Ministry of Foreign Affairs

Business Opportunities Report for Reuse of Wastewater in Morocco

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Business Opportunities Report for Reuse of Wastewater in Morocco

Netherlands Enterprise Agency – RVO

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Netherlands Enterprise Agency (RVO), in collaboration with the Netherlands Embassy in Morocco, commissioned this study of the reuse of the wastewater sector in Morocco in light of the possible opportunities this sector presents for the Dutch private sector.

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Executive Summary

Located in a predominantly arid to semi-arid climatic zone, Morocco[1] is facing an increasing challenge of water scarcity. Water demand exceeds water availability, with groundwater being depleted predominantly for agricultural purposes. As such, there is a need for renewable fresh water, the usage of which currently stands at 2.5 billion m^3 per year from various sources. Wastewater in Morocco, if treated and re-used, could generate more than 13% of Morocco's total water demand. This highlights the significance and importance of wastewater treatment for Morocco.

The standard supply chain for wastewater reuse starts from the generation point, through collection, transportation, storage, treatment and, ultimately, reuse of safe discharge. Sources of wastewater include domestic wastewater for both urban and rural areas, industrial wastewater and rainwater. This report focuses on the treatment of wastewater. In Morocco, wastewater service providers include the autonomous municipal utilities (**Régies**), Municipalities, ONEE and private companies.

Morocco has achieved a significant improvement in the wastewater sector in the last ten years. 123 wastewater treatment plants have been built, increasing the treatment capacity to 900 million m^3 per year. Indicatively, 75% of the total population of 34 million is connected to the sewer network, with 62% connected to wastewater treatment plants. The Moroccan National Water Plan (PNA) for 2020 - 2030 was designed to fill the gap in wastewater treatment capacity and spur growth in the sector. The annual target recommended by the PNA is 325 million m^3 of wastewater to be reused by 2030.

Reuse projects generally include advanced treatment, dependent on the reuse purpose, and reuse infrastructure (distribution network), be it nationwide or at the local level. The most complicated part of the chain is the treatment. Treatment requires innovation and advanced technology, whereas the distribution networks that service treated wastewater don't require sophisticated technologies. As such, this report focuses on wastewater treatment plants, as this is not only the bottleneck in Morocco's case but also where Dutch expertise, technology and businesses can benefit most.

The total capacity of wastewater plants in Moroccan urban areas at the end of the year 2016 was 2.3 million m^3/day, including pre-treatment and marine outfall with 131 WWTPs (Please see the annexes for details). The total treatment capacity increased from less than 50,000 m^3/day in 2000 to more than 900,000 m^3/day in 2016 (not including pre-treatment and marine outfall). Only 21% of the generated wastewater is treated to acceptable standards, while 30% is pre-treated before its discharge to marine outfall. The additional amount generated from the rainwater runoff increases the potential for non-conventional water reuse, such as rainwater harvesting. A significant proportion of wastewater (60%) is discharged directly to the sea, while 40% is discharged into the inland natural environment. Despite the improvements made in the past 10 years, the level of wastewater reuse is low. It is expected that by 2030 the annual volume of wastewater generated will grow to 900 million m^3.

Within the framework of the PNA, the Office National de l'Electricité et de l'Eau Potable (ONEE) and the Autonomous municipal utilities (Régies) are planning the construction or expansion of 34 WWTPs. The investments in wastewater treatment plants are estimated at around EUR 300 million Netherlands is a pioneer in this field with innovative technologies that have been successfully implemented in full scale in various countries across the world. As such, the Dutch have a competitive advantage with regards to the reuse of wastewater, so this also offers a strategic market entry opportunity for Dutch businesses to the Moroccan wastewater sector.

[1] The Western Sahara is listed as a non-self-governing territory under Article 73 *e* of the Charter of the United Nations. Any reference in this report to (the cities in) the Western Sahara should be read in this context. For more information: https://www.rvo.nl/onderwerpen/internationaal-ondernemen/landenoverzicht/marokko/westelijke-sahara

In order to ensure efficient reuse of wastewater, consideration has to be given to various reuse aims. Within municipalities, wastewater can be reused for industrial, domestic, natural and agricultural purposes, with agriculture accounting for the largest proportion of wastewater reused.

In the context of Dutch wastewater technology and expertise, opportunities lie in treatment schemes for the different water qualities required for different reuse aims. Specifically, in domestic wastewater treatment plants (WWTP), industrial WWTP, sludge management and training. **WWTP**: there is an opportunity in WWTP construction projects in Morocco, through public tenders that will be listed over the coming 2 years. Within the framework of the PNA, the Office National de l'Electricité et de l'Eau Potable (ONEE) and the Autonomous municipal utilities (Régies) are planning the construction or expansion of 34 WWTPs. **Training**: Morocco, given its location, could act as a hub to provide wastewater management experts and professionals to the rest of the region. **Sludge Management**: there are currently institutional and organisational obstacles and shortcomings in the regulation that hinder the fast development of this sector. There is limited experience at the national level, with not enough knowledge of and know-how about the technical options for sludge management, treatment, disposal reuse, etc. This provides a good entry point for the Dutch industry.

The wastewater treatment sector in Morocco will grow over the coming years, as will the need to reuse treated wastewater. The Dutch have technology and expertise in WWTP that applies itself well in the context of Morocco.

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List of Abbreviations

ACTA	Anti-Counterfeiting Trade Agreement
Aecid	Spanish Cooperation Agency for International Development
AFD	French Agency for Development
AfDB	African Development Bank
AFWA	African Water Association
AGIRE	Appui à la Gestion Intégrée de Ressources en Eau
AMDI	Moroccan Agency for Investment Development
BMDA	Rabat (Bureau Marocain Du Droit d'Auteur
BOD	Biological oxygen demand
BOT	Build Operate Transfer
CCG	Central Guarantee Fund)
CIDA	Canadian International Development Agency
COD	Chemical oxygen demand
CPI	Corruption Perception Index
CSR	Corporate Social Responsibility
CTB	Belgian development agency
DBO	Design Build Operate
DEA	The Direction of water and wastewater
DGCL	Ministry of Interior
DRSC	Directorate of Public Utilities and Concessions
DWA	German water association
EBRD	European bank for reconstruction and development
ECOWAS	Economic Community of West Africa States
EIB	European Investment Bank
EU	The European Union
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FIDIC	The International Federation of Consulting Engineers
FMO	Dutch Development Bank
GDP	Gross Domestic Product
GIZ	German development cooperation agency
IEA	Institute of water and Wastewater
IsDB	Islamic Development Bank
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
KfW	German government owned development banks
MENA	Middle East and North Africa
MWh	Megawatt hour
NCESD	National Charter for the Environment and Sustainable Development
NWRP	National Wastewater Reuse Plan
O&M	Operation and maintenance
OCP	Office Cherifien des Phosphates
OECD	Organisation for Economic Co-operation and Development
OLAND	Oxygen-Limited Autotrophic Nitrification-Denitrification
OMPIC	Office Marocain de la Propriété Industrielle et Commercial
ONEE	National Office of Electricity and Drinking Water
PNA	National Wastewater Program
PNDM	national solid waste program

RVO	Netherlands Enterprise Agency
SBR	Sequencing Batch Reactors
SMEs	small and medium-sized enterprises
TSE	Treated Sewer Effluent
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
UASB	Up-flow Anaerobic Sludge Blanket
VFM	Value for money
WB	World Bank
WHO	World Health Organisation
WIPO	World Intellectual Property Organisation
WWTP	Wastewater treatment plants

1 Introduction

1.1 Context

1.1.1 Country Profile

As part of the westernmost region of North Africa, Morocco[2] is also known as 'Al Maghreb' in Arabic, literally meaning 'the West'. Morocco is bordered by Algeria to the east, Mauritania to the south, the Mediterranean to the north-east and the Atlantic Ocean to the west.

Table 1: General Information

GENERAL INFORMATION	
Area	710,850 Km^2
Institutional system	Constitutional monarchy
Capital	Rabat
Economic Capital	Casablanca
Other main cities	Fez, Meknes, Marrakech, Oujda, Agadir and Tanger
Climate	Mediterranean
Time Zone	GMT (GMT+1 in summer)
Official language	Arab
Languages commonly used	French, Spanish
DEMOGRAPHY	
Population	34,5 million inhabitants
Density	67,59 inhabitants/m2
Activity rate population	47.4%
Urban population	60%
Life expectancy	72 years
CURRENCY	
Currency	Moroccan Dirhams (MAD)
EUR 1	MAD 10.93 (average Nov. 2016 – Nov. 2017)

Population: Morocco's population of around 34 million people is composed of Arabs, Berbers and Sahrawi. Intermarriage between different groups is common, as is intermarriage with other various sub-Saharan African minorities. This has blurred ethnic differences through the centuries. There are, however, cultural divisions between cosmopolitan coastal regions, where European and Arab cultures tend to play a strong role, and the country's Berber and Sahara-dominated interior locales. The country has had a strong Jewish presence for many years (at one point the local Jewish community was 250,000 strong) though a substantial percentage of this population moved to Israel and Western Europe after 1948. Mellahs, the historic Jewish quarters that can be found in many of the Kingdom's cities, have distinct wall and fortified gates.

The country's central geographic location has resulted in a rich culture and 3000-year history of privileged relations with Europe and other nearby regions. Morocco's population is relatively young; approximately 29% of the population is below 15 years of age, while 65% is between 15 and 65, and around 6% is over 65. Average life expectancy has risen to 70 years for men and 74 years for women.

[2]The Western Sahara is listed as a non-self-governing territory under Article 73 *e* of the Charter of the United Nations. Any reference in this report to (the cities in) the Western Sahara should be read in this context. For more information: https://www.rvo.nl/onderwerpen/internationaal-ondernemen/landenoverzicht/marokko/westelijke-sahara

According to the latest national population and housing census (RGPH 2014)[3], the overall illiteracy rate in Morocco is 32%, of which for men it is 22% and women 42%. Ten years ago, the overall illiteracy rate was 43%. Besides a gender difference in illiteracy rates, there is also a large divide between the rural and urban areas in Morocco. The illiteracy rate in the urban areas is 23% compared to 48% in the rural areas. The share of people in the age of 10 years+ who have attended higher education (minimum BA-level) is 6%, compared to almost 9% ten years ago.

Morocco has rapidly been transforming into a largely urban society over the past decade, with approximately 60% of citizens now living in cities and urban areas, due to a trend of rural migration to coastal centres. The high population growth rate in urban agglomerations in recent years is accompanied by a rise in unemployment with pressures mostly felt by younger generations. The trend of urban migration is partly fueled by the dwindling appeals of rural life and the higher standard of living perceived in the cities. The influx of Morocco's increasingly young population into urban areas, especially those located on the country's Atlantic seaboard, feeds a significant informal employment sector, which has been a focal point of the government's current long-term reform and legislative agenda.

Languages: There are at least four languages in regular use around the country, making Morocco a multi-lingual Kingdom. Many locals know numerous foreign languages: classical Arabic is the country's official language, but its local dialect, Darija, is the most commonly used in everyday life. Darija differs from classical Arabic in both pronunciation and vocabulary, and it can have additional local influences in different regions of the country.

Berber is widely spoken in the southern regions of the country; an estimated eight million people use Berber daily. French is still extensively spoken, especially among influential foreign-educated classes, older generations and in the big urban centres. Spanish is widespread in the northern regions of the country, but French remains the favorite language for business, science and in higher education. English and German is also spoken in far smaller proportions, and mainly in connection with tourism and in large cities, such as Marrakech and Agadir.

Religion: The great majority of Moroccans are Sunni Muslims and followers of the local Malekite rite, which is principally known for its focus on tolerance. The King is considered to be the "commander of the believers" and Morocco's top religious authority. Sufism is also widespread, and there are numerous Sufi holy places and festivals. Morocco was home to one of the world's largest Sephardic Jewish population prior to 1948, but emigration has sharply lowered numbers to around 4,000, down from around 250,000. The remaining community is still economically and politically influential, and the Moroccan Jewish Diaspora has been a powerful ally in foreign relations with the EU and the US. Christianity is practiced primarily by the country's European residents and by a growing community of sub-Saharan African immigrants.

Geography and Climate: Morocco offers a wide range of geographic diversity, with a total area of 710,850 sq. meters. The country's rich soil and mild climates have resulted in thriving local agriculture sectors. The Kingdom is spread over four topographical zones: The Atlas and the Rif mountain ranges to the north, reaching altitudes of 4,165 metres; the fertile coastal plains to the west; the drier Anti-Atlas region in the centre; and the Sahara Desert to the south. Morocco's Mediterranean and Atlantic coastlines extend well over 3,500 km. To the north, the Strait of Gibraltar separates North Africa from Europe by a mere 17 km at the narrowest point, making neighboring Spain easily visible most days.

[3] Every ten years the national population and housing census RGPH (RECENSEMENT GENERAL DE LA POPULATION ET DE L'HABITAT) is carried out by the National Statistics Bureau of Morocco HCP.

Morocco has a Mediterranean climate. Rainfall is concentrated in the winter months, in line with northern hemisphere weather patterns. Most of the rainy conditions come off the Atlantic Ocean buffeting the coastal regions with rains and strong winds. The hot and dry summer months see temperatures as high as 40°C throughout the country and even higher in some remote inland regions. The Atlas is temperate and generally accounts for most of the country's snowfall during the winter months. The southern and Anti-Atlas regions are predominantly desert climates sprinkled with several lush oasis areas.

1.1.2 Foreign Companies

During the last eight years Morocco has become a main destination in Africa for foreign investors. In 2016 alone, 81 Greenfield foreign direct investment (FDI) projects were announced with a total value of almost USD 6.6 billion – the highest number and value since 2009. The share of Morocco in Greenfield foreign direct investments in North Africa was 12% in 2016, compared to 20% in 2015, making it second after Egypt. Morocco's share in Africa's Greenfield FDI projects was 7% in 2016.

Table 2: Morocco Green FDI Investments

	2009	2010	2011	2012	2013	2014	2015	2016
Number of announced Greenfield[1] FDI projects	50	55	96	68	51	75	74	81
Value of announced Greenfield FDI projects (million USD)	6,840	2,445	2,921	1,203	2,649	5,203	4,357	6,596
% in Africa	8	3	4	2	4	6	6	7
% in North Africa	17	13	24	7	22	20	20	12

Note: (1) Green Field Investments are a form of Foreign Direct Investment where a parent company starts a new venture in a foreign country by constructing new operational facilities from the ground up.

Source: UNCTAD

The majority of foreign companies investing in Morocco are coming from the EU – mainly France and Spain – but increasingly from the Middle East (mainly United Arab Emirates). In recent years, companies from the USA have also shown a growing interest in investing within the Kingdom. Although the Netherlands has a large Moroccan Diaspora, only a relatively few number of Dutch companies are investing in the country. During the last 12 years of the total volume of foreign direct investments in Morocco, less than 1% came from Dutch companies. It is estimated that around 60 – 70 Dutch companies are located in Morocco through either a Joint Venture with a local partner, a local agent or an affiliate. Most of these companies are active in agriculture and related business activities and have less than 250 employees (i.e. belonging to SMEs). In 2016, the total FDI stock from the Netherlands in Morocco amounted to just over EUR 500 million. Large(r) Dutch companies active in Morocco are, among others, Heineken, DAF, Unilever, Philips, Klaas Puul, The Makers, and APM. Agricultural companies active in the Kingdom are, among others, Enza Zaden, Messem, Van Oers, and Koppert.

1.2 Objective

The purpose of this intervention is to (1) gain better insight in one of the focus sectors of the Royal Dutch Embassy in Morocco, and (2) increase bilateral cooperation by bringing together needs and opportunities in Morocco on the one hand, and Dutch solutions and technologies on the other hand. The final purpose of this project is to contribute to the more sustainable management of the natural resource 'water' in Morocco by promoting and facilitating the circular use of wastewater; This should be done by (1) ('offer') getting a complete picture of the actual 'outflow' of industrial and municipal wastewater in Morocco and its level of treatment at the point of discharge; (2) developing an inventory of the possibilities to actually be allowed by the 'owners' of the wastewater and legal frameworks covering wastewater, to use that wastewater for further treatment that would allow for reuse of the

water; (3) developing an inventory in the Netherlands about what treatment techniques are available for treating various types and levels of pollution of wastewater to re-usable levels; (4) ('demand') to list the existing options and future possibilities for economic circular use of treated water for primary or secondary purposes (for instance in agriculture) on the Netherlands and the Moroccan commercial side; (5) link Dutch wastewater treatment techniques/concepts to the Moroccan sources of used water, and (6) link (innovative) Dutch secondary water use based industries, activities, concepts to the Moroccan circular water usage market.

1.3 Guide for the reader

This report contains seven chapters that give a description of the investment environment in Morocco, including economic development, governance, trade regulations and access to finance. This information is based on the latest reports – among others – from the World Bank Group and the national report *"Morocco between Millennium Development Goals and Sustainable Development Goals – Achievements and Challenges*". Further Information is provided about main trends and developments in the Moroccan wastewater sector. It includes a revision of water related legislations; water law (No. 36-15) issued in August 2016, the national program for sanitation and wastewater reuse. The progress in the sector revision in term of water shortage, infrastructure and key players are shown. The report also offers a detailed supply chain analysis, key challenges in the value chain and the mapping of key players within this sector. The report also presents an assessment of first-hand information collected by the team on the readiness of the Dutch companies for the Moroccan wastewater market. At the end, the possible interventions from Dutch companies and the possibilities for government to government cooperation in the sector are visualised with maps, tables and SWOT analysis, not only of the Moroccan water market but also analysis of Dutch Companies' readiness for the Moroccan wastewater market.

2 Institutional Context

2.1 Territorial Decentralisation of Wastewater Service

According to the Communal law (Loi n° 113-14 portant loi organique relative aux communes), wastewater services (as other public services[4]) are under the responsibility of the municipalities. Furthermore, according to the same law, the Communal Council decides on the manner in which the service is operated and managed: 1) directly by the agency, 2) an independent communal (or inter-communal) water / wastewater utilities (Régies), 3) a concession to private sector, 4) or any other methods for the delegated management of public facilities in accordance with applicable laws and regulations. Multi-service utilities for water distribution are common. In larger urban areas, most water supply utilities also provide wastewater services and distribute electricity (water and electricity are acquired in bulk from ONEE). Such horizontal multi-service utility bundling is not seen in smaller urban centres, where wastewater services are provided either by ONEE or by direct management by municipalities (local régie directe).

2.2 The current situation

Morocco has 17 specialist public and private wastewater service utility operators, including those in the municipalities. They currently serve 112 centres (large cites, and small- and medium-sized towns). The total population connected to the wastewater network is more than 20 million inhabitants. The details are presented in the tables below:

Table 3: Key players in Wastewater System Operation

Operators	The main cities	No. of centres	Total inhabitants (connected to wastewater service)	%	Explanations
12 Régies	Marrakesh, Fez, Meknes, Kenitra, El Jadida, Safi, Larach, Agadir, Settat, Oujda, Beni Mellal, Taza	16	6,543,000	34%	Régies (autonomous inter-communal utilities) are multi-service utilities: water, wastewater, electricity (for the 7 first cities)
4 Private concessions	1) LYDEC: Casablanca, Mohammadia	16	7,986,000	42%	The private operators have been managing concession contracts for more than 20 years including: water, wastewater, electricity (and public lighting in Casablanca)
	2) REDAL, Rabat, Salé, Temara				
	3) AMENDIS: Tanger, Assilah				
	4) AMENDIS: Tetouan, Mdiq				
ONEE	The biggest cities: Nador, Khouribga, Berkane, Khemisset, Al Houceima, BerrechidBenguerir	112	4,630,000	24%	Even ONEE supplies water in more than 550 small and medium centres

[4] "Public services of the following sectors: supply and distribution of drinking water – electrical distribution - wastewater - collection of solid waste and similar waste, its transfer to the public waste landfills and treatment - public lighting - public urban transport - …".

Operators	The main cities	No. of centres	Total inhabitants (connected to wastewater service)	%	Explanations
Total	**17 operators**	**144**	**19,159,000**		

Source: Ministry of Interior Affairs

2.3 The main players in the Wastewater Sector

Multiple players are involved at both the central levels (ministries, secretariats, ONEE) and the local levels (Régies, private concessionaires, operators, river basin agencies, municipalities). Sector institutions perform one or more four key functions: (1) policy formulation and supervision; (2) water resources management; (3) service provision; and (4) regulation. The main sector organisations and their functions are described below.

2.3.1 Ministry of Interior (DGCL, DEA, DRSC)

The Ministry of Interior, through its Water and Wastewater Direction (DEA) assists local governments and municipalities with water and sanitation issues, and plays an active role in planning, implementing and supporting the operations of sewerage infrastructure and wastewater treatment. The Communal Chart (communal law) gives the municipalities the responsibility for water and wastewater services, and to choose the management options (in this case, for wastewater). The Ministry of Interior (DGCL, Direction Générale des Collectivités Locales), therefore, ensures the supervision (tutors) of local municipalities and monitors the communal utilities (Régies). The Ministry of Interior also acts as a de facto sector regulator, through its Directorate of Public Utilities and Concessions (DRSC: Direction des Régies et services concédés), which has representatives on the boards of each Régie (autonomous municipal utility) and on the permanent monitoring committees for each concession. Through these routes, the Ministry of Interior has a direct say in the management and performance of Régies and provides technical advice on concession contract administration issues, including performance, investment programmes and tariff adjustments.

The Office of water and wastewater (DEA: direction de l'eau et de l'assainissement) is responsible for wastewater planning and budgeting, and is the main actor in the PNA (National Sanitation Programme). The Secretariat of State in charge of Environment and the Ministry of Finance are jointly the main decision makers regarding the Sanitation Subsidy within the framework of the PNA. DEA also monitors the sanitation sector in Morocco and is an important player when deciding on setting and / or revising the wastewater tariff.

2.3.2 Secretariat of State in charge of sustainable development

The Secretariat of State in charge of sustainable development (environment department) is responsible for monitoring, developing and executing government policy in the field of the environment and sustainable development. The main missions are:

- Preparation of the national strategy of sustainable development and monitoring its implementation (in coordination with relevant ministries).
- Suggestion of laws and regulations on environmental protection and control of their enforcement.
- Government representation in bilateral and multilateral negotiations.
- Consideration of climate change dimension and the green economy in government programmes.

- Establishment of structures for the observation and monitoring of the environment status, and collecting environmental data and information at national and regional levels in collaboration with relevant departments.

The Environment department is the main partner of the DEA (Ministry of interior) for PNA management and monitoring. It is also the co-authorising authority for the budget related to the PNA.

2.3.3 Secretariat of State in charge of Water and river basin agencies

The Secretariat of State in charge of Water prepares and implements the laws and regulations relating to prospecting, development, operation and management of water resources. It is responsible for steering the national policy for water, mainly through:

- prospecting for and assessing water resources (surface and ground water resources); and taking into account non-conventional water resources, such as desalination and wastewater reuse.
- Water Resources Planning and Water Management;
- control and protection of water resource quality; applying the user pay / polluter pay principle (at the local level by the river basin Agencies). In this case, it controls / monitors wastewater discharges.

The Secretariat of State in charge of Water has recently prepared the national plan for wastewater reuse (please refer to the appropriate chapter of this report). Morocco's river basin agencies are semi-autonomous, financially-independent public entities with responsibility for river catchments. They are administered by a Board of Directors chaired by the Secretariat of State in charge of Water (and comprising local governments, water user associations and other stakeholders, such as academics and chambers of commerce). River basin agencies have the principal responsibilities of, (1) developing and implementing an integrated master plan for river catchment areas; (2) authorising / controlling / monitoring water abstraction and discharge, and (3) collecting charges for water abstraction and effluent discharges. The river basin agencies are also responsible for monitoring compliance, while enforcing water quality and pollution prevention rules.

2.3.4 Local Municipalities

The communal charter of 1976 gives municipalities' full responsibility for the management of distribution services of drinking water and sanitation. Municipalities may, therefore, manage these services themselves, create autonomous communal utilities or assign the services management to ONEE or to private concessionaires, as in the case of Casablanca (LYDEC), Rabat (REDAL), Tangier and Tetouan (AMENDIS).

Local municipalities own the water supply and sewerage assets and are responsible for providing water and wastewater services in their communities according to the communal chart of 1976. They have the option to: provide these services directly (Régies directe), establish an autonomous, often multi-service, public utility (Régie autonome) or delegate the service to ONEE or a private operator.

Decades ago, all large cities and many urban centres delegated the provision of drinking water to specialist operators. Wastewater services remained part of the core municipal functions until the mid-1980s but they are now gradually being delegated to specialist operators (refer to the table above).

2.3.5 Service Providers

The National Office for Electricity and Potable Water (ONEE): The National Office for Electricity and Potable Water was formed by the merger in 2012 of the ONEE and ONEP national offices in charge of Electricity and Potable Water, respectively. It is a financially autonomous public electricity, water and sewerage enterprise that plays an important role in planning and executing the Government's strategic water and electricity sector goals.

ONEE-water branch: the mandate of ONEE, created in 1972, is potable water planning and security at a national level. It is the main national water producer (80% of the bulk water supply in the country), providing potable water supply services in medium and small towns on behalf of the local municipalities that entrusted it to do so. ONEE's mandate was amended in 2000 to include wastewater services in centres willing to replace services provided by Régies directes (municipalities). ONEE is thus taking responsibility for wastewater in urban centres where it already provides water. As at the end of 2016, ONEE was responsible for wastewater services in some 112 urban centres. ONEE is managed in accordance with commercial principles; its activities are governed by a Framework Agreement with the Government (Contract programme), updated annually, which sets the goals, means and priorities for its interventions.

Autonomous Municipal utilities (Régies): Régies have the status of autonomous municipal utilities and are managed in accordance with commercial principles under the supervision of the Ministry of Interior and the Ministry of Finance. The regulations governing their management and operation for water supply, wastewater and electricity are set out in Decree No. 2-64-394 of 1964. The first ten Régies were created during the nationalisation decade (1961-1971). For historical reasons, such Régies retained responsibility for electricity distribution and represent an exception to ONEE's (Electricity Branch) monopoly rule. The more recently created Régies do not provide electricity services. As at the end of 2016, Morocco had 12 Autonomous Municipal utilities (Régies) responsible for wastewater services in some 16 cities, serving more than 6 million inhabitants.

Private Concessionaires: The four private concessions in Morocco encompass water, wastewater and electricity services. In April 1997, a 30-year concession for the distribution of water, sewerage and electricity services was announced by the municipalities of Casablanca and Mohammédia with LYDEC, an international consortium controlled by the Suez group. This negotiated contract symbolised the Government's determination to bring private sector practices and financing into Morocco's water sector. The Casablanca / Mohammédia concession was followed in 1999 by a negotiated concession for the Rabat / Salé conurbation, and by competitive bid concessions in Tangiers and Tetouan in 2002.

All aspects of the concessions are regulated by contracts, including service and performance obligations, investment obligations, tariff adjustments, reporting, dispute resolution and termination. Concessionaires are accountable to a Delegating Authority, comprising representatives from local municipalities, and supported in technical issues by the Ministry of Interior (DRSC). Day-to-day contract administration is the responsibility of technical Permanent Monitoring. There are 4 concessions in Morocco in the large cities of Casablanca, Rabat, Tangiers and Tetouan, and their neighbouring municipalities. The table below gives a comprehensive list of wastewater service providers in Morocco.

Table 4: Wastewater Service Providers in Morocco

Operators		Main Cities	Population connected to wastewater service	%	%
12 Régies	RADEEF	Fez, Sefrou	1,200,000	6%	34%
	RADEEMA	Marrakesh	960,000	5%	
	RADEEM	Meknes	710,000	4%	
	RAK	Kenitra	470,000	2%	
	RADEEJ	El Jadida	620,000	3%	
	RADEES	Safi	312,000	2%	
	RADEEL	Larach, Ksar Kebir	260,000	1%	
	RAMSA	Agadir, Inzegan, Ait Melloul	879,000	5%	
	RADEEO	Oujda	511,000	3%	
	RADEET	Beni Mellal, Kasbah Tadla	196,000	1%	
	RADEEC	Settat	276,000	1%	
	RADEETA	Taza	149.000	1%	
4 Private concessions	LYDEC	Casablanca, Mohammadia	4,078,000	21%	42%
	REDAL	Rabat, Salé, Temara, Skhirate	2,184,000	11%	
	AMENDIS Tanger	Tanger, Assilah	1,065,000	6%	
	AMENDIS Tetouan	Tetouan, Mdiq, Fnideq	659,000	3%	
ONEE	ONEE (112 centre at end of 2016)	Nador, Khouribga, Berkane, Khemisset, Al Houceima, Berrechid, Benguerir, etc.	4,630,000	24%	24%
Total		**17 operators**	**19,159,000**	**100**	**100**

Source: combined resources from Ministry of Interior Affairs

3 Moroccan Business Climate in brief

3.1 Political Environment

The Kingdom of Morocco is a constitutional monarchy based on French and Islamic law, and French legal procedures. A new constitution came into force on July 1st, 2011. King Mohamed VI is the head of state. The country has a bicameral system, consisting of a directly elected 395-seat lower Chamber of Representatives and a 120-seat upper Chamber of Advisers indirectly elected by an electoral college. Representatives are elected every five years by universal suffrage. The last election for the lower house was held in October 2016 which was won by the PJD (Justice and Development Party). Voter turnout is relatively low in Morocco. During the elections of 2016 voter turnout was 43%, while in 2011 it was 45%.

The Kingdom has undergone some significant changes in recent years, including reducing the gender gap, tackling poverty and slowly decentralising its government. The manner in which it has gone about implementing these reforms has ensured that political risk is kept at a minimum. This has been achieved thanks to, in large part, the strong executive authority of the King.

The King, who also holds the title of the Commander in Chief as the country's military leader and Commander of the faithful as the country's religious leader, appoints the Prime Minister following parliamentary elections. With the Prime Minister's recommendations, the King then appoints the other members of the government. In event of legislative gridlock, the King has the power to dissolve parliament and call for new elections. Similarly, the monarch can dismiss a minister from office if they feel it is appropriate.

While power is consolidated at the highest levels of the monarchy, moves have been made to expand the authority of parliament in recent years, following a number of amendments to the constitution in the early 1990s. The changes have, among other things, given elected officials greater responsibility for a range of issues, including budgetary and investigatory matters. Additionally, the Chamber of Representatives has been given the authority to dissolve the cabinet through a vote of no-confidence.

