sanitation services in rural areas. These in return reflect as challenges on water utility level such bad operation and maintenance practices; increasing levels of non-revenue water, weak cost recovery and bad asset management, low energy efficiency, lack of human resources development and lack of management and technical capacity.

As a result, water utilities in Jordan still lag behind in achieving the 6th Sustainable Development Goal, therefore, adopting good management practices utilizing Integrated Water Resources Management (IWRM) tools is required to use limited resources efficiently and deliver water and sanitation service in an effective manner. Benchmarking is considered one of IWRM tools for performance improvement through systematic search and adaptation of leading practices and learning from the best. This PhD research looked at current state of performance assessment mechanism at Jordan water utilities, and investigated the reasons why benchmarking is not applied in the Jordanian water sector.

The research developed and tested benchmarking system for water utilities in Jordan. One utility benchmarking exercise for 9 water utilities in Jordan has been applied for the first time in Jordan, following international benchmarking practice, utilizing online data collection tool to collect data variables and calculate performance indicators from the participating utilities. A series of workshops and performance assessment meetings were conducted and performance plans were set to the participating utilities. Data reliability was evaluated and data sources gaps are now identified at each water utility, performance indicators correlations related to water losses, energy efficiency, cost recovery and human resources were investigated and analyzed.

The research built on the pilot benchmarking program outcomes and conducted scientific work of investigating performance indicators correlations. The research applied the German benchmarking system over Jordan benchmarking results. Then average values of performance data for year 2014 representing Jordan's water sector were benchmarked and compared with similar international benchmarking initiatives (regionally and internationally) following the 5 pillars of German benchmarking system.

The results of this research are a very useful entry point for helping to solve water utility management challenges in Jordan, and can be replicated and expanded to other similar water utilities in the Arab region.

ملخص

قطاع المياه في الأردن يعاني من مشاكل مشتركة ويواجه العديد من التحديات من حيث خدمة تزويد المياه والصرف الصحي. وتتلخص هذه التحديات في ندرة المياه؛ زيادة الطلب على المياه بسبب تزايد السكان والصراعات بين مستخدمي المياه .التحضر السريع، تلوث المياه وقضايا نوعية المياه؛ محدودية فرص الحصول على خدمات مياه الشرب والصرف الصحي في المناطق الريفية .هذه في التالي تنعكس على التحديات على مستوى مرافق المياه مثل فاقد المياه، مشاكل التشغيل والصيانة؛ انخفاض في معدلات الإيرادات واسترجاع الكلفة، وإدارة سيئة للأصول، وانخفاض كفاءة استخدام الطاقة، وضعف تنمية الموارد البشرية وبناء القدرات الفنية.

ونتيجة لذلك، لا تزال مرافق المياه في الأردن متأخرة في تحقيق الهدف (6) للتنمية المستدامة، لذا اعتماد ممارسات الإدارة المتكاملة للموارد المائية (IWRM) هي أدوات مطلوبة لاستخدام الموارد المحدودة بكفاءة وتقديم خدمات المياه والصرف الصحي على نحو فعال. تعتبر المقارنة المعيارية واحدة من أدوات الإدارة المتكاملة للموارد المائية لتحسين الأداء من خلال البحث المنهجي والتعلم من الأفضل. بحثت هذه الرسالة حول الحالة الراهنة لآلية تقييم الأداء في مرافق المياه في الأردن، والتحقيق في الأسباب الكامنة لعدم تطبيق المقارنة المعيارية في قطاع المياه الأردني.

طور البحث واختبر نظام للمقارنة المعيارية لمرافق المياه في الأردن. وقد طبق تجربة واحدة للمقارنة المعيارية لتسعة مرافق مياه للمرة الأولى في الأردن وفقا للممارسات الدولية، وذلك باستخدام أدوات لجمع البيانات والمتغيرات وحساب مؤشرات الأداء من المرافق المشاركة. وأجريت سلسلة من ورش العمل والاجتماعات لتقييم الأداء، كما تم تحديد خطط تحسين الأداء للمرافق المشاركة. تم تقييم موثوقية البيانات وتحديد الثغرات بمصادر البيانات لدى المرافق ، وقد تم دراسة مؤشرات الأداء وارتباطاتها وتحليلها مثل فاقد المياه، وكفاءة الطاقة، واسترداد التكاليف والموارد البشرية.

بنى البحث على نتائج البرنامج التجريبي للمقارنة المعيارية ومن ثم اسقاط المنهجية الألمانية للمقارنة المعيارية على نتائج المشروع الأردني. ومن ثم مقارنة متوسط بيانات الأداء لعام 2014 لقطاع المياه في الأردني مع مبادرات المقارنة المعيارية الدولية المماثلة (إقليميا ودوليا) وتبعاً للتصنيف المعتمد للركائز الخمسة المتبعة في نظام المقارنة المعيارية الألماني.

تعتبر نتائج هذه الدراسة كمدخل مفيد ومهم لحل المشاكل والتحديات التي تعاني منها مرافق المياه في الأردن ، وبالإمكان إعادة تطبيقه والتوسع فيه ليشمل مرافق مياه مشابهة في المنطقة العربية.

Acronyms and Abbreviation

ACWUA	Arab Countries Water Utilities Association
ACWUA-WANT	ACWUA Water Networking and Training program
ADERASA	Association of Water and Sanitation Regulatory Entities of the Americas
AMM	Asset Maintenance and Management
ATT	Arbeitsgemeinschaft Trinkwassertalsperren e. V
AWC	Arab Water Council
AWC	Aqaba Water Company
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
BDEW	Bundesverband der Energie- und Wasserwirtschaft e.V.-The German Association of Energy and Water Industries
BM	Benchmarking
BOT	Build Operate Transfer
CEO	Chief Executive Officer
CIS	Customer Information System
CMMS	Computerized Management Maintenance System
COCLUWA	The association of larger regional water Utilities-Netherlands
CRM	Customer Relationship Management
CWWA	Canadian Water and Wastewater Association
DBVW	Deutscher Bund der verbandlichen Wasserwirtschaft e. V.
DOI	Diffusion of Innovations
DOS	Department of Statistics
DVGW	Deutsche Vereinigung des Gas- und Wasserfaches e.V. Technisch-wissenschaftlicher Verein-The German Association for Gas and Water Utilities

DWA	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V.-The German Association for Water, Wastewater and Solid Waste
EBC	European Benchmarking Cooperation
EBRD	European Bank for Reconstruction and Development
ESCWA	Economic and Social Commission for Western Asia
EU	European Union
FAS	Financial Accounting System
Fi	Financial
GDP	Gross Domestic Product
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH-The German Organization for International Development
Hrs	Hours
IBNET	International Benchmarking Network
ICT	Information and Communication Technology
ISO	International Standards Organization
ISSP	Institutional and Strengthening Support Program
IT	Information Technology
IWA	International Water Association
IWRM	Integrated Water Resources Management
JD	Jordanian Dinar
JMP	Joint Monitoring Program for Water Supply and Sanitation
JSMO	Jordan Standards and Metrology Organization
JVA	Jordan Valley Authority
KAC	King Abdullah Canal
KPI	Key Performance Indicator
KWh	Kilo Watt Hour

l/sc/d	Liter per service connection per day
LDCs	Less Developed Countries
Lpcd	Liter per capita per day
M&E	Monitoring and Evaluation
MC	Management Contract
MCM	Million Cubic Meter
MDGs	Millennium Development Goals
MENA	Middle East and North Africa Region
MP	Monitoring Protocol
MWI	Ministry of Water and Irrigation
NGO	Non-Governmental Organization
NRW	Non-Revenue Water
NWMP	National Water Master Plan
O&M	Operation and Maintenance
OFWAT	Office for Water Services
Op	Operational
PDCA	Plan-Do-Check-Act
Pe	Personnel
Ph	Physical
PI	Performance Indicator
PMU	Performance Monitoring Unit
PPP	Public Private Partnership
PSP	Private Sector Participation
PWWA	Pacific Water and Wastes Association
QS	Quality of Service
RAED	Arab Network for Environment and Development
SCADA	Supervisory Control and Data Acquisition

SDGs	Sustainable Development Goals
SOPs	Standard Operations Procedures
Sq km	Square Kilometer
SWAP	Swap Project with Wadi Arab Water System II
TF	Task Force
TOR	Terms of Reference
UID	Utility Identification Code
UN	United Nations
UNHCR	The United Nations High Commission for Refugees
UNICEF	The United Nations Children’s Fund
USAID	United Stated Agency for International Development
USD	U.S Dollar
USGS	U.S. Geological Survey
Vewin	Association of Dutch water companies
VKU	Verband kommunaler Unternehmen e.V.
WAJ	Water Authority of Jordan
WHO	World Health Organization
WOPs	Water Operators Partnerships
WR	Water Resources
WSAA	Water Services Association of Australia
WSS	Water Supply and Sanitation
WUA	Water Users Association
WURC	Water Utility Regulatory Commission
YWC	Yarmouk Water Company

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Background about Jordan

The Hashemite Kingdom of Jordan (also known as Jordan), on the East Bank of river Jordan, hence its name. The capital is the city of Amman, and the official language is the Arabic language. Jordan is located in the southwest part of Asia. Its total area is 89,342 square Kilometers (sq km) (land 88,802 sq km, water 540 sq km). It is comprised of 12 Governorates (Irbid, Mafraq, Ajloun, Jerash, Balqa, Amman, Zarqa, Madaba, Karak, Tafileh, Ma'an and Aqaba). It is bordered by Saudi Arabia to the north-west, Syria to the south, Iraq to the south-west, and Palestine to the east. It has access to the Red Sea via the port city of Aqaba.

Jordan's terrain is mainly characterized to be mostly desert plateau in east, highland area in west. The Great Rift Valley separates East and West Banks of the Jordan River. Jordan is a naturally water scarce country. Its climate ranges from semi-arid in the northwestern part of the country to arid desert in its eastern and southern reaches. Jordan is subject to periodic droughts that may extend for four to five years in duration. Average annual rainfall varies from less than 50 mm to over 600 mm in certain parts of the country. Water supply from surface sources has declined substantially over the past ten years. Jordan's Ministry of Water and Irrigation (MWI) attributes part of this decrease to reduced rainfall levels. Most recent (2010–2011) climate models for Jordan predict decreases in rainfall over the long term (El Nesr, Alazba, and Abu-Zreig 2010; Black et al 2012; Smiatek, Kunstmann and Heckl 2011).

The total population of Jordan is about 9.5 million as of year, 2015 national statistics, 69.4% of total population are Jordanian citizen's (about 6.6 million inhabitants), and about 30% are non-Jordanian residents, half of them are Syrian refugees (about 1.3 million inhabitants) according to Department of Statistics Population and Housing Census report issued in February, 2016. Urban population is estimated beyond 80% of the total population, with Amman accounting to 60% of the population of Jordan (DOS 2016). Jordan's economy is among the smallest in the Middle East, with insufficient supplies of water, oil, and other natural resources, underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, unemployment, inflation, and a large budget deficit. Jordan relies largely on a service-based economy because of its lack of natural resources. It is in the midst of broad economic reforms that focus on privatization and free trade. A decrease in government subsidies is helping to reduce the budget deficit, and increasing the amount that the government can spend on human development projects like health, education, and social security (World Bank, 2008). Jordan has a Purchasing Power Parity-adjusted per capita GDP of US $10,902.4 (World Bank, 2015) which reflects its middle-income status.

Jordan is affected by the security situation in the neighboring Syrian Arab Republic (Syria) started in year 2011 and the influx of Syrians into the country, as well as by developments in Iraq and Gaza in 2014 (UNHCR, 2015) provides asylum for a large number of refugees, including from Syria and Iraq, which exacerbates the pressure on Jordan's already scarce resources and strained sectors such as the country's water supply, housing, education and healthcare and labor (Al Wazani et al. 2014).

1.2 Water resources overview

Jordan is a non-oil producing country; its main natural resources are phosphates, potash and oil shale, considered among water scarce countries around the world. With significant high population growth; the influx of refugees due to political instabilities in the region, fostered the over abstraction of groundwater resources in addition to the impacts of climate change are likely to exacerbate water security in the future. The high population growth rate together with the country's rapid economic development has been accompanied by an increase in water demand, while the available water resources are insufficient, limited and decreasing. As it stands now, current total demand exceeds renewable supply.

According to Jordan National Water Sector Strategy (2016-2025); the total water resources of 2015 were 988 MCM and should be developed to 1358 MCM to meet total water demand by 2025. The Disi water conveyance project[1] is operational since 2013 and the Red Dead conveyance project[2] is expected to be fully operational by 2025. The total capacity of the Red Dead project, in addition to other 15 water supply projects listed in the strategy; about 423 MCM would be additional water supply quantities, however, water deficit of about 141 MCM still foreseen in the year 2025. Table (1) below shows the development of resources and projected demands as referenced in Jordan National Water Sector Strategy (2016-2025).

Table 1: Development of Water Resources and Projected Demand in Jordan

Development of Resources and Projected Demand in MCM/a

Year	2014	2015	2020	2025	2030
Groundwater Safe yield	275	275	275	275	275
Non-renewable groundwater	144	144	169*	234**	234
Groundwater Over Abstraction	160	160	140	118	96
Surface water (Local + Tiberius Lake)	258	260	270	280	290
Treated wastewater	125	140	180	220	240
Additional Resources (Desalination + SWAP)	10	10	90***	90	240****
Total Resources	972	988	1124	1217	1375
Sustainable Resources	612	829	984	984	1259
Municipal, Industrial, Tourist demands	714	717	727	751	810
Irrigation use	497	505	520	535	550
Oil shale and Nuclear power demand	0	0	57	72	90
Total Demands	1211	1222	1304	1358	1450
Deficit in MCM/a (with over abstraction)	-239	-233	-180	-141	-75
* Reduction of 16 MCM from Disi system to Aqaba due to Red - Dead phase 1 +10 MCM from Ageb +15 MCM local sources mainly surface.					
** 50 MCM from Sheideah and 15 MCM from Azraq deep ground water					
*** Red - Dead phase 1 (80 MCM)					
**** Red - Dead phase 2 (150 MCM)					
(Source: National Water Master Plan,	http://www.mwi.gov.jo/NWMP/)				

Although water supply service levels in Jordan are fairly high, reaching about 98% of total population, the distribution system is still far from optimal operation efficiency. In spite the fact that overall supplied water for municipal uses via water networks was 429 MCM in 2014; households received water at an average of 62 liters/person/day (against a worked supply of 126 liters/capita/day) for one or two times a week for a limited number of hours and use roof top tanks for the weekly storage. Nearly 64 liters/capita/day is lost due to physical and administrative gaps (MWI, 2015). It is worth to mention that intermittent supply system creates additional risks that may compromise water quality during storage. Table (2) below depicts the national water supply amount in MCM for year 2014 as stipulated in the national water sector strategy.

[1] The Disi Water Conveyance Project is a water supply project in Jordan. It is designed to pump 100 MCM of water per year from the Disi aquifer, which lies beneath the desert in southern Jordan and Northwestern Saudi Arabia

[2] The Red-Dead Sea conveyance project is a planned pipeline from the Red Sea to the Dead Sea to provide potable water to Jordan, Palestine and Israel, bring sea water to stabilize Dead Sea water level and generate electricity to meet project desalination needs

Table 2: National Water Supply Volume by Sector for Year 2014

National Water Supply (MCM), by Sector, 2014

Source	Domestic	Industrial	Irrigation	Total	Share
Surface	103.8	4.8	150	259	26.6%
Ground	325	32.2	231.3	589	60.6%
Treated wastewater	0	1.7	123.3	125	12.8%
Total Used	429	39	505	972	100%
Sector Share	44.1%	4%	51.9%	With treated wastewater	
Less Treated wastewater	0.0	1.7	123.3	125	
Total Freshwater used	429	37.3	381.7	848	
Share	50.6%	4.4%	45 %	W/out treated wastewater	

Source: Ministry of Water and Irrigation, Water Budget 2014

Water resources in Jordan can be mainly categorized into:

1. Surface water resources: The Jordan River and the Yarmouk River, which are shared with Israel and Syria.
2. Groundwater resources (12 renewable and non-renewable aquifers) which are overexploited and over abstracted in an unsustainable manner.
3. Reclaimed wastewater and modest desalination of brackish water.

Figure (1) below depicts groundwater basins and surface water catchment areas in Jordan.

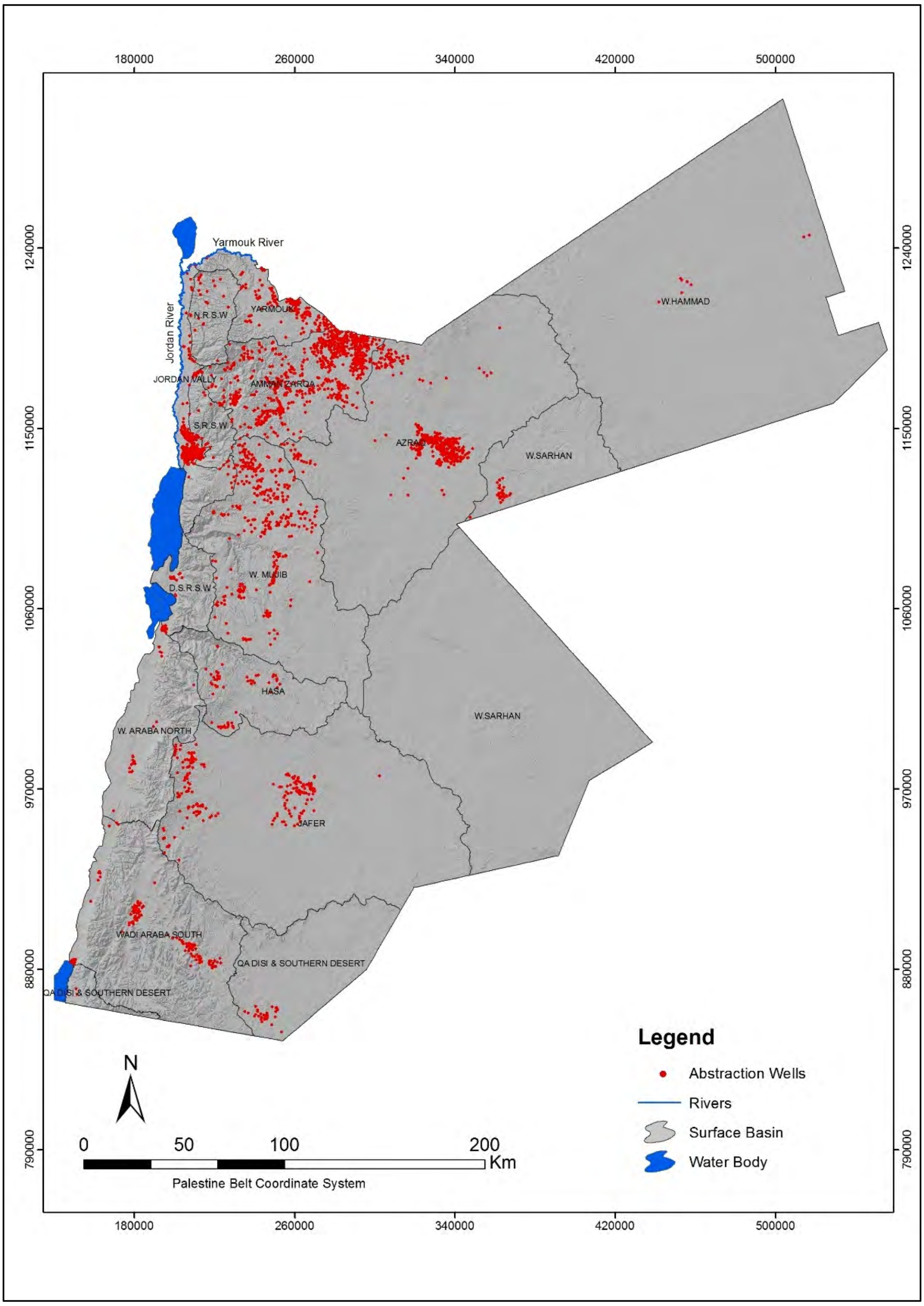


Figure 1: Water Resources in Jordan

Source: BGR, 2017

In terms of resources, and according to the 2014 water budget, groundwater resources amounted for 61% and surface water 26% according to Figure (2) below:

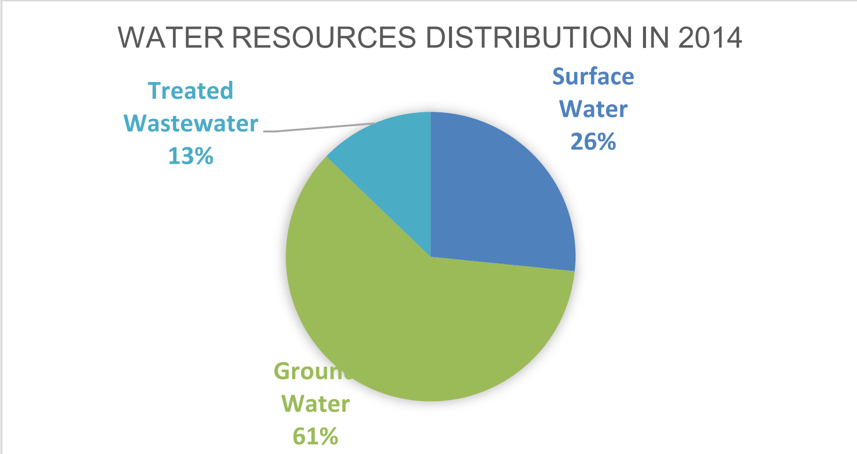


Figure 2: Jordan Water Resources Distribution-2014

(Source: Adapted from National Water Strategy 2015, MWI)

Significant reductions in surface flows are also caused by human activities throughout the watersheds that drain into the Jordan River Valley. Over the past 50 years, Jordan has come to depend primarily on groundwater for its municipal, industrial and Highlands's agricultural sectors. During the past 20 years, Jordan's public and private sectors have engaged in extensive well-drilling and over-pumping of groundwater that is far beyond natural recharge capacity. This over-pumping has reduced the natural base flows into the side wadis and natural springs along the rift, causing significant economic and environmental harm. Programs in rainwater harvesting in rural and urban settings have been limited in geographic scope and have had negligible countrywide impact on surface water capture for domestic use or groundwater aquifer recharge.

1.3 Water supply challenges in Jordan

Limited water resources are the biggest challenge Jordan is facing in the future —it is among the lowest in the world on a per capita basis less than 95 m^3 per person per year in 2014. As mentioned earlier, the current total uses exceed renewable supply. The difference (the water used that is not renewable) comes from nonrenewable and fossil groundwater extraction and the reuse of reclaimed water. However, according to WHO studies (Howard G., Bartram J., 2003); water quantity of about 20 liters per capita per day should be assured to take care of basic hygiene needs and basic food hygiene, but laundry/bathing might require higher amounts unless carried out at source.

The three major issues that impact on the water supply availability in Jordan are Non-Revenue Water, Treated wastewater and the Transboundary water resources. If supply remains constant, per capita domestic consumption is projected to fall tremendously, putting Jordan in the category of having an absolute water shortage that will constrain economic growth and potentially endanger public health.

Over the past two decades, Jordanian public and private sector actors have invested in water supply through the following:

1) The development of public desalination facilities for municipal use, and micro and small private desalination facilities for drinking water and agricultural use;
2) The extraction of fossil freshwater from the aquifer shared with Saudi Arabia (Disi Aquifier);

3) The exploration of very deep (1,000–2,000 m) sources of brackish water for eventual desalination; and
4) The study of options for Red Sea-Dead Sea conveyance to halt the decline of the Dead Sea and provide desalinated seawater for municipal and industrial use. The cost of new urban bulk water supply to Amman is expected to exceed US$1.35 per m^3 as in the case of the Amman Water Conveyance Project.

Jordan has made significant achievements in meeting the Millennium Development Goals (MDGs) for water and sanitation. More than 98% of the population are connected to the municipal water systems throughout Jordan and have access to clean water, and about 65% are connected to the sewers network. By international comparisons, Jordan is very advanced in the joint management of water and wastewater. For example, the development of water supply systems to meet the growing demands in Amman was accompanied by wastewater collection and treatment systems to take treated wastewater back to the Jordan Valley for reuse. However, there is still a need for improvement to enhance water and sanitation services provision according to approved percentages in the MDGs and work hardly towards the approved Sustainable Development Goals (SDGs).

1.4 Importance of PhD thesis

The water sector in Jordan suffers from common problems and faces many challenges in terms of water supply and sanitation service provision. These challenges are summarized in water scarcity; increasing demand due to growing populations and conflicts of water users; rapid urbanization; water pollution; water quality issues; limited access to drinking water & sanitation services in rural areas; ineffective water pricing and lack of funding resources. These in return reflect as challenges on water utility level such improving bad operation and maintenance practices; increasing percentages of non-revenue water, and lack of cost recovery and bad asset management, low energy efficiency, lack of human resources development and lack of management and technical capacity.

Water utilities in Jordan still lag behind in achieving the Sustainable Development Goal (6) which relates to ensure availability and sustainable management of water and sanitation for all. They are working hard to improve their efficiency, the quality of their services and the level of their overall performance. Despite some important differences in the legal status of water service providers and the institutional set-up of the water sector, the challenges throughout the country remain similar. In utilities world, key performance indicators for water supply and wastewater services are an effective instrument to help manage utilities and improve performance. Well designed and appropriate indicators for a utility can provide crucial information on the important aspects of the processes of water supply and sanitation as well as in relation to corporate governance of utilities.

Therefore, there is an urgent need to strengthen the water and wastewater utilities to improve their performance in order to help them achieving the SDG (6) and adopting better management practices. Meeting SDG goal require utilizing Integrated Water Resources Management (IWRM) tools. Benchmarking is considered one of IWRM tools for performance improvement through systematic search and adaptation of leading practices (IWA 2011). The main aim of this thesis is to develop a benchmarking framework for water and wastewater utilities in Jordan, investigating about the status of performance assessment practices in Jordan and identifying the reasons why benchmarking is not applied in the Jordanian water sector and introduce it as an IWRM tool for performance assessment and performance improvement for water and wastewater utilities in Jordan.

2- Literature Review

This chapter reviews the related literature and background information about the water situation in Jordan and water sector framework conditions in relation to water and sanitation services provision. Also, it shed the light on benchmarking concept and its use for water and wastewater utilities in different countries and the status of benchmarking application in the Jordanian water sector.

2.1 Situation of water supply and sanitation in the Arab region and Millennium Development Goals (MDGs)

At the United Nations Millennium Summit in September 2000, member States adopted the Millennium Declaration. Among the outcomes of this declaration were the Millennium Development Goals (MDGs), which is a set of global political commitments aimed at tackling major challenges impeding development. The MDG commitments call on all countries to develop achievable action plans and allocate the financial and human resources needed to meet these global targets. In doing so, the MDGs formalize eight development goals, whose progress is monitored and reported upon through a series of targets and associated indicators for measuring achievement by the target year 2015. These goals are listed in Table (3) below.

Table 3: Millennium Development Goals of United Nations

Goal 1.	Eradicate extreme poverty and hunger
Goal 2.	Achieve universal primary education
Goal 3.	Promote gender equality and empower women
Goal 4.	Reduce child mortality
Goal 5.	Improve maternal health
Goal 6.	Combat HIV/AIDS, malaria and other diseases
Goal 7.	Ensure environmental sustainability
Goal 8.	Develop a global partnership for development

While almost all the MDGs can be indirectly linked to water supply and sanitation (WSS) issues, Goal 7 on environmental sustainability addresses them directly. One of its targets is *"to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation".* Moreover, Governments and Heads of States, at the World Summit on Sustainable Development in 2002, agreed to add an additional target *"to halve, by 2015, the proportion of people lacking improved sanitation".* These targets are measured by the following indicators:

- Proportion of population using an improved drinking water source;
- Proportion of population using an improved sanitation facility.

Monitoring WSS started when the United Nations General Assembly declared the 1980s as the International Drinking-Water Supply and Sanitation Decade, with the explicit target to achieve universal coverage by 1990. The World Health Organization (WHO) established the framework and procedures for monitoring progress towards achieving this target. The information collected essentially originated from national water and sanitation authorities, and focused on infrastructure, utilities and service provided. In 1991, WHO and the United Nations Children's Fund (UNICEF) decided to maintain the momentum of the International Drinking-Water Supply and Sanitation Decade by establishing the Joint Monitoring Program for Water Supply and Sanitation (JMP).

After the adoption of the Millennium Declaration, JMP became the official instrument to measure progress towards achieving the MDG drinking-water and sanitation target. Starting in the 2000 report, the JMP underwent a paradigm shift and started using available survey data on the use of drinking-water and sanitation. In practice, this meant measuring access at the household level, rather than infrastructure and service provision.

Although the Arab countries are on the track to meet the MDG sanitation target, progress towards the drinking water and sanitation services target is lagging. Most Arab countries met MDG drinking water coverage target, while Algeria, Palestine, Sudan and Yemen still face major challenges, which have generally been attributed to water shortage as well as water management, lack of financial resources and insufficient investments. See results generated in Table (4) using JMP online database.

Table 4: Percentages of total improved water and sanitation services in MENA countries and proportion of 2015 population gained access according to MDG progress

Country	Water			Sanitation		
	Total Improved (%)	Progress towards MDG target	Proportion of the 2015 population that gained access since 1990 (%)	Total Improved (%)	Progress towards MDG target	Proportion of the 2015 population that gained access since 1990 (%)
Algeria	83.6	Limited or no progress	24.0	87.6	Good progress	36
Bahrain	100.0	Met target	65.0	99.2	Met target	63
Djibouti	90.0	Met target	39.0	47.4	Limited or no progress	4
Egypt	99.4	Met target	37.0	94.7	Met target	46
Iran (Islamic Republic of)	96.2	Met target	31.0	90.0	Met target	39
Iraq	86.6	Good progress	48.0	85.6	Met target	
Jordan	96.9	Met target	55.0	98.6	Met target	56
Kuwait	99.0	Met target	42.0	100.0	Met target	43
Lebanon	99.0	Met target		80.7	NA	
Libyan Arab Jamahiriya		NA		96.6	Met target	31
Morocco	85.4	Met target	33.0	76.7	Met target	39
Oman	93.4	Met target	59.0	96.7	Met target	61
Palestine	58.4	Limited or no progress		92.3	Met target	
Qatar	100.0	Met target		98.0	Limited or no progress	78
Saudi Arabia	97.0	Met target	47.0	100.0	Met target	50
Sudan		NA			NA	
Syrian Arab Republic	90.1	Moderate progress	42.0	95.7	Met target	48
Tunisia	97.7	Met target	38.0	91.6	Met target	39
United Arab Emirates	99.6	Met target	81.0	97.6	Met target	79
Yemen		NA			NA	

Source: Customized generated tables based on the online database of WHO/UNICEF Joint Monitoring Program (JMP) – updated data 2015 (accessed Jan 2017)

In Jordan, and according to the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation estimates on the use of water sources and sanitation facilities updated in April 2013, we can notice the trends of drinking water coverage (Table 5 and Figure 3) and the estimated trends of sanitation coverage for both urban and rural areas respectively (Table 6 and Figure 4). Figures indicate the development that Jordan witnessed in terms of drinking water service into pipes onto premises and sanitation coverage through improved facilities. The decrease of percentage from year 1990 towards 2015 in piped drinking water is due to the distinguished population growth that Jordan witnessed in those years associated with unstable political situation in the neighboring countries and migrations fluxes into Jordan.

Table 5: JMP - estimated trends of drinking water coverage in Jordan

Jordan	Drinking water coverage estimates					
	Urban (%)		Rural (%)		Total (%)	
	1990	2015	1990	2015	1990	2015
Piped onto premises	97	93	86	80	94	91
Other improved source	2	5	4	12	2	6
Other unimproved	1	2	9	7	4	3
Surface water	0	0	1	1	0	0

Source: WHO/UNICEF JMP, 2015

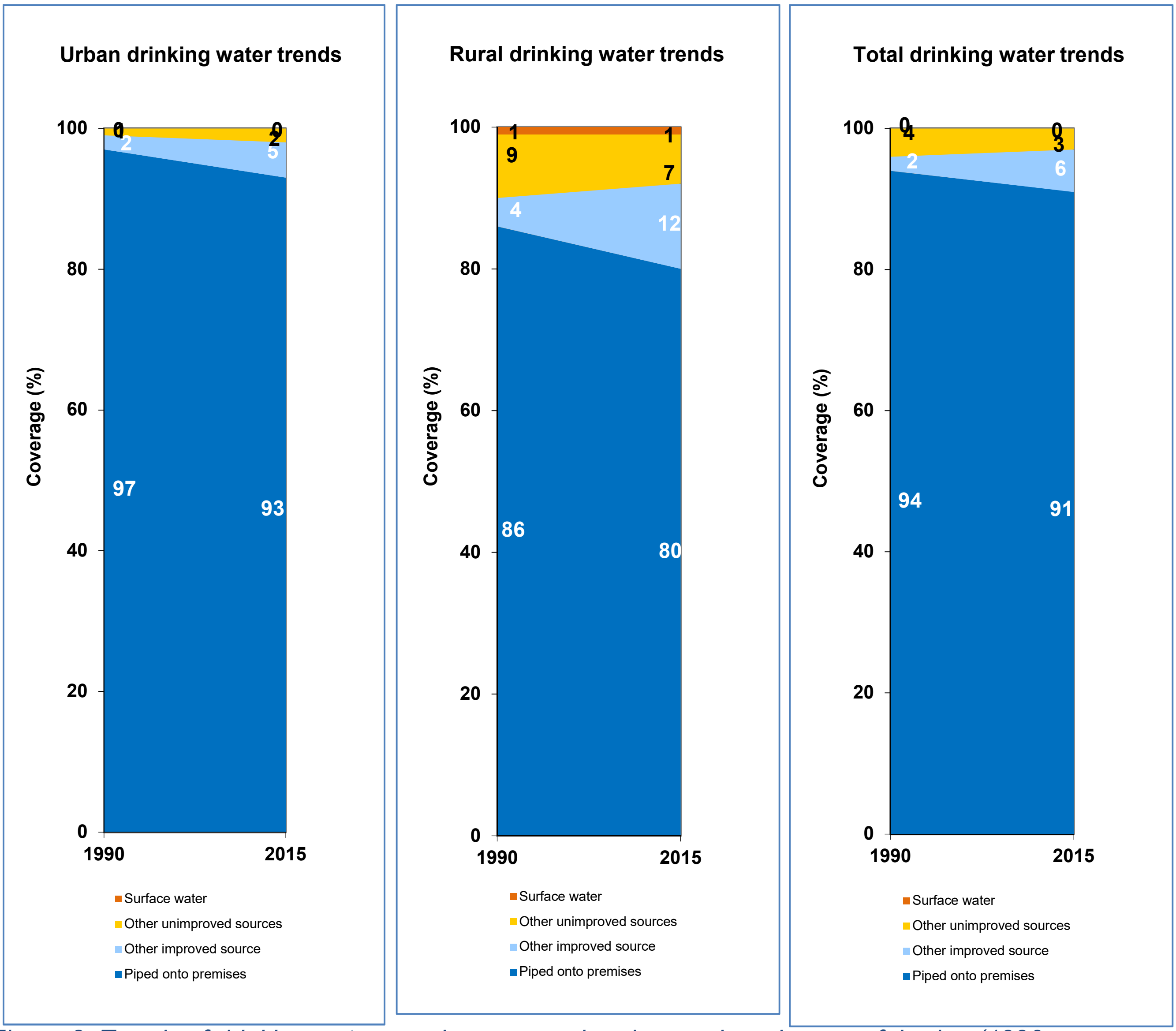


Figure 3: Trends of drinking water supply coverage in urban and rural areas of Jordan (1990-2015)

Source: JMP database

Table 6: JMP - estimated trends of sanitation coverage in Jordan

Jordan	Sanitation coverage estimates					
	Urban (%)		Rural (%)		Total (%)	
	1990	2015	1990	2015	1990	2015
Improved facilities	98	99	95	99	97	99
Shared facilities	1	1	1	1	1	1
Other unimproved	1	0	1	0	1	0
Open defecation	0	0	3	0	1	0

Source: WHO/UNICEF JMP, 2015

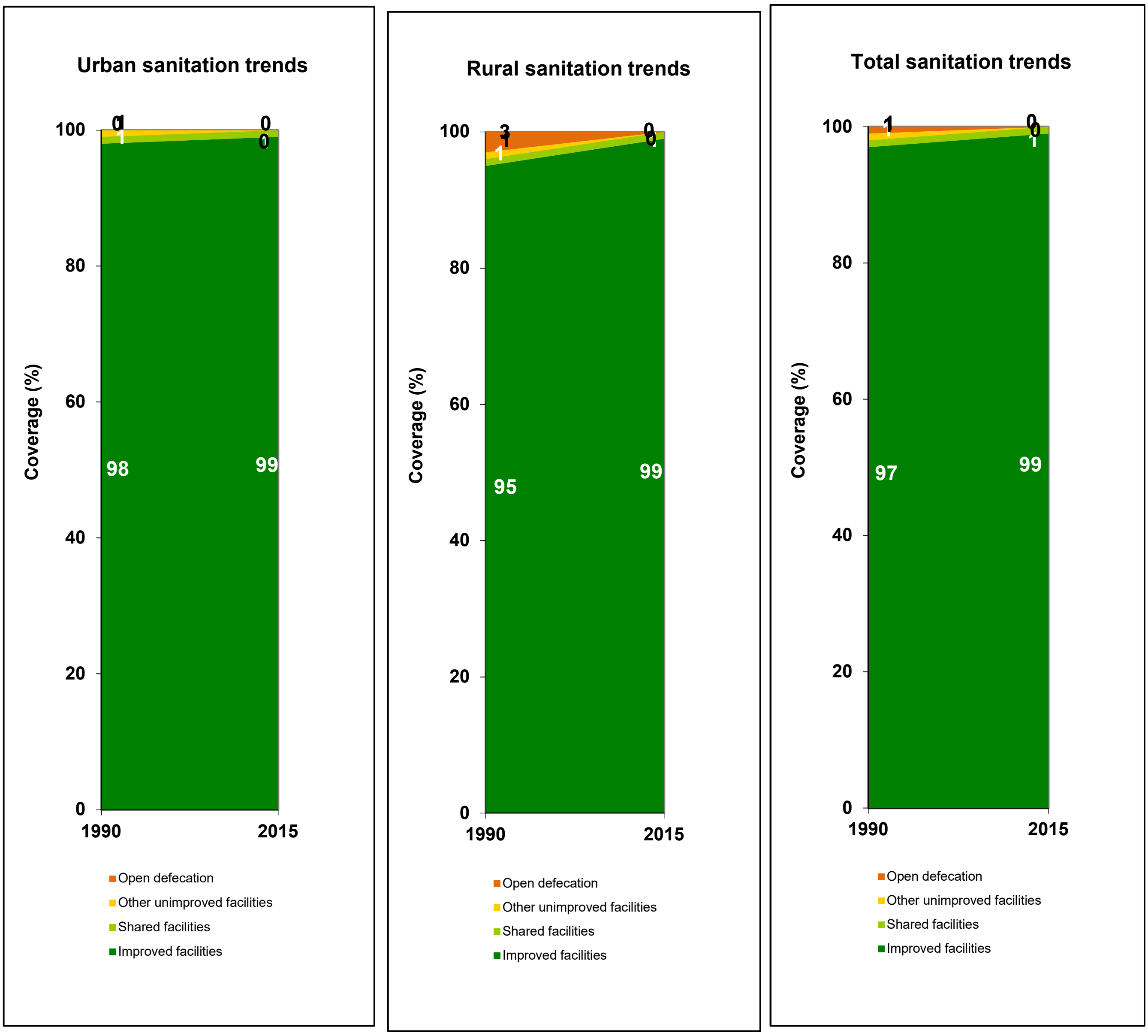


Figure 4: Trends of sanitation coverage in urban and rural areas of Jordan (1990-2015)

Source: JMP database

There is high variability in access to drinking water and sanitation services among the Arab countries, with some countries nearly fully reliant on desalination such as the Gulf Council Countries, while other countries are not able to pursue sufficient investments to meet basic needs, such as in Arab Less Developed Countries (LDCs) and countries emerging from or existing in a state of conflict. The water supply and sanitation target supported by the MDG indicators are health-based and do not reflect the level or quality of services provided in countries that may otherwise appear to have achieved full or near full access to water supply services and/or sanitation services.

A regional monitoring initiative (MDG+ initiative) has been launched in year 2012 under the auspices of the Arab Ministerial Water Council to build upon the basic MDG indicators by incorporating additional indicators that reflect level and quality of services as well as environmental protection based on regional specificities that reflect concerns and constraints manifest in the Arab region. These additional indicators were selected as not to measure only accessibility to improved infrastructure, but consider also reliability, regularity, affordability, sustainability and quality of service provided. The MDG+ initiative is implemented by the Economic and Social Commission for Western Asia (ESCWA) in consultation with the Arab Countries Water Utilities Association (ACWUA), the Centre for Environment and Development for the Arab Region and Europe (CEDARE), the Arab Water Council (AWC) and the Arab Network for Environment and Development (RAED).

It is expected that this regional initiative will help to strengthen the capacity of Arab countries and counterparts in the area of water supply and sanitation monitoring and help to increase attention about access and availability of these services at the national level through a regionally appropriate approach. It is also expected that these additional indicators can help to inform the regional and global debate as the formulation of a sustainable development goal related to the water sector is pursued during the preparation of a post-2015 development framework.

In June 2012, governments at high level united nations conference on environment and development (Rio+20 or Earth Summit 2012) agreed to launch a process led by UN member states in the General Assembly to create a universal set of “Sustainable Development Goals” or SDGs. The Rio outcome gave the mandate that the SDGs should be coherent with and integrated into the UN development agenda beyond 2015.

A list of SDGs compared to the MDGs can be found in table (7)

Table 7: Comparison of Sustainable Development Goals and Millennium Development Goals

SDGs vs. MDGs	
Sustainable Development Goals	Millennium Development Goals
1. End poverty in all its forms everywhere	1. End poverty and hunger
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2. Achieve universal primary education
3. Ensure healthy lives and promote well-being for all at all ages	3. Promote gender equality and empower women
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	4. Reduce child mortality
5. Achieve gender equality and empower all women and girls	5. Improve maternal health
6. Ensure availability and sustainable management of water and sanitation for all	6. Combat HIV/AIDS, malaria, and other diseases
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7. Ensure environmental sustainability
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8. Develop a global partnership for development

9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	
10. Reduce inequality within and among countries	
11. Make cities and human settlements inclusive, safe, resilient and sustainable	
12. Ensure sustainable consumption and production patterns	
13. Take urgent action to combat climate change and its impacts	
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development	
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development	

Water supply and sanitation was given special attention in the SDGs as stated clearly to ensure availability and sustainable management of water and sanitation for all. MDGs were set to ensure access to water and sanitation services and building systems, however, the SDGs are now calling for optimizing these systems.

As published in UN-Water Decade Program for Capacity Development Magazine (Capacity Pool); The SDGs are intended to be applicable to all counties and provide an “international framework that will enable countries to better target and monitor progress across all three dimensions of sustainable development (social, environmental and economic) in a coordinated and holistic way” (Ibid, 2013).

2.2 Jordanian water sector framework conditions

This section describes the water sector in Jordan, illustrating the water sources and the uses and allocation of water resources. It also shed the light over the policies, laws and regulations which govern the sector and set the foundations for the institutional setup and organizational structure for the water sector in overall.

2.2.1 Water sources and uses

Jordan currently uses around 980 MCM of water across all use sectors. Irrigation uses the largest share of this amount – some 52% – while most of the rest goes to serve urban consumers. About 25% of the amount supplied comes from surface water, mostly from the Yarmouk and Jordan Rivers, while roughly 57% is withdrawn from renewable fresh groundwater aquifers, almost all of which are located in the highlands. Table (8) shows the water resources and its distribution over main uses.

Table 8: Water Resources and Distribution of Uses in Jordan

Uses	Surface Water	Groundwater	Treated wastewater	Total Volume (MCM)	Percentage
Domestic	104	325	0	429	44%
Irrigation	150	231	123	505	52%
Industry	5	32	2	39	4%
Total	259	589	125	972	100%

Source: MWI, 2013

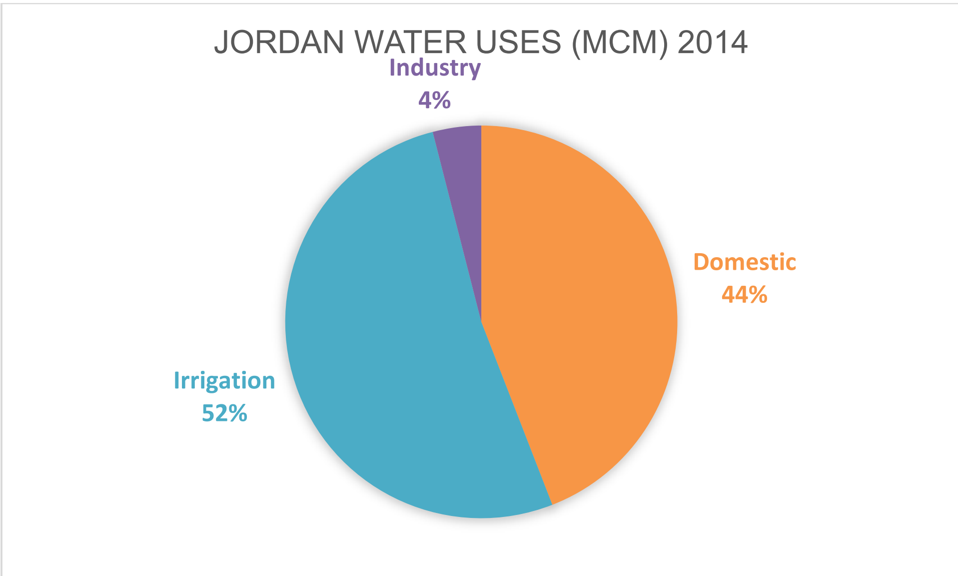


Figure 5: Jordan Water Uses in MCM as of 2014

Source: MWI, 2014

Jordan shares important water resources with neighboring countries. Surface water comes from the Jordan River or its tributaries, which are shared among five countries. Although no comprehensive basin-wide agreement exists, there are bi-lateral agreements between Jordan and Syria for the Yarmouk River and Jordan and Israel for both the Yarmouk and the main Jordan River. Jordan and Syria also share common groundwater aquifers, but these are unregulated and burgeoning use of these aquifers in Syria, as well as direct surface water diversions, has become a growing source of friction between the two countries. There is also a large fossil groundwater reservoir (Dissi Aquifier) which is shared by Jordan and Saudi Arabia, which is viewed by Jordan as a medium-term solution to its present water supply problems.

Municipal use is met primarily by groundwater sources. Per capita municipal consumption levels have remained at a fairly constant level since 1994. This is an impressive achievement given that the population has grown by 48 percent (1.97 million) over that same period. However, almost all urban domestic water, with the exception of Aqaba and a few sectors in Amman, is supplied on an intermittent, rationed basis that requires household storage in cisterns and/or roof top tanks. Most Jordanian urban households purchase drinking water and supplement municipal supplies with tanker water, especially during the summer months. Government of Jordan policy calls for a targeted supply of 120 liters/capita/day (lpcd) in Amman, 100 lpcd in other urban areas, and 80 lpcd in rural areas.

Industrial water uses in 2014 was 39 million cubic meters (MCM). The largest portion of water in the industrial sector is consumed by fertilizer industries, potash, phosphate, oil refineries, thermal power plants, cement factories, and various light and medium industries. A key use issue is industrial effluent releases to wastewater streams that are increasing with the current and planned growth of consumptive use by businesses (tourism, medical facilities) and industry (mining, power supply) and increases in the release of brine from industrial desalination. Recent world economic growth has averaged 2.4%, while GDP growth in Jordan over the past 10 years has averaged a strong 6.5% per year. Hence, where industrial growth expands at a rate of 4% per year and another where it expands at 8% per year. Water use is assumed to track with growth in industrial output. These two scenarios yield industrial water needs of 91 and 201 MCM, respectively, in 2030.

Irrigation water is heavily subsidized, with very low tariffs for surface water deliveries to the Jordan Valley, and very low tariffs and little quantitative restriction of over-abstraction of groundwater in the Highlands. Many studies have concluded that agricultural water use is of low economic return and that large-scale reallocation to municipal and industrial use is feasible. They cite the sector's declining contribution—now about 3.2 percent—to gross domestic product (GDP) for use of 65 percent of the country's total water supply. However, irrigation in the Jordan Valley supports a large number of jobs that would be difficult and expensive to replace, uses much of the country's reclaimed wastewater that has no other current use, is trending toward higher water use efficiency, supports export-oriented value chains, and enjoys substantial political support.

Groundwater over-abstraction in the Highlands is unsustainable and will terminate at different rates in the 11 over-exploited groundwater basins as supply is exhausted, saline water is encountered, or pumping costs exceed financially supportable levels on private farms. While U.S. Geological Survey (USGS) modeling shows that over-extraction at current rates can continue for up to 30 years in some well fields, extraction costs and water quality issues may lead to earlier closure in others. In 2002, a groundwater extraction bylaw began imposing abstraction tariffs and requiring well registration and monitoring, but has not significantly slowed extraction rates. Tariff increases, shifting to higher value crops and more efficient production technologies, and administrative closures will be needed to reduce over-abstraction of groundwater and shift its allocation towards domestic and industrial use.

2.2.2 Institutional setup

The main government agency entrusted with water resources responsibilities and with drinking water supply and wastewater services is the Ministry of Water and Irrigation (MWI) which was created in 1992 to manage the country's water resources. MWI is responsible for the formulation and implementation of water and wastewater development programs and for recommending water sector policies and tariff revisions to the Council of Ministers.

The Water Authority of Jordan (WAJ) which was established by law in 1988 as an autonomous entity with financial and administrative independence beholden to government and civil service regulations. WAJ is governed by a Board of Directors chaired by the Minister for Water and Irrigation, with representatives from the Ministries of Planning, Agriculture and Health, as well as the Secretary General of WAJ and the Secretary General of the Jordan Valley Authority (JVA).

WAJ is in charge of the implementation of policies related to the provision of domestic and municipal water and wastewater disposal services. Its responsibilities include the design, construction, and operation of these services, as well as the supervision and regulation of construction of public and private wells, licensing well drilling rigs and drillers, as well as issuing permits to engineers and licensed professionals to perform water and wastewater related activities. WAJ's Law was amended in 2001 under Article (28) in order to allow for private sector participation (PSP) in the water and wastewater service delivery sector through the assignment of any of WAJ’s duties or projects to any other body from the public or private sector or to a company owned totally or partially by WAJ.

Out of the need to introduce private sector operators into water and wastewater operations, MWI/WAJ hired a Management Contractor (MC) to run water and wastewater facilities including water supply, sanitation services, metering and billing. The MC was converted in 2007 to a public company owned by WAJ (Miyahuna) and providing since then services for Greater Amman Area, today Miyahuna is responsible over the management contract of running Zarqa and Madaba governorates, followed by Balqa in the near future. A similar set up was done for Aqaba by creating Aqaba Water Company (AWC) to run all services related to water and sanitation within Aqaba Governorate. The Aqaba experience seems to be a successful one in terms of cost recovery and financial viability. A series of micro PSP options were introduced to raise efficiency in metering and billing in more than one Governorate, namely: Madaba, Karak and Balqa.

In 2010/2011 WAJ created the Yarmouk Water Company (YWC) for the Northern Governorates including Irbid, Jarash, Ajlun and Irbid, to provide water and sanitation services to all these Governorates. Figure (6) shows the amount of water supplied in MCM by all utilities under WAJ as well as WAJ itself.

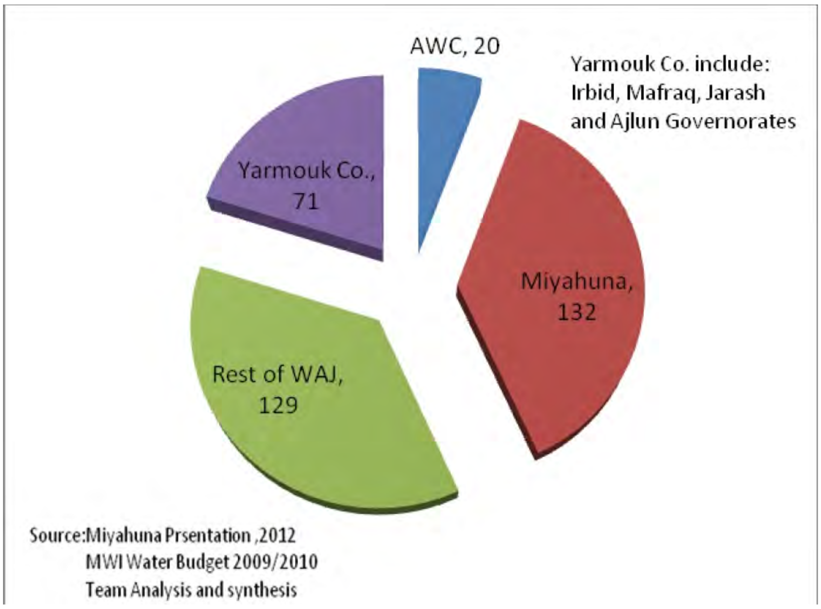


Figure 6: Drinking water supply share per utilities and WAJ in MCM

Source: MWI water budget 2009/2010

The Jordan Valley Authority (JVA) was created in 1977 and given the mandate to develop the Jordan Valley and the area south of the Dead Sea. Other responsibilities include: the development of water resources (irrigation, domestic, industrial and municipal), development of towns and villages; design and construction of road networks, domestic water supply, electricity, telecommunications and provision of tourist facilities.

Other Government Ministries and organizations involved in the water sector include the Ministry of Finance which oversees budgets and project financing; the Ministry of Planning which is involved mainly in Donor affairs; the Ministry of Agriculture which is involved at Farm Level Management including collection and communication of relevant data with regard to irrigated agriculture; and the Ministry of Health which monitors the suitability of drinking water that is supplied by WAJ as well as effluents from public and private wastewater facilities.

Table (9) below summarizes institutional responsibilities of all involved institutions in Jordan's water sector.

Table 9: Summary of Institutional responsibilities for involved institutions in Jordan's water sector

SUMMARY OF INSTITUTIONAL RESPONSIBILITIES

Sector policy	Sector policy developed by MWI and adopted by Council of Ministers
Service provision	WAJ and private operators where responsibility has been delegated by the Council of Ministers e.g., Miyihuna, AWC, YWC, As-Samra BOT Company
Regulation of prices, water resources and customer service standards	Prices: WAJ Board of Directors / Council of Ministers Water resources: Water Authority of Jordan Service standards: no regulation of service standards
Drinking water policy, monitoring and enforcement	Policy: Ministry of Health Monitoring: Water Authority of Jordan / Ministry of Health Enforcement: Ministry of Health
Environmental policy, monitoring and enforcement (with respect to water resources)	Policy: Water Authority of Jordan (as per Art.6b WAJ law) Corporation for Environmental Protection (as per Art.5f Law of Environmental Protection) Monitoring: Water Authority of Jordan, Corporation for Environmental Protection (as per Art.5e and Art.17 of the Law of Environmental Protection) Enforcement: Corporation for Environmental Protection and the courts (as per Art.22 Law of Environmental Protection)
Contracting for private investment	MWI: contract development WAJ: contract counterpart and contract monitoring
Public Awareness and Education	Campaigning and outreach: NGO's (Jordan Environmental Society, RSCN, etc.)
Measurements and testing	Third party inspector on water quality: Royal Scientific Society

Source: USAID-ISSP project, Institutional Assessment Report, October 2011

In the late 1990s, a project management unit was established within the MWI to implement the rehabilitation of Amman Water Supply, which was funded by donor agencies. Part of its function was to monitor the Amman Management Contract. As the infrastructure works in Amman came to an end, the European Union (EU) supported the extension of the project management unit's mandate and its transition to the Performance Monitoring Unit (PMU) of the MWI. The functions of the PMU include:

- Technical monitoring and performance auditing the private water companies in the country by applying agreed-upon indicators to establish a fair basis for comparing the

utilities and to provide tools to evaluate their performance and the effectiveness of their service provision;
- Promoting private sector participation (PSP) in water services and management;
- Developing public-private partnerships (PPPs);
- Planning and providing strategic advisory services to decision makers; and
- Applying commercial principles on the retail side of municipal water supply and wastewater treatment.

The PMU is governed by a Board of Directors chaired by the Minister of Water and Irrigation. Both the WAJ and the JVA Secretaries General are members. The PMU Chief Executive Officer reports to the Minister of Water and Irrigation, but historically has close reporting and coordination relationships with WAJ.

Since its startup, the PMU has played an important role in restructuring the water sector. Institutional reformers regard it as a potential interim regulatory body for water utilities that would be responsible for monitoring and auditing functions, including performance indicators and service benchmarking systems. In addition, the PMU has been supporting all PPP and PSP transactions.

2.2.3 Legal and regulatory framework of the sector

Referring to the previous sections which illustrated the institutional set up. Herewith, an overview of the laws/bylaws that created the institutions governing the water sector in Jordan. The MWI was established in 1992 (By-law No.54/1992) issued by the executive branch of the Government under the Jordanian Constitution. The establishment of MWI was in response to Jordan's recognition of the need for a more integrated approach to national water management.

WAJ was created in 1988 by virtue of Law No.18/ 1988 and its amendments as an autonomous corporate body with financial and administrative independence, responsible for the provision of water and wastewater services and the management of water resources and regulating ground water use.

JVA was created by virtue of Law No.19 / 1988 amended by new Law No.30/ 2001. As explained previously it is responsible for developing the Jordan Valley and the area south of the Dead Sea and for developing water resources there for irrigation and for operating the multi-source supply system for Amman and the King Abdullah Canal (KAC) in coordination with WAJ.

Though there is no one water law governing the sector and setting its policies, however, several policy and strategy and planning documents exist that provide the direction and guidelines for the sector:

1. Water policies for the following key areas:
   - Irrigation water policy
   - Surface water utilization policy
   - Groundwater management policy
   - Water utility policy
   - Wastewater management policy
   - Water reallocation policy
   - Water demand management policy
   - Energy efficiency and renewable energy in the water sector policy
   - Water substitution and reuse policy

- Climate policy for a resilient water sector

2. National Water Strategy in Jordan- MWI (2015-2025): It aims at building a resilient sector based on a unified approach for a comprehensive social, economic and environmentally viable water sector development. The strategy key areas are: Integrated Water Resources Management; water, sewage and sanitation services; water for irrigation, energy and other uses; institutional reform; and sector information management and monitoring.
3. WAJ Strategy (2008-2012): It sets the strategic directions and objectives of WAJ that are in alignment with sector policies and overarching strategy. It is developed based on the balanced score card approach, addressing the areas of customer satisfaction; financial aspect; operational aspect and human resources aspect.
4. JVA Strategy (2011- 2014): It sets the strategic directions and objectives of JVA that are in alignment with sector policies and overarching strategy. It addresses the development of conventional as well as non- conventional water resources; improving irrigation water management; surface water resources management; socio- economic development of the Jordan valley; protecting the Red Sea and the soil in the Jordan Valley; investment promotion in the area; and performance improvement.

2.2.4 Service providers

It was stressed out in the strategy that water and sanitation services should be available for present and future generations. Water utilities in Jordan should work on changing its businesses as usual practices to adopt commercial practices in a regulated water market to achieve Operation and Maintenance (O&M) cost recovery, but also focusing on high quality service that is properly valued and paid for by customers. The strategy called to reduce public subsidies and appropriately targeted across water sector services, and on rational basis to water utilities. The government is very concerned about water loss in water systems, therefore, the strategy highlighted Non-Revenue Water (NRW) reduction with greater investments and human resourced development including significant investments for the utilities and capacity building for top management and operations level. A partnership between consumers and utility companies must be forged where consumers can expect to receive improved service and utilities can expect to receive an adequate tariff for that service (MWI 2009). This recommendation again triggers the inclusion of benchmarking activities in the water sector to measure and improve the performance of newly corporatized and WAJ administered water utilities in Jordan.

2.3 Challenges facing the water sector in Jordan (Performance Overview)

Jordan’s Water Strategy (Water for Life) 2008-2022 is one of the strategic documents in the Jordanian water sector, where it shed the light on the status of water sector back in 2008 and has a vision inspired by the speech of H.M. King Abdullah II in November 7, 1999 "*Our Water situation forms a strategic challenge that cannot be ignored. We have to balance between drinking water needs and industrial and irrigation water requirements. Drinking water remains the most essential and the highest priority issue".* The national water strategy tackled main components of the water sector stating the current status under each component; the future challenges and lists the strategic goals by 2020 and the approach (plans or actions) that should be taken to achieve the vision. The main components tackled in the national strategy are: water demand, water supply, and institutional reform, water for irrigation, wastewater and alternative water resources. Issues and challenges related to water supply and sanitation service provision and water utilities are not independently mentioned in the strategy document, however, it can be summarized from difference chapters in the strategy. The related issues extracted are (Non-Revenue Water, Service Levels, Performance, and Corporatization).

2.3.1 Overall Utility Performance

The preceding water strategy gave attention to the performance of water and wastewater utilities. It was stated clearly to monitor and rate performance efficiency of water and wastewater systems and their management. Improvements on performance shall be introduced with due consideration given to the sustainability principle (MWI 2009). Human resources performance is also included where the strategy stated that the ministry will continually appraise human resource performance to upgrade capabilities and sustain excellence. Incentives for excellence shall be introduced in compliance with the needs for dedication.

Although benchmarking was not clearly stated in the strategy at that time but the goals and objectives mentioned here are strongly related to performance assessment and performance improvement (Benchmarking) programs.

2.3.2 Non-revenue Water

Non-revenue water rates in Jordan exceed 40% and it is considered among the serious problems in the sector especially in a water scare country like Jordan. The national water strategy emphasized the need to reduce NRW through partnerships and innovations within utilities daily management practices. To reach this goal will require the rehabilitation of water supply systems (including improved water meters), optimization of operation and management, and network restructuring.

Although the ministry implemented different projects and interventions to reduce physical losses but illegal use and water thefts still contribute to large amounts of NRW. The ministry started in 2013 with a strong campaign to detect and stop illegal uses and thefts, through closing illegal water wells and strengthening the penalties and enforcing water resources protection legislations. The national water strategy proposes to target reduction of NRW by 3-6% per year with a targeted reduction to 25% nationally by 2025. Thus, the strategy also includes strengthening the criminalization of water theft and operation of unauthorized wells.

Table (10) below shows the summary of NRW quantities and percentages distribution in Jordan's 12 governorates as referenced from MWI water budget for year 2014. It shows that the main 3 governorates (Zarqa, Balqa, Irbid) in addition to Amman contribute about 75% of NRW nationwide. The water systems of Amman, Zarqa and Madaba are run by Miyahuna, where Irbid and other northern governorates are run by Yarmouk Water Company. In both Yarmouk and Miyahuna, water supply is currently intermittent. In Miyahuna, the number of hours of water supply per week available to each area has decreased over the past years from 66 hrs in 2005 to 36 hrs in 2010. Intermittent supply has a number of negative impacts, including damage to the network, increased probability of meters under-reading because of air entrainment, increased NRW, due to high pressure while pipes are live, and public health risk.

Table 10: Summary of NRW quantities by governorate according to MWI water budget 2014

Summary of NRW Quantities by Governorate and Ranking – 2014

Gov.	NRW%	Net supply (MCM)	Losses (MCM)	% of total losses	Share of losses
Amman	38.50	179.19	68.99	33.48	74 % of losses
Zarqa	64.41	66.55	42.86	20.80	
Balqa	68.24	35.74	24.39	11.84	
Irbid	36.12	45.20	16.33	7.92	
Karak	69.23	20.48	14.18	6.88	26 % of losses
Mafraq	53.04	24.74	13.12	6.37	
Ma'an	73.16	14.22	10.40	5.05	
Aqaba	28.20	16.00	4.51	2.19	
Tafilah	57.16	5.47	3.13	1.52	
Madaba	34.96	8.86	3.10	1.50	
Jarash	45.06	6.68	3.01	1.46	
Ajloun	42.20	4.85	2.05	0.99	
Jordan	50.85	428	206.07	100.00	

Source: Ministry of Water and Irrigation, Water Budget 2014

In recent years, Micro PSPs were developed that outsourcing commercial functions to private sector companies (billing, collection and even Geographical Information System (GIS) mapping) with substantial improvements achieved on commercial NRW. The first pilot PSP in Madaba reflected improved billings and collection of at least 30%. Such PSPs still operate in the governorates of Madaba, Karak and Balqa.

There is no accurate accounting of technical vs. physical loss, so it is assumed that 50% of NRW is technical– although it is believed that in reality and from the results of some studies and evaluations, commercial exceeds technical losses.

2.3.3 Service Levels

In terms of service provision, the strategy encourages on expanding service area and to improve existing systems. The general objective of any water distribution system is to distribute water to consumers in adequate quantity and quality and at the required time to meet the demand in the most efficient manner (Ministry of Water and Irrigation (MWI) 2009). Jordan must make improvements in water distribution systems including fixing of shortfalls in the various components of the existing systems, such as operational problems, metering problems, supply interruptions, undersized pipes, high water losses in the tertiary networks, lack of pressure management, and absence of pressure zones (MWI, 2009). The strategy also recommended on expanding energy efficiency programs for water supply and distribution systems and utilizing renewable/alternative energy to provide 10% of the power required to pump water throughout the Kingdom.

2.3.4 Cost Recovery

In spite of efficiency improvements from corporatization and projects to modernize infrastructure, internal and donor-supported programs to enhance revenues, the financial performance of WAJ and the companies collectively has been deteriorating during the last seven years (ACWUA 2013). The sector entities have not been able to raise revenues to match increases in operating and capital costs.

