Integrated Water Resources Management
in the Lower Jordan Valley

Sustainable Management of Available Water Resources with Innovate Technologies

Management Of Highly Variable Water Resources in semi-arid Regions

SALAM

SMART MOVE

funded by

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Subproject SALAM

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Data Gathering and Consistency Analysis, Development Scenarios on National Level and Impacts, Regional Budgets and Expected Water Deficits

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Sustainable Management of Available Water Resources
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– Management Of Highly Variable Water Resources in semi-arid Regions –
(SMART-MOVE, project phase III)

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Data Gathering and Consistency Analysis, Development Scenarios on National Level and Impacts, Regional Budgets and Expected Water Deficits

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1 Introduction

The ultimate goal of SALAM is to develop water resources development schemes that suggest an increase of the overall water availability in the region. The first step in this endeavor is to assess the water needs or water deficits (current and future) by means of water budgets. Water budgets should delineate a clear picture of the current water availability, water development prospects, water development projects under study and or execution in other frameworks, and water needs current and foreseen for engineering time horizons (of 20 years for example). This deliverable presents the water budgets of Jordan, Israel and Palestine in that span over geographical areas that are relevant to the solutions that are to be suggested.

These water budgets have been taken from documents prepared by others for the decision makers in each country. In order to obtain data and figures that could be comparable we suggested, as a first step in the preparation of this deliverable to prepare a template for data collection (TDC) that would be filled by the stakeholders. Once the TDC was finalized, we handed out to the stakeholders for them to fill it.

2 The template for Data Collection (TDC)

The template for data collection or TDC was formulated jointly with RWC in order to provide a single structure for the reporting of the water budgets. A template document was prepared and discussed together with the stakeholders and its structure is presented in appendix A of this document. It comprises a number of sections as follows:

1. Definition of the encompassed area by means of maps.
2. Physical data and information (rainfall, surface water resources and groundwater resources).
3. Water demands – fresh, brackish and treated effluent - (agriculture, industry, domestic, environment) for three time horizons of 2015, 2025 and 2035.
4. Water sources – fresh, brackish and treated effluent for three time horizons of 2015, 2025 and 2035.
5. Water budgets for three time horizons of 2015, 2025 and 2035.
6. Parallel projects – provide information on project that could have an impact or being impacted by SALAM findings.
7. Policy of data sharing and communication.
8. Socio economic constraints with regard to the water allocation and uses.

This template was distributed to the stakeholders and during the workshop held at the Dead Sea in May 2016, we provided the required information and guidance needed for filling in the data.

3 Results

3.1 Water Budget of the Jordanian component

The figures presented below have been supplied by the Jordanian ministry of water and irrigation and are based on the published Jordanian Master plan for water. We consider two scenarios, one baseline scenario based on conservative assumptions and one optimistic scenario.

3.1.1 Introduction

Jordan faces a complex set of development challenges stemmed from the chronic water scarcity. The situation is further aggravated by climatic conditions, geography and the geopolitical environment. Water scarcity poses a serious challenge that affects the wellbeing, security and economic future of all Jordanians. On November 7, 1999, H.M. King Abdullah II stated, "*Our water situation forms a strategic challenge that cannot be ignored. We have to balance between drinking water needs and industrial and irrigation water requirements. Drinking water remains the most essential and the highest priority*". Despite the severe challenges, Jordan is one of few countries in the world to have managed its meager freshwater resources well. Jordan has one of the highest coverage rates in the region and almost 91% of treated wastewater is reused for agriculture. Many new policies and efficiency improvements have been undertaken to augment, conserve, reuse and recycle all available freshwater. The Government has constructed dams and the Disi-Amman conveyance system to mobilize new water sources. It is exploring additional sources of supply such as deep aquifers and brackish and large-scale seawater desalination. Efforts are being made to optimize the use of existing resources by reducing physical and commercial losses. Energy efficiency improvements are part of the strategy as currently 14% of the country's energy resources are consumed by water delivery.[1] Despite these improvements, there remains a critical imbalance between supply and demand, especially in a context of regional insecurity and the social, economic and environmental impacts of climate change.

This strategy builds on the previous strategic documents, which helped to shape the management of the water sector in Jordan over the past 20 years. The first strategy, "Jordan Water Strategy and Policies", was formulated in 1998. It was followed in 2008 by the, "Water for Life: Jordan's Water Strategy 2008–2022". The first Sector Strategy (1998) was associated with Policies included groundwater, water utilities, wastewater reuse and management, and irrigational water. An investment program and action plan was developed for the years 1997-2010 and updated in 2002 to extend until 2011. The said investment program was completely implemented except Red-Dead for a total value of about 3 billion USD. Legislation amendments were implemented including Article 28 of WAJ law to allow for private sector participation (2002) or Groundwater Bylaw aiming at protection of groundwater resources (2002). The National Water Master Plan (NWMP) was put into operation in 2004.

This strategy is in alignment with the royal initiative for economic change in all sectors that was formulated in the nationally adopted document Jordan 2025, A National Vision and Strategy" in 2015. It considers the adopted Sustainable Development Goals (SDGs) by the United Nations in September 2015. The strategy also builds on the new development in the sector, this include the implementation of the approved Action Plan to Reduce Water Sector Losses in 2013, the development in strategic projects (e.g. Nuclear Power plan, Oil-shale and Red–Dead conveyance), the increased demand resulting from the pressure of Syrian refugees on water resources, increased cost

[1] International Bank For Reconstruction And Development & International Finance Corporation Country Partnership Strategy For Hashemite Kingdom Of Jordan For The Period Fy12-Fy15, February 1, 2012.

of production specifically the effect of electricity and fuel increased prices and the fiscal strain affecting the service delivery. It also builds on the recently developed sector policies.

The strategy included provisions for climate change, water-energy-food nexus, and focus on water economics and financing, sustainability of overexploited groundwater resources and the adoption of the new technologies and techniques available including Decentralized Wastewater management, increased needs for utilization of surface water in municipal supply, reuse of treated wastewater. It incorporates more decentralization, commercialization, and consolidation of water and wastewater services as well as increasing private sector participation and the changes in legislation. All of this is in line with the new strategies adopted in other sectors including National Energy Strategy 2007-2020 approved by the Royal Energy Commission, "Agriculture Document of 2009" issued by the Ministry of Agriculture, the environmental policy and plan of action developed by the Ministry of Environment or Strategy documents for health. Also education and municipal affairs reflect synergies and partnership with the water sector and follow the new updates of water and wastewater management master plans, commit to solid waste management and the newly approved reform legislation including the decentralization law.

As Jordan moves towards the post-Millennium Development Goals (MDG) era, it needs to examine the outcomes and achievements of its existing water strategy at midpoint (2015), evaluate its performance, contextualize the current situation in the country and the region, reinforce efforts to achieve the strategic goals set as part of this strategy and reconfigure it for the future. Ministry of Water and Irrigation (MWI) recognized the need to introduce an updated National Water Strategy 2016-2025 to ensure that national goals and priorities are realigned to the country's changing needs and relate to the new SDGs. The revised strategy will respond to the substantive changes in the regional geopolitical situation, the ongoing risks and threats to Jordan's renewable water resources, a growing population and an expanding economy that is water- and energy-dependent and highly vulnerable to risk.