3.1.1 Main Political Parties

- **PJD** (Justice and Development Party): 125 seats[5]
- **PAM** (Authenticity and Modernity Party): 102 seats
- **Istiqlal** (Independence Party): 46 seats
- **RNI** (National Rally of Independence): 37 seats
- **MP** (Popular Movement): 27 seats
- **USFP** (Social Union of Popular Forces): 20 seats
- Other parties: 38 seats

3.1.2 National Elections

Last elections: October 2016 (Chamber of Representatives); October 2015 (Chamber of Advisers); September 2015 (Municipal and Regional Councils). Next national elections: October 2020 (Chamber of Advisers); October 2021 (Chamber of Representatives).

[5] Seats won during parliamentary elections in October 2016

3.1.3 Judiciary System

The judiciary system is based on a combination of Islamic law and European civil law, and is headed by the Supreme Court. Judges to the high court are appointed by the Supreme Council of the Judiciary, which is led by the King. There are five Chambers in the Supreme Court: constitutional, penal, administrative, social and civil. The constitutional chamber has the authority to review legislation.

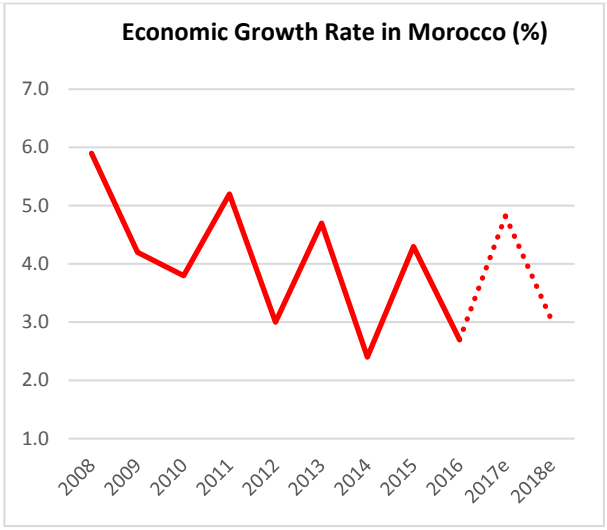
3.1.4 Women's Rights

Among some of the biggest reforms passed under King Mohammed VI, one has been that of the family code (Moudawana), a legislative overhaul aimed at reducing the gender gap and strengthening the rights of women. The Moudawana largely closed the door on polygamy, enabling women to file for divorce without their husbands' approval and making the decision subject to a court ruling. Similarly, the legal age for marriage for young girls was raised from 15 to 18. The new legislation also codified family responsibility as being within the domain of both spouses. Finally, the nationality code was amended to grant Moroccan women married to foreigners the right to pass on citizenship to their children. The Moudawana was one example of how the Kingdom built upon its reputation of a progressive social legislation, but reforms such as this have had more than a simply symbolic effect. The commitment of leaders to protecting the rights of women can be seen in the increasingly active role women play in determining the social, political and economic agenda of the country, women now holding a number of significant positions in the private sector.

3.2 Economic Developments

During the last 15 years, Morocco's annual economic growth rate was on average 4%. At the same time, growth rates have widely fluctuated between succeeding years. These variations are a result of the strong influence in performance of the agricultural sector (including forestry and fishery). With a share of 14% in GDP and almost 40% in total (formal) employment, fluctuations in agricultural output due to (severe) weather conditions have a relatively huge impact on the economic development of the country. One of the main staple foods is cereals. Cereal production during the past eight years has fluctuated sharply due to the amount of rainfall in a particular season. In the agricultural seasons of 2008/09, 2012/13, 2014/15, and 2016/17, cereal production was with more than nine million tons high at the time that annual rainfall was above the long-term average of around 327 mm. The opposite was the same; below average rainfall led to low cereal production creating a drain on many people's income. The result was that economic growth in those years with relatively low agricultural production slowed down as well. For example, the years 2012, 2014, and 2016 showed below average economic growth rates and had low agricultural output at the same time. As for 2017, the International Monetary Fund (IMF) expected a relatively high economic growth rate of 4.8%. For 2018, it is expected that the growth rate will fall back to around 3.0%. The expected high growth rate for 2017 was primarily caused by a strong performance of the agricultural sector during the 2016 – 2017 season.

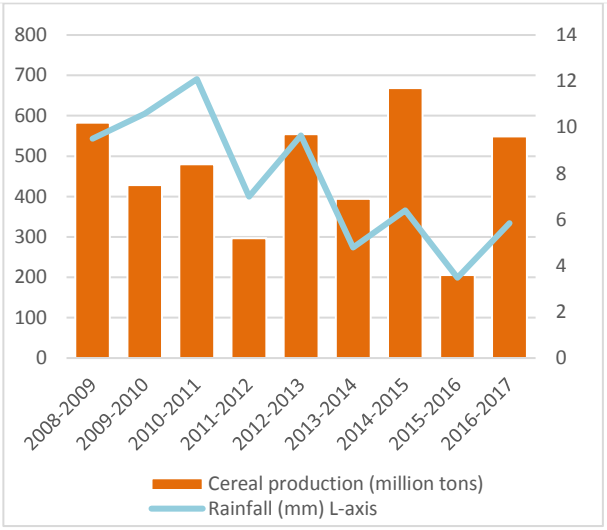
Figure 1: Economic Growth Rate in Morocco



Note: (e) estimate by IMF

Source: HCP Maroc, IMF

Figure 2: Agricultural Season

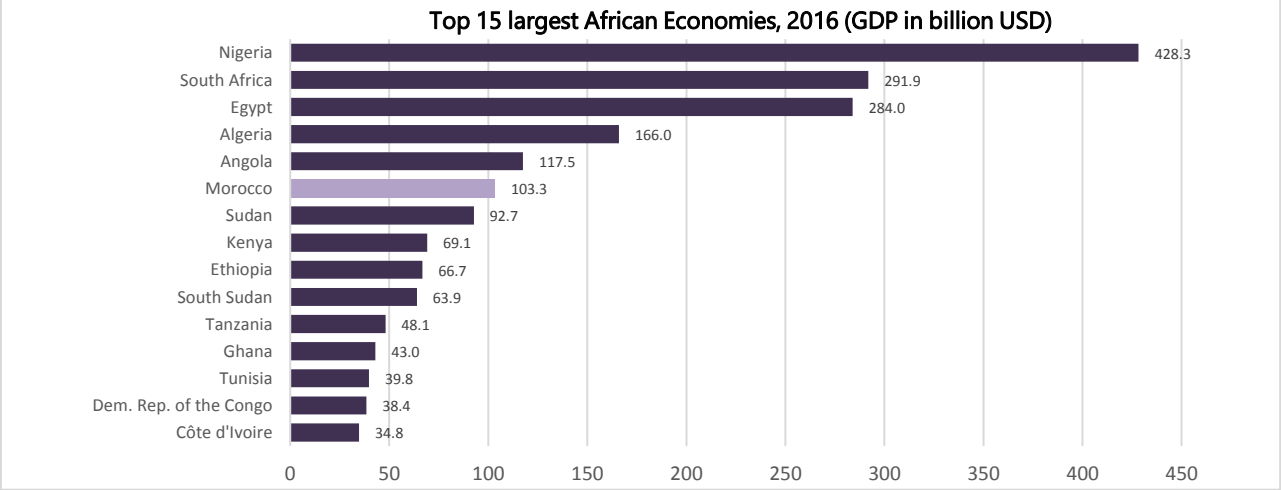


Note: The agricultural season begins in September and ends in May of the following year

Source: Ministry of Agriculture, HCP Maroc

The relatively high average economic growth rate of 4% during the past 15 years has resulted in the fact that Morocco's economy, with an overall GDP of USD 103 billion in 2016, is number six in Africa. But with a GDP per capita of less than USD 3,000, Morocco has the lowest income level in North Africa. This is primarily caused by the large influence of the agricultural sector in Morocco, which traditionally has a relatively low value added compared to manufacturing or construction.

Figure 3: Largest African Economies in 2016



Source: UNCTAD

Within Morocco income per capita differs widely between regions. Moreover, income levels along Morocco's western coastline are among the highest in the country whereas in the eastern provinces near the Atlas mountains income levels are well below the national average. Income disparity is growing as investments by public and private actors are unevenly distributed across the country.

The volume of investments by public enterprises, a main source of investments, by region shows an overwhelming preference for the two most populated regions in the Kingdom, namely Casablanca – Settat and Rabat- Salé. These two regions combined receive more than half of the total investment budget from Moroccan state companies, a trend that has been seen over the last couple of years.

3.3 Foreign Trade and Foreign Direct Investments

Due to its strategic geographical location between Europe and Africa, Morocco's foreign trade plays a significant role in the development of the country. During the last six years, total foreign trade has increased steadily from a level of around MAD 448 billion (EUR 41.1 billion) in 2010 to over 600 billion dirhams (EUR 55 billion) in 2016. This increase of around 30% is mainly caused by a stronger rise in imports than exports. In recent years Morocco has been importing goods at a higher level than it exports, resulting in a continuous trade deficit of around 190 billion dirhams (EUR 17 billion). With a share of two-thirds in Morocco's total foreign trade, the European Union is the most important trading partner. Looking at individual countries, France and Spain are Morocco's largest trading partners for many years, now followed by China and the USA.

The Netherlands has a share of 2% (MAD 12.7 billion ~ EUR 1.16 billion) in total foreign trade, making it number 11 of Morocco's main trading partners. In 2016, Morocco imported more from the Netherlands than it exported, resulting in a trade deficit of MAD 2.9 billion (approximately EUR 266 million). The main import products from the Netherlands are fuel products (diesel, oil), commercial vehicles, and seed oil. Main export products to the Netherlands are phosphoric acid, agricultural products (e.g. citrus fruits, vegetables), and canned fish and vegetables.

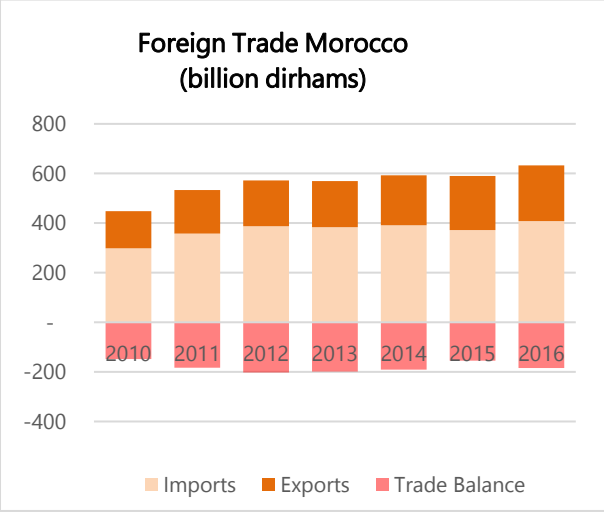
Table 6: Foreign Trade in Morocco, 2016 v. 2010 (percentage)

Country Top 20	% in foreign trade Morocco 2016	% in foreign trade Morocco, 2010
Spain	18.4%	12.7%
France	16.0%	17.9%
China	6.3%	6.0%
USA	5.3%	5.9%
Italy	5.1%	5.5%
Germany	4.8%	4.1%
Turkey	4.0%	2.1%
Portugal	2.4%	1.5%
UK	2.3%	2.4%
India	2.2%	3.1%
The Netherlands	2.0%	2.1%
Brazil	1.9%	2.7%
Russia	1.9%	2.9%
Belgium	1.5%	1.8%
Saudi Arabia	1.4%	4.0%
South Korea	1.4%	1.0%
Algeria	1.3%	1.8%
UAE	1.2%	0.6%
Romania	1.2%	0.4%
Japan	1.1%	1.1%

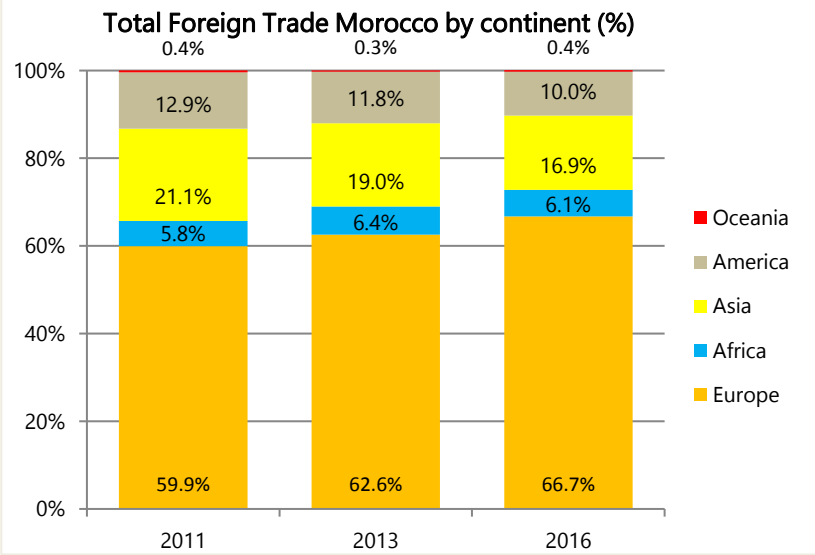
Source: Office des Changes Maroc

Africa is becoming more of an important trading partner for Morocco. During the last five years King Mohammed VI travelled to several African countries to promote and stimulate foreign trade and investments between Morocco and the rest of Africa. This has resulted in a significant increase in Moroccan companies from the public and private sector to look for new business opportunities on the African continent. Specifically, companies who are active in real estate, construction, mining, finance, and telecom. Countries in Western Africa are their main target. In 2016, almost 60% of Morocco's foreign trade with Africa was with West African countries, followed by East-Africa (16%). This has resulted in the fact that Morocco has become the largest African trading partner for countries like Côte d'Ivoire, Senegal, and Mauritania. In that regard, Morocco has increasingly become a regional trading hub for (Francophone) West Africa.

Figure 5: Foreign Trade Morocco



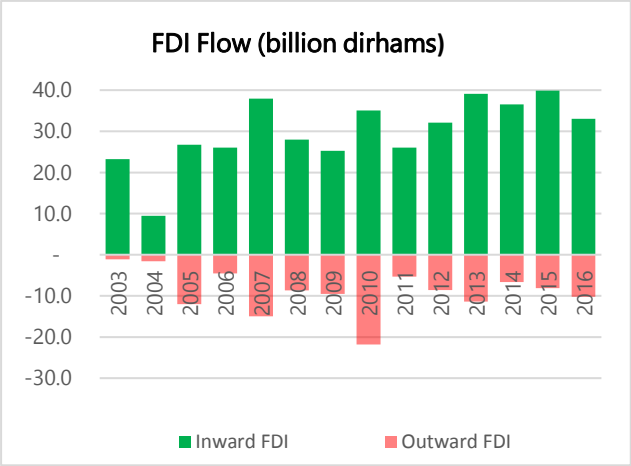
Source: Office des Changes Maroc



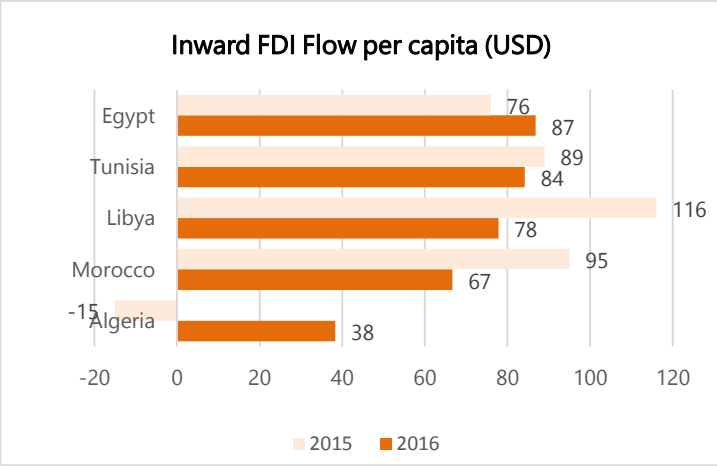
Source: Office des Changes Maroc

The flows of Foreign Direct Investments (FDI) into Morocco has been more or less stabilising between MAD 30 and 40 billion (approximately between EUR 2.8 – 3.7 billion) annually during the last six years. Outward flows in FDI is relatively low. With the exception of the year 2010 it has been below eleven billion dirhams (approximately one billion euros) per year since 2008 resulting in a net flow of FDI in 2016 of MAD 22.8 billion (EUR 2.1 billion). In 2015, it was MAD 31.8 billion (EUR 2.9 billion) due to a larger volume of inward FDI.

Figure 6: FDI Flow



Source: Office des Changes Maroc



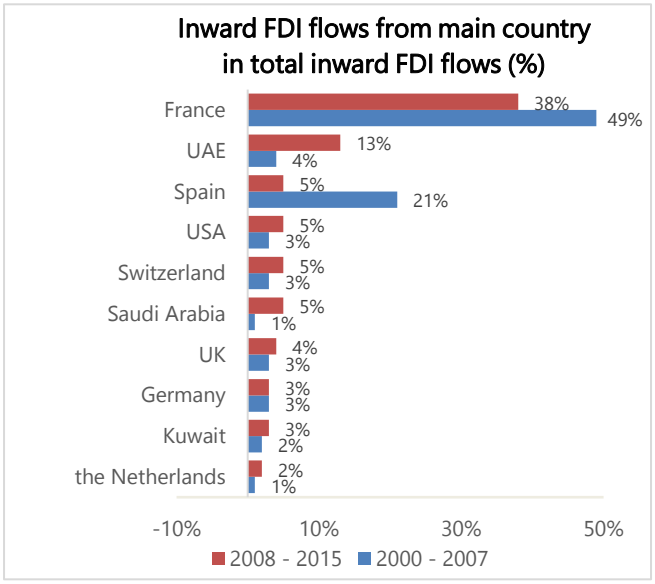
Source: UNCTAD

Compared to neighbouring countries in Northern Africa, Morocco's level of inflow of foreign direct investments per capita in 2016 was 67 US dollars, which was much lower than the levels received by Egypt, Tunisia and Libya. Only Algeria had a lower level of FDI per capita received. In 2015, Morocco was among the top receiving countries in Northern Africa. The largest foreign investor in Morocco is France with a share of 32% in total inward FDI, followed by UAE (12%) and Saudi Arabia (11%). The Netherlands is a relatively small foreign investor in Morocco with a share of around 3%.

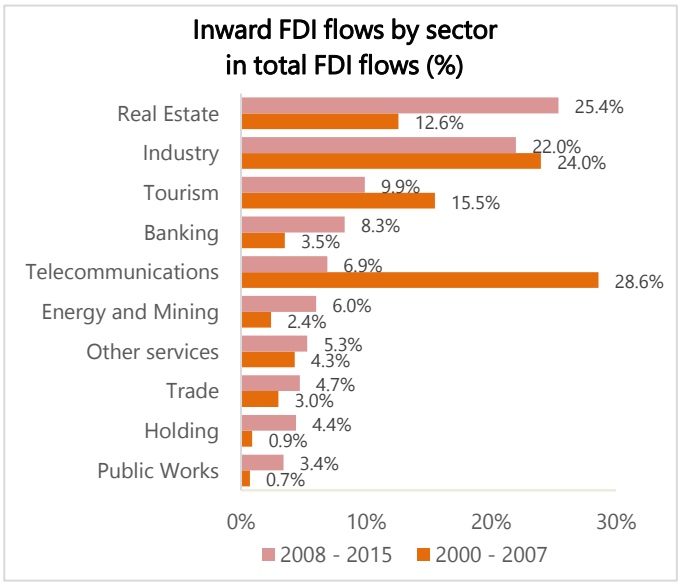
Looking at the last 15 years of FDI flows in Morocco, there is a shifting trend in the origins of the main foreign investors. During the first eight years of this millennium, France and Spain were the two largest investors followed at a distance by other European countries. During the subsequent period of eight years Spain saw its share in total FDI flows tumbling from 21% to only 5%. Additionally, France saw its share decreasing although it remained the largest foreign investor in Morocco by far. New investors are mainly coming from the USA and the Middle East, like the United Arab Emirates (UAE) and Saudi Arabia. In 2014, UAE and Saudi Arabia were the second and third largest foreign investors in Morocco. In 2015 and 2016, these two countries together with Qatar, strengthened their investment position in the Kingdom.

The share of the Netherlands in FDI flows to Morocco doubled and reached 4.5% or around one billion dirhams (around EUR 90 million) in 2016. This makes the Netherlands among the Top 10 foreign investors in Morocco. FDI stock from the Netherlands in Morocco amounted to 514 million euros in 2016, a decrease of 22% compared to 2015. One of the main private investments done by a Dutch company in recent years is the construction of a new shrimp factory for Klaas Puul in Tanger with a total investment of fifteen million euros in 2014. Also in 2014 Dutch financial institute FMO provided a loan of EUR 1.5 million to the Dutch clothing manufacturer The Makers based in Tanger to relocate their production facility to another free zone in the city.

Figure 7: Inward FDI Flows



Source: Ministry of Finance

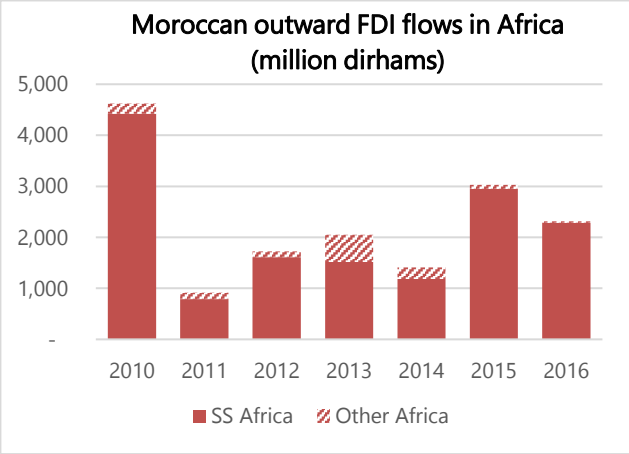


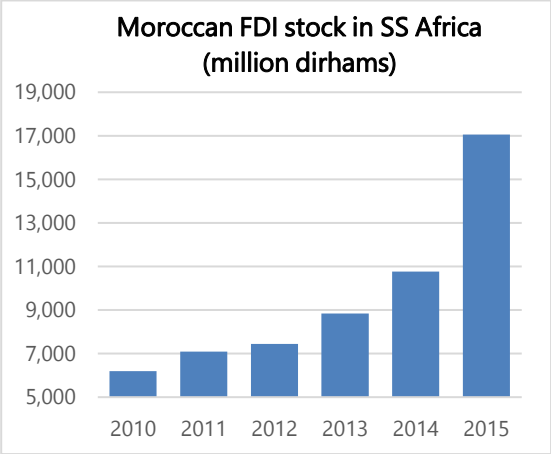
Source: Ministry of Finance

During the last eight years the economic sectors receiving the largest shares in foreign direct investments were real estate and the rapidly growing high-tech manufacturing industry (cars, aeronautics, food processing, etc.). Tourism and the banking sector (banking, insurance) followed with 9.9% and 8.3% respectively. The share of FDI in Morocco's wastewater sector during the last eight years was relatively small (less than 3%). The drop in FDI in the telecommunication sector is significantly. During the first eight years of this millennium telecommunications received the highest share in FDI, but in the following eight years it dropped to 6.9%. One of the reasons for this drop is the fact that during the first decade of this millennium, Morocco strongly invested in the development of industrial parks aimed at attracting foreign telecommunications and IT companies to set up businesses in the Kingdom as part of their global outsourcing or offshoring strategy. Industrial park Casanearshore (Casablanca) is a good example of that trend. It opened up in 2007 and attracted foreign companies like Oracle, SAP, and Altran. During the last eight years Morocco's strategy has become more of attracting foreign companies active in automotive, aeronautics, and renewable energy.

Morocco's relationship with Africa has been expanding over the last five years. Not only has foreign trade increased significantly, but more Moroccan companies are investing in Africa, especially in Sub-Saharan Africa. Of Morocco's total outward FDI flows to Africa, roughly 90% goes into Sub-Saharan Africa. That is over 50% of total Moroccan FDI outflows between 2008 and 2016. The main recipients receiving Moroccan FDI flows in 2016 were the (French speaking) West African countries Côte d'Ivoire, Cameroon, Senegal, Guinea, and Benin. Furthermore, other Sub-Saharan African countries such as Congo, Chad and Togo have seen increased flows of foreign direct investments from the Kingdom. Concerning Moroccan FDI stock in Sub-Saharan Africa, it almost tripled from MAD 6.2 billion in 2010 to MAD 17 billion in 2015.

Figure 8: Moroccan Outward FDI Flows
Figure 9: Moroccan FDI Stock





Source: Office des Changes Maroc

Looking at Moroccan FDI stock by the economic sector in Sub-Saharan Africa, it is dominated by investments in the banking sector (40%), followed by the telecommunications sector (34%), insurances (13%) and industry (6%).

3.4 Trade and Foreign Investment Regulations

3.4.1 Laws and Regulation

Aware of the fact that investment is a key factor to ensure sustainable and sustained economic growth, Morocco has liberalised its economy by easing procedures, providing better protection to private operators through introducing new laws aiming at improving investment conditions and, thus, acquiring significant flow of domestic and foreign private capital, including the labour code; this Code matches the basic principles set by the Constitution and international standards as spelled out in the UN conventions and its specialised organisations in connection with the work field. The protected rights include:

- Trade union freedom and effective adoption of the right to organise and to bargain collectively;
- Prohibition of all forms of work coercion;
- Effective abolition of child labour;
- Prohibition of discrimination in terms of employment and professions; and
- Equal wages.

Copyrights

The law on copyright and related rights anticipates measures that aim, on one hand, to strengthen and modernise the protection system for creators and works, and on the other to harmonise national legislation with commitments made by Morocco as part of International treaties and agreements. The Moroccan Office of Industrial and Commercial Property (OMPIC)[6] under the Ministry of Industry and Communications is responsible for its sister rights as well as the protection and exploitation of copyright.

[6] OMPIC is the organization in charge of industrial property protection (trademarks, patents, industrial designs) and maintaining of the central trade register in Morocco. OMPIC is a public institution with legal personality and financial autonomy. It is supervised by the Ministry of Industry, Trade, Investment and the Digital Economy.

Industrial Property

The Law on the Protection of Industrial Property anticipates provisions for a brand opposition system, as well as for border measures to control merchandise suspected of being counterfeit. It also covers the protection of sound signals and brand smells, and includes the deposit of brands in electronic format. What is more, as a signatory of international treaties on industrial property Morocco has many advantages. These include a strengthened legal framework that protects industrial property rights for both national and foreign investors and conformity to the highest international standards in the field. The formalities for protecting the rights of Industrial and Commercial Property and applying international and national legislation are made at the Moroccan Office of Industrial and Commercial Property (OMPIC).

Freedom of Pricing and Competition

The 06-99 Law on free pricing and competition sets the rules for the protection of competition, and aims to boost economic efficiency, improve the welfare of consumers and ensure transparency and fairness in trade relations. The Competition Council is the body responsible for ensuring transparency and fairness in economic relationships, through the close analysis and regulation of market competition. It achieves this by attentively checking anti-competition and disloyal business practices as well as any operations that increase economic concentration and monopoly.

Personal Data Protection

The Law on the Protection of Individuals with regards to the processing of personal data introduced a set of legal provisions aimed at protecting the identity, rights and individual and collective freedoms as well as privacy against all attacks that may affect them through the use of computers. The Law defines, among others and with precision, the right of access to databases containing personal data, to object to certain treatments, to request correction of erroneous data and delete outdated information or those whose purpose of treatment was performed. The CNDP (National Commission for the Control of Personal Data Protection) is responsible for verifying that personal data is handled in an approved, legal manner, and that its use does not carry a risk to private lives, freedoms or fundamental human rights.

Arbitration & Mediation

The arbitration legal arsenal is characterised by a series of innovations aimed at harmonising the Moroccan Trade Law with international principles. The scope of arbitration to legal entities under public law is being broadened. The implementation of the arbitration judgments relating to these acts remains, however, subject to the exequatur which returns to the administrative jurisdiction in the competence of which the judgment will be executed, or in the administrative court of Rabat where the arbitration judgment concerns the whole national territory.

The text also gives the tribunal the right to rule, either automatically or at the request of either party, on the validity or limits of its powers, or the validity of the arbitration agreement. It can also take, at the request of either party, any interim measure it deems necessary within the limits of its mission. This law has also contributed to achieving an international quality of arbitration and provides conventional mediation as an alternative for resolving conflicts.

3.4.2 Free Trade Agreements

Over the last decade, within the framework of its global openness and liberalisation strategy, Morocco has set up a legal framework conducive to developing its commercial relations with some of its potential partners, through the conclusion of free trade agreements either bilaterally or regionally.

Table 7: Free Trade Agreements

No.	Agreement	Description
1.	Morocco-European Union association agreements	Nature of agreement: Association agreement Date of signature of the agreement: February 26th, 1996 Entry into force: March 1st, 2000 Field of application: any sector of economic activity.
2.	Morocco-United States Free Trade Agreement	Nature of agreement: Free Trade Agreement Date of Signature of the agreement: 06/15/2004 Entry in force: 01/01/2006 Field of application: any sector of economic activity.
3.	Morocco - EFTA Free Trade Agreement	Nature of the agreement: Free trade agreement Date of Signature of the agreement: 06/19/1997 Entry in force: 03/01/2000 Field of application: Trade of goods
4.	Morocco-Turkey Free Trade Agreement	Nature of agreement: Free trade agreement Date of Signature of the agreement: 04/07/2004 Entry in force: 01/01/2006 Field of application: Trade of goods
5.	Arab Free Trade Zone	Date of signature: 02/27/1981 Date of application: 01/01/1998 Field of application: All products originating and coming from the Arab states contracting, with the exception of the prohibited products excluded for sanitary, moral reasons, as well as for public security and preservation of the environment.
6.	Morocco Arab Countries Trade Agreement	Date of signature: 02/25/2004 Date of application: 27/03/2007

3.4.3 Tax System

Value-Added Tax (VAT)

In general, VAT arises when a service is performed, goods are delivered or, in case of imports, when clearance documents are filed with customs. Exports are exempt from VAT. The applicable VAT rates are as follows:

- 7% rate applies for some goods of general consumption, water, renting out of water and electricity meters;
- 10% rate applies to bank and credit transactions and exchange commissions except leasing, the supply of catering services and the activities of some professions (lawyers, interpreters);
- 14% rate is applied for transportation transactions, electrical energy, etc.; and
- 20% is the standard VAT rate applicable to transactions other than those subject to the reduced VAT rates mentioned above.

Corporation Income Tax and Withholding Tax

Residency is key for determining corporation taxation. Under territoriality rules relating to corporate tax, companies, whether residing in Morocco or not, are subject to corporate tax on all profits or income relating to goods or property they own, activities they perform or profit-making transactions they carry out in Morocco, even when these are occasional by nature, of which the right of taxation is attributed to Morocco by virtue of a double tax treaty.