While WAJ and the water companies have been able to cover operating costs; salaries, wages, operations and maintenance, full cost coverage has decreased as operating costs have increased. Operating costs increased significantly in 2011 and 2012 as electricity costs increased substantially. The current cost coverage shortfall is growing as electricity costs increase and the Disi water is flowing with its higher bulk rate cost. The cost of water ranges between USD 0.90 and USD 1.05 per cubic meters (m^3) significantly exceeds the current costs of bulk water (around USD 0.40 to USD 0. 5 per m^3) (ACWUA 2013).

Capital cost recovery also poses a significant challenge. As a policy position, operating revenues are usually considered to cover operating costs and capital expenditures are expected to be funded by the government and donors (equity as capital contributions and grants) and by national and foreign loans (as debt). Capital expenditures have been quite substantial, considering the sector's financial capacity. Between 2005 and 2010, WAJ has invested over 900 million JD ($1.3 billion) to rehabilitate and construct new infrastructure. This amount excludes the BOT investment in As-Samra and Disi. As a result, total cost recovery is not achieved and if the cost increase cannot be passed on to the customer, it will financially hurt either the utility companies or WAJ— or require increased budget support from the Government. Figure (7) below shows the trend in total cost coverage ratio and operating costs coverage for the water sector in Jordan up to the year 2013.

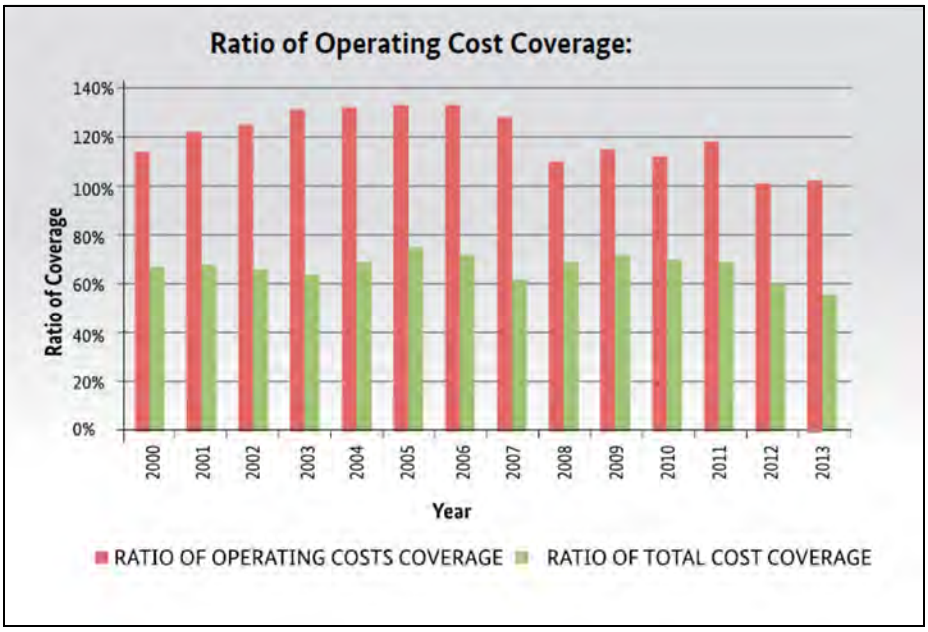


Figure 7: Ratio of operating cost coverage

Source: Jordan Water Sector, Facts and Figures, MWI, 2013

2.3.5 Energy Efficiency

Jordan has extremely limited primary energy resources and is forced to depend to a large extent on imported oil and natural gas. WAJ/water utilities are considered among the largest consumer of electricity in Jordan at about over 2,000 GWh in year 2013 which cost about 109 Million JDs in the same year (MWI 2013). Figure (8) shows the incremental energy consumption trend for water production and supply.

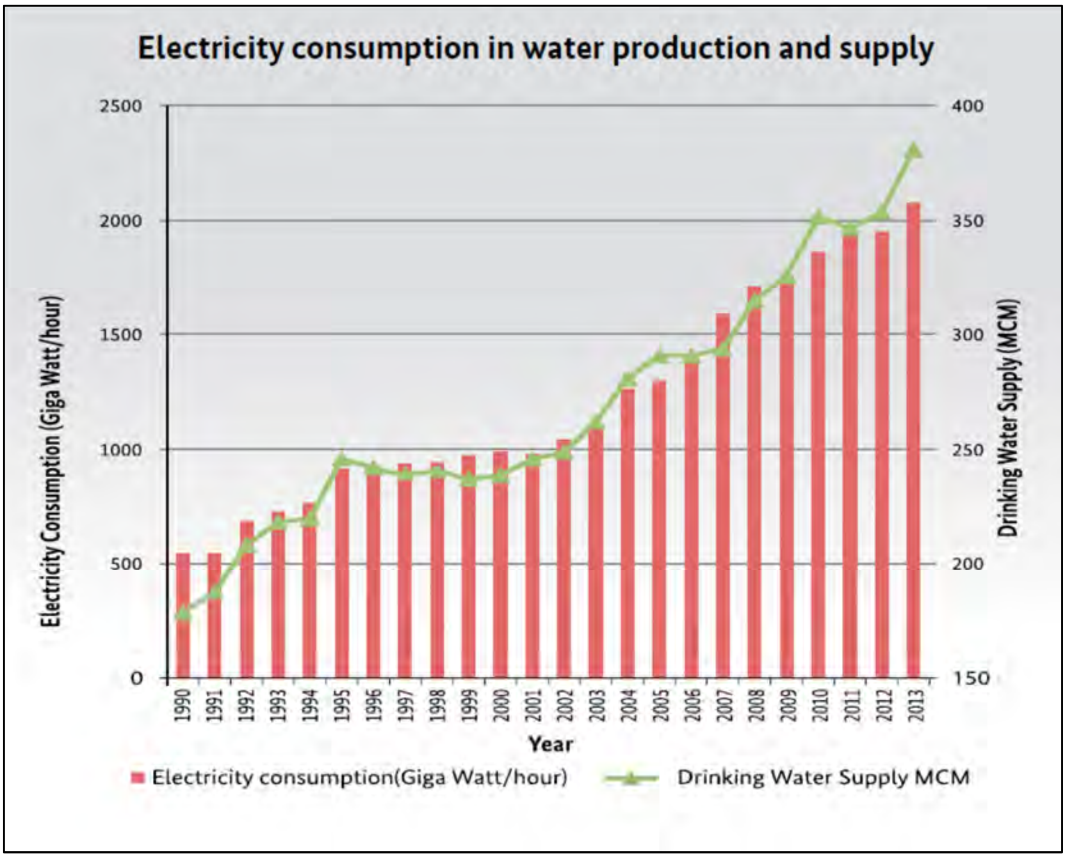


Figure 8: Electricity consumption in water production and supply (1990-2013)

Source: Jordan Water Sector, Facts and Figures, MWI, 2013

The reason behind this high number of energy consumption rate for WAJ is because fresh water has to be pumped around 1,400 meters from the Jordan Valley up to the consumers in the cities. Another reason is the operational inefficiency of the water pumps in function. To reduce the burden on the national electricity supply and avoid electricity blackouts, there is an urgent need to tap into potential power savings within WAJ. In relation, recent energy audits in a number of WAJ pumping stations revealed an energy saving potential of between 25-30%.

MWI have set two priority targets/actions within the national water strategy:

- A 15% reduction in the specific energy consumption of billed water corresponding to a 0.46 kg reduction of CO_2 emissions for the production per each billed m^3 of water.
- To increase the share of renewable energy resources in power generation for the sector to 10%, corresponding to a total saving of 0.26 kg of CO_2 emissions per each billed m^3 of water.

2.3.6 Assets Management

In Jordan, there is no specific Asset Maintenance and Management (AMM) policy, strategy or plans that are conducive of implementing AMM best practices (except in Aqaba Water which is considered ahead of all other utilities and service providers in that respect) (ACWUA 2013). The utilities themselves currently lack the integration and cross-functional utilization of whatever existing asset data there is. In this respect and except for AW, no complete and accurate asset registries are available as a first step to implementing AMM best practices.

Miyahuna is currently embarking on a comprehensive AMM improvement plan that includes developing asset registry, an asset management plan and the procurement of components of asset management systems for both rotating and fixed assets.

In the best-case scenario and considering the unavailability of asset registries, but there are in the water utilities standalone systems and applications that constitute the base for any AMM implementation, however, this lacks the proper institutional, functional and electronic integration and synchronization. Functional systems that are in place include GIS, Customer Relationship Management (CRM), Supervisory Control and Data Acquisition (SCADA), billing systems and financial accounting systems (FAS). However, those need not only be integrated, but functionally synchronized and business processes that adopt best practices in AMM be established and institutionalized (ACWUA 2013).

Moreover, it was stated in the national water sector strategy that MWI/WAJ should develop and implement an asset management plan to guide expenditures on operations and maintenance and capital investments.

Generally speaking, about the water sector in Jordan and according to Humpal D., El-Naser H., et al. (2012); the challenges that are facing WAJ and its utilities providing municipal water supply and wastewater services have been identified and studied by various groups for about two decades now. These challenges are summarized as follows:

- Systems inefficiencies induced by the governance and institutional structure of the water delivery system;
- Poor cost recovery and financial sustainability of the sector; the levels of subsidies by the government and donor agencies may reach up to 100 percent of the revenues from water delivery services;
- The institutional structures have not provided the incentive framework to hire and retain qualified people and manage the sector more efficiently; in the past decade, the brain drain in the sector has become a major challenge, with many qualified staff leaving to work for the private sector in Jordan or in the Gulf states; and
- The donors' technical support to the agencies has not been effective due to various reasons related to the organizational governance and framework, donors' program design, and inability to engage the sector institutions in the design and implementation of these programs.

In summary and according to (WAJ 2013), a range of technical and financial challenges face the sector as listed in Table (11) below:

Table 11: Technical and financial challenges facing the water sector according to WAJ 2013

Technical Challenges	Financial Challenges
• Limited water resources • Uncontrolled population spread • Old water networks • High rate of water loss • Systems inefficiencies induced by the governance and institutional structure of the water delivery system, • Institutional structures not providing incentive framework to retain	• Inability to cover the capital and operating expenditures within the currently applied tariffs which are non-dynamic and are not linked to service delivery costs, • Limited resources of funds, • Deceasing central government support, • High cost of searching and developing new water resources,

qualified staff and manage sector efficiently.	• Increasing cost of service delivery due to increasing cost of production inputs.

Source: ACWUA, 2014

When talking about challenges hindering the performance of water and wastewater utilities in Jordan, this requires a detailed study and analysis for each Water Company or public water administration. Within research methodology; the study will go beyond material available in literature and conduct further investigation with Jordanian utilities about challenges, issues and problems they are facing, in order to capture performance gaps and identify performance improvement measures accordingly following the benchmarking concept and methodology.

2.4 Benchmarking for water utilities

2.4.1 What is benchmarking

Before starting with the benchmarking definitions according to different sources; investigation about the history of benchmarking concept and process is required. The first mainstream reference to benchmarking was probably the 1989 book "Benchmarking – The search for Industry Best Practices that Lead to Superior Performance" by Robert C, Camp. His description of the modern concept of benchmarking is based on the case of Xerox Corporation, where he used to work. In the 1970's, this US copier manufacturer heavily lost market share to Japanese manufacturer. For Xerox Corporation, this came as quiet a surprise, for the company was increasing its productivity and did not pay much attention to developments outside the organization. Cabrera E., Dane P., et al. (2011).

Looking for explanations why sales had decreased, Xerox started a comparative analysis of copiers from different competitors in 1979. Functional specifications were compared, copiers were dismantled and mechanical parts investigated. More extensive benchmarking followed by comparing copiers of other Japanese manufacturers, including its Japanese subsidiary Fuji-Xerox. The results confirmed significantly higher production costs in the US. As it turned out, Japanese companies –including Fuji- sold copiers at Xerox's production costs. This marks the birth of the modern concept of Benchmarking, which in 1981 was introduced at corporate level in Xerox. Cabrera E., Dane P., et al. (2011).

Although benchmarking was developed as a tool for business improvement to gain back market share in a competitive environment, it can also be applied in the water industry which generally lack competition. After all, the concepts applied in benchmarking are universal and their application does not depend on the type of industry or service. Cabrera E., Dane P., et al. (2011).

According to IWA recent definition in Cabrera E., Dane P., et al. (2011), **"Benchmarking is a tool for performance improvement through systematic search and adaptation of leading practices"**. A powerful tool that is suitable for enhancing performance but it is not the only tool for improving water services. Other options include process optimization, business process redesign, restructuring, merging utilities, etc. Benchmarking without a clear goal will often lead to disappointment and waste of resources. However, over the past decade many cases have proven benchmarking to be powerful management instrument to achieve improvements in the water industry.

The scrutiny of business practices has intensified in recent years, and the need for transparent and standardized information with which to compare utilities' performances has gained prominence, leading to increased emphasis on measurement of results, on transparency, and on accountability. The primary objectives of benchmarking according to IBNET definition are; 1) To provide a set of Key Performance Indicators (KPIs) related to a utility managerial, financial, operational, and regulatory activities that can be used to measure internal performance and provide managerial guidance. 2) To enable an organization to compare its performance on KPIs with those of other relevant utilities to identify areas needing improvement, with the expectation of developing more efficient or effective methods to formulate and attain company goals as set forth in its business plans.

According to The German Association of Energy and Water Industries (BDEW); Benchmarking is the process whereby a company compares and improves its performance by learning from the best in a selected group. The process involves identification of, familiarization with, and adoption of successful methods and processes used by benchmarking partners. This results in an improvement in a company's performance, as well as in reduction of costs (BDEW 2012). The association of Dutch water companies (Vewin) is advocating for benchmarking because it aims to increase efficiency, quality and transparency in the industry. Water companies were carrying out benchmarking on voluntary basis and actively use the Benchmark as a tool to identify aspects allowing them to improve their business processes further.

According to the Canadian Water and Wastewater Association (CWWA, 2009), benchmarking can be defined as a systematic process for securing continual improvement through comparison with relevant and achievable internal and external norms and standards. Benchmarking implies comparison, which may be internal comparisons with previous performance or future targets, or external comparisons of performance against similar municipalities or households. "Benchmarking" simply stated is measuring performance against a standard of quality (industry sector or technical standard).

After studying different definitions for benchmarking, they all agree that it is a proven tool for performance improvement; however, different approaches were used in order to assess current performance of the utility and investigate improvement gaps at different levels to increase performance efficiency. Since the 1990s there are two types of benchmarking to be distinguished. Metric Benchmarking; which involves systematically comparing the performance of one utility with that of other similar utilities, and even more importantly, tracking one utilities performance over time. A water or wastewater utility can compare itself to other utilities of a similar size in the same country or in other countries. Likewise, a nation's regulators can compare the performance of the utilities operating there. Metric benchmarking, essentially an analytical tool, can help utilities better understand their performance. Cabrera E., Dane P., et al. (2011)

The second type is process benchmarking; which is a normative tool with which one utility can compare the effectiveness of its processes and procedures for carrying out different functions to those of selected peers. A utility can compare its billing and collection system, for example, to those used by other utilities to which system performs better.

In simple words, metric benchmarking made reference to the comparison of key performance indicators. This was and still is the basis for the system used by Office for Water Services (OFWAT) and by most of the water industry regulators in the world, which also was named “Yardstick”. However, metric benchmarking soon became appealing to a completely different type of users: utilities who wished to determine their competitive level by screening their performance areas for strengths and weaknesses and comparing them to the performance of other utilities. Cabrera E., Dane P., et al. (2011)

Process benchmarking was used to identify the “Xerox benchmarking” as described by Robert Camp. This method identifies an organization that is best in class in a particular process or business area; and after determining which factors are the key to the success, adapts the best practices to improve performance. The two techniques shared some similarities. They both needed the participation of several utilities. They both involved some sort of comparison and above all, metrics were a crucial first step for Xerox benchmarking.

Both concepts have often been confused since then, and the actual words, especially “process” have led to a good number of misunderstandings as people tried to interpret what the terms implied. In addition, after referring to dozens of papers and technical references in which the terms “metric benchmarking” and “process benchmarking” were used with different meanings, representing all shades of grey. Even IWA benchmarking specialty group could not draw the line between metric and process benchmarking. Therefore, and in the recent edition of the manual “Benchmarking Water Services-Guiding water utilities to excellence” (Cabrera E., Dane P., et al. 2011), it was stressed clearly that IWA specialty group on benchmarking strongly recommends abandoning the use of the terms “metric benchmarking” and “process benchmarking”. Instead “performance assessment” and “performance improvement” should be considered consecutive components of benchmarking.

The IWA had issued a manual for benchmarking water services, by which provides a step-by-step guide on how to benchmark, as well as a new benchmarking framework. After long deliberations, it was decided that the old framework was too extended to achieve a common understanding and therefore a new terminology was created. Figure (9) demonstrates the new benchmarking framework, which maps most of practices qualified as benchmarking in the water industry. Any current benchmarking project can be placed in the figure according to the objectives pursued, the techniques used and also taking into account the level of details investigated.

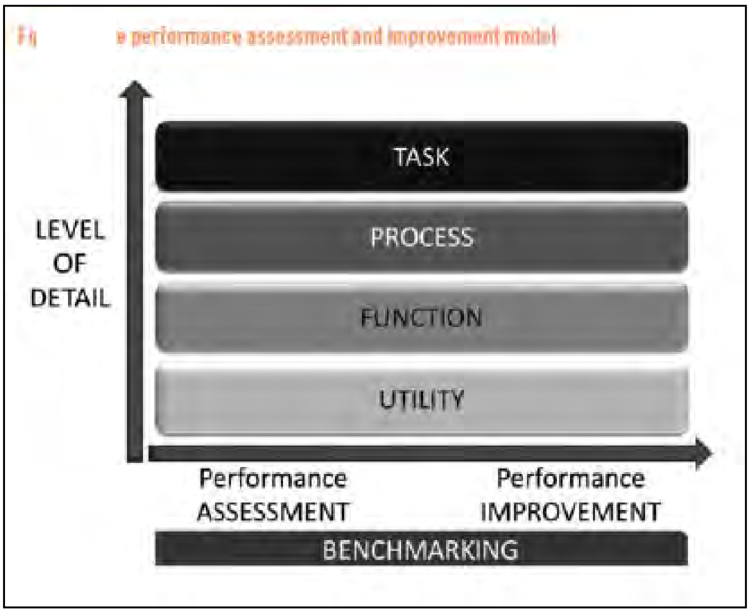


Figure 9: New benchmarking framework developed by IWA-benchmarking specialty group

Source: IWA, 2011

This new framework also accommodates regulatory activities within the water industry and goes some way towards solving the problem of defining benchmarking across projects which focus on different levels within the utility: for instance, a funding institution will try to assess the overall utility performance, or at least financial or service performance, while a plant engineer might be interested in the assessment and improvement of performance for a single task within a very specific process (e.g. membrane cleaning in a micro-filtration plant).

While water industry is focusing on benchmarking water and wastewater services, similar projects and initiatives have been also applied on river basins. A pilot project has been established as a step towards a benchmarking of managing (partial) river basins in Germany. It is considered as a contribution for a framework of compatible international benchmarking activities. In accordance with standards of IWA and German DWA a process model, variables and Indicators have been elaborated. A first field test has been run in the area of river Lippe, Germany (Schulz, A.; Stemplewski, J. 2009).

2.4.2 Benchmarking purposes

There are many positive outcomes for benchmarking in the water sector; the ultimate value of benchmarking is the extent to which it leads to greater efficiency and delivery of better services (Van den Berg C., Danilenko A. 2011). The adaptation of performance improvement measures considered mainly in sector reform plans. Benchmarking also promotes transparency, and considered as effective tool for rationalizing the use of scarce resources. Benchmarking is most effective when combined with due diligence. Benchmarking constitutes a cost-effective tool providing sector managers, including independent regulators, ministries, provincial governments, municipal authorities, and investors with bird's eye view of the utilities overall performance that can be used to priorities needs and establish the main directions for new policies and programs (Van den Berg C., Danilenko A. 2011).

In the past 20 years, many benchmarking projects have been undertaken in the water industry all over the world. In many occasions, the drive to benchmark was initiated outside the utility, and benchmarking was seen as a logical option helping to answer some questions and/or to meet such demands: Public debate about liberalization or privatization of public services, Demand for more transparent and efficient public services, Political pressure for full cost recovery, Requirements for large investments to improve the service in terms of coverage and quality, which in their turn require smart innovations by the water industry to keep charges at a reasonable level.

However, external drivers are usually not sufficient to initiate benchmarking (excluding regulatory obligations). Usually the utility management, with its operational responsibility for the service, has its own drivers to benchmark. The natural need to continuously improve the organizations and its products can be facilitated in benchmarking projects that provide a detailed insight in the performance and identify areas of improvement (Cabrera E., Dane P., et al. 2011). Benchmarking projects is not only useful to utilities; however, there are other stakeholders in the water industry who are involved in benchmarking projects:

Governments/regulators: Governments are politically responsible for the regulation of the water sector. And they need to guarantee the appropriate levels of service and compliance with applicable standards. They also seek transparency of the water industry and assure sustainable and efficient operations. In addition, comparative performance assessments can help both governments and regulators to introduce artificial competition in a sector which constitutes a natural monopoly and to put pressure on utilities to raise efficiency and transparency (Cabrera E., Dane P., et al. 2011).

Customers: Customers and consumer organizations are usually focused on obtaining a good service and a good product while paying a fair price. Additionally, questions regarding affordability for those with the lower incomes are often a main concern. Consumers can benefit from comparative performance assessments through getting insights over the performance of the local utility, seeking efficiency and higher level of services and perform comparative assessment of value for money (Cabrera E., Dane P., et al. 2011).

Owners/shareholders: The owners and shareholders are legally responsible for the utility. As a result of such responsibility, and to comply with the applicable regulations, they need insight in the utility's performance, its efficiency and the magnitude of the financial or other risks undertaken by the utility. Benchmarking and comparative performance assessments are excellent tools to assess those magnitudes and place them in perspective when compared with others. Additionally, benchmarking demonstrates that there is a culture within the organization to continuously improve and become more efficient (Cabrera E., Dane P., et al. 2011).

From another hand, it was also clear in the past years that many utilities are reluctant to enter the benchmarking arena. Therefore, it is important to acknowledge the reasons that may refrain utilities from joining a benchmarking project, and to bear in mind these issues when a benchmarking project is being prepared:

- The utility is considered to be unique and not comparable
- The company is being restructured or merged, so there is no stable situation for assessing performance
- There is a lack of reliable data to submit
- There are not enough available resources (budget, manpower)

- There are doubts on the added value of the program
- The suggested methodology is too complicated
- There is no guarantee for confidentiality of individual performance data

2.4.3 Performance assessment basics

Performance assessment is a widespread activity used in economics, business, and sports and in many other areas of life in general, in order to compare and score entities and individuals and make management decisions (Matos et al., 2003). Assessment is defined as a "process or result of this process, comparing a specified subject matter to relevant references" as in ISO 24500. Performance assessment is therefore any approach that allows evaluation of the efficiency or the effectiveness of a process or activity through the production of performance measures such as performance indicators.

The assessment of utility's performance with the use of performance indicators can measure the quality of service and utility's effectiveness and efficiency, make transparent comparison between objectives, provide benchmarking between similar undertakings' and encourage them to provide an improved service. The performance assessment of the water supply services seems to be the right tool to help to solve some of the major problems of the sector (Alegre H., Babtista J., et al. 2006)

Performance assessment of water utilities is not an easy job. The amount of data present in a single utility can be overwhelming. In other words, reality is very complex and all efforts exerted to reproduce it require some sort of simplification. In this simplification, we find two contradictory needs: on one hand, a higher level of detail delivers a more faithful representation of reality. On the other hand, large quantities of data are not always the best option to make decisions and do not make up information. For those same reasons, performance assessment could be described as the art of simplification: the more condensed the data is, the better; but an excessive simplification of the picture may not provide sufficient information to make sound decisions (Cabrera E., Dane P., et al. 2011).

Indicators are a great tool to assess performance because by combining the adequate indicators a general picture of reality can be achieved. Despite the fact that indicators are accessible and easy to understand, creating a good indicator is not always an easy task. A good indicator needs to fulfill certain characteristics; performance indicator (PI) should comply with the following requirements (individually and collectively) as indicated in Alegre et al. 2006; ISO 24500) and also displayed in the following table (12) requirements of PI:

Table 12: Specific requirements considered when designing a performance indicator

(Individually) ***PI should comply with the following requirements***	***(Collectively)*** ***PI should comply with the following requirements***
Be clearly defined, with a concise meaning	Every PI should provide information significantly different from the other PI in the system;
Be reasonably achievable (which mainly depends from the related variables)	Definitions of the performance indicators should be univocal (this requirement is made extensive to its variables);
Be as universal as possible and provide a measure which is independent from the	Only such PI should be established which are deemed essential for effective performance

particular conditions of the utility	evaluation.
Be auditable	
Be simple and easy to understand	
Be quantifiable so as to provide an objective measurement of the service, avoiding any personal or subjective appraisal	

Source: Alegre et al. 2006; ISO 24500

Performance Indicators (PIs) may be considered as providing key information needed to define the efficiency and effectiveness of the delivery of services by an undertaking (Deb & Cesario, 1997). Efficiency is the extent to which the resources of an undertaking are utilized to provide the service, for example, maximizing service delivery for the minimum use of available (possibly natural) resources. Effectiveness is the extent to which declared or imposed, objectives, such as levels of service, (specifically and realistically defined) are achieved (Matos, R., Cardoso, A. et al. 2003).

Indicators can be used for many assessment and analysis purposes; PI can be used in assessing the fulfillment of objectives/targets, it can also be used in trend analysis in addition to the popular usage for peer comparison. Regardless of the purposes, performance assessment system needs to be well designed and tailor made for its objectives. The IWA manuals on performance indicators for water supply (2nd edition) and wastewater provide a structure that may prove to be a valuable guide when building up such a system.

In this thesis, the IWA performance indicators system will be reviewed because IWA system provide a long list of indicators (over 150) and even longer list of variables which are needed to calculate the indicators. Also, it is considered as universal reference and the industry standard on the topic. A system of performance indicators is comprised of a set performance indicators and related data elements which represent real instances of the utility as shown in figure (10) Alegre H., Babtista J., et al (2006). The classification of these data elements depends on the active role they play.

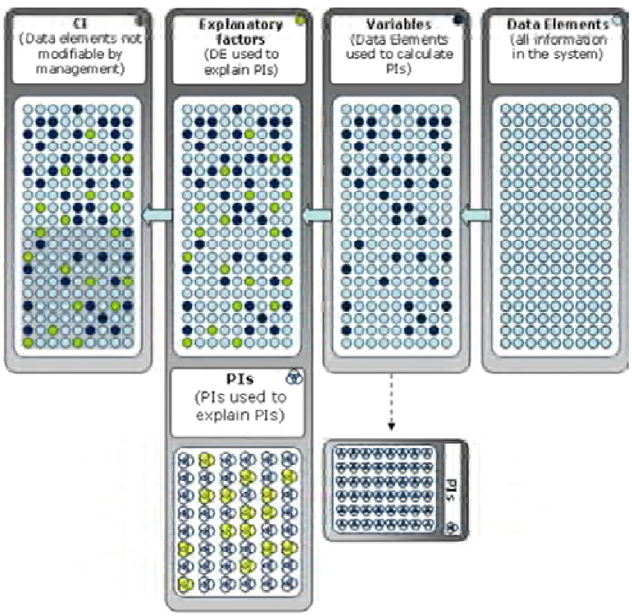


Figure 10: Components of the IWA performance indicators system

Source: IWA, 2011

Data Elements: is a basic datum from the system which can either be measured from the field or is easily obtainable. Depending on their nature and role within the system, data elements can be considered variables, context information or explanatory factors (Alegre H., Babtista J., et al (2006).

Variables: is a data element from the system that can be combined into processing rules in order to define the performance indicators. The complete variable consists of a value (resulting from a measurement or a record) expressed in a specific unit, and a confidence grade which indicates the quality of the data represented by the variable (Alegre H., Babtista J., et al (2006).

The variables in the IWA PI system are divided into the following groups:

- A- Water volume data
- B- Personnel data
- C- Physical assets data
- D- Operational data
- E- Demography and customer data
- F- Quality of service data
- G- Financial data

Performance indicators: measures of the efficiency and effectiveness of the delivery of the services by an undertaking that result from the combination of several variables. The information provided by a performance indicator is the result of a comparison (to a target value, previous values of the same indicator, or values of the same indicator from other undertakings). Individual PI should be unique and collectively appropriate for representing all the relevant aspects of undertaking performance in a true and unbiased way, thus reflecting the managing activity. Each performance indicator should contribute to the expression of the level of actual performance achieved in a certain area and during a given period of time, allowing for a clear comparison with targeted objectives and simplifying an otherwise complex analysis. A performance indicator consists of a value (resulting from the evaluation of the "processing rule") expressed in specific units, and a confidence grade which indicates the quality of the data represented by the indicators. Performance indicators are typically expresses as ratios between variables; these maybe commensurate (e.g. %) or non-commensurate (e.g. $\$/m^3$). In the latter case, the denominator shall represent one dimension of the system (e.g. number of service connections; total mains length; annual costs), to allow for comparisons. The use as denominators of variables that may vary substantially from one year to other, particularly if not under the control of the undertaking, shall be avoided (e.g. annual consumption, that may be affected by weather or other external reasons), unless the numerator varies in the same proportion. A clear processing rule shall be defined for each indicator, specifying all the variables required and their algebraic combination (Alegre H., Babtista J., et al (2006).

IWA performance indicators are arranged in the following groups:

- Water Resources (WR)
- Personnel (Pe)
- Physical (Ph)
- Operational (Op)
- Quality of Service (QS)
- Economic and financial (Fi)

Some indicators are broken down into sub-indicators. Normally sub-indicators are parts of the top indicator which may or may not be assessed separately. For instance, the "quality of supplied water" indicator which accounts for the number of successful quality tests with respect to the total can be broken down as follows:

QS18-Quality of supplied water:

- QS19-Aesthetic tests compliance
- QS20-Micorbilogical tests compliance
- QS21-Physical-cheminal tests compliance
- QS22-Radioactivity tests compliance

Context information: are data elements that provide information on the essential characteristics of an understating and account for differences between systems. There are two possible types of context information:

- Information describing pure context and external factors to the management of the system. These data elements remain relatively constant through time (demographics, geo-graphics, etc.) and in any case, are not affected by management decisions.
- Some data elements on the other hand are not modifiable by management decisions on the short and medium term, but the management policies can influence them on the long run (for instance the state of infrastructure of the utility)

Context information is especially useful when comparing indicators from different utilities. The context information elements provided in IWA PI system are classified in the following categories:

- Service data
- Physical assets:
    - Water resources
    - Impounding reservoir storage
    - Treatment
    - Transmission and distribution storage tanks/service
    - Pumping stations
    - Transmission and distribution network
    - Service connections
- Consumption and peak factors
- Demography and economics
- Environment

Explanatory factors: an explanatory factor is any element of the system of performance indicators that can be used to explain PI values, i.e., the level of performance at the analysis stage. This includes PI, variables, context information and other date elements not playing an active role before the analysis stage.

The use of performance indicators should always be linked to the establishment of a proper performance assessment system, in which all the above-mentioned elements are present and defined, and aimed to fulfill a clear objective or obtain information on specific areas or issues.

One last important issue regarding the definition of a performance assessment system is the quality of data. In most cases, quality of data used to feed the indicator system is not even recorded. Quality is either taken for granted or not considered very important. However, the main use of a performance assessment system is decision making, it is difficult to imagine data quality not being relevant. In other words, making a crucial decision on an indicator with a value of 20 ± 1% in error is completely different from having to make that same decision if the result is 20 ± 100%.

2.4.4 Benchmarking process

Benchmarking consists of two consecutive components. The first step is performance assessment, which aims at analyzing performance, comparing it with other organizations within or outside the industry, and identifying performance gaps. The next step is performance improvement, which is designed to find improvements by learning from the leading practices and adapting them to the own situation (Cabrera E., Dane P., et al. 2011).

Benchmarking usually is organized in projects/exercises with start and finish dates. However, from a management point of view, benchmarking should not be considered as single, isolated action but a continuous process. What was considered a good practice yesterday could well be outdated today and need to be updated. Therefore, utilities need to permanently search for opportunities for further improvement to assure that their customers get the best value for money and shareholders too. Therefore, benchmarking should follow the plan-do-check-act principle as show in figure (11).

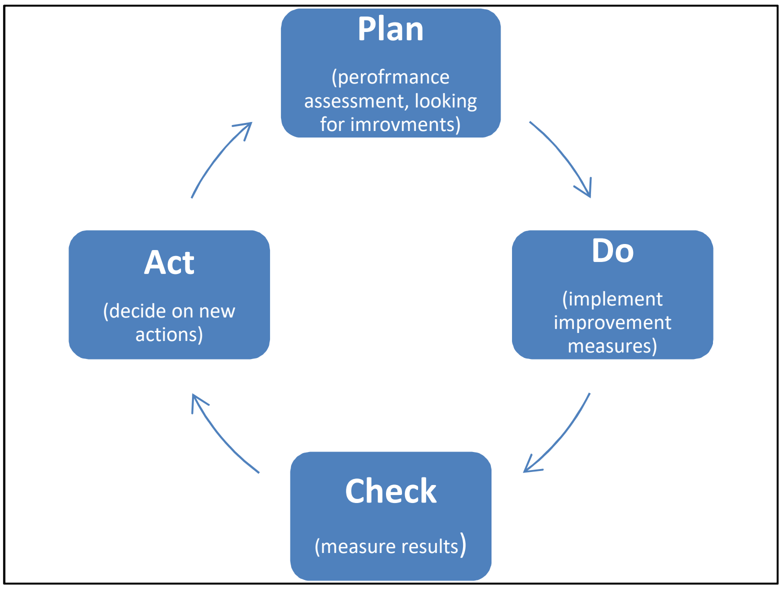


Figure 11: Plan-Do-Check-Act (PDCA) principle diagram

Source: IWA, 2011

Although almost every benchmarking reference in the literature has its own benchmarking process with different number of steps, they all follow the same principles. A typical benchmarking process with six different steps is presented here in figure (12) as stated in the IWA benchmarking process (Cabrera E., Dane P., et al. 2011):

1- Project planning
2- Orientation, training and project control
3- Data acquisition & validation
4- Data analysis & assessment reporting
5- Improvement actions
6- Review of improvement actions

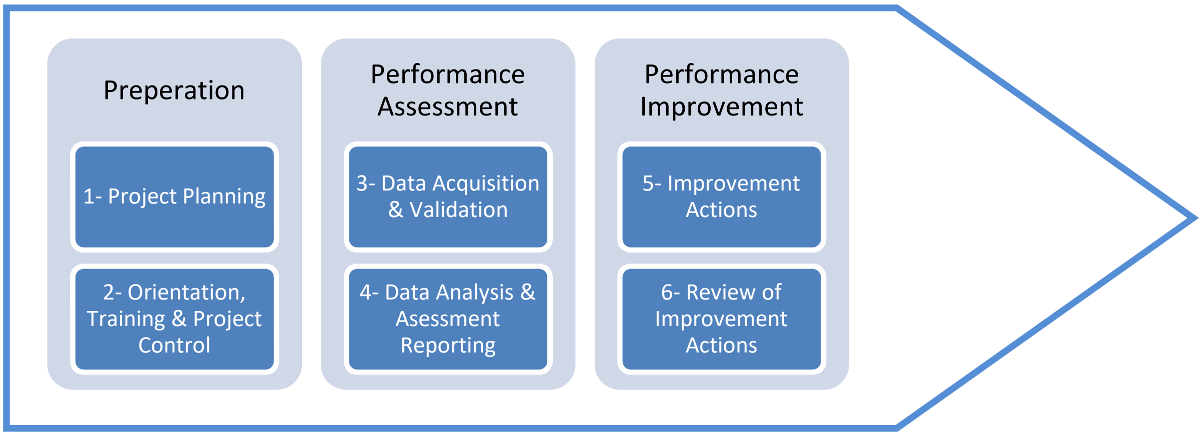


Figure 12: The new benchmarking process according to IWA benchmarking specialty group

Source: Cabrera E., Dane P., et al. 2011

1- Project planning

At the start of a benchmarking project, the scope and level of detail are determined based on the demands and needs of the interested utilities. The performance assessment model and the data requirements also need to be elaborated to show participants what they can expect, and to estimate project resources. Based on this information, a detailed project plan with budget and planning can be drafted. In a case of a closed group a “Go or No Go” decision can be made based on the project planning. In case of an open project, interested utilities are invited to participate at this stage and based on their response the project may or may not be launched.

2- Orientation, training and project control

Before starting to benchmark, all staff involved in the project needs to be prepared. The objectives of the exercise and the project plan should be clear at this stage. Furthermore, staff needs to be informed about the methodology and data requirements and trained in the data collection methods that will be applied in the project. These considerations include the staff from participating utilities and staff from the project team (organizing body and/or commissioned third parties).

3- Data acquisition and validation

One of most time-consuming activities in a benchmarking project is the data acquisition by the participants. This step requires significant efforts from the participants, depending on their experience, availability of the information and accessibility. The role of the project team in this step is to assist utilities in cleaning up methodology issues and definition problems and to secure meeting deadlines.

When the required data is collected, it needs to be validated by the utilities and by the project team, for instance by looking at consistency with data from previous years, outliers, on-site visits or auditing. Although this activity maybe intensely time consuming, the availability of a reliable dataset is a key to successful benchmarking. Participants in a benchmarking project expect good quality comparisons and, accordingly, proper identification of performance gaps as these are the triggers for improvement actions.

4- Data analysis and assessment reporting

Once data are validated, they are analyzed, performance indicators are calculated and performance comparisons are made between the participants. In this stage, possible remaining errors in the dataset can be identified and cleared up to improved data quality. Performance gaps are then determined and explained (if possible) keeping in mind the differences in the operating environment of the utilities.

The result of this step is a draft report (at individual/or group level) with the preliminary results of the performance assessment. This is the basis for discussing performance differences with the participating utilities in a workshop. After discussing the preliminary results of the performance assessment in a workshop, possible errors and further explanations on performance gaps or differences in the operating environment of utilities are processed. Final reports on the performance assessment are produced and distributed to disseminate the results within the company and to its stakeholders. These assessment reports can be supplemented by improvement action plans after the upcoming steps.

As an applied example and according to aquabench database and records in 2012 (the leading German benchmarking company) Möller, K.; Bertzbach, F.; Nothhaft, S.; Waidelich, P.; Schulz (2012), in the last eight years of process benchmarking 483 courses of action have been elaborated and documented as mentioned in table (13) below.

Table 13: Number and areas of action proposals derived from seven benchmarking projects implemented by aquabench, Germany

Project	Project year	No. of participants	Optimising areas	Action-proposals
Sewer operation	2003 – 2010	23	Camera and flushing technology, work time models, crew strengths, cleaning intervals, management of vehicles and outside services, work preparation and management systems	92
Sewer operation – pumping stations	2004 – 2010	20	Modification cleaning technique, modification of cleaning and inspection intervals, differentiation of inspection activities, optimization of remote action and power consumption	72
WWTPs	2004 – 2010	24 (since 2009)	Each sub-process: investments plant technology, scheduled maintenance intervals, control of facilities, use of materials, controlling, insourcing	>200 (since 2009)
Laboratory	2006 – 2010	14	Scope of investigation, sampling efficiency, automation, laboratory capacity, procedures, quality assurance	37
Indirect discharger monitoring	2006 – 2010	17	Strategy (activities and frequencies), efficiency sampling and laboratories, employee qualification, price and charges models	39
Sewer construction	2004 – 2010	13	Time recording software, reduction of through times, improvement of cost determination, coordination with other pipeline agencies, raw material standards, manholes, shoring, award of contract practice	19
Material management	2004 – 2010	12	Contract specifications, change to building cleaning, introduction of e-procurement, centralisation, condition analysis toner, storage capital tie-up	24

5- Improvement action

Based on the performance assessment and the knowledge that is available in the group, the project team and the participating utilities jointly try to discover best practices, present and discuss these in the workshop and identify improvement opportunities. For further analysis of interesting practices, site visits or task groups may additionally be organized.

With the best practices identified, participants should be able to draft their own improvement action plan. The action plan can be quite different for each utility and needs to be prioritized, based on the contribution of the proposed actions to the strategic objectives of the utility and the cost/benefit ratio. In order to implement the suggested improvement initiatives, senior utility management should approve the necessary changes and the necessary internal procedures should be followed to secure investments and organizational changes.

6- Review of improvement actions

After implementing improvement actions, the results should be assessed to review if the objectives have been reached. Usually, this is done in a following benchmarking exercise. In order for the benchmarking process to be complete, this needs to be documented and evaluated, including lessons learnt and new benchmarking needs. Closing the cycle provides essential information for preparing a new benchmarking effort.

2.4.5 Benchmarking efforts in the water industry

This section will shed the light over current benchmarking efforts in the water industry as considered to be leading in benchmarking arena internationally.

2.4.5.1 Office of Water Services (OFWAT)

The regulatory work carried out by OFWAT in England and Wales set out some of the industry basics regarding performance assessment and its comparison. Created in 1989, OFWAT soon made of the yardstick competition one of its main regulatory tools for the newly privatized water industry in the country. As a consequence, metrics were collected and audited and indicators calculated and compared. The need for a transparent and equitable model led to the development of communication techniques (graphs and tables) as well as important concepts like confidence grading (Cabrera E., Dane P., et al. 2011).

As economic regulator for water undertakings, they ask companies to report on performance indicators that cover the following areas: Water Quality, Customer experience, Reliability and availability, Environmental impact and Finance. Recently they publish performance data for England and Wales water companies with recent live data under the website: www.disocverwater.co.uk with an interactive public information and comparison tools.

2.4.5.2 The World Bank (IBNET)

The World Bank is considered as the best example of funding agency interested in prompting transparency and investment prioritization through comparison of performance indicators. In 1999, the Bank published its "benchmarking start-up kit" which comprised a series of documents and a spreadsheet based on software to collect data from water utilities worldwide. This kit was the precursor of IBNET and

online database (www.ib-net.org) for water and sanitation utilities performance data. While the wealth of data in IBNET is certainly remarkable, the fact that is a voluntary network and the obvious difficulties in assuring data quality limits the usefulness of the system (Cabrera E., Dane P., et al. 2011).
The IBNET focus on the trends in water and wastewater coverage in many countries, especially in the developing world, where efforts to widen access to a safe water supply and sanitation services have intensified as part of the larger efforts to achieve the sector's Millennium Development Goals. These trends will demonstrate the progress that has been made in reforming the water utility sector (Van den Berg C., Danilenko A. 2011). IBNET measures the performance of water utilities based on a set of indicators for operational efficiency, financial sustainability, and customer responsiveness. Operational efficiency is measured through two indicators: non-revenue water and staff productivity. The two indicators used to determine financial sustainability are operating cost coverage ratio and collection period. Moreover, and in regards to the utilities' customer responsiveness; it is measured through using the indicator of affordability of service (Van den Berg C., Danilenko A. 2011).

2.4.5.3 Water Services Association of Australia (WSAA) benchmarking

WSAA developed the "Aquamark" model as an industry-based framework for asset management process benchmarking as a result of earlier exercises identifying its need. The core purposes were to: Provide meaningful water industry comparisons in asset management practice, and to promote retention of industry learning and intellectual property. Implementation services are encouraged beyond the scope of the benchmarking projects to facilitate implementation and stimulate ownership by the participating utilities in the project outcomes to gain the benefits from their investment (Cabrera E., Dane P., et al. 2011).

2.4.5.4 German benchmarking

The German water industry's benchmarking concept is part of the modernization strategy for the regulatory framework of the German federal government. It was developed and promoted by the water sector itself in consultation with the political partners. Main objectives were: 1) to increase transparency of performance (in terms of reliability, water quality and safety, customer service, sustainability and economic efficiency) and costs in the water supply and wastewater services and 2) to optimize processes and open up potentials for improvement. Figure (13) shows the five-pillar model "Criteria for the assessment of the efficiency of water supply and wastewater disposal (Five-pillar model, DVGW, DWA 2005)".

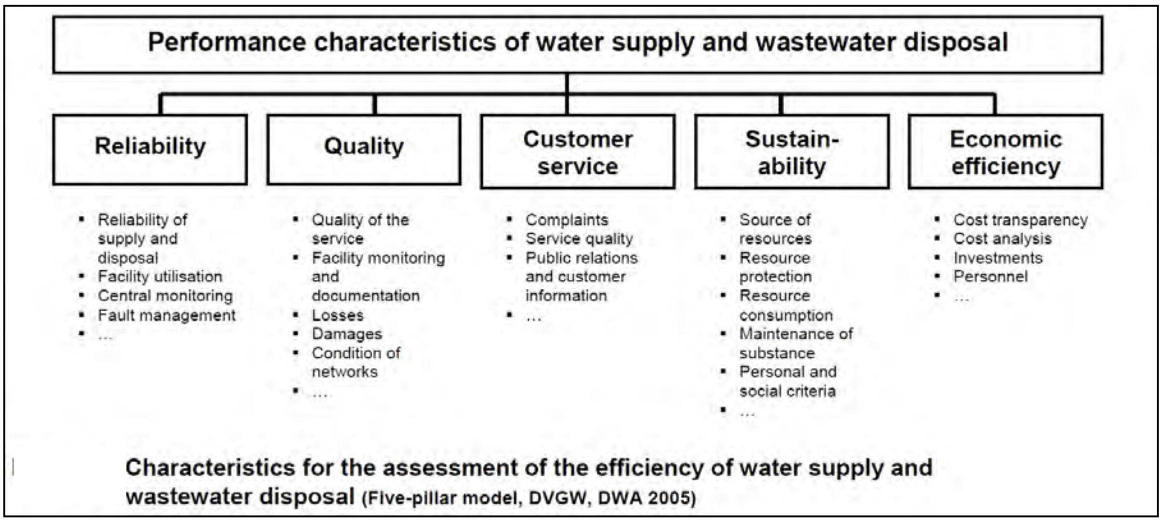


Figure 13: German five-pillar model "Criteria for the assessment of the efficiency of water supply and wastewater disposal"

Source: DVGW, DWA 2005

However, Günthert F.W (2012) sees sustainability not to be presented among the 5 pillars to assess the performance of a water company, but as an overarching goal for the other four main features in order to assess and evaluate performance of water and wastewater companies (Figure 14). The issue of sustainability plays an increasing role in the lifetime of water and wastewater facilities. After many companies pay attention primarily on cost reduction, this is often confused with economic efficiency, which can be featured as infrastructure reinvestment, asset management and preservation, resource protection, etc. In agreement with the above argument; Stemplewski, J., Schulz, A., Schön, J. et al. (2000) states that benchmarking goes beyond the scope of corporate accounting, it combines business and technical principles and know-how then applies these in concrete action plans targeting enhancing efficiency and cutting costs.

According to performance indicators for wastewater manual drafted by IWA operation and maintenance (Matos, R.; Cardoso, A.; Ashley, R.; Duarte, P.; Molinari, A.; Schulz, A., 2003) Sustainability means both the traditional definition (including social-environmental-economic criteria) and the undertaking definition, which is that the service provider remains in business (Foxon et al., 2001).

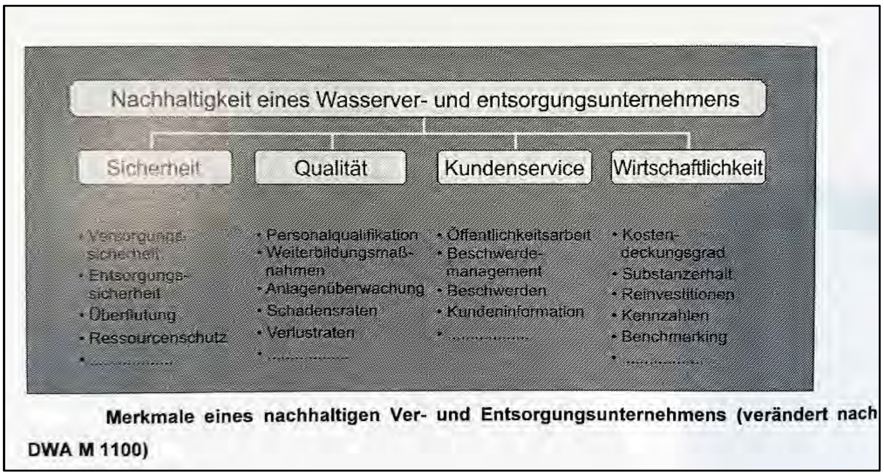


Figure 14: Characteristics of a sustainable water and wastewater utilities, according to Günthert F.W and adapted from DWA M 1100

For the German water industry, the concept of successful benchmarking was based on two prerequisites: voluntary participation and confidentiality of utilities' data and results.

A conceptual framework provided by the leading national water associations maintained a variety of performance assessment initiative offered to the individual utilities (around 6,400 water suppliers and 6,900 wastewater utilities). This framework also included guidelines and manuals on methodology, code of practice and quality management of benchmarking projects. Figure (15) shows the benchmarking framework used in the German water sector.

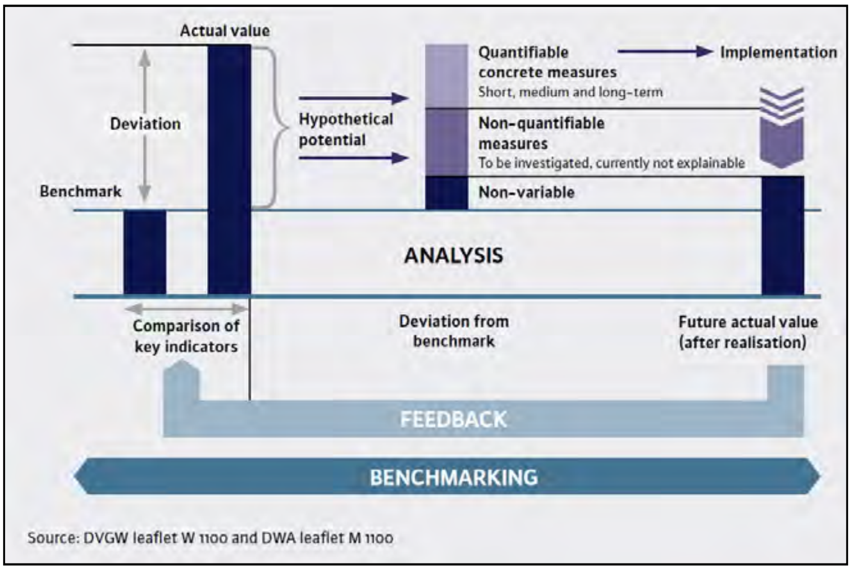


Figure 15: German benchmarking framework for water and wastewater services

Source: DVGW leaflet W1100 and DWA leaflet M1100

For drinking water services in Germany, the IWA performance indicator system for water supply services has been widely applied in nation-wide performance assessment studies on the federal states level. The majority of these projects do not explicitly challenge performance improvement, but significant progress has been made on the scope of individual utilities (Cabrera E., Dane P., et al. 2011).

For performance assessment and benchmarking projects of the wastewater industry, the German Association for Water, Wastewater and Solid Waste (DWA) system of key performance indicators provides as well a common basis for the projects compatible with the international IWA performance indicators system. Similar to water supply, process benchmarking has its dominant role in identifying improvement potentials in wastewater collection and treatment processes, widely accepted by the utilities with significant scope and specialized focus throughout the years. There has been remarkable methodological development and progress in supporting tools and communication of benchmarking results over the last ten years. Web-based data acquisition and quality control tools offer easy access to data and ensure high data quality.

As shortcoming of the existing institutional scheme of performance assessment and benchmarking is that less motivated utilities are still reluctant in joining the initiatives and very likely among others will be significant improvement potential. Starting from late 1990s, the current system of voluntary performance assessment and benchmarking has become under pressure from rigorous debates in price control schemes by the Federal Trade Commissions, along with an intense discussion on regulatory schemes for the German water supply industry (Cabrera E., Dane P., et al. 2011).

2.4.5.5 Dutch benchmarking

The Netherlands have a long tradition on national water statistics and benchmarking. In the 1980's, the association of larger regional water utilities (COCLUWA) started developing a set of comparative performance indicators. In 1991 first comparisons were made, driven by the need of utility managers of better management information. In 1997, the Dutch drinking water sector started a benchmarking program at a national scale. Although voluntary, the program was initiated under the pressure of discussions on liberalization and privatization of public services all over Europe (Cabrera E., Dane P., et al. 2011).
The benchmarking program, coordinated by Vewin, offers a wide view on utilities performance. Water quality, service quality, environmental impacts and finance and efficiency are thoroughly analyzed every three years. The results of these exercises are published on Vewin website and made available to the public and to stakeholders to increase transparency (Cabrera E., Dane P., et al. 2011).
The recently renewed Dutch Drinking Water Act reflects the political decision to keep the drinking water sector public and promote efficiency by introducing mandatory benchmarking. This mandatory program will largely be based on the present voluntary benchmarking scheme, which underlines the value of having a strong sector program (Cabrera E., Dane P., et al. 2011).

2.4.5.6 European benchmarking cooperation

In 2004, the European Benchmarking Cooperation (EBC) was initiated by the Dutch and Scandinavian national water associations and several utilities of the 6-Cities Group (Cabrera E., Dane P., et al. 2011). Objective of this IWA supported initiative is to allow European water utilities to improve their business process by

offering an international benchmarking program and providing a network to exchange knowledge and best practices.
The participants in EBC's benchmarking program can choose themselves at what level of detail they wish to participate: basic, standard or advanced. The advanced level provides utilities with the most detailed insight in their processes and performance. However, reality in Europe is that in most cases water services are provided by rather small scale utilities which are not always able to provide detailed performance information. By the offering different benchmarking levels (Basic, Standard and Advanced) EBC especially encourages smaller utilities to join the network, learn and benefit from it and move forward.
Data is collected via the program website www.waterbenchmark.org. After reporting, participants are invited for a workshop to discuss assessment results, lean from best practices and prepare for improvement actions. Since 2007, EBC annually organizes international benchmarking exercises. Started as North European initiative, the program has developed into a European program covering today some 45 water utilities from 21 different countries (of which 3 outside Europe) representing some 55 million inhabitants.

Since the early 1990s, benchmarking has been in constant evolution in the water sector. Most of the early efforts consisted in the comparison of metric figures, but they later evolved into more complex schemes seeking the improvement of performance. Table (14) below shows an overview for benchmarking projects/efforts in the water industry at different countries of the world.

This inventory list is helpful in identifying the most relevant experience which can be further investigated to base useful model to build on the Jordanian benchmarking framework with most relevant conditions. Logically, if we apply simple filter selecting only the national benchmarking projects. We get 7 results from (USA, Canada, Denmark, Austria (water and wastewater programs), Netherlands and Germany). And then if we wanted to narrow the selection of IWA manual based program, we get only 2 programs (Water Supply benchmarking from Austria and the German program). However, the Austrian program is only for water supply and level of details is on function and process levels. While the German program offers all expertise on water supply and wastewater, level of details is spread on utility, function and process levels. In addition, it is based on IWA manual and standards which makes it compatible with other international projects and measurements. Based on above, this research will study the application of IWA/German program as an example of a national benchmarking program covering all details of investigation for water services in Jordan.

Table 14: Overview of some benchmarking efforts in the water industry

Program Name	Country	Program type	Level of detail	Type of activity	Geographical Scope	IWA manuals based
6- Cities Group of Scandinavia	Scandinavia	BM	U, F & P	WS & WW	R	No
DANAVA	Denmark	BM	U &F	WS	N	No
European Benchmarking Cooperation	Europe	BM	U, F & P	WS & WW	R & I	Yes
Germany	Germany	BM	U, F & P	WS & WW	N	Yes
NWWBI	Canada	BM	U, F & P	WS & WW	N	No
OEWAV	Austria	BM	U & F	WW	N	No
OVGW	Austria	BM	U & P	WS	N	Yes
QualServe	USA	BM	U	WS & WW	N	No
SEAWUN	South-East Asia	BM	U	WS	R	No
Vewin	Netherlands	BM	U, F & P	WS	N	No
WSAA	Australia	BM	F & P	WS	R & I	No
ADERASA	Latin America	PA	U	WS & WW	R	No
FIWA	Finland	PA	U	WS & WW	N	No
IBNET	World Bank	PA	U	WS & WW	I	No
Norsk Vann	Norway	PA	U	WS & WW	N	No
OFWAT	England a Wales	PA	U & F	WS & WW	N	No
Svensk Vatten	Sweden	PA	U	WS & WW	N	No
PA**: Performance Assessment**; BM: **Benchmarking (Performance Assessment & Improvement)**, U: **Utility level**, F: **Functions level (core processes),** P: **Process level**, WS**: Water Supply**, WW: **Wastewater,** N: **National,** R**: Regional**, I: **International**						

Source: Benchmarking Water Services: Guiding water utilities to excellence. IWA Publishing, 2011

2.5 Benchmarking efforts in Jordan

2.5.1 Performance Assessment and Monitoring

The Performance Monitoring Unit (PMU) under the umbrella of the Ministry of Water and Irrigation in Jordan is responsible for monitoring and evaluation of the performance of the water utilities, promotion of private sector participation (PSP) in water services and management, development of public-private partnerships (PPP), planning and providing strategic advisory to decision makers, application of commercial principles on the water sector.
The Monitoring and Auditing Methodology which PMU is currently applying is the “Regulation by Contract” approach on already established public companies (Miyahuna and Aqaba Water). Based on the Assignment Agreement, PMU developed and signed with WAJ to monitor water companies, a Monitoring Protocol (MP) that governs its quantitative and qualitative performance monitoring activities. For monitoring water utilities performance PMU use: quantitative performance indicators and qualitative monitoring approaches for performance assessment.

Within the monitoring protocol, the scope of the PMU regulatory functions is divided into: 1- Recurring activities: monitoring, evaluation & inspection. 2- Occasional activities: review of performance indicators. 3- Agreeing on targets of business plans. The current monitoring protocol subdivides the requirements into three groups: corporate requirements, service delivery, and customer affairs. PMU reports on the companies’ performance according to a set of performance indicators quarterly and annually and reports on all the other MP requirements annually. It worth mentioning that there is no enforcement authority in these processes, neither fines nor incentives.

With regards to PMU performance indicators system establishment and development; it is building upon international experiences; PMU PI’s monitoring set and manual were built based on IWA Indicators. A set of IWA indicators were chosen and customized to suite the Jordanian utilities circumstances. Afterwards, data collection and calculation methodologies were developed. As a result, for the ongoing regulatory review, and the ongoing review of wastewater PIs, referring to monitored utilities comments, and lessons learned, limitations of data availability; changing priorities and discussions with PMU staff led to issuing additional two versions of the PI’s. The latest manual (Performance Indicators for Water & Wastewater Services, Version 07, December 2009) includes 3 levels of indicators:

- Level 1 Regulatory Performance Indicators (KPI's), (11)
- Level 2 Performance Indicators, (21)
- Level 3 Performance Indicators, (12)

Figure (16) below shows the development stages for PMU PI’s, Figure (17) shows the thematic groups selected for PMU PIs.

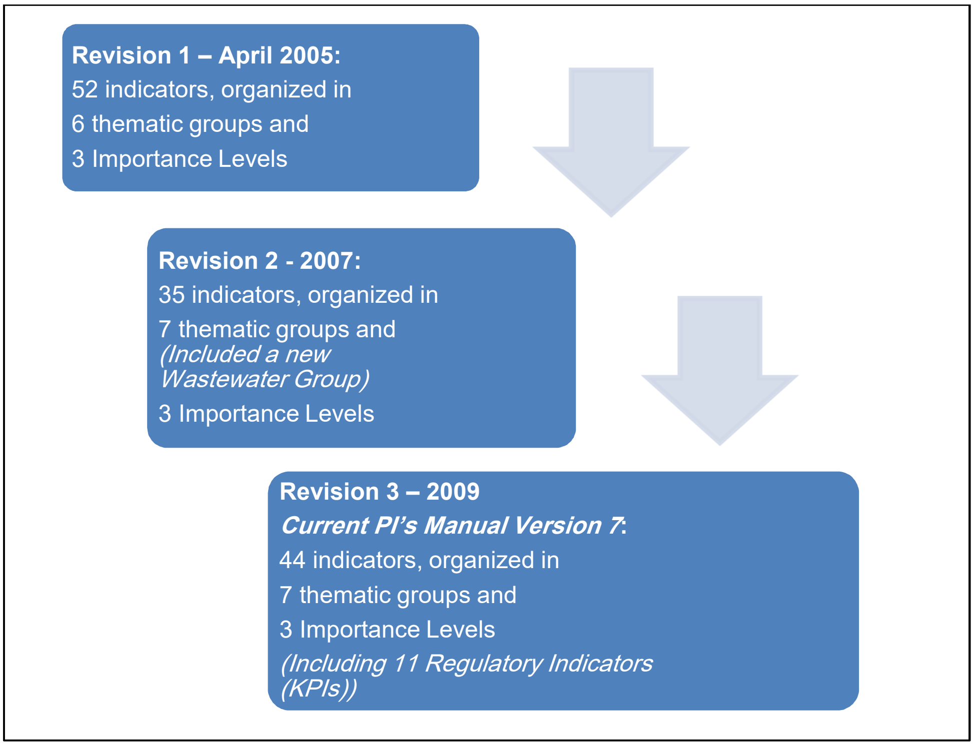


Figure 16: Development stages for Jordan-PMU Performance Indicators

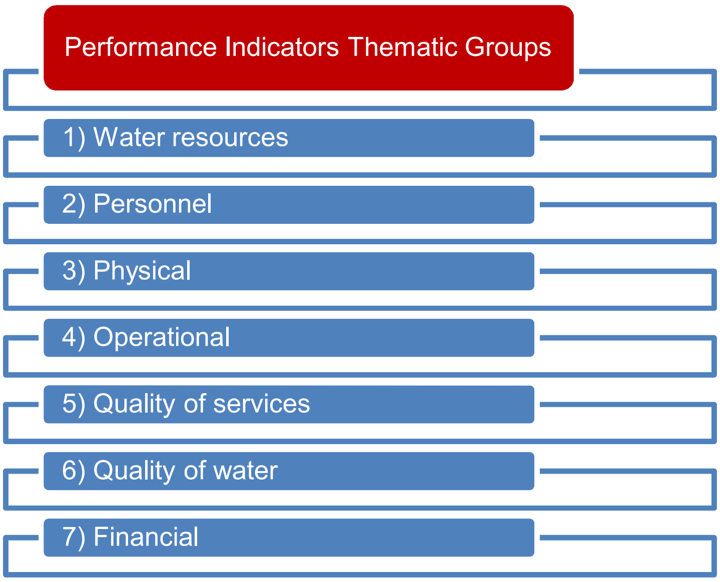


Figure 17: Jordan-PMU Performance Indicators thematic groups

The following table number (15) lists the recent PI as published in the manual V07, December 2009. Table number (16) on the other hand lists the variables used in calculating those indicators.

Table 15: List of Performance Indicators which are used by PMU-Jordan

Performance Indicators to monitor and evaluate the performance of utilities in Jordan	
Water Resources Category	**1.** WR01 - Efficient use of water resources **2.** WRc01 – Water resource requirement per capita / system input per capita **3.** WRc02 – Water consumption per capita
Personnel Category	**4.** PE01 – Employees per water service connection **5.** PEc01 – Total employees per 1000 water subscribers **6.** Pe16 – Training per employee
Physical Properties Category	**7.** Phc02 – Average energy consumption per cubic meter pumped
Operational Aspects Category	**8.** Op08 – Subscriber meter replacement **9.** Opc02 – Water losses per km of network **10.** Opc08 – Speed of repair of bursts **11.** Op22 – Water losses per connection **12.** Op26 – Network repair rate **13.** Op27 – Service connection repair rate **14.** Op32 – Water quality tests performed
Quality of Services Category	**15.** QS03 – Population coverage **16.** QS10 – Continuity of supply (Supply Index) **17.** QSc01 – Customer receiving continuous supply **18.** QS15 – Quality of supplied water **19.** QS17 - Microbiological water quality compliance **20.** QS18 – Physical – Chemical water quality compliance **21.** QS20 – New connection efficiency **22.** QS22 – Non-Billing complaints (Service complaints) **23.** QS25 – Water Quality complaints **24.** QS27 – Billing complaints
Financial Matters Category	**25.** Fic01 – Collection ratio **26.** Fic02 – Doorstep billing coverage **27.** Fic03 – Operating cost coverage ratio (water and wastewater) **28.** Fic06 – Unit revenue **29.** Fi07 - Energy costs ratio **30.** Fic07 – Unit total cost **31.** Fic08 – Unit running cost per billed water **32.** Fic08a – Unit running cost per system input **33.** Fic09 – Debtors ratio **34.** Fic11 - Operating cost coverage ratio /water and sewerage (Total Revenue) **35.** Fic12 - Total cost recovery **36.** Fi36 – Non-revenue water by volume
Wastewater Category	**37.** WEnc1 – Wastewater treatment plant discharge compliance **38.** WQS1 – Resident population connected to the sewer system **39.** WQc01 - Wastewater application response times **40.** WQc02 – Speed of response to sewer blockages **41.** Wop34 – Sewer Blockages **42.** Wop37– Flooding to properties from sanitary sewers

Performance Indicators to monitor and evaluate the performance of utilities in Jordan	
	43. Wop44 – Wastewater effluent tests carried out.
Water Demand Component	**44.** WRc03 – Water saving from water demand management initiatives

Source: Performance Indicators manual PMU, 2009

Table 16: List of variables used for calculating the PI of PMU-Jordan

List of Variables of the Jordan PMU-PI system	
Variables related to the IWA water balance	A07 - Water produced A08 - Imported treated water A09 - Exported treated water A15 - Billed authorized consumption A18 - Unbilled authorized consumption N23 – Estimated proportion of NRW attribute to real losses
Personnel variables	B23 - Total training time N02 – Number of Employees (sewerage and water reclaimed) N24 - Total number of all staff engaged in the utilities/ companies N49 – Training time for senior management staff N50 – Training time (excluding senior management)
Physical variables	C06 - Length of Water network C32 - Water service connections WC1 – Total sewer length
Operational Variables	D25 - Network failures D26 - Water service connection failures D29 - Number of hours per week that the system is pressurized. D40 - Meter replacement N04 - Energy consumed in pumping N13 – Number of Bursts repaired in target time. N35 – Number of days in the applicable quarter N47 – Number of effluent quality tests carried out in the period. N48 – Number of compliant effluent quality tests WD46 - Wastewater effluent tests (actual) WD57 - Wastewater effluent tests (required) D41 – Water quality tests performed D43 –Microbiological water quality tests performed D44 –Physical-Chemical water quality tests performed D46 – Water quality tests required D52 – Compliance of microbiological tests D53 – Compliance of physical-chemical tests WD38 – Sewers blockages WD41 – Flooding from sanitary sewers
Demography and customer-related variables	E05 – Resident population E06 – Subscribers Meters E10 – Registered Subscribers WE1 – Resident population, expressed in inhabitants

List of Variables of the Jordan PMU-PI system	
	WE4 – Resident population connected to sewer network
Quality of Services Variables	F01 – Population supplied F07 – New connections within target time F08 – New connections requested F11 – Service complaints F14 – Water quality complaints F16 – Billing complaints only N10 – Active subscribers N14 – Customers receiving continuous supply N51 – Number of late responses to wastewater applications N52 – Number of wastewater applications N53 – Number of compliant effluent quality tests N54 – Actual water savings achieved N55 – Complaints of “No Water Supply” N56 – Other Service Complaints (excluding “No Water”) N57 – Waste Water effluent N58 – Active subscribers for Re-claimed water
Financial Variables	G08 – Energy cost N01 – Domestic billed volume N18 – Cash collected N19 – Doorstep billing N20 – Water and sewerage revenues N21 – Water and sewerage operating costs N28 – Amount billed in period N41 – Base year inflation index value; Consumer Price Index (nonfood items) Index N42 – Inflation index value (current year); CPI (nonfood items) index N43 – Total water and sewerage costs N44 – Accounts receivable N59 – Billed wastewater (reclaimed) N60 – Total Revenue of water and sewerage
Time Data Variables	WH1- Assessment period

Source: Performance Indicators manual PMU, 2009

In March 2005: WAJ/PMU made the decision to proceed with the implementation of the proposed PI system. The pilot areas that were selected were: Amman (Lema Management Contract), Aqaba Water Company, Tafila Water Administration, Balqa Water Administration.