MWI has also elaborated a set of principles to guide future water sector planning:

- Jordanians must recognize that there are limits to the country's renewable, affordable traditional available water supply.
- Jordanians must use and reuse water more effectively, efficiently and responsibly.
- Citizens and the private and public sectors must share responsibility for water management and protection and work together to improve conditions within their local watersheds.
- A deeper knowledge of the availability, quality and protection of water is the foundation for effective decision-making. Including the knowledge of increased cost of any new additional non-conventional resources.
- Healthy aquatic ecosystems are vital to a high quality of life for Jordanians and must be preserved in pursuing socioeconomic and community-level development.
- Jordan needs to address the impact of climate change on its social, economic and environmental development. Adaptation measures must ensure institutional response capacity, community education and awareness of the risks.

3.1.2 National Water Strategy implementation, 2008-2015

The previous National Water Strategy has set the pace for national efforts to manage the water sector and ensure optimal service levels. It is aligned to the achievement of the MDGs. There is substantive evidence that Jordan has achieved the water and sanitation goals and it has also demonstrated best practices in strategic water, sanitation and hygiene (WASH) service coverage of vulnerable populations and wastewater reuse.

Jordan has a robust policy framework that encompasses the entire spectrum of water management, comprising reallocation, substitution, energy efficiency, groundwater and surface water policies. Four national policy and strategy documents and six sector policies provide guidance for Jordan's water sector.

3.1.3 National Millennium Development Goals (MDG) achievements

Despite its limited natural resources, narrow economic base and location in a conflict-stricken region, Jordan has made strategic advances towards achieving the MDGs. Progress made in the past 15 years had led to reductions in poverty and infant mortality, increased adult literacy and increased access to water supply and sanitation.

In this context Jordan achieved the following with limited renewable water resources and financial support:

1. The proportion of population with access to improved water supply (through network) exceeds 94%. The water quality compliance to microbiological parameters exceeds 99.3% in the whole Kingdom.
2. Acknowledging that safe sanitation is vital for improved human health, disease and pollution prevention, Jordan is keen to apply the global best practices in wastewater treatment, management and reuse, especially in 2015 with the overwhelming pressure on water and sanitation as a result of hosting over 650,000 Syrian refugees and another over 750,000 Syrian residents.
3. The proportion of the population with safe sanitation exceeds 93% (63% coverage by sewer system and 30% by other safe sanitation methods).
4. Jordan is reusing 91% of its treated wastewater in agriculture to reallocate fresh water for domestic purposes.[2]
5. Establishment of water utilities in the South and North Governorates

Jordan unequivocally supports the SDGs, which reaffirm human rights and underscore the right to development as central objectives. In the Jordanian context, the SDGs reaffirm the need to achieve sustainable development by promoting economic development, social inclusion, environmental sustainability and good governance including peace and security. Jordan remains committed to these development principles, which is reflected in this National Water Strategy 2016-2025.

3.1.4 National Water Strategy 2016-2025: rationale and national priorities

This Strategy defines the steps to ensure a sustainable future for the water sector in Jordan; it uses the distinct opportunity to reinforce and strengthen integrated water resources planning and management that is aligned with the SDGs, revising the scope, context and relevance of the strategy for the sustainable future of water resource management in the coming decades. The National Water Strategy builds on the vision that by 2025, Jordan Water sector will gain more **resilience** and will have the following characteristics:

- Access to safe, affordable and adequate water supply and sanitation for all Jordanians is ensured.
- Adequate wastewater collection and treatment facilities for cities, small towns and major industries and mines are provided.
- Public health and the environment, in particular groundwater aquifers, are protected.

[2] The Jordanian Perspective - Establishing the Post-2015 Development Agenda: Sustainable Development Goals (SDG) towards Water Security. Ministry of Water and Irrigation, Amman, Jordan. March 2014.

- Efficient and productive use of water includes cost recovery.
- Responsible and efficient water management for all uses based on Integrated Water Resources Management (IWRM) principles comprises greater understanding and more effective management of groundwater and surface water.
- A skilled and sustainable water sector is enabled to adapt to increased population and economic development.
- New innovative and efficient technologies, infrastructure and partnerships are introduced.
- A viable and targeted legal and regulatory framework facilitates the implementation processes.
- A well-resourced climate change adaptation planis defined.
- A well-resourced humanitarian WASH sector coordination system is established.
- Sector alignment and synergy with relevant national priorities and development plans is realized.

The strategy aims to create new momentum for the sector to be better prepared; do business differently and more efficiently; add value to national development in conjunction with other national socioeconomic sustainability initiatives; engage in institutional reform for greater efficiency and effectiveness; and improve inter-sectoral linkages to generate greater synergy and impact on the health and economic well-being of all Jordanians.

The strategy key areas are:

(i) integrated Water Resources Management;
(ii) water, sewage and sanitation services;
(iii) water for irrigation, energy and other uses;
(iv) institutional reform; and
(v) sector information management and monitoring.

The strategy also addresses cross-cutting issues of climate change adaptation, transboundary/shared water resources, humanitarian WASH sector coordination, public/private partnerships, and the economic dimensions of water. The strategy identifies the results (objectives) to be achieved and reflects the Government's national vision for the sustainable development of the water sector. Within the timeframe of this strategy, MWI will adopt a sector-wide integrated water resources planning and management approach, develop sector policies and legislation to enhance performance, equitable service provision and optimization of available resources, initiate institutional reforms to restructure sector management, enhance fiscal discipline in cost recovery, improve internal efficiencies in sector coordination and management and build technical capacity. MWI will coordinate and lead the implementation of the water-related SDGs and targets in Jordan, combine a deeper understanding of the available amounts, actual quality and natural protection of Jordan's water resources as a foundation for effective decision making, develop new partnerships with civil society and engage with all stakeholders through regular consultations in water sector project planning, thus building awareness of the efficient use and conservation of water and protecting the water infrastructure. Other measures include developing appropriate, cost-responsive water and wastewater tariffs in municipal, irrigation and industrial water use, developing ’new water’ through rain harvesting, recycling, innovation, adaptation, new technology and peoples' participation and improve energy efficiency and renewable energy use in the water sector.

3.1.5 Sustainable Development Goals 2016-2030

Jordan’s vision for the water-related SDGs envisages a sustainable environment, universal access to sanitation, sound wastewater management and reuse, pollution prevention, safe drinking water delivery, water security and regional cooperation. This vision will optimize the utilization of the interlinked resources of water, energy and food security. Jordan will adopt 'Sustainable management

of water and sanitation for all Jordanians' as a **national water sector objective**. It will align and refine the SDG targets and indicators in the context of the National Water Strategy. Jordan will also work towards the related SDGs and targets that complement the achievement of the national water sector objective, guided by principles of human rights and justice.