Moreover, non-resident entities receiving remunerations such as royalties, interest or other payments for work performed, or services rendered to their permanent establishment in Morocco, or branches or entities domiciled, or performing activities in Morocco are taxed generally through withholding tax.

The normal corporate tax rate is 30% (37% for banks and insurance companies). It is 15% for companies with an annual turnover not exceeding three million dirhams.

The withholding tax rate is 10% maximum on the distribution of dividends to non-resident shareholders and after-tax profits to the branch's head office. Thus, total tax burden is 37% (30% + 0.7*10%) (43.3% for banks and insurance companies), though some double tax treaties signed by Morocco can reduce the withholding tax rate.

Taxable income is determined on the basis of financial statements obtained according to the generally accept Moroccan principles, with some adjustments relating to fiscal law. It should also be noted that a minimum levy is required by the fiscal law. The minimum levy in general may not be less than 0.5% of the sales with a minimum of 1,500 dirham. However, the entity will not be subject to its levy during the first 36 months following the commencement of operations.

Tax losses arising from normal business activities of the enterprise are deductible. Losses may be carried for four years.

Income Tax

Individuals who are tax residents in Morocco are liable for income tax on all their income deriving from Morocco. Income tax is calculated by applying a progressive tax rate to the taxable income base. As a general rule, all types of remuneration and benefits received by an employee for services rendered are considered taxable income. Each month, the Moroccan employer has to withhold and pay income tax to the Treasury on every payment to the employee.

Repatriation of profits and transfer pricing

In addition to paying interest and dividends, the payment of management fees, service fees and royalties are methods of repatriating profits to the non-resident associates, controllers and owners of Moroccan entities. In these circumstances, the payments made by the Moroccan resident to the non-resident associate must reflect the market value of the goods and/or services to the Moroccan company. This means that deductions claimed by a Moroccan company for payments made that are in excess of the actual value of the goods and/or services delivered, can be disallowed by the tax office and an alternative price is as such set on such goods or services by the tax office.

Other transactions between the Moroccan taxable entities (or branches), and their related foreign entities or head offices are also subject to the transfer pricing rules.

Foreign tax relief

Considering that a Moroccan resident is taxed on worldwide income, the Moroccan tax system provides relief from foreign taxes paid on such worldwide income by means of a foreign tax credit. This foreign tax credit cannot exceed the Moroccan tax otherwise payable in respect of the foreign-source income.

Withholding tax

Dividends paid to a non-resident are subject to a 10% withholding tax unless the rate is reduced under an applicable tax treaty. Interest on loans obtained from a non-resident is subject to a 10% withholding tax. Royalties paid to non-residents are subject to a 10% withholding tax unless the rate is reduced under an applicable tax treaty.

Professional Tax

Professional tax applies to individual or legal entities, either Moroccan or non-Moroccan, which carry on professional activity in the Kingdom. Professional tax is determined on the basis of the gross rental

value of the premises using leases and rent contracts, by comparison or direct appreciation performed by the tax authorities. There is a tax exemption for the first five years since the start of the activities.

Property Tax
Property tax applies to building used by their owners for primary or secondary residence or made freely available to their spouses, children and relatives for use. The tax is calculated annually by applying the property tax rate to the rental value of the building. New buildings acquired as a primary residence are exempt from property tax during the first five years and they also benefit from 75 precent reduction of the rental value thereafter.

Communal Tax
Communal tax applies to the land, buildings and equipment, and is levied on the rental value, as ascertained for professional tax or property tax as the case may be. The communal tax is established on the rental value at the rate of 10.5% for the buildings located in the vicinity of urban communes and delimited centres and 6.5% for the buildings located in the peripheral zones of urban communes.

Free Zones Tax System
Free Zones offer number of tax advantages such as:

- Exemption of taxes on dividends and partnership shares
- Corporate tax is 0% during the first five years and then a reduced rate of 8.75% starting at the 6th year applies, for the next 20 years
- License Tax & Urban Tax: exempted for 15 years
- Exemption of all registration taxes and stamp duties
- Exemption of VAT and tax-free repatriation of foreign earnings

Double Taxation Treaties
Morocco has signed double tax treaties with 39 countries, including with the Netherlands, US, a majority of the European countries, many Middle Eastern countries, some East Asian countries and some African countries.

3.4.4 Investment Incentives

In addition to the tax exemptions granted under the common law, Moroccan law provides specific financial, tax and customs advantages to investors, as part of agreements or investment contracts to be concluded with the State, provided that they meet the required criteria. This includes:

- The contribution of the state to certain investment expenses: Investment Promotion Fund;
- The contribution of the state to certain expenses for the promotion of investment in specific industrial sectors and the development of modern technologies: the Hassan II Fund for Economic and Social Development;
- Exemption from customs duties under Article 7.I of the Finance Act No. 12/98;
- Exemption from import VAT under Section 123-22 °-b of the General Tax Code.

These four advantages can be benefited from in a single investment project.

Investor Protection
International conventions relating to the guarantee and protection of investments apply. As part of foreign investment promotion efforts, Morocco has ratified international conventions relating to the guarantee and protection of investment. These include agreements on the establishment of:

- The International Centre for Settlement of Investment Disputes "ICSID"

- The Multilateral Investment Guarantee Agency "MIGA"
- The Inter-Arab Organisation for Investment Guarantee Corporation

Bilateral agreements and conventions relating to the guarantee and protection of investment. The promotion of foreign investment in Morocco is not only limited to the adherence to international multilateral conventions but extends to the bilateral ones, as part of strengthening relations with key partners. So many treaties, agreements and conventions for the promotion and protection of investments and avoidance of double taxation have been signed throughout the recent decades.

Agreements and Conventions related to Promotion and Investment Protection
The main provisions of these agreements and conventions concern the following aspects:

- Treatment of permitted investments;
- Free transfer of capital and income;
- The non-expropriation of investment, except for public utility reasons and following a court decision (on a non-discriminatory basis and to pay a prompt and adequate compensation); and
- Disputes with recourse to domestic courts or international arbitration at the choice of the investor.

Non-double Taxation Agreements
Morocco has signed agreements with several countries to avoid double taxation with respect to income tax. These agreements establish the list of taxes and incomes concerned, the rules for mutual administrative assistance and the principle of non-discrimination.

Investor protection under the national law
Foreign investors benefits from a convertibility regime, which ensures that the investor has the right to:
- Carry out investment operations in Morocco;
- Transfer income produced by these investments abroad;
- Re-transfer income from the liquidation or sale of investments.

CNEA (Comité National de l'Environnement des Affaires)
The National Committee of Business Environment (CNEA) was created in December 2009, in order to ensure a clear and transparent framework for investment for the benefit of national and international operators. This high-level body is chaired by the Prime Minister, and is composed of representatives of the public and private sectors who aim to identify and implement measures to enhance Morocco's attractiveness to foreign entities. CNEA has become a Public-Private platform for Public-Private Dialogue on how to improve the Moroccan business environment and the image of the nation on an international scale.

3.5 Business Environment

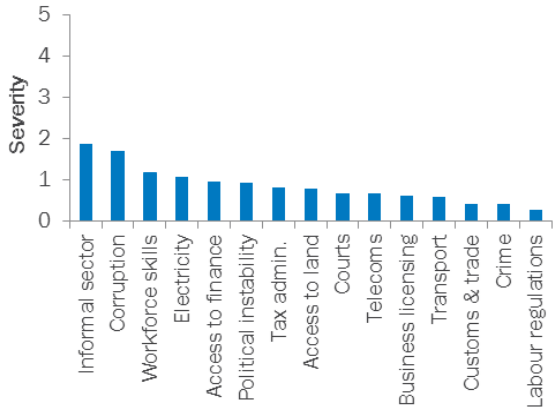
3.5.1 Introduction

Thanks to various economic reforms in recent years, Morocco's business environment has improved considerably. According to the World Bank Ease of Doing Business Index 2018, Morocco ranks number 3 in Africa after Mauritius and Rwanda. In North Africa Morocco has the highest ranking. Globally the country stands at rank number 69 out of 190 countries. In 2010 Morocco only ranked number 128 globally.

At the same time, companies operating in the Kingdom are facing many obstacles. Competitors' practices in the **informal sector** appeared as the main constraint to doing business in Morocco. These

companies are offering their products below cost price as they pay no taxes and social security, providing employment without labour contracts, and paying employees below official minimum wage. The share of firms that reported competing against firms in the informal sector was 47.3%. The informal sector in Morocco is large, accounting for an estimated 40% of the official estimated GDP. Those living in rural areas, especially young people and women, face difficulties finding jobs in the formal sector and are therefore relegated to working in the informal sector. Also, some small businesses prefer to operate in the informal sector in order to avoid complicated bureaucratic procedures and payment of taxes.

Figure 10: Company Obstacles faced in Morocco



Note: Estimated for a hypothetical "average" firm. Higher values correspond to a weaker business environment.
Source: World Bank Enterprise Survey

Corruption was the second most severe obstacle facing firms economically active in Morocco. As in other Mediterranean countries, personal contacts and informal gifts or payments are often used to facilitate or speed up administrative or customs procedures. Of firms surveyed by the World Bank, 18.2% reported that an informal gift or payment was expected or requested to obtain an import licence – the highest in the Mediterranean region. In addition, 7.5% of firms reported that an informal payment or gift was expected or requested by tax officials – above the Mediterranean average of 6.2%. When it comes to the court system, 65.3 percent of firms surveyed tended to disagree or strongly disagree that the court system was fair, impartial and uncorrupted.

Workforce skills were the third major constraint. Tertiary education does not provide the young with the necessary skills that are demanded by the private sector. Although the Moroccan government has managed to increase the number of children enrolled in primary and secondary schools, the quality of this education lags behind. According to the African Development Bank, there is also a skills mismatch in the form of an oversupply of university students majoring in social sciences, education and humanities (around 75% of Moroccan students). Only around 18% of students pursue scientific, technical and engineering subjects at university – the fields that offer most of the jobs in the private sector.

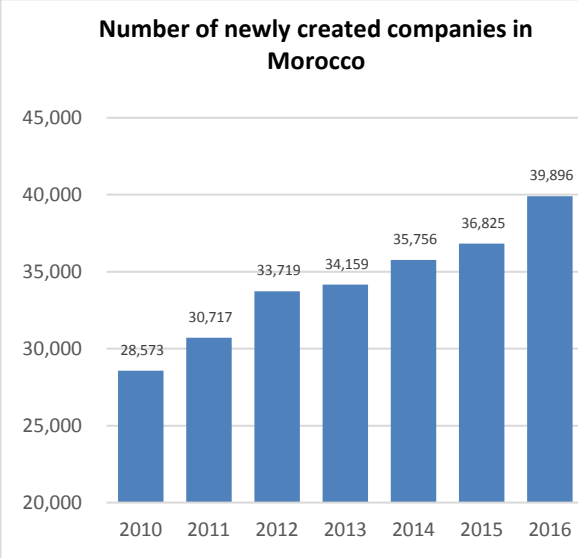
3.5.2 Starting a Business

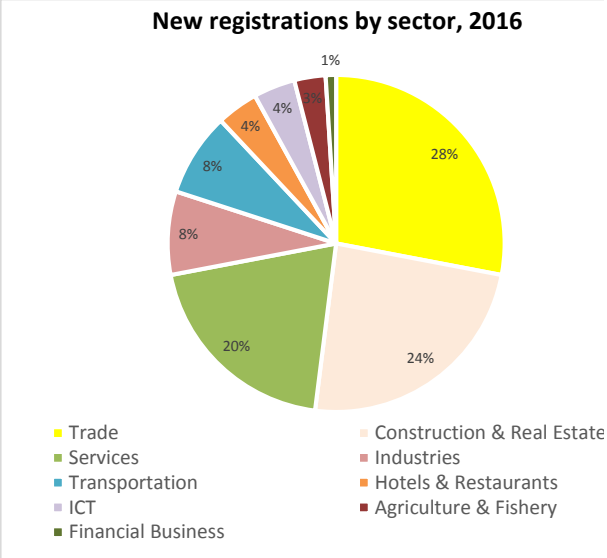
According to the Moroccan Office of Industrial and Commercial Property (OMPIC), the number of newly created companies in Morocco has been increasing during the last couple of years. In 2010 the total number of newly registered companies was around 29,000, which rose to almost 40,000 in 2016, an increase of 40% in only six years. The regional breakdown of new registrations in the Trade Register

in 2016 shows that the majority set up a new business in Casablanca - Settat, with a share of 37% in total newly created companies in 2016. This number 1 position has been constant over the years. Secondly is the region of Rabat-Salé-Kenitra (15%). Looking at the legal form of the newly created companies in 2016, almost 50% are Single Member Limited Liability Companies (one-person companies or SARLAU) and about 48% are Limited Liability Companies (SARL).

New registrations of companies by sector breakdown reveals that there are three sectors which together count for two-third of all new registrations in Morocco in 2016. These sectors are Trade, Construction & Real Estate and Services (excluding financial services). The sector Transportations only had a share of 8%. In 2010 the sectors Trade, Construction & Real Estate and Services were also the Top 3 ranking sectors for new registrations.

Figure 11: Newly Created Companies
Figure 12: New Registrations in 2016





Source: OMPIC

Source: OMPIC

How to create an enterprise in Morocco?
The main stages for creating a commercial enterprise of **natural entity** type are as follows:

Stage 1: Negative certificate
It is a document which proves that the trading name (for legal persons), acronym or trading name (for individual businesses) requested is not already used and can be registered for the registration in the trade register. This is the first document needed to create an enterprise.

Stage 2: Drafting the statutes of the company
The status is a set of contractual, and legal provisions that define the impersonal and objective rules applicable to a determined legal situation. The status can be a notarial deed; written by a notary at the customer's request or private agreement concluded by the parties or by third parties (trustee or counsel...).

Stage 3: Establishment of the subscription form
The subscription form is a document that must be filled by the person who wishes to participate in the capital formation of the enterprise. This form includes a promise of contribution in cash.

Stage 4: Establishment of the statement of subscription and payment

The statement of subscription and payment is a document drawn up and signed by the president in which he states the amount of payments made by shareholders.

Stage 5: Blocking of funds

Blocking of capital is made at the bank that provides the customer with a bank certificate proving that he has the necessary and mandatory funds required by law.

- For the SARL: suppression of formality of blockage for companies of which the capital does not exceed MAD 100,000;
- The amount differs depending on the legal form of the chosen-enterprise.

Stage 6: The registration of legal acts

The formalities of registration has the effect of acquiring certain date to private conventions and ensure the conservation of acts, it gives rise to the collection of a tax called "registration fee".

- 1% of the capital with a minimum of MAD 1,000.

Stage 7: Subscription to business tax and tax identification

This is the registration of the company with the tax administration. This stage of the creation allows the enterprise to choose its tax regime and particularly obtain its identifier to the business tax.

Stage 8: The registration in the trade Register

The registration in the commercial register means the birth of the enterprise. The registration in the commercial register must be made within three months after the creation of the company. The registration of a company can be required by the managers or members of the administrative, executive or management or by agents provided with the powers.

Formalities after the creation

Publication

After the registration in the trade register and in a period not exceeding one month, two advertisements are mandatory in the journal of legal notices and the Official Gazette.

Membership to the CNSS

Membership of the CNSS (Morocco's social security system) is a legal obligation. Any enterprise subject to the social security must be member of the CNSS, issuing it therefore a membership number which is an official recognition of its identification, its registration and attachment to the regime. For the creation of a natural person enterprise (individual) the following stages have to be taken:

Stage 1: Negative certificate (optional)

The trader can opt for the choice of a trading name (for individual business) that affix to his business and that will allow him to make known his business to the public. In this case, the trader must request a negative certificate attesting that this trading name (for individual business) is not already used and can be operated for the registration in the trader Register.

Stage 2: Subscription to the business tax

it is the registration of the company with the tax administration. This stage of creation allows the enterprise to obtain its identifier to the business tax.

Stage 3: The registration in the Commercial Register

Trader must file a written application to the secretariat of the clerk's tribunal on which depends the principal establishment or commercial enterprise. The registration in the trade Register must be made within three months after the opening of the commercial establishment or the acquisition of goodwill.

3.6 Safety and Security

3.6.1 Bribery and Corruption

In 2016, Morocco ranked 90th out of 176 countries (89th in 2015) in Transparency International's Corruption Perception Index (CPI). Corruption remains a major problem despite a series of measures to fight it, including setting up a new anti-corruption body. The problem could be partly explained by the low salaries in the public sector. To improve the business climate and create a more attractive environment for investors, Morocco has pushed for greater transparency. Measures include adopting an access to information law, setting up an anti-corruption commission (the ICPC), creating an Ethics Committee working towards eliminating corruption and fraud within firms, reforming the Government tender processes with a law requiring open bidding, and creating a specialised unit working on money laundering.

3.6.2 Terrorism Threat

There is the same level of threat from terrorism in Morocco as in European countries. Attacks could be indiscriminate, including in places frequented by foreigners. The security advices from the United Kingdom, The Kingdom of The Netherlands, Germany or other European countries are the same: "You should take sensible security precautions and maintain a high level of vigilance at all times. Avoid political gatherings and demonstrations. Always observe instructions given by the local security authorities"[7].

3.6.3 Intellectual Property

While Moroccan laws are generally adequate, enforcement is sometimes lacking. Morocco has a relatively complete regulatory and legislative system for the protection of intellectual property. It is a member of the World Intellectual Property Organisation (WIPO) and is a party to several international conventions and agreements: Berne copyright convention for artistic and literary works, Paris convention for industrial property, Brussels satellite convention, and Madrid, Nice, Hague agreements for the protection of intellectual property.

To help the enforcement of intellectual property rights, an Anti-Counterfeiting Trade Agreement (ACTA) was signed in October 2011 by eight countries. These include Morocco, Canada, Japan, South Korea, and the US. At an initial stage, it is essential for foreign companies to protect their trademarks in Morocco by applying for trademark protection with the Moroccan Office for Industrial and Commercial Property in Casablanca (Office Marocain de la Propriété Industrielle et Commerciale – OMPIC). Full details on how to proceed can be found in English on OMPIC'S website. The Moroccan Copyright Office in Rabat (Bureau Marocain Du Droit d'Auteur – BMDA), supervises copyright and related rights for literary and artistic works.

3.6.4 Organised Crime

Morocco's ratification of several international and regional agreements and conventions shows the country's commitment to fight organised crime (drug trafficking, terrorism, illegal migration). On the

[7] Advisable to always check the Dutch government's advice on travel to certain countries before travel through their website, https://www.nederlandwereldwijd.nl/reizen/reisadviezen?land=&country-search-submit=

fight against cyber-criminality, the Moroccan government has also taken the necessary measures to upgrade the relevant services. But organised crime presents no direct threat to foreign businesses in Morocco.

3.6.5 Human Rights

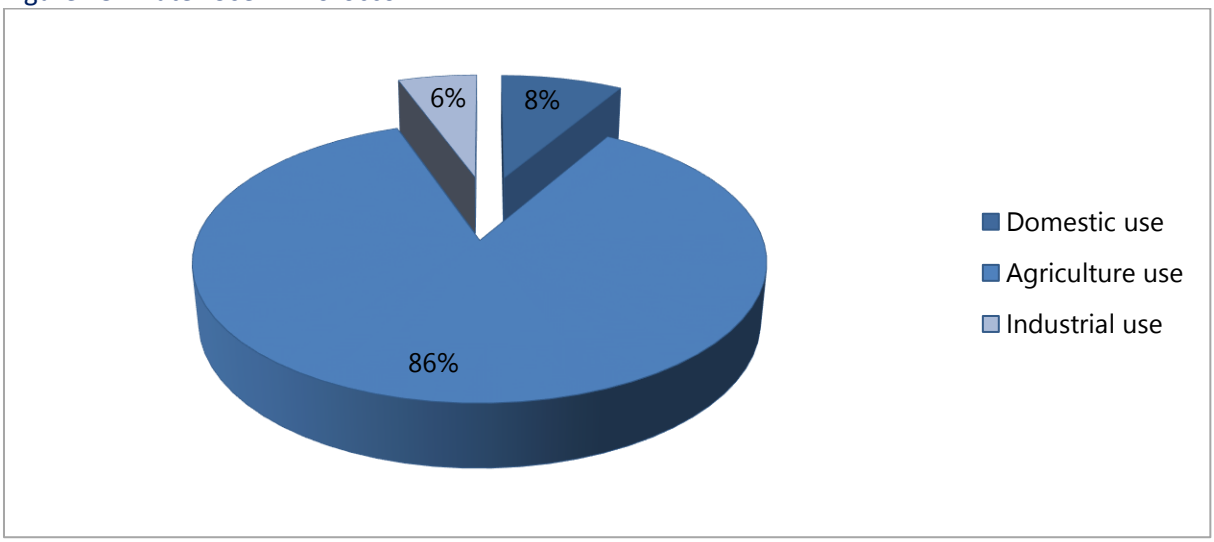
Morocco has acceded to the seven major UN Conventions on human rights, with some reservations on religious grounds. It has also ratified over 50 ILO conventions on labour rights, including the convention on Freedom of Association. Activists have commended reforms on good governance and freedoms and called on further action to implement the human rights guaranties provided under the Constitution. Recurring concerns relate to freedom of expression, access to education and gender-equality. Morocco's National Council for Human Rights (CNDH) closely follows the country's human rights progress and issues recommendations.

4 Main Trends and Developments in the Wastewater Sector

4.1 Importance of wastewater sector to the economy

Located in an arid to semi-arid climate zone, with average rainfall of 400 mm/year, Morocco is facing the increasing challenge of water scarcity. The total amount of renewable available fresh water is 2.5 billion m^3 per year. Water demand exceeds water availability, with groundwater being depleted mainly for agriculture purposes. Agriculture is the biggest water user in Morocco, as shown in the following pie chart:

Figure 13: Water Use in Morocco



Untreated wastewater has a double effect on water resources and, ultimately, economic activities. Discharging untreated wastewater affects water quality and reduces the chance for optimal use of available water resources, but reusing wastewater is an additional non-conventional water resource that can supplement conventional water resources. A Moroccan study in early 2000, supported by the World Bank, showed that around 3% of GDP is lost by environment degradation, mainly by liquid pollution generated by wastewater discharges. If, however, the total wastewater generated were to be treated and reused, it could generate more than 13% of the country's total water demand. In recent decades, most countries in the region focused on the water supply infrastructure, with sanitation being left behind. Recently, however, Morocco has made the protection of the environment and the promotion of the principles of sustainable development its national priority. To make up for lost time regarding sanitation and recovery of treated wastewater, and to upgrade this sector, the National Wastewater Programme (PNA) was initiated by Ministry of the Interior (Office of water and wastewater, DEA) and the Environment Department, and launched officially in 2005.

4.2 National Wastewater Programme (PNA)

The PNA is aimed at enhancing access to sanitation and wastewater treatment, and promoting the reuse of treated wastewater. The main impacts of the PNA are the improvement of sanitary and health conditions in the municipalities, sustainable development, including environmental protection, mainly water resources protection, improving the situation regarding water basins and economic development, including tourism improvement (seaside tourism, beach quality, etc.). Furthermore, the

programme has had indirect consequences linked to job creation and employment opportunities, particularly in engineering, construction and tourism sectors.

The main target of the national wastewater programme for 2020 - 2030 is to fill the gap in wastewater treatment capacity and, ultimately, achieve the following specific targets:

- Reduction of pollution caused by wastewater by at least 60%;
- Improved overall sewerage connection ratio to 80% in urban areas.

4.2.1 Funding the PNA Programme

The government estimated the funding available for implementation, operation and maintenance of the necessary infrastructure to achieve the programme goals. The total investment is estimated at MAD **43 billion**. This fund is meant to be made available for public and private stakeholders in the supply chain. The PNA encompasses the rehabilitation and extension of the sewerage and wastewater network, connections construction, reinforcement of the urban rainwater network and the construction of wastewater treatment plants (primary, secondary and even tertiary treatment), the acquisition of equipment for wastewater infrastructure operation and maintenance. The funding is a combination of public subsidy and cost recovery; the scenario adopted initially was to fund this important programme as follows:

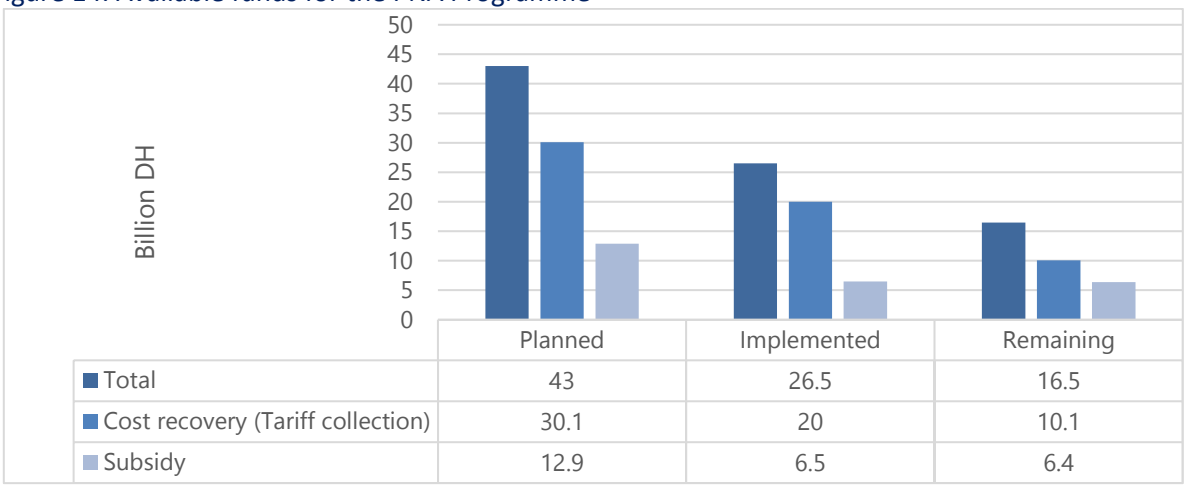
- 70% by the operators (to be covered by wastewater tariffs);
- 30% by Government subsidy (a special fund was created to finance the PNA).

A strategic review of PNA was conducted in 2008, with the support of KfW and the World Bank, with a view to speeding up its progress, particularly through the optimisation of the financing mechanisms and cost recovery. Through the scenarios presented, the Moroccan authorities decided to enhance the public subsidy and keep the wastewater tariff within an acceptable range (average of MAD 2 /m^3 in the case of ONEE small and medium centres).

4.2.2 PNA Progress

Since its launch in 2005, the PNA has allowed the implementation of several projects in consultation and partnership with relevant stakeholders and operators, namely ONEE (the National Office of Electricity and Drinking Water) and the autonomous municipal utilities (Régies). Thus, the total investment cost (under the PNA), including the operators and municipalities, had reached MAD **26.5 billion**[(*)] by the end of 2016, with the funding allocated by the government via the PNA subsidy reaching MAD **6.5 billion**. (*MAD: Moroccan Dirham, 11 DH=1 €)

Figure 14: Available funds for the PNA Programme



A number of projects have recently been awarded to private companies. The biggest player in privatisation is a Belgian company, Waterleau, which has been awarded five projects.

Table 8: Examples of PNA Projects

Project	Company	Project size	Contract duration	Start year	Clients
Marrakech wastewater treatment plant	Waterleau Belgium	237,000 m³/day EUR 100 million	10 years BOT	2008 2016 (after the expansion of the WWTP)	RADEEM
Fez wastewater treatment plant	Waterleau Belgium	130,000 m³/day	10 years BOT	2013	RADEEF
Bouskoura wwtp	Waterleau Belgium	8,000 m³/day	5 years	2015	LYDEC
Kenitra	Waterleau Belgium	8,000 m³/day	5 years	2016	RAK

Source: PNA

4.2.3 PNA Performance Indicators

The main achievements and results are as follow:

- Wastewater Projects were completed in more than 130 centres and are still ongoing or due to start in around 80 centres.
- The proportion of households with access to a sewage disposal network has increased to 75% (national average).
- The pollution drawdown rate[8] reached 45% through the construction and commissioning of 123 wastewater treatments plants involving various technologies (natural and aerated ponds, activated sludge, trickling filters).

4.2.4 Institutional Development Support and Capacity Building

The wastewater sector in Morocco has attracted the attention of many international organisations, research and training centres from several bilateral development cooperation partners. A number of development cooperation programmes and research projects have been initiated in the wastewater

[8] The pollution drawdown rate reflects the decline in pollution

sector and / or subsector (reuse sludge management, etc.), capacity building, twinning, technical visits and trip studies, etc. Technical support programmes from international agencies, mainly through German cooperation (GIZ, Kfw), European partners (European Commission), Canadian cooperation (ACDI), United State Aid (USAID), the Food and Agriculture Organisation (FAO), the World Health Organisation (WHO), UNDP, etc.

Key partners include; the German development cooperation agency (GIZ), WaterNet (Dutch organisation), International Institute of Water (France) and the German water association (DWA). JICA, for instance, supports sewerage projects, capacity building, institutions modernisation and master planning (Source: JICA website). The total German development cooperation (GIZ & KfW) fund in the Moroccan water sector, mainly in the integrated water resource plan (AGIRE), is EUR 385 million. The integrated water resources management programme (Appui à la gestion intégrée de ressources en eau – AGIRE) is a partnership between the Moroccan State Secretariat for Water and the Environment (Secrétariat d'Etat chargé de l'Eau et de l'Environnement – SEEE), the regional water management agencies (Agence de Bassin Hydraulique – ABH) of the Tensift, Souss-Massa-Drâa and the Oum Er-Rbia basins, as well as GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The programme is aimed at strengthening the institutional, legal and organisational structures in the water sector, and building the capacity of the water management agencies (http://agire-maroc.org/). Waternet was active in the water sector in Morocco for seven years (2009-2016). The total budget on projects funded by Waternet is USD 2.5 million. This was partly funded by Waternet as a donation from its own fund (EUR 1.4 million), with the rest of the fund being awarded by the EU and the Dutch government.