2.5.2 PMU PI’s Initiative Implementation

Performance assessment process started by formulating a team responsible on monitoring and evaluation (M&E) function at PMU, then in-house development of an Oracle PIs application (Data Base) was initiated in 2006, followed by collection of variable values from utilities, associated with preparation of GIS based schematic layouts for AWC and Balqa water administration (those schematics were necessary for understanding and calculating many of the technical PIs).

Afterwards, the step of verification and analysis for data collected from utilities was implemented. Calculating and finalization of the performance indicators, followed by designing and producing draft monitoring reports that include findings and recommendations, this report is reviewed and discussed with the concerned management in order to produce final monitoring report. Those are the summary steps for performance assessment process is taking place at PMU in MWI.

PMU faced some challenges in implementation of the Performance Indicators system; those were mainly reported on data collection challenges, the development of the PI application (DB development) and the confidence level. Data collection challenges exists in all governorates (Karak, Tafila, Ma'an and others) because there are no computerized systems running in those water administrations. The mitigation measure to deal with this challenge was through selecting representative officers within each area, then holding awareness sessions and representatives training on PIs concepts. This enabled PMU eventually to agree on the set of collected variables and collection frequency with the representatives and their management based on each utility conditions.

With regards to the confidence level issue, it was addressed by emphasizing on the importance of data quality and assessing confidence grades for PIs and apply IWA confidence grading system that describes the reliability (From established information reporting system, supported by good quality assurance procedures and good audit trails) and accuracy of the PI.

PMU currently produces quarterly and annual monitoring reports for Miyahuna and AW Company and shall start the process of monitoring Al-Yarmouk Water Company in Northern Jordan. PMU is also supposed to roll out its monitoring activities all over Jordan including JVA (Jordan Valley Authority) activities. Basically, it shows here that no complete benchmarking activities/exercise is taking place, PMU is monitoring the performance of water utilities and comparing KPIs for each utility and by itself, but never compared in peer groups.

After investigating the benchmarking status in Jordan, it can be clearly stated that only performance assessment practices have been applied through the work done by PMU. The complete application for benchmarking definition through performance assessment and performance improvement steps is not applied in the Jordanian water sector yet. Therefore, this study will investigate the possibility of applying benchmarking exercise in Jordan as a tool to improve performance of water utilities in Jordan.

3. Research Objectives and Plan

3.1 Problem and research aims

Several difficult problems currently confront the Jordanian water sector. The most fundamental of these is the very limited quantity of renewable water resources available to the Kingdom. In addition to that, being a country with one of the highest population growth rates which has been further aggravated periodically by a high influx of refugees from surrounding military conflicts, this also increased the stress over limited available resources. Retaining the coverage of the services or even expanding it carries the burden of ever higher cost and narrowing the gap between demand and availability of resources, not forget to mention water loss issues and high NRW rates which is affecting the quality of service delivery and utilities financial sustainability. These problems also emerge, in financial terms, as a large and burdensome annual draw against the national treasury as subsidies are provided by the Government of Jordan in order to maintain low tariff rates (USAID-ISSP, 2011).

These macro challenges reflect in return as obstacles and hurdles facing water and wastewater utilities and affect their performance at technical, operational, administrative and social responsibility levels. The levels of NRW, cost recovery rates and the financial status of water utilities are not really promising towards having sustainable utilities and high quality service. Thus, the Jordanian water sector is going under reform process in order to bring rational and effective institutional structure from which coherent management solutions can be launched and sustained. According to the USAID-Institutional Support and Strengthening Program (USAID-ISSP) published in October 2011; one of the reform recommendations was to complete the corporatization of existing water utilities, and establish new ones to cover all communities in Jordan. Corporatization of the major water utilities will enable them to achieve the full potential efficiency benefits of a private sector performance ethic, leading to improved service delivery. Furthermore, the institutional assessment study done by the same program also recommended establishing an independent Water Utility Regulatory Commission (WURC) to oversee the financial and technical performance of the fully-corporatized water utilities. This will provide the firm autonomous oversight of the utilities required to drive improvements in financial efficiency and service delivery, identify tariff and off-setting subsidy levels and protect the interests of Government.

Currently PMU or the future WURC will be responsible on monitoring/assessing the performance of corporatized utilities and driving improvements in financial efficiency and service delivery. The current approach of monitoring performance of the two utilities (Miyahuna and Aqaba Water) is not sufficient and do not lead towards performance improvement. The threat over limited water resources require special attention and protection, protection of water resources can be secured through effective utility management systems. Therefore, and considering the current situation of the water sector and the urgent need for performance improvement and optimization, in addition, to the future setup of having autonomous corporatized utilities. All this would require an innovative management tool for performance improvement; through systematic search and adaptation of leading practices "Benchmarking".

Although benchmarking is an approved approach and widely practiced method to improve performance in the existing international water industry since the 1990s, however, it is relatively new approach for the Jordanian water utilities. The complete definition of water and wastewater services benchmarking do not exist in Jordan; thus, this research will be the first attempt towards developing and testing "best-fit or custom-made" benchmarking system; taking in consideration the technical, cultural, structural and political setup of Jordanian water utilities, and testing the hypothesis of implementing benchmarking exercise for the first time in Jordan, and compare it to successfully proved benchmarking initiatives in the international water sector.

3.2 Research objectives

In order to meet the purpose of this study, the following objectives have been set:

- Review the current practices for performance assessment and performance improvement in water utilities in Jordan.
- Investigate the reasons why benchmarking is not applied in the Jordanian water sector.
- Introduce benchmarking for water utilities as a management tool towards performance improvement and optimization.
- Assess the performance for water utilities in Jordan and identify improvement gaps.
- Develop and test (custom made) benchmarking framework for water utilities in Jordan.

To achieve the objectives set above; the following approach was applied:

- Desk research and review of current and previous studies and reports related to the performance of the Jordanian water sector
- Develop questionnaire and semi-structured interviews with utility managers and directors of performance monitoring units
- Implement benchmarking exercise in cooperation with the PMU and sample water utilities, based on benchmarking good practices
- Utilize online data collections tools to collect variables and calculate performance indicators from the participating utilities.
- Conduct group workshops and meetings with sample utilities and review data forms and structures
- Conduct performance assessment and performance improvement workshops with the participating utilities

3.3 Research plan

In this research, the following steps have been done:

- Literature review about Jordanian water sector framework and performance assessment status quo in the water sector
- Identification of different benchmarking approaches (systems)
- Benchmarking system design and pilot application
    - Conduct semi-structured interviews
    - Formulate benchmarking task force (focal points)
    - Develop utility data questionnaire and data collection
    - Conduct workshops
    - Data analysis and evaluation of results
- Presentation of the new benchmarking framework

3.4 Structure of the thesis

This study comprises of six chapters and three main parts (A, B, and C) as shown in figure (18). The first part which includes background information about Jordan and its water resources, the status of water supply and sanitation in Jordan in the light of MDG's. In addition, detailed review over the water sector framework and challenges facing the sector, with an investigation over benchmarking history and concept and related studies about ongoing benchmarking approaches for water and sanitation services. The second chapter includes an investigation about current performance assessment in Jordan which justify the research methodology and objectives for introducing benchmarking concept into the Jordanian water sector.

The second part of the study comprises of two chapters. The research objectives, stating also research problem and research aims, research plan in addition to the limitations and obstacles faced the research project. Moreover, the second part includes the methodology of research with details on benchmarking project implementation and presentation of the final outcome of benchmarking framework for Jordan.

The third part of the study will include discussion and conclusions drew from the applied methodology, also discussing the results and drafting study recommendations. The diagram below illustrates the structure of the thesis.

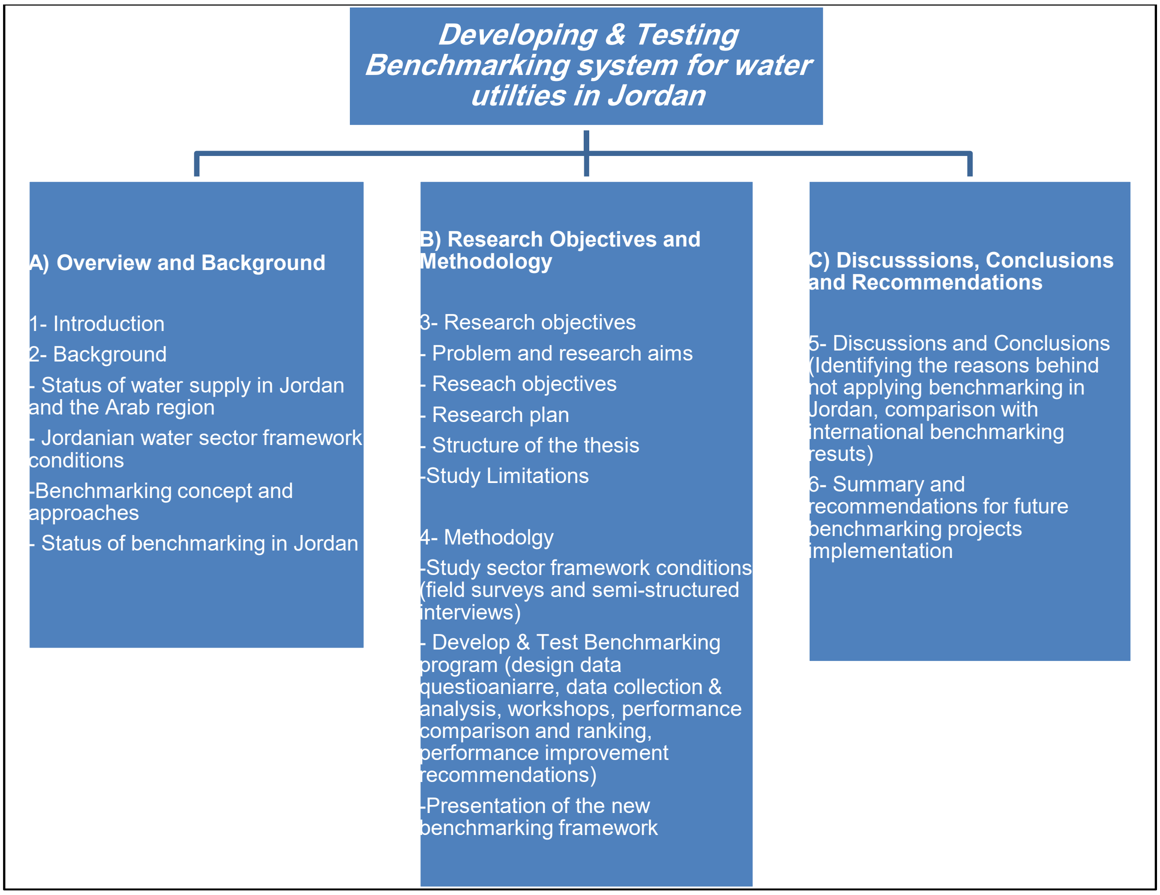


Figure 18: Thesis structure, parts and chapters

3.5 Research limitations

Benchmarking in general is a very time consuming process and face many challenges. The main challenges were moving around data issues, below are the key obstacles and challenges faced during program implementation:

- Data availability/reliability and difficulties in data collection from different sources: this issue was noticed at WAJ utilities and not at commercialized utilities. Most of WAJ public utilities are focusing on daily operation and maintenance tasks and do not give attention for data management. The mitigation was done through seeking missing data from WAJ central departments via official correspondence, as each utility reports to WAJ on estimated performance figures. Collected performance data were cross checked with PMU staff who are experienced with the water sector and rationality of submitted figures.
- Lack of database documentation at water utilities, which reflect on having different source and values for the same question of data. This point relates to the previously mentioned issue which focus on data availability and reliability. Utilities which suffer from improper data management do lack the tools and infrastructure to enable them report periodically on specific performance values. The introduction of GIS systems, CIS and CMMS systems, asset management registry, bulk water metering, SCADA systems and others are very crucial in order to enable utility on logging and retrieving data electronically and on timely manner.
- Lack of knowledge and awareness about benchmarking concept and process among overall water utility staff. During project timeframe, the researcher held training sessions and introduction sessions about benchmarking concept and process. For the next benchmarking cycles, similar training sessions are required to be implemented on local utility level in order to have top management and staff are aware and supportive of benchmarking applications.
- Changing of task force members and program coordinator at PMU during the planning stage affected timely performance and delayed program cycle. The redundancy of contact persons'/task force members was the major point of delaying the process, unfortunately, this issue is out of control and related to governance matters within the water sector.
- Data collection tool; problems in log-in access and plausibility check data validation were very strict for some data not available at some utilities. Because benchmarking research engaged all water utilities, it was unavoidable not to use the same online questionnaire for all utilities, this did not allow plausibility checks function properly in some cases. Consequently, the researcher was working closely with task force members in order to guide them on (out of range) values or non-valid figures. The researcher and project teams also communicated closely with task force members through, field visits, telephone and emails on daily basis to ensure correct data is being submitted for this study.

4. Methodology

The main objective of this chapter is to present research methodology. The methodology starts by literature review and defining research objectives, and then it moves to describe research structure. The chapter finally describes the approach, techniques and tools used in the benchmarking exercise as the main method used in this research.

4.1 Research Work Plan

The research is formed of three main steps (Figure 19). It starts with desk research and review about Jordan's water sector in general and the studied problem. This is followed by thorough literature review that covers water sector framework conditions and challenges facing water utilities and affects service provision performance (i.e. Non-revenue water, energy efficiency, cost recovery, asset management, etc.) in addition to literature review about benchmarking concept for water utilities and different international benchmarking programs related to problem under investigation.

Building on the previous experiences of benchmarking initiatives; research objectives and plan are set and designed, then reflected in a detailed methodology over three main steps to test benchmarking in Jordan: planning and preparation stage mainly by survey design and semi-structured interviews to understand water sector conditions, performance assessment stage for Jordan water utilities following international best practices of IWA and the German benchmarking approach, followed by performance improvement plans for water utilities in Jordan. Then, a discussion about analyzed data is conducted in comparison with international benchmarking data for similar KPIs. The discussion is followed by a set of conclusion, recommendation and suggestions for future benchmarking program implementation.

This research study is supported by (The Reliable Quality Water for Jordan Project); grant agreement funded and administered by the European Bank for Reconstruction & Development (EBRD) offered to the Water Authority of Jordan (WAJ) which aims towards building sustainable technical capacity for reliable quality water for WAJ through a set of bundle projects related to: establishing a unit of excellence to monitor overall water quality, improving regulatory framework and standards of industrial wastewater discharge into domestic sewage networks, develop twinning program between water utilities in Jordan and regional/international water utilities, and conducting a pilot benchmarking exercise for Jordan water utilities. The Arab Countries Water Utilities Association (ACWUA) was contracted to deliver the benchmarking exercise, depending on its previous regional experience in capacity building and technical assistance for its wide network of water and wastewater utilities in the Arab region. Official letters from WAJ and EBRD supporting this PhD thesis are attached in annex (1), by which accepted the proposed research methodology and provided political support facilitating smooth communication and cooperation with water utilities to participate in the benchmarking exercise and research implementation

.

Research activities	*Year 1*				*Year 2*				*Year 3*				*Year 4*			
	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4
A. Study Jordan's water sector framework conditions (Literature Review)																
Study the legal, policy, economic and technical framework conditions	■															
Identify challenges for water sector and study benchmarking status quo in Jordan		■														
Semi-structured interviews and utility survey			■													
Surveys and interviews analysis				■												
B. Develop and test Benchmarking system for Jordan water utilities																
B.1 Preparation and Planning stage																
Identify the roles, duties of the BM task force					■											
Identify the representation of the task force from different utilities						■										
Kick-off meeting with the national BM task force						■										
Draft a framework for Benchmarking (scope (BM level/ only W or W&WW), methodology, definitions, code of conduct, basic or advance model, participating utilities, KPIs) (series of workshops)						■										
B.2 Performance Assessment stage																
Set up Jordan BM online software							■									
Set up data questionnaire							■									
Training on questionnaire software (workshop) for utilities							■									
Data acquisition from participating utilities							■	■								
Plausibility Check (Data Validation)									■							
Data analysis										■						
Draft utility individual reports & prepare workshop report (consortium/individual)											■					
Performance assessment workshop											■					
B.3 Performance improvement stage																
Performance improvement workshop											■					

Research activities	*Year 1*				*Year 2*				*Year 3*				*Year 4*			
	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4
Draft consortium/individual utility report (assessment & improvement plans)												■				
C. Concluding remarks about Jordan benchmarking system																
Compare Jordan benchmarking results internationally													■			
Extract challenges and obstacles for benchmarking implementation														■		
Identify opportunities and recommendations														■		
D. Thesis writing																
First Draft															■	
Second Draft																■

Figure 19: Research Work Plan

4.2 Study water sector operations framework conditions

This section will give a closer look about general operating conditions in water utilities in Jordan and investigate about the status of current performance monitoring, performance assessment and benchmarking issues -in particular- for water utilities in Jordan. Since benchmarking is relatively a new approach used for improving the performance of water utilities in general, and had never been tested or implemented within Jordan water sector before; a list of investigatory questions put into survey form, which has been developed and used for guidance through meetings and interviews conducted with top management and related staff from water utilities. Surveys and meetings outcomes were then collected and analyzed to understand sector preparedness and willingness to implement benchmarking as a tool for performance improvement.

4.2.1 Design utility questionnaire

In order to get an understanding of current status of performance assessment protocols and water services benchmarking practices in Jordan; field questionnaire was designed to support in information gathering during semi-structured in interviews. The questionnaire covered many topics related to overall utility organization and data availability, resources related questions and benchmarking implementation related questions:

- Ownership and management structures for each water utility, data records availability and annual reporting at the water utility, what are the main challenges affecting utility performance and other factors achieving sustainability.
- The questionnaire also investigated whether water utility had Internal KPIs used to measure its performance, engagement of ongoing benchmarking projects, motivation to participate in benchmarking projects.
- Costs and staff related questions; what are the costs/resources used while participation in benchmarking projects, how to motivate utility staff to participate in benchmarking projects
- Implementation related questions; obstacles may be faced when implementing performance assessment/benchmarking project, and what are lessons learned to avoid mistakes in next performance monitoring project, examples of performance improvement measure taken as recommendation of Benchmarking projects, why benchmarking for water services is not applied in Jordan.

The questionnaire was shared with the PMU for comments and modification. PMU advised that the complete benchmarking concept has never been applied in Jordan, therefore, all questions related to benchmarking implementation were replaced by performance assessment and monitoring implemented by PMU on commercialized water utilities in Jordan. Complete questionnaire form (in Arabic and English) including 15 detailed questions covering the above issues is included in Annex (3)

4.2.2 Conduct semi-structured interviews

The study was conducted on all water utilities in Jordan. There are nine water utilities delivering water supply services in all governorates:

1. Jordan Water Company (Miyahuna)

2. Aqaba Water Company
3. Yarmouk Water Company
4. Madaba Water Administration- (Management Contract by Miyahuna)
5. Zarqa Water Administration- (recently reformed into Management Contract by Miyahuna)
6. Balqa Water Administration-subsidiary of WAJ
7. Karak Water Administration- subsidiary of WAJ
8. Tafila Water Administration- subsidiary of WAJ
9. Ma'an Water Administration- subsidiary of WAJ

Figure (20) below shows population distribution at each utility service area. Bulk population areas are mainly within Miyahuna, Yarmouk Water and Zarqa Water which all combined forms more than 80% of Jordan's population.

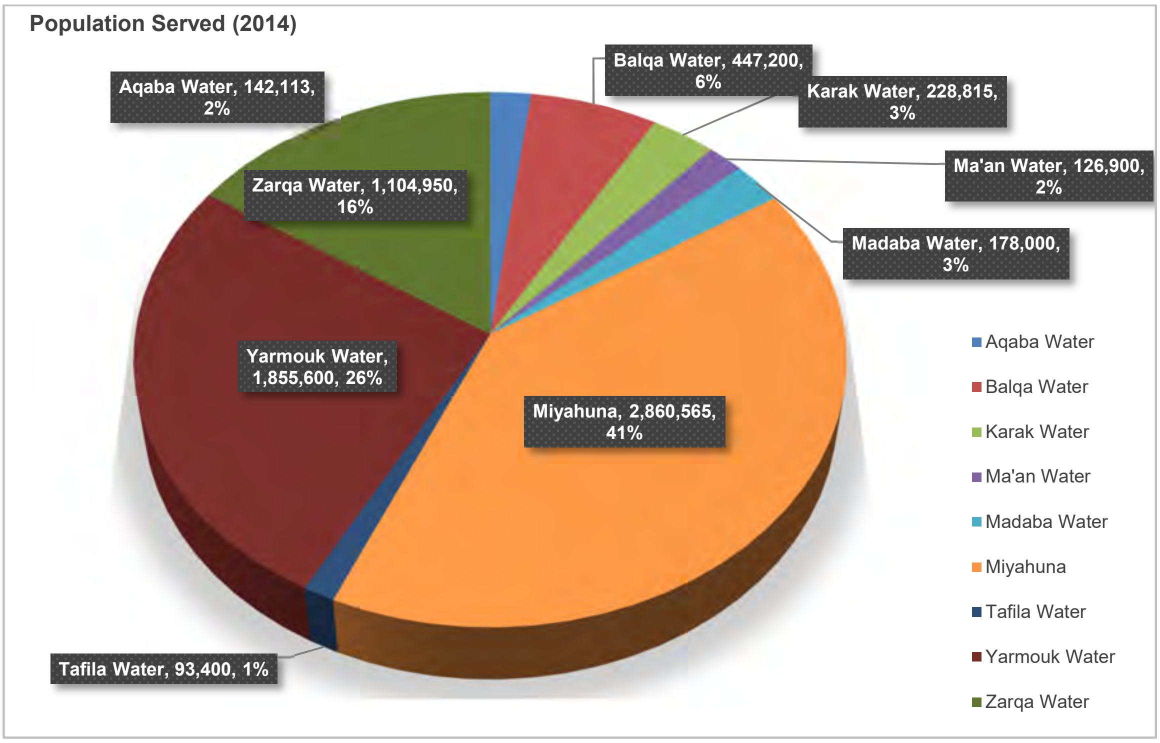


Figure 20: Population distribution for each utility service area

Adapted from Jordan Department of Statistics (DOS) 2014

Individual utility field visits were scheduled to conduct semi-structured interviews with the utility managers and personnel related to performance monitoring efforts practiced at water utilities, and reporting KPIs records to PMU. All interviews were audio recorded, then it was summarized and analyzed in the following section (4.2.3) Questionnaire analysis.

4.2.3 Questionnaire analysis

Under this section, is the analysis of existing performance assessment mechanism lead by PMU, then followed by summary of findings/feedback compiled from the nine utilities.

Existing performance assessment mechanism

Currently, PMU with its assigned role and capacity oversees projects with private sector participation and also regulates performance of the water companies; Miyahuna, Aqaba and Yarmouk. Both Aqaba water Company and Miyahuna Water Company have been reporting variables to PMU since 2004 and receiving a quarterly monitoring report which includes an assessment on a number of KPIs, since they are used to gauge the utility adherence to the strategic goals of MWI for improved and sustainable water services, and as well as the utility itself which gives an overview of the standing of the utility (ACWUA 2015).

The report also assesses the performance by applying the agreed upon PIs adapted by the PMU in accordance with the Assignment Agreement signed between WAJ and the Company. The report begins by providing summary and recommendations to the companies. It then goes over each indicator with definition, significance, analysis, and long term analysis. The analysis is represented in a figure including previous years' indicator and is compared, whether it has increased/decreased/ or in compliance with international standards. The analysis also provides the possible reason for change. As for the long-term assessment, it simply states description of the figures and changes that has occurred over the quarterly year. However, following the monitoring report, there is no performance comparison with other utilities nor actions taken either from PMU nor the utility. Figure (21) below shows the current status of KPIs reporting between water utilities and PMU.

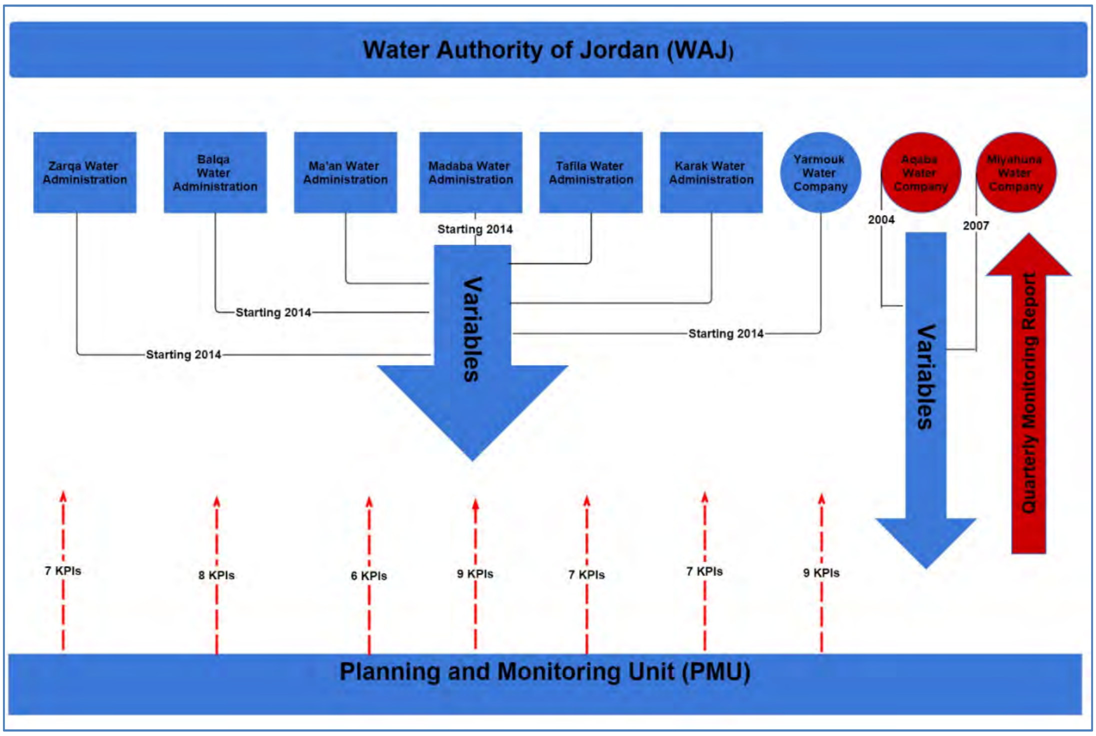


Figure 21: Current Status of KPIs monitoring system between PMU and water Utilities

As for the remaining utilities, some have recently started to report variables to PMU starting 2014 (Balqa, Madaba, Yarmouk, and Zarqa), but no reports have yet been published. Some utilities yet don't have the ability/resources to report those variables including: Karak, Ma'an and Tafila.

The following sections include summarized analysis for main points addressed during utilities interviews:

Ownership Structure

Most water utilities in Jordan are owned by The Water Authority of Jordan, these are; Balqa Water Administration, Tafileh Water Administration, Ma'an Water Administration, Zarqa Water Administration, Karak Water Administration, as well as Yarmouk Water Company. Yarmouk Water Company is a limited liability company owned by the government (WAJ) and serves four northern governorates; Irbid, Mafraq, Ajloun, and Jerash. As for Amman governorate, it is served by Miyahuna Water Company which is a private company owned by the government. Madaba Water Administration is now managed through a Management contract with Miyahuna that took place in early 2014, Miyahuna works as an operator for Madaba Water Administration. The other limited liability company is Aqaba Water Company which is owned by 15% shares to the company and the remaining 85% shares by WAJ. Figure (22) shows the water sector structure showing commercialized water utilities and WAJ water administrations. The ownership structure was one of the main aspects to be looked at when clustering the participating utilities in the benchmarking exercise.

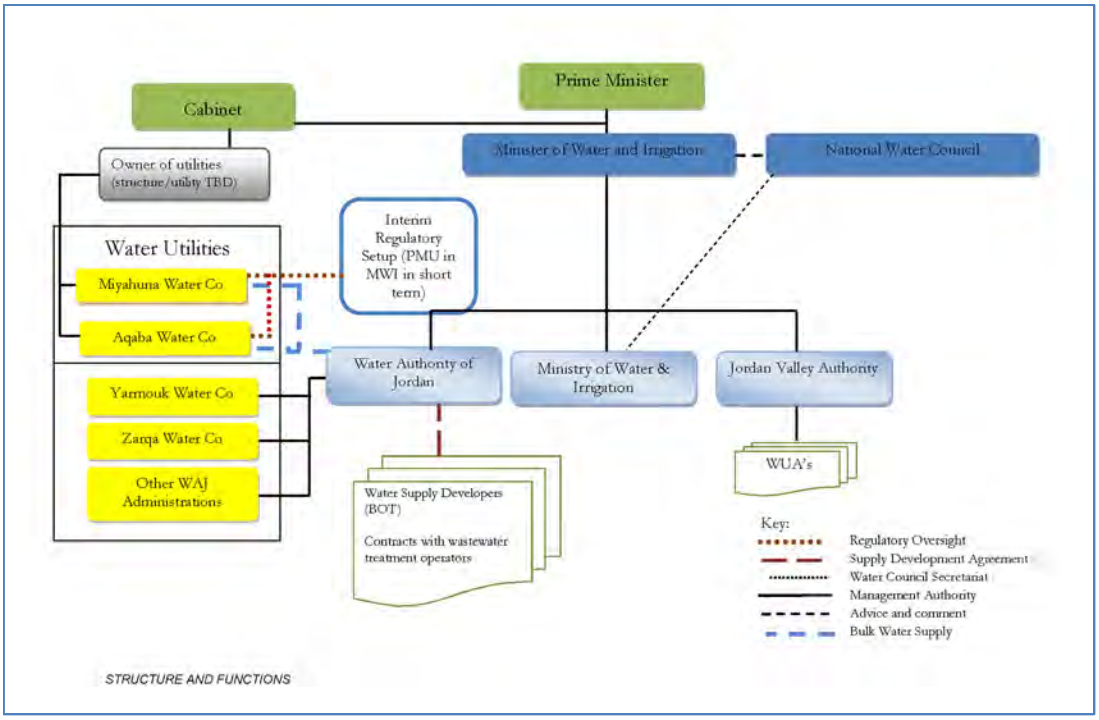


Figure 22: Jordan water sector current structure

Source: USAID-ISSP program, 2011

Management/Organizational Structure

The management or organizational structure describes functions, tasks, flow of communication and authorities between multiple teams or departments in a single organization. The organizational structure helps organization to focus on its strategy and goals, it helps in business planning through distribution of resources, decision making and setting training plans. Therefore, sample utilities were checked for organizational structure availability in order to know whether there is a department that are responsible for collecting and reporting KPIs. None of the inspected utilities has a special unit or department for benchmarking or performance monitoring; however, most of utilities manage to provide variables data through the IT department in coordination with the technical departments. Except the case in Miyahuna; Business Planning department is responsible on performance monitoring programs. The following utilities were able to provide the management structure; Miyahuna, Aqaba, Balqa, Madaba, Ma'an, Tafileh. However, the remaining utilities are not able to provide the management structure for their operating units; Yarmouk Water Company, Karak, Zarqa. Organizational structure was also one of the aspects to be looked at when clustering the participating utilities in the benchmarking exercise according to its management approach and operations dynamics.

Annual Report

Annual reporting is a documentation and information sharing about company's previous year achievements and financial performance. None of WAJ water administrations issue individual annual reports and share performance figures and statistics with the public. General performance data of these utilities is included in WAJ annual report covering governorates as service areas and not as individual utilities and posted on WAJ official website. As for Aqaba Water, the latest annual report provided was from 2010 as they are still working on the following years. Miyahuna Water Company provided 2011 and 2012 annual reports as well as the business plan (2013-2017). Miyahuna and Aqaba Water issue main KPIs in the annual reports and are available to the public. Moreover, Yarmouk Water Company do not issue annual reports, however, the laboratory department deliver its internal annual report on regular basis.

Data Records Availability

Data records availability in the utility can provide the capability of the utility gathering information needed for variables in order to calculate KPIs. It was found that some utilities have automated systems/programs (such as GIS, SCADA, X7, BM4, CMMS) that leads to good data availability and easy access. These utilities include; Aqaba Water Company, Madaba Water Administration and Miyahuna Water Company. Balqa Water Administration, Yarmouk Water Company and Zarqa Water administration reported that the data is available, however, it requires time to gather data sets as they are scattered within different sources. While the remaining utilities reported that data is recorded manually and only available in hard copy documentation.

Main Challenges Affecting Utility Performance

Water utilities were asked to report on main challenges that affect their performance. Those challenges which affect the performance and require improvement, can assist in determining the benchmarking scope. Water utilities face critical issues in every aspect of their operation, including limited water availability and quality, NRW and illegal water use, high operational costs and high energy consumption, some utilities require treatment for controlling emerging contaminants at trace levels, major rehabilitation and replacement of aging water distribution systems, financial sustainability, serious funding issues, centralization (specifically for WAJ directorates) and communication challenges. Overall, nine utilities reported their main challenges affecting performance. The total number of challenges were 95. Those challenges were taken and clustered into common challenges that are shared among all utilities (Refer to Table 17 below).

Table 17: Utilities Common Challenges based on questionnaire analysis

No.	Common Challenges	PI Category
1	Lack of financial support for new strategic projects	Financial
2	High energy costs	Financial
3	High operating costs	Financial
4	High NRW levels	Operational
5	Water quality issues	Operational
6	Lack of automated systems	Operational
7	Lack of trained qualified staff	Personnel
8	Low billing efficiency	Quality of Services
9	Increasing population growth	Quality of Services
10	Limited water resources	Water Resources
11	Increasing water demand	Water Resources
12	Arab spring implications	Arab Spring-Political
13	Lack of equipment, machinery & tools	Equipment Issues
14	Centralization and limited authority	Organizational

The common challenges fall into 8 different categories; Operational aspects, Financial, Quality of services, Personnel, Water Resources, Arab Spring, Organizational, and Equipment related issues.

Figure 23: Leaks at ground water pumping station in Ma'an

Factors achieving sustainability

Each utility has a different opinion on factors that can achieve its sustainability in running utility business. In the case of Aqaba Water Company; the increase in non-residential consumption will lead to better financial stability, by which one of the factors achieving sustainability, as well as the availability of high quality infrastructure. Balqa Water Administration reported that decentralization, management and cost recovery can be the main factors sustain utility business. As for Ma'an Water Administration, modesty with employees, team spirit and personnel dynamics are factors to sustain the utility.

Madaba Water Administration reported that some of the factors achieving sustainability are; reduce overstaff, reduce NRW, and applying water balance to monitor water consumption. Miyahuna Water Company reported that reducing physical losses through plugging leaks in short amount of time, qualified and trained staff, water quality compliance, reduce NRW, as well as a committed water distribution program are the main factors sustaining the utility. As for Tafila Water Administration, accurate meter readings and applying water balance calculations are factors achieving sustainability in the utility. Yarmouk Water Company reported that financial support, water quality compliance, reducing the gap between supply and demand, as well as water resources sustainability are factors achieving sustainability in the utility. And lastly, Zarqa Water Administration reported that enabling working environment, implementing water balance principles and applying zoning and SCADA systems for water supply systems are factors achieving sustainability.

In general, it can be summarized that for a water utility achieving sustainability; it has mainly to practice sustainable management of water resources, optimum operation of water systems, ensuring cost recovery and financial sustainability.

Internal KPIs used to measure utility performance

Internal KPIs involves evaluating current internal performance status and trends. It can also include comparison of outcomes or outputs relative to utility's goals, objectives, baseline status, targets and standards. In Jordan, PMU requests variables from utilities in order to calculate KPIs. However, some utilities have some internal KPIs which they don't report to PMU; Aqaba Water Company, Balqa Water Administration, Madaba Water Administration, Yarmouk Water Company. The remaining Water utilities do not have internal KPIs and only report variables to PMU.

Since when utilities are engaged in performance assessment projects with PMU-MWI

The following utilities has recently begun to engage in performance reporting with PMU starting 2014; Balqa, Madaba, Yarmouk and Zarqa. As for Aqaba Water Company, it has the most experience with such project as it started with MWI in 2004. Following that, Miyahuna Water Company engaged in 2007. As for the remaining utilities, they do not have experience with performance assessment or benchmarking projects yet. This related to the importance of this study, thus, shows that performance monitoring and performance improvement business culture is still new to the Jordanian water sector and there is a need to share information and awareness among utility managers and decision makers.

Objectives, motivation from benchmarking project

Sample utilities have never been engaged in benchmarking projects before. Therefore, this question was reformulated in asking them what would be the objective they expect to achieve from participating in benchmarking projects. The common response and objective reported was that by participating in benchmarking exercise, utilities will receive neutral feedback after KPIs analysis and get access to best practices recommendation. Moreover, performance improvement was the optimum goal at most interviewed utilities.

Resources/cost used for each performance assessment project

For utilities that has participated in performance assessment projects, they have been asked to report about resources/cost that was spent for each project. That information will assist when implementing benchmarking projects in the future. Most utilities don't have a specific department for such projects, nor have tracked any expenses in specific for this matter. Many utilities projected around 10-20% of staff time can be utilized for benchmarking projects in the future, also utilities are willing to provide logistical support to attend meetings and provide meetings venues as in-kind contribution, overall, utility managers are all willing to participate and contribute.

Methods suggested to encourage utility staff engage in Benchmarking projects

Utilities were asked to suggest methods that might encourage utility staff to participate in Benchmarking project as it is not included in the common list of tasks and responsibilities for utility staff. Most common suggestions were to implement financial incentive program and provide related training courses for employees. Also, it was stressed to provide more awareness tools and workshops about benchmarking.

Obstacles may be faced when implementing performance assessment project

When implementing performance assessment and benchmarking projects, utilities may come across obstacles. The main common obstacles reported by utilities were the availability of data/information required in performance indicators calculation and analysis, in addition to financial obstacles and extra expenses not assigned in water utilities budgets.

Lessons learned to avoid mistakes in next performance monitoring project

For utilities that participated performance monitoring projects in the past, they reported some of lessons to be learned:

- Performance evaluation for all utilities has never been conducted, therefore, all utilities should agree on common KPIs
- No capacity building programs conducted after performance monitoring program
- No software or online platform have ever been used for benchmarking in Jordan
- No budget allocations for implementing benchmarking programs

Example of performance improvement measure taken as recommendation of Benchmarking projects and how much was the efficiency/saving

When asking, the utilities were engaged in performance improvement measures in the past with PMU: No benchmarking programs implemented earlier so there is no performance improvement measure taken based on benchmarking program recommendations

Why benchmarking for water services is not applied in Jordan?

Prior conducting this research, benchmarking projects have never been applied in Jordan. Utilities were asked to give their opinion why it is the case. Some common opinions agreed upon main reason of data unavailability, and methodology of benchmarking is probably misunderstood or not clearly explained. WAJ directorates think that the central management/headquarters should be the initiator for such program because they are managing the water sector in Jordan and allocating financial resources for each directorate, therefore, should plan for benchmarking programs within future annual plans.

Another rational explanation for why benchmarking is not applied yet in Jordan and other developing countries, is related to the water systems age. For water systems development, it starts with building the utility then operate it for decades. After running utilities for significant time, utilities start focusing on system optimization. Utilities in Germany and other developed countries are older and passed regular operations stage and concentrating now on optimization. Now it is the time for Jordanian water utilities to consider system optimization.

The complete individual filled surveys are included in annexes (3.1-3.9).

4.3 Develop and implement Benchmarking system for water services

This section will describe the steps taken for implementing the benchmarking exercise following the international best practices and testing it out over Jordan water utilities.

4.3.1 Preparation

4.3.1.1 Project Planning

This is the most important step while implementing any benchmarking exercise. Similar to any project planning stage; it is essential to ensure stakeholder engagement, apply effective communication tools and identify clear roles and responsibilities. Therefore, within this stage it was important to set out clear objectives for the pilot benchmarking project:

- Test out benchmarking approach as performance improvement tool for water utilities in Jordan.
- Train PMU staff on conducting benchmarking exercises and train water utilities on collecting and reporting on performance data variables.
- Develop systematic reporting mechanism on water utilities performance data.

At this stage; the identification of target utilities should take place based on the benchmarking scope and objectives. This research included all water supply utilities in Jordan to test out benchmarking concept on a national level, furthermore, the larger number of participants in any benchmarking exercise reflects a larger number of data sets collected and analyzed, by which resulting a wide range of knowledge and best practices exchange and discussions over ways to improve performance.

Benchmarking liaison officers (focal points) were nominated as utility representatives, to participate in meetings, workshops, data collection efforts, training on the online data acquisition tool and other activities of the benchmarking project. Detailed description of tasks and responsibilities, operating procedures for the focal points were drafted in the form of Terms of Reference (TOR) and shared with the PMU and water utilities, the TOR can be found in annex (4) in addition to the code of conduct which regulates and governs the overall process of benchmarking, confidentially requirements and data sharing/protection/privacy protocols (Annex 5). All documents and forms were developed during the planning phase following the international practices from similar benchmarking projects and tailored to the Jordanian water sector set up, thus considered as the foundations for the next benchmarking cycles in the future.

With reference to section 4.2.3 above highlighting the common challenges affecting water utilities performance, and after having the focal points nominated and ready to participate in the benchmarking exercise; it was the time to develop the assessment system and build consensus on the benchmarking scope. In other words, what are the areas need to be assessed and require improvement. What are the challenges hindering the performance of water utilities in Jordan from better quality service or even affecting the financial sustainability of water utilities? These questions draw up the features of performance assessment system design and serve as a starting point in setting up the adequate performance indicators and designated variables required to calculate them. After multiple meetings and discussions with the benchmarking task force and PMU officials; performance assessment system was developed following MWI strategic objectives and policies to enhance the performance of water utilities and better quality service delivery. The assessment system for Jordan Water Services Benchmarking Program comprised of 10 KPIs and 17 PIs (ACWUA, 2015). Table (18) illustrates the KPIs and PIs in categories (water resources, water quality, water loss, and financial, service quality, human resources, operational and physical).

Table 18: Key performance indicators and lower level performance indicators used in Jordan benchmarking assessment system

Adapted from PMU, 2014

Key performance indicators			
Indicator	**Definition**	**Unit**	**Category**
WRc02	Water consumption per capita	L/cap/d	Water resource
QS17	Microbiological water quality compliance	%	Water quality
Op22	Water loss per water service connection	l/Sc/d	Water loss
Fi36	Non-revenue water by volume	% of system input	Financial/ Water loss
Fic01	Collection ratio	%	Financial
Fic03	Operating cost coverage ratio (water and sewerage)	%	Financial
QSc01	Subscribers receiving continuous supply	%	Service quality
QS22	Non-billing (Service) complaints	% of no. of subs.	Service quality
QS27	Billing complaints	% of no. of subs.	Service quality
PEc01	Total employees per 1000 water subscribers	Nr/1000 subs.	Human resource
Lower level performance indicators			
Indicator	**Definition**	**Unit**	**Category**
WR01	Inefficiency of use of water resources	%	Water resource
WRc01	Water resource use per capita / day	L/cap/d	Water resource
Op32	Water quality tests performed	% of required tests	Wa ter qua lity

QS15	Quality of supplied water	% compliance	
QS18	Physical - chemical water quality compliance	% compliance	
QS25	Water quality complaints	% of non-billing complaints	Quality of service
QS10	Continuity of supply (Supply Index)	% of time	
QS20	New connection efficiency	% of requests	
Op26	Network repair rate	Nr/100 km	Operational
Op27	Water service connection repair rate	Nr/1000 Conn.	
OPc08	Speed of repair of bursts	% of bursts	
Op08	Subscriber meter replacement	% of total	
OPc02	Water losses per km of network	m^3/km/d	Water loss
FI07	Energy costs as percent of total running costs	%	Financial
PHc02	Average unit energy consumption	kWh/m^3 system volume	Physical
Pe01	Employees (water) per 1000 water service connection	Nr/1000 Service Connections	Human resources
Pe16	Training per employee	d/employee/q	

Based on field visits and semi-structured interviews with water utilities; those indicators are only applied in Aqaba Water and Miyahuna since 2004 and 2007 respectively, but WAJ water administrations were still having some issues in reporting these indicators to PMU on quarterly/annual basis. Therefore, this research tries to collect data from utilities and applying performance indicators analysis within benchmarking projects for the first time in Jordan.

Through a series of meetings; performance indicators were explained to utility focal points illustrating the formulas and how it should be calculated, then the applicability for every indicator was investigated, based on data availability and ability to provide variables required to calculate those indicators. The list of (75) data variables required to calculate performance indicators is included in annex (2). The set of variables and performance indicators in its final version are recognized as the performance assessment system for the benchmarking exercise. It was agreed to perform the benchmarking exercise for the 9 utilities over 2 year’s period (2013 and 2014). Because data of year 2015 will not be available before June 2016. During the planning stage; it was also agreed to design 3 clusters according to ownership form and management type (Public/Private):

1. Overall cluster: including the 9 utilities in overall

2. Public utilities cluster: includes the public water administrations (Ma'an, Balqa, Karak, Tafila) which still under the mandate and direct supervision of WAJ
3. Private utilities cluster: includes the private (commercialized) water utilities (Miyahuna, Yarmouk Water, Aqaba Water, Madaba Water and Zarqa Water (recently)

4.3.1.2 Orientation, Training and Project Control

- Identification of the software, tools and web support to handle with utilities' data.
- drafting the data questionnaire,
- Training on the questionnaire and software handling

While the assessment system is getting finalized and ready for application, in parallel, the identification of the tool to handle and analyze utilities data was in progress. Furthermore, through other concurring development initiatives at ACWUA, the latter had received technical and financial support from the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) to build the capacity and knowledge-exchange between ACWUA members in topics related to best practices in managing water utilities, (i.e. quality management systems, energy efficiency, water integrity, e-learning modules and benchmarking of water services) through a regional program titled ACWUA Water Networking & Training "ACWUA-WANT". Within "ACWUA-WANT" benchmarking component; ACWUA's technical team had received special training and coaching on how to administer benchmarking programs and use specialized benchmarking online software. Coaching and training was delivered by aquabench (Germany) which has been practicing benchmarking since 1996, aquabench online tool is compatible with benchmarking exercise steps (preparation and administration, data acquisition and validation, data analysis and reporting). The tool has flexible administration features; water utilities can enter data variables online and check the quality of entered data, software admin then can assess submitted data and conduct analysis and select benchmarks then generate many types of reports and charts (bar chart, pie chart, scatter plot, stacked charts, net chart, reference benchmark cluster, etc.). The same tool had been tested in this research to conduct benchmarking for water services in Jordan.

The definitions of the 75 data variables were entered into the online platform in addition to the formulas of the 27 performance indicators (Annex 2). Then data questionnaire was created through pulling the required data variables from system's data pool and plug them in one online page which utility representatives can access through secured user's credentials (Annex 2). Utility profiles were created for the 9 utilities with access credentials for each utility representative to let him/her insert data variables requested in the questionnaire. Figure (24) below shows the interface of the online data questionnaire. Matched data questionnaires were created for both years 2013 and 2014. The system displays the code for each data variable, and shows whether it is mandatory or optional field, the questionnaire also shows the unit and type of data (integer, percentage, sum up value, etc.) in addition, it shows data range of each variable to give users a hint if they are providing valid data or it is out of the range to be corrected. The system is also equipped with plausibility check features, which enables utility representative to eventually submit data valid for performance indicators calculations and analysis. Importing and exporting CSV data files is also possible to speed up data variable submission. Annex (2) shows data variables and a printed version of the data questionnaire for year 2013. After data questionnaires and user profiles were created, an orientation workshop was conducted to train participants on how to access the online platform for data entry, data validation and final submission.

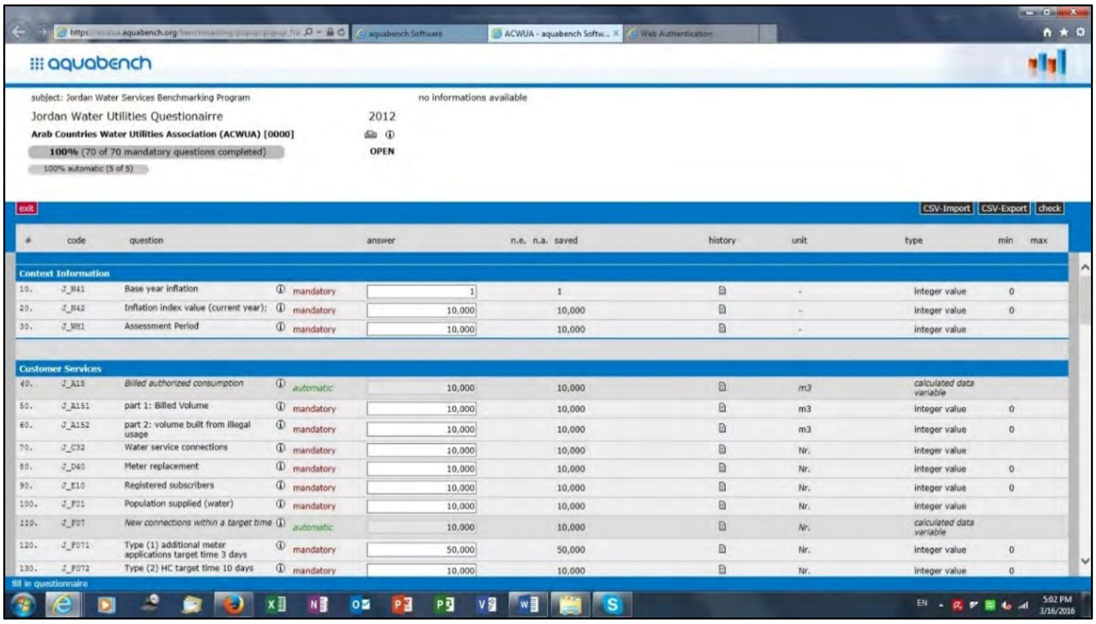


Figure 24: Sample screen shot of the online data questionnaire

Figure 25: Online data collection, entry and validation tool training workshop

4.3.2 Performance Assessment

4.3.2.1 Data Acquisition and Validation

Data acquisition process was implemented through two channels as explained in the orientation workshop; either by direct online submission or via submitting filled spreadsheets and then uploading those sheets to the platform and run the plausibility checks. Moreover, data acquisition and validation was a very lengthy process, because not all variables were available at each utility, not forget to mention that plausibility checks were passed over in some cases because it was the first benchmarking cycle for Jordanian water utilities. Very close follow up on daily basis through phone calls, email communication and meetings were the main approach to collect data from water utilities. Also, official letters were sent out to different utilities and to WAJ central offices to collect some data variables which are not available at utilities, but do exist at WAJ central departments. Data quality validation was carried out through individual plausibility checks of PIs, crosscheck of variables and outlier analysis by checking bar charts with the PMU and water utility representatives.

Data availability issue is a serious problem at WAJ water utilities which make it difficult to report on a certain number of data variables. Although regulatory reporting within WAJ utilities is generally well understood, limited technical and resource capacity make regular reporting a challenge (ISSP, 2015). It was noticed that there is insufficient level of knowledge in some aspects of the technical details and insufficient number of staff members dedicated to specific operations. It was also reported the lack of vehicles prohibits regular staff monitoring, preventing accurate reporting and the use of less accurate techniques or metrics (e.g. estimated meters' readings). Most importantly, and it was very noticeable during field visits, that service provision is the top priority of all staff and management, with less priority given for effective KPI collection and reporting. This mindset will not change without the willpower of executive management and without setting the right framework for accountability to carry out these reporting duties (ISSP, 2015). Water utilities need to understand that data reporting and self-monitoring tools will help in performance improvement and enhance water service delivery for its customers.

The USAID-ISSP project looked at reporting functions within WAJ utilities and assessed the current situation, and what are the changes or interventions that need to be introduced for better data variables reporting and enhance capabilities for KPIs calculation:

1. Modification of business processes covering specific technical aspects, which should yield better outcomes.
2. Improvement of the internal capacities within the utility by allocating staff members to specific tasks; provide training courses on data management protocols; establishment and implementation of clear policies and procedures along with the required associated tools and templates.
3. Provide sufficient IT Infrastructure, tools and applications which facilitates data collection from the field and synchronize it with information database related to customer, financial, water resources database.

4.3.2.2 Data Analysis and Assessment Reporting

After concluding the first round of data validation and it was ready to run the system; data sets were entered to the systems and after several quality checks carried out; those data sets were released and undergo KPIs calculations through previously entered equations and formulas (all formulas and calculation method were agreed upon during the planning phase of the performance assessment system). Table (19) shows the 27 performance indicators and the formulas used for calculations.

Table 19: Performance indicators calculations formulas

Code	Performance Indicator	Unit	Calculation Formula
J_Fi07	Energy costs ratio	%	J_G08 / J_N21 * 100
J_Fi36	Non-revenue water by volume	%	J_A26 / (J_A07 + J_A08) * 100
J_FIc01	Collection ratio	%	J_N18 / J_N28 * 100
J_FIc03	Operating cost coverage ratio (water and sewerage)	%	J_N28 / J_N21 * 100
J_Op08	Subscriber meter replacement	%	J_D40 / J_E10 * 100
J_Op22	Water losses per water service connection	L/connection/day	((1000 * J_A20) / J_C32) / J_N35
J_Op26	Network repair rate	Nr/100 km	J_D25 / J_C08 * 100
J_Op27	Water service connection repair rate	Nr per 1000 Sc	J_D26 / J_C32 * 1000
J_Op32	Water quality tests performed	%	J_D41 / J_D46 * 100
J_OPc02	Water losses per km	m3/km/day	(J_A20 / J_N35) / J_C08
J_OPc08	Speed of repair of bursts	%	J_N13 / (J_D25 + J_D26) * 100
J_Pe01	Employees per water service connection	Staff/1000 connections	(J_N24 - J_N02) * 1000 / J_C32
J_Pe16	Training per employee	day/employee/year	J_B23 / J_N24
J_PEc01	Total employees per 1000 water subscribers	Nr per 1000 subscribers	J_N24 * 1000 / J_E10
J_PHc02	Average unit energy consumption	KW per system input	J_N04 / (J_A07 + J_A08 + J_A09)
J_QS10	Continuity of supply (Supply Index)	%	J_D29 / (7 * 24) * 100
J_QS15	Quality of supplied water	%	(J_D52 + J_D53) / J_D41 * 100
J_QS17	Microbiological water quality compliance	%	J_D52 / J_D43 * 100
J_QS18	Physical-chemical water quality compliance	%	J_D53 / J_D44 * 100
J_QS20	New connection efficiency	%	J_F07 / J_F08 * 100
J_QS22	Non-Billing complaints (Service Complaints)	per 100 subscribers	J_F11 / J_E10 * 100
J_QS25	Water quality complaints	%	J_F14 / J_F11 * 100
J_QS27	Billing complaints	per 100 subscribers	J_F16 / J_E10 * 100
J_QSc01	Subscribers receiving continuous supply	%	J_N14 / J_N10 * 100
J_WR01	Inefficiency of use of water resources	%	(J_A24) / (J_A07 + J_A08 - J_A09)
J_WRc01	Water resource use per capita / system input per day	l/c/d	(J_A07 + J_A08 - J_A09) * 1000 / 365 / J_F01
J_WRc02	Water consumption per capita	L per Capita per day	J_N01 * 1000 / 365 / J_F01

Data analysis step generated tables, bar charts and other graphs by which were mainly utilized in utility individual reports and consortium report. Generated charts also helped in doing another round of quality checks and validation of variables. Outlier values were spotted out, thus, follow up with focal points was necessary to correct some wrong data variables which eventually lead to wrongly interpreted charts. Performance Assessment Workshop was held to discuss the assessment procedure and to gain a better insight into the details of comparative assessment, and thus more information on best practices. During that workshop, a review of the preliminary assessment results (Charts) for PIs and KPIs took place. Then a last round of data cleaning and missing data collection was documented and pursued closely with utility representatives.

At this stage, individual reports were drafted for each utility describing the benchmarking overall scope and utility individual results within the 27 performance indicators, each report also highlighted utility's performance variance between 2013 and 2014. It also maps out utility position within overall cluster to figure out performance category (low, average and high). Following benchmarking privacy and confidentially protocol as stated in the code of conduct. Thus, anonymous ID was given for each utility so PI results will not be exposed in benchmarking charts and public reports.

This section illustrates the charts resulted after concluding data analysis step for the 27 performance indicators split into 2 groups (Key Performance Indicators and Lower Level Performance Indicators) as listed in table (18) and mentioned earlier:

4.3.2.2.1 Key Performance Indicators

This section shows data analysis for the key performance indicators calculated in the benchmarking exercise:

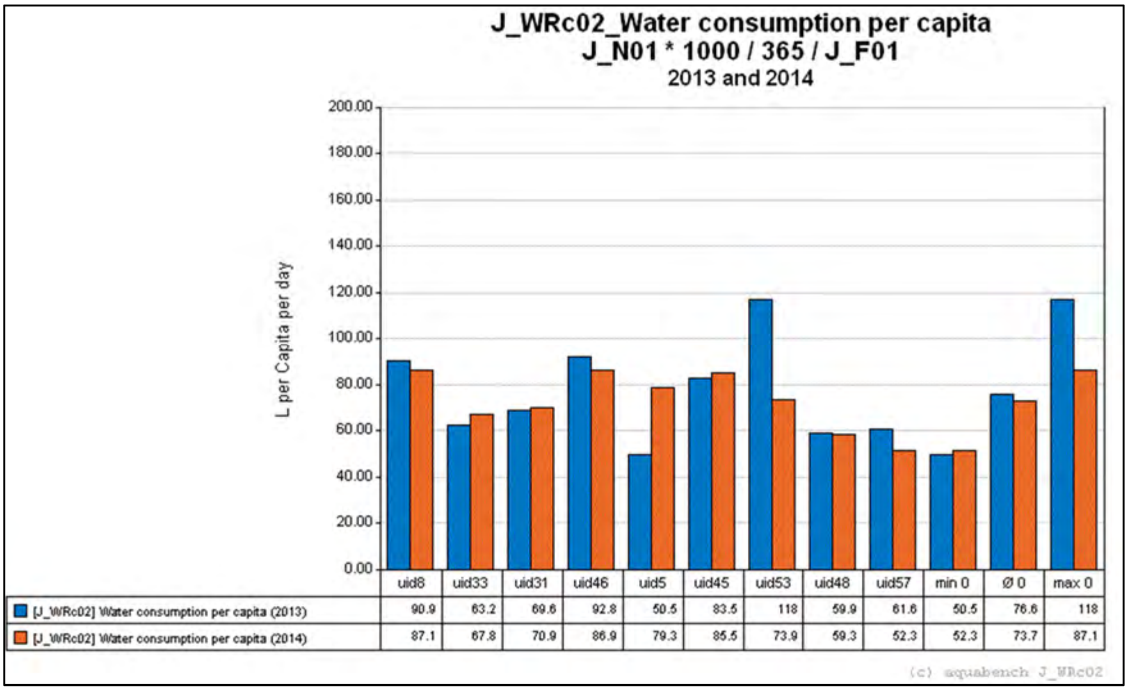


Figure 26: Water consumption per capita (2013, 2014)

The key performance indicator illustrated in Figure (26) measures domestic per capita consumption. It can be used to compare consumption patterns across the country, and to assess whether the population is receiving adequate water for its needs. The average domestic consumption per capita in Jordan had decreased with the amount of 3 liters from year 2013 to year 2014. The average value for year 2014 is 76.6 l/c/d. The maximum amount recorded 118 l/c/d in year 2013 where the minimum amount was recorded of 50.5 l/c/d in year 2013. The increase or decrease of billed consumption amounts is related to the percentage of billed services, however, water consumption per capita variance can be related to climate conditions, population growth, and migration or revers migrations from towns to big cities, etc.

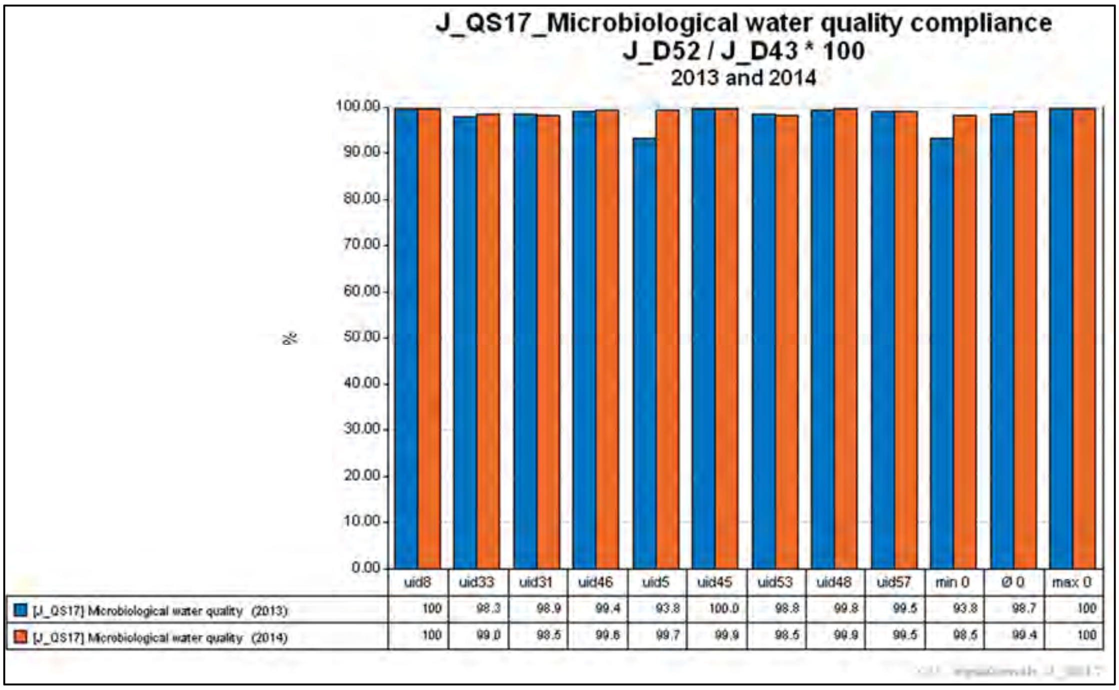


Figure 27: Microbiological water quality compliance (2013, 2014)

Microbiological water quality compliance indicator measures the percentage of Microbiological tests complying with JSMO standards, therefore, this PI cannot be over 100%. Moreover, it shows from the chart that microbiological water quality compliance is achieved mostly in all utilities which reflect a good water biological water quality indicator in Jordan in year 2014. However, it shows progress made at UID5 in comparison with year 2013 in this regard.