Jordan realizes that SDG implementation and sustainable development require significant mobilization of resources for developing countries from a variety of sources and the effective use of financing. Good governance and the rule of law at the national and international levels are essential for sustained, inclusive and equitable economic growth, sustainable development and the eradication of poverty and hunger.

3.1.6 Baseline Scenario

3.1.6.1 Fresh water

Table 1: Development of demand and supply with freshwater between 2015 and 2035 in the Baseline scenario in correspondence to the Jordan Water Master Plan.

	2015			2025			2035		
	Demand [MCM]	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**
Agriculture	700	507	72	700	594	85	700	600	86
Industry	39	38	97	70	70	100	110	110	100
Domestic	658	463	70	768	559	73	800	570	71
Environment	50	50	100	235	235	100	400	400	100
Tourism	4	4	100	10	10	100	20	20	100
TOTAL	**1451**	**1062**	**73**	**1783**	**1468**	**82**	**2030**	**1700**	**84**

3.1.6.2 Brackish water

Table 2: Brackish water potential and planned usage between 2015 and 2035 in the Baseline according to the Jordan Water Master Plan.

	2015			2025			2035		
	Potential [MCM]	**Planned [MCM]**	**Use [%]**	**Potential [MCM]**	**Planned [MCM]**	**Use [%]**	**Potential [MCM]**	**Planned [MCM]**	**Use [%]**
Industrial	0	0	0	0	0	0	0	0	0
Domestic	30	10	33	30	10	33	30	10	33
Agriculture	0	0	0	0	0	0	0	0	0
TOTAL	**30**	**10**	**33**	**30**	**10**	**33**	**30**	**10**	**33**

3.1.6.3 Treated effluent

Table 3: Portion of treated effluents in relation to the total waste water production between 2015 and 2035 in the Baseline scenario according to the Jordan Water Master Plan.

Year	**Domestic Supply**	**Estimated produced Wastewater**	**Collected and treated**	**Reused**
	[MCM/a]	[MCM/a]	[MCM/a]	[MCM/a]
2015	466.5	300	140	125
2025	559	365	240	228
2035	570	398	300	273

3.1.7 Optimistic Scenario

3.1.7.1 Fresh water

Table 4: Development of demand for and supply with freshwater between 2015 and 2035 for the Optimistic scenario leading to significant improvements of the socio-economic conditions in the LJV.

	2015			2025			2035		
	Demand [MCM]	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**
Agriculture	700	507	72	700	594	85	700	600	86
Industry	39	38	97	70	70	100	110	110	100
Domestic	658	463	70	768	559	73	800	570	71
Environment	50	50	100	235	235	100	400	400	100
Tourism	4	4	100	10	10	100	20	20	100
TOTAL	**1451**	**1062**	**73**	**1783**	**1468**	**82**	**2030**	**1700**	**84**

3.1.7.2 Brackish water

Table 5: Brackish water potential and planned usage between 2015 and 2035 in the the Optimistic scenario.

	2015			2025			2035		
	Potential [MCM]	**Planned [MCM]**	**Use [%]**	**Potential [MCM]**	**Planned [MCM]**	**Use [%]**	**Potential [MCM]**	**Planned [MCM]**	**Use [%]**
Industrial	0	0	0	0	0	0	0	0	0
Domestic	30	10	33	30	10	33	30	20	67
Agriculture	0	0	0	0	0	0	0	0	0
TOTAL	30	10	33	30	10	33	30	20	67

3.1.7.3 Treated effluent

Table 6: Portion of treated effluents in relation to the total waste water production between 2015 and 2035 in the Optimistic scenario.

Year	**Domestic Supply**	**Estimated produced Wastewater**	**Collected and treated**	**Reused**
	[MCM/a]	**[MCM/a]**	**[MCM/a]**	**[MCM/a]**
2015	466.5	300	140	140
2025	559	365	240	240
2035	570	398	300	300

3.1.8 Water Budget Summary by sources and demand sectors

3.1.8.1 Supplied Water in 2015

Table 7: Sectorial water allocation for the year 2015 corresponding to the Baseline scenario.

Source	Sector of demand			TOTAL
	Domestic [MCM/a]	Industry [MCM/a]	Agricultural [MCM/a]	
Surface Water	91.5	4.8	130	**226**
Freshwater Springs	12.5	0	20	**32.5**
Groundwater	325	32	456	**813**
Treated effluent	0	2	123	**125**
Total	**429**	**39**	**729**	**1196.5**

3.1.8.2 Additional Sources of Water 2025-2035

Table 8: Additional water sources that could be activated in any more optimistic scenario until 2035 as compared to the current Jordan Water Master Plan.

Add. Source of Water	2025 (MCM/a)	Confidence (%)	2035 (MCM/a)	Confidence (%)
Desalinated water	230	90	380	90
Treated waste water	100	90	160	90
Surface water	67	90	77	90
Nonrenewable GW	99	90	99	90

3.2 Water Budget of the Palestinian component

3.2.1 Strategic goals and objectives

The Middle East in general and the Israeli-Palestinian-Jordanian nexus in particular, have long been considered one of the most water constrained regions in the world. Water has been prominent on the Israeli-Palestinian agenda since the outset of the peace process in the early Nineties of the previous century. It remains so, as its allocation and use have not yet been agreed upon. The resolution of conflicts over water use is often seen as a zero-sum game.

The common approach to such conflicts, which is also reflected in international law, is to first assess the amount of water to be divided and then allocate it according to several principles among the parties. However, studies that have scrutinized international water agreements have indicated that agreements are only reached once the parties go beyond the legalistic definitions noted in international law and start discussing their actual needs (Wolf, 1999). In the Israeli-Arab setting the Johnston accords, the first though unratified agreement reached was also essentially a need-based agreement. In essence, that agreement was based on an assessment of the potential irrigation needs of the various riparian's, as they were viewed at the time. Yet, in the fifty plus years that elapsed since those accords were negotiated the nature of water consumption in the region has changed. In the Fifties of the previous century most of the water was used for irrigation, and agriculture was viewed as a major contributor to the GDP, a major base for employment and a base for food security. Since then the percentage of fresh water used for irrigation declined, primarily in Israel, as the urban

population grew, and the importance of agriculture in the national economy and as a basis for employment declined drastically. Today agriculture accounts for less than 10% of the labour force in Jordan and less than 3% in Israel. Moreover, food supply is no longer based on local production. Rather, as Allan (2001) has noted long ago, most of the water used for food in the Middle East is virtual water, that is, it is supplied through the global food market, as all countries in the Middle East rely on the global food market for their most basic staples (particularly wheat and meat).