Waternet works closely with public utilities, such as ONEE, and also with private companies in capacity building. Waternet was mainly active in technical assistance and capacity building. During its years of activity, Waternet build a relationship of trust with ONEE. The Moroccan counterpart often approaches Waternet's team to assist in capacity building and review of master plans. Waternet didn't extend its funding to Morocco after 2016. They consider the country to be sufficiently developed. Waternet would allocate its fund to other priority (urgent needs) in less developed countries. However, Waternet is willing to extend its activities in Morocco and play a bridging role if fund is allocated from Dutch government, ONEE or other party. Waternet was involved in the following projects in Morocco:

- Pilot project for disinfection in water supply;
- Organising a tour for water stakeholders in Morocco to Holland and Germany (funded by KFW and WB);
- Sludge-drying project: ONEE approached Waternet for support in the sludge problem. The capacity of the landfill is reaching its limits, but the government is planning more and more treatment plants. That increases the stress on the sludge problem. Waternet provided a study solution; and
- Rainwater harvesting: the restoration of old underground tunnels built in circa 1400. Waternet participated in the project assessment.

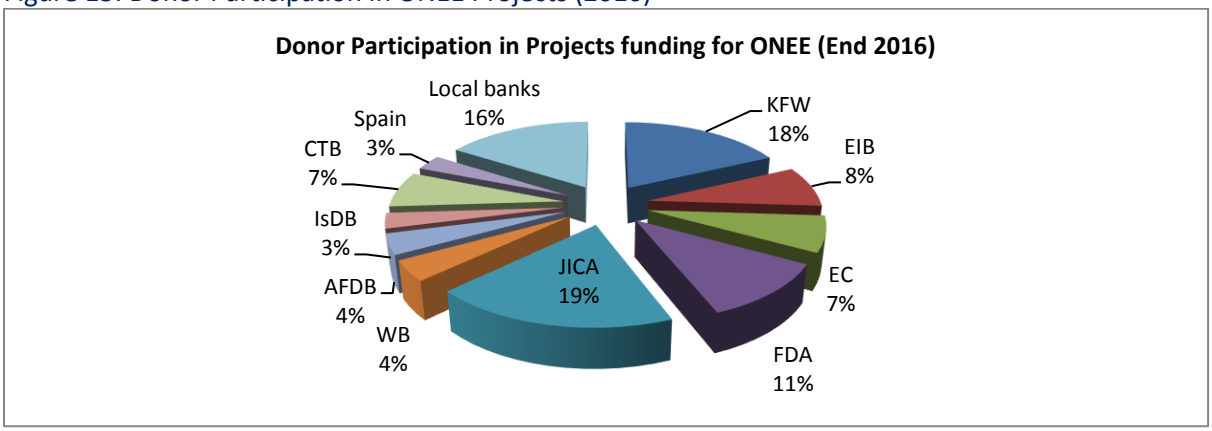
The Dutch Bank for Development (FMO) and the EIB support solid waste management for Morocco with a term loan facility of EUR 20 million to fund pre-identified solid waste management projects. The loan facility is provided in partnership between the FMO and the EIB, with both institutions providing a EUR 10 million loan.

4.2.5 Projects and Programmes funding

Since 2005, the implementation of the PNA was the subject of active and intensive donor coordination and contributions. The total investment is over MAD 26 billion, with comprehensive programmes for a river basin de-pollution and stand-alone projects. The main partners are: German government owned

development banks (KFW), European Investment Bank (EIB), French Agency for Development (AFD), Japan International Cooperation Agency (JICA), The World Bank (WB), The African Development Bank (AfDB), The Islamic Development Bank (IsDB), The Belgian development agency (CTB), Spanish Cooperation Agency for International Development (aecid), etc. For instance, the chart below shows the donor contributions (as at end 2016) in ONEE projects funding within the PNA framework:

Figure 15: Donor Participation in ONEE Projects (2016)



4.3 Value Chain Structure, Trade and logistics, and Challenges in the value chain

According to the arrangement set-up and wastewater sector organisation in Morocco the main wastewater service providers are the autonomous municipal utilities (Régies), ONEE and private companies. Wastewater projects and service provision are organised almost according to the same steps as internationally and commonly known, but in Morocco the project implementation (service delivery cycle) is fragmented according to the value chain.

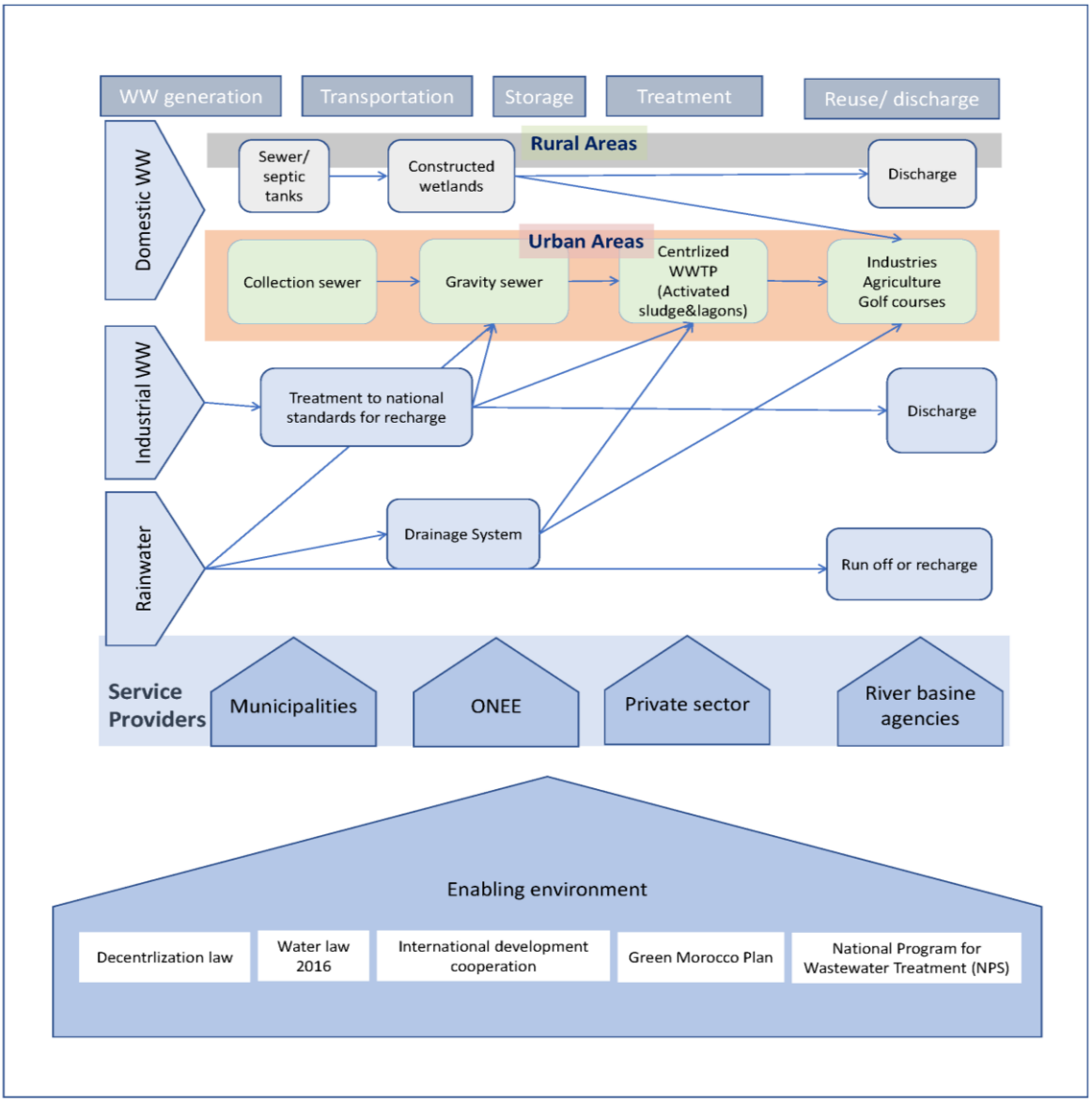
The standard supply chain path for all wastewater reuse subsectors starts from the generating point, through collection, transportation, storage, treatment and, ultimately, reuse or safe discharge. Subsectors include domestic wastewater both urban and rural areas, industrial wastewater and rainwater. Every step requires adequate infrastructure and should follow the process order. It is not possible to skip one step to the next. No treatment and reuse would be possible if the sewer infrastructure doesn't exist and that requires coordination between institutions responsible for different services. Moreover, responsibility for the wastewater infrastructure depends on the community size and population intensity. According to the decentralisation law, the municipalities have full autonomy (responsibility) to operate public services, including wastewater.

The municipalities are, therefore, authorised to contract with the private sector for design, construction and / or operation of wastewater treatment plant facilities. Municipalities in big cities create municipal utilities (Régies) or delegate to the private sector for long-term concessions. For small municipalities, ONEE is entrusted by municipalities to take responsibility for wastewater infrastructure management.

The feasibility of solutions varies from centralised treatment plants in urban areas to decentralised treatment plants (constructed wetlands and packaged treatment plants). The decentralised treatment plants require a less intensive sewer network and collection, so less wastewater (the capacity ranges from 300 to 10,000 m^3 per day, relevant for rural areas). The treatment and reuse infrastructure is less complicated and mostly limited to reuse in unrestricted agriculture. In urban areas the generated wastewater from sewer networks ranges from 10,000 to 130,000 m^3 per day).

For industrial wastewater, the River basin agencies are responsible for pollution control and enforcement of regulations that apply to all industries regarding treatment of their wastewater before ultimately discharge it into the environment or the public sewer network.

Figure 16: Supply Chain and Stakeholders Interaction



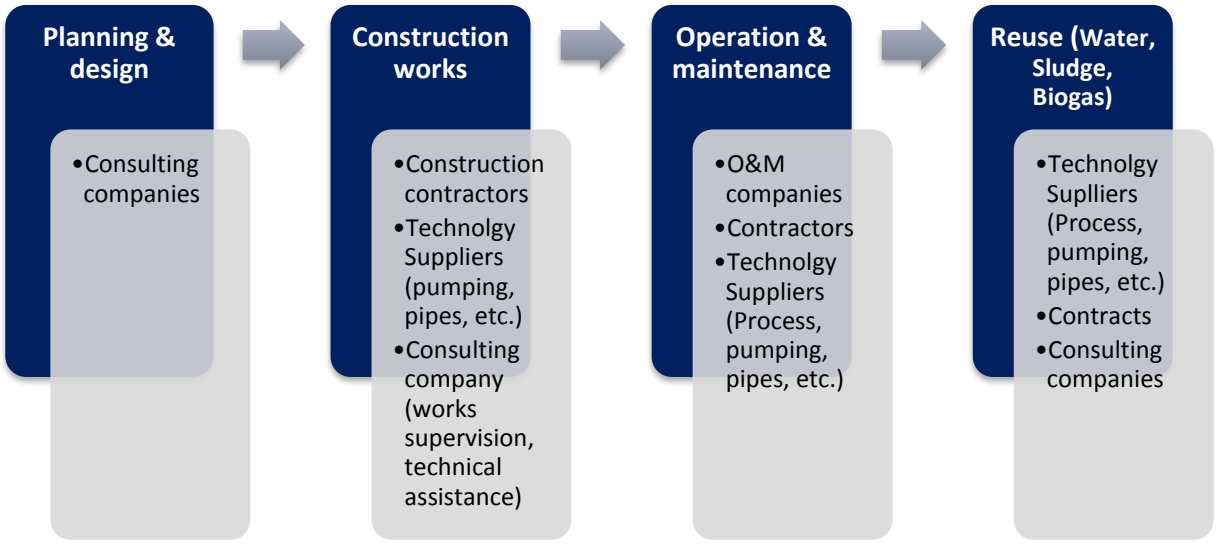
Source: Mostafa Biad

Many activities are achieved by the utilities themselves, but other important parts of the project cycles are entrusted to private companies, such as:

- Consulting companies; for example, SMEC Morocco (an international consulting company);
- Construction contractors; such as Elecnor, a Spanish company and DEF (French Design and construction);
- Technology Suppliers (process, pumping, pipes, etc.); such as Landistries (A Dutch manufacturer with distribution offices all over the world including Morocco and Veolia (an international company); and
- O&M companies and spare-parts suppliers, such as Waterleau.

Source: https://www.environmental-expert.com/water-wastewater/companies/location-morocco

Figure 17: Key input providers in the Value Chain

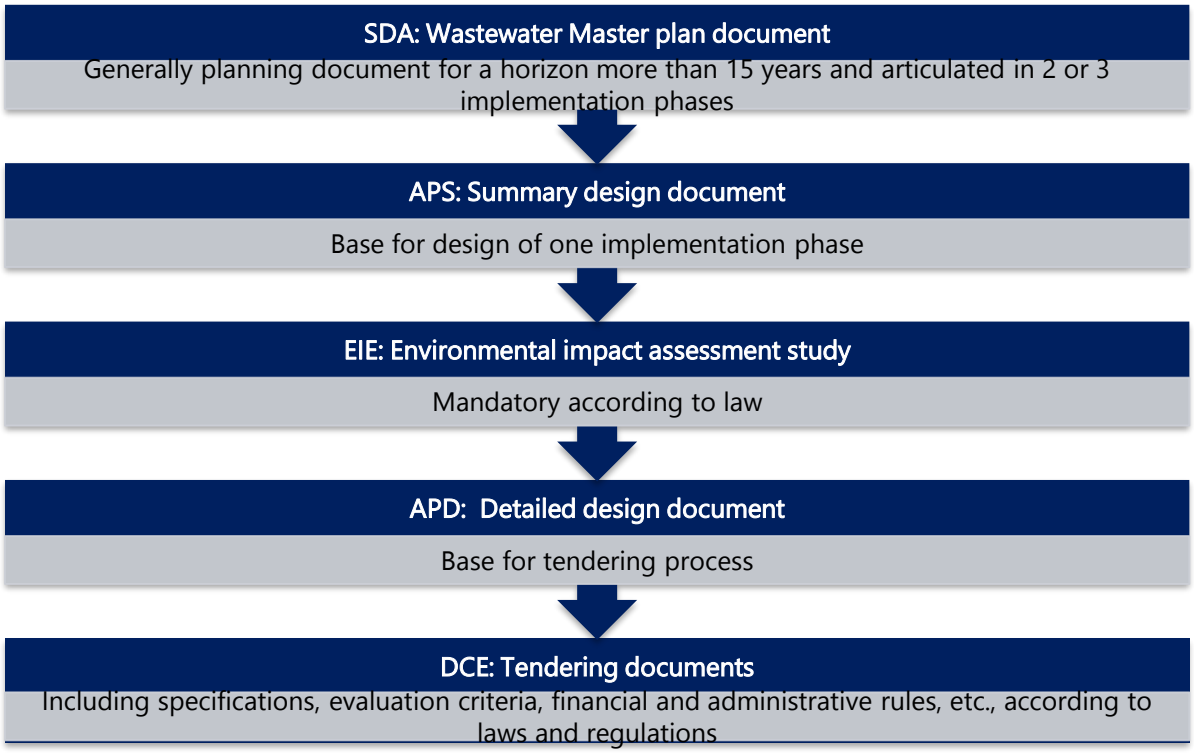


Source: The author

4.3.1 Planning and Design

Planning and design are outsourced, generally to national consulting companies, but the tenders could be open to international companies (usually collaborating with local companies) according to the project size and the conditions linked to the source of funding. The consulting companies prepare the design studies and the tendering documents for construction (under the supervision of the utility). The main documents and steps are as follows:

Figure 18: Wastewater Project Planning



4.3.2 Construction Works

The contracts are awarded in accordance with the public procurement law. Moroccan public procurement legislation was found to be in "medium compliance" with internationally recognised standards, according to assessments conducted by the European Bank for Reconstruction and Development (EBRD) in 2013. The tendering rules obey national laws and regulations. In projects funded by international development cooperation agencies, however, the process depends on the conditions fixed in financial agreements between the utility and the funding institution.

In general, the awarding procedures and the evaluation criteria are built around the principle of value for money (VFM). The evaluation and awarding process also obey national laws and regulations, and the funding Agency conditions. It is very common to see a consortium of international and national companies bidding together. The international companies are usually the owner of the technological solution and supply specific equipment (electromechanical equipment, etc.), while the local companies are responsible for civil works, excavation, pipes, etc. Construction time is one of the key challenges in construction projects; bureaucracy and long procurement process are reported to be a barrier for private companies being engaged in this business.

The International Federation of Consulting Engineers (FIDIC) general conditions for managing contracts are being increasingly introduced in engineering sectors in Morocco. If the contract is tendered as a works contract based on a detailed design (for instance FIDIC Red Book - http://fidic.org/), the tender documents then include precise specifications of the different project components and there will be limited possibility for the tenderers to offer other solutions. If the project is tendered for based on a design-build contract (for instance FIDIC Yellow Book) it will be more open for the tenderers to offer innovative solutions. In this case, the private sector participation law 86-12 for the year 2015 applies. According to this law, the public entities should make pre-assessment and feasibility studies for the private sector participation and ensure a transparent process. Public institutions responsible for wastewater infrastructure at all levels (ONEE and Régies) lack the capacity to implement new practices in tendering for wastewater infrastructure. The new legislation, including the public procurement decree (No.2.12.349) for the year 2013 and the public private partnership law (No. 86.12) for the year 2015, gives more possibilities for public procurement to introduce new practices. However, the technical capacity is still limited to addressing the financial and technical challenges facing wastewater projects. There is still great potential for development, however. Strengthening ONEE's capacity in the fields of tendering, prequalification[9], evaluation of tenders and contracting of projects in the water and wastewater sector is a core area where government-to-government Dutch-Moroccan development cooperation can be foreseen.

4.3.3 Operation and Maintenance (O&M)

Wastewater infrastructure operation and maintenance is almost always a duty of the utilities staff, but numerous specific actions are outsourced to private companies, generally local companies and micro-enterprises.

[9] Pre-qualification: An assessment made by the employer before inviting bids, of the appropriate level of experience and capacity of firms expressing interest in undertaking a particular contract, before inviting them to bid.

4.3.4 Common Tendering Practices for WWTP Construction and (O&M)

Common practices

Wastewater treatment and reuse are frequently considered as being for public good. As a result, it is often assumed that these services should be provided by governments. However, if an appropriate framework is available, then the private sector may be willing in some situations to deliver services and it can do so more efficiently than the public sector. Yet, the involvement of the private sector needs to comply with public procurement procedures, transparency and ensure economic efficiency for public utilities. Indeed, PSP requires that ONEE and the Régies adopt new practices to make the sector more attractive for the private sector, while also ensuring transparency. A lot of work has been done to explore best practices in water and sanitation projects tendering. The World Bank toolkits 2006 for PSP in water projects offer a comprehensive overview of trends in wastewater infrastructure tendering worldwide with assessment of risk sharing. The table below is taken from the WB toolkit:

Table 9: Possible PPP in Water and Sanitation Infrastructure

Option	Asset Ownership	Operations and Maintenance	Capital Investment	Commercial Risk	Duration
Service Contract	Public	Public and private	Public	Public	1-2 years
Management Contract	Public	Private	Public	Public	3-5 years
Lease	Public	Private	Public	Shared	8-15 years
Concession	Public	Private	Private	Private	25-30 years
Build-operate-Transfer (BOT)	Private and public	Private	Private	Private	20-30 years
Divesture	Private or private and public	Private	Private	Private	Indefinite (may be limited by licence)

Source: WB, 2006

In accordance with the public procurement decree (No.2.12.349) of 2013 and the public private partnership law (No. 86.12) of 2015; the contract forms described in detail below are currently applicable in Morocco.

Build Operate Transfer (BOT)

In the last few years some utilities adopted the Build Operate Transfer (BOT) or Design Build Operate (DBO) contracts in the big cities, such as Marrakech and Fes. The technologies relate to activated sludge, with the companies are paid based on performance and the effluent quality in terms of flow volume, biological oxygen demand (BOD), chemical oxygen demand (COD), etc. Recently Waterleau, a Belgian company, was the first company to be awarded DBO contract for the treatment and reuse of the municipal wastewater of the city Fes, Morocco's third largest city, but also the cities of Marrakech and Kenitra. Waterleau is responsible for operation and maintenance of the plant for 10 years. It is worth mentioning that according to the water law No. 36-15 launched in August 2016, the wastewater treatment and reuse concessions are limited to ten years, and subject to the Basin agencies' approval.

Turnkey contracts; WWTP Detailed design

The utility sets strategies for the design and implementation of solution systems (wastewater inflow characteristics are an input, the desired outflow characteristics, water quality are fixed by the utility as the performance of the WWTP, other constraints could be fixed such as level of treatment, land available for the WWTP, sludge / biogas / wastewater quality and reuse, etc.)

Conventional WWTP Construction Contract
It is common for utilities to engage a third consulting company for technical assistance and construction supervision during the project construction. The consulting company is hired through international tender. According to previous experience, the bidders are consortiums of international and national consulting companies. The amount of the contracts for work supervision technical assistance is around 5 to 10% of the total investment (project cost).

Operation and Maintenance offer (Management contract)
These are bids for supplying other services, such as operation and maintenance and / or spare parts for a defined period, etc. The main challenge for operation and maintenance is the tight maintenance budgets, which is linked to the insufficient coverage of the operating costs of wastewater disposal, operating costs are not covered by the tariff revenues (low tariff rate, willingness to pay of customers, low collection ratio, etc.). The deficit is covered by the government subsidy.

Reuse (treated water, sludge and biogas)
The specific and necessary complementary treatments (in the perspective of reuse alternatives for wastewater, sludge or biogas) are included in the WWTP construction contract; the operation and maintenance of the related equipment are also included in the O&M contract. This is mainly the case for complex treatment solutions, such as activated sludge WWTP, as the reuse rate is still low in Morocco. In such cases the executing agencies (utilities in large cities) prefer the option of turnkey contracts (including design-built), as they enlarge the scope of operation (DBO). The operation is under a separate contract, where the payment terms are fixed according to performance indicators, rather than quantities unit rate. In Morocco, wastewater reuse is applied in agriculture, golf course irrigation, industries and in small-scale groundwater recharge.

Waste Water Reuse
Due to the numerous available technologies and processes, there is a high number of possible flow diagrams for the treatment train that can be adopted, depending on the specific characteristics of each reuse application. The basic principle of wastewater treatment plants is the optimum removal of the various pollutants present in wastewater. The necessary level of wastewater treatment is defined by the effluent limit concentration which needs to be fulfilled before the final discharge of the effluent by the option of water reuse of this treated effluent, the economic feasibility, the environmental impact, the social perspective, and local / regional customs and practices. Sustainability is a crucial factor in water reuse, meaning that water resources conservation dictates the use of technologies that are economically viable, technically and institutionally appropriate, socially acceptable, and can effectively protect the environment and the natural water resources. Major reuse applications include:

- Urban;
- Industrial;
- Agricultural;
- Environmental and recreational;
- Groundwater recharge.

For each reuse application, quantity and quality requirements are generally considered. Thus, it is clear that each water reuse application should be assessed separately and all related individual characteristics and parameters should be evaluated before the selection of the appropriate reuse technology. However, based on the general guidelines of water reuse, it may be divided into the following categories:

- **Unrestricted urban reuse**: Irrigation of areas in which public access is not restricted, such as parks, playgrounds, schoolyards, and residences; toilet flushing, air conditioning, fire protection, construction, ornamental fountains and aesthetic impoundments.
- **Restricted urban reuse**: Irrigation of areas in which public access can be controlled, such as golf courses, cemeteries and highway central reservations. Agricultural reuse in irrigation of food crops intended for direct human consumption.
- **Agricultural reuse on non-food crops**: Irrigation of fodder, fibre, seed crops, pastureland, commercial nurseries and sod farms.
- **Unrestricted recreational reuse**: An impoundment of water in which no limitations are imposed on recreation activities involving bodily contact with water.
- **Restricted recreational reuse**: An impoundment of reclaimed water in which recreation is limited to fishing, boating and other non-contact recreational activities.
- **Environmental reuse**: Reclaimed water used to create artificial wetlands, enhance natural wetlands and sustain or augment stream flows.
- **Industrial reuse**: Reclaimed water used in industrial facilities primarily for cooling system make-up water, boiler-feed water, process water and general.

Table 10 below shows an example of possible guidelines for water reuse for each of the categories mentioned above. These guidelines are an amalgam of international best practices.

Table 10: Possible guidelines for wastewater reuse.

Types of Reuse	**Suggested Level of Treatment**	**Comments**
Urban reuse: All types of landscape irrigation (e.g. golf courses, parks, cemeteries); also vehicle washing, toilet flushing, use in fire protection systems, commercial air conditioners and other uses with similar access or exposure to the water	Secondary Filtration Disinfection	• At controlled-access irrigation sites where design and operational measures significantly reduce the potential of public contact with reclaimed water, a lower level of treatment, for example, secondary treatment and disinfection to achieve <14 faecal coli/100 mL, may be appropriate. • Chemical coagulation may be necessary before filtration to meet water quality recommendations. • The reclaimed water should not contain measurable levels of viable pathogens. • Reclaimed water should be clear and odourless. • Higher chlorine residual and / or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. • Chlorine residual of 0.5 mg/L or greater in the distribution system is recommended to reduce odours, slime, and bacterial regrowth.
Restricted access area irrigation: Sod farms, silviculture sites (forest crops), and other areas where public access is	Secondary Disinfection	• If spray irrigation, TSS less than 30 mg/L may be necessary to avoid clogging of sprinkler heads.

Types of Reuse	Suggested Level of Treatment	Comments
prohibited, restricted or infrequent		
Agricultural reuse: Food crops not commercially processed. Surface or spray irrigation of any food crop, including crops eaten raw	Secondary Filtration Disinfection	• Chemical coagulation may be necessary before filtration to meet water quality recommendations. • The reclaimed water should not contain measurable levels of viable pathogens. • Higher chlorine residual and / or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. • High nutrient levels may adversely affect some crops during certain growth stages.
Agricultural reuse: Food crops commercially processed. Surface irrigation of orchards and vineyards	Secondary Disinfection	• If spray irrigation, TSS less than 30 mg/L may be necessary to avoid clogging of sprinkler heads. • High nutrient levels may adversely affect some crops during certain growth stages. • Milking animals should be prohibited from grazing for 15 days after irrigation ceases. A higher level of disinfection, for example, to achieve <14 faecal coli/100 mL, should be provided if this waiting period is not adhered to.
Aquaculture reuse: Fishery production in inland freshwater pond aquaculture	Secondary Disinfection	• Wastewater fertilises pond water to help growth of planktons which is ideal for fish growth. • The animals in aquaculture make use of around 15% of nitrogen and 25% of phosphorus in sewage. • The decrease in dissolved oxygen level and the increase in concentrations of ammonia should be avoided as it is detrimental for the aquaculture. • De-chlorination may be necessary to protect aquatic species. • Some fish species are successfully grown in aquaculture, such as Tilapia.
Recreational impoundments: Incidental contact (e.g. fishing and boating) and full-body contact with reclaimed water	Secondary Filtration Disinfection	• De-chlorination may be necessary to protect aquatic species of flora and fauna. • Reclaimed water should be non-irritating to skin and eyes. • Reclaimed water should be clear and odourless. • Nutrient removal may be necessary to avoid algae growth in impoundments.

Types of Reuse	Suggested Level of Treatment	Comments
		• Chemical coagulation may be necessary before filtration to meet water quality recommendations. • The reclaimed water should not contain measurable levels of viable pathogens. • Higher chlorine residual and / or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. • Fish caught in impoundments can be consumed.
Landscape impoundments: Aesthetic impoundment where public contact with reclaimed water is not allowed, such as fountains	Secondary Disinfection	• Nutrient removal may be necessary to avoid algae growth in impoundments. • De-chlorination may be necessary to protect aquatic species of flora and fauna where their abundance is likely.
Construction use: Soil compaction, dust control, washing aggregate, making concrete	Secondary Disinfection	• Worker contact with reclaimed water should be minimised. • A higher level of disinfection, for example, to achieve <14 faecal coli/100 mL, should be provided when frequent work contact with reclaimed water is likely.
Industrial reuse: Once-through cooling	Secondary Disinfection	• Windblown spray should not reach areas accessible to workers or the public.
Industrial reuse: Recirculating cooling towers	Secondary Disinfection (Chemical coagulation and Filtration may be needed)	• Windblown spray should not reach areas accessible to workers or the public. • Additional treatment by user is usually provided to prevent scaling, corrosion, biological growths, fouling, and foaming.
Environmental reuse: Wetlands, marshes, wildlife habitat, stream augmentation	Secondary Disinfection (However, treatment levels vary)	• De-chlorination may be necessary to protect aquatic species of flora and fauna. • Possible effects on groundwater should be evaluated. • Receiving water quality requirements may necessitate additional treatment. • The temperature of the reclaimed water should not adversely affect ecosystem.
Groundwater recharge: By spreading or injection into aquifers not used for public water supply	Site-specific and use-dependent Primary (minimum) for spreading	• Facility should be designed to ensure that no reclaimed water reaches potable water supply aquifers. • For spreading projects, secondary treatment may be needed to prevent clogging.

Types of Reuse	Suggested Level of Treatment	Comments
	Secondary (minimum) for injection	• For injection projects, disinfection and filtration may be needed to prevent clogging.
Indirect potable reuse: Groundwater recharge by spreading into potable aquifers	Secondary Disinfection Filtration and/or Advanced wastewater treatment (maybe needed)	• The depth to groundwater (i.e. thickness to the vadose zone) should be at least 6 ft (2 m) at the maximum groundwater mounding point. • The reclaimed water should be retained underground for at least 6 months prior to withdrawal. • Monitoring wells are necessary to detect the influence of the recharge operation on the groundwater. • The reclaimed water should not contain measurable levels of viable pathogens and should meet drinking water standards after percolation through the vadose zone.
Indirect potable reuse: Groundwater recharge by injection into potable aquifers	Secondary Disinfection Filtration Advanced wastewater treatment	• The reclaimed water should be retained underground for at least 9 months prior to withdrawal. • Monitoring wells are necessary to detect the influence of the recharge operation on the groundwater. • Recommended quality limits should be met at the point of injection. • The reclaimed water should not contain measurable levels of viable pathogens and should meet drinking water standards after percolation through the vadose zone. • Higher chlorine residual and / or a longer contact time may be necessary to assure virus and protozoa inactivation.
Indirect potable reuse: Augmentation of surface supplies (discharge of reclaimed water directly to a water supply reservoir, a lake, or a short stretch of river followed by capture in a reservoir or to a wetland adjacent to a river)	Secondary Disinfection Filtration Advanced wastewater treatment	• Recommended level of treatment is site-specific and depends on factors such as receiving water quality, time and distance to point of withdrawal, dilution, and subsequent treatment prior to distribution for potable uses. • The reclaimed water should not contain measurable levels of viable pathogens. • Higher chlorine residual and / or a longer contact time may be necessary to assure virus and protozoa inactivation.