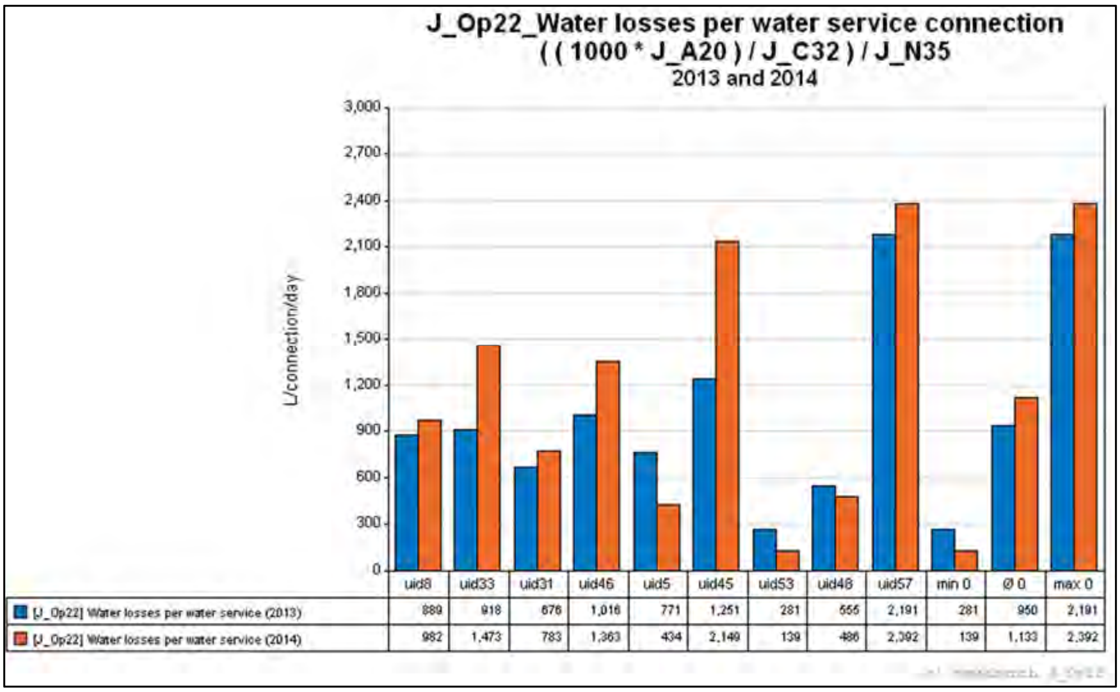


Figure 28: Water losses per connection (2013, 2014)

Water losses per connection indicator measures water losses (including real losses and apparent losses) per water service connection. But in accordance with the IWA system, the calculation does not include any adjustments to take account of the fact that the systems are not always pressurized. However, according to the graph; year 2015 witnessed about 19% increment in the average water losses per water service connection in Jordan, this also noticeable in most utilities and especially in the highly-populated cities (UID 33, UID45, UID57). Which means that more work is required to reduce water losses (real and apparent losses).

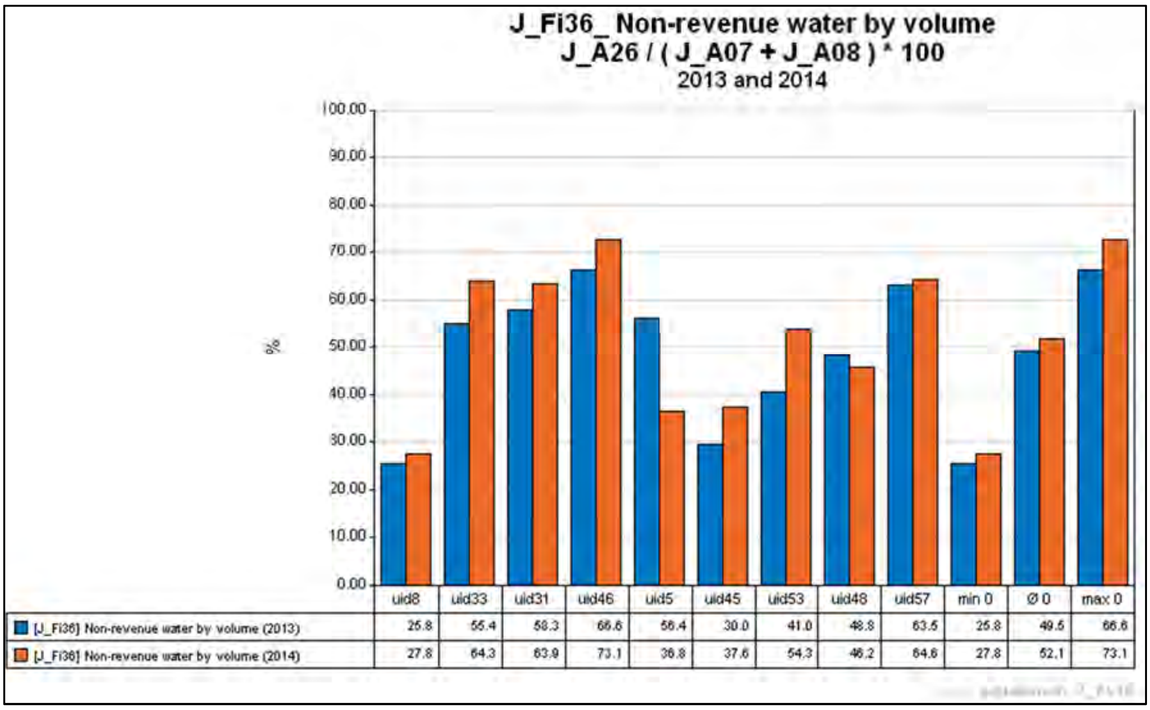
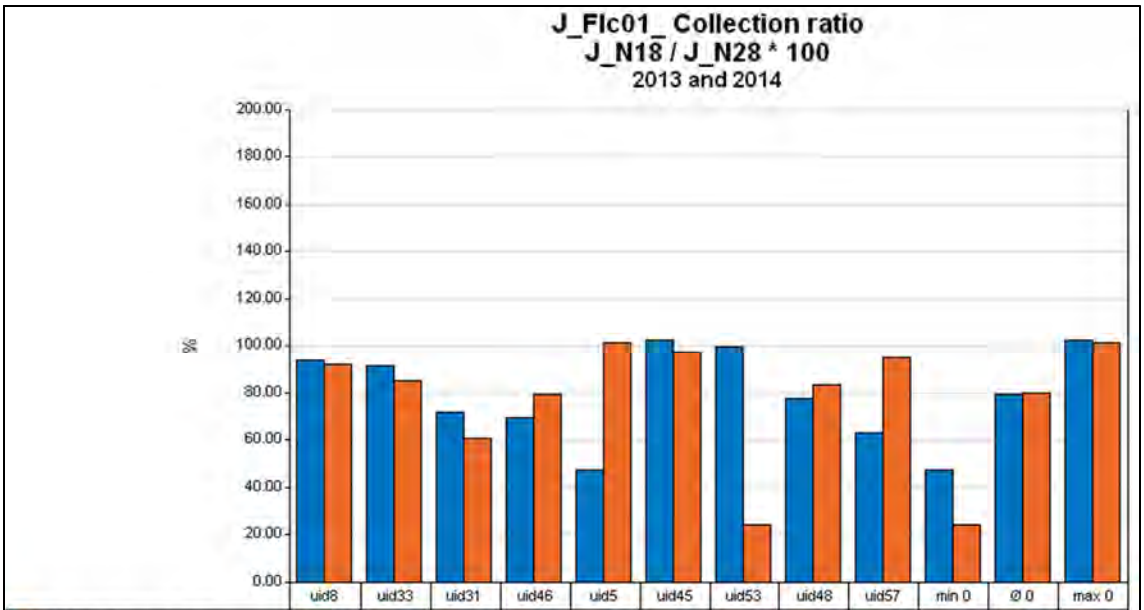


Figure 29: Non-revenue water by volume (2013, 2014)

The NRW by volume indicator measures NRW water as a percentage of system input volume:

$$\frac{(\text{Water Produced} + \text{Water Imported}) - (\text{Billed Authorized Consumption} + \text{Exported Treated Water})}{(\text{Water Produced} + \text{Water Imported})} \times 100\%$$

NRW is the one of the largest challenges facing the Jordanian water sector. Figure (29) shows that NRW levels are significantly increasing in year 2014. The maximum percentage value reached in year 2014 was 73% in UID46, where the minimum value was recorded in year 2013 with a percentage of 25.8% in UID8. The figure shows that higher NRW percentages noticed at some water utilities, which should urge them to give additional attention to NRW reduction strategies and programs.

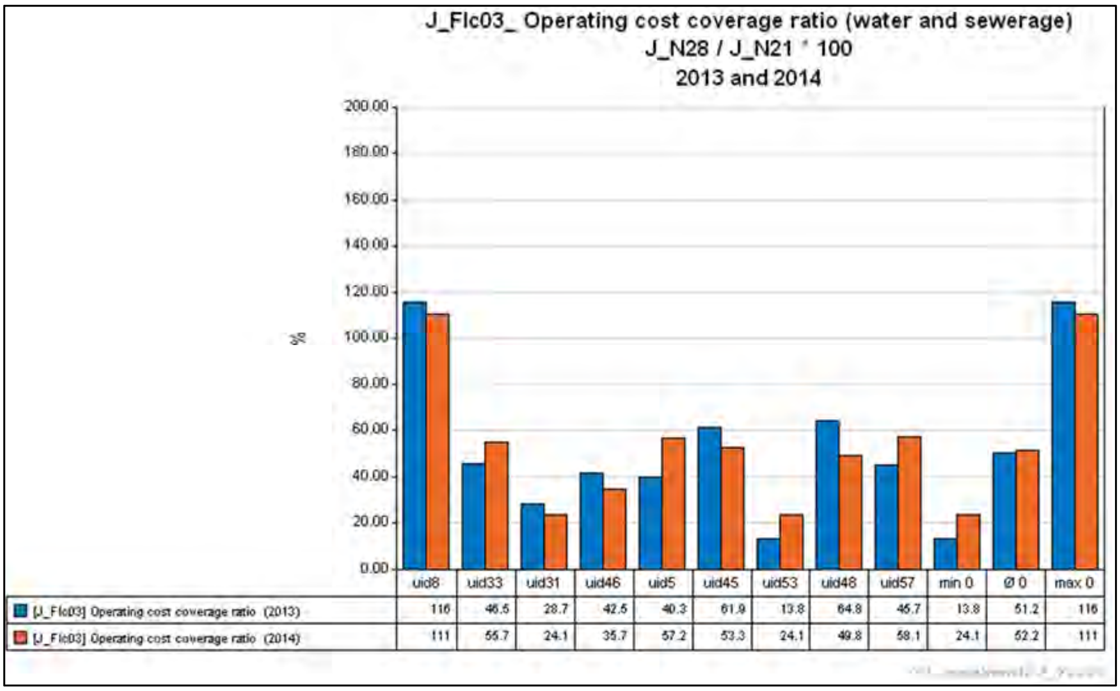


	uid8	uid33	uid31	uid46	uid5	uid45	uid53	uid48	uid57	min 0	Ø 0	max 0
[J_FIc01] Collection ratio (2013)	94.5	91.9	72.4	70.4	48.1	103	100	78.2	63.7	48.1	80.3	103
[J_FIc01] Collection ratio (2014)	92.9	85.6	61.6	79.8	102	98.1	24.9	84.1	95.9	24.9	80.5	102

Figure 30: Collection ratio (2013, 2014)

The collection ratio is the ratio of cash collected / billings during the same period. This is an imperfect indicator because cash collected always lags behind billings and no allowance is made for this in the calculation. The Collection Ratio should be read in conjunction with the Debtors Ratio.

The average value of this indicator for both year 2013 and years 2014 shows steady overall performance around 80% among all water utilities (Figure 30). Again, it is noticeable that some water utilities perform better within collection ratio performance. Which in some cases; water utilities tend to outsource a private sector company for billing and collection. Many utilities still need to pay attention to its collection ratio and include it as a priority for its future performance improvement plans.



	uid8	uid33	uid31	uid46	uid5	uid45	uid53	uid48	uid57	min 0	Ø 0	max 0
[J_FIc03] Operating cost coverage ratio (2013)	116	46.5	28.7	42.5	40.3	61.9	13.8	64.8	45.7	13.8	51.2	116
[J_FIc03] Operating cost coverage ratio (2014)	111	55.7	24.1	35.7	57.2	53.3	24.1	49.8	58.1	24.1	52.2	111

Figure 31: Operating cost coverage ratio (water and wastewater) (2013, 2014)

The operating costs coverage ratio is a basic, but important, measure of financial sustainability. This ratio is the prime reference describing the lowest level of commercial sustainability of the services. This ratio is taken by the majority of financing agencies for eligibility of financing projects. This indicator is part of the top priority ratings worldwide. Moreover, this indicator shows the deficiency of water utilities in covering the cost of its operation (water and sewage). Only one utility in Jordan "UID8" is covering the operation costs (Figure 31), and this is due to difference in customer's type, where UID8 main customers are large consumers (hotels, factories and industries) which simply covers the less cost coverage generated by domestic customers. Generally speaking, water utilities in Jordan still facing a problem in costs recovery, it raises the attention to overlook cost recovery mechanisms and investigate performance improvement measures to enhance utilities financial sustainability.

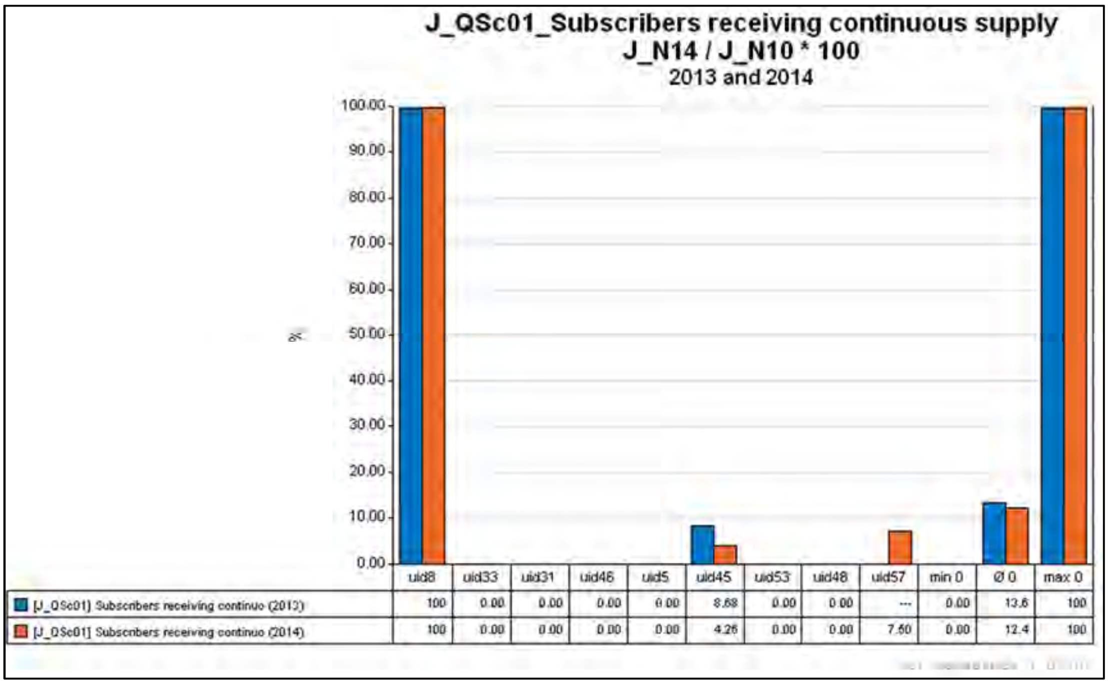


Figure 32: Customer receiving continuous supply (2013, 2014)

Subscribers receiving continuous supply indicator measures the percentage of active subscribers receiving continuous supply. A continuous supply is defined as one in which the subscriber normally receives water supply for 24 hours, seven days per week. This is indicator is related to utilities which has sufficient water supplies and less values for water losses in the network. Unfortunately, only 2 utilities were able to submit variables required to calculate this indicator (Figure 32). However, it is also clear from the general view of water supply situation in Jordan that rationing system is applied in all governorates and it is not nearly foreseen to see continuous water supply system to be applied in Jordan due to severe water shortage and deteriorated water networks.

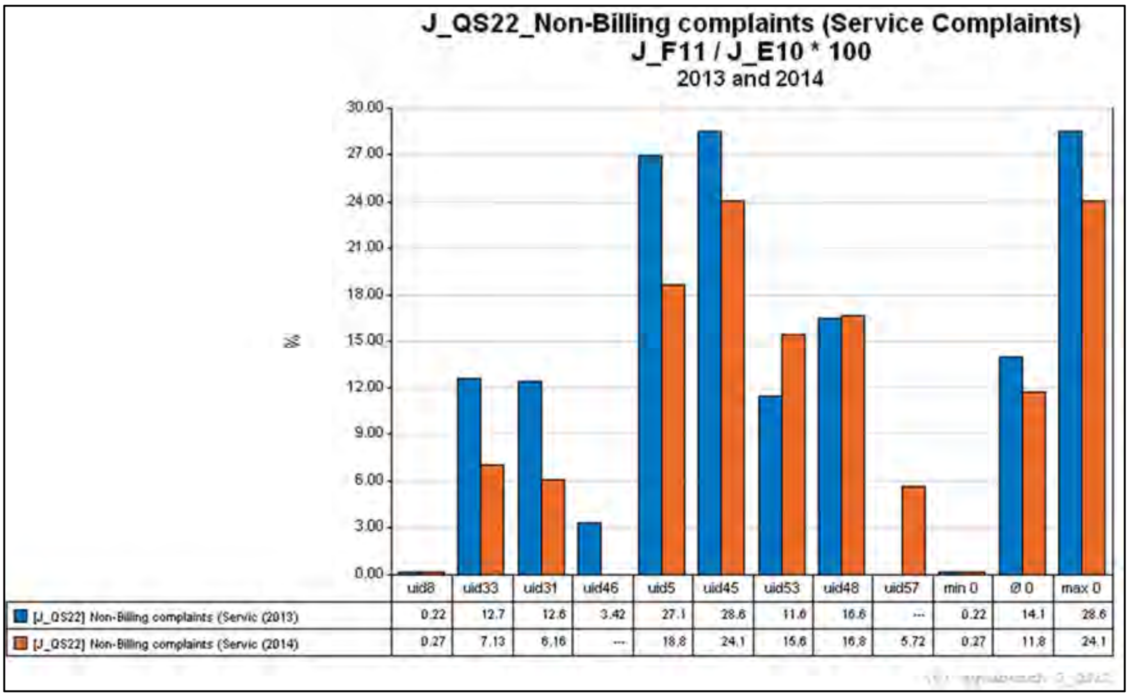
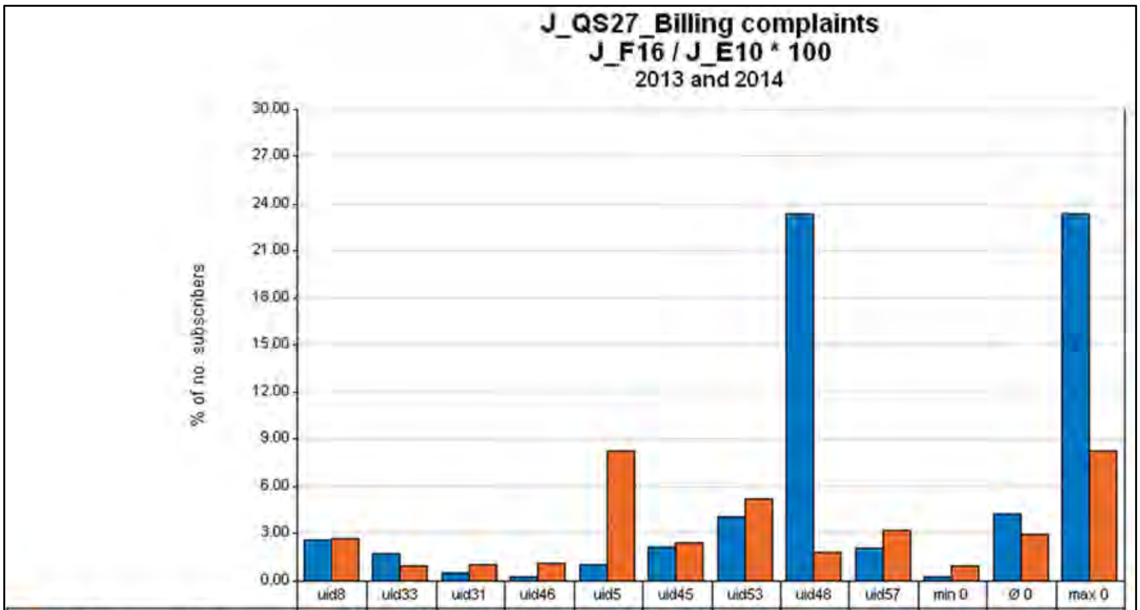


Figure 33: Non-Billing complaints (Service complaints) (2013, 2014)

Non-billing complaints indicates about the quality of service during the year such as pressure complaints, water continuity complaints, water quality complaints, and complaints about service interruptions. A complaint is defined as any written, or spoken, communication from a subscriber that draws attention to a perceived shortfall in subscriber expectation. A complaint is a complaint regardless of whether or not the complaint is justified. It worth mentioning that repeated complaints should be reported separately. It is noticeable in figure (33) that percentage of non-billing complaints is decreasing from year 2013 to year 2014. The maximum of non-billing complaints percentage registered in 2014 is about 24% of total registered subscribers. Although percentage declined from previous year, however, such percentage is considered high in general when compared to international figures, (i.e. German utilities value is 5% according to aquabench GmbH database).



	uid8	uid33	uid31	uid46	uid5	uid45	uid53	uid48	uid57	min 0	Ø 0	max 0
[J_QS27] Billing complaints (2013)	2.72	1.85	0.63	0.31	1.16	2.29	4.21	23.5	2.19	0.31	4.31	23.5
[J_QS27] Billing complaints (2014)	2.78	1.00	1.14	1.19	8.35	2.52	5.31	1.93	3.33	1.00	3.08	8.35

Figure 34: Billing complaints (2013, 2014)

Billing complaints is the number of complaints about billing. A complaint is defined as any written, or spoken, communication from the subscriber that draws attention to a perceived shortfall in subscriber expectation. A complaint is a complaint regardless of whether or not the complaint is justified. Billing complaints percentage is far less than service complaints. However, figure (34) shows that in UID5 and UID48 there is a spike in these values in years 2014 and 2013 respectively. Which require further investigation about the significant increase in billing complaints within those 2 utilities. This indicator is considered above international figures where international best practices should not have any billing complaints because of clear billing and tariff system which is applicable for all customers' types.

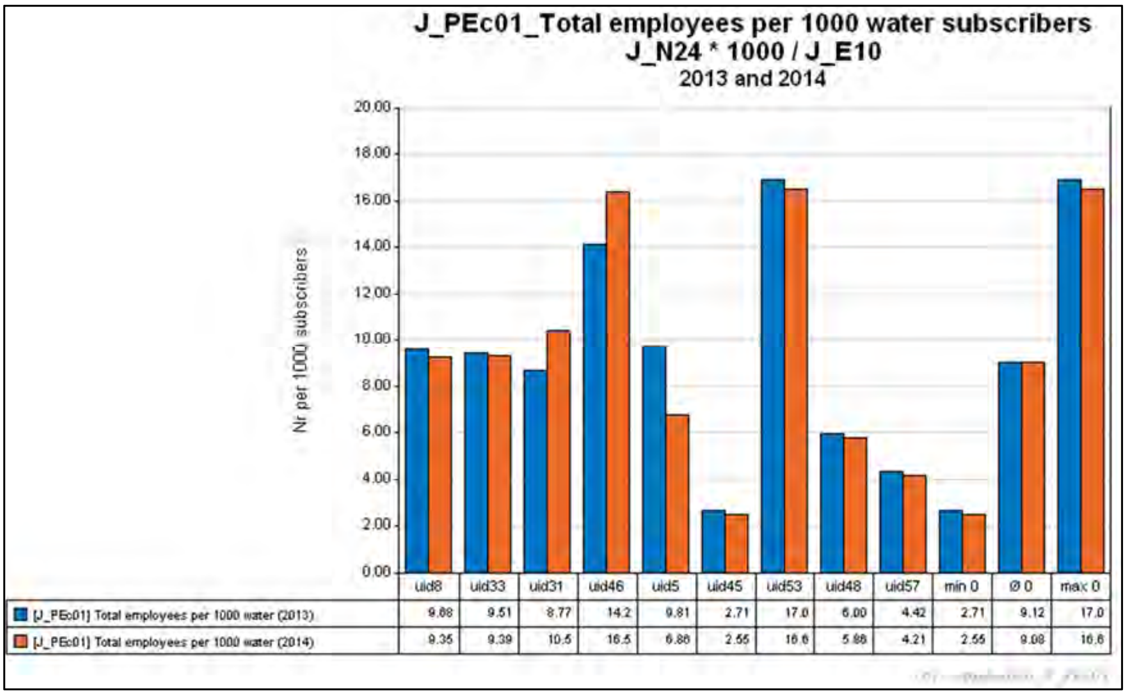


Figure 35: Total employees per 1000 water subscribers (2013, 2014)

The total employees per 1000 water subscriber's indicator measures total manning levels at the governorate. The figures include all staff employed by the utility regardless of their function or status. This KPI varies with maximum value of 17 employees and average of 9 employees and a minimum value of 2.55 employees per 1000 subscribers (Figure 35). This reflects a wide spectrum of personnel management in examined utilities, utilizing systems automation on one hand or serious cases of overstaffing on the other. UID53 and UID46 needs to look after the reasons behind over staffing or look at modernization of processes in order to keep up with other better and average valued utilities.

4.3.2.2.2 Lower-level Performance Indicators

This section shows data analysis for the lower-level performance indicators calculated in the benchmarking exercise:

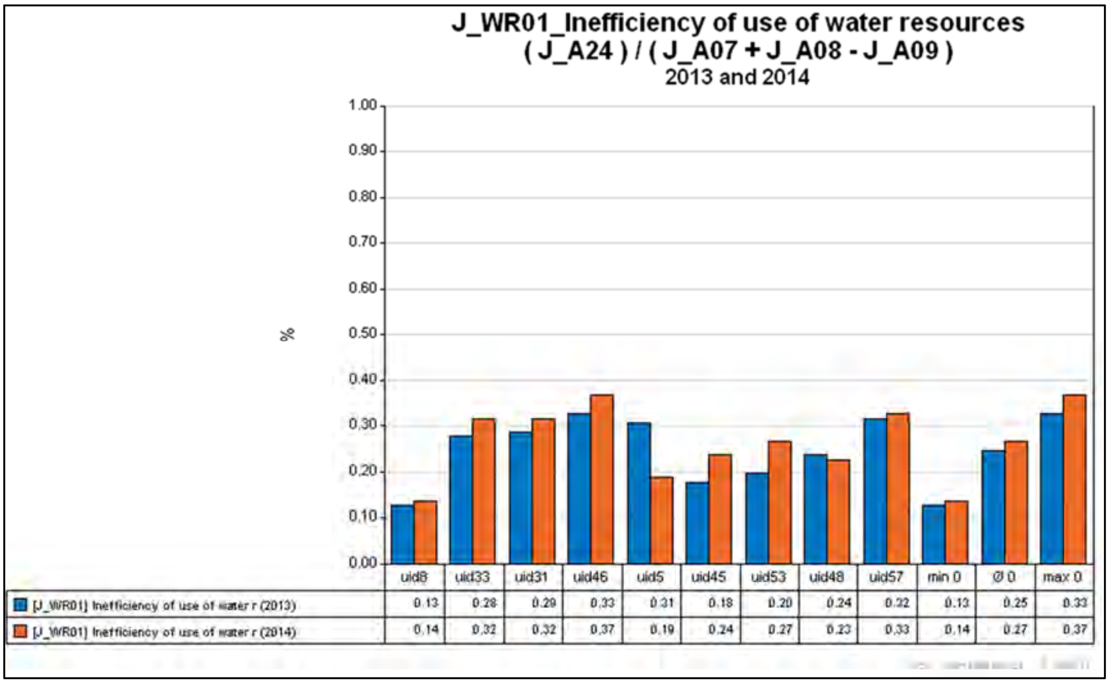


Figure 36: Inefficient use of water resources (2013, 2014)

Inefficient use of water resources indicator measures the proportion of "System Input Volume" lost through leakage and other forms of real losses. The definition of system input volume has been modified in 2009 to include exported water in line with changes in the last edition of the IWA manual. This indicator can give a general overview of inefficiency of water supply systems. With an average value of 27% in year 2014 it shows that only about 70% of available water resources of system input are utilized where the rest is lost from different means of physical losses (Figure 36). Thus, generally speaking, Jordan water sector needs to give attention and consider enhancing water supply system efficiency and value limited water resources. In other words, this is another model of emphasizing the importance of setting NRW reduction strategies and performance improvement plants to reduce water losses of water supply networks in Jordan.

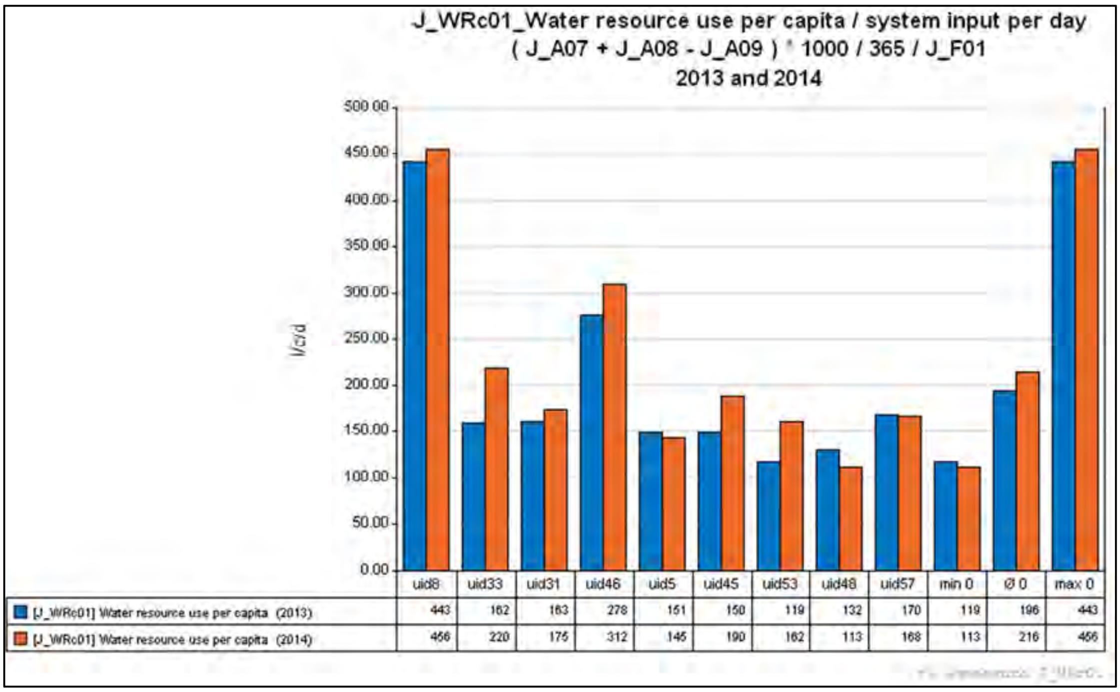


Figure 37: Water resource requirement per capita / system input per capita (2013, 2014)

Water resources requirement per capita indicators in figure (37) monitors water resource use per capita. For simplicity, the volume of water resources used is taken to be the system input volume minus any water exported to neighboring utilities, as such the calculation does not take account of treatment losses. The PI will be used to track whether actual per capita water resource use is consistent with the assumptions underpinning the National Water Master Plan. This indicator shows how much is of water resources available per person per day without calculating water losses. The average value had increased about 10% from 196 l/c/d in year 2013 to 216 l/c/d in year 2014 (Figure 37). Although water resources had increased, however, water losses and NRW rates have also increased. The more water is saved from losses, means more water to supply for customers, this indicator can also help decision makers in identify water resources availability and reallocation of resources in case one governorate reached extreme drought conditions and required additional water supplied from neighboring utilities.

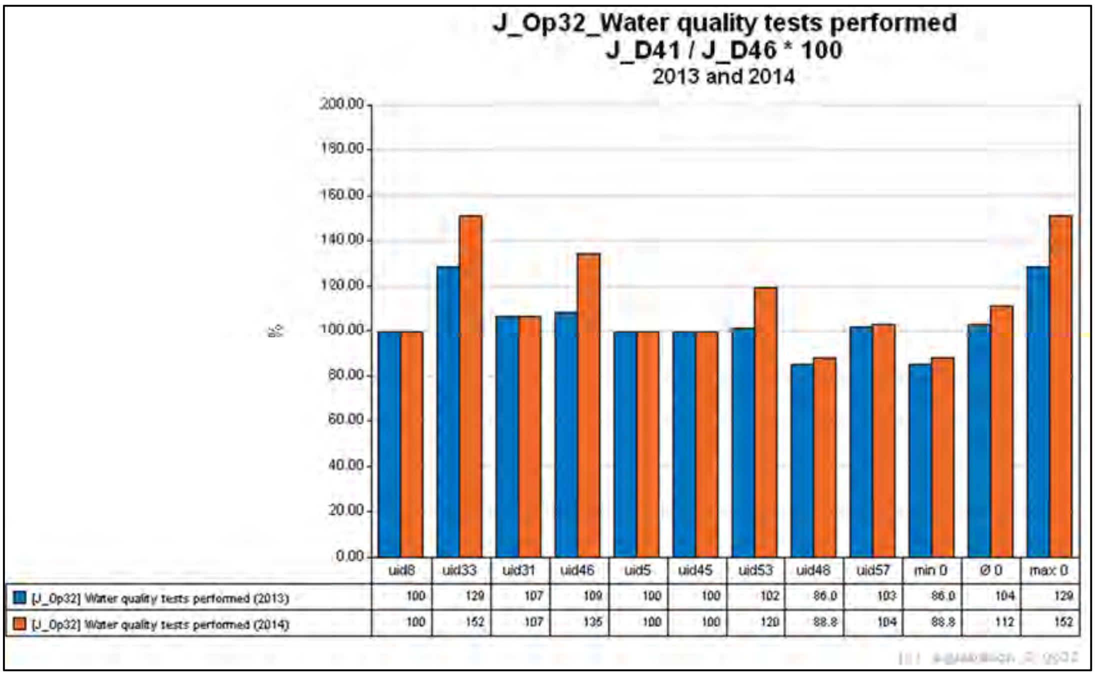


Figure 38: Water quality tests performed (2013, 2014)

Water quality tests performed indicator measures whether all the required water quality tests have been made, it compares the actually executed tests with the number required as laid out in the national standards or legislation. Figure (38) shows that all water utilities have performed water quality tests in compliance with Jordanian standards, however, one utility UID48 did only around 88% of required tests, and thus further investigation is required to find out whether this utility faced water quality issues in those years or just passed the year without any water quality breakouts. It worth mentioning, that all water utilities have to meet the national standard of water quality testes conducted through the year.

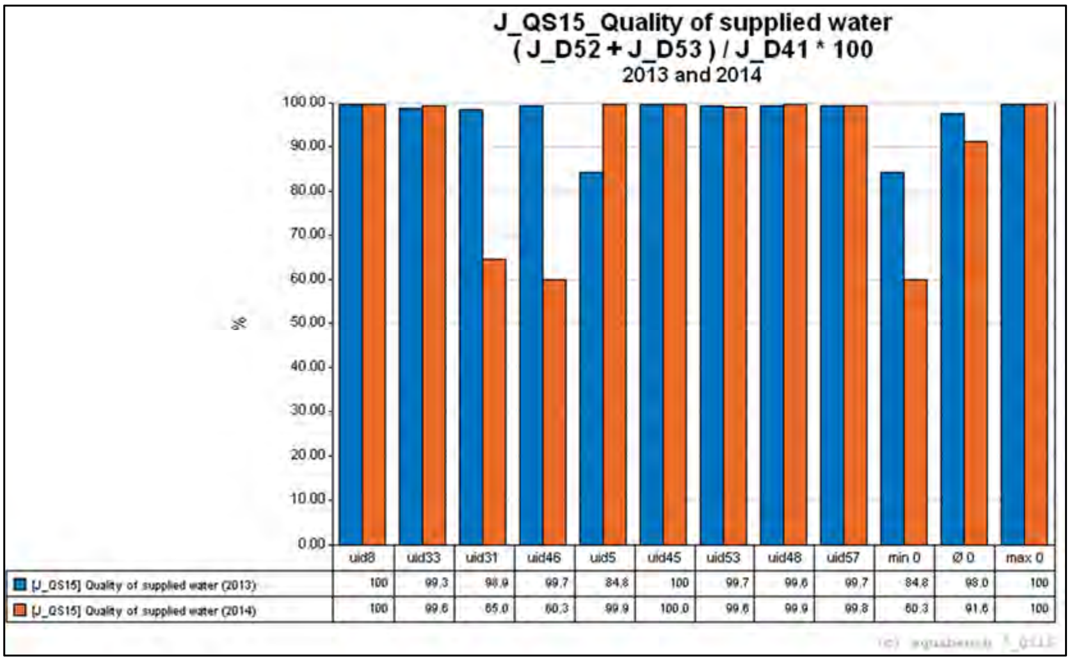


Figure 39: Quality of supplied water (2013, 2014)

Quality of water supplied indicator measures water quality compliance on monthly basis. It cannot be greater than 100%. It expresses the percentage of successful water quality (microbiological, chemical and physical) tests. This indicator is one of the top-ranking gauges whether the Government's target of providing safe water to its population is met by the utilities. Figure (39) shows that successful water quality tests are assured in most of Jordanian utilities, thus, providing safe water supply. However, UID46 and UID31 shows less number of successful water quality tests performed in year 2014 which gives the attention whether water quality issues occurred within its service area, and what are the reason behind not conducting water quality tests within that year.

Figure 40: Physical – Chemical water quality compliance (2013, 2014)

Physical-chemical water quality compliance indicator measures the percentage of physical-chemical tests complying with JISM standards. This PI cannot be over 100%. Figure (40) shows full compliance in the physical and chemical water quality within Jordanian standards

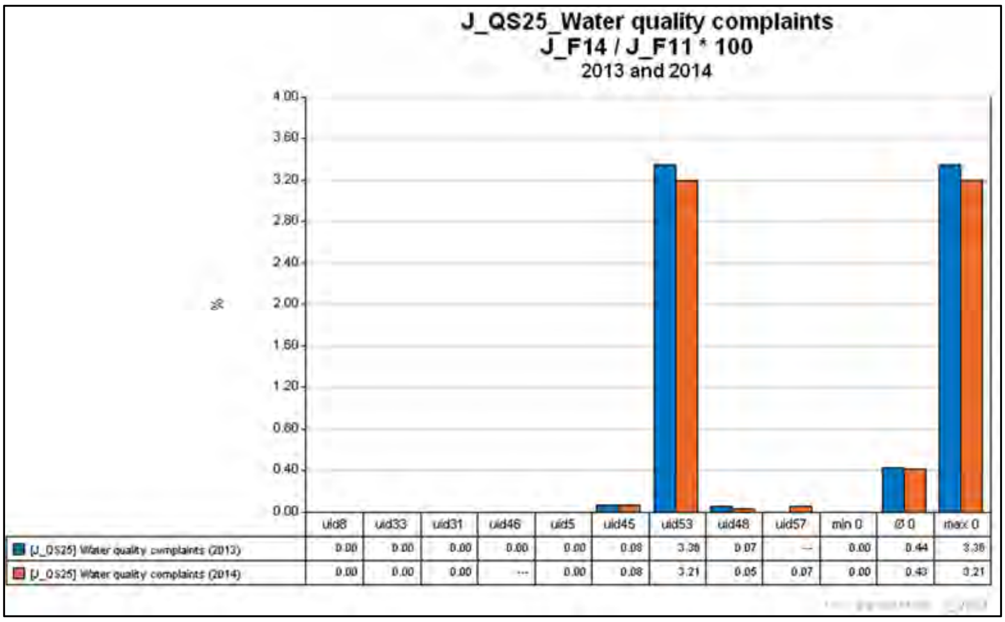


Figure 41: Water Quality complaints (2013, 2014)

Figure (41) shows the number of water quality complaints during the year per number of service complaints during the year to measure customer satisfaction over water quality. Not all utilities have been recorded these indicators, however, it shows that UID53 shares more than 3% of its service complaint within water quality issues. Although same utility is complied with all water quality parameters and national standards, however, customers over there have registered water quality complaints. Which in this case; brings the attention to conduct water quality surveys in that service area. This relates to the previous figure of indicator "Op32" showing more water quality tests conducted in the same year for the same water utility UID53.

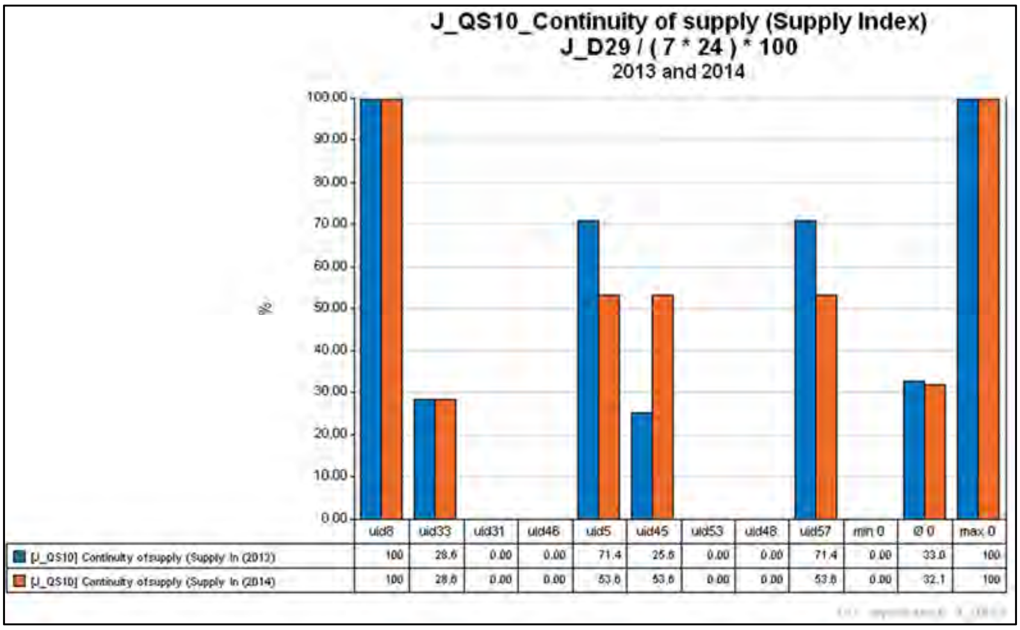


Figure 42: Continuity of supply (Supply Index) (2013, 2014)

Supply Index indicator provides a measure of water supply continuity. It is the weighted average hours of supply during the period, weighted average to be used in reporting areas where rationing is not the same in the entire area. As it shows in figure (42) This Indicator is not applicable for all water utilities, where not all utilities can measure the variable of J_D29 to measure the number of hours per week the water system is pressurized. Therefore, it cannot give an indication of comparison or benchmarking within Jordanian utilities. Generally speaking, Jordan water supply system is managed on rationing basis, therefore, continuity of supply can only be measured in Aqaba, some areas of Amman and Madaba. Where the latter 2 towns have also reduced its continuous supply period.

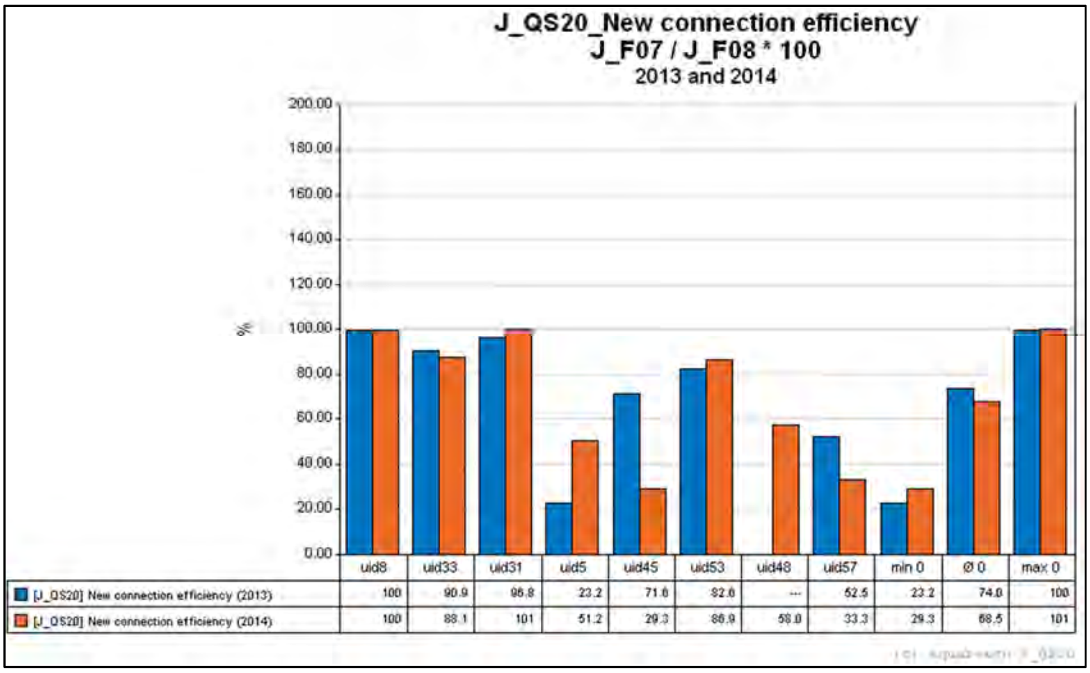


Figure 43: New connection efficiency (2013, 2014)

New connection efficiency indicator measures the proportion of new connections installed within the target time (10 days). It measures the service provider's compliance of responding to application for new connections with installation within a set target period, it shows the responsiveness and ability to provide customer services in this particular aspect. The average new connection efficiency within water utilities in Jordan is 74% (Figure 43). High density populated utilities values are below the average. Less populated utilities have higher new connection efficiency rates. Utilities with the low new connection efficiency rate are required to revise the standard operations procedures they have and investigate how to improve service and respond to new connections within targeted time. (Figure 43) also shows an interesting case of UID5 making about 28% of progress in connection efficiency in 2014, whereas UID45 connection efficiency rate declining about 42% in the same year. An analysis for both cases would lead to investigate the reason behind improvement and declining of performance at both utilities respectively.

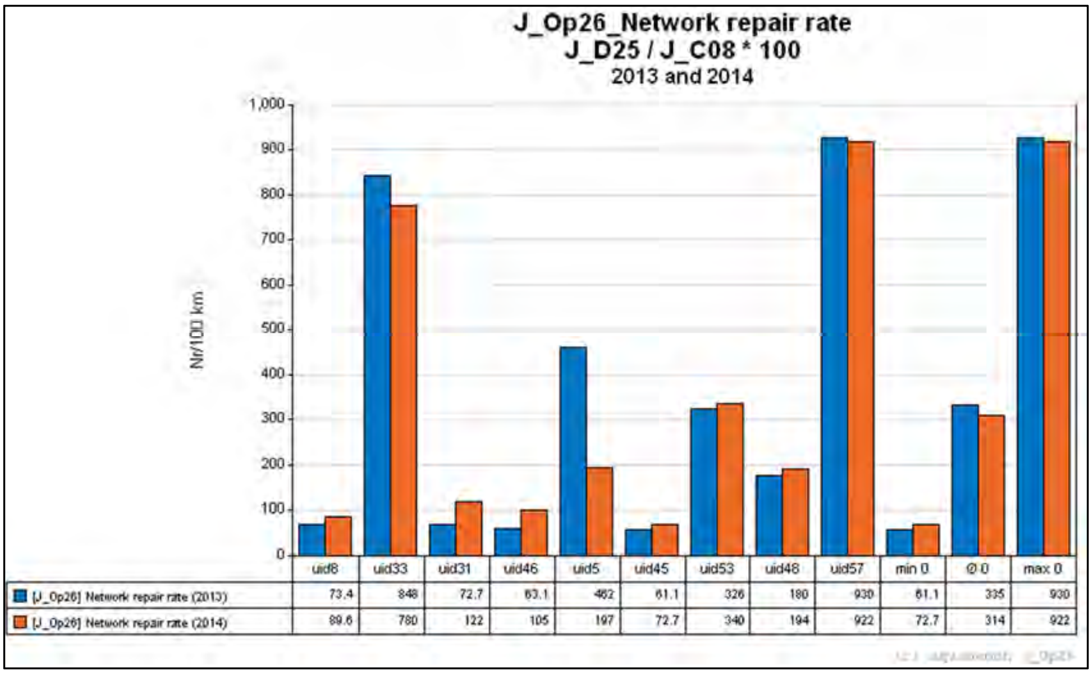


Figure 44: Network repair rate (2013, 2014)

Network repair rate indicator J_Op26 as shown in figure (44) records the density of bursts and other failures in the network, and provides an indication of the condition of the network. It excludes bursts/failures in service connections which are reported separately in J_Op27. It indicates the network status, more bursts and more repairs means bad status of the network and more water losses. Lower the value is better network performance. Utilities with UID33 and UID57 requires significant network rehabilitation programs and illegal connection prevention campaign, because it known that illegal use and networks breakouts affect the network condition and increase repair rate. It worth mentioning that UID5 have significant drop down which triggers further communication and exchange of experiences on water network management practices and to look over lessons learned within witnessed improvement.

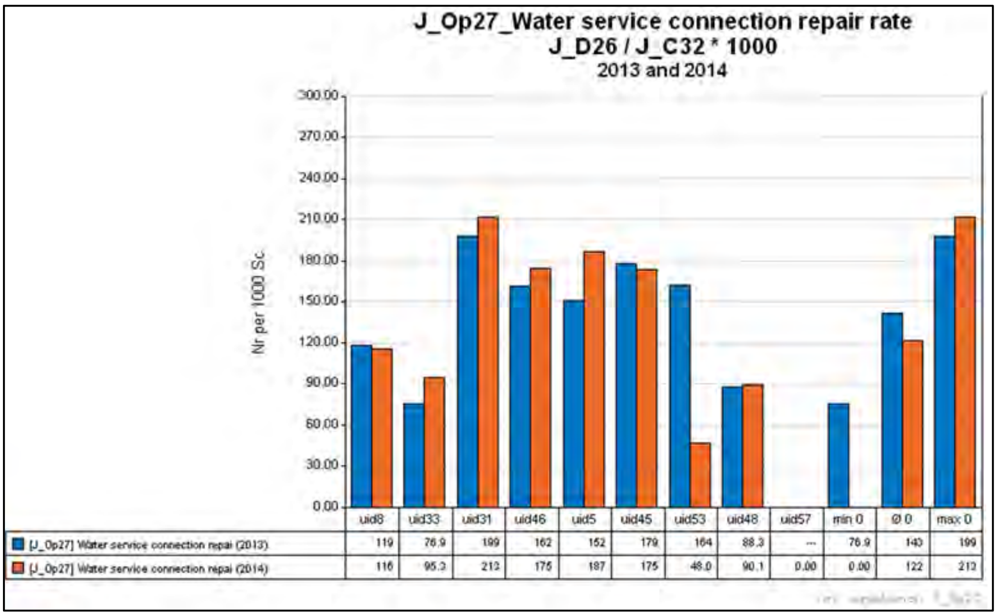


Figure 45: Service connection repair rate (2013, 2014)

Water service connection repair rate indicator measures the density of service connection repairs, and provides an indication of the condition and serviceability of service connections in the network. Service connection replacements should be reported if the replacement is made in response to a failure in the connection. If connection replacements are made for other reasons (for instance part of a capital project to rehabilitate the network) they should not be included within the records of this indicator. Figure (45) shows that service connection repair rate is relatively increasing within Jordanian water utilities. The maximum value recorded for UID31 for year 2013 marks at 199 repairs per 1000 service connection. Further investigation needs to take place to identify the reason behind it whether it is low quality of service connection fittings, or low-skilled workers/plumbers or it is vandalism, illegal usage/ or thefts are the reason.

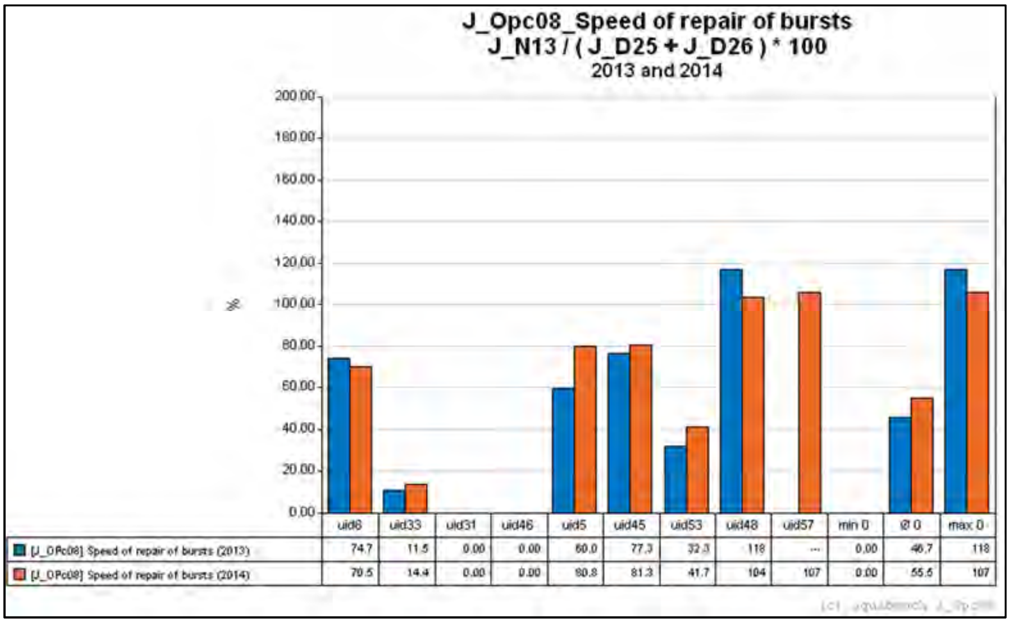


Figure 46: Speed of repair of bursts (2013, 2014)

Speed of repairing bursts indicator records the efforts extended to keep water losses minimal by repairing the known bursts within the target time. It measures the speed at which bursts and other failures in the distribution system are repaired. The target times for repair are those specified in the relevant assignment and development agreements or as otherwise agreed with PMU. Not all utilities provided reliable data on this indicator and especially when it comes to compatibility with targeted response time. However, the average value shows that it is around 55%. Commercialized utilities have better performance on this indicator, this is important to transfer this knowledge and practice to public utilities in order to improve the speed of repairs and save larger water quantities.

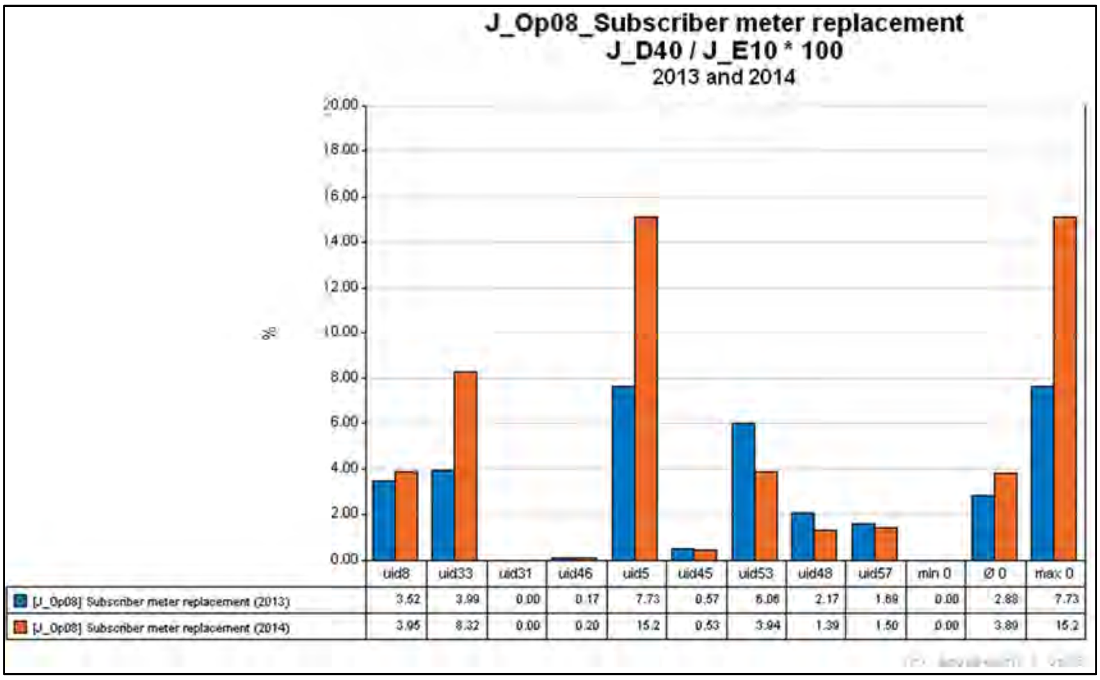


Figure 47: Subscriber meter replacement (2013, 2014)

Subscriber meter replacement indicator expresses the efforts for (regular) replacement of meters in percent of the total number of customer meters (Active Subscribers). These replacements are necessary to reduce meter inaccuracies due to aging. To attribute this activity to improved billing needs time and other measures to reach a higher confidence level in billing. Not all utilities are capable in providing this indicator. Moreover, the utilities who are working on meter replacement programs have better collection ratio and lower water losses associated with meter reading in accuracies, which ultimately to be reflected on NRW rates at the utility. Figure (47) shows that average value of meter replacement percentage is around 4% of total meters count every year, which is quiet low. On another hand, internationally, meters are replaced every specific period of time (i.e. 6 years)

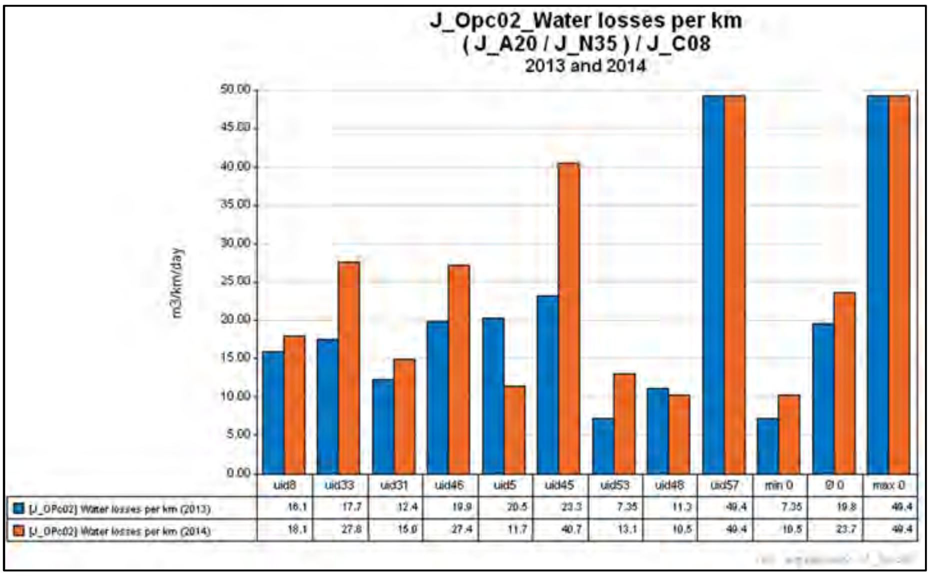


Figure 48: Water losses per km of network (2013, 2014)

Water losses per km length of network indicator measures water losses (including real losses and apparent losses) per km of network. The calculation does not include any adjustment to take account of the fact that the system is not always pressurized. A common unit that could be compared to internationally published data would be m³/day/km. The variables used for calculation of this indicator are partly pretty inaccurate at start of the initiative yet are expected to gain reliability over time. It is noticeable in figure (48) that most of the utilities have larger water losses per km of the network, however, one utility "UID5" had significant decrease of water losses of the network with almost to the half amount in comparison with year 2013 network losses. On the other hand, serious NRW reduction work is necessary at utilities UID33, UID46, UID45 and UID57. This is another indication that more attention and maintenance programs needs to be applied in order to protect and maintain water mains and reduce thefts, violations and illegal usage.

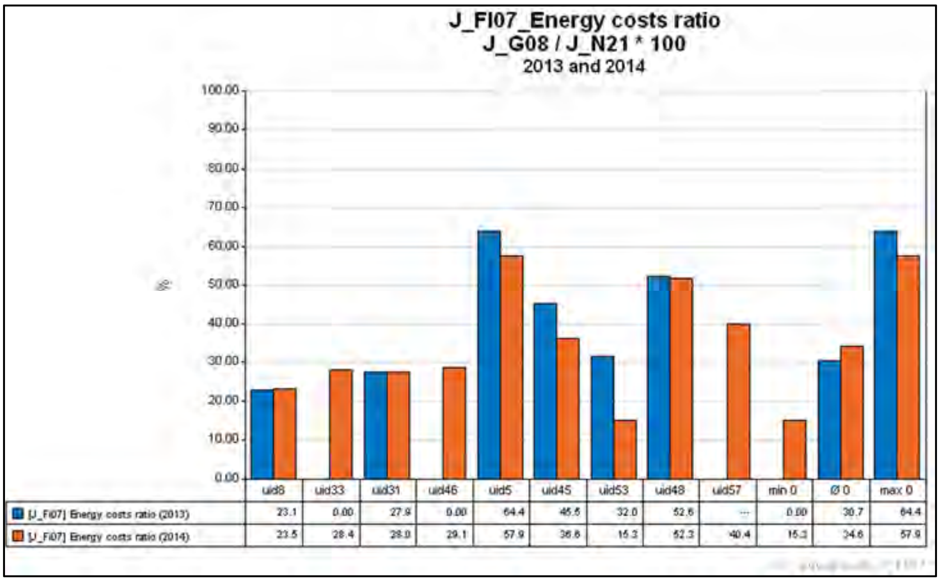


Figure 49: Energy costs ratio (2013, 2014)

Energy costs ratio indictor measures the energy costs as percent of total running costs. It can give a good indication about energy cost ratio at the utility, however, it would be difficult to be accurately measured when water head (elevation) is not taken in consideration. Because Jordan water utilities have different terrain and topography, some utilities heavily depend on pumps and some are managing the system through gravitational flow.

But general analysis would recommend that, utilities which are spending more than average value of 30% in energy costs (Feng. L et al. 2012) as for the case in utilities (i.e. UID5, UID45 and UID48) have to consider energy efficiency programs and energy recovery schemes.

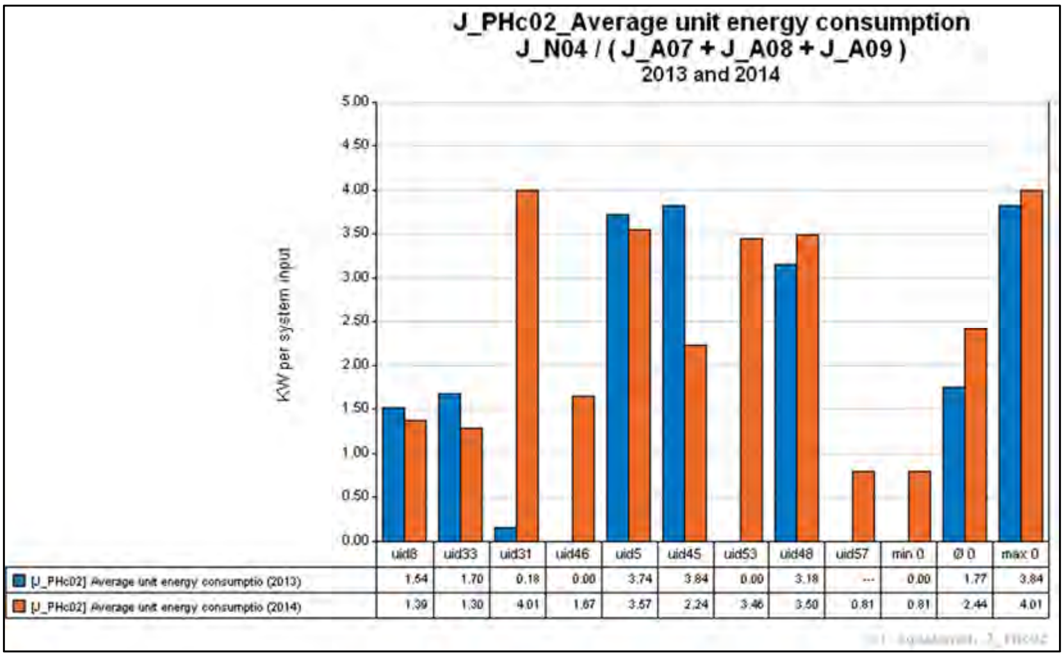


Figure 50: Average energy consumption per cubic meter pumped (2013, 2014)

Average energy consumption per cubic meter indicator measures energy uses per m³ total system input volume, one of the most influential indicators with high impact on the over-all production cost. Careful observation of this value can indicate deterioration of pump/motor efficiency. It also may indicate the need for investments in the distribution network which was quite commonly avoided by means of increased network pressure (short-sighted investment). This indicator gives a good indication about energy used per each cubic meter pumped/produced, however, again it would be difficult to measure when water head (elevation) is not taken in consideration. Because Jordan water utilities have different terrain and topography, some utilities heavily depend on pumps and some are managing the system through gravitational flow. Never the less, the utilities which are using more energy than average value of 1.7-2.4 kWh per system input as show in (Figure 50) have to consider conducting energy audits for their facilities and pumping stations to help them identifying adequate energy efficiency programs or energy recovery schemes.