Any call on countries to improve water allocation and management cannot ignore the highly sensitive and politicized nature of water. However, experience has shown that cooperation over water issues often resolves conflicts. Where water resources are shared between countries, trans-boundary water allocation and management remain a major challenge. The inevitable consequence of increased demand and decreased supply is an increase in the value of this scarce resource, leading to increased competition over its allocation. Therefore, there is a need for comprehensive and stable arrangements of a sustainable nature that will satisfy all parties involved. In most situations, especially where different types of water uses compete with one another, such management will depend on the establishment of agreed substantive and procedural rules and principles governing water allocation and management across international borders.

Palestinians depend extremely for their water supply on Groundwater aquifers two of them in the West Bank and the coastal aquifer in Gaza are shared with Israel as well as with other Arab countries. Furthermore, water becomes a limiting factor for development and establishment of an independent state of Palestinian . As the shared water resources are becoming increasingly exhausted, the reliance on them consequently leads to their over-exploitation. In a major challenge the design of a well functioning Palestinian water management needs to be identified through two main levels; the political level and technical level, considering beneficial water use sustainably, equitably, and in accordance with the principles of international water law. Regional cooperation in managing water resources in a water scarce region is imperative in order to ensure resource preservation and its sustainable development. However, the shared water basins are still managed in a unilateral manner without any cooperative effort. Even where cooperative modalities exist in exchanging data and developing models, actual joint management of the shared water systems has not taken root yet.

The objective of this contribution is to develop regional water management options that identify regional solutions to water supply problems that result in appropriate and preferencially lower water supply costs, determine regional water infrastructure needs, and indicate effective and efficient implementation strategies that take also accountof the identification and addressing of local issues and concerns within the regional water plans.

3.2.2 National perspective for future water cooperation

There is an urgent need to formulate Palestinian strategies and developing programs aim at coping with this conflict and to protect their sovereignty on their water rights. In this study a detailed strategy will be formulated based on short term, mid-term and long-term perspectives. Considering the following specific objectives aligned with the long term perspective of the PWA Vision:

- Ensuring water security to meet future increases in demand for water and enable the socio-economic development;
- Enabling the equitable allocation of water resources among competing water uses for sustainable developmen;
- Adapting alleviation measures for water shortage problem in Palestinian Territories due water scarcity and Israeli occupation;
- Enhancing regional cooperation by deploying the principles of (IWRM) for shared water resources; without compromise the water rights .

- Environmental protection and management principles.

In Palestine, as in most Mediterranean countries, there is a growing awareness of the benefits of using treated wastewater as a valuable additional water source. This is clearly expressed in the National Water Policy:

- *"Treated wastewater represents a potential resource and should be optimized for agricultural, recharge and aquaculture purposes;*
- *It is the National Policy to treat all wastewater produced to a quality sufficient to meet national standards for safe and productive reuse and to support the distribution and productive reuse of treated wastewater.*
- *It is the National Policy to strengthen treated wastewater reuse through sound contractual arrangements between the producers and the users".*

However, despite this formal recognition of the importance of reuse, formalized reuse of wastewater in Palestine remains minimal at the present time. The majority of existing WWTPs discharge directly into wadis or the Mediterranean Sea. The main drivers of limited reuse of treated waste water are i) lack of investment ii) socioeconomic and cultural constrains (affordability and financial capacity of service providers , religion and cultural values , lack of good governance)

Some farmers pump this water directly out of the wadis and use it for irrigation purposes. This activity is not regulated and there is no guarantee that the quality of the water being pumped is suitable for irrigating the kind of crops grown. However, the mere existence of these irrigated fields demonstrate that (a) there are no cultural constraints inhibiting the use of treated wastewater for agricultural purposes and (b) there is a demand for such water on the part of the farmers.

The strategic objectives that have been fixed, take into account the following hypotheses:

- Palestinians will get full rights of access and use of land based on the 1967 border and exercise their rights on water resources based on international law. Consequently, the amount of water made available for the country will be much greater than at present;
- the Palestinians will succeed in negotiating fair water sharing agreements with neighboring countries, for transboundary water resources (Jordan River, Gaza Wadi, and groundwater);
- the population will increase dramatically, because of demographic expansion plus many returnees coming back to the country.

The strategy developed under this scenario is ambitious in terms of both the service provided to citizens (quantity and quality of water) and economic development (irrigation and industry). It is based on:

- the equitable sharing of transboundary water resources (groundwater and rivers) with neighboring countries (Jordan, Syria, Lebanon, Israel and Egypt);
- the optimal use of all available water resources, from both an environmental, economic and social perspective (health, revenue, jobs);
- the sustainable use of these resources (voluntary limited rate of abstraction and resource protection);
- Financially viable autonomous service providers.

The strategic objectives have been translated in figures, according to the set of selected performance indicators. The value of each performance indicator has been fixed separately for the Gaza Strip and for the West Bank.

The Long Term National Strategy (NWSS) to meet the future water demand based the assumption that the state of Palestine will have full control of national water resources, The Main pillars of (NWSS) are:

The main pillars relevant to this study are as follows:

1) The Palestinian population (natural and right of return) will almost double a number of 9.3 million by year 2035 (UNFPA ,2016)
2) The established State of Palestine will continue the development of all sectors.
3) The current water supply and consumption in Palestine is compressed and doesn't reflect the real numbers (since water accessibility is limited

Accordingly, the above-mentioned pillars will lead to the following assumptions:

1) All closed military and settlement areas will be accessible for agriculture, which will be a key player of the agriculture development planning.
2) The right of return will be applied and around 2 million will return gradually by year 2035.
3) In particular, the Jordan valley will experience the growth and additional settlement of multi-sector development areas.
4) The State of Palestine will be part of regional efforts to cope with challenges like water scarcity, climate change, and instability.

3.2.3 Current and future status of supply and demand by year 2035

3.2.3.1 Baseline Scenario

Due to the population growth and the related needs for development and the expected expansion of agriculture the Palestinian supply of fresh water, brackish water, and effluent is expected to increase by 305%, 650%, and 1700% by the year , (figure 1).

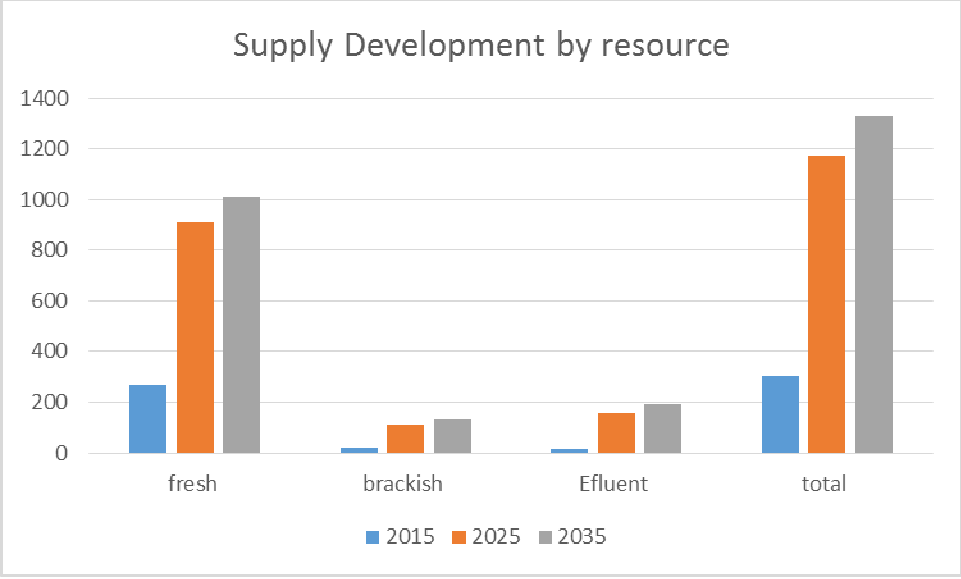

Figure 1: Supply development by resource for Palestine for 2015, 2025, and 2035 for the Baseline scenario.