4.4 International Cooperation available funds

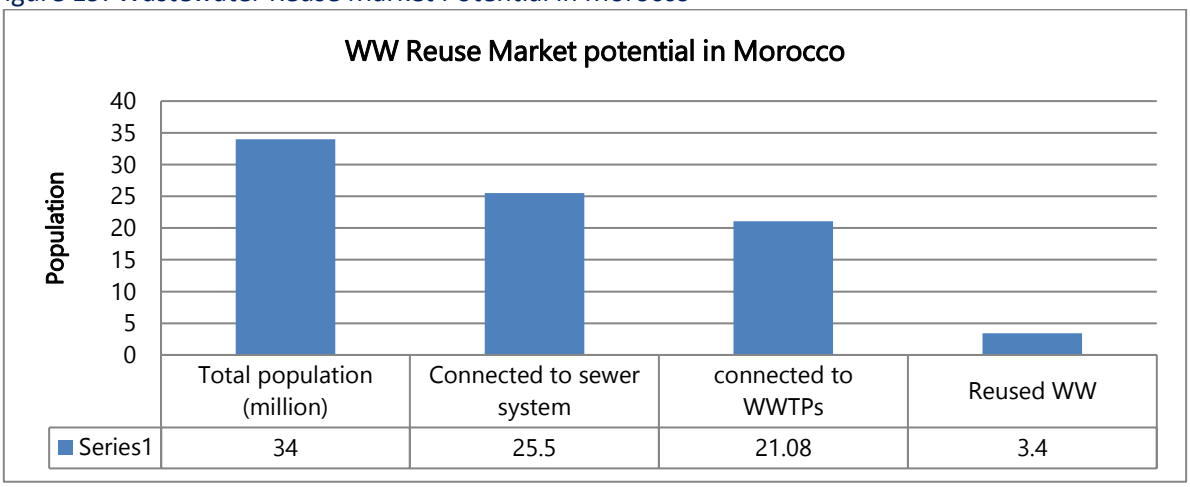
The wastewater sector remains a priority area of international cooperation with Morocco and an essential building block for development of the country. Morocco has always been a serious and credible partner for international support and funding agencies, and it has had various kinds of support for building its wastewater strategy. A number of agencies have contributed through organisational and institutional support for the achievement of water policy and wastewater sector reform, with other funding agencies participated heavily in funding wastewater projects and programs, etc. Some non-limitative actions are listed below.

4.5 Production Inventory of actual wastewater in the Moroccan sector

4.5.1 Domestic wastewater volume and service availability

Morocco has achieved a significant improvement in the wastewater sector in the last ten years. 123 wastewater treatment plants have been built, thereby increasing the treatment capacity to 900 million m^3 per year. 75% of the total population of 34 million is connected to the sewer network and 62% are connected to wastewater treatment plants.

Figure 19: Wastewater Reuse Market Potential in Morocco



The total treatment capacity increased from less than 50,000 m^3/day in 2000 to more than 900,000 m^3/day in 2016 (not including pre-treatment and marine outfall[10]). Only 21% of the generated wastewater is treated to acceptable standards, while 30% is pre-treated before its discharge to marine outfall. The additional amount generated from the rainwater runoff increases the potential for non-conventional water reuse, such as rainwater harvesting. In terms of quality, the wastewater character in Morocco falls within the worldwide normal ranges and is shown in table 1. Wastewater inflow character is a key indicator for wastewater treatment plant design and for performance assessment of WWTPs' operation contracts.

Table 11: Wastewater Characteristics in Morocco

Parameters	Small centres	Average centres	Large centres	National average	Typical wastewater character range
BOD_5 (mg/L)	400	350	300	350	560-230
COD (mg/L)	1,000	950	850	900	1,200-500

[10] A marine outfall is a pipeline or tunnel that discharges municipal or industrial wastewater, storm water, combined sewer overflows, from wastewater treatment plants to the sea

TSS (mg/L)	500	75	80	60	600-250

Source: International Journal of Environment and Pollution Research, 2014

4.5.2 WWTP Technologies

The starting point for building a water treatment matrix is the definition of the conceivable reuse aims; municipal wastewater can be reused for an industrial, a domestic (household / irrigation), a natural and an agricultural purpose. These reuse options require different water qualities. The different water qualities are reached by using specific treatment schemes. The next step in building the treatment matrix is the construction of treatment trains or schemes. With the different primary, secondary and tertiary unit process operations, numerous different treatment trains can be constructed. In Morocco, the prevailing treatment technologies are natural ponds, trickling filter and activated sludge.

Natural lagoons are used in small to medium communities. It consists of primary and secondary treatment. The natural lagoons are, in general, 1-4 metres deep (sealed with plastic film). The retention time of sewage in the lagoon is several weeks. Thus it requires large space and it is not adequate for cities. In fact, the total number of natural lagoon treatment plants in Morocco is represents more than 60%, but the natural lagoons WWTPs are small in capacity. Thus, in terms of total capacity, they account for less than 10% of the total capacity. The average capacity per WWTP is 2,400 m^3/day.

Activated sludge: The activated sludge process is a type of wastewater treatment process for treating sewage or industrial wastewaters using aeration and a biological floc composed of bacteria and protozoa. A variant of the activated sludge process is the **Nereda** (Dutch technology) process, where aerobic granular sludge is developed by applying specific process conditions that favour slow-growing organisms.

Activated sludge is the first technological solution in large cities (18 WWTPs), representing around 14% of the total number of WWTPs, but, in terms of capacity, it accounts for more than 15% of the total, with an average of 20,000 m^3/day per WWTP.

Trickling Filter (TF): TF is an aerobic treatment system that utilises microorganisms attached to a medium to remove organic matter from wastewater. It is a simple and reliable biological process suited to areas where large tracts of land are not available for land-intensive treatment systems. The effluent receives secondary treatment. Tertiary treatment units can be added to meet higher standard quality. TF is a relatively new introduction to the Moroccan market and not been tested yet. The total capacity of wastewater plants in Morocco in urban areas at the end of year 2016 was 2.3 million m^3/day, including pre-treatment and marine outfall with 131 WWTPs (Please see more details in annex 4).

Table 12: WTPs by Technologies and Capacities in Morocco

Technology	Treatment Capacity (m3/day)	No.	% (No.)	% (Capacity)	Average Capacity (m^3/day)/ WWTP
Natural lagoons	193,869	80	61%	9%	2,423
Activated sludge	348,007	18	14%	15%	19,334
Aerated lagoons	78.990	10	8%	3%	7,899
Pre-treatment and marine outfall	1,571,131	8	6%	70%	196,391
Trickling filter	32,202	8	6%	1%	4,025
Percolation/infiltration	32,419	4	3%	1%	8,105
Others	3,030	3	2%	0%	1,010
Total	**2,259,648**	**131**	**100%**	**100%**	**17,249**

Source: Ministry of Interior Affairs

4.5.3 Wastewater Reuse potential and challenges

Wastewater reuse was among the alternatives strongly suggested by the PNE (National water Plan) as non-conventional water resources to cope with the fresh water resources deficit. The target recommended by the PNE is **325 million m³** of wastewater reused in 2030.

In fact, treated wastewater can be reused for agricultural purposes, irrigating green spaces, parks and golf courses and in the industrial sector especially for washing phosphates, or for groundwater recharge. Organised and controlled reuse of wastewater has numerous advantages for Morocco and might in fact have several types of benefits which vary according to circumstances, including:

- Environment protection and mitigation of impact of wastewater treatment plants discharge;
- Mobilising additional water resource with value for accepted uses, wastewater resources are characterised by great regularity and contributing to reduce local fresh water deficits, especially in agriculture;
- Conservation of renewable water resources of higher quality (required for demanding uses such as drinking water supply);
- Providing and valorising the nutrients contained in wastewater and limiting the use of chemical fertilisers.

The potentials in this area are far from negligible. They can make a significant contribution to reducing the deficits recorded or expected in certain river basins. Despite the existing potential, organised and controlled wastewater reuse remains very limited due to institutional and financial regulatory constraints, and because the level of wastewater treatment was low and has evolved favourably after 2006 with the implementation of National Liquid Wastewater Programme (PNA).

Consequently, to achieve the objective of reuse and to remove the constraints that hinder the development of wastewater reuse, a **National Plan for Wastewater Reuse** was developed in 2016. It was developed in accordance with the guidelines of the national water strategy and the National Water Plan (draft).

The Objectives of the National Wastewater Reuse Plan (NWRP)

- The eradication of the uncontrolled use of wastewater by 2020; There is no comprehensive global data on raw wastewater reuse even though it is common practice. It is estimated that about 7% (or 20 million hectare) of irrigated land uses wastewater or polluted water (WHO, 2006). Of this 20 million ha, only 10% uses treated wastewater;
- Direct or indirect reuse of the total water potential usable by 2030, 325 million m^3 per year;
- The preservation of water resources, particularly underground, in both quantitative and qualitative terms.

The wastewater reuse programme foresees the completion of 162 projects to reuse 325 million m^3 per year by 2030. The breakdown of these wastewater reuse projects by basin is given in the table below. The NWRP was published in May 2016, but the objectives are still to be translated into detailed actions plans by concerned parties. A significant trend in the NWRP is a *river basins*-based planning approach in accordance with integrated water resources management (IWRM) principles. The NWRP suggests potential reuse per river basin.

Table 13: Wastewater Reuse Potential per Basin by 2030

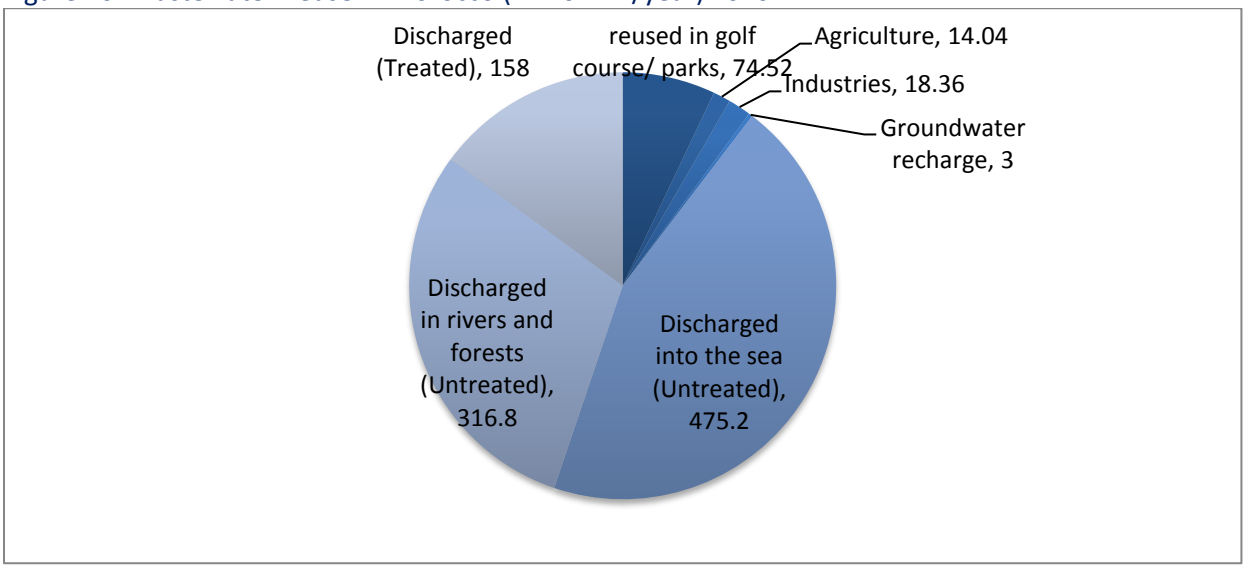
River Basin	Volume of reused treated wastewater per year (MCM/ year)				
	Irrigation	Industries	Landscaping/golf courses	Groundwater recharge	Total
Loukkos	20	-	7	-	27
Moulouya	12	-	9	-	21
Sebou	34	-	15	10	59
Bouregreg	19	-	1	-	20
Oum ErRabia	15	16	4	-	35
Tensift	1	1	56		58
Souss Massa	38	-	40	10	88
Sud Atlas	3	-	1		4
Total	142	17	133	20	312

Source: NWRP

The implementation of the PNA and the national wastewater reuse plan was a real trigger for controlled reuse of wastewater, with several projects already being carried out and others underway or in the study phase. 18 wastewater reuse projects with a total production of 38 million m^3 are already in operation and supplying good quality water to the following users:

- Use for irrigation of green spaces, parks and golf courses (69.3%);
- Use for agricultural purposes, which currently accounts for only 13%;
- Industrial use in phosphate mining (16.6%);
- Groundwater recharge by treated wastewater (1.1%)

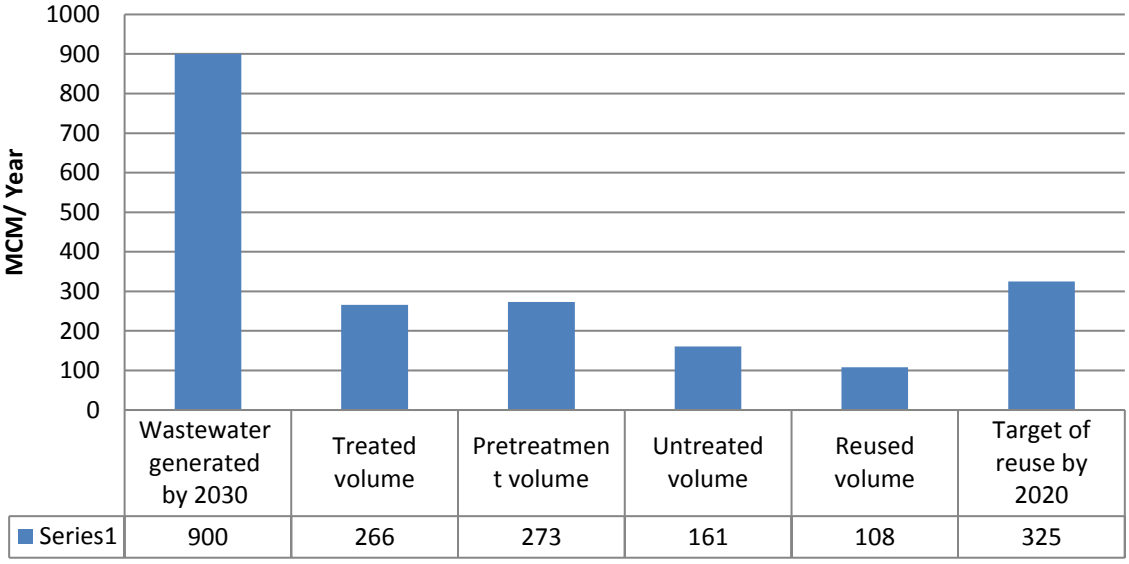
Figure 20: Wastewater Reuse in Morocco (million m^3/year) 2016



Source: Combined resources from ONEE, ministries

The level for wastewater reuse is still low even though the potential is very high; in fact, the volume of wastewater collected in urban centres has increased sharply in recent decades. It is expected that by 2030 the generated wastewater will grow to 900 million m^3. Out of the total discharge to the natural environment, a significant volume of wastewater (60%) is discharged directly to the sea (the Mediterranean and the Atlantic Ocean), while 40% is discharged into the inland natural environment. (Maâmora forest, Sebou River, Oum Er-Rbia River, Moulouya River and Draa River). The analyses and studies carried out by specialist departments estimate the volume of reusable wastewater to be **325 million m^3 per year** by the horizon of 2030.

Figure 21: Wastewater Reuse Potential (million m^3/Year)



Source: PNA

Wastewater reuse promotion requires the establishment of a regulatory framework, institutional and financing arrangements specific to reuse projects, with close collaboration of the Ministries of Water and Environment, Public Health and Agriculture. The national wastewater reuse plan came with concrete recommendations, some of which were incorporated into a new water law issued in 2016. The enforcement procedures are in the process of development.

Industrial wastewater potential market: Industry plays an important role in the Moroccan economy with contribution to GDP up to 35%. Morocco has 37 industries, of which the key ones are; automotive, aeronautics, electronics, food processing activities, leather craft, products from the sea and textiles. Even though industrial activities consume only 6% of the total water demand, the sectors' wastewater effluent has a heavy pollutant load. This by extension significantly increases the water footprint of the industrial sector. Since Morocco is committed to international agreements in environmental protection, all industries have to comply with standards for effluent discharge. Efforts are still ongoing to develop standardisations for industrial direct discharge to the environment or indirect to the public sewer system. The total volume of industrial wastewater discharged is about 964 million m^3 (around 87% of consumed fresh water). (Source: Ministry of Water)

Table 14: Volume and Sources of Industrial Waste

Industry sector	Discharged Volume (Millions of m^3)
Chemical and Para-chemical Industries	931
Textiles and Leather Industries	10
Agri-food industries	22
Metallurgical, Mechanical and Electrical Industries	Low volume, but containing toxic substances like cyanide

Source: Horizon 2020 Mediterranean report- Morocco 2014

In its effort to promote the investment environment, the Ministry of Industry, Trade and Investment created industrial zones and parks. These parks offer integrated infrastructure for industries. Clustering industries in zones increases the feasibility of wastewater treatment infrastructure with the possibility of applying economies of scale. It creates the opportunity to build common facilities for treatment of the industrial wastewater and for a large-scale reuse of treated domestic wastewater in industries.

Industrial effluent quality: While most of the discharge volume is generated form chemical and Para-chemical industries, it is not the main pollutant in the industrial sector. More than 50% of the organic load is discharged by the food-processing sector, most notably by the sugar-producing industry, slaughterhouses, dairies, cheese makers and oil mills. The food-processing industries are concentrated in the Loukkos basin upstream of the El Makhazine River dam and pose a threat to the quality of water at this dam. (Source: horizon 2020 report 2014).

On the other hand, the paper industry ranks third in the world for the use of water (5 to 20 m^3 per tonne of paper produced) and is one of the industries with the greatest amount of effluent. It is, therefore, recommended to seek reuse of treated wastewater in paper and textile industries. The characteristics of raw industrial wastewater effluents vary widely, depending on the type of industry and, indeed, within each industry depending on technologies and materials used. In the textile industry in Morocco, for example, the following table shows the wide range of the key indicators of wastewater quality

Table 15: Textile Industry Wastewater Quality

Parameter	Range
pH	6-11
Temperature (°C)	35-46
Total dissolved solids (mg/L)	8,000-12,000
BOD (mg/L)	80-6,001
COD (mg/L)	150-12,001
Total suspended solids (mg/L)	15-8,001
Total Dissolved Solids (mg/L)	2,900-3,108

Source: The water footprint in Morocco, IHE UNESCO 2015

4.5.4 Sludge Management and Valorisation Potential

Sludge is one of the major sub-products of wastewater treatment plants; however, sludge treatment issues are often neglected in comparison with water-related parameters such as the outflow load and the ratio of removal of different wastewater pollution compounds. Sludge is a potential threat for the environment; for example, foaming sludge can be lost from the treatment process or sewage sludge may be even deliberately disposed of into watercourses. There no sludge management initiatives are currently being implemented.

Efficient wastewater treatment plant produces vast amounts of sludge. In Morocco, the amount of sewage sludge generated is about 98,000 million tonnes of dry solids annually (2014) – this is expected to increase to almost 110,000 million tonnes by 2020. Sludge management is an integral part of the modern wastewater treatment plants. However, the problem of disposal, storage and reuse is still very problematic; it is important not to lose the nutrients in the sludge, to make use of its material and energy, and to dispose of it efficiently and sustainably. The total sludge produced by municipal wastewater plants in Morocco is given in the table below (T/year).

Table 16: Sludge produced by regions in Morocco

Operators	2014	2015	2016	2017	2018	2019	2020
Régies	56,000	57,000	58,300	60,000	60,600	62,000	63,000
ONEE	37,000	37,800	38,600	40,000	40,100	41,000	42,000
Concessions	4,450	4,500	4,600	4,700	4,800	5,000	5,000
Municipalities	564	575	586	600	610	620	630
Total	**98,014**	**99,875**	**102,086**	**105,300**	**106,110**	**108,620**	**110,630**

Source: Ministry of Interior Affairs

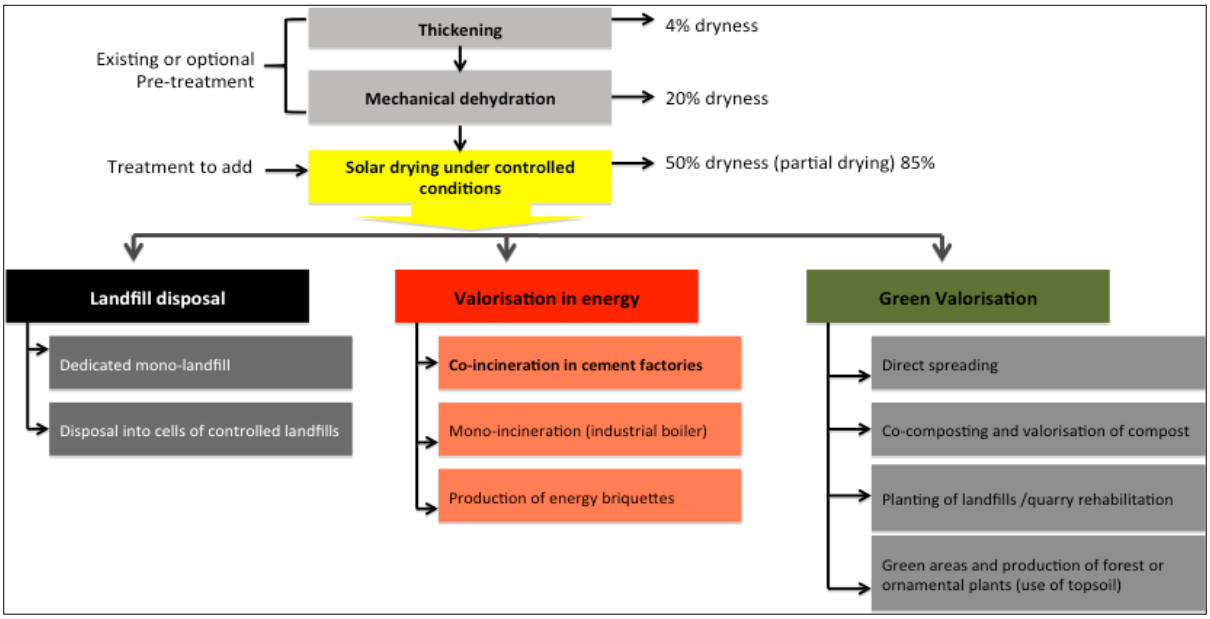
The technical potential for green valorisation (agriculture, forestry, green spaces and re-vegetation of quarries and landfills) is estimated at a minimum of 50% of total deposal by 2020, i.e. nearly 55 000 tonnes/year. This estimation is based on the lagoon cleaning plans, the economically viable distance (transport, dryness) and the ability of soil for spreading, etc.

Regarding the energy valorisation, the theoretical energy potential is estimated to be 3 million MWh/year at the urban level. The technical energy potential was about 200,000 MWh in 2015 when, the WWTPs of Fez and Marrakech contributed more than 60% to this potential, essentially in regions of Marrakesh-Safi and Fez-Meknes with activated sludge technologies and a high number of the population connected. This potential is likely to reach 330,000 MWh by 2030. The practical and technical challenges of sludge handling are:

- Stabilising – sludge is not inert and can have an unpleasant odour;
- Reducing the water content and sludge volume to the minimum;
- Utilising the energy potential when economically possible;
- Reducing the number of harmful micro-organisms if people, animals or plants are in contact with the sludge; and
- Recovering phosphorus for agriculture.

According to FAO expertise, the technological options for sludge management and disposal are summarised in the chart below (Figure 26).

Figure 22: Technological Options for Sludge Management



The main constraints of sludge management and disposal are linked to institutional and regulatory aspects:

- Need for agreements between sludge producers & managers of final sludge disposal;
- Sludge disposal not considered in the national solid waste program (PNDM);
- Non-enforcement of terms of the recent organic law 113-14, defining the competences and responsibilities of municipalities, especially in the wastewater sector;
- Lack of national standards for sludge disposal and valorisation;
- Low level of information and knowledge of sludge valorisation options and techniques.

4.6 Export of Wastewater Knowledge and Capacity Building

Through the years, Moroccan actors in the wastewater sector have gained significant experience and knowledge in planning, design, construction and operation of projects. Some of these started very quickly to share this knowledge and experience at the international level, mainly in Africa and the MENA region; among these actors there is mainly ONEE, private consulting companies and private contractors. ONEE was soon very present and dynamic at the African level as an active member in AFWA (African Water Association). It was also known as a reliable partner in capacity-building and training projects for African countries through North-South-South cooperation (triangular cooperation) or south-south cooperation. ONEE also succeeded in penetrating the African water market through various projects:

- In 2007, it was awarded a 10-year management contract for water supply in Cameroon after an international tendering process; and
- Since 2009, it has been involved in a technical assistance contract to support SNDE (National Water Supply Company in Mauritania) in a very large water supply project for Nouakchott city.

ONEE, via its International Institute of water and Wastewater (IEA), has signed numerous agreements for triangular cooperation for African beneficiaries. The main supporting donors are JICA, GIZ, IsDB and the Arab Bank for Economic Development in Africa (BADEA). The projects consist of training at ONEE premises (training centre, wastewater pilot projects, laboratories, etc.) for various topics linked to wastewater management.

In the wastewater sector, ONEE is a key player in the sector and provides support and technical assistance at the international level, for water operators in sub-Saharan Africa through sharing of knowledge and know-how in the context of North-South cooperation and South-Public-public. Under the cooperation agreement between the Kingdom of Morocco and the Republic of Guinea, a partnership agreement was concluded between the two parties in February 2016 for the establishment of studies and technical assistance for the completion of wastewater project of the Guinean capital Conakry ONEE staff are leading such project. ONEE (and IEA) provided technical assistance for the training needs assessment and implemented a training programme for Guinean managers and officials and focused on wastewater projects, design construction operation and maintenance. Private and public companies are also conducting numerous projects related to wastewater and protection environment in countries across Africa, namely Guinea, Cote d'Ivoire, Senegal, Madagascar, Cameroon, etc.

4.7 Aspects of Corporate Social Responsibility (CSR) in the sector

In the throne speech on July 30, 2009, His Majesty the king prompted the development and the implementation of a National Charter for the Environment and Sustainable Development for the protection of spaces, reserves and natural resources. The National Charter for the Environment and Sustainable Development (NCESD) was developed as part of a participative approach that involved all components of Moroccan society at both national and territorial level and was adopted by the National Council for the Environment in 2011. The wastewater sector is at the top of the agenda in the Environment and Sustainable Development charter. The PNA was recognised as an effective tool to enhance wastewater collection, treatment and discharge reuse and call upon the actors and stakeholders to continue their efforts to fulfil the expectations of the populations and meet the objectives.

5 Dutch Wastewater Sector and Dutch Diamond Approach

Innovation and water technologies are an essential part of Dutch engineering DNA with regards to water and waste management. More than 25% of the Netherlands is under sea level. As such, it is vital that the Dutch keep their land dry.

The Dutch started managing water by building dikes and dunes. After the tragic flood in 1954, the Dutch built one of the world's largest flood management infrastructures, the delta project. Over the years, the Dutch have developed more water management technologies, systems and processes. "Room for the rivers", the famous Dutch innovation for flood management system not only manages the water but creates room for rivers and other water bodies to thrive. This project developed a flood management system to keep the Netherlands dry whilst still allowing the country to make the best use of rivers. Dutch expertise in water is not limited to flood management. In Amsterdam, in 1847, Dr. Samuel Sarphati initiated the first public private partnership in sanitation project. His project was a revolutionary change in the wastewater management. Cooperation between public and private sectors stimulates innovation in wastewater treatment technologies.

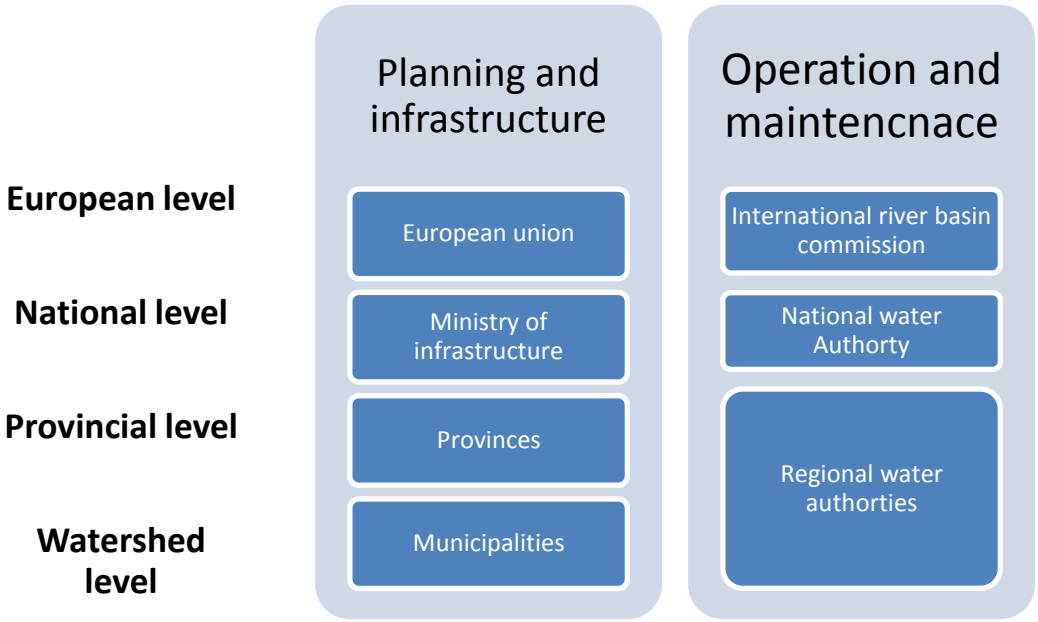
Given this vast experience, the Netherlands is the home to a number of globally-renowned water research institutes, including the institutions listed below:

- 'Water Resources' of TU Delft ranks number 1 in the several academic world-ranking lists. TU Delft ranks the fourth in civil and environmental engineering according to QS World University Rankings. Water management is number 1 in the civil engineering expertise in TU Delft. Quarter of TU Delft's 20,000 students are international students;
- IHE Delft Institute for Water Education was established in 1957 when a postgraduate diploma course in hydraulic engineering was first offered to practicing professionals from developing countries. Today, IHE Delft has developed into one of the largest graduate water education facilities in the world;
- Wageningen University and Research Centre ranks number 1 in Agriculture and Forestry and number 6 in environmental sciences in QS World University Rankings;
- Wetsus, European centre of excellence for sustainable water technology is a facilitating intermediary for trend-setting know-how development; and
- KWR is an applied research organisation that conducts research into water quality, health, systems, technology and knowledge management for the benefit of Dutch and foreign water sector stakeholders from the private and public sector. Formed in 1948 as Kiwa, KWR is currently owned and operated by Dutch water companies. It generates knowledge to enable the water sector to operate water-wisely in urban settings.