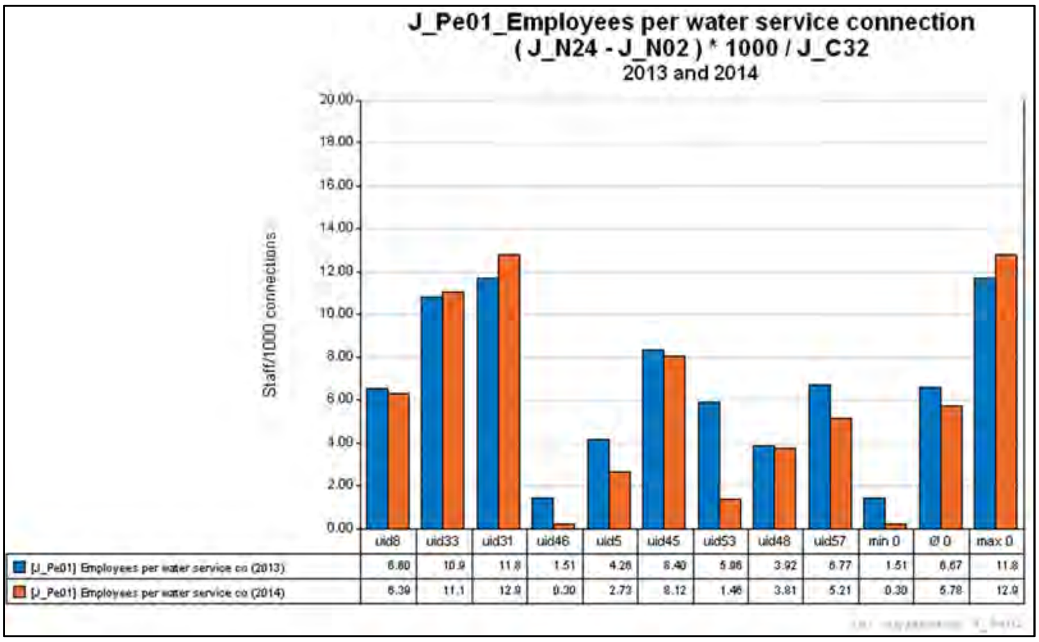


Figure 51: Employees per water service connection (2013, 2014)

Number of employees per water service connection indicator is an internationally very commonly used indicator to get an impression about the dependency of a utility on own human resources. Widely automated utilities are the frontrunners with very low figures. But also, those utilities which make extensive use of outsourcing of part of the works required to provide the services come up with low indicator values however deals only with employees involved in the water services. The average value for this indicator in Jordanian water utilities is around 6 employees per 1000 service connection (Figure 51). However, this value is still high in comparison with international practices as shown in Figure (87). Therefore, utilities with even higher values are required to investigate business mapping processes and automated systems. Or perhaps consider implementing outsourcing and PSP contracts.

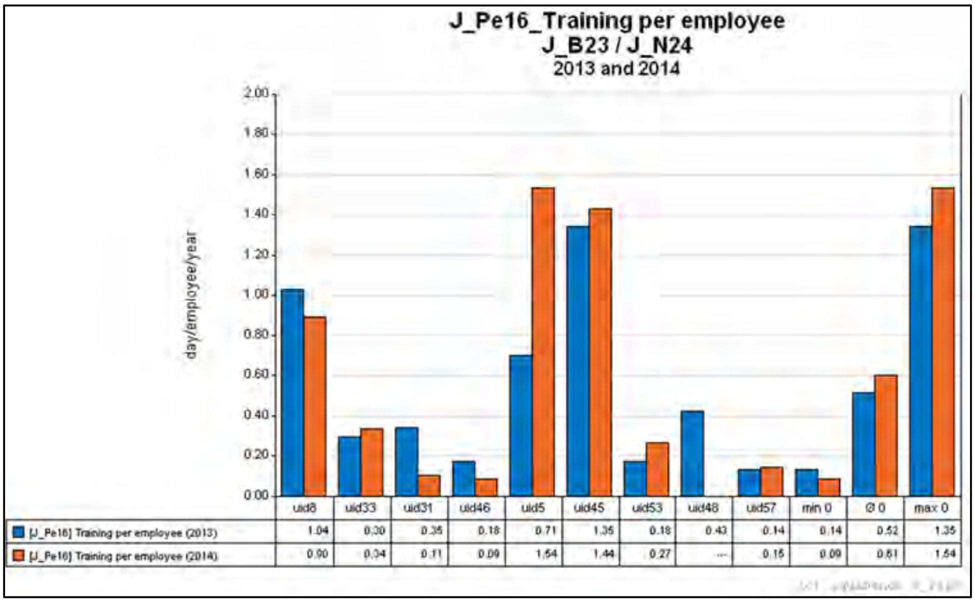


Figure 52: Training per employee (2013, 2014)

Duration of training per employee indicator is expressed in average training day per year per employee; indicates the efforts extended towards better staff qualification. Ideally a high value here should have an impact on e.g. better accuracy of data, lesser repair cases etc. It is significant in Figure (52) that private water utilities offer more training time per employee, thus reflecting on utility operations and service delivery performance. There is a high variance between the minimum “0.5” and maximum value “1.5” training day/employee/year. Moreover, the international target value for staff training should be “5” training days.

4.3.2.2.3 Performance Indicators Correlations

This section includes performance indicators correlations in trial to help understanding utilities operating conditions and identify performance gaps. The following charts are presenting relations between different indicators illustrating the position of (9) utilities based on performance figures for year 2014.

Figure (53) below shows the correlation between the indicators of collection ratio percentage and NRW by volume percentage. It is clearly shown that when collection rate increases, it helps the utility in collecting revenues and covering its operational costs, mainly collecting water revenues is an essential part of it. Thus, will decrease NRW levels. This is clearly shown for example in UID8 where it is covering operational costs with almost 90% collection ratio and scored the lowest NRW (around 28%) among other utilities. By looking at figure (54) we can see that UID8 by scoring collection ratio about 90% is already covering the operational costs for water and sewage services. While other utilities although reached the same collection ratio percentages between 80-100% but could only cover 60% of operational costs, also suffer from high NRW levels as illustrated in figure (53).

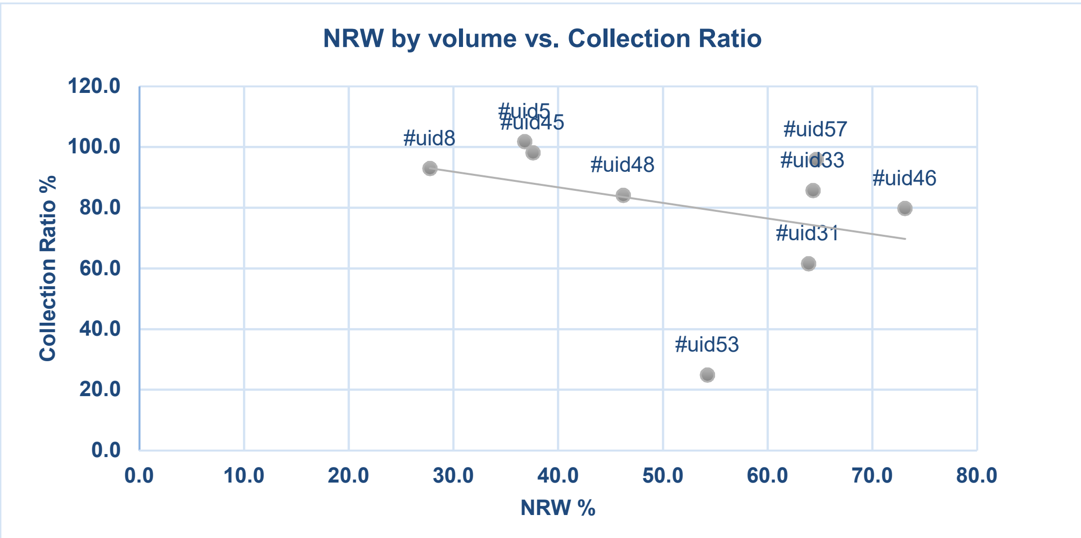


Figure 53: Correlation between NRW and Collection Ratio

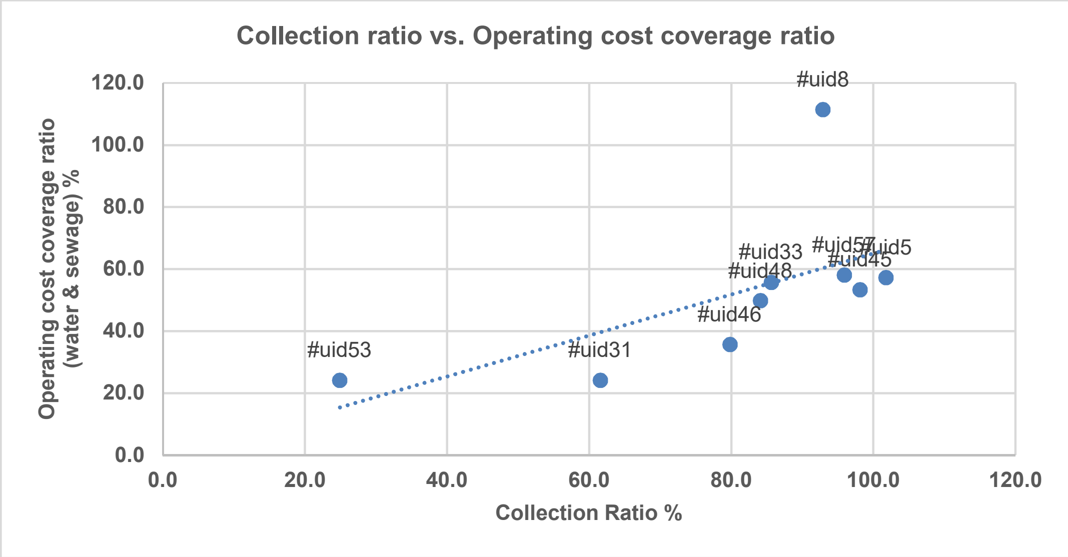
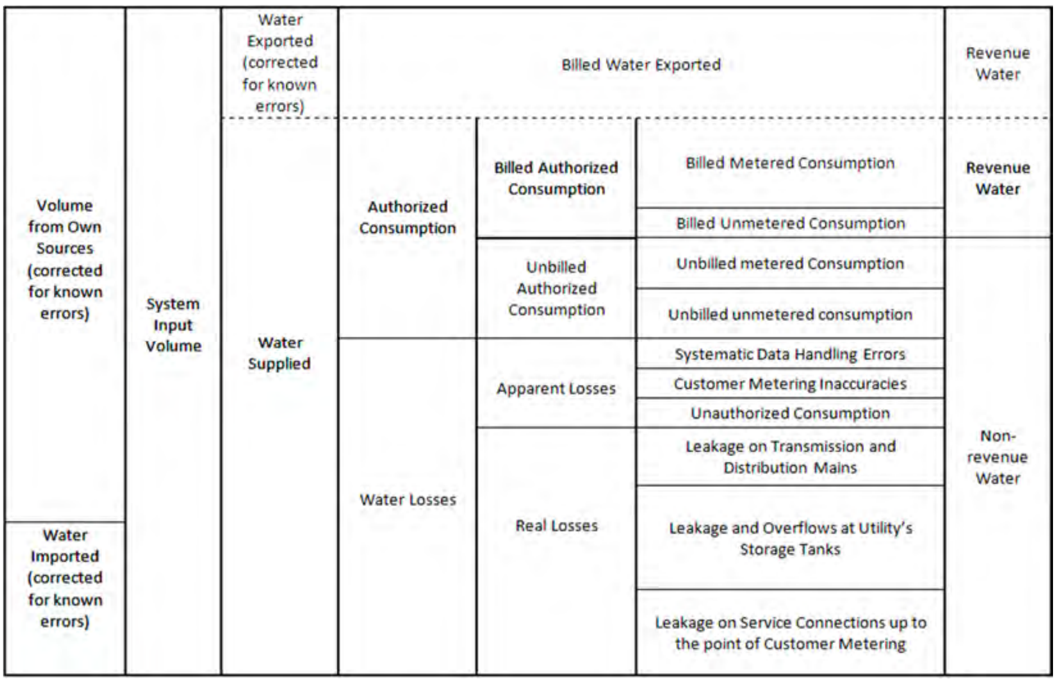


Figure 54: Correlation between Collection ratio and Operating cost coverage ratio

Figure (55) shows the internationally recognized IWA water balance illustrating different segments of water consumption and map out sources of NRW. We can see that share of revenue water is very minimal once apparent and physical losses increase, therefore, when utilities illustrated in figure (53) indicate high collection rate and high NRW levels encourage us to search for other factors affecting high water losses whether it is unbilled authorized consumption or apparent or physical losses as shown in IWA water balance illustrated in figure (55).

It also worth mentioning that most utilities in figure (54) still cannot achieve full cost recovery because water tariff is heavy subsidized by the government and water price is low, so water sales only will not achieve full cost recovery. But in addition, many utilities are suffering from bad operating procedures and consume high energy as it will show in the following sections when Jordanian water utilities energy consumption is compared to other countries.



Source: American Water Works Association (AWWA), Alliance for Water Efficiency

Figure 55: The IWA Water Balance

Figure (56) shows another correlation between NRW by volume percentage indicator and the percentage of network repair rate indicator, it is clearly showing that water networks requires high maintenance suffer from higher NRW rates. UID 33 and UID 57 show high NRW levels and high network repair rate, which indicates the bad condition of its water network. Increasing network repair rate can be associated to frequent attacks and illegal water use (theft) or bad network operation and maintenance leading to high NRW rates. Therefore, and building on above, high network repair rate indicates high water losses and high NRW levels.

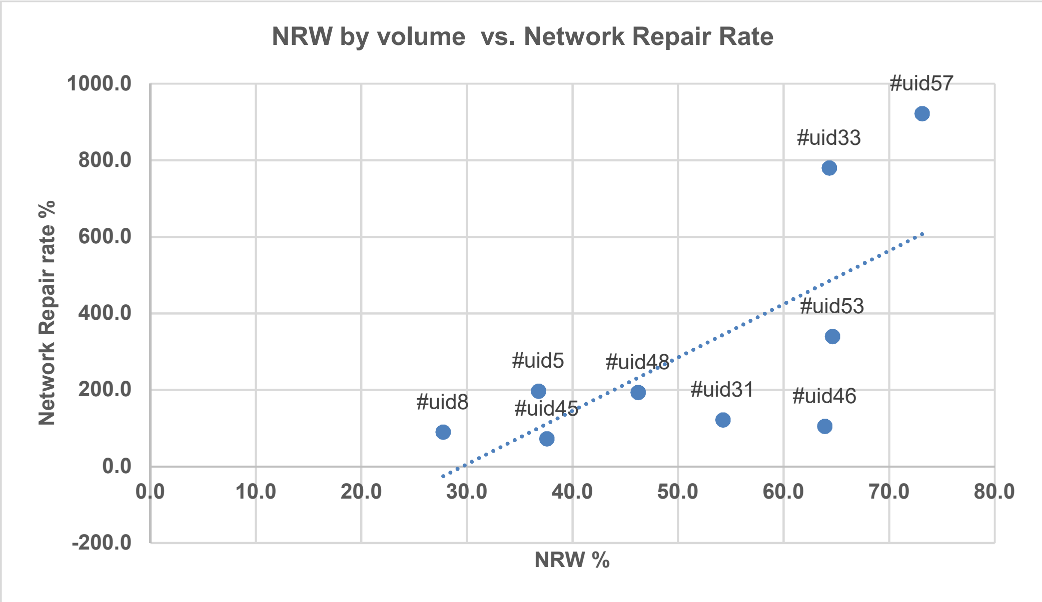


Figure 56: Correlation between NRW and Network Repair Rate

Another correlation in Figure (57) shows the relation between service connection repair rate and NRW by volume percentage. Normally it shows that increasing service connection repairs will reduce NRW levels. However, this is not the case for UID53 and UID31 where they high service connection repair rate in comparison to other utilities but still reflect high NRW rates, this indicate that those utilities are suffering from illegal connections and water thefts at service connection level, or maybe it can be bad fittings and connections which cause high physical water losses. Frequent monitoring on service connections is required to fight illegal connections and assure professional pluming works when establishing new connections.

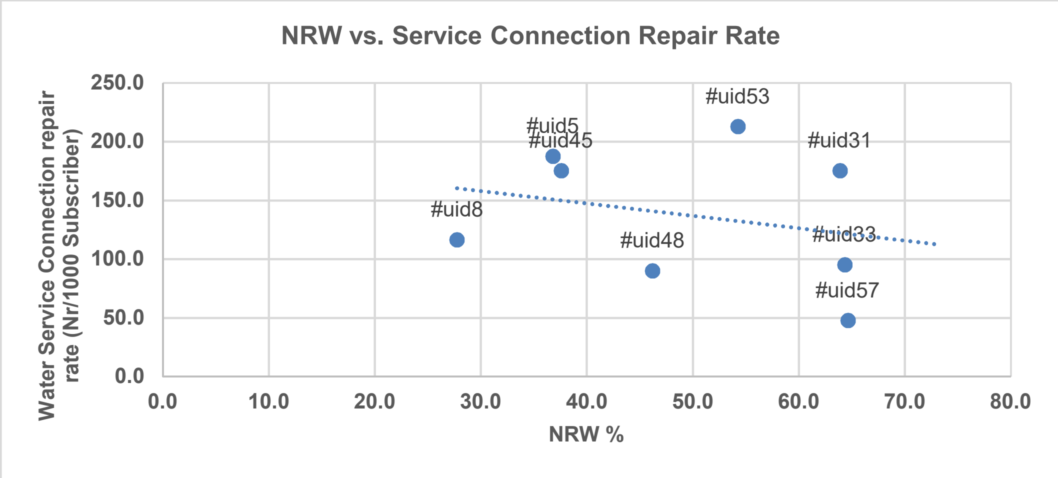


Figure 57: Correlation between NRW and Service Connection Repair Rate

Figure (58) shows an interesting correlation between NRW by volume percentage and subscriber meter replacement percentage. It supports the assumption by which portion of NRW is related to apparent losses due to customer's meter in accuracies. Utilities with lower meter replacement rates have higher percentage of NRW. However, it is not the main reason or even a significant portion of NRW, because for example UID5 and UID33 have high meter replacement rate in comparison to other utilities, but still suffer from high NRW, which means that they need to look at other reasons behind high water losses (physical or apparent losses).

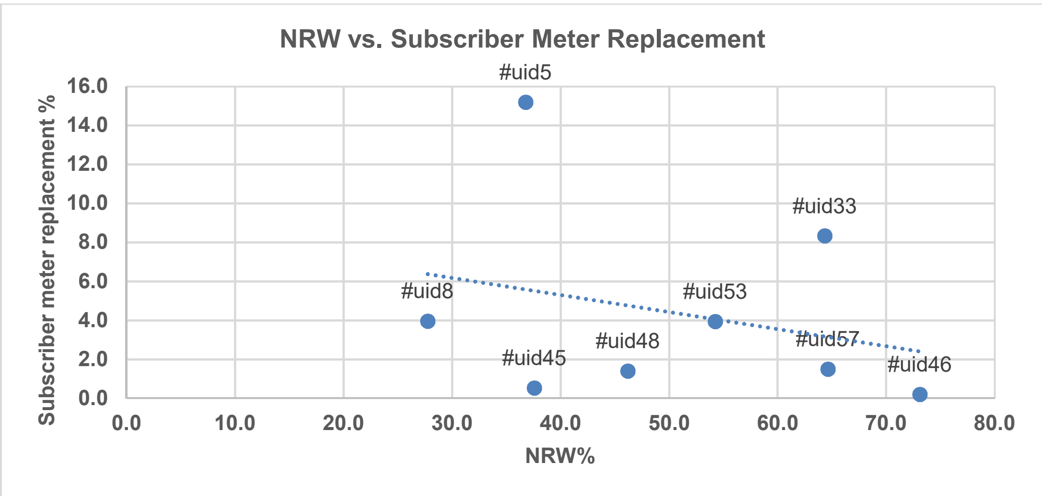


Figure 58: Correlation between NRW and Subscriber Meter Replacement

Figure (59) shows correlation between service complaints and billing complaints. It shows a natural relation (increment proportion) between the 2 types of complaints, but it is not always the case. Service complaints are the highest rate and common in Jordan, this is normal for intermittent supply systems, when water is pumped only for 24 hrs. during the week and some areas face even delays in pumping schedule, shortage of supply or low pressure in the network. Therefore, we can notice that service complaints are much higher than billing complaints. Billing complaints are mainly associated with over registering meters due to technical malfunction in the meter itself, or another reason due to air pumped in the network associated with intermittent supply impact, while mechanical meters' count air released before counting actual pumped water consumption. However, UID5 in comparison with other utilities has the highest percentage of service and billing complaints which needs to be analyzed investigated searching for potential answers and solutions.

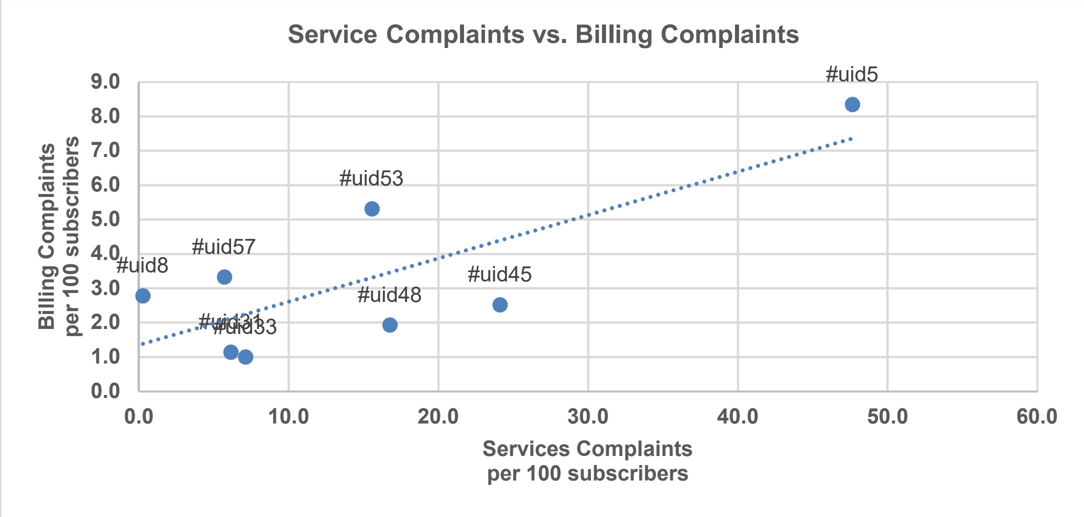


Figure 59: Correlation between service and billing complaint

Figure (60) below shows the correlation between water quality complaints and quality of water supplied, when utility supply high quality water, there should be no or minimum quality complaints. Performance Indicator values for UID31 shows lower water quality test results but no registered quality complaints, also UID53 registered water quality complaints although water quality tests meet WAJ requirements. This trigger further investigation on water quality monitoring and customer service center for both utilities.

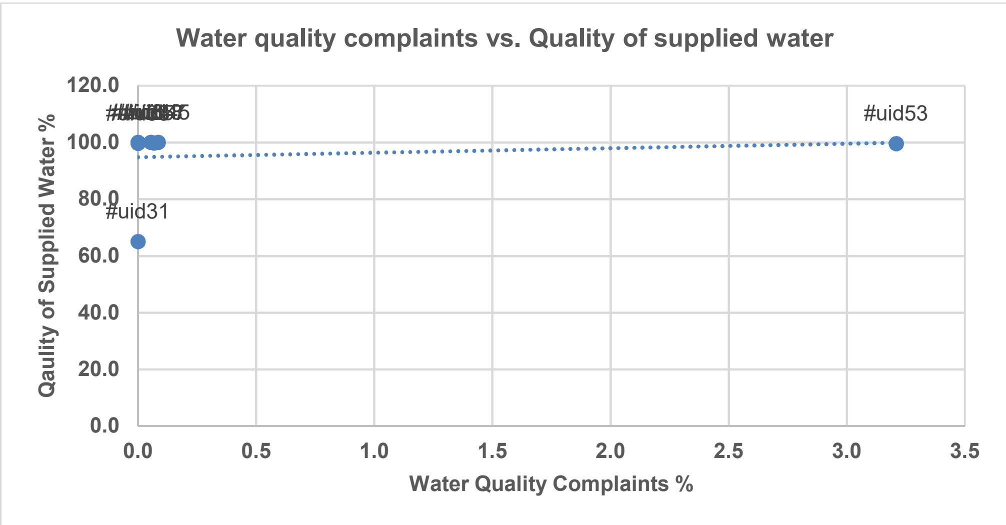


Figure 60: Water quality complaints vs. Quality of supplied water correlation

The next correlation (Figure 61) is about new connection efficiency and number of employees per 1000 service connection. There is no direct relation or trend to be concluded here, but in most cases connection efficiency is associated with lower number of employees to avoid overstaffing problems. But it is more related to the total number of connections and size of service area. Sometimes the procedures for establishing new connection requires longer time no matter what is the number of staff allocated for number of service connections.

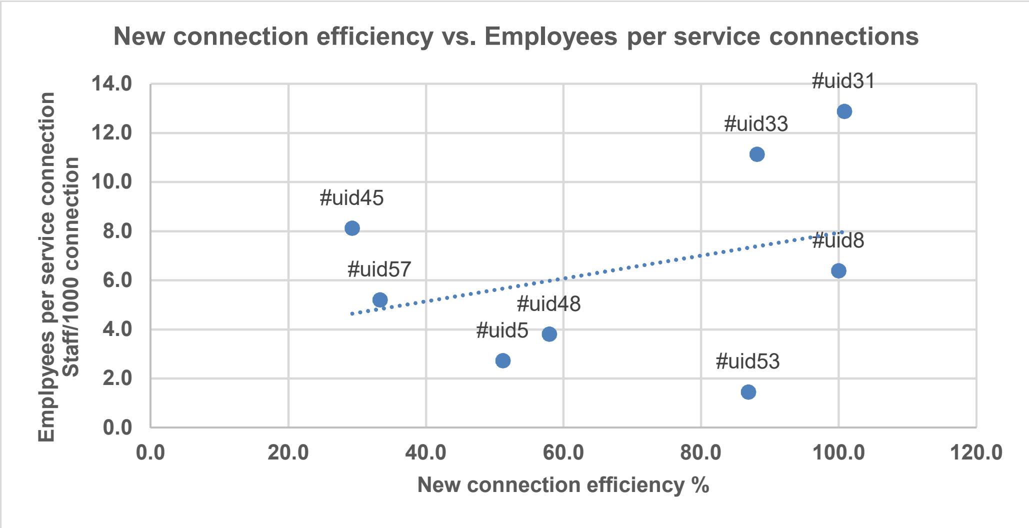


Figure 61: Correlation between new connection efficiency and number of employees per service connections

The following figure (62) shows an interesting correlation between water losses per service connection and water service connection repair rate (number of repairs per 1000 connection). The logical interpretation should denote that more repairs would reduce water losses, however, when repair rate is high and water losses per service connection still score high values, this means that this utility should either revise its maintenance procedures or double check the quality of materials and fittings used in fixing service connections which still cause high water losses. Or it suffers from illegal connections and water thefts, when operations team are fixing leaks frequently but still water loss per service connection is high, as the case of UID45 in figure (62) below.

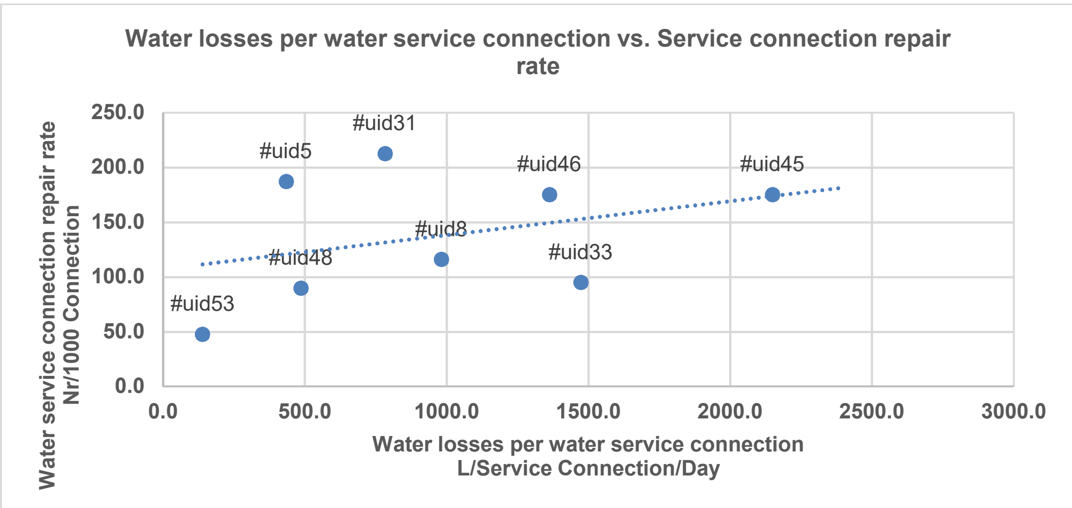


Figure 62: Correlation between water losses per service connection vs. Water service connection repair rate

Figure (63) below shows the correlation between water losses per service connection and water losses per Km network length. It is clearly showing the same behavior for water losses at both network and service connection level. These indicators give only one information about losses level (high or low) and not as it stands for, it doesn't indicate whether losses are mainly occurring in water service connections or in water mains. This sheds the light on revising these PIs and consider using the German method in water loss calculations following in table (23).

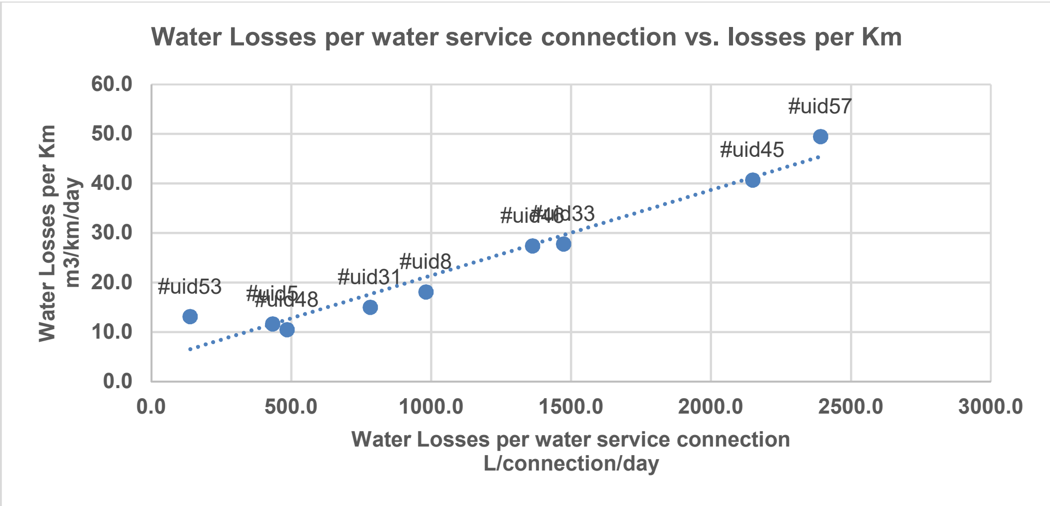


Figure 63: Correlation between water losses per service connection and water losses per Km of water network

However, it can be useful in giving only an indication how much water losses are associated with different measurement scales (per service connection and 1 Km of network length). It gives utility manager or the decision maker a sense of water quantities lost when monitoring water losses on quarterly or semiannual basis.

Figure (64) shows the correlation between NRW and water losses per service connection, the figures indicates that half of water utilities suffer from high losses per service connection which significantly contribute to high NRW. Utilities situated below the trend line still suffer from high NRW percentage but it is not mainly associated to losses at service connection level, this is only an assumption how it may appear from the figure.

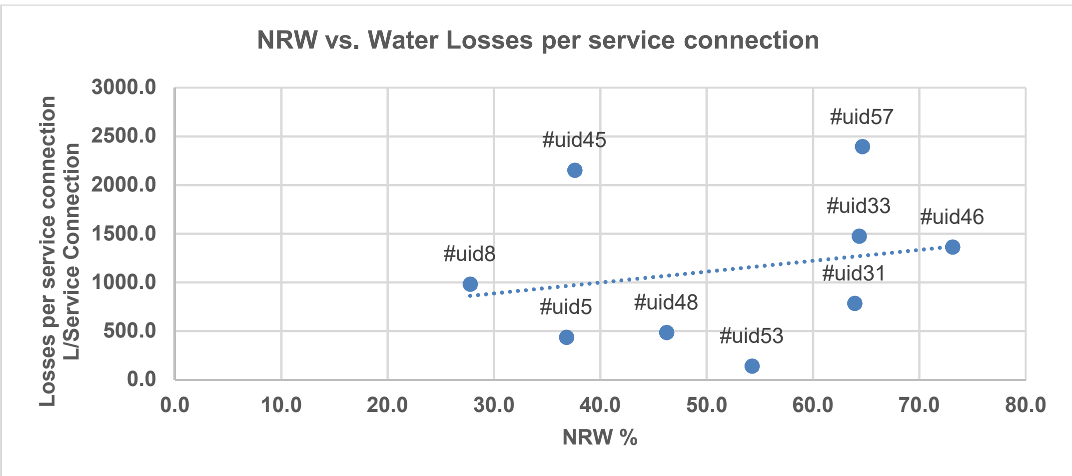


Figure 64: Correlation between NRW by volume and water losses per service connection

Consequently, utilities in figure (65) acts the same behavior as shown in the previous graph which cannot give a clear indication where physical losses are incurring; at service connections level or at water network level. Clearly, these figures/indicators are not used to identify location of losses; however, it is only indicative to the water loss quantity when it divided over the number of service connections within service area or the length of water network for the same service area.

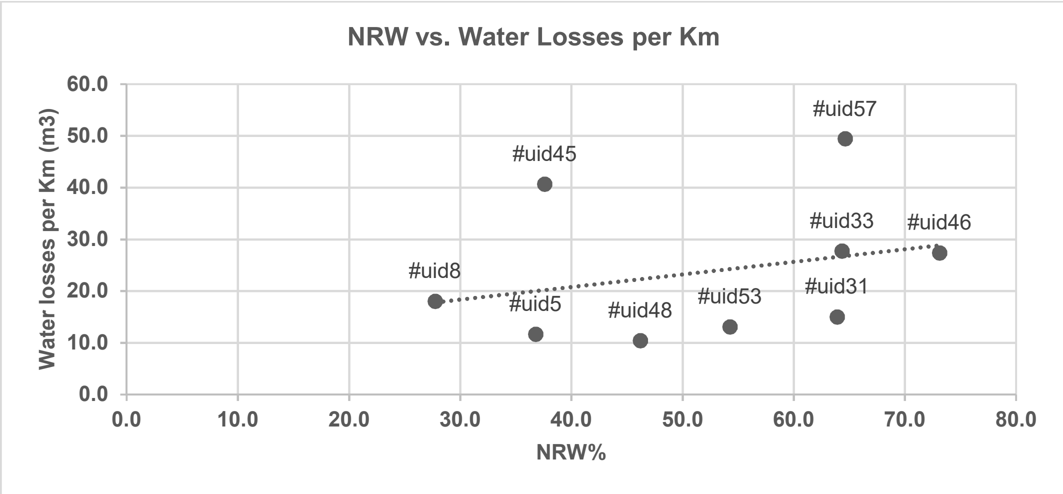


Figure 65: Correlation between NRW by volume and water losses per Km water network

This require further investigation for the difference between networks failures and service connections failures. Figure (66) shows the correlation between water network repair rate and service connections repair rate. This may reflect clearer image about physical water losses locations, as logically located with more sub-connections and fittings problem, in addition to human interaction of illegal use or bad connections. It shows that more work is need to fix service connections leaks than network repairs. However, for example in UID33 and UID53 indicates having illegal use and violation rates over main lines more than recorded over service connections. Again, both explanations can help utility managers in allocating water loss problems and network rehabilitation plans within utility service areas.

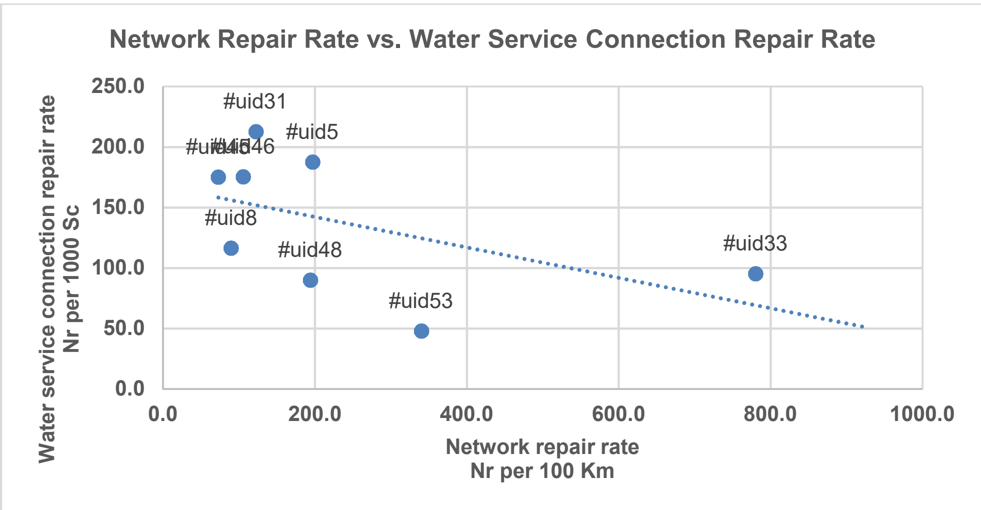


Figure 66: Correlation between network repair rate and service connection repair rate

In trial to understand human resources impact on NRW levels within water utilities; figure (67) showing a correlation between NRW percentage by volume and number of employees per 1000 subscribers. If we assume that UID8 is the best performer with lowest NRW level of 28% and around 9 employees per 1000 subscribers; this means that utilities having higher NRW value and less number of employees are understaffed and need more resources to manage and reduce NRW, and utilities having higher number of employees than UID8 and still suffer from high NRW, it means that they are over staffed, and also lack technical competencies.

For example, UID53 has more than 16 employees per 1000 subscriber and more than 50% NRW. They have enough human resources but they are not efficient/competent. On the other hand, UID33 has same number of staff as UID8 but NRW levels are double rates in UID8 which means the case that it is not only number of staff matters, however, the technical capacities or qualifications to do the job properly and maintain good operating water system.

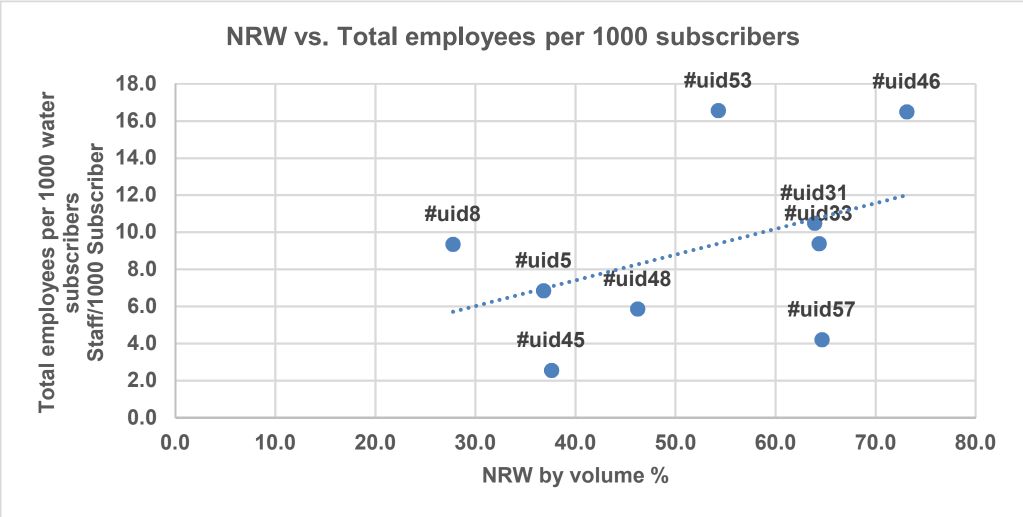


Figure 67: Correlation between NRW and total number of employees per 1000 subscriber

Building on the previous analysis regarding staff competencies, figure (68) shows the correlation between NRW levels and training days per employees. This figure explains the analysis of previous correlation mentioned above and shows water utilities giving more attention to human resources and allocate additional budget for training. If we look at NRW levels in figure (68) below, it shows that NRW rates are increasing for utilities having less training days offered for its staff. Such a result can be driven when comparing UID8 and UID33 in both figures at similar number of staff allocated per 1000 subscribers, but showing variance in NRW performance correlated to training support offered at different magnitudes.

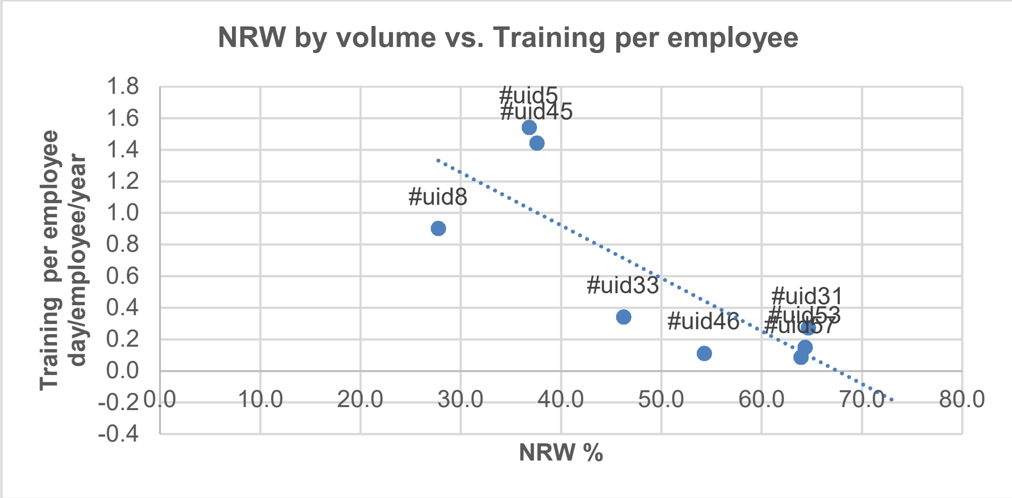


Figure 68: Correlation between NRW by volume and training per employee

Figure (69) below is showing another interesting correlation when you compare number of training days offered in correlation to the total number of employees for each utility. Naturally, the more number of employees working in a utility, the less amount of training days can be offered. Utilities which are situated below the trend line need to give more attention to offer training to its staff. It is also obvious, that overstaffing at some utilities can explain along limited financial resources; the inability to offer training and capacity building programs, where the priority goes to disburse wages and salaries.

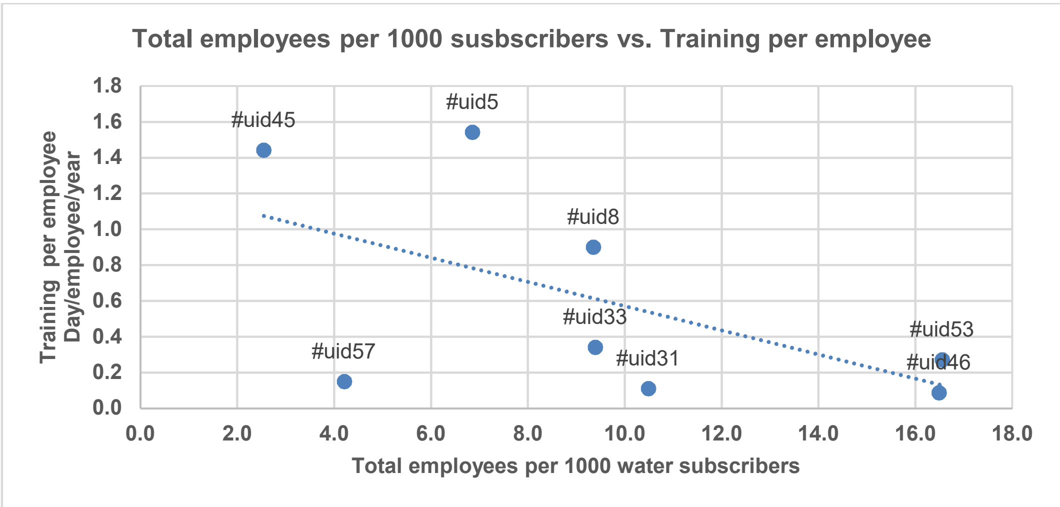


Figure 69: Correlation between employees per 1000 subscriber and training days per employee

It is common that energy costs ratio contributes significantly to water utilities budgets, and mostly, energy consumed in operations (water production and transfer). If we look at figure (70) which shows a correlation between energy costs ratio and average unit energy consumption; we can assume that better performing utility consumes less energy with the least energy cost ratio combination. Consequently, when utilities consume more energy, thus increase energy cost ratio in their annual budget. But some utilities consume less energy per cubic meter of water, but have higher energy costs ratio (i.e. UID53 and UID33), these have to look at other energy consumption patterns in buildings, vehicles and other sources. On the other hand, there are some utilities are consuming more energy per cubic meter of water, but you see that energy costs are less in comparison with other utilities, those probably have heavier budget items such as salaries via over staffing (i.e. UID31 and UID46). This require them to reduce staff members efficiently and apply energy efficiency programs in operations. Generally speaking, all utilities need to adapt energy efficiency schemes as it is essential to achieve cost recovery and ensure utility sustainability.

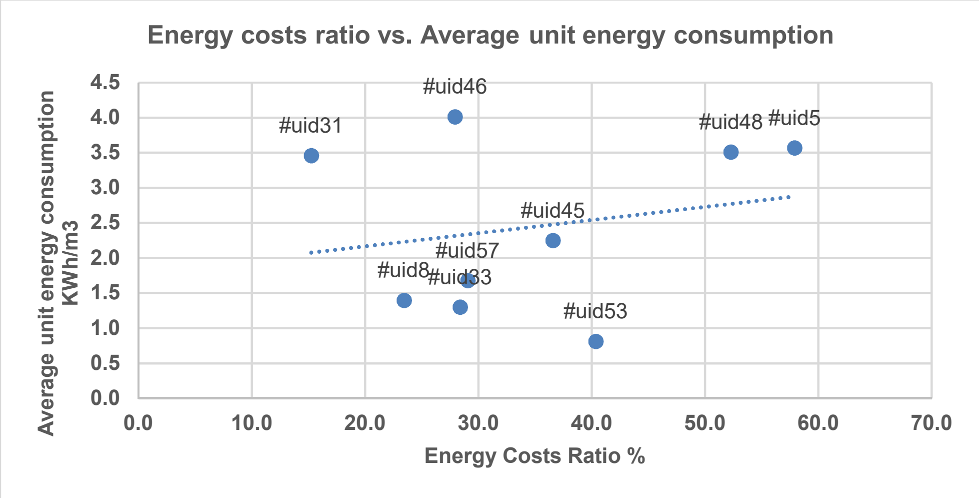


Figure 70: Correlation between energy cost ratio vs. Average unity energy consumption

4.3.2.2.4 Assessment Reporting

Reporting on performance assessment through individual assessment reports were disseminated in preparation for discussion and investigation during the performance improvement workshop. Each utility received a copy of its individual report, every report described the performance of single utility and level of performance (i.e. poor, average, high) over the 27 (KPIs and PIs). Descriptive statistics methods were used to represent analyzed data; using conditional formatting tools within Microsoft Excel software to highlight minimum & maximum distribution of values and percentile positioning. Percentiles representation are useful for showing how a particular score ranks with regard to other scores on the same variable (UC Davis, 2007).

Following to utility's position in clusters based on minimum & maximum distribution of values and percentile positioning; values were coded into colored signs (red: low performer / yellow: average performer / green: good performer). These color signs were arranged according to cluster position following the main general rule of 25% percentile (poor), 25-75% percentile (average) and 75-100% percentile (good performer). It worth mentioning that color coding took in consideration the meaning and purpose of each indicator. In other words, some indicators the higher value means lower performance, in this case, the 25% percentile means good performer, 25-75% percentile still represent average performance and 75-100% percentile means lower performance.

Positioning in cluster and color coding represented good and low performance categories for each indicator within single utilities. Individual utility reports were the feed in material for the performance improvement workshop held to identify benchmarks and performance improvement measures for each utility. The benchmarking exercise grouped participants in 3 clusters:

4.3.2.2.5 Overall Cluster

This cluster compiled all data collected and KPIs/PIs analysis from the 9 water utilities. Figure (71) below shows the results for KPIs highlighted in blue and PIs highlighted in green for all water utilities. However, empty cells mean that it is not applicable at the utility or the utility did not provide the related variables required for KPI/PI calculations. The values are graphically displayed in colored bars illustrating minimum and maximum values. Longer highlighted bar is the higher the value and the shorter bar shows lower value within the overall cluster.

Performance Indicator Description	code	#uid8	#uid33	#uid31	#uid46	#uid5	#uid45	#uid53	#uid48	#uid57
Key Performance Indicators:										
1 Water consumption per capita	J_WRc02	87.05	67.82	70.93	86.91	79.34	85.51	73.92	52.29	52.27
2 Microbiological water quality compliance	J_QS17	100.00	98.96	98.49	99.62	99.72	99.89	98.47	99.94	99.51
3 Water losses per water service connection	J_Op22	981.84	1473.26	782.85	1362.88	433.98	2149.00	139.29	485.61	2391.91
4 Non-revenue water by volume	J_Fi36	27.76	64.34	63.91	73.13	36.80	37.59	54.27	46.22	64.64
5 Collection ratio	J_FIc01	92.91	85.63	61.60	79.82	101.77	98.14	24.92	84.13	95.93
6 Operating cost coverage ratio (water and sewerage)	J_FIc03	111.43	55.72	24.14	35.65	57.23	53.34	24.14	49.78	58.10
7 Subscribers receiving continuous supply	J_QSc01	100.00					4.26			7.50
8 Non-Billing complaints (Service Complaints)	J_QS22	0.27	7.13	6.16		47.66	24.14	15.58	16.79	5.72
9 Billing complaints	J_QS27	2.78	1.00	1.14	1.19	8.35	2.52	5.31	1.93	3.33
10 Total employees per 1000 water subscribers	J_PEc01	9.35	9.39	10.49	16.49	6.86	2.55	16.56	5.86	4.21
Lower-Level Performance Indicators:										
11 Inefficiency of use of water resources	J_WR01	0.14	0.32	0.32	0.37	0.19	0.24	0.27	0.23	0.33
12 Water resource use per capita / system input per day	J_WRc01	456.33	220.39	175.23	311.92	145.44	190.16	161.64	113.40	168.10
13 Water quality tests performed	J_Op32	100.00	151.68	107.25	135.19	100.00	100.00	120.09	88.81	103.83
14 Quality of supplied water	J_QS15	100.00	99.59	64.99	60.34	99.88	99.96	99.56	99.93	99.81
15 Physical-chemical water quality compliance	J_QS18	100.00	99.75	98.25	99.77	100.00	100.00	100.00	99.92	99.89
16 Water quality complaints	J_QS25	0.00	0.00	0.00		0.00	0.08	3.21	0.05	0.07
17 Continuity of supply (Supply Index)	J_QS10	100.00	28.57			53.57	53.57			53.57
18 New connection efficiency	J_QS20	100.00	88.12	100.84		51.17	29.29	86.88	57.95	33.34
19 Network repair rate	J_Op26	89.61	780.46	122.15	105.41	196.79	72.73	340.06	193.91	921.80
20 Water service connection repair rate	J_Op27	116.35	95.27	212.74	175.31	187.43	175.19	47.95	90.05	0.00
21 Speed of repair of bursts	J_OPc08	70.50	14.40			80.75	81.26	41.69	104.36	106.67
22 Subscriber meter replacement	J_Op08	3.95	8.32		0.20	15.19	0.53	3.94	1.39	1.50
23 Water losses per km	J_OPc02	18.07	27.78	15.02	27.39	11.66	40.68	13.12	10.46	49.44
24 Energy costs ratio	J_Fi07	23.45	28.39	27.95	29.06	57.92	36.58	15.25	52.30	40.37
25 Average unit energy consumption	J_PHc02	1.39	1.30	4.01	1.67	3.57	2.24	3.46	3.50	0.81
26 Employees per water service connection	J_Pe01	6.39	11.13	12.89	0.30	2.73	8.12	1.46	3.81	5.21
27 Training per employee	J_Pe16	0.90	0.34	0.11	0.09	1.54	1.44	0.27		0.15

Figure 71: Calculated performance indicator values with highlighted bars (overall cluster)

Those values were translated into colored codes as explained earlier above using descriptive statistics methods (Figure 72). All charts and analysis illustrated in the data analysis section were based on the overall cluster combining public and private utilities in one group (cluster) as shown in figure (72).

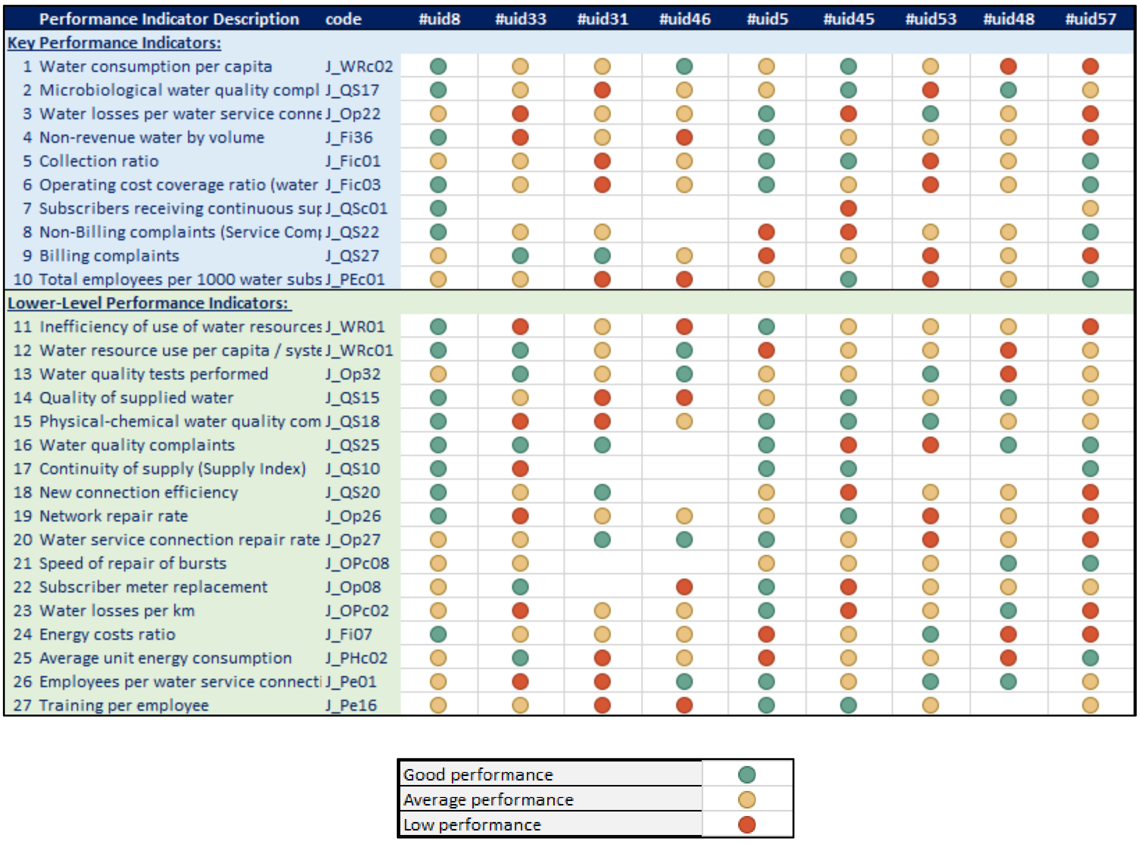


Figure 72: Performance status based on position in overall cluster

The positioning in cluster chart helped in identifying good and low performer within each PI comparison. This is helpful for a single utility to measure its performance within overall cluster, and also it is helpful to plan twinning and matchmaking initiatives to transfer knowledge and best practices between participating utilities. These vertical data sets are the core input for individual utility reports, and also function as performance improvement guide when noticing low performance in a certain indicator.

As stated earlier, the 27 performance indicators measure the overall utility performance through vital indicators tackling certain fields such as (water resources availability and distribution, main water quality indicators, water losses in general approach, financial performance, operations and personnel within the utility). Some indicators are related and some are not, however, they can measure the overall performance of a water utility. Thus, counting each performance status category (good, average, low) was done in to represent the overall performance. Figure (73) shows the overall utility performance ranking for the 9 utilities when are compared in the overall cluster and based on cluster positioning. Utility performance ranking is calculated through combining "good" and "average" performance points together against "low" performance points. Furthermore, blank PI cells for utilities could not report on a certain PIs, points were added to low performance category to complete the total number of 27 indicators.

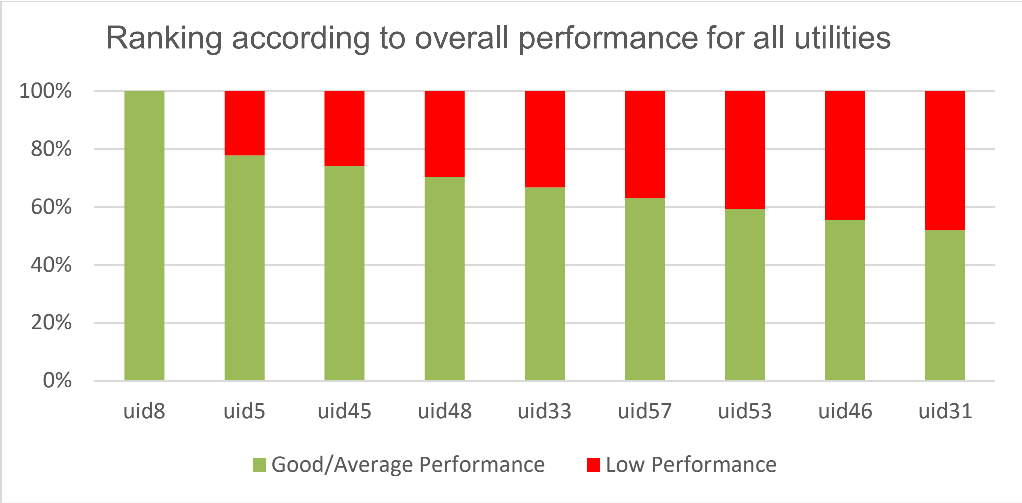


Figure 73: Overall cluster utility performance index

UID8 has the best performance without low performance ranking in addition to UID5 which has around 75% of good-average performance status. While utilities # UID31, UID46 and UID53 occupy/show "low performance" status. The best four ranking utilities are private utilities; it is also noticeable that majority of other utilities are within average performance status. However, these results will vary slightly after splitting utilities in public and private clusters as to be shown in the following sections. It is very essential here to state that ranking utilities here is only displayed for scientific research only, seeking for performance improvement. Thus, it does not imply that utility X is better than utility Y or Z. Because it is well known that boundary conditions are different from one utility to another. This analysis is only meant for knowledge sharing among water utilities and learn from peers.

4.3.2.2.6 Private Utilities Cluster

The private sector cluster includes the private (commercialized) water utilities (UID8, UID45, UID5, UID48 and (recently) UID57. It worth mentioning that UID8 and UID45 have been reporting these PIs and KPIs since establishment because it is associated with the assignment agreement signed with WAJ. However, UID48 and the other management contracts assigned to UID45 for operating UID5 and UID57 still in the early stage of performance indicators calculations and reporting.

Figure (74) shows the overall utility performance for the private utilities when are compared in a closed group, excluding public utilities performance values. It noticeable that distribution of cluster has changed and accommodated different performance status when excluding public utilities performance values. The average performing utility in the overall cluster become a low performer after comparing it within private utilities cluster settings.

	Performance Indicator Description	code	#uid8	#uid5	#uid45	#uid48	#uid57
Key Performance Indicators:							
1	Water consumption per capita	J_WRc02	🟢	🟡	🟢	🟡	🔴
2	Microbiological water quality compliance	J_QS17	🟢	🟡	🟡	🟢	🔴
3	Water losses per water service connection	J_Op22	🟡	🟢	🔴	🟡	🔴
4	Non-revenue water by volume	J_Fi36	🟢	🟡	🟡	🔴	🔴
5	Collection ratio	J_FIc01	🟡	🟢	🟢	🔴	🟡
6	Operating cost coverage ratio (water and sewerage)	J_FIc03	🟢	🟡	🟡	🔴	🟢
7	Subscribers receiving continuous supply	J_QSc01	🟢		🔴		🟡
8	Non-Billing complaints (Service Complaints)	J_QS22	🟢	🔴	🔴	🟡	🟡
9	Billing complaints	J_QS27	🟡	🔴	🟡	🟢	🔴
10	Total employees per 1000 water subscribers	J_PEc01	🔴	🔴	🟢	🟡	🟡
Lower-Level Performance Indicators:							
11	Inefficiency of use of water resources	J_WR01	🟢	🟡	🔴	🟡	🔴
12	Water resource use per capita / system input per day	J_WRc01	🟢	🟡	🟢	🔴	🟡
13	Water quality tests performed	J_Op32	🟢	🟢	🟢	🔴	🟢
14	Quality of supplied water	J_QS15	🟢	🟡	🟢	🟡	🔴
15	Physical-chemical water quality compliance	J_QS18	🟢	🟢	🟢	🟡	🔴
16	Water quality complaints	J_QS25	🟢	🟢	🔴	🟢	🔴
17	Continuity of supply (Supply Index)	J_QS10	🟢	🔴	🔴		🔴
18	New connection efficiency	J_QS20	🟢	🟡	🔴	🟢	🟡
19	Network repair rate	J_Op26	🟡	🔴	🟢	🟡	🔴
20	Water service connection repair rate	J_Op27	🟡	🟢	🟢	🟡	🔴
21	Speed of repair of bursts	J_OPc08	🟡	🟡	🟡	🟢	🟢
22	Subscriber meter replacement	J_Op08	🟢	🟢	🔴	🟡	🟡
23	Water losses per km	J_OPc02	🟡	🟡	🔴	🟢	🔴
24	Energy costs ratio	J_Fi07	🟢	🔴	🟡	🔴	🟡
25	Average unit energy consumption	J_PHc02	🟡	🔴	🟡	🔴	🟢
26	Employees per water service connection	J_Pe01	🔴	🟢	🔴	🟢	🟡
27	Training per employee	J_Pe16	🟡	🟢	🟡		🔴

Good performance	🟢
Average performance	🟡
Low performance	🔴

Figure 74: Performance status based on position in private utilities cluster

Furthermore, figure (75) shows the performance ranking for single utilities within the private cluster. It shows that good performance levels are the highest in UID8 in comparison to lower performance levels noticed for UID57. It worth mentioning that UID57 used to be run under WAJ system till year 2015. Thus, such performance levels are not associated with the overall performance of the other management contract initiated in year 2014 in UID5 for example.

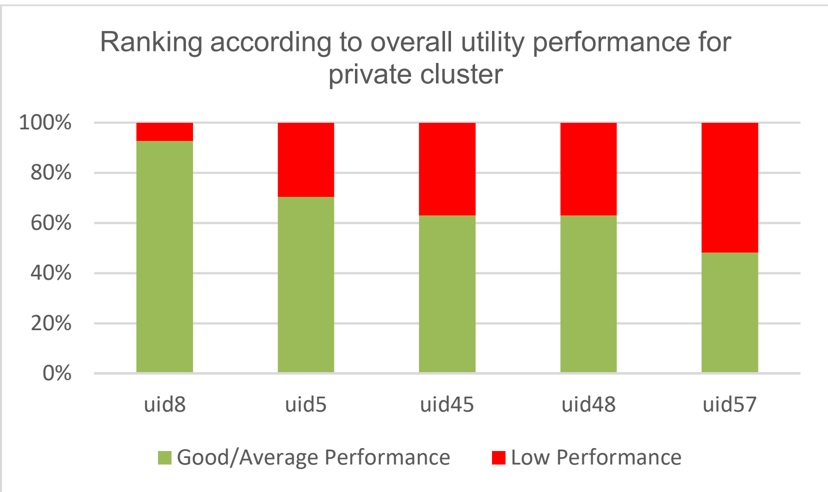


Figure 75: Overall utility performance index-private cluster

4.3.2.2.7 Public Utilities Cluster

The public utilities cluster: includes the public water administrations (UID31, UID33, UID46 and UID53) which still under the mandate and direct supervision of WAJ central administration in Amman. Most of these utilities lacking autonomy, during semi structured interviews; they complained about centralization issues, and lack of financial resources and budget allocations to bring in qualified staff and train existing personnel. Figure (76) shows the performance status for each applicable indicator according to utilities position in the public cluster. It is noticed that average performing utilities have jumped into better performance status because they are no longer measured with the better performing private utilities. This an indication to exchange good practices between public utilities because all of them are following WAJ governing rules and instructions.