The planned sectorial use allocation of the different water types for 2015, 2025, and 2035 will be 54.5%, 38.9%, 4%, and 2% for agriculture, domestic, industry, and environemt, respectively (Figure 2).

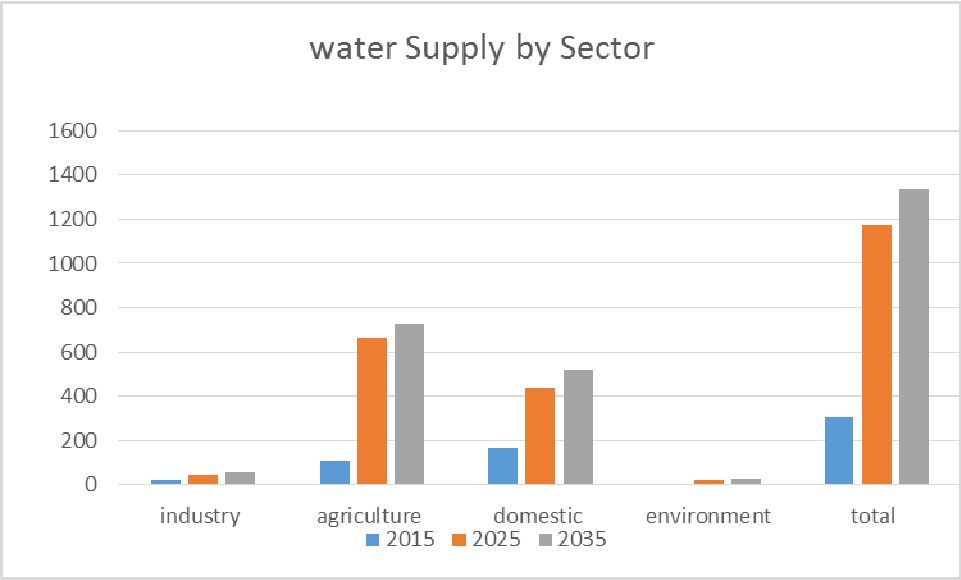

Figure 2: Water type allocation for different use sectors in Palestine for 2015, 2025, and 2035 for the Baseline scenario.

Demand

On the demand side by 2035 the the increase for fresh water, brackish water, and effluent will increase by 316%, 200%, and 542%, respectively, as shown in Figure 3.

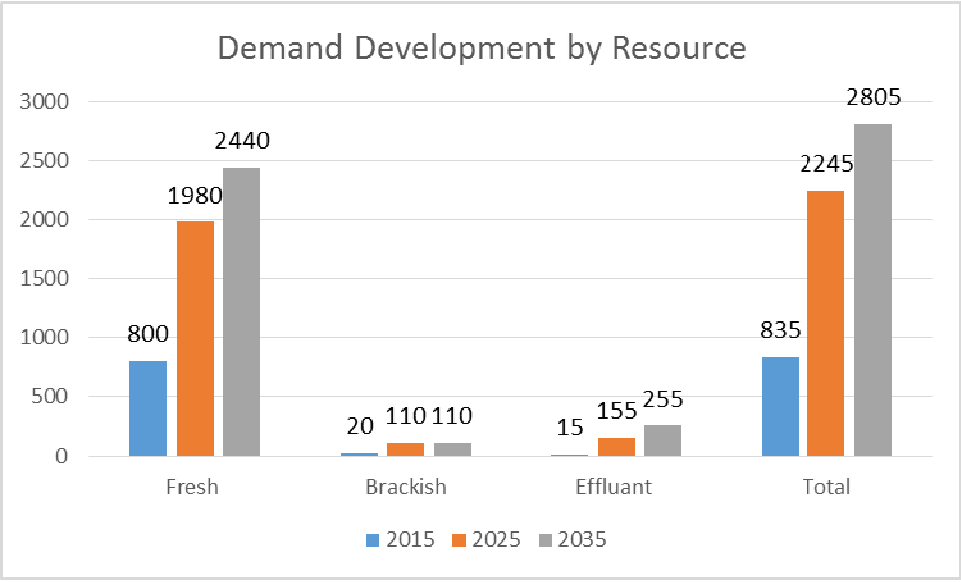

Figure 3: Demand development by water resource for Palestine for 2015, 2025, and 2035 for the Baseline scenario.

However, the total growth in sectorial water demand between 2015 and 2035 (Figure 4) will be 323% for agriculture, 352% for domestic, 200% for industry, and 180% for environment.

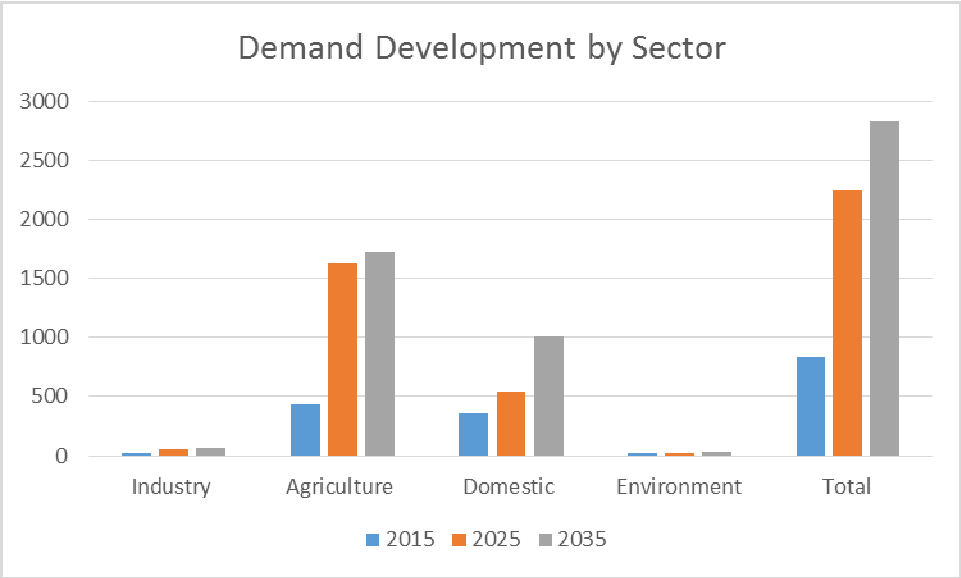

Figure 4: Sectorial demand development for Palestine for 2015, 2025, and 2035 for the Baseline scenario.