5.1 Dutch wastewater sector and Dutch Diamond Approach

Water management in the Netherlands is carried out at three levels; national, provincial and municipal levels. At the European level, the Dutch water legislation complies with the European water directive. The figure below shows the functions of different players at different levels.

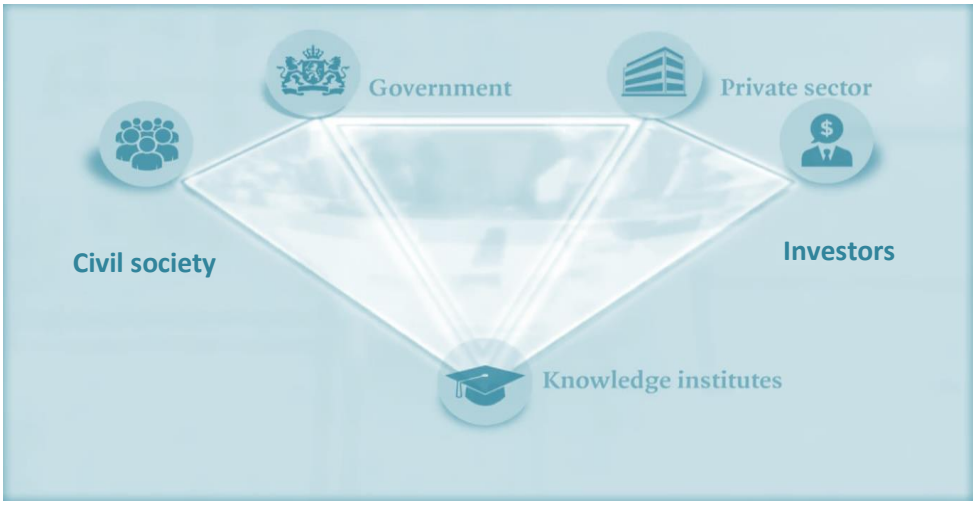
Figure 32: Water Institutions in the Netherlands



Source: Hala Alhamed

The responsibility for domestic wastewater management in the Netherlands is entrusted to the 408 municipalities according to the environment management act. Every municipality is obliged to collect and transport the domestic wastewater generated in its territory to the wastewater treatment plant. The treatment plants are then operated by the regional water authority. The private sector is involved in the whole process, planning through operation and maintenance. The Dutch model for bringing all stakeholders to the table is a long tradition and well-known worldwide. **The Dutch Diamond Approach** is the term used for stakeholder dialogue. It does not stop at private public and knowledge institutes collaboration, but it goes beyond the famous triple helix model to expand to involve two more stakeholders; civil society organisations and investors.

Figure 33: Dutch Diamond Approach



The team interviewed several Dutch actors in the Morocco wastewater sector, including the Dutch water partnerships, Waternet, investors and private companies. After the first interview with the Dutch water partnership, the team learned that a pre-assessment of the Dutch companies' readiness for the Morocco market is essential as a first step towards assessing the fitting technologies and institutions.

5.2 Stakeholders matrix Dutch Waste Water reuse Sector

The waste water reuse landscape in the Netherlands is represented in figure 28 below. The sector is quite vibrant and works well together.

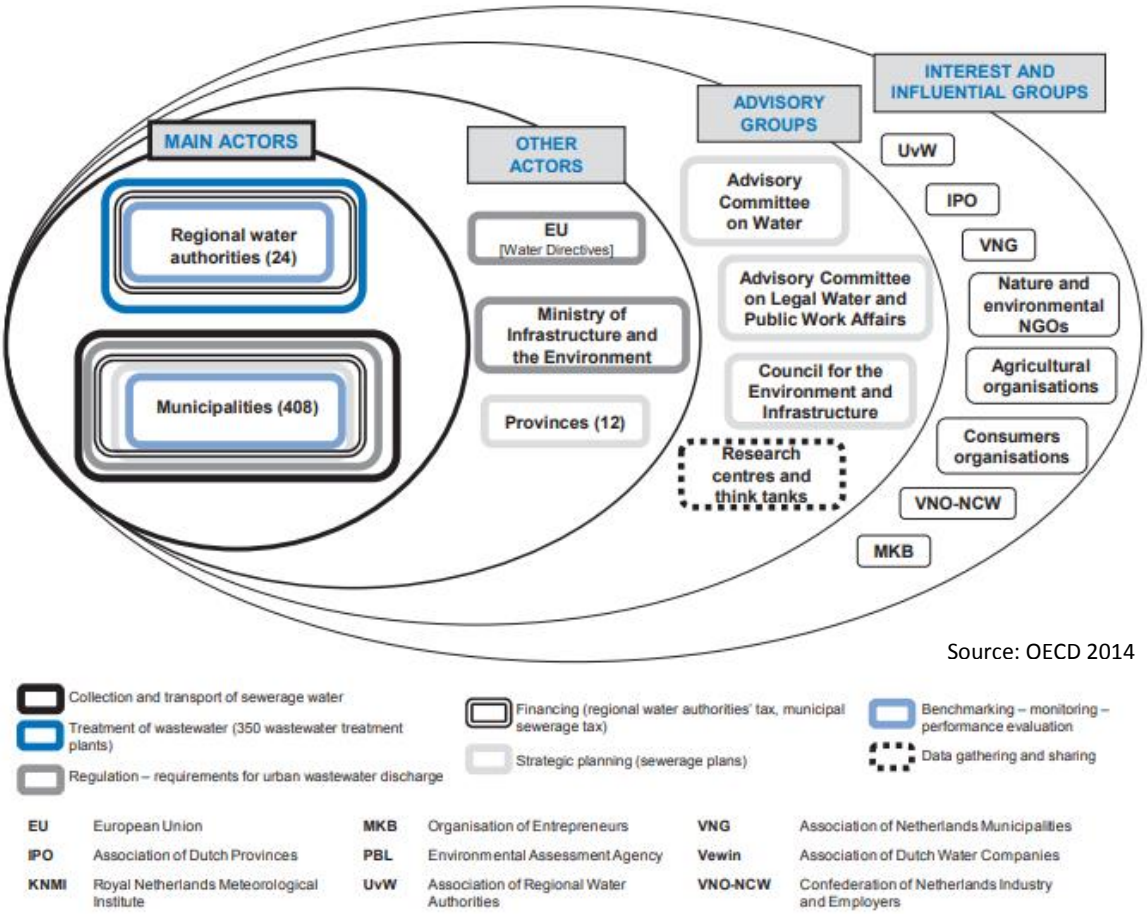


Figure 28: Institutional mapping for sewerage and wastewater treatment in the Netherlands.

In addition to the mapping above, the table below shows relevant Dutch wastewater sector players that could play a role in Morocco's plan to reuse wastewater. They have been classified according to the Dutch diamond i.e. knowledge institutions, public, business, NGOs and investors. Business partners include active companies in different parts of the supply chain; consultation, supply and manufacturing and operation.

Public organisations are mainly water boards (Waterschappen) and the Dutch water authority. The Dutch Water Authority is a national organisation comprising 21 regional water authorities in the Netherlands and their umbrella association, the Unie van Waterschappen. It promotes the interests of the regional water authorities at national and international level. It's worth mentioning that Dutch water authority is active in developing countries only for development cooperation purposes, so it does not play a significant role in promoting Dutch business abroad.

A number of non-government organisations (NGOs) play a role in Dutch knowledge transfer abroad, such as Water alliance, WaterNet, Dutch water sector and others. Investors and possible funding opportunities are listed taking into consideration the fund countries list, sectors and relevance.

Table 18: Dutch organisations relevant for Morocco

Type of organisations		Fields of activities		
		Sludge management	**Domestic WW**	**Industrial WW**
Business	**Manufacturers / Supplier**			
	Paques		√	√
	Nijhuis Industry	√	√	
	Sweco		√	
	COLUBRIS (Now Redox)	√	√	
	Landustrie Sneek	√	√	√
	Colsen	√	√	
	Eijkelkamp Soil & Water		√	
	Consultants		√	
	Royal HaskoningDHV	√	√	√
	ARCADIS Nederlands	√	√	√
	Mott Macdonald	√	√	√
	Saaf consultant	√	√	
	Daily Business	√	√	
	WASTE	√	√	
	Middle East Partners	√	√	
	Columbus	√	√	√
	Operators		√	
	Sweco		√	
	Veolia	√	√	√
	Bluetech		√	
	Royal HaskoningDHV		√	
Knowledge institutes	TU Delft	√	√	√
	Wetsus	√	√	√
	NRC	√	√	√
	WaterCampus Leeuwarden	√	√	√
	ECN	√		
NGOs	Waternet	√	√	
	Aqua for All	√	√	
	Water Alliance	√	√	
	Dutch water partnership	√	√	
Public	Dutch water authorities	√	√	
	24 Water boards in the Netherlands (not all of them active abroad)	√	√	
Investors and available fund	Private investor with impact indicators	√	√	√
	FMO	√	√	√
	The Dutch Good Growth Fund	√	√	√
	Sustainable Water Fund (FDW)	√	√	√
	Develop2Build (D2B)	√	√	√

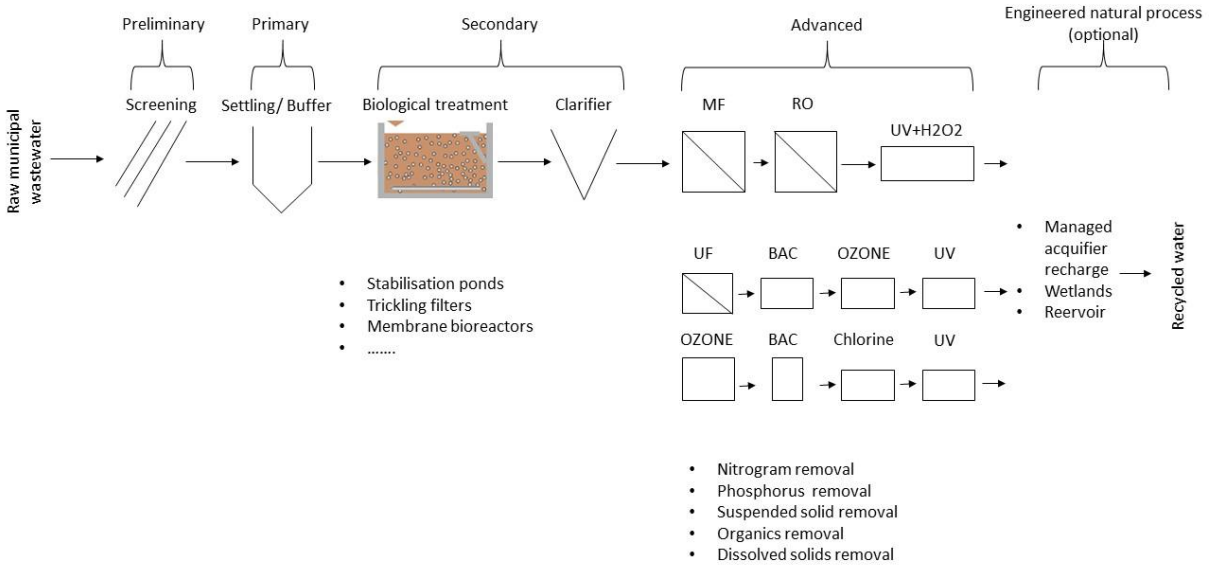
	Development Related Infrastructure Investment Vehicle (DRIVE)	√	√	√
	Netherlands-MENA Partnership (Shiraka)	√	√	√
	The DHI subsidy scheme	√	√	√
	Partners for Water - WWSD	√	√	√

5.3 Standard or Typical Treatment Schemes

The standard or typical schemes have their own strengths, are related to specific reuse applications and are mostly represented by many examples in practice. Without excluding any other possibilities, these schemes seem to be representative for the majority of the possibilities in the reuse matrix. Naturally, many variations on the standard schemes exist; variations depend on local situations and greatly vary due to the present wastewater infrastructure and regulations (Figure 30). In brief, these schemes are:

- Secondary wastewater treatment, including P- and N-removal, followed by dual media filtration and disinfection by UV or chlorine; the reuse varies from urban applications, green landscaping to industrial usage;
- Secondary wastewater treatment, including P- and N-removal, followed by double membrane filtration and final disinfection by UV; eventually also other processes such as advanced oxidation and activated carbon adsorption can be applied. The treated water is of such a high quality that many applications (industrial, household, etc.) are possible;
- Secondary wastewater treatment, followed by only disinfection (chlorination), enabling the reuse of the treated water for irrigation under restricted conditions;
- Local MBR: small-scale treatment of (part of the) wastewater by a package MBR system with reuse of the water in the direct neighbourhood (as toilet flush water);
- Secondary wastewater treatment, including P- and N-removal, followed by infiltration through large ground areas (Soil aquifer treatment); the extracted water can be reused for unrestricted irrigation;
- Secondary wastewater treatment, including P- and N-removal, followed by constructed wetlands as a natural polishing step. The treated effluent can be reused for nature conservation or agriculture; and
- Lagoons or Pond systems: treatment of wastewater by lagoons (several types in series), occasionally followed by chlorination; reuse of the effluent only for (very) restricted irrigation. This is a typical application for Mediterranean countries with moderate treatment facilities. In Morocco, this system dominates, with around 60% of the wastewater treatment plants being natural lagoons. The treatment of sewage through natural stabilisation ponds was recommended in early 2000 by the National Sanitation Master Plan (SDNAL), particularly because of the low investment and operating costs.

Figure 23: Process combinations of water reuse schemes using advanced treatment process to produce high-quality water



5.4 Innovative Technologies

Within the traditional schemes, a lot of research is continually undergone to achieve higher effluent quality with reduced cost, footprint, energy consumption and carbon footprint, with higher possibilities of reuse of the effluent while recovering energy and nutrients. **The Netherlands** is a pioneer in this field with so many technologies invented and successfully implemented in full.

Table 19: The most eye-catching technologies implemented recently in the Netherlands and widely used internationally

Technology	Specification
Energy saving and cost reduction	• Energy efficient aeration • Anaerobic biological processes • Microbial fuel cells • Physicochemical treatment
Nutrient removal / recovery	• Treatment of partial flow from dewatering of digested sewage sludge as Annamox, Demon, Sharon, recovery of ammonia by producing ammonium sulphate, and recovery of struvite Pearl, Phosnix • Phosphorus recovery from sludge: Seaborne, Sephos, BCFS
Sludge treatment	• Sludge Pre-treatment: hydrolysis (thermal, ultrasonic, chemical, physical), ozonation • Conversion Techniques: pyrolysis, gasification, torrefraction • Electro-osmotic dewatering sludge • Supercritical Gasification, supercritical oxidation

The invented technologies for the secondary treatment level can be broadly divided into physicochemical processes and biological processes. Physicochemical wastewater treatment is a frequently used technique in the area of wastewater treatment, especially for industrial wastewaters from certain industries that don't meet the standards for discharge, and certainly not for reuse as processed water. The techniques include flocculation, coagulation, flotation, neutralisation,

electroflotation, membrane technology - membrane filtration, NH3 stripper-absorbers and sludge treatment. Physicochemical wastewater treatment techniques are applied for the removal of heavy metals, oils and greases, suspended matter and emulating organic substances, organic and inorganic components, difficult to decompose non-polar organic substances, toxic pollutants or high salt concentrations and phosphorus. The physicochemical wastewater treatment techniques are used as pre-treatment, final treatment and as a specific treatment for wastewater reuse as process-water.

Biological Treatment of Wastewater (Secondary treatment) uses a wide variety of microorganisms, primarily bacteria. These microorganisms convert biodegradable organic matter contained in wastewater into simple substances and additional biomass. Depending on the environment, several types of biological processes are involved and they are mainly aerobic and anaerobic processes.

However, the characteristics of municipal wastewater can be treated by the means of biological wastewater treatment, which is much cheaper, produces less sludge with higher quality regarding its dewater ability and treatability characteristics, and has an obvious economic advantage, both in terms of capital investment and operating costs compared to physicochemical processes.

In the following paragraphs, some examples of the most pronounced, mainly relying on biological processes, innovative Dutch technologies are discussed. The selected technologies proved stable with high-quality effluent for reuse of treated municipal wastewater and suitable for industrial wastewater in most cases. The selected technologies were suitable both for green field (new plants) and brown field (retrofitting) applications.

5.4.1 Energy Saving and Cost Reduction Technologies

a) Nereda Technology

Engineering consultancy Royal Haskoning DHV in partnership with the Delft, University of technology in the Netherlands led the development of Nereda technology[11]. Currently over 30 full scale Nereda plants are operational or under design or construction across 5 continents, successfully treating both industrial and municipal wastewaters. The full-scale plants have met effluent requirements for carbon, nitrogen and phosphorus, while achieving more sustainable wastewater treatment.

The technology can be easily used for retrofitting existing plants, an example of which is using the existing SBRs in Cargill's WWTP in Rotterdam, NL treating edible oil industry waste. Cargill's old SBR-wastewater treatment facility showed variable and sub-optimal performance, suffering from frequent bulking sludge formation. Modification of the existing reactors and implementation of the Nereda technology made the plant perform steadier and better at reduced energy consumption, where the effluent is discharged into the surface water.

The conventional continuous activated sludge can be retrofitted as well to Nereda and this was demonstrated by retrofitting Frielas WWTP in Lisbon and Epe WWTP managed by Waterschap Vallei & Veluwe in the Netherlands.

[11] Nereda® is Aerobic treatment innovative technology. The technology is the full scale application of aerobic granular sludge

Figure 24: Image (Royal Haskoning DHV) Overview of the ereda WWTP in Epe

Royal Haskoning DHV works with specialist partners throughout the world. ACCIONA Agua is the Nereda licence partner to deliver the technology in Spain and Portugal; Aquatec Maxcon in Australia; EPS Group in Ireland; WABAG in Switzerland and India; WEC Projects in South Africa; Aqua-Aerobic Systems, Inc. in the United States and Canada. However, no partners are licensed to deliver Nereda technology in Northern Africa, so far, which gives a high potential for interested companies in Morocco to develop such a partnership. A SWOT analysis for the technology is developed below for its potential application in Moroccan context.

Table 20: SWOT Analysis for Nereda Technology Application in Morocco Context

Strengths	**Opportunities**
• Nereda plants showed to achieve similar or improved enhanced biological nutrient removal compared to similarly loaded activated sludge (AS) • Reliable and stable operation even with sudden peaks due to industrial waste or at low temperatures • No bulking sludge • Biological COD, N, P removal • No chemicals added • Easy operation • Simple one-tank concept • No anaerobic tanks needed • Excellent settling properties • No secondary settling tanks needed • High MLSS levels (up to g/L) • No support media needed • 25-75% reduction in footprints • No mixers needed • Saving on recirculation pumps • 20-50% energy usage reduction • Lower construction and operation costs	• Potential to harvest bioplastics • Potential to extract high-value reuse product (alginate) used in variety of industries as a thickener and as a basis for coatings. • Combining alginate extraction with existing excess sludge treatment could improve sludge treatment efficiency • Plant can be operated by Royal Haskoning DHV and gradually handed over to client • Nereda Technology offers significant energy savings which will be of greater importance with Morocco's commitment to reducing carbon emissions. • Expectation is that the granulation period should be shorter in Morocco due to relatively higher wastewater temperatures compared to the Netherlands. • A potential for partnership and being licensed to deliver Nereda to the Middle East

• Developed for a wide range of scenarios from green-field to retrofitting brown-field systems • Hybrid plants of Nereda + AS can be advantageously applied for extension of existing AS plants or increasing loading capacity • Sludge processing better performance	
Weaknesses	**Threats**
• Long start-up due to granulation which can take up to 5 months. (However, once there are a number of plants operational in Morocco to utilise as the "sludge seed" factory, the long granulation phase will be eliminated) • A modern technology implemented across 5 continents, but not in Africa	• Alginate and bioplastics extractions are still under study

b) Anaerobic Treatment technologies

In recent years, anaerobic treatment technologies have received great attention, since the production of methane-rich biogas is considered a green energy source, replacing fossil fuels. If the system operation is managed properly, it can be a net energy producer, while reducing organic material at the same time.

c) Up-flow anaerobic sludge blanket (UASB)

The UASB reactor is the most commonly applied high-rate anaerobic system for municipal wastewater. This reactor configuration was designed in the Netherlands by Lettinga and his co-workers in the early 70s. The number of UASB reactors operated worldwide is more than 700, corresponding to nearly 65% of all the existing anaerobic treatment systems. UASB technology is a proven and reliable process providing energy source from biogas. It is a maintenance-free, low cost and rugged process with a straightforward design. Paques B.V., Biothane Veolia Water Technologies, Royal Haskoning DHV, Colsen B.V, ATO B.V are among other Dutch companies that designed and constructed UASB and developed patents, such as Biothane UASB and BIOPAQ UASB. It is a promising well-proven and reliable technology for use in Morocco due to the country's high temperatures, reduced need for maintenance and the low cost of energy recovery as biogas.

Figure 25: Examples of Configurations of Treatment Plant with UASB Reactor and different Post-Treatment Process

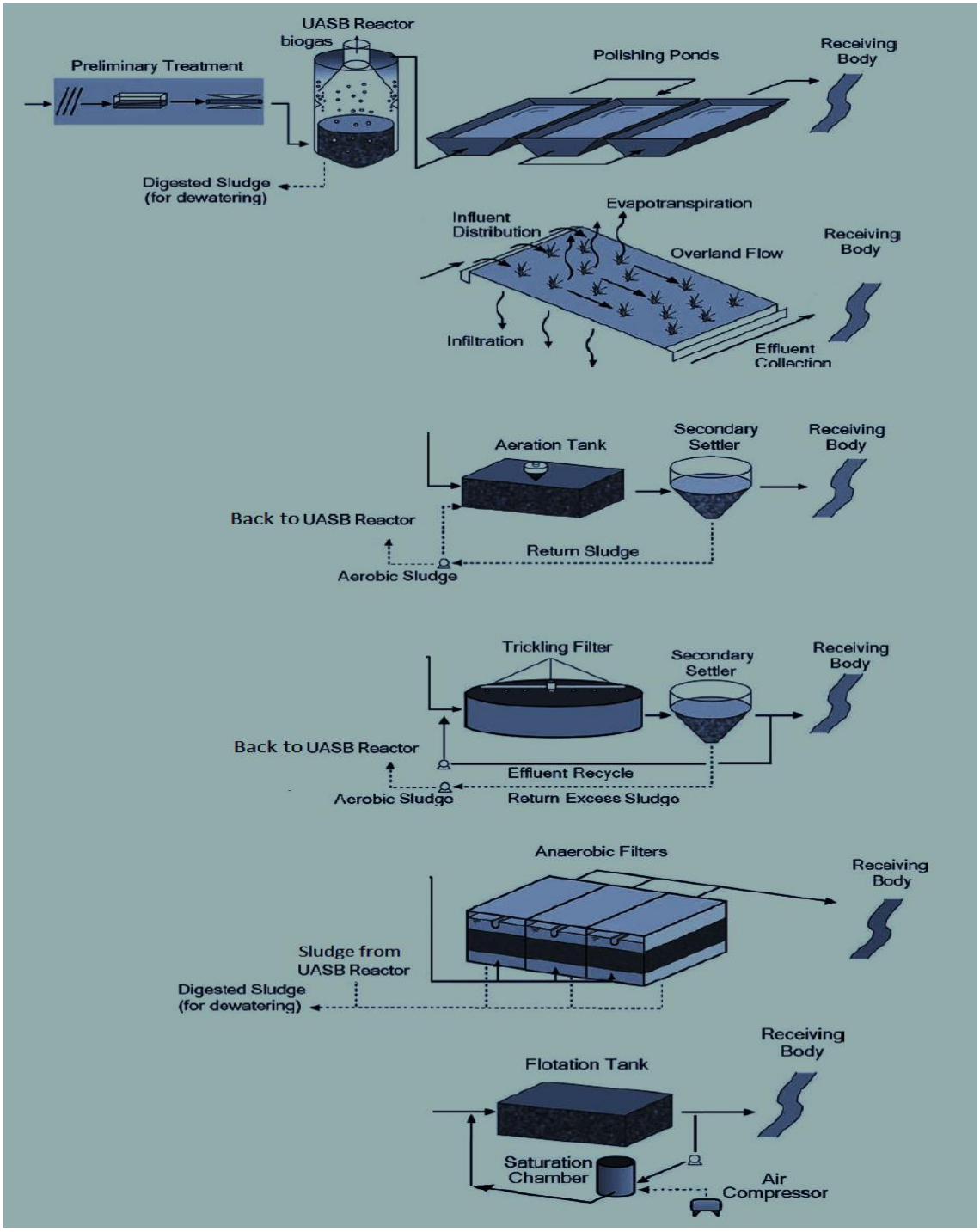


Table 21: SWOT Analysis for UASB Technology Application in Morocco Context

Strengths	Opportunities
• Up to 90% saving in operational cost (compared to aerobic treatment) • No aeration is needed • No mechanical mixing • Less investment costs as less units needed	• High potential of self-sufficient plant regarding energy requirements

• Energy recovery as biogas (CH4) • No high-tech equipment except for pumps and fine screens • Robust and can handle shock hydraulic and organic loading • Compact and suitable for urban area • Small scale applications allow decentralised treatment, so it saves on the sewerage network costs • Low sludge production with high quality, so it saves on sludge treatment costs • Effectively removes Helminth's eggs from the influent, allows effluents agricultural reuse • Removal efficiencies for COD, BOD and SS reached 70-80%, 75-85%, and 70- 80%, respectively • Microorganisms can naturally form granules, which enhance the settling quality and prevent biomass washout from the reactor • Applied to high-strength industrial wastewaters and for digesting the primary and secondary sludge produced by conventional aerobic biological • However, there are some full-scale applications treating municipal wastewaters in tropical regions • systems in municipal wastewater treatment plants	• Successfully implemented all over the world and in developing countries • Nutrients (N,P) are conserved in the treated wastewater with a high potential for crop fertigation • Great economical potential for nutrient recovery in the future • Successful full-scale applications where recognised in warm and tropical countries rather than at low temperatures • Nitrogen in the effluent can be treated autotrophically via combined partial nitritation / anammox[12] (PN/A) with significant savings in terms of aeration costs, sludge production and external organic carbon source
Weaknesses	**Threats**
• Potential odour problems • Long start up • Post treatment is required to meet effluent standards	• Lack of direct nutrient removal capability (Post treatment is required) • Special care must be taken with the pre-treatment units as they determine reactor stability and long-term performance successes

5.4.2 Nutrient Removal Technologies

a) Biological Nitrogen removal innovative technologies

Innovative nitrogen removal mainly focuses on treatment of side streams or sludge digester effluents at municipal wastewater treatment plants and can also be applied to treatment of other concentrated nitrogen containing, with low carbon / nitrogen ratio wastewaters, such as industrial effluents, leachate or effluents from anaerobic digesters in general. *Dutch Companies Experience*[13]: The following paragraph summarises the state-of-the-art of the most recent advances in biological nitrogen removal applied in the Netherlands.

Paques B.V developed the SHARON/ANAMMOX® process; one of the first innovative nitrogen removal systems. It was applied in Rotterdam, the Netherlands[14]. Since 2006, Paques B.V. has been designing granular reactors as one-stage implementations, with the majority of their systems applied for industrial wastewater treatment. As the technology kept performing well over time, this bioreactor

[12] Anammox is an abbreviation for anaerobic ammonium oxidation. It is a globally important microbial process of the nitrogen cycle

[13] These differ in terms of the method to grow and retain anammox bacteria, number of stages, configuration, control strategies, and include granular sludge blanket reactors (GSBRs), suspended growth sequencing batch reactors (SBRs), moving bed biofilm reactors (MBBRs), and rotating biological contactors (RBCs).

[14] Where ANAMMOX® is realised as a granular sludge bed in two reactor compartments on top of each other. After 3.5 years of start-up, the second stage converted 90–95% of the nitrogen load of more than 10 kg m−3 d−1

has been used to seed other wastewater treatment plants, from the United Kingdom to China, and the biomass was used to start the largest anammox reactor in the world. While the premier full-scale application of SHARON/ANAMMOX ® technology was in Dokhaven WWTP, Rotterdam, NL.

Figure 27: A) Sludge Treatment facilities in Dokhaven WWTP, B) View on Anammox, and C) SHARON Reactors

Photo: Waterschap Hollandse Delta

b) Oxygen-limited Autotrophic Nitrification-denitrification (OLAND)

This configuration keeps operational costs low but process control flexibility is limited. DeSah B.V designed and implemented a decentralised implementation of OLAND in DeSah B.V building in Sneek NL on a small scale. Advanced Wastewater Solutions B.V.- ENVAQUA developed the technology for full-scale treatment of wastewater from the fertiliser production industry of nitrogen load up to 150 kg-N d^{-1}.

c) DEMON® Technology

The Sequencing batch reactor technology DEMON® was operated on a digester in the side-stream in Amersfoort WWTP for nitrogen removal only. In 2017, Amersfoort Wastewater Treatment Plant (WWTP) was transformed into an Energy and Nutrient Recovery Factory to allow both phosphorous and nitrogen to be recovered to create a high-value fertiliser product from an existing resource, with a process that is both environmentally and economically viable, thereby promoting the circular economy. The facility was designed and constructed by the Dutch company, Eliquo Water & Energy in 2013. Besides the DEMON technology, three advanced technologies have been combined for the first time worldwide. These are:

- The LysoTherm® by Dutch-based Eliquo Water & Energy which allows for an efficient, low cost and higher biogas recovery;
- Wasstrip ® for phosphorus removal; and
- Pearl reactor by Ostara Nutrient Recovery Technologies Inc-Vancouver, Canada to produce a "ready to use" fertiliser product, sold as Crystal Green®.