	Performance Indicator Description	code	#uid33	#uid31	#uid46	#uid53
Key Performance Indicators:						
1	Water consumption per capita	J_WRc02	Low	Average	Good	Average
2	Microbiological water quality compl	J_QS17	Average	Average	Good	Low
3	Water losses per water service conne	J_Op22	Low	Average	Average	Good
4	Non-revenue water by volume	J_Fi36	Average	Average	Low	Good
5	Collection ratio	J_FIc01	Good	Average	Average	Low
6	Operating cost coverage ratio (water	J_FIc03	Good	Average	Average	Average
7	Subscribers receiving continuous sup	J_QSc01				
8	Non-Billing complaints (Service Comp	J_QS22	Average	Good		Low
9	Billing complaints	J_QS27	Good	Average	Average	Low
10	Total employees per 1000 water subs	J_PEc01	Good	Average	Average	Low
Lower-Level Performance Indicators:						
11	Inefficiency of use of water resources	J_WR01	Average	Average	Low	Good
12	Water resource use per capita / syste	J_WRc01	Average	Average	Good	Low
13	Water quality tests performed	J_Op32	Good	Low	Average	Average
14	Quality of supplied water	J_QS15	Good	Average	Low	Average
15	Physical-chemical water quality com	J_QS18	Average	Low	Average	Good
16	Water quality complaints	J_QS25	Good	Good		Low
17	Continuity of supply (Supply Index)	J_QS10	Good			
18	New connection efficiency	J_QS20	Average	Good		Low
19	Network repair rate	J_Op26	Low	Average	Good	Average
20	Water service connection repair rate	J_Op27	Average	Good	Average	Low
21	Speed of repair of bursts	J_OPc08	Average			Good
22	Subscriber meter replacement	J_Op08	Good		Low	Average
23	Water losses per km	J_OPc02	Low	Average	Average	Good
24	Energy costs ratio	J_Fi07	Average	Average	Low	Good
25	Average unit energy consumption	J_PHc02	Good	Low	Average	Average
26	Employees per water service connecti	J_Pe01	Low	Low	Good	Good
27	Training per employee	J_Pe16	Good	Average	Low	Average

Good performance	Good
Average performance	Average
Low performance	Low

Figure 76: Performance status based on position in public utilities cluster

Figure (77) shows the overall utility performance ranking within public utilities when are compared in a closed group, excluding private utilities performance values. It is noticeable that majority of them rank in similar performance categories and require serious performance improvement, however, there is an indication that UID33 can be of good example to share its good practices with UID31 at certain issues (i.e. average energy consumption, water quality tests, collection ratio and operating costs coverage ratio).

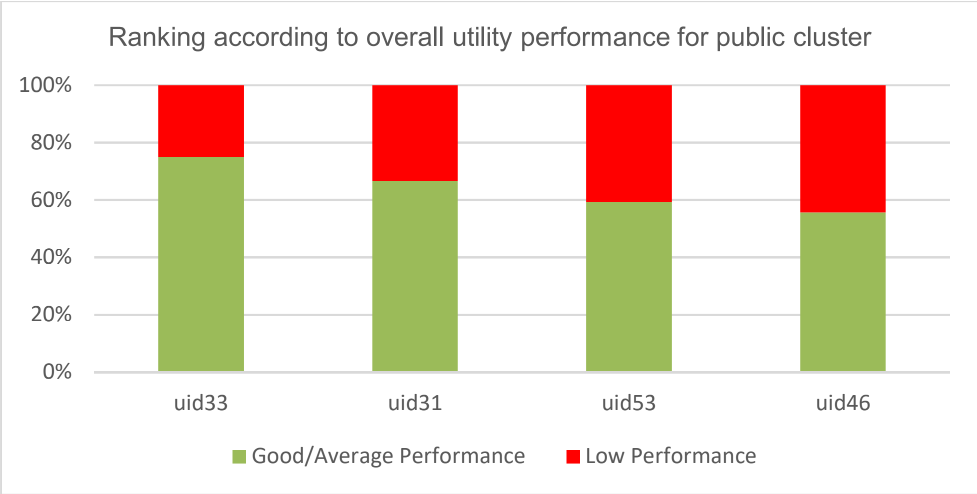


Figure 77: Overall utility performance index-public cluster

4.3.3 Performance Improvement

The main objective of this phase is to identify and prioritize improvements actions, followed by implementation of the improvement initiatives through an action plan (i.e. focusing on the low hanging fruits). However, within this research study; and due to limited budget and timeframe, further implementation of improvement actions was not applicable.

4.3.3.1 Performance Improvement Workshop

Performance improvement workshop was organized at this stage, it was attended by the benchmarking task force members and utility managers, PMU and WAJ officials and EBRD delegates. The two-day' workshop conducted in cooperation with Aqaba Water to give benchmarking participants an overview about good practices in data management, operation and maintenance procedures within Aqaba Water and utilize opportunity to exchange and share knowledge and good practices.

During the first day of the workshop; the final analysis of KPIs and PIs took place with thorough discussion about each indicator and how utilities needs to report with better quality data in the future. Then identification of benchmarks was also explained and implemented, while each utility member holding a copy of his/her utility individual report. Utilities had the platform and unique chance for discussion and interaction to identify reasons behind good and poor performance, and what are the deriving keys for good performance.

During the second day of the workshop, the group went on field visit to Aqaba Water and listened to Aqaba Water company experience in data management and handling in many fields (i.e. accounting system, programming the data bank, data analyses) and how these data management practices helped to optimize other priority operational aspects: energy saving, non-revenue water, documentation, and other subjects related to water utilities daily business (Figure 78). Also, Aqaba Water presented the internal KPIs manual developed by Aqaba water staff to understand and educate all staff members on the data collected and it is importance, they described to audience the first steps in order to have utility team members aware and ready to collect correct data and on a timely manner.

Figure 78: Aqaba Water Field visit and presentation on performance indicators

The benchmarking task force member and utility managers worked on performance improvement exercise as they split into groups and exchanged good practices and management issues based on their performance status outlined in individual reports, and as shared in the first day of the workshop. Then participants were asked to exchange ideas of performance improvement using the performance improvement forms distributed to all participants.

4.3.3.2 Performance Improvement Plans

During the performance improvement workshop, each utility had revised its individual report and looked at performance gaps, identified the benchmarks for each indicator in a group discussion then an exchange of good practices between water utilities took place. This exercise enabled the participants to work on improvement measures. The majority agreed on the following aspects: reduce NRW, increase collection rate, and enhance water quality monitoring and analysis, energy efficiency and use of renewable energy systems, meter replacement programs. Those measures have been documented and summarized in improvement plans (Tables 20-21) listing the improvement measure, actions, timeframe and recommendation for 2 utilities. The complete list of improvement plans exists in Annex (7)

Table 20: Performance Improvement Plan for UID31

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID31	Increase collection of bills	• Increase the number of collectors • Provide incentives for the collectors • Link customer database to GIS database and apply handheld meter readers and doorstep billing • Create customer's database and link it to GIS system	1 year
	Enhance quality of supplied water	• Upgrade water quality laboratory in UID31 to do all quality tests required by JSMO and WAJ • Increase the number of water quality tests • Enhance water quality complaints registry • Handel water quality complaints when they occurred and solve it as soon as possible	1 year
	Reduce energy consumption	• Conduct energy audits on water wells and water pumps and analyze energy consumption patterns and identify cost saving measures • Shut down water wells which don't cover operational costs • Investigate the use of solar energy in water supply systems	2 years
	Increase training per employee	• Prepare training needs plan for employees and provide the required training courses, • Conduct applied exams at the end of each training course to measure the knowledge gained	2 years

Table 21: Performance Improvement Plan for UID8

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID8	Reduce non – revenue water	• Apply pressure management on all DMAs • Meter replacement program • Reduce water leakage complaint response time • Seek government support to cover NRW supplied to Bedouin communities	2 years
	Reduce energy costs as percent of total running costs	• Conduct energy audits on water pumps and energy facilities • Apply energy efficiency management guidelines • Utilize solar energy in electricity production	2 years

The workshop participants highly recommended the continuation of conducting benchmarking for the Jordan water sector and to learn from this initiative for future program implementation.

4.4 Presentation of the new Benchmarking framework

Benchmarking consists of two consecutive components. The first step, performance assessment aims at analyzing performance, comparing it with other organizations within or outside the industry, and identifying performance gaps. The next step, performance improvement is designed to find improvements by learning from the leading practices and adapting them to the own situation. Benchmarking is usually organized in projects (exercises) with start and finish dates. However, from a management point of view, benchmarking should not be considered a single, isolated action but a continuous process because the search for better practices never ends. The benchmarking framework for Jordan water utilities is based on the pilot benchmarking exercise conducted through this research, and following the steps of the International Water Association IWA published book in 2011, titled "*Benchmarking Water Services-Guiding water utilities to excellence*".

4.4.1 Preparation Stage

4.4.1.1 Program Planning

At the program planning stage, it is very important to set clear objectives, thematic objectives and individual utility objectives. Identification of target group utilities and scope of the performance assessment and improvement, in addition to identification of deliverables. Governance of the program will be discussed through defining roles and responsibilities. Recruitment of participants, formulating the code of conduct and confidentiality requirements, communication plan and actions will be also identified for smooth communication through the program.

Objectives:

The primary objective of benchmarking is to achieve the improvement in performance of the participating utilities, other secondary objective is to provide stakeholders with insight (overview) the utility performance and thus offering more transparency. Possible utility objectives in a benchmarking exercise can be:

- Systematic acquisition of essential utility management data
- Assessment of current performance
- Assessment of performance trends (periodic benchmarking)
- Design and review of improvement actions
- Transparency to utility owners and stakeholders

Scope and Deliverables:

The project scope is very crucial and forms the basis for the utilities to decide whether to join a particular benchmarking exercise or not. Grouping the target group is the key to gain comparable results. In order to define the scope of benchmarking exercise, utilities should be surveyed about their areas of interest, challenges towards internal improvement. Another important issue is the level of detail for the benchmarking project (utility, function, process or task).

Depending on the program scope, the following deliverables can result from the benchmarking exercise:

- Data questionnaire and IT solution for performance data handling
- Training workshop and documentation

- Utility visits for data validation, by the project team
- Validated individual data
- Utility individual report
- Consortium report
- Public report
- Workshops and workshop reports (minutes) on cause analysis of assessment results, on best practice exchange, on improvement action planning
- Individual presentations, workshops and deeper analysis and consulting

Governance, Roles and Responsibilities:

The actors and their roles, when participating in a performance assessment effort can change depending on what motivates the initiative. For instance, it will depend on whether the assessment activity is launched "bottom-up" by the industry (e.g. national water associations or several utilities) or "top-down" approach (regulatory authorities or funding agencies). The latter activities should better be called comparative performance assessment, yardstick competition and not benchmarking, since the innovative element of learning from each other (performance improvement phase) is usually missing.

Below is the list of players to be involved in benchmarking projects:

- **Project responsible body:** typical tasks the responsible body (organizer, owner, initiator) of benchmarking effort are coordinating the participants, commissioning the project team and supervising the benchmarking process. A project responsible body is often a consortium of water utilities or national association. In the Jordanian benchmarking pilot project; PMU was the project responsible body.
- **Project steering group:** the steering group is often composed by representatives of the project responsible body. It controls the project development through the benchmarking process. It is sometimes divided into a larger strategic committee and a smaller project group. Additionally, stakeholders like authorities (sometimes funding of the activities) can be invited to a larger steering committee in order to involve them in the general project development. In the Jordanian benchmarking project; the steering group is comprised of the director of the PMU, representative of EBRD and the CEO's-managing directors of water utilities
- **Participants:** participants in the benchmarking projects are water utilities. In the Jordanian benchmarking project; national benchmarking task force was formed representing the 9 participating utilities across Jordan.
- **Operational project team:** external benchmarking experts (consultants, academics, etc.) can be commissioned to provide operational tasks of the benchmarking process. In the Jordanian benchmarking project; ACWUA forms the operational project team and the benchmarking consultant and the researcher was leading the team.

Project Schedule:

The schedule and duration of the project is one of the critical success factors. Benchmarking projects face delays at certain critical points in the process such as:

- Getting enough participants before the scheduled project start
- Changing contact person/or benchmarking liaison officer at the water utility

- Long time needed for data acquisition and validation
- From draft reports to final reports

Financial Planning:

Jordan benchmarking project was totally funded by EBRD. However usually participants cover the costs of their own activities themselves. Additionally, a fixed fee is usually charged to cover common project costs. Depending on project design, costs can result from:

- Costs of participant's activities: utility personnel hours, travel and accommodation costs for utilities (e.g. workshop and meetings participation)
- Common project costs: personnel hours and travel and accommodation costs from the responsible body.
- Assistance of the project coordinator by an external facilitator/project team (e.g. costs for deriving the data questionnaire, for data validation, compilation and analysis, for reporting, for facilitating the improvement phase).
- Organization of the kick-off meeting and the workshops.
- Organization of company visits (during data validation or for know-how exchange during the improvement phase).
- ICT costs (like website, database, certificates, licenses, etc.)
- Translation costs, printing, mail and phone calls, etc.

Code of Conduct and Confidentiality:

In benchmarking project, it is crucial to achieve an atmosphere in which sensitive data, especially weaknesses, are handled with care. A clear code of conduct helps accomplishing trust within participants and a pleasant atmosphere of collaboration which is beneficial to everybody involved. Eventually, the feeling of participants competing against each another needs to be avoided at all costs. Therefore, benchmarking projects are usually set up with strict confidentiality arrangements, generally, three spheres of confidentiality requirements could be distinguished: 1) Interaction between participant and project team. 2) Interaction between participant and participant. 3) Transparency to the public. Code of conduct for Jordan benchmarking project was developed and listed within annexes.

4.4.1.2 Orientation, Training and Program control

This stage is important to tackle issues at the assignment level and the utility level, such as drafting the data questionnaire, identification of the software, tools and web support to handle with utilities' data. Training workshop to kick-off the program should be conducted by the consultant/project team to introduce the program and assign roles and responsibilities to participants. Training on the questionnaire and software handling to be delivered and explained as well.

Preparation of Questionnaire:

Data survey or questionnaires often start with basic utility profile information that help distinguish type, size and other attributes that will ultimately explain differences or factors influencing scoring and results. Some questionnaires for more detailed projects require additional data such as strategic plans and planning documents, performance reports and metric information, practice information, policies, documentation for procedures, prioritization of programs or environmental factors, governance structure, customer base information, etc.

Training of project team members:

Training will be necessary for team members in order to assure a smooth and efficient assembly of data in the appropriate form for analysis. Roles and responsibilities should be identified for data input, performing any analytical and validation processes, interpretation of results, formulation of any special information required. Attendance at internal training and orientation should be mandatory. Jordan benchmarking team was trained by leading experts from aquabench, Germany to administer the program.

4.4.2 Performance Assessment Stage

4.4.2.1 Data Acquisition and Validation

This will be done through a questionnaire to be sent out to participants either by spread sheet or a web based application. After collecting the data, quality comes first through data validation methods: individual plausibility checks of draft PIs, crosscheck of variables, outlier analysis. Jordan benchmarking program used online questionnaire supported by excel spread sheets.

Collection of variables:

It is the duty of the project team to support the utilities during their data compilation, both on the level of data and on the level of workflow of data acquisition as well. The first task during data compilation is to achieve an overview on the required data by an assigned core person or core team. It is very recommended to start with the initial steps immediately after receiving the questionnaire. These initial steps are:

- Screening required data volume and data quality
- Identifying data sources
- Identifying data gaps between requirements and availability
- Allocating the data collection to the different divisions

Data validation by project team:

The incoming utility data should be checked by the project team using several methods:

- Individual plausibility checks of draft PIs: simply by checking the preliminary PIs if they are lying within the expected range or not.
- Crosscheck of variables: to check the consistency of submitted data (i.e. looking at the number of employees to the personnel costs).
- Outlier analysis: through interpreting the preliminary PI results by checking bar charts and scatter plots.

Joint validation by utility and project team:

For utilities participating for the first time in a benchmarking exercise, a visit of a member of the project team is very important. It aims at checking the data together (the utility and benchmarking expert) by structured interviews to grant the required data quality by looking at the data origin and data derivation. Once the benchmarking expert is acquainted with the utility individual context, s/he can validate data levels much better. Also, the draft assessment results and first opportunities for improvement can roughly be discussed during the on-site bilateral data workshop.

4.4.2.2 Data Analysis and Assessment Reporting

Sensitivity analysis will be done for clustering criteria or different PI, in addition to comparability of single PIs over time. Data analysis will generate tables, bar charts, scatter plots and other types of reports in order to generate utility individual report, consortium report, and public report. The workshops serve as a platform to discuss the assessment procedure in order to improve this phase in future exercises. The workshops allow gaining a better insight into the details of the comparative assessment and therefore more information on best practices.

Pre-analysis of utility data:

Before performance comparisons will be carried out, preliminary analysis is recommended to get a feeling for the figures. Resources needed for this step should not be underestimated, especially in new projects. Pre-analysis can focus on the following topics:

- Analyzing the profiles of the participating water services and clustering them according to main explanatory factors for performance differences
- Sensitivity analysis of clustering criteria for different performance measures
- Sensitivity analysis of different denominators for determining which PIs would fit best to assess performance in some certain criteria
- Comparability of single PIs overtime

Data analysis and visualization of results:

The choice of tables and graphs illustrating the comparison results mainly depends on the grade of confidentiality agreed upon within the project. The most common results analysis and charting options are:

- Tables
- Bar charts
- Scatter plot
- Box and whisker plots
- Box plot chart, clustered in peer groups

Utility individual report:

The individual report for each utility is the core tool of the benchmarking effort regarding the main objective of utility improvement. It is developed to foster buy in by senior management and to facilitate the implementation of changes. Therefore, it must be concise and targeted, and shall not only include the assessment results in figures and graphs, but also recommendations and planned actions for closing the performance gaps.

Depending on the scope of the benchmarking effort; improvement actions can be outlined and included as an annex to the individual report. In most cases, utility reports are confidential. The results of other participants must be reported anonymously. It is the responsibility of the project team to avoid any traceability of individual results while generating the reports. Utility individual reports may include the following items:

- Executive Summary
- Benchmarking participant group
- Analysis of individual results
- Comparative benchmarking results
- Key opportunities and process gaps
- initiatives for improvement

Consortium report:

The consortium report is often combined with the individual reports. Its aim is to describe the general context of the participating water utilities, their structure and clustering into peer groups of more or less homogeneous performance conditions. The consortium report summarizes the differences between the peer groups, even providing evidence on why it is not recommended to compare utilities of different peer groups.

Public report:

The goal of a public report is to achieve a certain degree of transparency. The stakeholders of water services (customers, public authorities, donors, employees, general public, etc.) are informed about the benchmarking effort and its outcomes. Due to the confidentiality of many benchmarking activities, the results are published on an aggregate level. For that very same reason, the public report is first drafted and discussed within the project steering group before it is published.

Jordan benchmarking program delivered individual and consortium reports only. Project responsible body (PMU) did not agree to share public report because it is the first benchmarking exercise for Jordan water sector.

Assessment and best practices workshop:

Closed workshops among the participating water utilities together with the operational project team are the crucial link between the assessment and the improvement pause of a benchmarking exercise. Therefore, workshops should not stop at the analysis of the comparative assessment but also focus on exchanging experiences and stepping into performance improvement. The objectives of an assessment workshop are:

- Getting a common view on the general assessment results be presentations of the draft reports from the project team.
- Analyzing reasons for good and poor performances and filtering the different influences of explanatory factors on the performance levels
- Deriving the keys for good practices (e.g. by specific case studies and examples from leading edge utilities in a certain performance area).
- Drafting action plans for improving performance (or at least brainstorming of possible improvement actions).
- General exchange of practical experience among the utilities.

This is where Jordan pilot benchmarking exercise stopped, due to time and cost limitations.

4.4.3 Performance Improvement Stage

4.4.3.1 Improvement Actions

At this stage, utility management needs to step in. The data collection in the performance assessment stage is usually the task of supporting staff, but now choices have to be made about the areas to improve, how to improve, how to prioritize between possible improvement actions, decide on action plans and assign budgets to start the improvement actions. These are typical management tasks and general management, operational management and experts on specific processes need to be involved in this process.

Identification of improvement actions:

Once the performance gaps are known, the process of identifying improvement actions can start. As a result, utilities should prepare a list of prioritized improvement actions, ready for decisions making and implementation. There are two types of improvement actions:

- First type of action is optimizing the existing technologies and working methods: for instance, by adapting the treatment process settings or changing the frequency of billing. In this category, the "quick wins" can usually be found; actions without the need for large investments, with a short implementation time and quick results
- Second type of action is the application of new technologies, innovations, good practices of working methods or organizational solutions. Because the implications of implementing this type of improvement actions are usually much larger than optimizing the existing situation, more research is required and more complex decision making at a higher management level.

Prioritization of improvement actions:

Usually there will be far too many potential actions to implement at the same time, considering the available resources and budget. So, the challenge for utilities is to priorities the actions properly before decision making and implementation.

Implementation of improvement action(s):

From a utility perspective, once the specific improvements have been identified, scoped, scheduled, connected to target values and resourced, and committed by the utility, the work effort needs to be managed as a project in order to assure effective implementation. A project manager or coordinator should be established within the utility, and clear accountability is necessary.

Documentation of progress & results:

Regular reporting and documentation of progress and results should be built into the improvement plans. This may be best achieved by creating regularly, standard improvement initiative reports. This assures accountability, clarity of purpose, increases efficiency of the effort, and creates greater ability to adapt to necessary changes as the improvements are implemented.

4.4.3.2 Review of Improvement Actions

Once improvement actions have been implemented, results have to be evaluated with the objective to check if the previously identified performance gaps are closed. This assessment is the start of an update of the action plan and the definition of new benchmarking needs.

Objectives of this step:

- To check at utility level if the previously identified performance gaps are closed
- To evaluate success of the benchmarking and improvement efforts, including benefits, both at utility and project level
- To assess new benchmarking need

Assessment of improvement success:

The use of performance measures, employee's surveys, stakeholder and steering group feedback and other forms of assessment can be used. Ongoing comparison to performance measures and target values originally established, or regular monitoring against critical success factors may be of particular benefit. Measurable improvement in practices can also be measured. This is sometimes accomplished through structured change management processes.

Assessment of new benchmarking needs:

Benchmarking should not be limited to a single action. After identifying performance gaps and implementing actions to close them, utilities must continue to assess and improve. In this rapidly changing work, business improvement should be a continuous focal point for utility management. Therefore, repeated participation in a benchmarking program is recommended. This enables continual monitoring of performance over time. Also, being part of an active professional benchmarking network makes it much easier to spot new, innovative improvement opportunities.

Final evaluation and documentation:

At the conclusion of the benchmarking process, the exercise itself should be evaluated by the project coordinator and the participants. Part of the evaluation could cover the performance assessment methodology, the project plan, utility benefits, as well as lessons learnt from the project so as to improve the next exercise.

A report can summarize final results and be distributed to all participants. Some level of quality control or auditing of data quality can also be undertaken. This report can be distributed as a final report; or in some instance, it can be an annual report that summarizes progress against plan. Sometimes the plan is also updated. Lessons learned, provided by participants, can be a benefit to each utility as well as other interested parties.

Project closure:

After filing all relevant project documents and communications by the project coordinator, the benchmarking project is closed. When benchmarking projects are part of continual process of a benchmarking program, a long-term relationship is established between utilities and the program facilitators and maintained around efforts to benchmark, report, share practices and build into improvement process of utilities. Nevertheless, each benchmarking project has a definite scope and life, so it is important to bring closure to the project, as originally defined, and then move on to the next one.

5. Discussion and Conclusion

This chapter discusses the outcomes of the pilot benchmarking exercise implemented in this research and compare it with similar benchmarking programs internationally and the region; through looking at the same set of indicators applied in Jordan benchmarking exercise. Testing out benchmarking process was also used to validate the main research question. Despite that fact, benchmarking is an approved approach and widely practiced method to improve performance in the international water industry since the 1990s, hence it is not applied the Jordanian water sector.

5.1 Benchmarking Sector Performance

Referring to section (2.4.5 Benchmarking efforts in the water industry), we noticed that, there are several benchmarking models or schemes to monitor, assess and enhance the performance of water and wastewater utilities. The ministry of water and irrigation and PMU selected to create their own system targeting specific performance categories (financial, operational, personnel, physical, quality of service and water resources) through key performance indicators and lower level performance indicators classification. Moreover, this research rearranged performance indicators following the 5 pillars of German benchmarking system as illustrated in table (22) and compared it to other utilities performance regionally and internationally.

Table 22: Performance indicators cascade over the German benchmarking system

Pillar	Indicator
1- Customer service	Continuity of supply (Supply Index)
	New connection efficiency
	Non-Billing complaints (Service Complaints)
	Water quality complaints
	Billing complaints
	Subscribers receiving continuous supply
2- Economic efficiency	Energy costs ratio
	Collection ratio
	Operating cost coverage ratio (water and sewerage)
3- Quality of Supply	Water quality tests performed
	Quality of supplied water
	Microbiological water quality compliance
	Physical-chemical water quality compliance
4- Reliability	Non-revenue water by volume
	Water losses per water service connection
	Water losses per km
	Speed of repair of bursts
	Inefficiency of use of water resources
	Water resource use per capita / system input per day
	Water consumption per capita
	Subscriber meter replacement

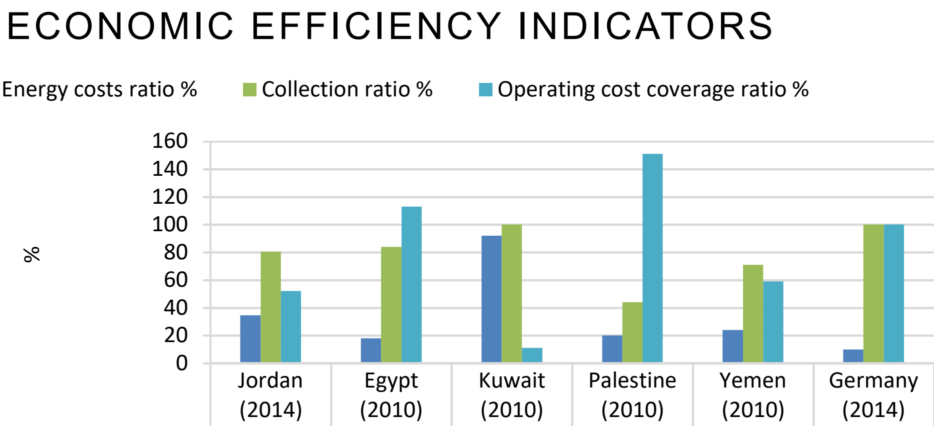
Pillar	Indicator
5- Sustainability	Network repair rate
	Water service connection repair rate
	Employees per water service connection
	Training per employee
	Total employees per 1000 water subscribers
	Average unit energy consumption

The average values of the 27 indicators are distributed over the five pillars of German benchmarking system and compared with other regional/international figure for individual utilities or a group of regional utilities.

5.1.1 Economic Efficiency

Economic efficiency pillar is focusing on cost related indicators, financial and administration processes which affect utilities financial performance. Jordan water sector performance within economic indicators is considered within average values in comparison with the performance of neighboring countries in terms of collection ratio but still there is about 20% requires improvement in collection processes, referring to the national benchmarking results in Chapter (4), collection ratio at Jordan water utilities ranges between (80-100%) which means that some utilities have good performance overall. Moreover, energy costs ratio is moderately high in comparison with other countries, in Jordan water utilities this indicator value ranges between (15-58%). Applying energy efficiency schemes and reducing energy consumption is already within ministry of water irrigation priorities and strategic objectives. Furthermore, energy saving and utilizing renewable energy was among improvement plans proposed by Jordanian water utilities.

The average of Jordanian water utilities is covering only 50% of the operating costs, values recorded range between (52-111%) which still opens the discussion for revising the existing tariff structure and subsidy schemes, serving the poor while help out utilities in covering operation costs (Figure 79), currently water utilities in Jordan are subsidized and cannot reach full cost recovery, this situation is similar to water utilities in Germany post the war, but German water utilities are not subsidized anymore and reached full cost recovery and it is important to look at their working mechanism at tariff structures. However, this research is considered as utility or metric benchmarking to identify the main performance gaps and areas of interventions. Process benchmarking or further investigation over function and tasks level can help us in diagnosing the administrative and operating procedures, which may not assist the utilities in covering its operational costs.



	Jordan (2014)	Egypt (2010)	Kuwait (2010)	Palestine (2010)	Yemen (2010)	Germany (2014)
Energy costs ratio %	35	18	92	20	24	10
Collection ratio %	81	84	100	44	71	100
Operating cost coverage ratio %	52	113	11	151	59	100

Figure 79: Economic Efficiency Indicators[3]

5.1.2 Customer Service

The customer service category looks at communication channels between utility and its customers. Mainly for new service applications response, supply interruptions, complaints service provision complaints, methods of communications, improved services, etc. The reviewed literature on previous benchmarking initiatives looks at customer service category but though different indicators/surveys (i.e. poll or survey asking for personal opinions about water quality and company's service level). Therefore, only benchmarking with Germany average values provided by aquabench database to give indication on how customer service indicators are benchmarked to good practice levels. Both indicators related to service continuity are not highly performed in comparison to Germany or other country with continuous supply because of the known fact that Jordan's water supply run on rationing concept due to shortage of water resources and deteriorated networks which can contribute to high water losses when continuous supply regime is applied.

Significant room for improvement (30%) is required to increase new connection efficiency, system process reengineering can be applied in order to revise the procedures and steps are taken to install new connection. Modern communication tools should be investigated (online applications and payment) with integrated synchronization to Customer Information System (CIS) and GIS database. The average value for Jordan's service complaints is almost doubled when compared to Germany average value, it is associated to the intermittent water supply because water is supplied only for once a week in Jordan and if any technical problem happened during water delivery day, residents (customers) will register service complaints naturally. Indicators shows that water quality complaints value is very low which can correlate to good quality of water supply indicators in the following section. Water quality complaints in Jordan are mainly registered due to intermittent supply and high dosage of residual chlorine arriving at customers' intake. In addition to lack of rooftop tanks cleaning maintenance at customers which can also contribute to large number of water quality complaints aiming at water utilities. However, utilities only register

[3] Egypt, Palestine, Kuwait and Yemen values from reference number: 18
Germany values from: aquabench GmbH database

water quality complaints proofed before customer storage facilities. Water quality complaints inside homes and storage tanks are not registered. (Figure 80)

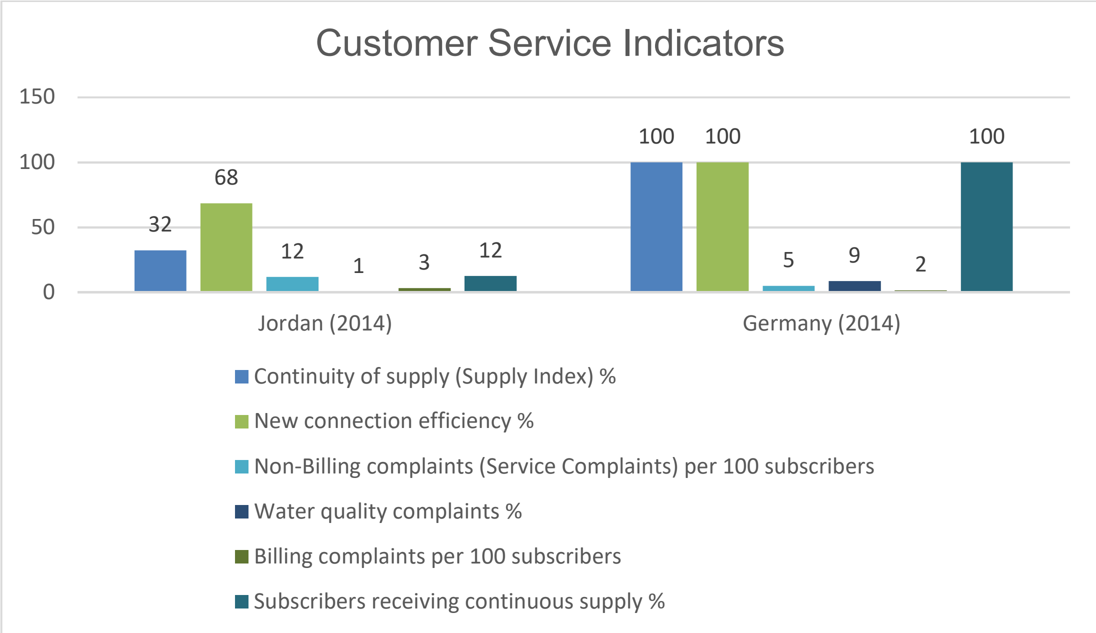


Figure 80: Customer service indicators chart[4]

5.1.3 Quality of Supply

This category is focusing on water quality issues, tests, compliance with biological, chemical and physical water quality parameters. It is the main goal for water utilities to provide safe, clean and high quality drinking water to customers. Figure (81) shows that Jordan water utilities are complied with required water quality tests and complied with quality parameters, however, there was 2 utilities which did not score high on quality of supplied water indicator which negatively affected the results of 92%. However, all main water utilities covering the majority of population are complied with this indicator and match the international good practice of 100% compliance. Therefore, it is essential here for Jordan water utilities to revisit water quality monitoring protocol and set clear water safety plans for each water utility.

[4] Germany values from aquabench GmbH database

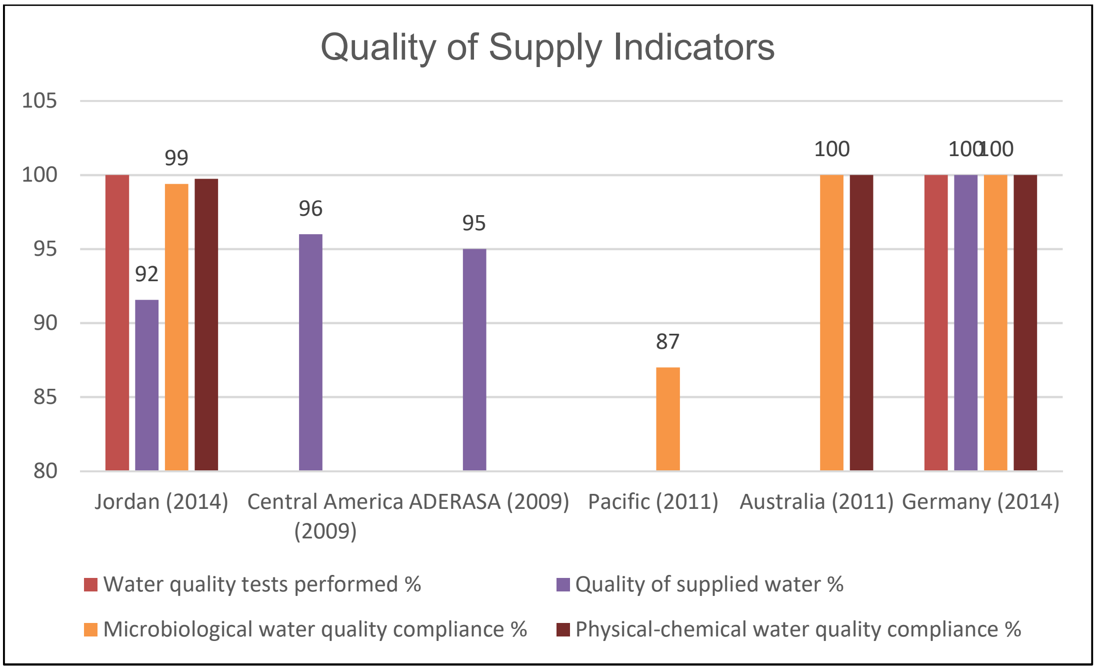


Figure 81: Quality of Supply Indicators[5]

5.1.4 Reliability

Water systems condition including different type of assets, water treatment plants, transmission networks, pumps, storage tanks vehicles and other facilities need to be well maintained and reliable to provide high quality service, therefore, operational indicators which reflect system infrastructure and network condition give clear indication about water service provision associated with the least water losses, and efficient service delivery to maintain sustainable management of water resources.

Performance indicators assigned to this category are related to NRW, water losses per Km of network, per service connection and interrelation to available water resources and reflection over water consumption. As shown earlier in figure (56) NRW rate increases when network repair rate increases in return, this indicates the condition of water network and its reliability to deliver water supply with minimum losses. Another example shown in figure (62) where water losses volume per service connection increases proportionally when water service connection repair rate increases as well. Service connection installation, maintenance and monitoring is another important factor in assessing the reliability of water supply systems.

One of the major challenges facing water utilities in developing countries is the high level of water loss in distribution systems. If a large proportion of water that is supplied is lost, meeting consumer demands is much more difficult. Since this water yields no revenue, heavy losses also make it harder to keep water tariffs at a reasonable and affordable level (Frauendorfer R, 2010).

Figure (82) shows NRW percentages at different utilities from MENA region and international utilities. Values for neighboring countries are obtained from the IBNET benchmarking database, international values were obtained from multiple international benchmarking projects in Africa, India and pacific countries. Although NRW values are

[5] Reference values for Central America and ADERASA (16), Pacific and Australia (46)
Germany reference values from aquabench GmbH database

not from the same years, however, it is used here in trial to position Jordan's average NRW performance with regional and international water utilities.

Figure (82) shows that Jordan is considered among the low performing countries in NRW percentage when compared with regional water utilities, African, south Asian and south American water utilities. However, Pacific and Central American utilities share the same low NRW performance around 50%. Although this indicator is considered among financial indicators reflecting NRW costs and losses since utilities are not collecting any revenue from this water volume, on another hand it is mentioned here to reflect the reliability of supply systems when it comes to water losses. Moreover, this gives rough estimation on water losses but cannot clearly specify whether it is physical, commercial or administrative losses. This result shows the importance and emphasize benchmarking as a tool for identifying problems and searching for a better management practice of water networks.

Hence, the NRW balance is the next step to allocate different categories of losses. Generally, high NRW levels have an impact on service delivery to customers, water quality and financial sustainability. It worth mentioning that the best performer Jordan water utility recorded lower value as 27 NRW by volume percentage.

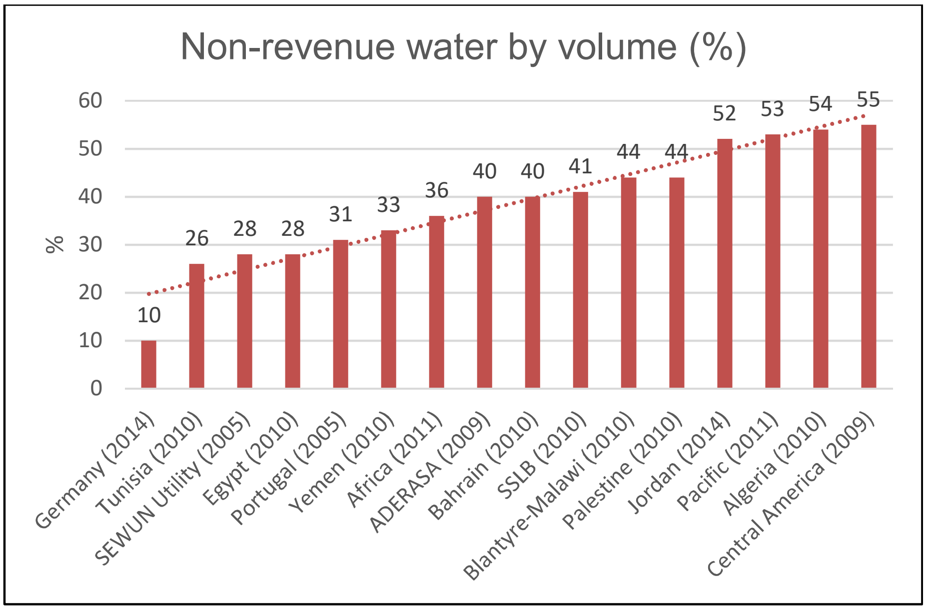


Figure 82: Non-revenue water per volume for regional and international utilities[6]

Water losses per Km of network indicator is used to measure physical and apparent losses per water mains, many utilities do not take in consideration pressure and elevation head parameters when calculating losses. It is simply calculated through dividing total water losses over total water network length. However, this simple, traditional performance indicator to roughly measure losses in water mains and easy way to set targets and improvement actions.

Jordan value positioned around the median value as average performer in this regard (figure 83). Other African and neighboring countries record higher value of water losses in their water networks. Utilities with similar values should pay attention to major water losses in main lines, usually the reason is either deteriorated infrastructure which

[6] Reference values for Central America and ADERASA (16), SEWUN and Pacific (46), Portugal (35), Malawi (34), Tunisia, Egypt, Yemen, Bahrain, Palestine and Algeria (18), Germany value from aquabench GmbH database

require rehabilitation or serious incidents of illegal use and breaks can be inspected on main water lines. It is another issue that Jordan water utilities require paying attention to when designing water loss reduction programs, thus, focusing on retaining well maintained infrastructure and reliable water systems. Utility twinning on national level would be useful because best performer Jordanian utility recorded a value of 10 m^3/Km/Day water lost per Km of water network.

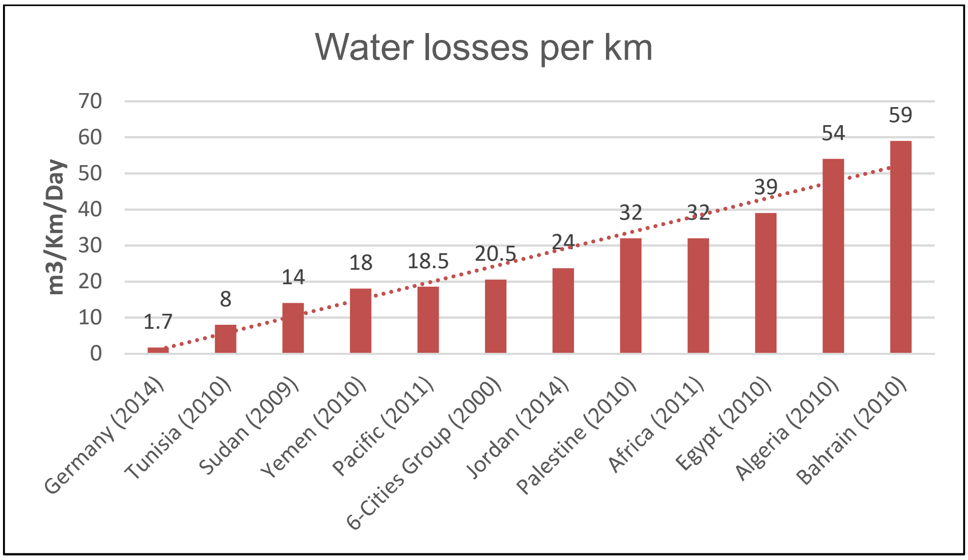


Figure 83: Water loss per Km in different countries and benchmarking initiatives[7]

In Germany, real water losses per water mains is calculated differently, taking in consideration pressure rate at water networks because it is continuous supply. Real losses per mains length is calculated according the following formula:

Real losses per mains length

$$real\ losses\ per\ mains\ length\ (m^3/km \cdot h) = \frac{annual\ real\ losses\ (m^3/a)}{total\ mains\ length\ (km)\ x\ 8760\ (h/a)}$$

According to DVGW W 392 for year 2003, the real losses per mains length (table 23) are the decisive PI and assessment in subject to the structure of the distribution network (rural, urban or metropolitan) can be done following the reference table below classifying the structure of a water supply system on basis of network system input rate.

[7] Tunisia, Sudan, Yemen, Palestine, Egypt, Bahrain and Algeria (18), Africa (58), Pacific (46), 6-cities group (51), Germany values from aquabench GmbH database

Table 23: Standard values for real water losses per mains length in water distribution networks in m^3/km.h according to DVGW W 392 (2003)

assessment of water losses	structure of distribution network		
	area 1 (metropolitan) spec. network system input rate >15.000 m³/km·a	area 2 (urban) spec. network system input rate 5.000-15.000 m³/km·a	area 3 (rural) spec. network system input rate <5.000 m³/km·a
low water losses	< 0.10	< 0.07	< 0.05
medium water losses	0.10 - 0.20	0.07 - 0.15	0.05 - 0.10
high water losses	> 0.20	> 0.15	> 0.10

The differentiated classification scheme of DVGW W 392 (2003) determines that comparisons of this PI are only allowed within a group of comparable and similar structured water utilities. The real losses per mains length of a rural water utility cannot be compared with those of a metropolitan one.

By looking at similar physical loss indicator; losses per water service connection still considered high in Jordan in comparison to African water utilities or western utilities (i.e. Canada. Figure (84) depicts that water utilities in the pacific have also higher water losses per water service connection. Again, this indicator gives water utility managers an estimate of how much water volume is lost at connection level. Furthermore, simple calculation method is used by dividing total water losses over the total number of water connections then dividing it over the number of service connection repairs which are not completed in target time. Jordanian water utilities should revise standard operation procedures (SOPs) followed to repair leaks at service connection level.

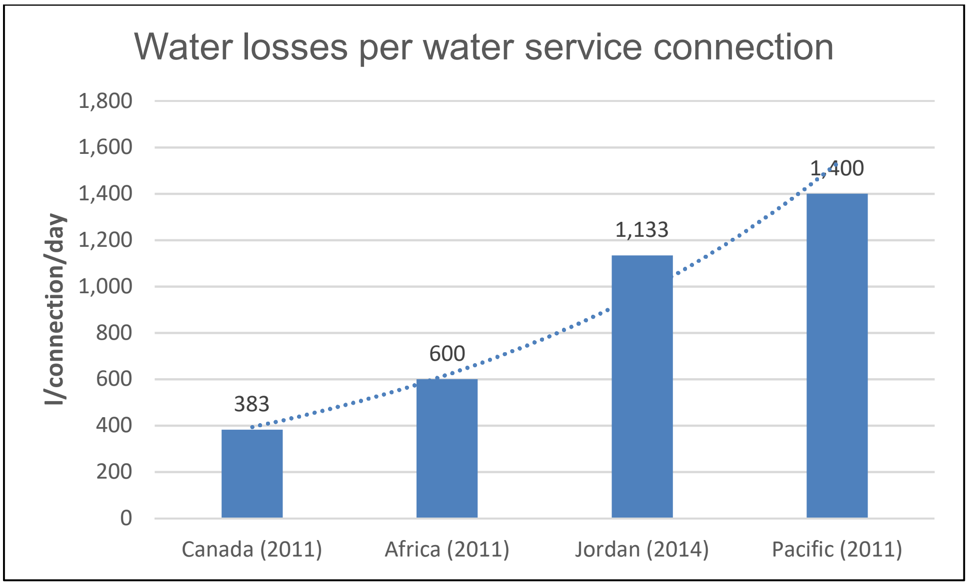


Figure 84: Water losses per water service connection at selected regions[8]

Water resources per capita measures available water resources within utility system input without taking in consideration any losses due to water treatment, transmission

[8] Canada reference value (1), Africa (58), Pacific (46)

and losses. It is an indication for water resources planning when it is compared to water consumption. It helps water utilities to control water distribution among different regions and especially during water droughts and shortage conditions. Moreover, monitoring this indicator next to water consumption per capita reflects a quick indication about the reliability of system delivery. Values in figure (85) shows that only 34% of system input volume is consumed by the end user, where the remaining 66% is lost in water treatment and transfer processes. But after looking at NRW and physical water losses indicators (per Km network and per service connection), it is interpreted that water is lost in main lines and service connections and other potential causes of water thefts and illegal usage.

In June 2015, Jordan times had reported according to a government official that WAJ have had discovered many illegal connections on water mains in southern Amman, which were diverting more than 5,000 m^3 of water per day to nearby farms. Water thefts and illegal use is a hot issue in Jordan's water sector, therefore, Jordan's national water strategy (2016-2025) gives stern attention to tackle illegal uses because it is one of the major issues affecting the supply of water for domestic and other uses (MWI, 2015). The ministry had launched a campaign in 2013 aiming at stopping all illegal uses including; closing illegal groundwater wells, amending the legislations by increasing penalties and enforcing of this amended legislation, communication and outreach strategy also was designed to help in implementation (MWI, 2015)

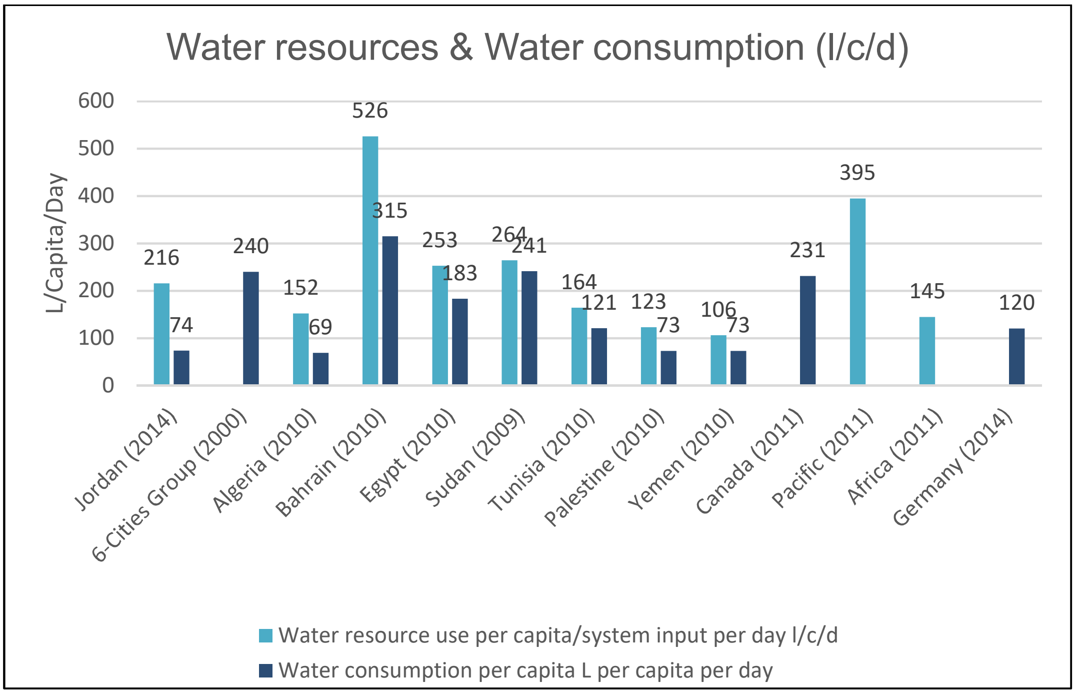


Figure 85: Water resources input and water consumption at different counties[9]

5.1.5 Sustainability

Sustainable water systems are the key for successful and effective water and wastewater operations and better services. Sustainability with its wide definition about managing available resources in economically viable approach and environmentally sensible objective, social equity and stakeholder engagement in a holistic process to

[9] Reference value for 6-cities group (51), Algeria, Bahrain, Egypt, Sudan, Tunisia, Palestine, Yemen (18), Canada (1), Africa (58), Pacific (46). Germany reference value from aquabench GmbH database

save existing resources for future generations. When applying sustainability concepts on water and wastewater utilities, they will run in a healthy and self-sufficient manner.

In terms of water sustainability for water utilities, sustainability has been defined in multiple ways. According to the American Water Works Association's (AWWA) sustainability can be achieved through providing adequate and reliable water supply of desired quality – now and for future generations – in a manner that integrates economic growth, environmental protection, and social development (AWWA 2016). AWWA's definition also states that sustainable water utilities might adopt such financial actions as asset management practices and a full cost of service rate structure that allows for the generation of revenue to maintain and protect their infrastructure (Herrick Ch., et al. 2013). In supporting of this approach; according to the Alliance for Water Efficiency (AWE); water utilities sustainability is very crucial to fiscal sustainability where it refers to a water provider's ability to generate sufficient inflows of revenue necessary to provide quality service and meet financial obligations (AWE 2012).

Whereas, the German water industry stressed out in the profile of German Water Sector profile that in order for water sector to remain sustainable; it needs to be efficient, to cover costs and be transparent for the customers (ATT., DBVW., DWA., BDEW., DVGW., VKU. 2015). Today, with limited water supplies and expensive energy, evolving systems should focus much more on increasing water efficiency and minimizing energy use (Daigger G. 2011), therefore, operators in the German water sector make great efforts to treat water and wastewater with a minimum expenditure of energy.

Eventually, adoption of new technologies and efficient energy consumption, sustainable financial planning and improved rehabilitation strategies will not be applicable without having a qualified and enhanced staff professional skills. This point was prominently highlighted through semi-structured interviews conducted with utility managers at the early steps of research methodology, asking about the main factors achieving sustainability for water utilities.

Performance indicators selected for discussion under sustainability pillar within this research, are mainly focusing on network infrastructure status, personnel, and energy consumption. Figure (86) shows the network repair rate in Jordan in comparison to other benchmarking initiatives (i.e. 6-Cities Group, ADERASA, Canada and Central America). Jordan water utilities has a high value in comparison with other western utilities, but in comparison with ADERASA countries (Argentina, Bolivia, Colombia, Costa Rica, Chile, Nicaragua, Panama and Peru) network repair rate values are quite similar. In Jordan, the reason behind this result because of deteriorated water networks, geographical terrain and mountainous service areas, and most importantly, illegal uses (thefts) and criminal attacks against water mains. All of the above increases network and service connection repair rates and contribute to high water losses as shown earlier in figures (56 and 62). Such network condition is not sustainable and will not help water utilities in delivering safe and clean drinking water to the public. Water utilities need to review their infrastructure sustainability plans and follow international good practices of strategic asset management.

Referring to Jordan's national benchmarking figures in chapter (4); this indicator ranges between 72-922 repairs per km of water network. This shows that some good performing Jordanian utilities are following good management practice to its existing water infrastructure. Thus, can support low performing utilities and transfer knowledge and know-how on this regard. It is also worth mentioning that commercialized utilities in Jordan are the ones which recorded good performance within water network status, which raise the question again about management structure, work flow and standard operations procedures variances between public and private utilities.

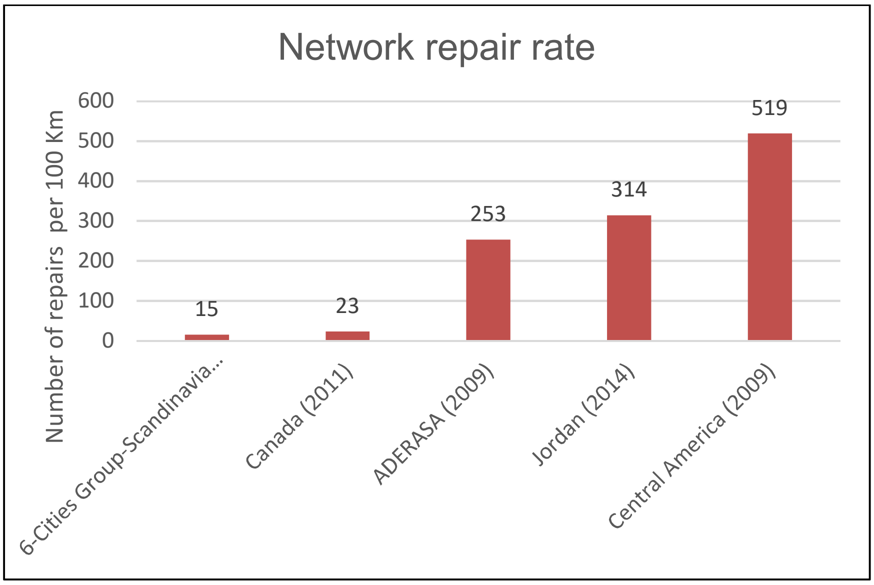


Figure 86: Network repair rate value from different benchmarking initiatives[10]

Number of employees per service water connection or the staff productivity index (SPI) is an important measure of the efficient use of human resources in a utility (only water services), it relates the number of employees to the number of water connections (WOPs Africa 2009). Lower number denotes better performance and sustainable operations by a qualified staff. Jordan has an average staffing rates (Figure 87) when compared with 5 staff/1,000 connections internationally recommended staffing targets for developing country utilities and the 2 staff/1,000 connections for developed country utilities (Tynan N., Kingdom B. 2002). International benchmark is not a rule, because number of staff/1,000 connections should be analyzed along human resources costs within utilities overall budget.

This indicator is widely common to get an impression about the dependency of a utility on its own human resources. Automated utilities will own the least figures in this case, but also those utilities which extensively practicing outsourcing of part of the works required to provide the services. Figure (87) shows Jordan’s position with another similar indicator but this time total number of staff per 1000 subscriber, by which, calculations in this case includes number of water and sewage services staff within utility. Here the indicator reflects less performing for Jordan water utilities, where it has higher value than SEWUN and Central American utilities. Furthermore, serious overstaffing cases would be a burden on utilities budget and harm its financial status and long term sustainability.

[10] Reference values for 6-cities group (51), ADERASA and Central America (16), Canada (1)

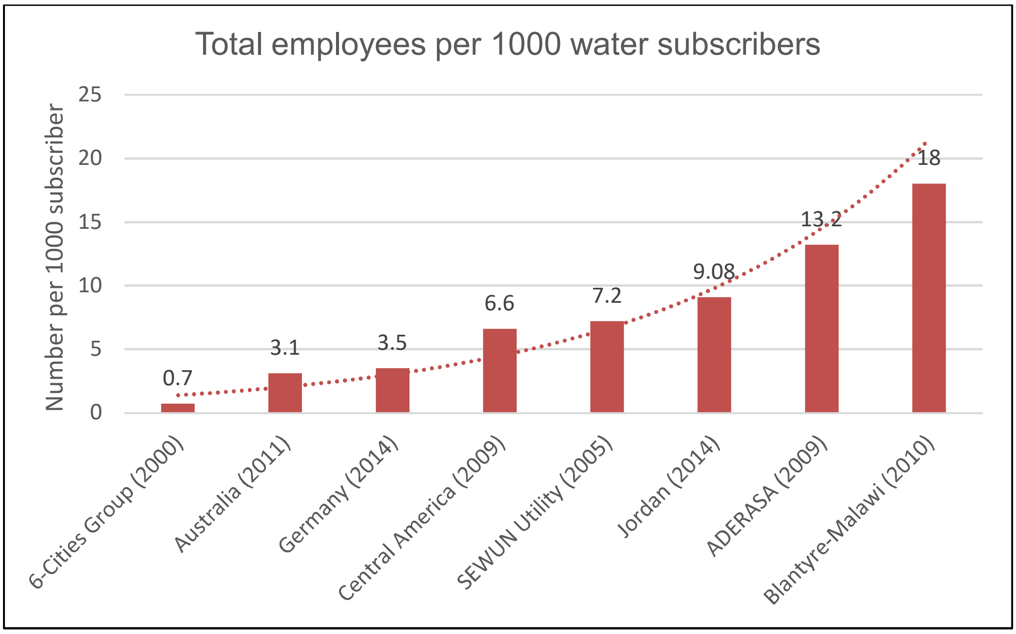


Figure 87: Total employees (water and sewage) per 1000 water subscribers[11]

Among sustainability indictors is the training time delivered per employee per year, it indicates the efforts extended towards better staff qualification. Training and capacity building is a continuous process. Utility staff should be always receiving effective training and capacity building programs in order to enhance their skills and improve performance with reduced costs and effective timely accomplishments in daily operations. Sustainable utilities require professional and committed staff, effective training will naturally have an impact on staff performance and service provision. Jordanian water utilities are offering a good amount of training to its staff, but as said earlier, training is a continuous process very essential to maintain working skills in operations, finance, management and data handling.

Training and capacity building development programs should be given an additional shares of utilities budget, nonetheless, a clear training strategies and plans should be in place following an extensive training needs assessment looking at classified target groups and high priority topics. In comparison with other water utilities (Figure 88) shows that Jordan water utilities are having low investment in training in comparison to other water utilities in German and African water utilities. The African figure considered very high in comparison to other water utilities, it can be explained via intensive donor attention to African water utilities which give them access to abundant amount of training of training programs.

[11] Reference values for 6-cities group (51), Australia (44), Central America and ADERASA (16), Malawi (34), SEWUN (46), Germany reference value is checked at aquabench GmbH data base

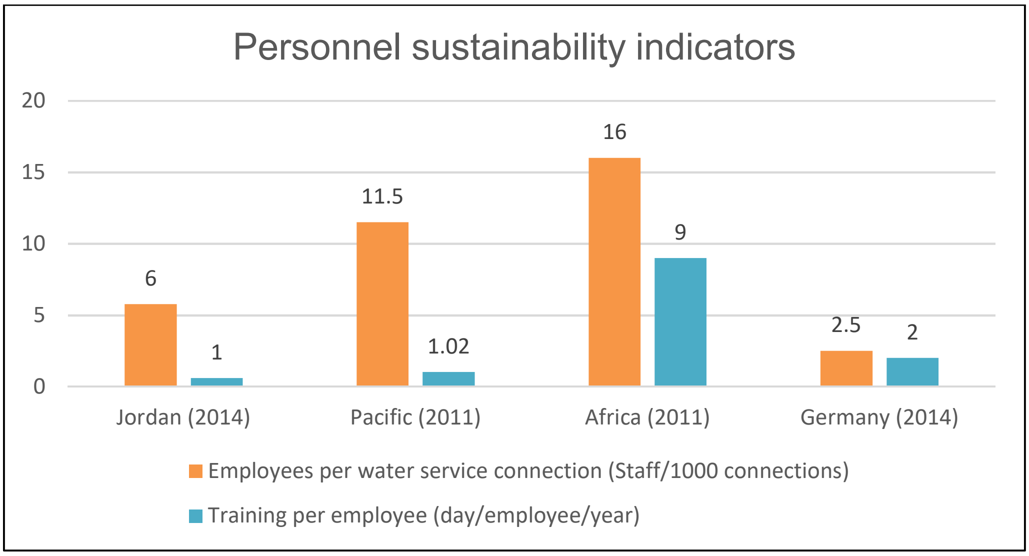


Figure 88: Personnel sustainability indicators (Staff/1000 connections and Training days per employee)[12]

Low attention to human resources and capacity development in water utilities will increase turnover rate and mobilization of qualified personnel searching for better opportunities out of the water utilities (i.e. higher paid jobs at the private sector or better financial offers at the Gulf countries). This indicator of counting the number of training days as a measure of staff development does not necessarily reflect the quality of the training, nor does it indicate the distribution of training and participation amongst the entire staff (PWWA, 2011). Accurate assessment of training programs and expenditure requires accurate register to include both internal and external training, training costs, source of funding (paid by utility or donors), number of staff and training topics covered.

Energy consumption is strongly affecting environmental sustainability, climate change mitigation and natural resources conservation, in a parallel track; energy costs are fundamentally affecting utilities fiscal sustainability. Sustainable energy supply is a challenge in Jordan's water sector, water pumping consumes 14% of national energy supply. High pumping inefficiency results in high costs and increased CO_2 emissions (Hayek B., Busche D., 2015).

Energy costs comprise the highest share of O&M costs within water and wastewater utilities, but in the same time it is quite controllable. It has been reported that the potential for energy savings at water and wastewater utilities in the developing countries can reach between 30– 40% depending on the baseline situation (ACWUA, 2014), and that many energy efficiency measures have a pay-back period of less than five years (Feng L. et al, 2012), which means that investing in energy efficiency measures would enable the utility to expand and/or improve its services through efficiency gains it is achieving, hence, contribute to utilities' suitability.

Average unit energy consumption (kW/m^3) is the easiest parameter to obtain for monitoring the energetic performance of pumps and/or stations. It is calculated either by dividing the electrical power by the flow-rate or by dividing energy consumption in

[12] Reference values for Pacific (46), Africa (58), Germany value from aquabench GmbH database

a certain time by the pumped system input. Although it is not useful to compare different pumps or pump station because it does not take the head loss into account. But it allows operators and management to identify unusual changes in the consumption pattern of a pump or station.

Figure (89) depicts that average energy unit consumption in Jordan is quiet high in comparison with energy consumption values from Canada, Netherlands and Germany (it worth mentioning here that Vewin energy consumption is also from green sustainable energy sources which leads the way towards sustainable energy use and sustainable utility management). The reason behind high energy consumption at Jordan water utilities because of the natural mountainous topography of service areas which requires high energy to pump water from low areas to highlands, and lack of energy efficiency practices by water utilities. Such high-energy consumption patterns continue, will adversely affect utilities operations, cost recovery and fiscal sustainability.

On the other hand, WAJ currently is focusing on energy efficiency measures and working closely with donors to improve energy efficiency at national level. An assessment conducted by GIZ water program (Hayek B., Busche D., 2015) revealed that the annual energy saving potential from all the investigated pumping facilities (10 well fields and 15 pumping stations) would reach to 42,100 MWh (33.5% reduction), which is equivalent to 3.3 million Euro (based on 2013 electricity tariff). The saved power will result in reducing CO2 emissions by 30,637 t/y. Jordan water utilities top management should consider energy efficiency and engage in energy consumption reduction programs. However, local and regional capacity and knowledge in this subject is still emerging and requires strengthening (ACWUA, 2014).

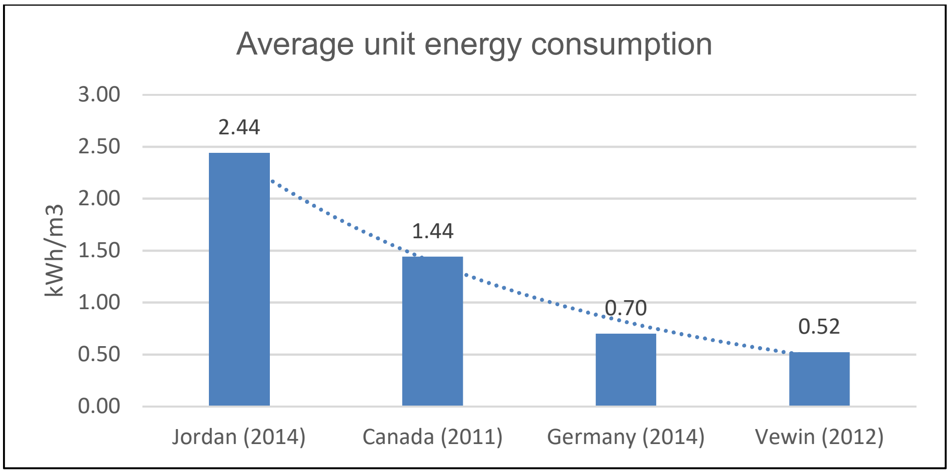


Figure 89: Average unit energy consumption per system input in different countries[13]

5.2 Benchmarking as a tool for performance improvement

Many developments and interventions have been achieved in the past 20 years in performance assessment and benchmarking water services around the world. All the stakeholders in the business have come to realize that, by assessing the performance of the services in a systematic way, utilities are driven to continually improve their performance (H. Alegre et al. 2009). As a matter of fact, the experience of several regulators has proven the effectiveness of benchmarking with good results achieved.

[13] Reference values for Vewin (56), Canada (1), Germany reference value from aquabench GmbH database

Because in some cases, the application of benchmarking creates strong incentives for the operators to be efficient and innovative by mitigating their operation and capital costs (Marques R. et al. 2011).