Baseline scenario

Table 9: Development of demand and supply with freshwater between 2015 and 2035 in the Baseline scenario in correspondence to the Palestinian Water Master Plan.

	2015			2025			2035		
	Demand [MCM]	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**
Agriculture	420	100	24	1,482	520	35	1,482	550	37
Industry	15	10	66	23	15	65	28	20	71
Domestic + tourism	340	154	45	450	350	78	900	410	46
Environment	25	5	20	25	25	0	30	30	
TOTAL	**800**	**269**	**34**	**1,980**	**910**	**46**	**2,440**	**1,010**	**54**

Brackish water

Table 10: Brackish water potential and planned usage between 2015 and 2035 in the Baseline according to the Palestinian Water Master Plan.

Year	Feasible Potential [MCM/a]	Planned Use [MCM/a]	Degree of Use [%]
2015	20	5	25
2025	110	110	100
2035	130	130	100

Treated effluent

Table 11: Portion of treated effluents in relation to the total waste water production between 2015 and 2035 in the Baseline scenario according to the Palestinian Water Master Plan.

	Produced [MCM/a]	Collected and treated [MCM/a]	Reused [MCM/a]
2015			
Industrial Waste Water	0	0	0.5
Domestic Waste Water	65	2	15
2025			
Industrial Waste Water	0	0	0
Domestic Waste Water	155	65	40
2035			
Industrial Waste Water	0	0	0
Domestic Waste Water	255	200	150

3.2.3.2 Optimistic scenario

The optimistic Scenario relies on the assumptions that

1) Palestinian resources are available, accessible and manageable for and by the State of Palestine;
2) the State of Palestine is equal partner in the development of additional water resources; and
3) the State of Palestine accepts the principle of water swap at regional level.

However, the State of Palestine water demand will increase for fresh water, brackish water, and treated effluent by 316%, 200%, and 542%, respectively (**Fehler! Verweisquelle konnte nicht gefunden werden.**). The figures for the sectorial increase of water demand will be 260% for industry, 400% for agriculture, 284.5% for domestic use, and 120% for agriculture (Figure 6).

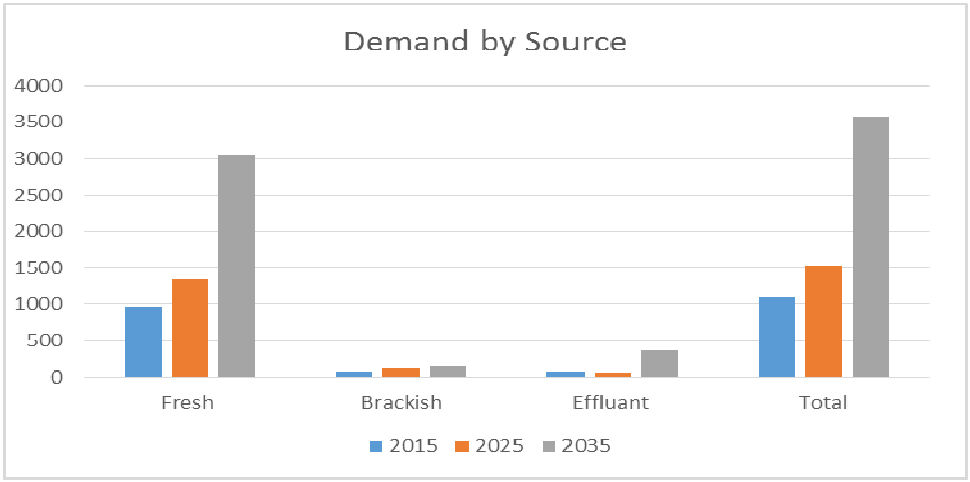

Figure 5: Demand development by water resource for Palestine for 2015, 2025, and 2035 for the Optimistic scenario.

In correspondence with the Baseline scenario the planned supply under the Optimistic scenario is depicted for resources and sector allocation in Figure 7 and Figure 8.

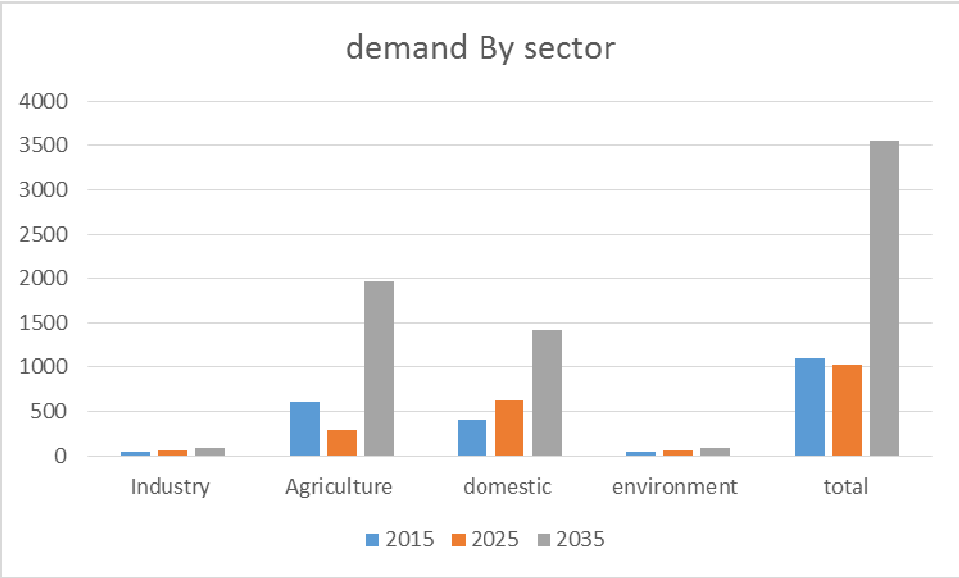

Figure 6: Sectorial demand development for Palestine for 2015, 2025, and 2035 for the Optimistic scenario.