Figure 28: Energy and Nutrient factory at Amersfoort WWTP in The Netherlands

Source: L Kox, B Geraats Publication Date (Web): 16 March 2016 DOI: https://doi.org/10.21139/wej.2016.011)

Activated sludge systems in Morocco have been successfully used for carbon removal, but better effluent quality, especially with regard to nitrogen, is needed to be in accordance with effluent standards in both existing and expected new facilities. The benefits of DEMON technology can be summarised as:

- Energy savings: aeration energy needed for the process is about 55-60%;
- No extra carbon is needed for nitrogen removal;
- Greenhouse effects - the process is a net consumer of CO_2, compared to heterotrophic bacteria;

- Alkalinity demand for nitrogen removal is reduced by about 45%;
- The process sludge production is much reduced;
- Suitable for anaerobically-digested industrial wastewater of industries like olive oil.

d) Phosphorus removal Innovative Technologies

The Moroccan market is mostly concerned with the removal of phosphorus in case of discharging the effluent of wastewater treatment plants to avoid eutrophication, as currently the activated sludge systems are only for COD removal. However, the concept of phosphorus recovery is less likely to be on the agenda. Phosphorus is abundant in Morocco and its production is one of Morocco's main industries and exports. Retrofitting of existing treatment plants for phosphorus removal or taking this in consideration in new plants can be more within the scope of Moroccan markets, rather than the relatively expensive recovery.

e) BCFS® Process[15]

The BCFS process was developed to optimise the activity of denitrifying and P-removing bacteria. BCFS was developed at the University of Delft and has since been implemented in the Netherlands in a number of full-scale installations (e.g. Hardenberg WWTP). Royal Haskoning DHV is one of the leading Dutch companies in the design and construction of BCFS. One of the earliest full-scale installations was in Hardenberg WWTP, one of seven WWTPs managed by the Dutch water board ''Groot Salland", where the treatment facility was upgraded for P-removal using BCFS, avoiding much construction work for cost reduction. Deventer WWTP[16], also managed by "Groot Salland", was built as a BCFS process.

[15] The BCFS® Process (a Dutch acronym for biological-chemical phosphorus and nitrogen removal). In this technology in combination with optimal operating conditions for biological nitrogen removal, chemical precipitation of phosphorus is used to ensure compliance with effluent standards regarding phosphorus.
[16] Instead of using iron chloride salts for chemical stripping of phosphorus, calcium salts were used instead for the sake of phosphorus recovery which added some cost but seemed beneficial for allowing recovery of phosphorus

Figure 29: BCFS® Process at Deventer WWTP

Source: Waterschap Groot Salland 2009

Retrofitting and upgrading of existing activated sludge facilities for phosphorus removal to meet the discharge standards can be achieved by incorporating BCFS process to avoid much construction works.

5.4.3 Sludge Treatment

For several reasons, such as reliability, simplicity and yield, the activated sludge process is the most widely used for biological wastewater treatment in the world, but it results in the generation of a considerable amount of excess sludge that has to be disposed of. The sludge is treated as required for utilisation or disposal, and additional treatment of effluent may be needed to accommodate specific water reuse opportunities.

The disposal of excess sludge is one of the most serious challenges in biological wastewater treatment, for two main reasons: (1) New wastewater treatment regulations are causing a rise in the number of plants. This increase in the number of WWTPs is translated into a higher production of sewage sludge. (2) Sludge disposal routes such as incineration or landfilling are being subjected to more stringent environmental quality requirements.

a) Sludge Management for use in Agriculture

Reuse in agriculture has become the principal disposal method for treated sewage sludge (biosolids). This provides the nutrients and micronutrients (such as N, P, K but also Fe, B, Cu and Ni, among others) necessary for plant and crop growth. The use of sludge in agriculture also enhances the organic content of soils, increases the water holding capacity, the soil aggregation, reduces the soil bulk density, increases the cation exchange capacity, and enhances the plant root environment. Plants are, therefore, better able to withstand drought conditions, extract water and utilise nutrients. The solids resulting from wastewater treatment must undergo further treatment prior to land application. Land application of biosolids requires the disinfection and stabilisation of biosolids. The objective is to:

- Reduce or even completely eliminate the presence of pathogens (specifically thermal and chemical treatments, but also biological treatments reaching thermophilic temperatures);
- Stabilise the organic matter producing products that would not decompose very rapidly;
- Minimise generation of offensive odours;
- Reduce the moisture content and, therefore, improve its storage capacity and reduce its volume and transportation costs; and
- Partially eliminate several organic pollutants and emerging contaminants.

b) Conventional Sludge Management

Sludge treatment aimed at minimising the negative impacts of sludge direct soil application is a key step in sludge management schemes (Figure 8), with such treatments including: "thickening", "dewatering", "conditioning" "drying".

- *Thickening*: Sludge thickening produces a concentrated product that essentially retains the properties of a liquid. Gravity thickening, or concentration by simple sedimentation, is the thickening process most commonly applied to municipal sludge. The product of gravity sludge thickening often contains 5 to 6% solid material by weight. Alternatives to gravity thickening include flotation thickening (in which a gas is incorporated with sludge solids, causing them to float), as well as the use of gravity drainage belts, perforated rotating drums and centrifuges.
- *Dewatering*: Sludge dewatering processes produce material with the properties of a solid, even though the dewatered sludge is still mostly water. Dewatered sludge can be transported in a dump truck, whereas a tank truck is required to transport thickened sludge. Dewatering may be accomplished on sand drying beds and, occasionally, in lagoons, where gravity drainage and evaporation removes moisture. More often, larger municipal installations use mechanical means for dewatering sludge. Mechanical sludge dewatering equipment includes filter presses, belt filter presses, vacuum filters, and centrifuges. The solids content of mechanically dewatered sludge typically ranges from 20 to 45% solids by weight; most processes produce concentrations of solids at the lower end of that range.
- *Conditioning*: Sludge conditioning processes do not, in and of themselves, reduce the water content of sludge. Conditioning alters the physical properties of sludge solids to facilitate the release of water in dewatering processes. Indeed, the mechanical dewatering techniques discussed in the previous paragraph would not be economical without prior sludge conditioning. Chemical and, less frequently, physical techniques are used to condition sludge. Chemical conditioning most commonly involves adding synthetic organic polyelectrolytes (or "polymers") to sludge prior to dewatering. Inorganic chemicals (most commonly, ferric chloride and lime) can also be used. Inorganic chemical conditioning dosages are large and increase the mass of the solid phase of sludge. Physical conditioning techniques include heat treatment and freeze & thaw treatment.
- *Drying*: If circumstances justify removal of water beyond that achievable by dewatering processes, drying is needed. Thermal drying with direct or indirect dryers is used to achieve near-complete removal of water from sludge. Solar drying is feasible in some locations. Partial drying also results from heat produced in biochemical reactions during composting and from other chemical reactions described in the stabilisation processes below.

c) Stabilisation Processes

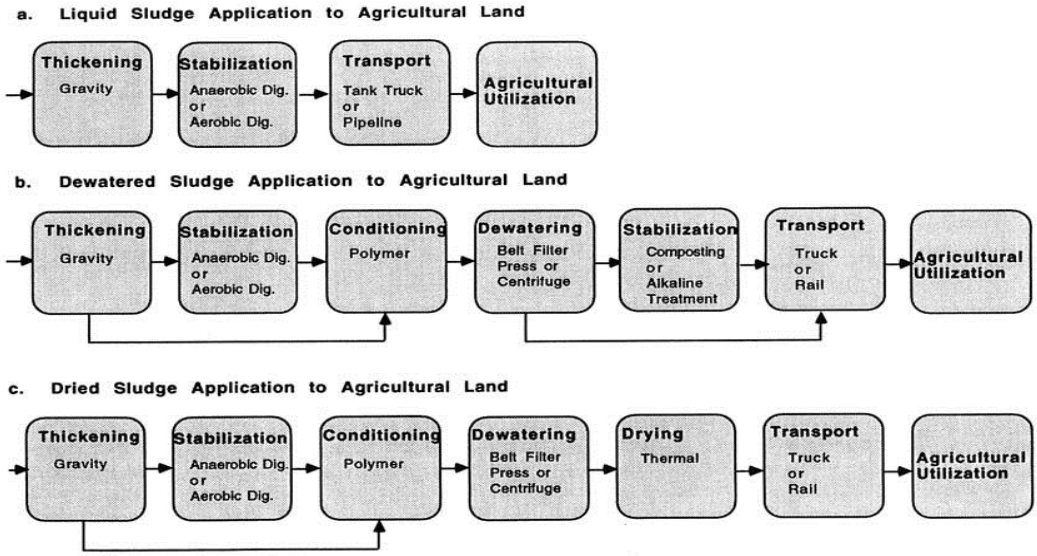
The purpose of sludge stabilisation is to minimise subsequent complications due to biodegradation of organic compounds. It leads to appreciable inactivation of pathogenic organisms and viruses Stabilisation is usually accomplished by biological or chemical treatment processes, as described

below. Stabilisation can also be achieved by drying sludge adequately or sludge combustion to impede microbial activity.

In biological stabilisation processes, the organic content of sludge is reduced by biological degradation in controlled, engineered processes. Most commonly, domestic wastewater sludge is biologically stabilised as a liquid in anaerobic digesters from which methane gas is a by-product. Liquid sludge can also be biologically stabilised in aerobic digesters to which oxygen (or air) must be added. Composting is a process that biologically stabilises dewatered sludge.

Chemical stabilisation of sludge is aimed not at reducing the quantity of biodegradable organic matter, but at creating conditions that inhibit microorganisms in order to retard the degradation of organic materials and prevent odours. The most common chemical stabilisation procedure is to raise the pH of sludge using lime or other alkaline material, such as cement kiln dust.

Figure 30: Conventional Sludge Management Schemes



A basic objective of sludge treatment is to reduce volume. This can be achieved by reducing the water and organic matter content. A higher objective is to reduce volume and use the organic matter of sludge for energy recovery. The most effective and innovative technologies for energy recovery are further discussed.

d) Innovative Energy Recovery from Sludge as Biogas

1. Advanced thermal / high pressure pre-treatment + anaerobic digestion[17]:

The introduction of a pre-treatment process prior to anaerobic digestion is now one of the most profitable and interesting options for optimising the sludge digestion and subsequent wastewater treatment plant energy balance. Anaerobic digestion is one of the oldest and still most commonly used processes for sludge stabilisation. Concentrated organic and inorganic sludge matter is decomposed microbiologically in the absence of oxygen and converted to methane and inorganic end products. The main benefits from digestion are the stabilisation of sewage sludge, volume reduction and biogas

[17] Advanced thermal / high pressure pre-treatments lead to partial solubilisation of sludge, with the main mechanism in such cases assumed to be enzymatic hydrolysis, and are implemented to enhance energy recovery in anaerobic digestion processes. This way, full energy integration can be achieved in thermal hydrolysis plants with a complete energy recovery and self-sufficiency.

production. Biogas is renewable energy. A combined heat and power plant (CHP) unit uses the biogas to produce electrical energy and heat which can be used to heat the sludge that is fed to digestion, to heat the operation building, and dry the sludge. If a district heating system exists, it is also possible to sell the heat to a nearby heat supplier. Additional advantages of thermal treatments include:

- Sludge sanitation (i.e. produced sludge disinfection is Class A) as no pathogen regrowth and suitable for agricultural application;
- Reduction of sludge viscosity with subsequent enhancement of sludge handling;
- No odour and no foam formation in subsequent anaerobic process;
- Very good dewaterability of the final sludge; and
- No extra energy needs, since energy requirements can be covered by excess biogas production and the energy balance is positive.

Potential in Morocco: Solar drying could be used in combination with bio-drying in Morocco to minimise the overall cost of this energy-consuming technology. Nitrogen can be recovered and sold as a fertiliser, while bio-dried sludge can be co-incinerated with coal in the coal-driven power plants.

Dutch Companies Experience: There are several commercial thermal / high pressure pre-treatment processes innovated in the Netherlands, with different operation schemes as Lysotherm® (by ELIQUO Water & Energy BV) and Turbotec® (by Sustec BV). The full-scale application of Lysotherm® technology was implemented in Amersfoort WWTP in the Netherlands and combined with the production of fertilisers. According to Eliquo, the LysoTherm process can increase biogas production by up to 50%.

2. As biomass fuel (Mechanical dewatering + Bio-drying / Solar drying):

Another alternative for energy recovery is mechanical dewatering that can be further enhanced by bio-drying of sewage sludge which is an innovative first developed in the Netherlands. The heat produced by the bacteria is used to remove water from the sludge at the lowest possible residence time and minimal carbon biodegradation, hence increased energy content that can be used to produce steam and / or power if combusted, reducing fossil fuel requirements and contributing positively to the prevention of climate change.

Dutch Companies Experience: GMB BioEnergie B.V. has one successfully running full-scale bio-drying installation present in Zutphen, The Netherlands treating 150 ktons/year of dewatered sewage sludge, and also has a second bio-drying plant in Tiel, the Netherlands, treating 80 ktons sludge per year. In both facilities, the stiff sewage sludge is mixed with previously composted sludge as well as wood chips, after which the mixture is driven into large concrete tunnels. By blowing oxygen-rich air through these tunnels, the number of bacteria in the sludge grows and the temperature rises to seventy degrees, after which the mass composites and nitrogens are released in the form of ammonia. A large air-cleaning installation recovers this ammonia from the air. The ammonia is then converted into ammonium sulphate; a nitrogen fertiliser that is sold to Dutch agriculture. The tunnels are driven empty and the bio-dried sludge is being transported to various power plants, which combust the material in their coal-fired plants and thus save a lot on fossil fuels.

Figure 31: Wastewater and Sludge Processing Facilities in Zutphen

Source: http://www.installatieenbouw.nl/wat-gebeurt-er-met-de-reststromen-uit-onze-waterzuiveringen

There is a clear economic advantage of a thermal pre-treatment. When the capacity of the WWTP needs to be increased, the balance is clearly positive towards the thermal pre-treatment. Sludge management in Morocco is a big challenge, as it is non-existent so far and it needs a lot of investment. By applying thermal pre-treatment combined with anaerobic digestion of sludge in the WWTP, it can produce energy from biogas to be self-sufficient, besides the economic advantage of fertilisers production.

Land application is considered the most sustainable alternative. However, the latest trends in the field of sludge management, i.e. wet oxidation, pyrolysis, gasification and co-combustion of sewage sludge with other materials for further use as energy source, have generated significant research interest as well. Only the widespread and well-proven technologies are considered in this report.

In fact, an interesting option for improving methane yields in WWTPs is Anaerobic co-Digestion (AcoD) of sludge and other organic waste like the organic fraction of municipal solid waste (OFMSW), food waste (FW), fat oil and grease, agro-waste and others. The main aim of the approach is to improve biogas production and energy recovery up to levels similar to those of the energy demand of the WWTP. While doing so, the WWTP becomes a local centre for waste disposal.

Dutch Companies Experience: There are more than 30 co-digestion plants operational in the Netherlands combining manure and organic waste to sewage sludge. WWTP Apeldoorn, Veluwe Water board is an example where co-digestion of organic industrial waste at the sludge digester of WWTP Apeldoorn generated 60 million m^3 of biogas per year resulted in an increase in energy production and the WWTP is self-sufficient regarding energy for both electricity and heat

Potential in Morocco: Co-digestion of external wastes is applicable at many WWTP. Most WWTP with digesters can be rather easily extended with this process. The energy production is very much dependent on quality of the waste. Overall economics depend on the availability and biodegradability of the external wastes and its costs, (over)capacity of the WWTP of for N-removal, distance of houses and buildings for heat deliverance. Moroccan olive oil industries producing organic industrial waste, fat oil and grease and agro-waste such as olive oil industry waste creates a great opportunity for this application in Morocco.

6 Business Opportunities

6.1 Business Opportunities Overview and Recommendations

This section presents an overview of the business opportunities in Morocco's waste water sector relevant for the Dutch private sector. There are a number of opportunities and projects in the next 3 years i.e. 2018 to 2020, that could be of interest for the Dutch private sector. We discuss those opportunities and projects below. There are three criteria applied to establishing which business opportunities are relevant:

1) Link to the national wastewater plan for 2018 to 2020. There is a list provided of all domestic wastewater treatment plants to be implemented in the next two years. Only WWTPs relevant to the Dutch technologies are presented;
2) Link to industrial wastewater opportunities were also analysed based on: the new environmental regulations; developments in industrial zones; and international experience best practices in this field. Industrial wastewater treatment does not fall under the responsibility of ONEE nor the Régies. Every industry has the responsibility to treat its wastewater before discharging it into the environment, so the potential of this sector was assessed and presented in this BOR. This assessment was matched to the locations of various proposed industrial zones and the types of industries set to be established there. Consideration was also given to the NWRP priorities and information provided by ministry of industry (http://www.zonesindustrielles.ma/map/?lang=fr). It is important to note that the industrial waste management is a relatively new business area in Morocco. The industrial parks started to be filled in 2010, with to date some of the parks achieving a more than 60% occupation rate. They are fully operated by the private sector in terms of supplying basic infrastructure, such as water, road, and electricity. There is no enforcement of industrial waste management regulations in these parks; and
3) Relevance to the needs of the local market as defined by various relevant national stakeholders, such as ONEE, during the interviews. In defining these opportunities, deference was also paid to the suggestions of Dutch organisations and / or companies with experience in Morocco, e.g. Waternet.

In the Rif region, which extends from the Loukkos basin and part of Moulouya basin, three business opportunities have been identified i.e. investment in knowledge centres, sludge management and domestic wastewater treatment plants. Industries have potential for reuse of wastewater. Details on these opportunities follow below.

There are two domestic WWTPs planned for the Sebou basin and there is potential for reuse in industries and agriculture. In the Um ArRbia basin, there is one domestic wastewater plant planned and a potiential market for industrial wastewater treatment and reuse for the industrial parks (most of the industrial zones are located in the Um ArRbia and Boureger Basins). The Tensift Basin has potential for waste water reuse on golf courses, irrigation and landscaping. Four domestic wastewater plants are planned in the Souss Massa basin for the coming 3 years. Potential reuse, according to the National Water Resources Plan (NWRP), exists in agriculture and landscaping. In Sud Atlas, one WWTP is planned, but there is little chance for reuse in agriculture activities.

6.2 Summary of Business Opportunities or Dutch Intervention

Table 22: Potential areas for Dutch intervention in Wastewater market in Morocco

Intervention	Type of intervention	Relevant Dutch partners
Building New wastewater treatment plants on basis of tendering options: (1) Built (according to existing design document), (2) Design-Build, (3) Design-Built-Operate. It is expected that the tree options will be present in the coming programme	Supply, BOT	Business
Industrial wastewater treatment plants for industrial zones	BOT (build operate, transfer) Technical assistance	Business Government
Rehabilitation and expansion of existing wastewater treatment plants on basis of the same tendering options mentioned above	Construction	Business
Technical assistance for construction works supervision and coordination	Consultancy service	Business
Consultancy and technical studies opportunities	Consultancy service	Business
Sludge management technical support, provide master planning and technology supply (ref. chapter below)		Business / knowledge institutes and government
Contracts Management for Operation & Maintenance of urban sewage wastewater operations and maintenance in major cities	Operation	Business
Contributing in reuse of treated wastewater projects (ref. chapter below)	Construction	Business
Rehabilitation of existing outdated drainage system and introduction of new solutions and technologies for rainwater harvesting	Construction	Business
Technical assistance in procurement system modernisation, capacity building in preparing tender document for BOT, DBO projects and prequalification process	Technical support	Government
Technical assistance in regulatory framework establishment, institutional reform and modernisation of wastewater sector	Technical assistance	Government
Training centre for wastewater technical capacity in all level to support Moroccan knowledge exportation in the region	Technical assistance	Government and knowledge institutes
Master planning at city level	Technical assistance	Government

6.3 Three detailed three Business Opportunities

6.3.1 Bidding for Domestic WWTPs Construction Programme

Within the framework of the PNA (National wastewater Plan), ONEE and the Autonomous municipal utilities (Régies) are planning the construction or expansion of 34 WWTPs. The total value of investments in wastewater treatments plants from various financiers, i.e. international financing institutions, local banks, utilities funds, national budget (PNA subsidy), for the 2018 – 2020 period is estimated to be approximately EUR 300 million. The treatment technologies expected for programme for the next 2 years are as follows:

Table 23: List of Domestic Wastewater Projects for the next two years

WWTP technology	Number of WWTPs	Capacity (m3/d)	Cost (MDH)
Activated Sludge	5	172,200	1,638
Aerated lagoons	14	49,489	640
Natural lagoons	9	7,239	415
Pre-treatment + marine outfall	1	354,000	440
Trickling filter	5	21,425	352
Total	**34**	**604,353**	**3,485**

Source: PNA

Table 24: ONEE Planned Projects

Cities	Population	Projects components	Cost (Million DH)	Capacity (m^3/d)	WWTP technology
Bni Ansar	56,582	Bni Ansar city + Atalayoune touristic area	128	7,000	Activated sludge
Lqliaa	83,235	WWTP for towns of Lqliaa and Temsia	280	10,000	Activated sludge
Imouzzer Kandar	19,125	Sewerage + WWTP	73	7,511	Trickling filter
Taghazout	5,260	WWTP in Touristic area	18	1,092	Trickling filter
Ribate El Kheir	16,739	WWTP	26	1,500	Trickling filter
Ksar Sghir	12,997	Sewerage + WWTP	125	2,322	Trickling filter
Total	**193,938**	**-**	**650**	**29,425**	

Table 25: Régies Planned Projects

Cities	Operator	Cost (MDH)	Capacity (m3/d)	WWTP technology
Safi	RADEES	400	57,800	Activated sludge
Nouacer	LYDEC (private concession of Casablanca)	210	28,500	Activated sludge
Larache	RADEEL	180	15,000	Activated sludge
Ksar Kebir	RADEEL	110	9,000	Trickling filter
Salé	REDAL (private concession of Rabat)	440	354,000	Pre-treatment + marine outfall
TOTAL		**1,340**	**464,300**	

6.3.1.1 Recommendations

For WWTP construction projects, Dutch companies can bid for the different projects to be opened for tender in the coming two years. The advice is for Dutch companies to bid only for projects that require use of complex technologies or projects that require high added value, such as activated sludge and trickling filter WWTPs. Wastewater treatment using lagoons can be addressed by the domestic private sector, which has a wealth of experience and a comparative advantage over international companies.

Projects for the coming 3 years 2018-2020 could be a test for the Dutch private sector to get involved in the Moroccan wastewater sector and to become familiarised with how to do business in Morocco. The Moroccan wastewater market offers an excellent opportunity for small- to medium-sized Dutch

companies active or interested in starting business in the Middle East and North Africa (MENA) region. It is assumed that reuse business opportunities for the coming years (2018-2020) will be linked to the WWTPs construction programme mentioned above and, since the Netherlands is a pioneer in this field with so many technologies successfully implemented in full scale, Dutch companies would have a competitive advantage in reuse in Morocco's wastewater market.

Table 26: Linking the proposed projects to possible Relevant Dutch companies

Biding for Domestic WWTPs construction programme			
6 activated sludge WWTPs and 5 Trickling filters			
Possible business partners	**Technology providers** Paques Nijhuis Industry Sweco COLUBRIS (Now Redox) Landustrie Sneek Colsen	**Consultants** Royal HaskoningDHV ARCADIS Nederlands Mott Macdonald Columbus	**Operators** Sweco Bluetech Royal HaskoningDHV
Total estimated fund	EUR 200 million		
Time framework	2018-2020 tendering		
How to apply?	https://www.marchespublics.gov.ma/index.php5?page=entreprise.EntrepriseAdvancedSearch&searchAnnCons=&keyWord=water&lang=fr http://www.tendersinfo.com/searchresult#		

6.3.1.2 Relevant Tenders

Between 2018 and 2020 6 activated sludge WWTPs and 5 trickling filters will be tendered. The total investment cost for the 11 WWTPs is EUR 200 million, with a total treatment capacity of 193,000 m^3/day. All public tenders are announced on the Moroccan public tenders' gateway. (https://www.marchespublics.gov.ma/index.php5?page=entreprise.EntrepriseAdvancedSearch&searchAnnCons=&keyWord=water&lang=fr).

The website is available in Arabic and French. It offers a detailed guide on how to register as a company and apply for tenders. The tenders that are still open can also be found in English on the global procurement facilitator website http://www.tendersinfo.com/searchresult#

The financial and contractual model applied in Morocco now is BOT. The private sector carries the investment cost and gets the investment back from the government over 10 years. The monthly payments from the government consist of two parts: a fixed fee (the payback of the investment) and a variable fee based on performance indicators (quality and quantity of treated sewer effluent).

The awarded company would also implement a Treated Sewer Effluent (TSE) network to connect the treated effluent to its potential clients (reuse agreements would be signed). The users contribute to the investment costs of the TSE according to the anticipated demand. Once it's operational, the private sector is responsible for the operation and maintenance costs, and collect fees from users in two ways:

- *Wastewater collection fees*: Urban tariffs are differentiated by locality with average sewer connection tariff ranging from EUR 0.15 to 0.27 per m^3. It is sometimes linked to water supply consumption as percentage fees. In general, the level of urban water tariffs is high compared to other countries in the Middle East and North Africa.
- *Treated wastewater reuse fees*: From a previous project, the private companies sell treated wastewater to golf courses for irrigation at a fee of 2.5 DH per m^3 (€0.25/ m^3). The operational cost

for wastewater treatment depends on the use of technology, effluent quality to meet reuse standards and the size of the treatment plants. The average cost of treatment of 1 m^3 is MAD 1.8 (EUR 0.18/ m^3)

Potential Reuse (Clients): There is a good opportunity to sell the treated wastewater to the paper and textile industries. They require significant steady water input. In addition, the water quality for paper and textile industries can be easily achieved with minimum additional costs. On the other hand, the industries would enjoy steady flow and won't be subject to drought and fresh water supply shortage. This model has been implemented successfully in South Africa. Two Dutch companies have initiated a wastewater treatment and reuse project. They also communicated with the municipality of Durban, the industries and banks, by applying the Dutch diamond model in communication and advanced technologies to meet the client standards. The project has been running for over 10 years now as BOT. The company received financing from private banks and it is being serviced by the municipality of Durban and the users (Paper Industries). A similar approach can be applied in Morocco. Waternet can play a significant role in technical assistance in transferring knowledge and applying the Dutch Diamond model

Alternatively, there is big demand from golf courses for treated wastewater. Waterleau sells most of its treated water to golf courses and the reimbursement is almost the same as the price per litre for fresh water. Waterleau is in the process of expanding its TSE to increase its selling capacity.

6.3.2 Sludge Treatment, Disposal and Valorisation.

Further improvement of wastewater and sludge management is expected in the near future, especially in the field of sludge treatment and disposal (valorisation). Sludge treatment, disposal and valorisation provide a good entry opportunity for Dutch businesses. In fact, scale demonstration project(s) can be negotiated with the Moroccan authorities. Dutch public and / or private institutions can support Moroccan partners lead in sludge management, with an example being the sludge treatment at AL Houceima wastewater treatment plant. Al Houceima city is located in the north of Morocco on the Mediterranean Sea. Wastewater service is run by ONEE on behalf of the municipality (management agreement signed in 2004 between ONEE and the Municipality). Al Houceima is equipped with a centralised wastewater treatment plant; the features and characteristics of this WWTP are as follows:

- Type: Activated sludge at low load;
- Horizon: 2025;
- Capacity: 130,000 inhabitants;
- Nominal flow: 9,600 m^3 / d; and
- Organic load: 3,800 kg BOD5 / d.

Figure 34: Al Houceima WWTP

The performance indicators of the wastewater treatment plant are shown in Table 26 below.

Table 27: Perormance Indicators Al Houceima WWTP

	Influent	**Effluent**	**Efficiency**
Organic pollution (BOD_5)	400 mg/l	25 mg/l	92%
Organic pollution (COD)	1,050 mg/l	90 mg/l	91%
Suspended solids (SS)	450 mg/l	35 mg/l	92%
Bacteriological Pollution (Faecal Coliforms, FC)	107 FC/100 ml	102 FC/100 ml	99.99%

Al Houceima's WWTP Sludge treatment line starts with thickening and then dehydration by centrifugation. This process generates 20% of dry solids. The daily production of sludge averages about 20T / d. Liming sludge was initially expected, but not applied at the moment. The complementary sludge treatment needed for AL Houceima is solar drying and valorisation. Solar drying ensures that dry solids in the sludge increases to over 70%. This is very important for optimising transport and storage, and for any sludge valorisation and reuse. The main option for valorisation preferred by ONEE is "Production of topsoil from the mixture of sludge and mineral soil. The main final uses are: the landfills abandoned quarries sites rehabilitation and restoration of green spaces".

Proposal

- Demonstration project of sludge treatment and valorisation at Al Houceima.
- Using the local demonstration project for institutional support of Moroccan authorities for sludge management (to be scaled up at the national level):
    - Involvement of relevant stakeholders: at local level: ONEE, Al Houceima Municipality, Agriculture department, forestry department. At central level: Ministry of Interior, Environment department.
    - Capacity building: of the main stakeholders.
    - Institutional support: agreements elaboration, sludge treatment/valorisation guidelines and manuals, etc.
- The main counterpart: ONEE (and ministry of interior, DEA, Municipality of Al Houceima).
- The beneficiary: Al Houceima city (direct beneficiary), and other stakeholders of the sector.
- Estimated cost for the demonstration project is approximately 25 million DH (Moroccan dirham).

Table 28: Al Houceima possible links to Dutch partners

Theme	Possible Dutch Partner
Possible business partners	• Nijhuis Industry • Sweco • COLUBRIS (Now Redox) • Landustrie Sneek • Colsen
Knowledge institutions	• TU Delft • Wetsus • ECN
Possible funding opportunities:	• FMO • The Dutch Good Growth Fund • Sustainable Water Fund (FDW) • Development Related Infrastructure Investment Vehicle (DRIVE)

6.3.3 Training Centre for Wastewater Management Capacity Building

Morocco is perfectly located in North Africa, where it has the potential to export knowledge to African and Middle Eastern countries. It has been stated in diverse literature and development cooperation reports that the MENA region is lagging behind in the necessary skills and capacity in the field of wastewater engineering and management. At the same time, ONEE has made successful steps in playing a role in building capacity in other African countries. Speaking Arabic, the official language of MENA region countries, adds to the potential for exporting skilled labour from Morocco to the region.

If implemented, a training centre would bring employment opportunities to a wide range of the Moroccan young population by building qualifications that are in demand in the whole region and contribute to economic growth, while solving capacity shortage in other countries in the region. Furthermore, it offers a golden opportunity for market penetration for Dutch knowledge and business in Moroccan market.

The sector suffered from decades of under-investment, poor operations and maintenance. Newly-constructed plants and networks were often of sub-standard quality. These critical constraints were compounded at the operational level by fundamental issues affecting sustainability:

- Limited wastewater handling;
- Limited disposal capacity; and
- Poor cost recovery.