Published examples from the German voluntary benchmarking projects shows positive results compared with the first year of each benchmarking cycle, €20 million can be saved each coming year, which means savings between 0.5 and 3.0% of operating costs of a utility or up to 70% of the examined costs (Bertzbach F. et al. 2012).

Nevertheless, according to Oelmann and Growitsch (2011), if we compare the number of German water companies which take part in such a metric benchmarking with the total number of water suppliers the percentage will be less than 2%. Therefore, Bertzbach F. et al. (2012) stresses from authors accumulated experience in benchmarking, that operational change associated with change of concrete key performance indicators can be found mainly for benchmarking at process level and depends strongly on the individual situation of each utility. On the other hand, large number of German utilities adopted benchmarking concepts as a tool for performance improvement as published in the Profile of German Water Sector for year 2015, illustrating many statewide benchmarking projects in water and wastewater disposal stating that Benchmarking projects are a key tool so that the sector continues to develop steadily and dynamically.

It worth mentioning here that benchmarking exercise implemented in this research is the first benchmarking experience for the Jordanian water sector, therefore, it started with metrics comparison between participants and did not get into task or function level (Process Benchmarking). Literature and benchmarking scholars agree that improvement can mainly be touched after conducting benchmarking on process level. Building on that, water utilities participating in benchmarking projects should not have high expectations and temptations of fast improvement. Benchmarking requires patience as the process is not immediate and the results are not promptly tangible (De Witte K. and Marques R., 2009). On the other hand, performance gaps were identified at each water utility and through performance improvement workshop; utility managers and participants were engaged in fruitful discussion and exchange of experiences. Personal attitudes have been changed. Each utility is now able to identify its weakness and strengths points and capitalize on available resources. Based on that, performance improvement measure forms were filled and now it is the responsibility of the utility to follow up on improvement measures.

5.3 Personal attitudes towards benchmarking

The whole benchmarking exercise changed attitudes and perceptions. Before running the benchmarking program, some utilities were convinced that they are the best in everything, others were desperate from their current performance and did not see any chances for improvement. Some were reluctant on sharing performance data with others. Benchmarking activity and workshops played a significant role in encouraging utilities to enhance and set improvement plans and learn from others. Benchmarking is a networking, learning and communication opportunity as well (Bertzbach F. et al. 2012).

Stemplewski, J. and Schulz, A. et al. (2000) elaborated on personal attitudes and cooperation to ensure success in benchmarking listing the following points:

- Openness and honesty in dealing with benchmarking partners with respect to data and information

- Openness with respect to discrepancies and not to focus on justifications, but to look for benchmarks and ways of improvement
- Intensive collaboration between engineer and economists or business specialists toward better integration or corporate know-how.

Further on, following research initiatives can be investigated over benchmarking wastewater sector in Jordan or over special focus topics (i.e. Non-Revenue Water, Energy Efficiency, Water Quality, Training and Capacity Building, etc.)

5.4 Reporting to the public

In the Netherlands, between 1997 and 2005 benchmarking cycles the average efficiency of a Dutch water supply company increased by 23 % (Dijkgraaf et al., 2006) and (Oelmann et al., 2011). Netherlands benchmarking program is driven by the Dutch water association (Vewin) and it is compulsory for all water utilities to take part in benchmarking programs and publish reports and share it with the public, data sharing and exchange did not only detect efficiency potentials for water utilities but also put them under public pressure to improve their performance. Greater transparency and public awareness of relative performance put pressure on weak utilities to restructure their management teams or to develop better incentives for meeting well-defined targets (Berg S. 2012).

Transparency and the way information is made publicly available, is the other main focus (besides performance improvement) where programs show discrepancies (see figure 90). Again, a line can be drawn between regulatory programs, where information is deliberately published to inform sector stakeholders and make the industry "accountable", and industry–based programs, where public information is rather a consequential and additional goal of programs (Bertzbach, F.; Franz, T. 2016).

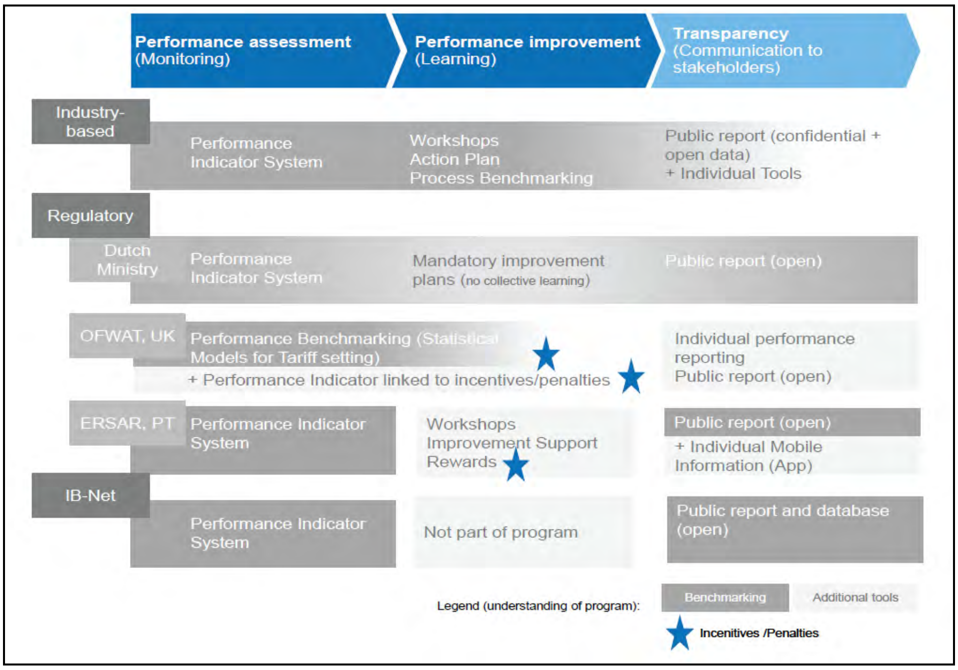


Figure 90: Scope of benchmarking as chosen by different programs

Source: Bertzbach, F.; Franz, T., The Worldwide Search for Best Practices by Benchmarking Programs of the Water Sector (2016)

Jordan benchmarking experiment generated utility and consortium reports but the decision of issuing public reports belongs to MWI-PMU (project owner/authority) and only they can decide whether to publish utility benchmarking data or not. As a matter of fact, MWI and WAJ do publish annual performance reports reflecting general performance of the water sector as a whole, but without referring to detailed performance indicators for each utility, also reports lack modernity of showcasing performance over the benchmarking pillars of (economic efficiency, reliability, customer service and sustainability). The public sector in Jordan can be described as conservative and prospering towards public reporting and sharing specific performance reports with the public. This can also relate to one of the pitfalls or drawbacks of benchmarking, the probability of a status quo in the organization being affected is large (De Witte K. and Marques R., 2009). However, from the integrated water resources management (IWRM) perspective; good water governance requires transparency and citizen access to annual reports that provide financial and operational information (Berg S. 2012). Therefore, Jordan water sector is on the right track towards transparency and information sharing with the public, and benchmarking is the right tool to fine tune public reporting in a systematic and modern approach.

5.5 Research question validation

Consequently, and judging from the growing number of initiatives worldwide, performance assessment has been accepted by the industry as a key tool to drive efficiency and best practices (H. Alegre et al. 2009). Benchmarking is an innovative idea which emerged with the Xerox copying machine and was adopted among water utilities in the late 1990s. Yet, why it was never being (applied) adopted in Jordan's water sector. The Diffusion of Innovations (DOI) theory, developed by E.M. Rogers in 1962, explains how over time an idea or product gains momentum and diffuses (or spreads) through a specific population or social system.

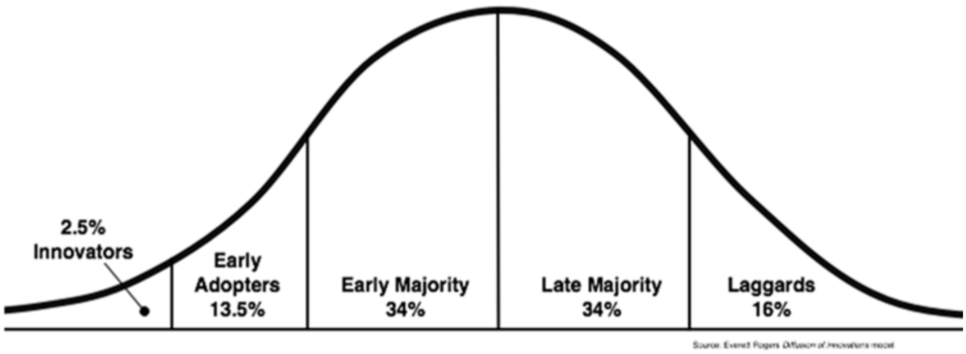


Figure 91: Adopters of innovations categories over time dimension

Source: Rogers E.M. (1962), Diffusion of Innovations, 1962

Figure (91) shows how an idea diffuses among a certain population/group/sector over time, and categorize them into five adopter's categories (see Rogers E.M. 1962) based on innovation perception, financial capabilities, leadership characteristics, and readiness to accept or change towards adopting new ideas. As for the stages by which a person adopts an innovation, and whereby diffusion is accomplished; include awareness of the need for an innovation, decision to adopt (or reject) the innovation, initial use of the innovation to test it, and continued use of the innovation (E.M. Rogers 1962).

Benchmarking is a management method that has spread throughout a wide array of sectors since the late 1980s. A recent publication counts on average 350 publications each year between the period 1993 to 2004 and cite studies from 2009 in which benchmarking is ranked by 9,000 managers as the most-used management tool. A survey among 450 organizations predicts that it will also continue to be the most-used tool in the future (Bertzbach, F., Franz, T). Furthermore, according to Alegre et al. (2009) benchmarking for water services has been accepted by the industry as a key tool to drive efficiency and best practices, which in this case allocate Jordan's water utilities between the late majority and laggards when adopting benchmarking as a tool for performance assessment and improvement.

Semi-structured interviews with utility managers indicates that awareness about benchmarking is not fully achieved yet since most of utilities staff were not aware of benchmarking concept. They are aware of performance indicators assessment but never took it further into knowledge exchange and performance improvement among water utilities, which is known as benchmarking. Nonetheless, according to DOI theory, laggards are characterized as traditional, skeptical and frankly suspicious of innovations and change to new ideas. However, that was not the case of Jordanian water utilities, lack of awareness and initiative spirit were among main reasons for not adopting benchmarking till today. Benchmarking idea sounds complicated to them and misunderstood by the old "yard-stick competition" definition, which made them hesitant to get into this new experience, besides the required application knowledge they are lacking.

Other factor was data availability for a certain number of indicators, some public utilities in the study were not familiar of data management, or how to seek records to help in indicators calculation to assess performance. In agreement with Sanford Berg, if we have no data on performance trends, lack comparisons among current operations, and have no idea of best practice, decision-makers cannot design performance incentives or establish reasonable targets for key indicators. Stakeholders need to know about the past, the present, and the future -best practice- (Berg S. 2012). The highest priority for Jordanian water utilities is to provide services often overtakes performance monitoring, leaving it as a secondary priority. However, with the support utilities are recently getting from donor funded projects and MWI's national strategy to enhance data management and acquisition at utility level; data can be available for future benchmarking cycles and different scopes. Therefore, data availability is not a long-term obstacle. Over time, data availability will improve and studies will be strengthened as professionals gain experience with these quantitative techniques (Berg and Padowski).

On another hand, the tools for improvement within benchmarking projects can be improved. After 19 years of voluntary benchmarking; German utilities work constantly to expand the benefits of methods and examinations. According to German benchmarking experts Möller, K.; Bertzbach, F.; Nothhaft, S.; Waidelich, P.; Schulz, A. (2012)); factors for a successful benchmarking implementation can be achieved when it is connected with the aims and strategies of the water utility, thus, improvement can be foreseen when it lies within responsibility of the utility, engagement of utility staff and its management, and when benchmarking and improvement actions are implemented at process level. In this case, the derivation of courses of action is an indispensable component of the project. There are so much to learn from the German experience in Benchmarking as it is in a mature stage now and went through many development stages through the past years.

Referring back to the Jordanian case; administrative, technical and financial capacities can be given the highest weight factor for not implementing benchmarking for water services in Jordan. Benchmarking requires adequate budget to cover the cost of meetings, workshops, data acquisition and analysis tool, utility staff time and consultant professional fees, reporting, etc. In case the PMU will be implementing benchmarking projects in the capacity of being the regulatory body for the water sector in the future, thus, consultant's fees costs will be allocated to PMU local staff. Currently, benchmarking projects are not included or listed on MWI's annual plans or budgets. Jordan water services benchmarking project was proposed as research idea through ACWUA and submitted to EBRD to seek funding and political support to MWI. Thus, benchmarking exercise implemented in this PhD research was successfully implemented through Top-Bottom approach and researcher advocacy initiative.

After the successful implementation of the first benchmarking initiative; the performance of Jordan's water sector was investigated and improvement gaps were identified. Investigating the current status for performance assessment and improvement for the water sector in Jordan was achieved through semi structured interviews and analysis. The expectations of this research were met, research questions were answered and research objectives were also met, section (3.5) lists research limitations/challenges and mitigation measures. However, according to Berg and Padowski in their review of previous benchmarking initiatives; any benchmarking study will have limitations, but sound studies can be used as a proof to other parties who might argue that the analysis is incomplete or incorrect. Based on the recommendation of Stemplewski, J.; Schulz, A. et al. (2000); benchmarking is an excellent method for mobilizing elements of competition as engines for development to ensure long-term competitiveness.

The significance of this study that; MWI top management is now introduced to benchmarking concept and approach, and now convinced about its benefits, and is willing to continue with benchmarking water utilities on national and regional levels as a tool for performance monitoring and improvement. We conclude here after having the first benchmarking exercise considered a successful pilot; that benchmarking is applicable on Jordan's water sector as an effective tool for performance improvement, through exchange of knowledge and know-how between water utilities. Jordan benchmarking was tested out in this research following the international best practices of IWA and it worked out with good results.

This experiment was supported by the regional water association ACWUA and donor support of EBRD and this played a strong role in introducing benchmarking concept to the Jordanian water sector. This research also put the foundations seeds for institutionalizing benchmarking in Jordan's water sector; now, the MWI is equipped with the necessary tools, forms and know-how while using the benchmarking framework document drafted through this research work development.

6. Summary and Recommendations

6.1 Summary

Water sector in Jordan is characterized with limited resources, and struggling to meet increasing competing demands in different sectors, more stress is pressured through political unrest in the region and refugee's migration influxes into the country. Thus, water resources protection and efficient management is necessary to run water utilities efficiently (sustainably) with better quality service. Research main goal is to protect water resources and improve resources efficiency, this thesis verified Benchmarking as performance improvement tool to Jordan's water sector through knowledge sharing, networking and systematic methodology for assessing utilities performance and spotting out improvement interventions. Performance monitoring using performance indicators is practiced by PMU since the past 7 years, as contractually mentioned in the assignment agreements to monitor the performance of Jordan Water Company (Miyahuna) and Aqaba Water only.

Scientific work of this PhD research comprises of assessing current situation of performance assessment for water utilities in Jordan, then testing out benchmarking exercise for the first time including all water utilities in Jordan in order to verify/answer research question why benchmarking is not yet applied in Jordan despite the fact it has been practiced worldwide. This research proofed that benchmarking is applicable to Jordan's water sector following the set research methodology including questionnaire development and, data collection and analysis and conducting workshops.

One (pilot) utility benchmarking cycle has been successfully conducted for (9) water utilities (5 private and 4 public) and collected performance data for 2 years (2013 and 2014), results related to water losses and energy consumption indicators for example illustrated that overall performance of Jordan's water sector in 2013 was better than year 2014, this can be explained to additional pressure affected water systems due to migrant fluxes into the country, in addition to the volatile political situation during Arab spring. The benchmarking exercise was tested out following international best practices of IWA, each utility had outlined its improvement measures based on the performance assessment and benchmarks identified for the main cluster (See Chapter 4). Data reliability was evaluated and data sources gaps are now identified at each water utility.

The research built on the benchmarking program outcomes and conducted the following scientific work of cascading the German benchmarking system over Jordan benchmarking project, then average values of performance data for year 2014 representing Jordan's water sector was benchmarked/compared with similar international benchmarking initiatives (regionally and internationally) following the classification of the German five benchmarking pillars:

6.1.1 Economic Efficiency

Results show that Jordan water sector performance for year 2014 was not economically efficient, water utilities have to work on cost recovery issues through multiple streams in order to increase the current average operating cost coverage ratio of 52%, controlling costs and making the best use of facilities and manpower, revise tariff structure (if applicable because the water tariff in Jordan is subsidized), improving billing and collection techniques to reach higher than 80%, asset management planning, and even outsourcing specific services. Cost recovery plans for each utility needs to be developed, based on identified revenue requirements that are based on full cost recovery; including NRW reduction strategies, reducing energy consumption which is currently over 30% of operational costs.

6.1.2 Customer Service

Customer services indicators investigated in this study were mainly focusing on connection efficiency and hours of supply and water quality complaints. There is room for improvement to increase connection efficiency through using modern online application service and revising the administrative and operational procedures, extend cooperation with municipalities and other public authorities. Ideally, having NRW reduction programs in place will enhance network operations which eventually enable utilities to increase hours of supply, however, in Jordan's context it is unlikely to happen due to shortage of water resources and commonly operating within intermittent supply conditions since decades. Improve service delivery and water quality would ultimately reflect in less amount of received complaints. The results show public utilities should learn from private utilities in establishing modern customer services centers to be connected with customer's and billing database and hotline service. This is a significant introduction to twinning between public and private utilities as a tool for performance improvement.

6.1.3 Quality of Supplied Water

Water quality indicators are quite sensitive because water resources in Jordan are mostly coming from over abstracted groundwater wells. High water quality parameters were recorded at private water utilities; however, southern water utilities have indicated low water quality in comparison with other utilities, therefore, these utilities have to increase the number of water quality tests in order to make sure that water is delivered within better quality standards and prevent source of pollutions, following comprehensive water safety plans over the watershed as a whole. During the performance improvement workshop, southern water utilities suggested to rehabilitate water quality labs and empower its staff in order to be able to conduct all types of water quality tests within short time and get equipped to solve water quality complaints.

6.1.4 Reliability

Jordan water sector unfortunately suffers from high NRW levels (52%) which seriously question the reliability of water networks. Physical losses reduction programs focusing on main water lines and water service connections, water network protection and fighting thefts, illegal use and other apparent losses as it is one of the main causes for high NRW in Jordan. NRW it is not only about fixing the leaks and tacking physical water losses, assessing NRW problem requires situational analysis of utility operations, hydraulic review of water balance, review of management structure, organizational structures and functions; assess staff capabilities and build partnerships with the public and private sectors. Reducing water losses will ensure additional water supplies provided to customers and maintain reliable water system to the public.

6.1.5 Sustainability

From previous noticed results regarding water losses of (24 m^3/km/day) and (1,133 liters/connection/day) associating high NRW levels, this reflects serious sustainability issues regarding water networks, which was also noticed within water network repair rate (314 repairs per 100 km) in comparison with other similar countries. Personnel sustainability indicators shows that Jordan water sector is performing well in terms of number of staff (6 per 1000 water service connections), and staff is getting a humble amount of training support of (1 training day/employee/year), however, this does not mean that it is enough at this stage. Sustainable water utilities need always to invest in its personnel and offer training and capacity building program continuously.

In terms of environmental sustainability and energy consumption, Jordan water utilities have to work seriously on reducing energy consumption within its daily operations (2.44 $kWh/m^3/day$) average value in year 2014, as it drastically affects its cost recovery, utilities fiscal sustainability, and impacts the environment with higher carbon footprint and CO_2 emissions. Energy efficiency programs and utilizing renewable energy solutions should be running on national level and expand beyond pilot initiatives and donor interventions.

The list of performance indicators investigated in this study was effective in describing the overall performance status of the water sector in Jordan and perform the first metric benchmarking study for water services, however, a new set of indicators can be developed for the next benchmarking cycle to better assess sector performance according to the 5 pillars of benchmarking system and set out an effective performance plans on short term and long term basis.

6.2 Recommendations

This section outlines study recommendations building on results and conclusions, short-term recommendations in order to follow up on what this research could not fulfill or as long-term recommendations to institutionalize benchmarking within the water sector in Jordan.

6.2.1 Create enabling regulatory environment

This research has prepared water utilities and trained them on live national benchmarking experience. Utilities are familiar with the process now and are ready to replicate the same process again or on different benchmarking scope. Consequently, voluntary benchmarking is unlikely to happen at this immature stage because water utilities still not ready for this advanced stage yet (utilities are now familiar with the benchmarking process and able to do it, however, enforcement of benchmarking is lacking).

However, in order for this to happen, let benchmarking extend out of pilot (experimental) phase and emerge into water sector policies and strategies; top-down approach application meeting sector framework and conditions has to be the main strategy to follow. Therefore, listing benchmarking in the water sector strategy and policies will create an enabling environment for benchmarking application. Utilities will take serious steps in data management and will target reporting capabilities enhancement. This will transform the water sector towards better service delivery and cost efficiency.

6.2.2 Sustain the national benchmarking task force

It is very crucial after success stories to keep momentum, and this lies mainly with human resources. Investment in human resources in this study was through formulating the national benchmarking task force from PMU and water utilities. This task force should stay active and in contact to keep benchmarking momentum and don’t stop when project funding ends.

The PMU should allocate permanent benchmarking team at the MWI to develop and manage new benchmarking projects and lead the benchmarking task force activities via:

- Follow up on the status of performance improvement plan mapped out at the end of the benchmarking exercise and work on budget planning or fund allocation to those improvement measures
- Initiate and manage benchmarking projects in the future following international best practices and steps of Jordan benchmarking framework document
- Update the list of performance indicator for Jordan water sector and search on new indicators within the 5 pillars of benchmarking
- Update the benchmarking framework document while implementing and learning from new benchmarking cycles.

6.2.3 Improve data management, unify data sources and data collection methods

It is recommended to improve data management and handling at water utilities and public ones in particular. Data collection was a very time consuming process because in some cases it is not managed properly and sometimes does not exist. The absence of data is evidence of weak managerial processes (Berg S. 2012). Current centralized management structure at WAJ contribute to having different sources of the same data variable. Water utilities should be able to report on all variables and send it to WAJ center for verification. Having different sources of data contribute to serious delay and wrong input data for benchmarking. All water utilities should have unified way to manage its data from the field and report it to WAJ/PMU.

Although data variables and performance indicator definitions was shared and explained to utility participants at the beginning of benchmarking exercise. It is always recommended for future benchmarking programs to have clear and specific definition of all data variables and performance indicators, it is not useful to collect so much data and get confused. This research was the starting point and by replicating the work, data variables and performance indicators will be clear and improved for all utilities.

Therefore, public utilities are required to invest in automation and data management systems, activate GIS system and integrate it with the billing, operations and customer database. Make sure that all water sources are metered and meters are calibrated and well-functioning. Regular meter readings to be collected from water sources and district metered areas. Scientific and professional data registry will enable utility to manager its water resources and calculate its water balance, consequently, identify action targets for NRW reduction.

6.2.4 Develop benchmarking awareness program

It is recommended to have awareness program about benchmarking targeting Jordan water utilities. Having benchmarking task force member from each utility is not enough dissemination. Information about benchmarking must not be kept on the management level in the utility. Sharing such information will encourage all staff to work as one team for improvement and help in data handling and acquisition for future benchmarking cycles.

One of the examples can be drawn from multiple success stories of benchmarking projects implemented in Germany back in the late nineties. While a group of wastewater operators which participated in a benchmarking project implemented by

Emschergenossenschaft/Lippeverband and the University of the German Armed Forces in Munich. In order to initiate the implementation of results as quickly as possible, the participants in the project presented the benchmarking system to a range of interested wastewater operators during public events. Positive responses were received then seven new operators joined the program and another project involving fourteen operators started in mid-2000 (Schulz, A., 2001).

A series of seminars and orientation sessions about performance indicators and benchmarking concept, process and benefits to utility staff, government, regulatory agency, stakeholders, and the public are necessary to spread the word to all utilities and through all working levels.

6.2.5 Seek top management support

William Muhairwe (2009) had identified four basic ingredients for organizational transformation in public enterprises: thoughtful leadership, careful measurement, open communication channels, and well-designed implementation strategies. Therefore, an active involvement from the top management with thoughtful leadership is necessary. If top management is not convinced about benchmarking viability and benefits, then it won't pass through into executive and operational staff and will never see the light. Staff will not be supported to work on data provision or participate in workshops, and won't be even interested in pursuing towards performance improvement plans.

Top management in Jordan water sector supported benchmarking and facilitated the work and travel of utility participants to work on data provision and participate in all trainings and workshops. Therefore, it is recommended from this thesis to engage top management and seek their support. This can be arranged through roundtable discussions to explore their interest and seek support in any benchmarking exercise.

6.2.6 Replicate benchmarking programs on utility and process levels for water and wastewater utilities

All benchmarking experts agreed that metric or utility benchmarking is the first step towards process benchmarking. This research provided a good platform for in-depth discussions between utilities about differences in performance (i.e. energy consumption, metering programs, water quality measure, etc.) This leads into further investigation over function and tasks level (process benchmarking).

Therefore, it is recommended to replicate this benchmarking exercise over again for water services with modification or additions on list of indicators, in addition, start another metric benchmarking about wastewater services and storm water management. Process benchmarking can tackle difference scopes (i.e. energy management, water quality management, physical and apparent losses, customer service centers, occupational safety, financial performance, etc.).

It is also recommended when selecting performance indicators to take care of long-term, comprehensive development with utilities which won't be changing over a short period of time. This again stress the recommendation of engaging utility managers and seek support of top management at early stages of the planning process.

6.2.7 Improve cooperation between public service entities

According to Parena and Smeets (2001) water utilities are always being benchmarked by customers, by the financial markets and even by potential employees. Therefore, it is important to embrace benchmarking positively rather than just take reactive measures because it is an opportunity to learn and add value to others. When a benchmarking cycle is over and performance improvement measures are captured.

It is recommended to improve communication and cooperation between public entities providing public services and share with them benchmarking results, to look at cooperation synergies and mutual efficiency plans. Because all service entities share the same infrastructure and works for the same cause. Energy consumption benchmarking results should be shared with the ministry of energy and natural resources, in order to investigate and work together on improvement plans (i.e. reduce energy consumption, utilize renewable energy, energy efficiency programs, etc.).

Similar case with municipalities which can have different database of building maps and geographical coordinates, this would affect network speed of repair, or paper works required for starting a new water connection. Many examples can be given, but the most important that open communication and cooperation between those organizations will save time, cost, energy and protect the environment.

Public utilities don't have to switch private, they need to revise their business processes and focus on sustainable efficiency, and this will not occur only when revising the structure or become private. Public utilities need to think private but stay public.

6.2.8 Develop capacity building programs

Last but not least, the most important recommendation is always about investing in human resources and capacity development. Water and wastewater service provision is an integrated process and requires responsible and professional team who is capable of delivering high quality safe water and cost effective performance. In case one department or function in the supply chain is under performing this will seriously impact on the system overall.

Generous budget for training water utility staff is the most effective investment utilities can have to sustain its assets and maintain high quality service. Water utilities in Jordan should increase the budget of training for staff at different levels and mainly operational (Blue Collar) staff. Not only on operational level for running water networks and water treatment plants but also IT, administrative and financial caliber. In addition to special training courses on data management and handling for each department; special long and short term training courses in the following fields will keep motivated staff committed to excellence:

1. Administration (human resources, customer services, communication, facilities management, quality control)
2. Finance (financial management, planning and analysis, accounting, inventory and tendering)
3. Water resources management and planning (water resources protection, water quality management, watershed management and safety plans, safe groundwater abstraction, survey of protection zones)
4. Operation & Maintenance (water production, water transmission, distribution, wastewater collection, wastewater treatment)
5. Engineering and planning (hydraulic modelling, water balance calculations, project management, GIS and IT utility applications)
6. Supporting services and logistics

7. References

1. AECOM (2013), Canadian National Water & Wastewater Benchmarking Initiative-Public Report, 2013

2. Al Wazani Kh. (2014), The Socio-Economic Implication for Syrian Refugees on Jordan, A Cost-Benefit Framework, Konrad Adenauer Stiftung, 2014

3. Alegre H., Babtista J., et al (2006), Manual of Best Practice-Performance Indicators for Water Supply Services, Second Edition, IWA Publishing, 2006

4. Alegre H., Cabrera Jr E., Merkel W. (2009), Performance assessment of urban utilities: the case of water supply, wastewater and solid waste, Journal of Water Supply: Research and Technology—AQUA, 2009

5. Alliance for Water Efficiency (2012), Financing Sustainable Water Initiative-Fiscal Sustainability, published in 2012

6. Arab Counties Water Utilities Association (ACWUA) (2014), Water Utilities Management in the Arab Region-Lessons Learned and Guiding Principles, First Edition, July 2014

7. Arab Counties Water Utilities Association (ACWUA) (2015), Energy Efficiency Guidelines in Water and Wastewater Utilities, Second Edition, November 2015

8. Arab Countries Water Utilities Association (ACWUA) (2013), Management of Utilities-Case Studies from the Arab Region, Support of ACWUA Management of Utilities and Utilities Reform Technical Working Groups Project-funded by the Swedish International Development Cooperation Agency (SIDA), published by ACWUA, 2013

9. ATT., DBVW., DWA., BDEW., DVGW., VKU., (2015), Profile of the German Water Sector, 2015, published by Arbeitsgemeinschaft Trinkwassertalsperren e. V. (ATT), Deutscher Bund der verbandlichen Wasserwirtschaft e. V. (DBVW), Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (DWA), Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW), Deutsche Vereinigung des Gas- und Wasserfaches e.V. Technisch-wissenschaftlicher Verein (DVGW), Verband kommunaler Unternehmen e.V. (VKU), October 2015

10. Berg S. (2012), Advances in Benchmarking to Improve Water Utility Operations: A Review of Six IWA Books, University of Florida, 2012

11. Berg S., (2012), Advances in Benchmarking to Improve Water Utility Operations: A Review of Six IWA Books, University of Florida, May 21, 2012

12. Berg S., Padowski J., Overview of Water Utility Benchmarking Methodologies: From Indicators to Incentives, Public Utility Research Center, University of Florida, USA

13. Bertzbach F., Franz T., Möller K. (2012), How to achieve and prove performance improvement – 15 years of experience in German wastewater benchmarking, IWA Publishing, Water Science & Technology, 2012

14. Bertzbach, F.; Franz, T. The Worldwide Search for Best Practices by Benchmarking Programmes of the Water Sector. KA Korrespondenz Abwasser, Abfall; Hennef, International Special Edition 2016/2017 en.dwa.de

15. Cabrera E., Dane P., et al. (2011). Benchmarking Water Services: Guiding water utilities to excellence. IWA Publishing, American Water Works Association. 2011

16. Corton M., Berg S. (2009), Benchmarking Central American Water Utilities, University of Florida, 2009.

17. Daigger G. et al. (2011), Sustainable Urban Water and Resource Management, the bridge-linking engineering and society, the bridge-national academy of engineering, published in 2011

18. Danilenko A., Berg C., Macheve B, Moffitt L. (2014), The IBNET Water Supply and Sanitation Blue Book 2014, The International Benchmarking Network for Water and Sanitation (IBNET)-Utilities Databook, The World Bank Group, 2014

19. De Witte K., Marques R. (2009), Gaming in a benchmarking environment. A non-parametric analysis of benchmarking in the water sector, Munich Personal RePEc Archive (MPRA), April 2009

20. Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (DWA). (2008), Corporate-Metric Benchmarking as Component of the Modernization Strategy - Performance Indicators and Evaluation Principles, German Association for Water, Wastewater and Waste, April 2008

21. DWA (2008), Corporate-Metric Benchmarking as Component of the Modernisation Strategy-Performance Indicators and Evaluation Principles, Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (DWA), April 2008

22. DWA M 1100 (2008): Benchmarking in der Wasserversorgung und Abwasserbeseititgung, DVGW und DWA M1100, März 2008

23. Economic and Social Commission for Western Asia (ESCWA) 2013. ESCWA Water Development Report 5, Issues in Sustainable Water Resources Management and Water Services, June 2013

24. Feng L., Ouedraogo A., Manghee S., Danilenko A. (2012), A Primer on Energy Efficiency for Municipal Water and Wastewater Utilities, Energy Sector Management Assistance Program, The International Bank for Reconstruction and Development, The World Bank Group, February 2012

25. Frauendorfer R., Liemberger R., (2010), The Issues and Challenges of Reducing Non-Revenue Water, Asian Development Bank publication, 2010

26. Günthert, F.W. (2012): Ziele und Nutzen von Benchmarking für die Wasserwirtschaft, Kongress Nachhaltigkeit in der Bayerischen Wasserwirtschaft, Oktober 2012

27. Günthert, F.W., Rapp, St. (2005): Abschlussbericht Leitfaden Benchmarking in der Wasserwirtschaft, DBU, Mai 2005

28. Hayek B., Busche D. (2015), Energy Efficiency in Water Pumping in Jordan, Water Portfolio - Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ),

Jordan, published in ACWUA Energy Efficiency Reader for water and wastewater utilities in MENA Region-Good Practices from ACWUA members, September 2015

29. Herrick Ch., Pratt J., Surbaugh H., et al. (2013), Changing Organizational Culture to Promote Sustainable Water Operations: A Guidebook for Water Utility Sustainability Champions, Subject Area: Infrastructure, published by the Water Research Foundation, 2013

30. Howard G., Bartram J. (2003), Domestic Water Quantity, Service Level and Health, World Health Organization (WHO), 2003

31. Humpal D., El-Naser H., et al. (2012). Review of water policies in Jordan and recommendations for strategic priorities, Jordan Water Sector Assessment Program, United States Agency for International Development (USAID), April 18, 2012

32. International Resource Group (IRG), USAID-Institutional Support and Strengthening Program (ISSP) 2011, Institutional Assessment Report (2011), USAID Contract No. EPP-I-OO-04-00024-00, Task Order No. 8. October 2011

33. International Resource Group (IRG), USAID-Institutional Support and Strengthening Program (ISSP) 2015, Detailed Assessment and Evaluation of the Regulatory Reporting Capacity within the Administrative Units in the Water Authority of Jordan (WAJ)-Final Report, June 2015

34. Jordan Department of Statistics (2016), Population and Housing Census Report, February, 2016

35. Kalulu K., Hoko Z (2010), Assessment of the performance of a public water utility: A case study of Blantyre Water Board in Malawi, July 2010.

36. Marques R., Gomes R., Monteiro A. (2005), Benchmarking the Water Losses in Portugal, published in Leakage conference 2005

37. Marques R., Simoes P., Pires Joao (2011), Performance Benchmarking in Utility Regulation: The Worldwide Experience, Polish Journal of Environmental Studies, Volume 20, No. 1, 2011

38. Matos, R.; Cardoso, A.; Ashley, R.; Duarte, P.; Molinari, A.; Schulz, A.: Performance Indicators for Wastewater Services, Operation & Maintenance Committee IWA, 2003

39. Ministry of Water and Irrigation (MWI) (2009), Performance Indicators for Water & Wastewater Services manual of PMU, Water Sector Audit Unit (WSAU), version 07, December 2009

40. Ministry of Water and Irrigation (MWI) (2013), Jordan Water Sector Facts and Figures (2013), Publication supported by: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, printed in January 2015

41. Ministry of Water and Irrigation (MWI) (2015), Jordan’s National Water Strategy (2016-2025), December 2015

42. Möller, K.; Bertzbach, F.; Nothhaft, S.; Waidelich, P.; Schulz, A. Benchmarking in the wastewater sector – taking stock. Expanded reprint of a two-part paper on

objectives, results and success factors of more than 15 years of benchmarking in the German wastewater sector. Hennef, 08 / 09 2012.

43. Möller, K.; Bertzbach, F.; Nothhaft, S.; Waidelich, P.; Schulz, A. 15 years of voluntary benchmarking – how it supports the modernisation strategy of the German water sector. Water Utility Management 12/2012, S. 6-10.

44. Muhairwe, William (2009). Making Public Enterprises Work—From Despair to Promise: A Turnaround Account International Water Association, xiv-415.

45. New South Wales Water Supply and Sewerage (2011), Performance Monitoring Report, NSW Office of Water, 2011

46. Oelmann M., Growitsch C. (2011), Analysis of the Current German Benchmarking Approach and Its Extension with Efficiency Analysis Techniques, Current Issues of Water Management, edited by Dr. Uli Uhlig, Published in print edition December, 2011

47. Pacific Water and Wastes Association (PWWA)., SPC–SOPAC AND PIAC (2011), Development of a Water Utility Benchmarking System, Benchmarking Report, December 2011

48. R. Parena R., Smeets. E (2001), Benchmarking initiatives in the water industry, Water Science and Technology, Vol 44 No 2–3 pp 103–110, IWA Publishing, 2001

49. Report of the main results of the general census of population and housing for year 2015 (Arabic), Jordan Department of Statistics, February 2016

50. Rogers E. (1962), Diffusion of Innovations, Third Edition, 1983 by the Free Press

51. Schulz, A.: Benchmarking in Waste-Water Management on the Basis of Indexing Systems, IWA 2nd World Congress, Berlin 10/2001

52. Schulz, A.; Stemplewski, J. Benchmarking the Management of (partial) river basins PI-09 Konferenz, Amsterdam 03/2009

53. Stahre P., Adamsson J, Performance Benchmarking – A Powerful Management Tool for Water and Wastewater Utilities, 6-Cities Group benchmarking initiative.

54. Stemplewski, J.; Schulz, A.; Schön, J. Benchmarking – an approach to efficiency enhancement in planning, construction and operation of wastewater treatment plants IWA World Water Congress. Paris 07/2000

55. Tynan N., Kingdom B. (2002), A Water Scorecard: Setting Performance Targets for Water Utilities. Public Policy for the Private Sector, Note Number 242. World Bank, Washington, D.C., 2002

56. UN-Water Decade Program on Capacity Development, (2013). Capacity Development for International Water Goals: from MDGs to SDGs, UNW-DPC's Capacity Pool, Magazine from the UN-Water Decade Program on Capacity Development, Issue No. 17, 2013

57. Van den Berg C., Danilenko A. (2011), The IBNET Water Supply and Sanitation Performance Blue Book, The International Benchmarking Network for Water and Sanitation Utilities Databook, The World Bank, 2011

58. Vewin, Association of Dutch water companies, (2013), Reflections on Performance 2012, Benchmarking in the Dutch drinking water industry, August 2013

59. WHO/UNICEF. 2011. First Consultation on Post-2015 Monitoring of Drinking-Water and Sanitation.

60. WOPs Africa (2009), Water Operators Partnerships-Africa, Utility Performance Assessment, Final Report June 2009

8. Annexes

8.1 Official supporting letters from benchmarking project owner and financer

8.2 Data variables requested in the benchmarking exercise and online questionnaire sample & KPIs/PIs

8.3 Semi-structured interviews questionnaire form (English and Arabic)

Filled individual surveys/questionnaires from 9 water utilities (3.1 — 3.9)

8.4 Terms of reference for the national benchmarking task force

8.5 Benchmarking code of conduct

8.6 Benchmarking program work plan

8.7 Performance Improvement Plans for 9 water utilities

8.1 Annex (1)

Official supporting letters from benchmarking project owner and financer

The Hashemite Kingdom of Jordan

Ministry of Water and Irrigation

Water Authority of Jordan

Programme Management Unit

المملكة الأردنية الهاشمية

Ref.: PMU/16/285 Date: 9/2/2016 التاريخ : الرقم :

Institut für Wasserwesen
Universität der Bundeswehr München
Munich, Germany

Subject: Reliable Quality Water for Jordan-Benchmarking Jordan Water Services Project

To whom it may concern,

Kindly note that "Reliable Quality Water for Jordan" program implemented by the Performance Monitoring Unit (PMU)/Water Authority of Jordan (WAJ) allow Mr. Mustafa Nasereddin to use and analyze the available data of Benchmarking Jordan Water Services Project -which is funded by the European Bank for Reconstruction and Development (EBRD)- in his PhD thesis for research and scientific purposes.

Sincere regards,

Eng. Iyad Dahiyat
Director of Performance Monitoring Unit (PMU)
Water Authority of Jordan (WAJ)

Eng. Iyad Dahiyat
PMU Director
Water Authority of Jordan

European Bank
for Reconstruction and Development

Institut für Wasserwesen
Universität der Bundeswehr München
Munich, Germany

7 January 2016

Subject: Reliable Quality Water for Jordan-Benchmarking Jordan Water Services Project

To Whom It May Concern

Kindly note that "Reliable Quality Water for Jordan" program implemented by the Performance Monitoring Unit (PMU)/Water Authority of Jordan (WAJ) allow Mr. Mustafa Nasereddin to use and analyse the available data of Benchmarking Jordan Water Services Project – which is funded by the Deauville Transition Fund, administered by the European Bank for Reconstruction and Development (EBRD) – in his PhD thesis for research and scientific purposes.

Yours Sincerely,

Nodira Mansurova
Municipal & Environmental Infrastructure
European Bank for Reconstruction and Development

8.2 Annex (2)

Data variables requested in the benchmarking exercise and

Online questionnaire sample and

Key Performance Indicators and

Lower Level Performance Indicators

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_A07	Operation	Water produced	Total volume of water treated for input to water transmission lines or directly to the distribution system. Data is preferred to be reported separately for each discreet town or distribution subsystem	m3
J_A08	Operation	Imported treated water	Total volume of water imported from other water undertakings or system. Data is preferred to be reported separately for each discreet town or distribution subsystem	m3
J_A09	Operation	Exported treated water	Total volume of water exported to other water undertakings or systems from the supply area Data is preferred to be reported separately for each discreet town or distribution subsystem	m3
J_A151	Customer Services	part 1: Billed Volume	part 1: Billed Volume	m3
J_A152	Customer Services	part 2: volume built from illegal usage	part 2: volume built from illegal usage	m3
J_A153	Operation	part 3: tankers	part 3: tankers	m3
J_A18	Operation	Unbilled authorized consumption	Total amount of unbilled water consumed. This may include items such as free supply to Mosques, free supply to Bedouins (if authorized), firefighting and training, flushing of the water and sewer network, street cleaning, watering of municipal gardens,	m3
J_C08	IT	Length of Water network	The total length of the transmission and distribution network (in km) - per definition all pipes > 1 diameter, not used for house connections Entered value should be more or equal to previous year value	km

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_C32	Customer Services	Water service connections	Total number of service connections. A Service Connection is the delivery point from the tertiary water network to the subscriber meter or meters. A single Service Connection (delivery point) cannot serve more than one plotEntered value must be more or equal to the previous entered value	Nr.
J_CI04	Context Information	Type of operation	WAJ administrations = Public Aqaba/Miyahuna/Yarmouk = Private	
J_D25	Operation	Network failures	Number of network failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings.	Nr.
J_D26	Operation	Water service connection failures	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings	Nr.
J_D29	Operation	Number of hours per week that the system is pressurized.	Amount of time the system is pressurized measured from the time when water first enters the network to the time when supply is discontinued. Data is preferred to be reported separately for each discreet town or distribution subsystem. The number of hours per week that system is pressurized less than 24*7=168 hours/week	Hour
J_D40	Customer Services	Meter replacement	Number of subscriber meters replaced during the period	Nr.
J_D41	Production and Quality	Water quality tests performed	Total number of treated (potable) water tests performed during the period	Nr.
J_D43	Production and Quality	Microbiological water quality tests performed	Total number of microbiological water tests performed on treated (potable) water during the period. Do not include tests of raw water.	Nr.

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_D44	Production and Quality	Physical-chemical water quality tests performed	Total number of physical-chemical water tests performed on treated (potable) water during the period. Do not include tests of raw water.	Nr.
J_D46	Production and Quality	Water quality tests required	Total number of treated (potable) water tests required by applicable standards or legislation during the period	Nr.
J_D52	Production and Quality	Compliance of microbiological tests	Number of microbiological tests performed on treated (potable) water during the period that complied with JISM standards.	Nr.
J_D53	Production and Quality	Compliance of physical-chemical tests	Number of physical-chemical tests performed on treated (potable) water during the period that complied JISM standards	Nr.
J_E05	Operation	Resident population	Total population who lives on permanent basis in the area served by the water undertaking. (Ref. to DoS) Jordan Department of Statistics Entered value must be more than previous year entered value	Nr.
J_E10	Customer Services	Registered subscribers	Total number of subscribers included in billing database, including those receiving water and those temporarily not receiving water.	Nr.
J_F01	Customer Services	Population supplied (water)	Resident population served by the water undertaking, In the absence of better information, the calculation may be based on the number of active subscribers (N10) * estimated occupancy (5.4).	Nr.
J_F071	Customer Services	Type (1) additional meter applications target time 3 days	First target time - 3 days	Nr.
J_F072	Customer Services	Type (2) HC target time 10 days	Second target Time - 10 days	Nr.

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_F073	Customer Services	Type (3) HC+pipe target time 30 days	Third target time - 30 days	Nr.
J_F081	Customer Services	Type (1) additional meter applications target time 3 days	First target time - 3 days	Nr.
J_F082	Customer Services	Type (2) HC target time 10 days	Second target Time - 10 days	Nr.
J_F083	Customer Services	Type (3) HC+pipe target time 30 days	Third target time - 30 days	Nr.
J_F14	Production and Quality	Water Quality Complaints	Number of water quality complaints during the year (quarter)	Nr.
J_F16	Customer Services	Billing complaints	Number of direct, written billing complaints. A complaint is defined as any written communication from a subscriber that draws attention to a shortfall in billing as perceived by the subscriber.	Nr.
J_G08	Financial	Energy Costs	Annual energy costs, including electricity and fuel. Include all energy used in the utility including for abstraction, treatment, distribution and administrative purposes.	JOD
J_N01	Customer Services	Domestic Billed Volume	the total volume of water billed for residential customers only (in m^3)	m3
J_N02	Human Resources	Employees (sewerage and water)	Nr of employees allocated to sewerage and water Re-claimed functions. Include employees who are engaged at the Sewage Treatment Plants and in operations and maintenance of sewerage and water Re-claimed systems. Only those staff 100% dedicated to sewerage	Nr.
J_N04	Production and Quality	Energy consumed in pumping	Energy consumed in pumping.	kW

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_N10	Customer Services	Active subscribers	Active subscribers are all customers with a water meter who were receiving a water service on the last day of the reporting period. The definition excludes customers on the billing database who were not receiving water (eg as a result of disconnection) or	Nr.
J_N13	Operation	Bursts/failures repaired in target time	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings	Nr.
J_N14	Operation	Subscribers receiving continuous supply	Nr of subscribers normally receiving continuous supply, i.e. 24 hours per day, 7 days per week. No allowance (excuse) need be made for interruptions to supply for maintenance or caused by network and equipment failure unless the interruption lasts more the	Nr.
J_N18	Customer Services	Cash collected	Value of cash collected in period. Approach must be consistent with N28. Include collections from subscribers associated with water and wastewater charges, meter fees, do not include water sales to other utilities, sewerage contributions from municipalities	JOD
J_N19	Customer Services	Doorstep billing	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).	Nr.
J_N20	Financial	Water and Sewerage Revenues	Include all revenues from the water service, the wastewater service, and Re-claimed water, including billings, tankering, exports to other utilities, all fees, charges and penalties, contributions from municipalities, and interest received. Do not include	JOD
J_N21	Financial	Water and sewerage operating costs	Total annual W&S operating costs. W&S operating costs include: imported water, energy, external services, leasing and rentals, consumables, materials for maintenance and repair, levies, do not include capital charges (depreciation and financing costs),	JOD

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_N23	Operation	Estimated proportion of non-revenue water attributable to real losses	Real losses in percent of Non-revenue water. This figure is not reliably known in any governorate in Jordan, so a default value of 50% should be used initially unless better information is available (eg. as a result of minimum night flow studies). Data is	Percentage
J_N24	Human Resources	Total number of all staff engaged in the utilities	Total staff contingent including full time and temporary employees	Nr.
J_N28	Customer Services	Amount billed in period	The amount of water and sewerage billings in the period. Approach must be consistent with N18. (Cash Collected). Include subscriber billings. I.E. Billings associated with water and wastewater charges, meter fees, do not include water sales to other utilities	JOD
J_N35	Operation	Number of days in the applicable quarter (year)	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).	Nr.
J_N43	Financial	Total water and sewerage costs	Total expenditures of water and sewerage, include operating costs and capital charges (i.e. interest charges (if any) and depreciation charges, any provisions)	JOD
J_N44	Financial	Accounts receivable	Accounts receivable are total unpaid amounts falling due from water and sewerage customers at the balance sheet date or earlier, including amounts classified in the annual accounts as bad or doubtful.	JOD
J_N47	Production and Quality	Number of effluent quality tests carried out in the period	Number of effluent quality tests carried out in the period.	Nr.
J_N48	Production and Quality	Number of compliant effluent quality tests	Number of tests carried out in the period which complied with Jordan Technical Regulation 893/2006 or with the contract standards (whichever is the more strenuous).	Nr.

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_N49	Human Resources	Training time for senior management staff	Total number of senior management staff training days in reporting period. Senior Management staff are defined as Directors and the first tier of managers reporting to directors	Days
J_N50	Human Resources	Training Time (excluding senior management)	Total number of training days in reporting period for staff other than Senior Management Staff. Senior Management Staff are defined in variable N49.	Days
J_N53	Operation	Number of repairs not completed in target time	The number of wastewater blockages that occurred in the sewers that were not repaired within the target time. The target time is measured from the time when utility first becomes aware of the failure to the time when the repair is completed and service is	Nr.
J_N55	Operation	Complaints of “No Water Supply”	Number of direct, telephone, and written complaints relating specifically to No Water Supply. A complaint is defined as any written, or spoken, communication from a subscriber that draws attention to a shortfall in service as perceived by the subscriber	Nr.
J_N56	Operation	Other Service Complaints (excluding “No Water”)	Number of direct, telephone, and written complaints of quality of the water service, excluding complaints about billing or no water supply. This PI includes complaints about the quality of the water service such as low pressure and water quality complaint	Nr.

Requested Data Variables

Code	Department	Variable Name	Description	Unit
J_N60	Financial	Total Revenue of Water and Sewerage	Include all revenues from the water service, the wastewater service, and Re-claimed water, including billings, tankering, exports to other utilities, all fees, charges and penalties, contributions from municipalities, taxes, and interest received. include	JOD

Requested Data Variables

Code	Department	Accumulated Data Variable	Description	Unit	Formula
J_A15	Customer Services	Billed authorized consumption	Billed metered and unmetered consumption. Data is preferred to be reported separately for each discreet town or distribution subsystem. Billed authorized consumption=Billed volume + Volume billed from illegal use + Tankers	m3	J_A151 + J_A152 + J_A153
J_A20	Production and Quality	Water losses		m3	J_A07 + J_A08 - J_A18 - J_A15
J_A24	Operation	Real water losses			0,5 * J_A26
J_A26	Operation	Non-revenue water			J_A07 + J_A08 - J_A15 - J_A09
J_B23	Human Resources	Total training time	Total number of training days in reporting period	Days	J_N50 + J_N49
J_F07	Customer Services	New connections within a target time	Number of new connections installed within a target time during the period. The target time is measured from the time when payment is first received from the subscriber to the time when the subscriber receives a water service.	Nr.	J_F071 + J_F072 + J_F073
J_F08	Customer Services	New connections requested	Total number of new connections requested during the period	Nr.	J_F081 + J_F082 + J_F083
J_F11	Operation	Service complaints Calculated field. F11 = N55 + N56	Number of direct, telephone, and written complaints of quality of service, excluding complaints about billing matters. This PI includes complaints about the quality of service such as pressure complaints, water continuity complaints, water quality complaints	Nr.	J_N56 + J_N55

subject: Jordan Water Services Benchmarking Program

questionnaire: Jordan Water Utilities Questionairre

2014

participant: **Arab Countries Water Utilities Association (ACWUA) [0000]**

status: **RELEASED**

0 % (0 of 42 mandatory questions completed)

0% optional (0 of 17) 0% automatic (0 of 5)

description:

5.	Type of operation			**J_CI04**
	Type of operation			
	WAJ administrations = Public Aqaba/Miyahuna/Yarmouk = Private			

10.	Water produced		m3	**J_A07**
	Water produced			
	Total volume of water treated for input to water transmission lines or directly to the distribution system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

20.	Imported treated water		m3	**J_A08**
	Imported treated water			
	Total volume of water imported from other water undertakings or system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

30.	Exported treated water		m3	**J_A09**
	Exported treated water			
	Total volume of water exported to other water undertakings or systems from the supply area Data is preferred to be reported separately for each discreet town or distribution subsystem			

40.	***Billed authorized consumption***		m3	***J_A15***
	Billed authorized consumption calculated data variable = J_A151 + J_A152 + J_A153			
	Billed metered and unmetered consumption. Data is preferred to be reported separately for each discreet town or distribution subsystem. Billed authorized consumption=Billed volume+Volume billed from illegal use+Tankers			

50.	part 1: Billed Volume		m3	**J_A151**
	part 1: Billed Volume			
	part 1: Billed Volume			

60.	part 2: volume built from illegal usage		m3	**J_A152**
	part 2: volume built from illegal usage			
	part 2: volume built from illegal usage			

70.	part 3: tankers		m3	**J_A153**
	part 3: tankers			
	part 3: tankers			

80.	Unbilled authorized consumption		m3	**J_A18**
	Unbilled authorized consumption			
	Total amount of unbilled water consumed. This may include items such as free supply to Mosques, free supply to Bedouins (if authorized), firefighting and training, flushing of the water and sewer network, street cleaning, watering of municipal gardens,			

84.	***Water losses***		m3	***J_A20***
	Water losses calculated data variable = J_A07 + J_A08 - J_A18 - J_A15			

85.	***Non-revenue water***			***J_A26***
	Non-revenue water calculated data variable = J_A07 + J_A08 - J_A15 - J_A09			

86.	***Real water losses***			***J_A24***
	Real water losses calculated data variable = 0.5 * J_A26			

90.	***Total training time***		Days	***J_B23***
	Total training time calculated data variable = J_N50 + J_N49			
	Total number of training days in reporting period			

100.	Length of Water network		km	**J_C08**
	Length of Water network			
	The total length of the transmission and distribution network (in km) - per definition all pipes > 1" diameter, not used for house connections Entered value should be more or equal to previous year value			

110.	Water service connections		Nr.	**J_C32**
	Water service connections			

	Total number of service connections. A Service Connection is the delivery point from the tertiary water network to the subscriber meter or meters . A single Service Connection (delivery point) cannot serve more than one plot Entered value must be more or equal to the previous entered value			

120.	Network failures		Nr.	**J_D25**
	Network failures			
	Number of network failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings.			

130.	Water service connection failures		Nr.	**J_D26**
	Water service connection failures			
	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings			

140.	Number of hours per week that the system is pressurized.		Hour	**J_D29**
	Number of hours per week that the system is pressurized.			
	Amount of time the system is pressurized measured from the time when water first enters the network to the time when supply is discontinued. Data is preferred to be reported separately for each discreet town or distribution subsystem. The number of hours per week that system is pressurized less than 24*7=168 hours/week			

150.	Meter replacement		Nr.	**J_D40**
	Meter replacement			
	Number of subscriber meters replaced during the period			

160.	Water quality tests performed		Nr.	**J_D41**
	Water quality tests performed			
	Total number of treated (potable) water tests performed during the period			

170.	Microbiological water quality tests performed		Nr.	**J_D43**
	Microbiological water quality tests performed			
	Total number of microbiological water tests performed on treated (potable) water during the period. Do no include tests of raw water.			

180.	Physical-chemical water quality tests performed		Nr.	**J_D44**
	Physical-chemical water quality tests performed			
	Total number of physical-chemical water tests performed on treated (potable) water during the period. Do no include tests of raw water.			

190.	Water quality tests required		Nr.	**J_D46**
	Water quality tests required			
	Total number of treated (potable) water tests required by applicable standards or legislation during the period			

200.	Compliance of microbiological tests		Nr.	**J_D52**
	Compliance of microbiological tests			
	Number of microbiological tests performed on treated (potable) water during the period that complied with JISM standards.			

210.	Compliance of physical-chemical tests		Nr.	**J_D53**
	Compliance of physical-chemical tests			
	Number of physical-chemical tests performed on treated (potable) water during the period that complied JISM standards			

220.	Resident population		Nr.	**J_E05**
	Resident population			
	Total population who lives on permanent basis in the area served by the water undertaking. (Ref. to DoS) Jordan Department of Statistics Entered value must be more than previous year entered value			

230.	Registered subscribers		Nr.	**J_E10**
	Registered subscribers			
	Total number of subscribers included in billing database, including those receiving water and those temporarily not receiving water.			

240.	Population supplied (water)		Nr.	**J_F01**
	Population supplied (water)			
	Resident population served by the water undertaking, In the absence of better information, the calculation may be based on the number of active subscribers (N10) * estimated occupancy (5.4).			

250.	***New connections within a target time***		Nr.	***J_F07***
	New connections within a target time calculated data variable = J_F071 + J_F072 + J_F073			
	Number of new connections installed within a target time during the period. The target time is measured from the time when payment is first received from the subscriber to the time when the subscriber receives a water service.			

260.	Type (1) additional meter applications target time 3 days		Nr.	**J_F071**
	Type (1) additional meter applications target time 3 days			
	First target time - 3 days			

270.	Type (2) HC target time 10 days		Nr.	**J_F072**
	Type (2) HC target time 10 days			
	Second target Time - 10 days			

280.	Type (3) HC+pipe target time 30 days		Nr.	**J_F073**
	Type (3) HC+pipe target time 30 days			
	Third target time - 30 days			

290.	***New connections requested***		Nr.	***J_F08***
	New connections requested calculated data variable = J_F081 + J_F082 + J_F083			
	Total number of new connections requested during the period			

300.	Type (1) additional meter applications target time 3 days		Nr.	**J_F081**
	Type (1) additional meter applications target time 3 days			
	First target time - 3 days			

310.	Type (2) HC target time 10 days		Nr.	**J_F082**
	Type (2) HC target time 10 days			
	Second target Time - 10 days			

320.	Type (3) HC+pipe target time 30 days		Nr.	**J_F083**
	Type (3) HC+pipe target time 30 days			
	Third target time - 30 days			

330.	***Service complaints [Calculated field. F11 = N55 + N56***		Nr.	***J_F11***
	Service complaints [Calculated field. F11 = N55 + N56 calculated data variable = J_N56 + J_N55			
	Number of direct, telephone, and written complaints of quality of service, excluding complaints about billing matters. This PI includes complaints about the quality of service such as pressure complaints, water continuity complaints, water quality complaints			

340.	Water Quality Complaints		Nr.	**J_F14**
	Water Quality Complaints			
	Number of water quality complaints during the year (quarter)			

350.	Billing complaints		Nr.	**J_F16**
	Billing complaints			
	Number of direct, written billing complaints. A complaint is deFinancialed as any written communication from a subscriber that draws attention to a shortfall in billing as perceived by the subscriber.			

360.	Energy Costs		JOD	**J_G08**
	Energy Costs			
	Annual energy costs, including electricity and fuel. Include all energy used in the utility including for abstraction, treatment, distribution and administrative purposes.			

370.	Domestic Billed Volume		m3	**J_N01**
	Domestic Billed Volume			

	the total volume of water billed for residential customers only (in m³)

380.	Employees (sewerage and water)		Nr.	**J_N02**
	Employees (sewerage and water)			
	Nr of employees allocated to sewerage and water Re-claimed functions. Include employees who are engaged at the Sewage Treatment Plants and in Operationerations and maintenance of sewerage and water Re-claimed systems. Only those staff 100% dedicated to sewerage			

390.	Energy consumed in pumping		kW	**J_N04**
	Energy consumed in pumping			
	Energy consumed in pumping.			

400.	Active subscribers		Nr.	**J_N10**
	Active subscribers			
	Active subscribers are all customers with a water meter who were receiving a water service on the last day of the reporting period. The deFinancialition excludes customers on the billing database who were not receiving water (eg as a result of disconnection) or			

410.	Bursts/failures repaired in target time		Nr.	**J_N13**
	Bursts/failures repaired in target time			
	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings			

420.	Subscribers receiving continuous supply		Nr.	**J_N14**
	Subscribers receiving continuous supply			
	Nr of subscribers normally receiving continuous supply, i.e.. 24 hours per day, 7 days per week. No allowance (excuse) need be made for interruptions to supply for maintenance or caused by network and equipment failure unless the interruption lasts more the			

430.	Cash collected		JOD	**J_N18**
	Cash collected			
	Value of cash collected in period. Approach must be consistent with N28. Include collections from subscribers associated with water and wastewater charges, meter fees,Do not include water sales to other utilities, sewerage contributions from municipalities			

440.	Doorstep billing		Nr.	**J_N19**
	Doorstep billing			
	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).			

450.	Water and Sewerage Revenues		JOD	**J_N20**
	Water and Sewerage Revenues			
	Include all revenues from the water service, the wastewater service, and Re-claimed water, including billings, tankering, exports to other utilities, all fees, charges and penalties, contributions from municipalities, and interest received. Do not include			

460.	Water and sewerage operating costs		JOD	**J_N21**
	Water and sewerage operating costs			
	Total annual W&S operating costs. W&S operating costs include: imported water, energy, external services, leasing and rentals, consumables, materials for maintenance and repair, levies,. Do not include capital charges (depreciation and financing costs),			

470.	Estimated proportion of non revenue water attributable to real losses		Percentage	**J_N23**
	Estimated proportion of non revenue water attributable to real losses			
	Real losses in percent of Non revenue water. This figure is not reliably known in any governorate in Jordan, so a default value of 50% should be used initially unless better information is available (eg. as a result of minimum night flow studies).Data is			

480.	Total number of all staff engaged in the utilities		Nr.	**J_N24**
	Total number of all staff engaged in the utilities			
	Total staff contingent including full time and temporary employees			

490.	Amount billed in period		JOD	**J_N28**
	Amount billed in period			
	The amount of water and sewerage billings in the period. Approach must be consistent with N18. (Cash Collected). Include subscriber billings. I.E. Billings associated with water and wastewater charges, meter fees, Do not include water sales to other utili			

500.	Number of days in the applicable quarter (year)		Nr.	**J_N35**
	Number of days in the referenced period (year)			
	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).			

510.	Total water and sewerage costs		JOD	**J_N43**
	Total water and sewerage costs			
	Total expenditures of water and sewerage , include operating costs and capital charges (i.e. interest charges (if any) and depreciation charges, any provisions)			

520.	Accounts receivable		JOD	**J_N44**
	Accounts receivable			
	Accounts receivable are total unpaid amounts falling due from water and sewerage customers at the balance sheet date or earlier, including amounts classified in the annual accounts as bad or doubtful.			

530.	Number of effluent quality tests carried out in the period		Nr.	**J_N47**
	Number of effluent quality tests carried out in the period			
	Number of effluent quality tests carried out in the period.			

540.	Number of compliant effluent quality tests		Nr.	**J_N48**
	Number of compliant effluent quality tests			
	Number of tests carried out in the period which complied with Jordan Technical Regulation 893/2006 or with the contract standards (whichever is the more strenuous).			

550.	Training time for senior management staff		Days	**J_N49**
	Training time for senior management staff			
	Total number of senior management staff training days in reporting period. Senior Management staff are deFinancialed as Directors and the first tier of managers reporting to directors			

560.	Training Time (excluding senior management)		Days	**J_N50**
	Training Time (excluding senior management)			
	Total number of training days in reporting period for staff other than Senior Management Staff. Senior Management Staff are deFinancialed in variable N49.			

570.	Number of repairs not completed in target time		Nr.	**J_N53**
	Number of repairs not completed in target time			
	The number of wastewater blockages that occurred in the sewers that were not repaired within the target time. The target time is measured from the time when utility first becomes aware of the failure to the time when the repair is completed and service is			

580.	Complaints of “No Water Supply”		Nr.	**J_N55**
	Complaints of “No Water Supply”			
	Number of direct, telephone, and written complaints relating specifically to "No Water Supply". A complaint is deFinancialed as any written, or spoken, communication from a subscriber that draws attention to a shortfall in service as perceived by the subscriber			

590.	Other Service Complaints (excluding “No Water”)		Nr.	**J_N56**
	Other Service Complaints (excluding “No Water”)			
	Number of direct, telephone, and written complaints of quality of the water service, excluding complaints about billing or "no water supply". This PI includes complaints about the quality of the water service such as low pressure and water quality complaint			

600.	Total Revenue of Water and Sewerage		JOD	**J_N60**
	Total Revenue of Water and Sewerage			
	Include all revenues from the water service, the wastewater service, and Re-claimed water, including billings, tankering, exports to other utilities, all fees, charges and penalties, contributions from municipalities, taxes, and interest received. include			

report: Key Performance Indicators
evaluation period:
subject: Jordan Water Services Benchmarking Program

description:

Key Performance Indicators

10.	***Non-revenue water by volume***	ƒ(x)	%	***J_Fi36***
	J_A26 / (J_A07 + J_A08) * 100			
	IE. Non revenue / system input volume *100			

20.	***Collection ratio***	ƒ(x)	%	***J_FIc01***
	J_N18 / J_N28 * 100			
	Cash collected as a percentage of amount billed			

30.	***Operating cost coverage ratio (water and sewerage)***	ƒ(x)	%	***J_FIc03***
	J_N28 / J_N21 * 100			
	IE Annual water and sewerage billings as a % of Annual water and sewerage running costs.			