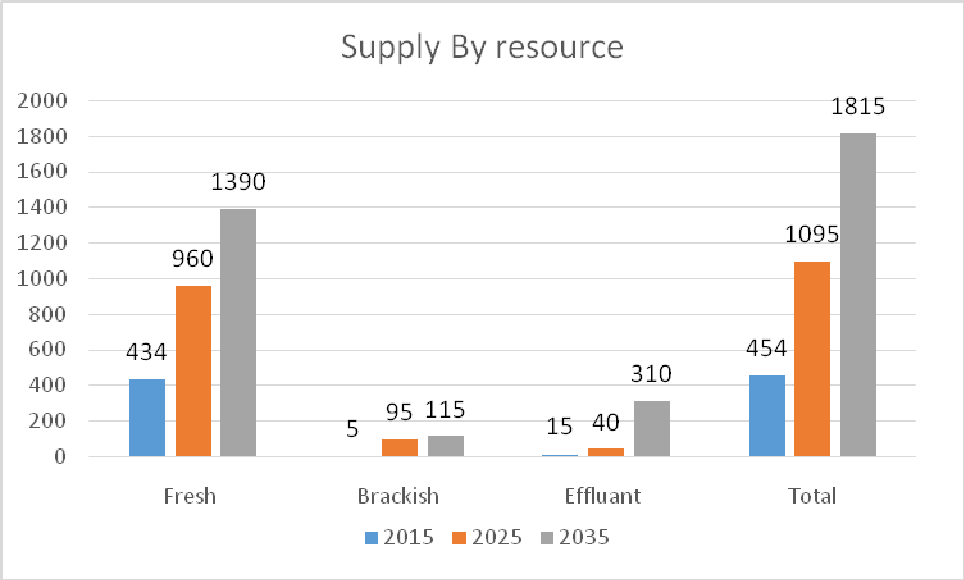

Figure 7: Supply development by resource for Palestine for 2015, 2025, and 2035 for the Optimistic scenario.

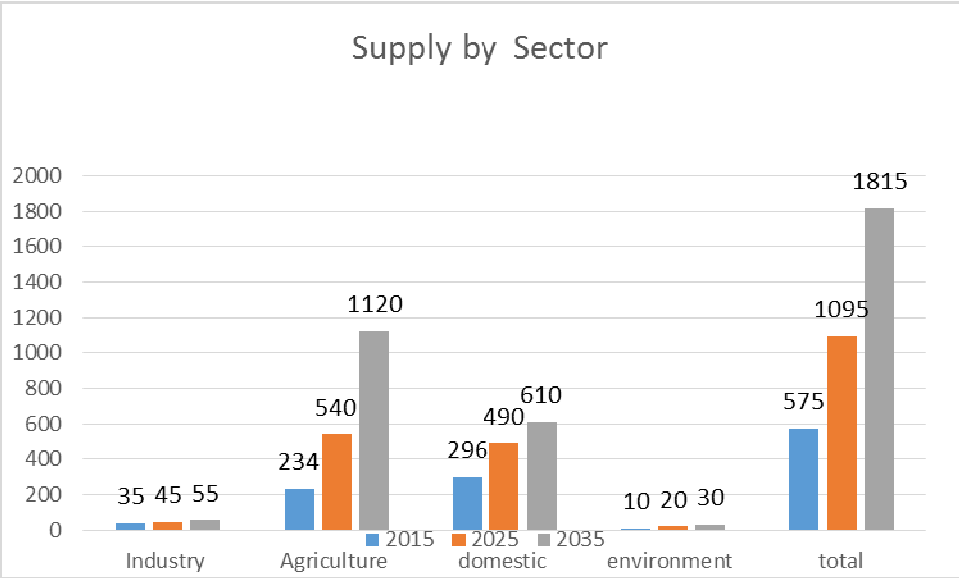

Figure 8: Water type allocation for different use sectors in Palestine for 2015, 2025, and 2035 for the Baseline scenario.

Optimistic scenario

Table 12: Development of demand and supply with freshwater between 2015 and 2035 in the Baseline scenario in correspondence to the Palestinian Water Master Plan.

	2015			2025			2035		
	Demand [MCM]	Supply [MCM]	Coverage [%]	Demand [MCM]	Supply [MCM]	Coverage [%]	Demand [MCM]	Supply [MCM]	Coverage [%]
Agriculture	546	233	43	741	510	69	1,600	820	51
Industry	15	15	100	30	20	67	50	30	60
Domestic + tourism	353	226	45	520	410	79	1,350	510	38
Environment	50	10	20	60	20	33	50	30	60
TOTAL	**964**	**484**	**50**	**1,351**	**960**	**71**	**2,440**	**1,390**	**57**

Brackish water

Table 13: Brackish water potential and planned usage between 2015 and 2035 in the Baseline according to the Palestinian Water Master Plan.

Year	Feasible Potential [MCM/a]	Planned Use [MCM/a]	Degree of Use [%]
2015	20	5	25
2025	95	50	52
2035	115	100	87

Treated effluent

Table 14: Portion of treated effluents in relation to the total waste water production between 2015 and 2035 in the Baseline scenario according to the Palestinian Water Master Plan.

	Produced [MCM/a]	Collected and treated [MCM/a]	Reused [MCM/a]
2015			
Industrial Waste Water	10	0	0
Domestic Waste Water	65	8	2
2025			
Industrial Waste Water	15	10	50
Domestic Waste Water	308	150	100
2035			
Industrial Waste Water	20	20	20
Domestic Waste Water	382	200	200

Supplied Water in 2015

Table 15: Sectorial water allocation for the year 2015 corresponding to the Baseline scenario.

	Sector of demand			TOTAL
Source	**Domestic**	**Industry**	**Agricultural**	
Surface Water	2	4	0	10
Freshwater Springs	14	20	0	15
Groundwater	65	360	15	430
Treated effluent	1.2	10	1	10
Total	87.2	410	21	475

Additional Sources of Water 2025-2035

Table 16: Additional water sources that could be activated in any more optimistic scenario until 2035 as compared to the current Palestinian Water Master Plan.

Add. Source of Water	2025 (MCM/a)	Confidence (%)	2035 (MCM/a)	Confidence (%)
Surface water	275	30	275	30
Ground water	300	30	300	20
Brackish	110	30	130	20
Desalination	600	20	800	70
Regional waste water	10	70	100	70

References:

Wolf, A. (1999): Criteria for equitable allocation: The heart of international water conflict. – Natural Resources Forum 23, 3-30.

UNITED NATIONS POPULATION FUND (UNDF) (2016): Palestine 2030 - Demographic Change: Opportunities for Development – Ramallah -Palestine http://palestine.unfpa.org/publications/palestine-2030-demographic-change-opportunities-development#sthash.v2YvDjRB.dpuf

PALESTINIAN WATER AUTHORITY (PWA) (2016): National Water Sector Strategy (2016-2032)

3.3 Water Budget of the Israeli component

3.3.1 Introduction

According to the decision taken during the SALAM meeting held at the Dead Sea, Jordan, on 13-14/5/2016, the project area of the Israeli side will be geographically confined to the Lower Jordan Valley. Today, this area is not connected to the Israel National Water system and the water supply relies on local resources. However in view of the demand forecast, the regional master plan recommends to increase the water availability by importing water from external sources. Based on the meeting decision we present shortly the main figures of the Israeli National master plan (version of 2012) that was prepared by the Israel Water Authority subject to government resolution 2348. Then we provide water budget figures that are pertinent to the Lower Jordan Valley.