Furthermore, ONEE faced severe organisational and staffing constraints. The sector tried to solve the problem by outsourcing operational and maintenance works to foreign companies, but this is so far unsustainable and there is a major need to shift to locally-hired private companies or personnel to promote better financial management. On the other hand, ONEE, as a commercially-oriented company, requires a new generation of managers who understand all aspects of the water and wastewater business, as well as the company's vision of a customer-oriented and financially accountable service provider.

The specific objective is to assist ONEE in effectively training and hiring technicians supporting the operation and maintenance in the wastewater sector. As the organisation is responsible for the provision of water and wastewater services, it has made significant investments in sector infrastructure in the past and acknowledged that equal investments must be made in human resources to manage and preserve those investments. This can be done by introducing Dutch expertise in

capacity building and providing tailored vocational training to supply workforce to both private and public sector in sanitary affairs. That includes development of curricula, research and advice on identifying training needs.

This promising initiative supports operators training and certification programmes (Phase I) and management training programmes (Phase II) in compliance with ONEE procedures and Moroccan government rules and regulations for developing skilled technicians and professionals.

Available Facilities:
ONEE has its own training centre. The International Institute for Water and the Sanitation – IEA – was created by ONEE with the aim of improving its training plan. http://www.iea.ma/en/message-from-the-director

IEA provides short courses (one to two weeks of training) to employees from ONEE, sanitation professionals from Africa. The facilities include class rooms and a conference room that can be used for the pilot project. Once the pilot phase proves the feasibility, the expansion, through construction of physical training centre facilities, can be discussed with ONEE.

Proposal

- Pilot project on development of technical and vocational training centres in sanitary section in Phase I and managerial skills training centres in Phase II.
- Project Phase I will combine intensive training with purchase of equipment and user-friendly maintenance management software to improve plant operations, address the gaps identified in the plant assessments. The training will be a combination of classroom training and facility visits covering all technologies and processes involved in treatment.
- Project Phase II will be a certificate programme developed for managers with the aim of nurturing and retaining promising professionals in the sector. The intensive, interdisciplinary courses, which will be part education and part professional mentoring, will consist of modules covering all aspects of utility operations, as well as field visits and team-based assignments.
- Using the pilot demonstration project for institutional support of Moroccan authorities for capacity building (to be scaled up at the national level): the project team will consolidate its experience with utilities into general manuals for distribution and use nationwide to encourage utility-led replication of the initiative.
    - Involvement of relevant stakeholders: at local level: ONEE, community (Rif region). At partnership level: Dutch companies and institutes with expertise in capacity building.
    - Capacity building: of the main stakeholders.
    - Institutional support: agreements elaboration, certification guidelines, etc.
- The main counterpart: ONEE (and ministry of interior, DEA, Municipality of Al Houceima).
- The beneficiary: Rif region (direct beneficiary) and other stakeholders of the sector.

Table 29: Training, possible Link to Dutch partners

Theme	Possible Dutch Partner
Possible business partners	• Waternet
Knowledge institutions	• IHE UNESCO
Possible funding opportunities:	• Develop2Build (D2B) • Development Related Infrastructure Investment Vehicle (DRIVE) • Netherlands-MENA Partnership (Shiraka)

6.3.4 Industrial Wastewater Treatment Opportunities

Industrial wastewater treatment potential

It is advisable for the Dutch private sector to investigate the newly-established industrial zones for their potential for industrial waste management. Food-processing industries offer a good starting point in view of the volume of water they use and the need for water in their processes. They are clustered in two main areas (The Agropolis in Meknes and the Agro-pole in Burkan in Rif region). In addition, food process industrial effluent has potential for reuse within the industries and in other sectors. In contrast to the chemical industry, which has limitations on reuse due to the high risk of toxic matters, food processing waste water can easily be reused. A feasibility study would be a good starting point to assess the willingness of industries to pay and the industrial park management for a reuse plant for their park.

6.3.5 Opportunities in Reuse Subsector

Morocco is starting a major programme for wastewater reuse for various purposes in various cities, including Marrakesh, Fez, Kenitra, Nador, El Houceima, etc. According to the national wastewater reuse plan the major purposes are: industries, golf courses, public parks, landscaping, agriculture and groundwater recharge.

Only around 12% of the treated sewage effluent is currently reused in a controlled manner (around 38 million m^3/y in 2016) in Morocco while the potential is over 325 million m^3/y (as stated by the water plan, PNE for horizon in 2030).

Table 30: Wastewater Reuse Purposes (volume)

Reuse Purposes	Volume (million m^3/y)
Irrigation (Agriculture)	149
Groundwater recharge	20
Golf courses – Landscaping	139
Industries	17
Total	**325**

The total estimated cost of installation of equipment for complementary treatment and wastewater distribution system is around EUR 720 million, the details according to reuse purposes are given below.

Table 31: Cost of Reuse Installation Equipment (MDH)

Reuse purposes	Complementary treatment	Reuse distribution system	Total
Irrigation (Agriculture)	882	1,505	2,387
Groundwater recharge	460	218	678
Golf courses Landscaping	3.197	1,443	4,640
Industries	-	224	224
Total	**4.539**	**3,389**	**7,928**

Construction of WWTP with reuse systems or upgrading existing system will be one of the highest priorities in the next period, with the main drivers being:

- Water scarcity and high pressure on conventional water resources;

- The water law (2016) eliminating the institutional and regulatory barriers hindering wastewater reuse at wider scale;
- Current discussions at higher level (PNE committee and ministerial committees) to merge the PNA and wastewater reuse plan;
- The first experiences in wastewater reuse for different purposes are encouraging, including examples in Marrakesh (golf courses irrigation), Khouribga and Benguerir (Phosphate industry), etc.

6.4 Government to Government Technical Assistance

The business opportunities listed above could be complimented by several technical assistance programmes. It is advisable, from an integrated water resources management point of view, to combine both the soft and hard part of the programmes to ensure success. The soft part is often characterised by: strengthening of government and regulatory roles; institutional reform; better enforcement of laws; and cost-recovery mechanism implementation.

6.4.1 Sludge Management Programme

There are currently institutional and organisational obstacles and shortages in regulations hindering quick development in the sludge management sector. In fact, there is limited experience and capacity at the national level about the technical options for sludge management, treatment, disposal reuse, etc. In order to start up a sludge management project, technical assistance is required in the following areas:

- How to organise the institutional set-up for sludge management;
- Establishing the regulations that need to be built and enforced for effective sludge management;
- Developing the technological options for sludge treatment, handling, reuse (energy recovery), disposal that fit the Moroccan context;
- Defining standards for Morocco, (support in guidelines, references establishment), etc.; and
- Eventually support setting up of a national plan for sludge management.

The issues indicated above would help promote and develop the use and management of sludge produced by WWTPs in Morocco. One option could be that Waternet leads an initiative to approach the Moroccan authorities for a pilot project. This could be funded by the development cooperation agencies, including FMO. Presenting and promoting Dutch industry and know-how is also a very important opportunity to get in touch with Moroccan stakeholders and decision makers. This could be done through dedicated events such as Moroccan-Dutch meetings on wastewater, during study tours organised in the Netherlands by a Moroccan delegation (like the one organised in 2016), participation in open fairs organised in Morocco (Pollutec, Envirotec, etc.), etc.

6.4.2 Industrial Wastewater

Industries have to comply with national standards for wastewater discharge. There are instruments and incentives for industries to support them in pre-treatment and / or treatment of their wastewater before discharging in the public network or directly in the environment (according to the proper standards). Technical assistance for law enforcement is needed to create an enabling environment and increase incentives for treatment and recycling wastewater in industries. This is potentially an opportunity for Dutch-Moroccan development cooperation (government-to-government) specifically:

- Support the river basin agencies in translating the water law 2016 into rules of procedures and actions;

- Create enforcement mechanisms such as implying discharge fees and development of system for collection;
- Support control over water abstraction from rivers and groundwater;
- Development of discharge standards; and
- Once the law has been enforced, it will open the door for a new market in wastewater treatment.

6.5 SWOT Analysis of Moroccan Wastewater Market for Dutch Business

The strengths, weaknesses, opportunities and threats of the local market as they relate to Dutch technology and service providers are shown below.

Table 32: SWOT Analysis of the Moroccan Wastewater Market

Strengths	**Weaknesses**
• Good reputation of Dutch technologies and service providers worldwide. • High knowledge and R&D level with research institutions and companies involved in R&D and innovation on the Dutch side • Shared time zone will help to facilitate business dealings. • Wider sectoral experience of Dutch companies can offer proven track record in more industrial contexts. • Various sources of funding are available for project implementation. • Openness in Morocco to new technologies and Foreign Service providers exists, providing these are cost competitive.	• The exchange rate is unfavourable to Dutch exports to Morocco. • Capital- and cost-intensive technologies will struggle in an environment of weaker water regulatory enforcement and lower water and discharge tariffs that provides little incentive for investment in wastewater treatment. • A lack of a local track record could lead to hesitance in local market. • A lack of local relationships / partnerships could hamper market entry. • No existing relationships between municipalities in Morocco and Dutch companies to provide a platform on which to build. • Poor skills exist at the operator level in Morocco. However, recently operation and maintenance foreign companies were hired with long-term contracts of up to 25 years. • French is the primary language of communication.
Opportunities	**Threats**
• Significant quantities of wastewater are produced in the domestic and industrial sector, much of which is treated sub-optimally or not at all. • Increasing water scarcity, could drive increased interest in exploring opportunities for water savings and reuse. • Discharge standards are getting stricter, which will drive increased treatment requirements. • Lack of engineering and consulting skills in Morocco could provide strong opportunity for Dutch technology providers and engineering and consultation offices as well. • Lack of operator level skills creates an opportunity for operation and maintenance Dutch companies. • Pressures to reduce energy and greenhouse gas emissions relating to water and wastewater management could increase interest in technologies that address these.	• There is currently direct reuse of raw wastewater in irrigation that provides little incentive for farmers to be willing to pay for investment in wastewater treatment as tariffs. • There is a strong presence of many international service providers who are well established in the market. • There might be some preference for using technologies which people are already comfortable with. • There might be some resistance to trying new technologies. • Lack of technical capacity in Morocco to understand problems and possible solutions. • Too few references.

- New and niche technologies, particularly for difficult problems, require integrated and durable solutions which could be met by Dutch companies.
- Opportunities could exist to provide support for all levels of government on policy implementation and enforcement.
- Opportunities could be found to offer skills development and training on the Moroccan market.
- Water and wastewater treatment is high on agenda through several programmes (PNDM, PNAR, REUSE, PNDI)

Annexes

Annex 1: References

1. Alliance for Global Water Adaptation (AGWA); 2016; Sustaining Waters, Sustainable Cities: Urban Climate Change and SDG Policy Solutions Through Water Resilience (A group of national governments including Germany, the Netherlands, and Morocco, along with AGWA, SIWI, and members of the #ClimateIsWater under the banner of the #BlueLineBonn).
2. Arab Reform Initiative, ISBN 979-10-93214-03-0, Civil Society and Public Policy Formation; Strategies from Morocco and Egypt
3. Arab Reform Initiative, September 2017, The Evolution of Morocco's Human Rights Movement, Mohamed Kadiri
4. Chauffour, Jean-Pierre. 2018. Morocco 2040: Emerging by Investing in Intangible Capital. Directions in Development. Washington, DC: World Bank. ISBN 978-1-4648-1066-4. License: Creative Commons Attribution CC BY 3.0 IGO
5. COP22Report from the side event "A nexus approach to integrated climate change adaptation and mitigation in Morocco and the wider MENA region"; By Holger Hoff, Potsdam Institute for Climate Impact Research/Stockholm Environment Institute.
6. Kingdom of Morocco; High Commission for Planning, National Report August 2015, Morocco between Millennium Development Goals and Sustainable Development Goals - Achievements and Challenges
7. Morocco - Enterprise Survey 2013, World Bank, European Bank for Reconstruction and Development, European Investment Bank
8. Morocco Country Profile 2013, World Bank, European Bank for Reconstruction and Development, European Investment Bank
9. Overseas Business Risk – Morocco; Updated 24 April 2017; Foreign & Commonwealth Office, United Kingdom
10. The Economist Intelligence Unit; Morocco Country Profile
11. The Water-Energy-Food Nexus in the Middle East and North Africa; by Martin Keulertz (Editor), Eckart Woertz (Editor); Routledge Special Issues on Water Policy and Governance ISBN-13 978-1138674226; 1 edition (August 26, 2016)
12. World Bank Group, Region Profile of Middle East and North Africa (MENA) Doing Business 2018 Indicators
13. Websites: https://tariffs.ib-net.org/ViewTariff?tariffId=2171&countryId=0

Annex 2: Survey

Based on the information collected during the above interviews the team concluded that a survey with potentially interested companies would answer the open questions for the completion of this report. Ten out of 40 companies responded to the survey.

Annex 3: List of Interviewees:

1. Mr. Ele Jan Saaf, Saaf consultant
2. Mr. Koen Maathuis, Waternet World
3. Ms. Suzanne Tietema, Dutch water partnership
4. Mr. Koen Overkamp, Dutch water partnership

Annex 4: List of WWTPs Projects for period 2018-2020

Cities	Operator	Capacity (m3/d)	Cost (MDH)	WWTP technology
Bni Ansar	ONEE	7.000	128	Activated sludge
Lqliaa	ONEE	10.000	280	Activated sludge
Larache	RADEEL	15.000	180	Activated sludge
Kénitra	RAK	53.900	440	Activated sludge
Nouacer	LYDEC	28.500	210	Activated sludge
Safi	RADEES	57.800	400	Activated sludge – secondary level
Imouzzer Kandar	ONEE	7.511	73	Trickling filter
Taghazout	ONEE	1.092	18	Trickling filter
Ksar Kebir	RADEEL	9.000	110	Trickling filter
Ribate El Kheir	ONEE	1.500	26	Trickling filter
Ksar Sghir	ONEE	2.322	125	Trickling filter
Salé	REDAL	354.000	440	pre-treatment + marine outfall
Bouarfa	ONEE	1.400	33	Aerated lagoons
Targuist	ONEE	1.600	28	Aerated lagoons
Moulay Driss Zerhoun	ONEE	1.050	35	Aerated lagoons
M'Rirt	ONEE	1.600	38	Aerated lagoons
Taourirt	ONEE	4.100	55	Aerated lagoons
Ouarzazate	ONEE	9.000	56	Aerated lagoons
Sabaa Aiyoun	ONEE	1.930	70	Aerated lagoons
Berkane	ONEE	2.000	75	Aerated lagoons
Oulad Teima	ONEE	2.020	35	Aerated lagoons
SIDI BENNOUR	RADEEJ	5.285	50	Aerated lagoons, tertiary level
AZEMOUR	RADEEJ	5.275	70	Aerated lagoons, tertiary level
Sidi Smail	RADEEJ	629	10	Aerated lagoons, tertiary level
BIR JDID	RADEEJ	13.600	85	Aerated lagoons, tertiary level
Taghjijt	ONEE	300	13	Naturel Lagoons
Skhour Rehamna	ONEE	379	25	Naturel Lagoons
Touissit	ONEE	457	25	Naturel Lagoons
Rommani	ONEE	580	28	Naturel Lagoons
Sidi Allal El Bahraoui	ONEE	2.036	40	Naturel Lagoons
Ain Bni Mathar	ONEE	1.309	55	Naturel Lagoons
Taznakht	ONEE	577	57	Naturel Lagoons
Goulmima	ONEE	1.301	82	Naturel Lagoons
Tafraout	ONEE	300	90	Naturel Lagoons

Annex 5: List of current WWTPs in Morocco

	Centres	Year of service	Operator	Technology	Level of treatment	Treatment Capacity (m3/day)
1	Bensergao	1989	RAMSA	Percolation/Infiltration	Secondary	750
2	Casablanca (Emissaire El Hank)	1993	Lydec	Pretreatment and marine outfall	Primary	228.241
3	Al_Hoceima	1996	ONEE	activated sludge	Tertiary	9.600
4	Ben_Slimane	1997	Commune	aerated lagoons	Tertiary	6.583
5	Drarga	2000	ONEE	Percolation/Infiltration	Tertiary	1.180
6	Agadir Anza	2002	RAMSA	Pretreatment and marine outfall	Primary	80.000
7	Agadir Mzar	2002	RAMSA	Percolation/Infiltration	Tertiary	30.000
8	Mrirt	2003	ONEE	natural lagoon	Secondary	2.803
9	Skhirate	2003	REDAL	natural lagoon	Secondary	3.563
10	Ain_Taoujdate	2004	ONEE	natural lagoon	Secondary	1.900
11	Al_Aaroui	2004	ONEE	natural lagoon	Secondary	1.378
12	Ben_Ahmed	2004	ONEE	natural lagoon	Secondary	1.533
13	Bouarfa	2004	ONEE	natural lagoon	Primary	1.964
14	Guelmim	2004	ONEE	natural lagoon	Tertiary	6.532
15	Kalaat_Mgouna	2004	ONEE	natural lagoon	Secondary	620
16	Rissani	2004	ONEE	natural lagoon	Secondary	994
17	Tafoghalt	2004	ONEE	Trickling filter	Secondary	55
18	Attaouia	2005	Commune	algal channel	Tertiary	1.300
19	Errachidia	2005	ONEE	aerated lagoons	Tertiary	5.710
20	Ouarzazate	2005	ONEE	natural lagoon	Secondary	5.321
21	Berkane	2006	ONEE	natural lagoon	Secondary	9.822
22	Biougra	2006	ONEE	natural lagoon + infiltration	Secondary	1.443
23	Bni_Bouayache_et _Imzouren	2006	ONEE	natural lagoon	Tertiary	5.160
24	Dar_El_Gueddari	2006	ONEE	natural lagoon	Secondary	265
25	El_Gara	2006	ONEE	natural lagoon	Secondary	1.045
26	Foum_El_Hisn	2006	ONEE	natural lagoon	Secondary	261
27	Outat_El_Haj	2006	ONEE	natural lagoon	Secondary	998
28	Settat	2006	RADEEC	natural lagoon	Tertiary	13.500
30	Sid_Lmokhtar	2006	ONEE	natural lagoon	Secondary	516
31	Taourirt	2006	ONEE	natural lagoon	Tertiary	5.978
32	Tinjdad	2006	Commune	natural lagoon	Secondary	
33	Tiznit	2006	ONEE	natural lagoon	Tertiary	4.900
34	Foum_Zguid	2007	ONEE	natural lagoon	Primary	231
35	Soualem + Sahel Oulad H'Riz	2007	RADEEC	natural lagoon	Tertiary	2.170
36	Tafraout	2007	ONEE	natural lagoon	Primary	271
37	Tata	2007	ONEE	natural lagoon	Secondary	772

	Centres	Year of service	Operator	Technology	Level of treatment	Treatment Capacity (m3/day)
38	Berrechid	2008	ONEE	natural lagoon	Secondary	16.000
39	Essaouira	2008	ONEE	natural lagoon	Secondary	6.232
40	Tanger	2008	Amendis	Pretreatment and marine outfall	Primary	114.338
41	Targuist	2008	ONEE	natural lagoon	Primary	891
42	Chichaoua	2009	ONEE	natural lagoon	Secondary	1.227
43	Meknes	2009	RADEEM	natural lagoon	Primary	0
44	Ait_Baha	2010	ONEE	natural lagoon	Secondary	224
45	Bouizakarne	2010	ONEE	natural lagoon	Secondary	710
46	Boujaad	2010	ONEE	natural lagoon	Tertiary	3.300
47	Bouznika	2010	ONEE	natural lagoon	Tertiary	5.070
48	Deroua	2010	RADEEC	natural lagoon	Tertiary	3.000
49	El Menzeh	2010	ONEE	activated sludge	Tertiary	452
50	Grand_Nador	2010	ONEE	activated sludge	Tertiary	29.073
51	Marrakech	2010	RADEEMA	activated sludge	Tertiary	93.589
52	Mhaya	2010	ONEE	OXYLAG system	Secondary	270
53	Sidi_El_Aidi	2010	RADEEC	activated sludge	Tertiary	100
54	Tamesloht	2010	ONEE	natural lagoon	Secondary	346
55	Tarfaya	2010	ONEE	natural lagoon	Primary	353
56	Fnideq_Tamuda_Bay	2011	Amendis	activated sludge	Tertiary	23.000
57	Melloussa	2011	ONEE	activated sludge	Secondary	
58	Oued_Zem	2011	ONEE	natural lagoon	Tertiary	4.700
59	Oujda	2011	RADEEO	aerated lagoons	Tertiary	40.000
60	Oulad_Teima	2011	ONEE	natural lagoon	Secondary	3.787
61	Ouled_Said	2011	RADEEC	natural lagoon	Tertiary	250
62	Tetouan	2011	Amendis	Pretreatment and marine outfall	Primary	97.000
63	Ait_Iazza	2012	ONEE	natural lagoon	Secondary	588
64	Azilal	2012	ONEE	natural lagoon	Secondary	1.805
	El_Jadida	2012	RADEEJ	Pretreatment and marine outfall	Primary	22.258
66	Khouribga_Centre	2012	OCP	activated sludge	Tertiary	17.600
67	Loualidia	2012	RADEEJ	aerated lagoons	Tertiary	2.500
68	Sidi_Ifni	2012	ONEE	natural lagoon	Secondary	1.200
69	Tahla	2012	ONEE	natural lagoon	Secondary	1.380
70	El_Marsa	2013	ONEE	Percolation/Infiltration	Secondary	489
71	Kariat_Arekmane	2013	ONEE	natural lagoon	Tertiary	1.500
72	Mediouna	2013	Lydec	activated sludge	Tertiary	7.200
73	Nouaceur	2013	Lydec	activated sludge	Tertiary	4.575
74	Rabat_Temara	2013	REDAL	Pretreatment and marine outfall	Primary	78.894
75	Saidia	2013	ONEE	aerated lagoons	Secondary	5.362

	Centres	Year of service	Operator	Technology	Level of treatment	Treatment Capacity (m3/day)
76	Sidi Kacem	2013	ONEE	natural lagoon	Secondary	7.600
77	Souk El Arbaâ	2013	ONEE	natural lagoon	Secondary	7.000
78	Zaouiate_Cheikh	2013	ONEE	natural lagoon	Tertiary	3.150
79	Akka	2014	ONEE	natural lagoon	Primary	113
80	Ben_Taib	2014	ONEE	natural lagoon	Secondary	545
81	Fès	2014	RADEEF	activated sludge	Secondary	109.766
82	Guercif	2014	ONEE	natural lagoon	Secondary	5.400
83	Khenifra	2014	ONEE	Trickling filter	Secondary	5.442
84	Rislane	2014	Commune	aerated lagoons	Secondary	
85	Sidi_Abderrazak	2014	ONEE	natural lagoon	Primary	
86	Sidi_Rahal_Chatai	2014	RADEEC	natural lagoon	Tertiary	1.142
87	Sidi_Yahia_Du_Gharb	2014	ONEE	natural lagoon	Secondary	1.929
88	Taounate	2014	ONEE	natural lagoon	Secondary	2.500
89	Tinghir	2014	ONEE	natural lagoon	Secondary	3.000
90	Assa	2015	ONEE	natural lagoon	Secondary	1.350
91	Bni_Drar	2015	ONEE	natural lagoon	Tertiary	860
92	Boudnib	2015	ONEE	natural lagoon	Secondary	553
93	Boukhalef	2015	Amendis	activated sludge	Tertiary	10.400
94	Casablanca (Emissaire Est)	2015	LYDEC	Pretreatment and marine outfall	Primary	950.400
95	Chefchaouen	2015	ONEE	activated sludge	Tertiary	10.000
96	Eaucean	2015		Pretreatment and marine outfall	Primary	
97	Ech-challalate	2015	ONEE	Trickling filter	Secondary	2.800
98	El Borouj	2015	ONEE	natural lagoon	Tertiary	1.285
99	El Kelaâ Des Sraghna	2015	ONEE	Trickling filter	Tertiary	8.400
100	Ifrane	2015	ONEE	activated sludge	Tertiary	8.900
101	Imouzzer_Marmoucha	2015	ONEE	natural lagoon	Secondary	208
102	Kariat Ba Mohamed	2015	ONEE	natural lagoon	Secondary	900
103	Khemisset	2015	ONEE	aerated lagoons	Secondary	12200
104	Midelt	2015	ONEE	natural lagoon	Secondary	4.100
105	Ouaouizeght	2015	ONEE	natural lagoon	Tertiary	541
106	Oued_Laou_Zaouit	2015	Amendis	activated sludge	Tertiary	3.117
107	Ouled_Frej	2015	RADEEJ	natural lagoon	Tertiary	2.004
108	Ras El Ain	2015	RADEEC	natural lagoon	Tertiary	300
109	Sidi_Yahia_Zaers_et_Tamesna	2015	ONEE	aerated lagoons	Secondary	3.150
110	Tan_Tan	2015	ONEE	natural lagoon	Secondary	7.870
111	Youssoufia	2015	OCP	activated sludge	Tertiary	3.385
29	Zagora	2015	ONEE	natural lagoon	Secondary	2.000
112	Zemamra	2015	RADEEJ	natural lagoon	Tertiary	2.580

	Centres	Year of service	Operator	Technology	Level of treatment	Treatment Capacity (m3/day)
113	Aghbala	2016	ONEE	natural lagoon	Tertiary	740
114	Ben_Guerir	2016	OCP	activated sludge	Tertiary	7.250
115	Beni_Mellal	2016	RADEETA	Trickling filter	Secondary	11.000
116	Bni_Zrantel	2016	Commune	natural lagoon	Tertiary	820
117	El Ksiba	2016	ONEE	natural lagoon	Tertiary	1500
118	Had Kourt	2016	ONEE	natural lagoon	Secondary	550
119	Jerada	2016	ONEE	aerated lagoons	Secondary	2.030
120	Mechraa Bel Ksiri	2016	ONEE	natural lagoon	Secondary	2.100
121	Ras El Ma	2016	ONEE	aerated lagoons	Secondary	1.455
122	Zaio	2016	ONEE	Trickling filter	Secondary	2454
123	Amizmiz		ONEE	natural lagoon	Secondary	850
124	Debdou		ONEE	natural lagoon	Secondary	1700
125	El Ouatia		ONEE	natural lagoon	Secondary	721
126	Immintanout		ONEE	Trickling filter	Secondary	1720
127	Lakhssas		ONEE	Trickling filter	Secondary	331
128	Midar		ONEE	natural lagoon	Secondary	1700
129	Talsint		ONEE	natural lagoon	Secondary	220

The project team developed a questionnaire that was shared with more than 50 companies in different sizes; big, medium and small sized companies and from different types; public, knowledge institutes and private companies in different functions; technologies suppliers, consultants, constructors and operators. Of course, all of them are active in water business. Only 25% of the companies responded to the questionnaire, half of the companies didn't have any interest outside Europe as their scope extends only in Europe including Russia. Only 9 companies (see table below), mainly SMEs positively expressed their interest in doing business in Morocco under certain pre-conditions in relation to risk, partners and support they seek from the Dutch government. All the companies that showed interest had experience or current activities in MENA region as Tunisia, Palestine, Jordan and Egypt, while half of the companies had experience in Morocco in cities as Casablanca and Guelmim. The next step, the team interviewed two of those who answered positively.

Table 17: Companies participated in the questionnaire

No.	Company name	Address
1	Colubris	http://www.colubris-environment.com/
2	Saaf consultant	http://saafconsult.com/
3	Colsen	https://www.colsen.nl/
4	Daily Business	Gert.debruijne@dailybusiness.nl
5	WASTE	www.waste.nl
6	Middle East Partners	http://www.middleeastpartners.nl/
7	Work4water	www.work4water.com
8	Columbus	www.columbusinnovationgroup.com
9	W-WWT / AWT Technologies European Office[18]	www.w-wwt.com

The team has contacted as well the Dutch Water Authorities (Waterschappen). However, being a governmental organization; it is out of their scope to make overseas business. The information

[18] W-WWT is a Canadian company with an office in the Netherlands. They showed interest and would like to get further information about the BOR

gathered through questionnaires that later was analysed using a combination of logical framework. The analysis resulted in the following findings below.

Table 18: Feedback from interviews and questionnaire

Survey Topic	Feedback results
Readiness for the Moroccan wastewater Market.	• Technology supply and technical or institutional support were the most interesting fields for business, besides engineering design, master planning and capacity building. • The companies showed almost no interest in activities that are characterized by getting involved in long contracts as operation and maintenance or pipe repairs and construction works. The companies surveyed showed interest in projects with duration of 6 to 36 months. However, the duration was more dependent on the third-party back-up regarding the financing. Half of the companies were interested in process water (industrial water) and solid waste besides wastewater and sludge treatment.
Experience of the Participating Companies	• All the companies have some experience or knowledge regarding the legal and regulatory environment in Morocco or at least in a similar country in such an extent that some companies have extensive experience of staff members who have been working and living in MENA region for years. • It's beneficial that most of the companies had experience with working with underfunded utilities, which is the case in Morocco as the water tariffs are too low and heavily subsidized by the government.
Expectations and Risks	• Payment risks, financing and funding issues were on top of the elements concerning the companies regarding both requirements and risks. Beside the efficient banking and the availability of funding, companies expressed the need of law enforcement and environmental awareness and their endorsement for the reuse of wastewater as a key requirement for an attractive business as this can open a market for wastewater reuse provided that the projects are providing equal opportunities for all stakeholders, are required to be accomplished through a reasonable time schedule and make a positive impact on sustainable development. • The lack of qualified partners for Dutch companies in Morocco is one of the biggest challenges in starting business there. Lack of knowledge or experience in MENA region and specifically the Moroccan market and business climate makes up most of the challenges. The prices of Dutch companies are not competitive which is blamed on the lack of knowledge of the decision maker who selects the lowest price and doesn't take into consideration OPEX (Operation expenditure) and TCO (total cost of ownership) in the selection. Inevitable challenges are the perception of political stability and the language barrier as the formal languages in Morocco are French and Arabic. • On the other hand, there are risks that the Dutch companies are willing to afford in doing business in Morocco, just as the case in doing business in The Netherlands or in Western Europe including technological risks. Moreover, they are willing to take payment risks as "sweat capital" in form of working hours.
Partnership Requirements	• Most of the companies think that working with public entities in wastewater sector involves risks including payment risks as the most pronounced because public entities don't have their own financing and yet are completely independent from the central government, • Accordingly, the companies do not prefer high level of involvement of utility and local government in the business and they rather prefer to work within a diamond model in which the business, investors, government and public (customers) work together. • The companies mostly prefer the business to business partnership and doing business with user groups and farmers, while partnerships with universities and research institutes are unlikely to take place. On the other hand, a modest preference is for making business in Morocco as a contracting agent with central government, local government or at utility level. Surprisingly, there was a low preference towards international development organizations partnership as well.

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