40.	***Water losses per water service connection***	ƒ(x)	L/connection/day	***J_Op22***
	((1000 * J_A20) / J_C32) / J_N35			
	[where A20 = A07+A08 - A09 - A15 - A18]Water losses / number of water connections (l/connection/day). Water losses / number of water connections, By using the factor N35 (effect of rationing/pressurizing the system) a first attempt is made to adjust this figure to a comparable level (uninterrupted supply)			

50.	***Total employees per 1000 water subscribers***	ƒ(x)	Nr per 1000 subscribers	***J_PEc01***
	J_N24 * 1000 / J_E10			

60.	***Microbiological water quality compliance***	ƒ(x)	%	***J_QS17***
	J_D52 / J_D43 * 100			
	IE. Microbiological tests complying with standards in percent of total microbiological tests performed			

70.	***Non-Billing complaints (Service Complaints)***	ƒ(x)	per 100 subscriber	***J_QS22***
	J_F11 / J_E10 * 100			
	i.e. % of total nonbilling complaints per number of registered subscribers			

80.	***Billing complaints***	ƒ(x)	per 100 subscribers	***J_QS27***
	J_F16 / J_E10 * 100			
	IE. Billing complaints as a percentage of registered subscribers			

Data variable				
330.	***Water consumption per capita***	ƒ(x)	L per Capita per day	***J_WRc02***
	J_N01 * 1000 / 365 / J_F01			
	IE. Domestic billed volume/population served.			

340.	***Subscribers receiving continuous supply***	ƒ(x)	%	***J_QSc01***
	J_N14 / J_N10 * 100			
	Active subscribers receiving a continuous supply as a percent of total Active Subscribers.			

850.	Non-revenue water	Σ123		**J_A26**
	Non-revenue water			

860.	Water produced	123	m3	**J_A07**
	Water produced			
	Total volume of water treated for input to water transmission lines or directly to the distribution system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

870.	Imported treated water	123	m3	**J_A08**
	Imported treated water			
	Total volume of water imported from other water undertakings or system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

880.	Type of operation	x|y		**J_CI04**
	Type of operation			
	WAJ administrations = Public Aqaba/Miyahuna/Yarmouk = Private			

890.	Cash collected	123	JOD	**J_N18**
	Cash collected			
	Value of cash collected in period. Approach must be consistent with N28. Include collections from subscribers associated with water and wastewater charges, meter fees,Do not include water sales to other utilities, sewerage contributions from municipalities			

900.	Amount billed in period	123	JOD	**J_N28**
	Amount billed in period			
	The amount of water and sewerage billings in the period. Approach must be consistent with N18. (Cash Collected). Include subscriber billings. I.E. Billings associated with water and wastewater charges, meter fees, Do not include water sales to other utili			

910.	Water and sewerage operating costs	123	JOD	**J_N21**
	Water and sewerage operating costs			

	Total annual W&S operating costs. W&S operating costs include: imported water, energy, external services, leasing and rentals, consumables, materials for maintenance and repair, levies,. Do not include capital charges (depreciation and financing costs),			

920.	Exported treated water	123	m3	**J_A09**
	Exported treated water			
	Total volume of water exported to other water undertakings or systems from the supply area Data is preferred to be reported separately for each discreet town or distribution subsystem			

930.	Billed authorized consumption	Σ123	m3	**J_A15**
	Billed authorized consumption			
	Billed metered and unmetered consumption. Data is preferred to be reported separately for each discreet town or distribution subsystem. Billed authorized consumption=Billed volume+Volume billed from illegal use+Tankers			

940.	part 1: Billed Volume	123	m3	**J_A151**
	part 1: Billed Volume			
	part 1: Billed Volume			

950.	part 2: volume built from illegal usage	123	m3	**J_A152**
	part 2: volume built from illegal usage			
	part 2: volume built from illegal usage			

960.	part 3: tankers	123	m3	**J_A153**
	part 3: tankers			
	part 3: tankers			

970.	Water losses	Σ123	m3	**J_A20**
	Water losses			

980.	Water service connections	123	Nr.	**J_C32**
	Water service connections			
	Total number of service connections. A Service Connection is the delivery point from the tertiary water network to the subscriber meter or meters . A single Service Connection (delivery point) cannot serve more than one plot Entered value must be more or equal to the previous entered value			

990.	Number of days in the applicable quarter (year)	123	Nr.	**J_N35**
	Number of days in the referenced period (year)			
	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).			

1000.	Unbilled authorized consumption	123	m3	**J_A18**
	Unbilled authorized consumption			

	Total amount of unbilled water consumed. This may include items such as free supply to Mosques, free supply to Bedouins (if authorized), firefighting and training, flushing of the water and sewer network, street cleaning, watering of municipal gardens,			

1010.	Total number of all staff engaged in the utilities	123	Nr.	**J_N24**
	Total number of all staff engaged in the utilities			
	Total staff contingent including full time and temporary employees			

1020.	Registered subscribers	123	Nr.	**J_E10**
	Registered subscribers			
	Total number of subscribers included in billing database, including those receiving water and those temporarily not receiving water.			

1030.	Compliance of microbiological tests	123	Nr.	**J_D52**
	Compliance of microbiological tests			
	Number of microbiological tests performed on treated (potable) water during the period that complied with JISM standards.			

1040.	Microbiological water quality tests performed	123	Nr.	**J_D43**
	Microbiological water quality tests performed			
	Total number of microbiological water tests performed on treated (potable) water during the period. Do no include tests of raw water.			

1050.	Service complaints [Calculated field. F11 = N55 + N56	Σ123	Nr.	**J_F11**
	Service complaints [Calculated field. F11 = N55 + N56			
	Number of direct, telephone, and written complaints of quality of service, excluding complaints about billing matters. This PI includes complaints about the quality of service such as pressure complaints, water continuity complaints, water quality complaints			

1060.	Other Service Complaints (excluding “No Water”)	123	Nr.	**J_N56**
	Other Service Complaints (excluding “No Water”)			
	Number of direct, telephone, and written complaints of quality of the water service, excluding complaints about billing or "no water supply". This PI includes complaints about the quality of the water service such as low pressure and water quality complaint			

1070.	Complaints of “No Water Supply”	123	Nr.	**J_N55**
	Complaints of “No Water Supply”			
	Number of direct, telephone, and written complaints relating specifically to "No Water Supply". A complaint is deFinancialed as any written, or spoken, communication from a subscriber that draws attention to a shortfall in service as perceived by the subscriber			

1080.	Billing complaints	123	Nr.	**J_F16**
	Billing complaints			
	Number of direct, written billing complaints. A complaint is deFinancialed as any written communication from a subscriber that draws attention to a shortfall in billing as perceived by the subscriber.			

1090.	Domestic Billed Volume	123	m3	**J_N01**
	Domestic Billed Volume			
	the total volume of water billed for residential customers only (in m³)			

1100.	Population supplied (water)	123	Nr.	**J_F01**
	Population supplied (water)			
	Resident population served by the water undertaking, In the absence of better information, the calculation may be based on the number of active subscribers (N10) * estimated occupancy (5.4).			

1110.	Subscribers receiving continuous supply	123	Nr.	**J_N14**
	Subscribers receiving continuous supply			
	Nr of subscribers normally receiving continuous supply, i.e.. 24 hours per day, 7 days per week. No allowance (excuse) need be made for interruptions to supply for maintenance or caused by network and equipment failure unless the interruption lasts more the			

1120.	Active subscribers	123	Nr.	**J_N10**
	Active subscribers			
	Active subscribers are all customers with a water meter who were receiving a water service on the last day of the reporting period. The deFinancialition excludes customers on the billing database who were not receiving water (eg as a result of disconnection) or			

report: Lower Level Performance Indicators
evaluation period:
subject: Jordan Water Services Benchmarking Program

description:

10.	***Energy costs ratio***	ƒ(x)	%	***J_Fi07***
	J_G08 / J_N21 * 100			
	Energy costs in percent of total running costs			

20.	***Subscriber meter replacement***	ƒ(x)	%	***J_Op08***
	J_D40 / J_E10 * 100			

30.	***Network repair rate***	ƒ(x)	%	***J_Op26***
	J_D25 / J_C08 * 100			
	IE. Number of network repairs during the year, including failures of valves and fittings in relation to total network length			

40.	***Water service connection repair rate***	ƒ(x)	Nr per 1000 Sc	***J_Op27***
	J_D26 / J_C32 * 1000			
	Number of service connection repairs during the year per 1000 number of active subscribers			

50.	***Water quality tests performed***	ƒ(x)	%	***J_Op32***
	J_D41 / J_D46 * 100			
	i.e. Number of actual tests of treated water in percentage of number of tests required under the standards			

60.	***Speed of repair of bursts***	ƒ(x)	%	***J_OPc08***
	J_N13 / (J_D25 + J_D26) * 100			
	Bursts repaired within target time/ Total bursts *100.			

70.	***Employees per water service connection***	ƒ(x)	Staff/1000 connections	***J_Pe01***
	(J_N24 - J_N02) * 1000 / J_C32			
	Nr of employees involved in the water service * 1000 / Number of water connections.			

80.	***Training per employee***	ƒ(x)	day/employee/year	***J_Pe16***
	J_B23 / J_N24			
	IE. Annual number of training hours / Nr of employees			

90.	***Average unit energy consumption***	ƒ(x)		***J_PHc02***

			KW per system input	
	J_N04 / (J_A07 + J_A08 + J_A09)			
	IE. Total energy consumed in pumping/total system volume			

100.	***Continuity ofsupply (Supply Index)***	ƒ(x)	%	***J_QS10***
	J_D29 / (7 * 24) * 100			
	Hours per week that system is fully pressurized / Total hours per week * 100.			

110.	***Quality of supplied water***	ƒ(x)	%	***J_QS15***
	(J_D52 + J_D53) / J_D41 * 100			
	I.e. Tests complying with national standards expressed as a percentage of tests performed.			

120.	***Physical-chemical water quality complianc***	ƒ(x)	%	***J_QS18***
	J_D53 / J_D44 * 100			
	Physical-chemical tests complying with standards as a percentage of total physical-chemical tests performed			

130.	***New connection efficiency***	ƒ(x)	%	***J_QS20***
	J_F07 / J_F08 * 100			
	Connections installed in target time in percent of total requested new connections			

140.	***Water quality complaints***	ƒ(x)	%	***J_QS25***
	J_F14 / J_F11 * 100			
	IE. Complaints attributable to WQ as a percentage of nonbilling complaints (service complaints).			

150.	***Inefficiency of use of water resources***	ƒ(x)	%	***J_WR01***
	(J_A24) / (J_A07 + J_A08 - J_A09)			
	The IWA definition has been modified to suit local conditions. Real (Physical losses)/(water produced + imports - exports) *100			

160.	***Water resource use per capita / system input per day***	ƒ(x)	l/c/d	***J_WRc01***
	(J_A07 + J_A08 - J_A09) * 1000 / 365 / J_F01			
	IE.System input volume/population served.			

170.	***Water losses per km***	ƒ(x)	m3/km/day	***J_OPc02***
	(J_A20 / J_N35) / J_C08			
	Where A20 = A07+A08-A09-A15-A18. Water losses / Total length of			

Data variable				
Data variable				
185.	Energy Costs	123	JOD	**J_G08**
	Energy Costs			

	Annual energy costs, including electricity and fuel. Include all energy used in the utility including for abstraction, treatment, distribution and administrative purposes.			

195.	Water and sewerage operating costs	123	JOD	**J_N21**
	Water and sewerage operating costs			
	Total annual W&S operating costs. W&S operating costs include: imported water, energy, external services, leasing and rentals, consumables, materials for maintenance and repair, levies,. Do not include capital charges (depreciation and financing costs),			

205.	Meter replacement	123	Nr.	**J_D40**
	Meter replacement			
	Number of subscriber meters replaced during the period			

215.	Registered subscribers	123	Nr.	**J_E10**
	Registered subscribers			
	Total number of subscribers included in billing database, including those receiving water and those temporarily not receiving water.			

225.	Network failures	123	Nr.	**J_D25**
	Network failures			
	Number of network failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings.			

235.	Length of Water network	123	km	**J_C08**
	Length of Water network			
	The total length of the transmission and distribution network (in km) - per definition all pipes > 1" diameter, not used for house connections Entered value should be more or equal to previous year value			

245.	Water service connection failures	123	Nr.	**J_D26**
	Water service connection failures			
	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings			

255.	Water service connections	123	Nr.	**J_C32**
	Water service connections			
	Total number of service connections. A Service Connection is the delivery point from the tertiary water network to the subscriber meter or meters . A single Service Connection (delivery point) cannot serve more than one plot Entered value must be more or equal to the previous entered value			

265.	Water quality tests performed	123	Nr.	**J_D41**
	Water quality tests performed			
	Total number of treated (potable) water tests performed during the period			

275.	Water quality tests required	123	Nr.	**J_D46**
	Water quality tests required			

	Total number of treated (potable) water tests required by applicable standards or legislation during the period			

285.	Bursts/failures repaired in target time	123	Nr.	**J_N13**
	Bursts/failures repaired in target time			
	Number of service connection failures (eg. as a result of bursts, leaks, etc), including failures of valves and fittings			

295.	Total number of all staff engaged in the utilities	123	Nr.	**J_N24**
	Total number of all staff engaged in the utilities			
	Total staff contingent including full time and temporary employees			

305.	Employees (sewerage and water)	123	Nr.	**J_N02**
	Employees (sewerage and water)			
	Nr of employees allocated to sewerage and water Re-claimed functions. Include employees who are engaged at the Sewage Treatment Plants and in Operationerations and maintenance of sewerage and water Re-claimed systems. Only those staff 100% dedicated to sewerage			

315.	Total training time	Σ123	Days	**J_B23**
	Total training time			
	Total number of training days in reporting period			

325.	Training Time (excluding senior management)	123	Days	**J_N50**
	Training Time (excluding senior management)			
	Total number of training days in reporting period for staff other than Senior Management Staff. Senior Management Staff are deFinancialed in variable N49.			

335.	Training time for senior management staff	123	Days	**J_N49**
	Training time for senior management staff			
	Total number of senior management staff training days in reporting period. Senior Management staff are deFinancialed as Directors and the first tier of managers reporting to directors			

345.	Energy consumed in pumping	123	kW	**J_N04**
	Energy consumed in pumping			
	Energy consumed in pumping.			

355.	Water produced	123	m3	**J_A07**
	Water produced			
	Total volume of water treated for input to water transmission lines or directly to the distribution system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

365.	Imported treated water	123	m3	**J_A08**
	Imported treated water			
	Total volume of water imported from other water undertakings or system. Data is preferred to be reported separately for each discreet town or distribution subsystem			

375.	Exported treated water	123	m3	**J_A09**
	Exported treated water			
	Total volume of water exported to other water undertakings or systems from the supply area Data is preferred to be reported separately for each discreet town or distribution subsystem			

385.	Number of hours per week that the system is pressurized.	123	Hour	**J_D29**
	Number of hours per week that the system is pressurized.			
	Amount of time the system is pressurized measured from the time when water first enters the network to the time when supply is discontinued. Data is preferred to be reported separately for each discreet town or distribution subsystem. The number of hours per week that system is pressurized less than 24*7=168 hours/week			

395.	Compliance of microbiological tests	123	Nr.	**J_D52**
	Compliance of microbiological tests			
	Number of microbiological tests performed on treated (potable) water during the period that complied with JISM standards.			

405.	Compliance of physical-chemical tests	123	Nr.	**J_D53**
	Compliance of physical-chemical tests			
	Number of physical-chemical tests performed on treated (potable) water during the period that complied JISM standards			

415.	Sanitary flooding incidents on properties	123	Nr.	**J_WD41**
	Sanitary flooding incidents on properties			
	Number of sanitary flooding incidents to the inside of properties. If a flooding event affects more than one property then count each property as a separate incident. Include only incidents related to sanitary sewers that are the responsibility of the was			

425.	Physical-chemical water quality tests performed	123	Nr.	**J_D44**
	Physical-chemical water quality tests performed			
	Total number of physical-chemical water tests performed on treated (potable) water during the period. Do no include tests of raw water.			

435.	New connections within a target time	Σ123	Nr.	**J_F07**
	New connections within a target time			
	Number of new connections installed within a target time during the period. The target time is measured from the time when payment is first received from the subscriber to the time when the subscriber receives a water service.			

445.	Type (1) additional meter applications target time 3 days	123	Nr.	**J_F071**
	Type (1) additional meter applications target time 3 days			
	First target time - 3 days			

455.	Type (2) HC target time 10 days	123	Nr.	J_F072
	Type (2) HC target time 10 days			
	Second target Time - 10 days			

465.	Type (3) HC+pipe target time 30 days	123	Nr.	J_F073
	Type (3) HC+pipe target time 30 days			
	Third target time - 30 days			

475.	New connections requested	Σ123	Nr.	J_F08
	New connections requested			
	Total number of new connections requested during the period			

485.	Type (1) additional meter applications target time 3 days	123	Nr.	J_F081
	Type (1) additional meter applications target time 3 days			
	First target time - 3 days			

495.	Type (2) HC target time 10 days	123	Nr.	J_F082
	Type (2) HC target time 10 days			
	Second target Time - 10 days			

505.	Type (3) HC+pipe target time 30 days	123	Nr.	J_F083
	Type (3) HC+pipe target time 30 days			
	Third target time - 30 days			

515.	Water Quality Complaints	123	Nr.	J_F14
	Water Quality Complaints			
	Number of water quality complaints during the year (quarter)			

525.	Service complaints [Calculated field. F11 = N55 + N56	Σ123	Nr.	J_F11
	Service complaints [Calculated field. F11 = N55 + N56			
	Number of direct, telephone, and written complaints of quality of service, excluding complaints about billing matters. This PI includes complaints about the quality of service such as pressure complaints, water continuity complaints, water quality complaints			

535.	Real water losses	Σ123		J_A24
	Real water losses			

545.	Population supplied (water)	123	Nr.	J_F01
	Population supplied (water)			

	Resident population served by the water undertaking, In the absence of better information, the calculation may be based on the number of active subscribers (N10) * estimated occupancy (5.4).			

555.	Water losses	Σ123	m3	J_A20
	Water losses			

565.	Number of days in the applicable quarter (year)	123	Nr.	J_N35
	Number of days in the referenced period (year)			
	Do not include water sales to other utilities, sewerage contributions from municipalities, interest payments, income from non-core activities (e.g. bottled water).			

575.	Other Service Complaints (excluding “No Water”)	123	Nr.	J_N56
	Other Service Complaints (excluding “No Water”)			
	Number of direct, telephone, and written complaints of quality of the water service, excluding complaints about billing or "no water supply". This PI includes complaints about the quality of the water service such as low pressure and water quality complaint			

585.	Complaints of “No Water Supply”	123	Nr.	J_N55
	Complaints of “No Water Supply”			
	Number of direct, telephone, and written complaints relating specifically to "No Water Supply". A complaint is deFinancialed as any written, or spoken, communication from a subscriber that draws attention to a shortfall in service as perceived by the subscriber			

595.	Non-revenue water	Σ123		J_A26
	Non-revenue water			

605.	Billed authorized consumption	Σ123	m3	J_A15
	Billed authorized consumption			
	Billed metered and unmetered consumption. Data is preferred to be reported separately for each discreet town or distribution subsystem. Billed authorized consumption=Billed volume+Volume billed from illegal use+Tankers			

615.	part 1: Billed Volume	123	m3	J_A151
	part 1: Billed Volume			
	part 1: Billed Volume			

625.	part 2: volume built from illegal usage	123	m3	J_A152
	part 2: volume built from illegal usage			
	part 2: volume built from illegal usage			

635.	part 3: tankers	123	m3	J_A153
	part 3: tankers			
	part 3: tankers			

645.	Type of operation	x|y		J_CI04
	Type of operation			
	WAJ administrations = Public Aqaba/Miyahuna/Yarmouk = Private			

8.3 Annex (3)

Semi-structured interviews questionnaire form (English and Arabic) blank

Sub-Annexes (3.1 – 3.9)

Filled individual surveys/questionnaires from 9 water utilities

Name: **الاسم:**	**Utility:** **المرفق:**
Telephone: رقم الهاتف Mobile: رقم الهاتف المحمول Telefax: رقم الفاكس E-Mail: البريد الالكتروني Internet: الموقع الالكتروني	**Department** (Technical/Economic) **القسم (فني / اقتصادي) :**

1. What is the ownership structure? 1. ما هو شكل ملكية المرفق؟
2. Describe the Management Structure? 2. ما هو وصف الهيكل الإداري للمرفق؟
3. Can we get a copy of the annual report (technical/financial) or annual statement? 3. هل يمكننا الحصول على نسخة من التقرير السنوي (الفنية / المالية) أو الكشف السنوي للمرفق؟
4. How do you evaluate data (records) availability in the utility? 4. كيف تقيمون توفر البيانات (السجلات) في المرفق؟
5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.) 5. ما هي التحديات الرئيسية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟
6. What is the factor(s) achieving sustainability for your utility? 6. ما هو العامل / العوامل التي تحقق الاستدامة لمرفقكم؟
7. What are the internal KPIs you are using to measure utility's performance? 7. ما هي مؤشرات قياس الاداء الداخلية التي تستخدمها لقياس اداء المرفق ؟
8. Since when your utility is engaged in performance assessment projects with PMU-MWI? 8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...) 9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟
10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.) 10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت المستغل وورش العمل والاجتماعات وغيرها)
11. What are the methods suggested to encourage utility staff to participate in BM project? 11. ما هي الأساليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟
12. What are the obstacles you may face when implementing performance assessment project? 12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟
13. What are lessons learned to avoid mistakes in next performance monitoring project? 13. ما هي الدروس المستفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟
14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency? 14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتحسين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع مستوى الكفاءة؟
15. In your opinion, why benchmarking for water services is not applied in Jordan? 15. حسب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

1. **What is the ownership structure?**

1. ما هو شكل ملكية المرفق؟

Management contract for water supply and sanitation services between WAJ and Miyahuna Water Company for 3 years
UID#45 works as operator for UID#5

2. **Describe the Management Structure?**

2. ما هو وصف الهيكل الإداري للمرفق؟

There is organizational structure for the management contract

3. **Can we get a copy of the annual report (technical/financial) or annual statement?**

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

Available at UID#45

4. **How do you evaluate data (records) availability in the utility?**

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

There are customer information system X7, financial system, complaints system
So data is available and easy to collect

5. **What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)**

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- Population growth
- Increasing water demand due to tourism and economic growth
- Water quality
- Covering operational costs and expenditure
- Infrastructure maintenance
- Retaining quailed staff and capacity building
- High energy costs

6. **What is the factor(s) achieving sustainability for your utility?**

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Reduce over staffing
- Maintain water quality standards
- Reduce NRW
- Applying the water balance
- using bulk meters to monitor water consumption

7. **What are the internal KPIs you are using to measure utility's performance?**

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

- Billing efficiency
- NRW

- Covering operational costs
- Energy consumption
- Complaint response time
- New house connections

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

Since January 2014

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

- Technical & Economic: Improve operation & maintenance, response to complaints, water supply, maintain water schedule, water resources conservation, reduce energy consumption
- Organizational and Economic: enhance customer satisfaction, improve billing and accuracy of metering, accuracy of collected data
- Improve performance according international best practices and compared according to available resources

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها)

5 employees with 10% time allocated

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

Provide incentives according to employee performance and department as a whole
Provide logistics support; transportation and office supplies

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

No specialized personnel in performance improvement
Lack of training and follow up

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

- Train alternative personnel to contribute in performance monitoring assignments

- Provide training and capacity building periodically
- Focus on the good practices and analyze the reasons behind low performance

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتحسين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع مستوى الكفاءة؟

The success of UID#5 management contract. contract started in October 2013 and since then the performance was monitored through KPIs and compared to previous performance and recorded good achievements. There is no any complaints about service delivery in Madaba these days

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. حسب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

Avoid facing negative results and avoid taking responsibility towards bad performance
Lack of resources, equipment and cadre for benchmarking in Jordan

1. **What is the ownership structure?**

1. ما هو شكل ملكية المرفق؟

Limited Liability company owned by 85% of shares by WAJ and 15% of shares owned by Aqaba Development Company

2. **Describe the Management Structure?**

2. ما هو وصف الهيكل الإداري للمرفق؟

CEO working under the supervision of board of directors (5 members from WAJ and 2 members from ADC)

3. **Can we get a copy of the annual report (technical/financial) or annual statement?**

3. **هل يمكننا الحصول على نسخة من التقرير السنوي (الفنية / المالية) أو الكشف السنوي للمرفق؟**

Available

4. **How do you evaluate data (records) availability in the utility?**

4. كيف تقيمون توفر البيانات (السجلات) في المرفق؟

90% of data is available through automated systems in Aqaba Water Company (GIS, SCADA, X7, ERP, and many others systems)

5. **What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)**

5. **ما هي التحديات الرئيسية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟**

- Lack of water resources (biggest challenge)
- Planning and design for new projects in Aqaba area
- Water demand forecasting
- Lack of funding for strategic projects (No support from government)
- Difficulty to hire qualified human resources and specialized labor force
- Population growth
- Gray area between running Aqaba Water as Government company or private company

6. **What is the factor(s) achieving sustainability for your utility?**

6. ما هو العامل / العوامل التي تحقق الاستدامة لمرفقكم؟

- High quality infrastructure
- Highly committed team
- High percentage of non-residential (commercial) consumption which increase billing percentage
- Focusing on automation of all systems in Aqaba Water
- Management approach

7. **What are the internal KPIs you are using to measure utility's performance?**

7. ما هي مؤشرات قياس الاداء الداخلية التي تستخدمها لقياس اداء المرفق ؟

KPIs and variables sent to PMU
Also internal KPIs:

- Cubic meter cost
- Average revenue per cubic meter

- Profit margin percentage
- Revenues
- Copy rights
- Average customers consumption
- Number of collection days
- Assets

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. **منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟**

Since year 2004

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

.9 ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

- Enhance personnel performance
- Focus on advantages and build on it
- Identify low performance gaps
- Cost recovery and overall performance

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

.10 ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت المستغل وورش العمل والاجتماعات وغيرها)

No allocated budget, however, all data is gathered from the automated system. One employee collects all indicators from the system and share it with the committee for approval before sharing with PMU. Around 5 days LOE per month.
There is a committee in the company to work on performance monitoring programs

11. What are the methods suggested to encourage utility staff to participate in BM project?

.11 ما هي الأساليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- Suggest employees incentive program based on annual evaluation
- Team building activities: overall performance for the company will increase the income for employees
- Utility incentive program related to water and energy prices. government to reduce energy costs in case there is high performance from the utility according to the KPIs

12. What are the obstacles you may face when implementing performance assessment project?

.12 ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

- No clarity of performance indicators definitions and assumptions
- No data availability in some cases

- No data verification/validation (no plausibility check)
- High investment cost in human resources or IT systems to collected variables and indicators calculations
- Feedback on reporting is not detailed and checking actual situation (only descriptive on figures)

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

- No performance evaluation conducted for all utilities and to agree on common KPIs
- No capacity building programs conducted after performance monitoring program
- No software or online platform for benchmarking in Jordan
- No budget allocations for implementing benchmarking programs

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

No benchmarking programs implemented earlier so there is no performance improvement measure taken based on benchmarking program recommendations

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

- No clear definition for KPIs for Jordan water sector
- Lack of data sometimes
- No software or online platform for benchmarking in Jordan
- No budget allocations for implementing benchmarking programs

1. **What is the ownership structure?**

1. ما هو شكل ملكية المرفق؟

Government entity owned by WAJ

2. **Describe the Management Structure?**

2. ما هو وصف الهيكل الإداري للمرفق؟

Within WAJ organizational structure

3. **Can we get a copy of the annual report (technical/financial) or annual statement?**

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

Please refer to WAJ

4. **How do you evaluate data (records) availability in the utility?**

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

Customer service system is only available using (COBOL)
GIS system started newly
Other data is manually handled (on papers)

5. **What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)**

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- There are no bulk water meters
- Deteriorated water network
- High non-revenue water
- Lack of financing for new strategic projects
- Issues in contracting system and projects supervision
- High water demand and shortage water resources
- Lack of trained staff
- High energy costs
- Low billing efficiency
- No enough computers available
- High operating costs
- Large service area
- Arab spring implications (employees and customers attitude)
- Procurement system is not flexible and affecting day-day management issues
- Lack of employees incentives
- Lack of equipment and tools

6. **What is the factor(s) achieving sustainability for your utility?**

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

The utility is surviving day after day to deliver water to its customer, suffering from lack of financial support and autonomy

Water resources availability is the main factor for utility service sustainability, Karak utility is working on emergency cases upon demand for all citizens

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي تستخدمها لقياس اداء المرفق ؟

None

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

None

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

UID#31 doesn't have priority for benchmarking projects. They only care to deliver water service to service areas

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت المستغل وورش العمل والاجتماعات وغيرها)

No cost allocated for benchmarking projects

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأساليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

Benchmarking is not a priority for UID#31

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

UID#31 never participated in benchmarking projects before

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس المستفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

UID#31 never participated in benchmarking projects before

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency? **14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟** None
15. In your opinion, why benchmarking for water services is not applied in Jordan? **15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟** They think that main issues need to be taken care of before start implementing benchmarking programs

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Government entity owned by WAJ

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

Organization structure with multiple administrations (directorates)

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

They generate quarterly reports and available with WAJ annual reports

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

Data available generally speaking, they are using DCMMS, GIS, BM4, X7 and SCA
But they are aiming at creating backbone system to integrate all data systems together.
A lot of data is generated manually (on paper)

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. **ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟**

- Technical challenges: they need automated system for reporting through collection of monitoring reports and feed in decision support system
- Administrative challenges: centralization and bureaucracy
- Financial challenges: lack of financial support and budget allocations for buying new equipment and IT systems, O&M, slow decision process due to centralization and bureaucracy
- Human resources challenges: lack of trained qualified staff, lack of training program per quality and quantity

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Decentralization
- Decision support system to monitor and control all operating systems
- Commercialization
- Covering operating costs (cost recovery)
- Knowledge management and human resources management
- Highly responsible staff committed to deliver quality service

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟ 10 KPIs as requested from PMU
8. Since when your utility is engaged in performance assessment projects with PMU-MWI? 8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟ January 2014
9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...) 9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟ Performance Improvement overall building on best practices
10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.) 10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها) There are no budge allocated for benchmarking programs as planned in the center (WAJ) But around 12 employees working on 40% level of effort for performance monitoring program
11. What are the methods suggested to encourage utility staff to participate in BM project? 11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟ • Training and capacity building programs • Incentives scheme • Employee enabling environment
12. What are the obstacles you may face when implementing performance assessment project? 12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟ • Data accuracy • Lack of knowledge about benchmarking • Lack of trained human resources for benchmarking programs • Financial obstacles • Lack employee enabling environment
13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

- Using web based application for variables submission
- Plausibility check and data verification/validation
- Setting clear workplan and engage utility staff in implementation
- Provide adequate budget for such program
- No need to start benchmarking department but make sure to have uniform template and to be shared with all departments

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

- When billing percentage decreased, the measure was to engage the private sector through management contract for billing and customer service management
- Good management skills plays a role in performance improvement

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

Lack of awareness and knowledge about benchmarking concept and benefits

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Private company owned by government (WAJ)

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

They have organizational structure

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

Annual reports for year 2012 is available in addition to business plan

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

UID#45 has IT department where they collect all data from all departments, generally speaking all data (records) are available

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- Financial constraint is the biggest challenge (lack of financing)
- High cost of Disi Water
- High non-revenue water
- High energy costs lifting drinking water to Amman
- High operational and productions costs where water tariff still the same
- Population growth and increasing service area
- Illegal water use
- Illegal connections to wastewater networks
- Shortage in water resources
- External water resources difficult to control and coordinate
- With new Disi water coming to Amman, networks are not ready for continuous water supply
- Meters with continuous water supply cannot register low flow water

Arab spring implications on illegal water use

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Management approach (form) is essential factor in sustainability of service
- Commitment to water distribution systems according water zones

- Reducing response time for fixing leaks
- Qualified and trained staff
- Water quality sampling matches Jordanian Water Quality Standards
- International certification for water quality service
- Reduce non-revenue water and illegal use
- Secure financing for strategic projects

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

There are no internal KPIs for UID#45, only annual monitoring personnel performance

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

Since starting of UID#45 assignment agreement in 2007

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

Technical and Economic objectives in operation and maintenance

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها)

Each department assigned one employee responsible to collect variables from respective department and provide it to PMU
UID#45 generates monthly reports with KPIs at Planning and Management department at UID#45

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- The only motivation is to provide reports to PMU as regular job description. We have no problem if benchmarking is obligatory or voluntarily, the only thing we worry about is the feedback to enhance performance

- Financial incentives are also suggested to perform benchmarking program or any other form of incentives

- Appreciation, recognition and support from management is also important to encourage utility staff

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

- KPIs calculations/formulas are not accurate
- There is no enough qualified staff to verify and double check figures and data provided by utilities
- No feedback from PMU on monitoring reports

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

- No feedback for monitoring reports shared with PMU
- We recommend to link between KPIs related to each other
- We recommend to share our performance with other companies or utilities (nationally or internationally)
- UID#45 is only comparing its performance with historical data and not with other similar companies

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

- No examples because no benchmarking program has been applied before. However, when there is decrease in performance, UID#45 should justify the low performance.

- If there are other companies to benchmark performance with, we could learn from good performing utility

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

- Because there is no support from top management the Ministry of Water and Irrigation to adapt benchmarking in Jordan as performance improvement
- It need allocating budget at the ministry and put it in the water sector agenda
- Financial and moral support and recognition to staff working in benchmarking

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Government entity owned by WAJ

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

Similar to WAJ directorates
Planning and management unit is responsible on PIs

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

There is annual report only with WAJ report

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

Available in hard copy format

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- Increasing water demand
- Low water productivity (availability)
- High maintenance works
- High NRW (biggest challenge)
- Arab Spring outcomes
- Old technology (pumps)
- High energy costs

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Employees inter-relations and personnel dynamics
- Follow up on daily works

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

N/A

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

N/A

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

- Technical issues to enhance O&M
- Sustainability of water resources

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها)

Within the daily works of employees and support from top management

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- Incentives scheme
- Building the capacity of employees
- Conduct awareness programs about benchmarking

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

Financial challenges

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

N/A

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

N/A

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

No vision for improvement
No awareness about benchmarking before

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Limited liability company owned by government (WAJ)

---

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

There is no organization structure
Management contract with Veolia did not manage to put new organizational structure and till today, there is no organizational structure
80 Managers
56 Heads of Department

---

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

There is no annual report for UID#48
Only the laboratories department issues annual report

---

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

Data are available in scattered reports but not in one annual report
Each department fill in the required variables and KPIs required from each department and then sent to PMU through the managing director

---

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- Financial challenge to upgrade the infrastructure (laboratories, new vehicles, lack for trained staff)
- Water quality issues
- Illegal water use
- Polluting water resources (on watershed scale) affecting the quality and quantity of supply and financial resources for remediation (no protections zones)
- New equipment for laboratories to measure major quality indicators (heavy metals, pesticides, radio activity) to meet the Jordanian water quality standards
- Lack of qualified staff
- Deteriorated network and undersized network
- High none-revenue water = 50%
- High energy costs = 50% of operational costs
- High water demand due to Syrian refugees and internal migration from rural to urban areas
- Scattered houses require high investment costs to connect to the main network

- Water quality issues in the network due to intermittent supply
- Water tariff is very low to cover the costs, even partially
- High operational costs
- No comparison applicable with other WAJ companies (UID#45 and UID#8)
- Discrepancy between the financial systems (WAJ/UID#48)
- No clear borders between WAJ and UID#48 as commercial utility system
- Different donors interests
- Buying water from private wells

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Financial support
- Over pumping for ground water resources
- Deterioration of water quality
- Private water well are not controlled
- Decrease the gap between supply and demand
- Qualified and trained staff
- Reduce water losses
- Support from partners
- Transfer the ownership of private water wells to the utility
- Financial sustainability
- Water resources sustainability

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

Only PIs related to water quality laboratories

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

Since January 2014 but never provided PMU with variables

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

Enhance overall performance of utility personnel

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل

والاجتماعات وغيرها)

Never calculated but it is part of the daily tasks of employees
About 10% level of effort for regular employee on monthly basis
About 5% level of effort for head of department on monthly basis

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- Clarity of vision and mission of the water utility
- Understanding the purpose and benefits of the BM program
- Provide incentives
- Over-time incentives
- Professional commitment and responsibility towards the submitted figures
- Employees loyalty towards his/her utility

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

- There is no bulk water meters to measure water quantities to calculate the water balance
- Lack of equipment and tools to measure and provide fields readings
- Flow of data in official channels takes long time

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

- Clarify the importance of benchmarking programs
- Conduct awareness workshops for utility staff about benchmarking

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

- Benchmarking programs may recommend to reduce number of samples but to maintain standard quality measures
- Maintain the job with the lowest applicable costs

15. In your opinion, why benchmarking for water services is not applied in Jordan?

15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

- Utilities are more worried about delivering water to citizens rather than conducting performance improvement projects (documentation and assessment projects)
- It is new concept not applied yet in water utilities in Jordan

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Government entity owned by WAJ

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

Similar to all WAJ directorates:
Operation & Maintenance dept
NRW department
Customer Services department
Admin and Financial dept

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

Available at WAJ with annual reports

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

- There is database but needs updating
- They are using X7 for customer services
- New GIS unit is being established
- Customer invoices are issued in Karak, readings are imported to Karak then issued from Karak Water Administration
- Customer complaints are done manually on paper format

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- Training and capacity building (O&M)
- Financial challenges, low financial resources
- Low production of ground water wells
- Search for new water resources
- Low billing efficiency

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

- Accurate meter readings (bulk and customers meters)
- Applying water balance calculations (reading bulk meters and matching it with customers invoices)

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

No KPIs used, nothing documented
Only meter readings

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

None

---

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

- Improve water quality
- Improve performance (O&M) to reach economic efficiency
- Sustainability of water resources

---

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها)

- Nothing major, part of the daily works of related personnel

---

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- Provide financial incentives for personnel
- Recording employee's performance and evaluation
- Promotions
- Training courses

---

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

- Financial obstacles
- No previous information about benchmarking programs
- Change management

---

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

None, because UID#53 did not participate in any performance monitoring program

---

14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency?

14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟

We may enhance performance during business as usual but without depending on performance improvement programs.
We only do it by instinct management skills

15. In your opinion, why benchmarking for water services is not applied in Jordan?
15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟

- There is no special unit for performance improvement or benchmarking unit in each utility
- Centralization issue, the center (WAJ) should apply benchmarking and not single directorates

1. What is the ownership structure?

1. ما هو شكل ملكية المرفق؟

Government entity owned by WAJ

2. Describe the Management Structure?

2. ما هو وصف الهيكل الإداري للمرفق؟

Within WAJ organization structure

3. Can we get a copy of the annual report (technical/financial) or annual statement?

3. هل يمكننا الحصول على ن□خة من التقرير ال□نوي (الفنية / المالية) أو الكشف ال□نوي للمرفق؟

Monthly and annual reports

4. How do you evaluate data (records) availability in the utility?

4. كيف تقيمون توفر البيانات (ال□جلات) في المرفق؟

- Data are available in soft copy format (GIS, X7 for billing, BM4, DCMS for customers service)
- There are deficiency in the X7 systems and generating errors in water quantities
- Handheld units are not connected with X7 system reflecting wrong quantities in calculating water balance
- 80% of data is available but data reliability is questionable

5. What are the main challenges affecting utility performance? (Technical, Admin, Human Resources, Financial, etc.)

5. ما هي التحديات الرئي□ية التي تؤثر على أداء المرفق؟ (الفنية، الإدارية، الموارد البشرية، المالية، الخ) ؟

- High non-revenue water percentage
- Low quality materials and equipment affecting the quality of work, response time, maintenance problems and increasing water losses
- Quality of service is related to materials quality and human resources qualifications
- Low quality and lack of experienced contractors
- Replacing employees is not sufficient (replacement employees cannot fulfill job requirement) only in titles but they don't deliver quality work. Except laboratories department (job replacement is actual and active)
- Financial allocations are limited, we are allowed to rent but not to buy new tools
- Lack of qualified trained staff (workers)
- Lack of equipment and machinery
- WAJ procurement procedures is not always solving supply problems
- Centralization and limited authorities
- No support for local innovations
- Malfunctioning meters, maintenance problems, can't release a tender for meters maintenance
- Lack of coordination between related departments (i.e. wells department vs. operation &

maintenance department) installing pumps not meeting design requirements will affect on overall performance and management of water well which will affect the quantities pumped, service hours, complaints, etc

- Lack of trust between customers (citizens) and WAJ
- Within Arab Spring movements, WAJ employees are not protected during operations
- Many procedures have been done in 2010-2011 without support from the central management (WAJ)
- Data accuracy problems created lack of trust between customers and WAJ and created customers services problems
- Lack of meter readers
- Malfunctioning meters cannot measure water quantities correctly then affecting water balance and NRW calculations

6. What is the factor(s) achieving sustainability for your utility?

6. ما هو العامل / العوامل التي تحقق الا□تدامة لمرفقكم؟

Best practices in O&M procedures, good data management, qualifying personnel, implementing water balance, enabling working environment.
Apply zoning and SCADA systems for water supply systems.

7. What are the internal KPIs you are using to measure utility's performance?

7. ما هي مؤشرات قياس الاداء الداخلية التي ت□تخدمها لقياس اداء المرفق ؟

They have internal KPI's please refer to ISSP report to get these KPIs. PMU wants only to provide them with variables and calculate KPIs

8. Since when your utility is engaged in performance assessment projects with PMU-MWI?

8. منذ متى يتعاون مرفقكم في مشاريع قياس الأداء مع وحدة مراقبة الأداء (وزارة المياه والري)؟

Not yet

9. What are the utility objectives from BM projects? What is the motivation to perform Benchmarking projects? Why to Benchmark utility performance? (Technical/Economic/Organizational/etc...)

9. ما هي اهداف المرفق عند تنفيذ مشاريع المقارنة المعيارية ؟ ماهو الدافع لاجراء مشاريع المقارنة المعيارية ؟ ما الهدف من اجراء المقارنة المعيارية لاداء المرافق ؟ (الفنية / الاقتصادية / التنظيمية / الخ ...)؟

- Vision and mission of UID#57 will be the leading factor/objectives/motivation for BM projects

- We want to be compared to optimum situation (company) and not local company like UID#45 or UID#8.
- UID#57 Water cannot work on commercial basis or have autonomy in making decision in O&M practices.
- It is very important to group companies or utilities in comparable groups when implementing benchmarking program.

- We need to compare the procedures and approaches different from one to utility to another.
- The amount of investment put in commercialized utilities contribute to many indicators which can give false indication about fixing leaks response time

10. What is the resources/cost used for each performance assessment project? (Personnel, time, workshops, meetings, etc.)

10. ما هي الموارد / التكلفة المصروفة في كل مشروع لتقييم الأداء؟ (عدد الموظفين، والوقت الم□تغل وورش العمل والاجتماعات وغيرها)

- Benchmarking team comprised of 5 persons with estimated efforts 5% at start up to 30% of their working time

- About 350 JDs per utility on monthly basis to contribute in Benchmarking project for a team of 5 employees

- Indirect cost when employees engaged in BM projects will cost their institution not fulfilling their daily job

11. What are the methods suggested to encourage utility staff to participate in BM project?

11. ما هي الأ□اليب المقترحة لتشجيع موظفي المرافق للمشاركة في مشاريع المقارنة المعيارية ؟

- Financial incentives to participate in BM projects
- Capacity building programs
- Providing enabling environment for employees
- English language training courses to enable them working in BM projects
- Increase the responsibility of employees and loyalty to his/her utility

12. What are the obstacles you may face when implementing performance assessment project?

12. ما هي العقبات التي قد تواجهها عند تنفيذ مشروع تقييم الأداء؟

- Lack of data availability
- Lack of resources, equipment, tools
- Lack of institutionalization (work is related to individuals and not to whole team)
- Centralized management and lack of communication
- Central management is not connected to the directorates (follow up is very time consuming)
- Sometimes central management thinks that they know better than departments (directorates)

13. What are lessons learned to avoid mistakes in next performance monitoring project?

13. ما هي الدروس الم□تفادة لتجنب الأخطاء عند تنفيذ مشروع لقياس الأداء في المرة القادمة؟

No BM projects applied in the past, therefore, no lessons learned from previous BM projects
14. Can you give an example of performance improvement measure taken as recommendation of BM project and how much is the saving/efficiency? **14. هل يمكنك ان تعطي مثالا على إجراء تم اتخاذه لتح□ين الأداء كتوصية ناتجة ضمن احدى مشاريع المقارنة المعيارية؟ و كم بلغ حجم التوفير / رفع م□توى الكفاءة؟** Only sending numbers (figures) to PMU but without any further follow up or performance measures to be taken afterwards
15. In your opinion, why benchmarking for water services is not applied in Jordan? **15. ح□ب رأيك ، لماذا لا تطبق مشاريع المقارنة المعيارية لقطاع المياه في الاردن؟** • No time for analyzing performance and comparing with other utilities • It is important to evaluate and compare all utilities using a system adequate for all utilities

8.4 Annex (4)

Terms of reference for the national benchmarking task force

Reliable Quality Water for Jordan Project

Benchmarking for Water Services in Jordan Project

Task Force Membership-Terms of Reference (BMTF-TOR)

Project Background

Benchmarking is a tool for performance improvement through systematic search and adaptation of leading practices. Utility benchmarking is the practice of compiling and analyzing a set of core cost and performance indicators from same-sector utilities against which to compare the performance of a utility. This is an important activity, as in the absence of competition in a given market (due to the natural monopolies that are typical of utilities in a market), it allows utility operators, regulators and policy makers to evaluate the efficiency and effectiveness of utilities, and identify areas of improvement.

In order to raise efficiency and proficiency of institutions working in water supply and waste water management, ACWUA in cooperation with various organizations have been carrying out capacity building programs in the Arab region for the past 4 years, working to increase and improve the capacity of Arab water utilities staff on water and wastewater management.

The Water Authority of Jordan "WAJ" is implementing a benchmarking program to introduce common practices regarding key performance indicators and their application in water utilities to provide strategic guidance to management to improve performance of the water sector at process and corporate levels. The exposure to international and regional applications would result in an in-depth exchange of experience and discussion, which contributes to the development of useful indicators at a national level and promotes common indicators for use within the region.

Project Objectives

The overall objective of the project is to ensure that water utilities in Jordan operate at the highest level of efficiency. The project will train the utilities in all aspects of benchmarking, resulting in increased transparency in the sector, and facilitating effective management tools for the member utilities.

The primary objectives for the project are set below:

- Review the benchmarking program to date implemented by the Planning and Management Unit "PMU" at the WAJ with a goal to ensure that going forward, benchmarking continues to be used as an effective managerial tool for reviewing the performance of operators in a transparent and non-politicized manner.

- Support the enhancement of regional and national benchmarking programs; working closely with the “PMU” at the WAJ;
- Establish a mechanism to ensure reporting discipline and quality of data;
- Ensure that participating utilities in benchmarking activities are in line with best practice;
- Assess opportunities for cross-border water partnerships between water operators in the region.

Formation of a National Benchmarking Task Force (TF)

ACWUA in coordination with the PMU of WAJ should form a benchmarking task force including members from water utilities in Jordan. As a focal point for benchmarking data, it will provide substantial added-value services to its members. The selection criteria which should be taken in consideration while selecting the voluntary task force members are as follows:

- The volunteer is expert specialist in Benchmarking and not only understands the concept;
- Currently working in the water sector either public, regulator entities and utilities;
- Experience in Performance Indicators and management/development;
- Experience/knowledge in performance management;
- Commitment and availability of time to be part of the task force;
- Approval from the supervisor/employer to be part of the task force;
- Fluency in English and Arabic Languages
- Gender equality.

Jordan Benchmarking Task Force Membership

Jordan benchmarking task force is comprised of 9 members who serve on the TF as representatives of their utilities and also include representation of PMU. Jordan BM-TF members are as follows:

No	Utility
1	Jordan Water Company (Miyahuna)
2	Aqaba Water Company
3	Yarmouk Water Company
4	Madaba Water Administration
5	Zarqa Water Administration
6	Balqa Water Administration
7	Karak Water Administration
8	Tafila Water Administration
9	Ma’an Water Administration
10	Planning and Management Unit (PMU)

Working Approach

Each task force members is expected to participate in the meetings, workshops, activities of the benchmarking project by the following:

- **Review of current benchmarking activities in Jordan**: TF member is expected to facilitate and provide support in data and information collection at his/her utility in regards to the current status of benchmarking activities in Jordan.
- **Draft a framework for benchmarking water services in Jordan**: TF member will assist in drafting and reviewing the proposed framework for benchmarking water services in Jordan.
- **Conduct benchmarking program for water utilities in Jordan**: TF members are the main players in the benchmarking program and should contribute in different program activities:

  A. Program Planning

  TF member will collaborate in setting clear objectives, thematic objectives and individual utility objectives. In addition, TF members should contribute to the scope of performance assessment and improvement. TF members should comply with the code of conduct and confidentiality requirements, communication plan and program meetings and workshops.

  B. Orientation, Training and Program control

  TF members should collaborate in drafting the data questionnaire. Participate in training workshop on the questionnaire and software handling as well.

  C. Data Acquisition and Validation

  TF member should collaborate in data acquisition phase and fill in data questionnaire for his /her utility in a timely and professional manner.

  D. Data Analysis and Assessment Reporting

  TF member should participate in closed workshops among the participating utilities together with the ACWUA and PMU as it is the crucial link between the assessment and the improvement phase of a benchmarking exercise.

  E. Improvement Actions

  TF member should participate in the performance improvement stage through identifying what to improve, how to improve it, and to establish the necessary action plans, including prioritization.

  F. Review of Improvement Actions

  TF member should collaborate with the project team to update action plans and to set a schedule to review improvement actions within allocated timeframe for multi benchmarking cycles.

- **Develop a benchmarking framework manual (procedures manual)**: TF member should provide support to the project team while developing a procedures manual for the proposed benchmarking framework for water services in Jordan.

Workplan and associated Tasks

Jordan Water Utilities Benchmarking Program

Updated Workplan-Feb 2015

		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17
		2014							2015									
Nr	**Tasks**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**
1	Identify the roles, duties of the steering committee																	
	Identify the representation (commercialized utilities, public utilities, ministry, PMU, ACWUA																	
	Kick-off meeting with the steering committee																	
2	Review of current Bencmarking activities in Jordan (interviews)																	
	Draft a framework for Benchmarking (scope (BM level/ only W or W&WW), methodology, definitions, code of conduct, basic or advance model, participating utilties, KPIs) (workshop)																	
3	**A) Performance Assessment**																	
	A.1 Set up Jordan BM online software																	
	A.2 Set up data questionnaire																	
	A.3 Training on questionnaire software (workshop) for utilities																	
	A.4 Data aquisition from participating utilities																	
	A.5 Plausability Check (Data Validation)																	
	A.6 Data analysis																	
	A.7 Draft utility individual reports & prepare workshop report (consortium/individual)																	
	A.8 Performance assessment workshop																	
4	**B) Performance improvement**																	
	B.1 Performance improvement workshop																	
	B.2 Develop Consortium/Individual utiltiy report (assessement & improvement plans)																	
5	Draft National Benchmarking Framework Manual																	
6	Develop Jordan BM project presentation and participation in international utilties management conference																	
	Deliverables																	
1	*Benchmarking steering committee TOR*	1																
2	*Kick-off meeting*			2														
3	*Mapping report for status quo in benchmarking activities in Jordan*						3											
4	*Data questionnaire and IT solution for performance data handling*										4							
5	*Training workshop and documentation*											5						
6	*Performance assessment workshop and minutes*															6		
7	*Performance improvement workshop and minutes*																7	
8	*Consortium report and utility individual report*																8	
9	*Benchmarking framework manual in Arabic*													draft			9	
10	*Individual presentation for knowledge sharing and exchange*																	10
11	*Project final report*																	11

8.5 Annex (5)

Benchmarking code of conduct

Benchmarking Code of Conduct

INTRODUCTION

Benchmarking – the process of identifying and learning from Good Practices in other organizations – is a powerful tool in the quest for continuous improvement and performance breakthroughs. The purpose of Code of Conduct is to guide Benchmarking encounters and to advance the professionalism and effectiveness of benchmarking water and wastewater services in the Arab region.

It is based upon the Code of Conduct used by APQC and the European EFQM. The layout and presentation have also been adapted to provide a more positive chronological approach. Adherence to this Code will contribute to efficient, effective and ethical Benchmarking.

PRINCIPLE OF PREPARATION

- Demonstrate commitment to the efficiency and effectiveness of Benchmarking by being prepared prior to making an initial Benchmarking contact.
- Make the most of your Benchmarking partner's time by being fully prepared for each exchange.
- Help your Benchmarking partners prepare by providing them with a questionnaire and agenda prior to Benchmarking visits.
- Before any Benchmarking contacts, especially the sending of questionnaires, take legal advice.

PRINCIPLE OF CONTACT

- Respect the corporate culture of partner organizations and work within mutually agreed procedures.
- Use Benchmarking contacts designated by the partner organization if that is its preferred procedure.
- Agree with the designated Benchmarking contact how communication or responsibility is to be delegated in the course of the Benchmarking exercise. Check mutual understanding.
- Obtain an individual's permission before providing his/her name in response to a contact request.
- Avoid communicating a contact's name in an open forum without the contact's prior permission.

PRINCIPLE OF EXCHANGE

- Be willing to provide the same type and level of information that you request from your Benchmarking partner, provided that the principle of legality is observed.
- Communicate fully and early in the relationship to clarify expectations, avoid misunderstanding, and establish mutual interest in the Benchmarking exchange.
- Be honest, complete and timely with information submitted.

PRINCIPLE OF CONFIDENTIALITY

- Treat Benchmarking findings as confidential to the individuals and organizations involved. Such information must not be communicated to third parties without the prior consent of the Benchmarking partner who shared the information. When seeking prior consent, make sure that you specify clearly what information is to be shared, and with whom.
- An organization's participation in a study is confidential and should not be communicated externally without their prior permission.

Benchmarking Code of Conduct

PRINCIPLE OF USE

- Use information obtained through Benchmarking only for purposes stated to and agreed with the Benchmarking partner.
- The use of communication of a Benchmarking partner's name with the data obtained or the practices observed requires the prior permission of that partner.
- Contact lists or other contact information provided by Benchmarking networks in any form may not be used for purposes other than Benchmarking.

PRINCIPLE OF LEGALITY

- Take legal advice before launching any activity.
- Avoid discussions or actions that could lead to or imply an interest in restraint of trade, market and/or customer allocation schemes, price fixing, dealing arrangements, bid rigging or bribery. Do not discuss costs with competitors if costs are an element of pricing. Do not exchange forecasts or other information about future commercial intentions.
- Refrain from the acquisition of information by any means that could be interpreted as improper, including the breach, or inducement of a breach, of any duty to maintain confidentiality.
- Do not discuss disclose or use any confidential information that may have been obtained through improper means, or that was disclosed by another in violation of a duty of confidentiality.
- Do not, as a consultant, client or otherwise pass on Benchmarking findings to another organization without first getting the permission of your Benchmarking partner and without first ensuring that the data is appropriately 'blinded' and anonymous so that the participants' identity are protected.

PRINCIPLE OF COMPLETION

- Follow through with each commitment made to your Benchmarking partner in a timely manner.
- Complete a benchmarking effort to the satisfaction of all benchmarking partners as mutually agreed.

PRINCIPLE OF UNDERSTANDING AND AGREEMENT

- Understand how your Benchmarking partner would like to be treated, and treat him/her in that way.
- Agree how your partner expects you to use the information provided, and do not use it in any way that would break that agreement.

BENCHMARKING WITH COMPETITORS

The following guidelines apply to Benchmarking with both actual and potential competitors:

- In Benchmarking with actual or potential competitors, ensure compliance with competition law. Always take legal advice before benchmarking contact with actual or potential competitors and throughout the benchmarking process. If uncomfortable, do not proceed. Alternatively, negotiate and sign a specific nondisclosure agreement that will satisfy the legal counsel representing each partner.
- Do not ask competitors for sensitive data or cause the Benchmarking partner to feel he/she must provide such data to keep the process going.
- Do not ask competitors for data outside the agreed scope of the study.
- Consider using an experienced and reputable third party to assemble and 'blind' competitive data.

Benchmarking Code of Conduct

- Any information obtained from a benchmarking partner should be treated as internal, privileged communication. If "confidential" or proprietary material is to be exchanged, then a specific agreement should be executed to specify the content of the material that needs to be protected, the duration of the period of protection, the conditions for permitting access to the material, and the specific handling requirements that are necessary for that material.

BENCHMARKING PROTOCOL

Benchmarkers:

- Know and abide by the ACWUA Benchmarking Code of Conduct.
- Have basic knowledge of Benchmarking and follow a Benchmarking process.
- Prior to initiating contact with potential benchmarking partners, determine what to benchmark, identify key performance variables to study, recognize superior performing companies, and complete a rigorous self-assessment.
- Prepare a questionnaire and fully developed process guide, and share these in advance, if applicable.
- Possess the authority to share and be willing to share information with benchmarking partners.
- Work through a specified contact and mutually agreed arrangements.

When the Benchmarking process proceeds to a face-to-face site visit, the following behaviors are encouraged:

- Provide meeting agenda in advance.
- Be professional, honest, courteous and prompt.
- Introduce all attendees and explain why they are present.
- Adhere to the agenda.
- Use language that is universal, do not use jargon.
- Be sure that neither party is sharing proprietary or confidential information unless prior approval has been obtained by both parties, from the proper authority.
- Share information about your own process, and if asked, consider sharing study results.
- Offer to facilitate a future reciprocal visit.
- Conclude meetings and visits on schedule.
- Thank your Benchmarking partner for sharing his/her process.

8.6 Annex (6)

Benchmarking program work plan

Benchmarking Program Workplan

Research activities	Year 1				Year 2				Year 3				Year 4			
	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4
A. Study Jordan's water sector framework conditions																
Study the legal, policy, economic and technical framework conditions	■															
Identify challenges for water sector and study benchmarking status quo in Jordan		■														
Semi-structured interviews and utility survey			■													
Surveys and interviews analysis				■												
B. Develop and test Benchmarking system for Jordan water utilities																
B.1 Preparation and Planning stage																
Identify the roles, duties of the BM task force					■											
Identify the representation of the task force from different utilities						■										
Kick-off meeting with the national BM task force						■										
Draft a framework for Benchmarking (scope (BM level/ only W or W&WW), methodology, definitions, code of conduct, basic or advance model, participating utilities, KPIs) (series of workshops)						■										
B.2 Performance Assessment stage																
Set up Jordan BM online software							■									
Set up data questionnaire							■									
Training on questionnaire software (workshop) for utilities							■									
Data acquisition from participating utilities							■	■								
Plausibility Check (Data Validation)									■							

Research activities	*Year 1*				*Year 2*				*Year 3*				*Year 4*			
	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4	Qr1	Qr2	Qr3	Qr4
Data analysis										■						
Draft utility individual reports & prepare workshop report (consortium/individual)											■					
Performance assessment workshop											■					
B.3 Performance improvement stage																
Performance improvement workshop											■					
Draft consortium/individual utility report (assessment & improvement plans)												■				
C. Concluding remarks about Jordan benchmarking system																
Compare Jordan benchmarking results internationally													■			
Extract challenges and obstacles for benchmarking implementation														■		
Identify opportunities and recommendations														■		
D. Thesis writing																
First Draft															■	
Second Draft																■

8.7 Annex (7)

Performance Improvement Plans for 9 water utilities

Annex (7) Performance Improvement Plans for 9 water utilities participated in the benchmarking program

Table (1) Performance Improvement Plan for UID33

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID33	Reduce water losses per water service connection Reduce Non-revenue water by volume Reduce water losses per KM	• Work on replacing the faulty old meters (meter replacement program) • Increase the frequency of leak detection and inspection campaigns • Disconnection of illegal water connections • Repairing broken water connections and leaking connections • Conduct hydraulic studies and apply zoning system for water network, and maintain pressure management Note: There are three tenders have been put forward to replace the domestic connections and sub-line networks	2 years

Table (2) Performance Improvement Plan for UID31

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID31	Increase collection of bills	• Increase the number of collectors • Provide incentives for the collectors • Link customer database to GIS database and apply handheld meter readers and doorstep billing • Create customer's database and link it to GIS system	1 year

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
	Enhance quality of supplied water	• Upgrade water quality laboratory in UID31 to do all quality tests required by JSMO and WAJ • Increase the number of water quality tests • Enhance water quality complaints registry • Handel water quality complaints when they occurred and solve it as soon as possible	1 year
	Reduce energy consumption	• Conduct energy audits on water wells and water pumps and analyze energy consumption patterns and identify cost saving measures • Shut down water wells which don't cover operational costs • Investigate the use of solar energy in water supply systems	2 years
	Increase training per employee	• Prepare training needs plan for employees and provide the required training courses, • Conduct applied exams at the end of each training course to measure the knowledge gained	2 years

Table (3) Performance Improvement Plan for UID46

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID46	Reduce energy consumption	• Conduct energy audit and follow energy efficiency operating guidelines • Replace old pumps • Apply new technology to reduce energy consumption • Utilize alternative energy (renewable energy)	4 years
	Increase collection ratio	• Increase the efficiency of billing system and upgrade it	5 years

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
		• Evaluate amount and ages of accounts receivable (debit amount) • Inspection of illegal usage • Conduct new field survey for all customers and update customer's database • Awareness campaigns to increase billing	
	Reduce Non-revenue water	• Replace the house meters older than 3 years • The installation of meters on all water sources • Rehabilitation of old water networks • Increase the speed of repair • Active campaign to detect illegal uses	1 year

Table (4) Performance Improvement Plan for UID5

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID5	Reduce Non–revenue water	• Install meters on all sources and wells and maintain calibration • Replace malfunctioned and old house meters • Rehabilitation old water networks according to leaks reporting and break ups • Increase speed of repair • Take preventive measures for non-recurrence of the complaint • Reducing network pressure (pressure management) • Campaign to detect illegal uses • Apply zoning system and conduct hydraulic studies • Awareness campaigns	2 years

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
	Reduce average unit energy consumption	• The use of new technology pumps and less energy consumption models • Use of alternative energy (renewable energy) • Awareness campaigns	5 years
	Increase collection rate	• Increase the efficiency of the X7 billing system and upgrade it • Evaluate of accounts receivable (Debits amounts) • Active campaign to detect illegal uses • Awareness campaigns • Activation of legal procedures for collection	5 years

Table (5) Performance Improvement Plan for UID45

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID45	Reduce energy costs ratio	• Replace old pumps with new energy efficient ones • Perform maintenance program for pumps • Utilizing alternative energy (solar power)	5 years
	Increase collection ratio	• Increase the number of collection (offices) branches • Electronic methods of collection (online) • Intensify field collection rounds • Increase service blockage campaigns	5 years
	Reduce Non–revenue water	• Rehabilitation old deteriorated water network • Replace old meters	5 years

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
		• The use of electronic meters on water sources • Increase campaign to detect illegal uses • Increase awareness at subscribers	

Table (6) Performance Improvement Plan for UID53

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID53	Increase collection ratio	• Increase the number of collectors • Provide Incentives for collectors	1 year
	Reduce energy consumption	• Quick feasibility study for water wells and shut down water wells which does not cover the production costs • Apply energy efficiency guidelines for water pumps	1 year
	Enhance the quality of supplied water	• Increase the number of water quality tests • Follow up and solve all problems and complaints when they occurred • Make sure to meet WAJ and JISMO water quality standards	1 year

Table (7) Performance Improvement Plan for UID48

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID48	Enhance operating cost coverage (water and sewerage)	• As electricity forms the major share of operating cost, electricity can be reduced by the following: ○ Use of renewable energy ○ Utilize gravity for pumping water ○ Using of energy efficient pumps ○ Maintains the pumps to always be in optimal conditions ○ Increasing the metered-billed volume of water to 100% in any period ○ Reducing the volume of non-revenue water and water loss which raise the metered and billed water • Another source for operating cost is the fuel used by vehicle and machines, shall be reduced by: ○ Using efficient vehicles and machines and keep them always in optimal conditions ○ The effective use of fleets and machines and reduce number of used vehicles ○ Set plans to invest in the reclaimed water which brings revenues that helps in cost recovery	4 years
	Enhance subscriber Meter replacement	Meter replacement program: • Map out (allocate) over-aged meters (critical age to be decided) • Replace the meters with new ones which has 100% sensitivity, which can be found in the market	5 years
	Reduce water losses per service connection	• Using water connections made of long-life materials which are anti-rust, insulated and stands for all conditions underground • Make the connections visible so the leak can be easily discovered • Reducing the number of connections per one land block or property • Using latest leak detection devices to find out leaks in water connections automatically or tracking the water loss per block	5 years

Table (8) Performance Improvement Plan for UID57

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID57	Reduce non-revenue water	• Installation of a new water meters on all water sources • Rehabilitate water networks • Increase the speed of repairs and reduce response time • Deliver awareness to the public • Patrols to capture illegal uses	1 year
	Enhance collection ratio	• Increase the efficiency of the X7 billing system and upgrade it • Illegal use inspection campaigns • Public awareness campaigns • Comprehensive survey to update customer's database	5 years
	Reduce average consumption of the power unit	• Utilization of alternative energy (renewable energy) • Rehabilitate water networks • Use new technology and automation systems for operation and monitoring supply systems • Awareness campaigns	5 years

Table (9) Performance Improvement Plan for UID8

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
	Reduce non – revenue water	• Apply pressure management on all DMAs • Meter replacement program • Reduce water leakage complaint response time	2 years

Utility	Subject of the improvement action	Performance Improvement action	Timeframe
UID8		• Seek government support to cover NRW supplied to Bedouin communities	
	Reduce energy costs as percent of total running costs	• Conduct energy audits on water pumps and energy facilities • Apply energy efficiency management guidelines • Utilize solar energy in electricity production	2 years