3.3.2 Israel Water Master Plan – key figures

The main goals and the water policy behind the master plan are:

- Water is an existential basic need for mankind and the environment.
- Water is an essential factor in the country development and in achieving its national goals.
- The natural sources of water will be rehabilitated and preserved as strategic assets.
- Operating lines and preservation goals will be set for all natural water reservoirs.
- Management of water extractions from the renewable natural water supplies will be sustainable and over-extractions will be avoided.
- Integrated management: the water sector will manage the natural and desalinated sources of water on an integrated basis.
- The Sea of Galilee: will mainly be designated for supplying water to the north of Israel, but will remain connected to the national system.
- Supply to the National System in central Israel and other connected regions will be based on seawater desalination with complementary form the natural resources.
- Effluent is mainly designated for agriculture and is part of the overall water management.
- The urban water supply systems and their measurement systems should be rehabilitated and upgraded.
- Preparations should be made for future peace arrangements and unilateral actions.

It is commonly acknowledged that overall natural replenishment in the country has been in decline in the last decades. The Israel Hydrological Service calculations claim that the actual average replenishment of fresh water is lower than 1.5 Billion CM/YEAR while it was of 1.7 Billion CM/YEAR a decade ago. The fresh component of the replenishment (salinity lower than 400 mg/L) is 1.2 MCM/Year and is expected to continue declining the coming decades to about 1 MCM/YEAR. Under these conditions, sweater desalination will remain in the foreseeable future the freshwater source that will close the gap between water demand (consumption) and the supply.

Table 17 summarizes the national balance from the National Master plan.

Table 17: Key components of the Israel water budget (version of 2012).

	2015			2025			2035		
	Demand [MCM]	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**
Agriculture	1,100	1,100	100	1,230	1,230	100	1,420	1,420	100
Industry	120	120	100	130	130	100	130	130	100
Domestic + tourism	980	980	100	1,180	1,180	100	1,360	1,360	100
***Environment**	150	150	100	140	140	100	130	130	100
TOTAL	**2,350**	**2,350**	**100**	**2,680**	**2,680**	**100**	**3,040**	**3,040**	**100**

* Environment: The actual amount is depending on water availability.

According to these estimations, approximately 800 MCM/year of desalinated water will be needed by 2025 and approximately 1000 MCM/year will be needed by 2035. One important decision of the Israel National Master Plan that will affect the future water supply to the Lower Jordan Valley is the decision that the water from the Sea of Galilee will mainly be allocated for supplying the north of Israel and surrounding areas such as Lower Jordan valley, Jordan and northern West Bank.

3.3.3 The Water balance of the Lower Jordan Valley

The last version of the master plan for the Israel water sector in the Lower Jordan valley was completed in 2015. The water supply is divided into three independent water supply areas (from North to South):

- Bardale,
- Central Lower Jordan valley (between Marj Naja and Bekaout in the north up to north Jericho in the south),
- Northern Dead Sea.

Today, the water supply relies only on local resources:

- fresh groundwater (Judea Group aquifer),
- brackish water from the Jordan River,
- storm water from Wadi Faria,
- secondary effluents from Nebi Musa WWTP and Og reservoir and
- brackish water from the springs along the western Dead Sea shore (Feshcha and Kane springs).

Agriculture is the main activity in the region. In the last decade, palm (date) plantations have become the major agricultural activity. The forecast is to double the area of the palm plantations (Israelis and Palestinians). The limitation to the expansion of this activity is water availability. Palm trees are irrigated with marginal water and therefore, we expect a deficit in marginal water for agriculture purposes. According to the master plan, the supply of brackish water to the area from Bardale in the north to North Jericho in the south will come from Northern Israel (Sea of Galilee and saline springs inside Bet Shean Valley). Additional water will be provided by direct pumping from the Jordan River and from Feshcha and Kane springs. Drilling of wells for brackish water from the Judea Group was proposed in SMART II. This recommendation is not mentioned in the Master Plan. The recommendation in SMART II was to produce 5 MCM/year. Northern Dead Sea will receive additional water from a new pipeline that will start in Malle Edumim. The source will be sea desalination water through the new fifth line that is now under construction. The fifth line will increase the water supply to Jerusalem metropolitan and to the surrounding cities (including the Palestinian cities).

3.3.3.1 Baseline Scenario

Table 18: Baseline (Conservative) Scenario – Lower Jordan Valley Water Demand (MCM/ year)

	2015			2025			2035		
	Demand [MCM]	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**	**Demand [MCM]**	**Supply [MCM]**	**Coverage [%]**
Agriculture	45.0	45.0	100	69.0	69.0	100	80.3	80.3	100
Industry	0.1	0.1	100	0.1	0.1	100	0.1	0.1	100
Domestic + tourism	8.6	8.6	100	10.2	10.2	100	12.6	12.6	100
Environment	0.0	0.0		0.0	0.0		0.0	0.0	0.0
TOTAL	**53.7**	**53.7**	**100**	**79.3**	**79.3**	**100**	**93.0**	**93.0**	**100**

The reason why the coverage is 100% during the all planning period is because the master plan cover the gap between the demand and the supply from outside sources – from Sea of Galilee to the central Lower Jordan Valley and from Jerusalem-Malle Edumim to the Northern Dead Sea area.

Table 19: Baseline (Conservative) Scenario - Brackish Water in Lower Jordan Valley.

Year	**Feasible Potential [MCM/a]**	**Planned Use [MCM/a]**	**Degree of Use [%]**
2015	6.2	5.3	85.5
2025	7.6	26	100
2035	8.5	32	100

According to the Master plan the region will need a significant amount of brackish water from external sources, such as springs in the Bet Shean Valley mixed with water from Sea of Galilee, additional pumping from the Jordan River and brackish water from Feshcha and Kane springs. Bringing the missing amount from these external sources will bring the degree of coverage to 100% as mentioned in Table 20.

Table 20: Baseline (Conservative) Scenario – Wastewater in Lower Jordan Valley.

Year	**Domestic Supply [MCM/a]**	**Estimated produced Wastewater [MCM/a]**	**Collected and treated [MCM/a]**	**Reused [MCM/a]**
2015			18.1	18.3
2025			20.4	19.3
2035			22.5	22.1

The source of the effluent is from Jerusalem metropolitan area. The effluent is transferred to the Jordan Valley via two routes and is stored in two reservoirs (Og and Nebi Musa) and from there supplied to the farmers for the irrigation of the palm plantations. Therefore, it is impossible to deduct the produced wastewater from the domestic supply. Nevertheless, the official percentage of produced wastewater from the domestic supply in Israel is 70%. The wastewater from the Og reservoir is destined to the agricultural area in Northern Dead Sea area and the Nebi Musa reservoir is destined to the central part of the Lower Jordan Valley. Sometimes wastewater is mixed with runoff water and or with brackish water to improve the quality before supplying to the farmers.

3.3.3.2 Optimistic Scenario

The baseline scenario and the optimistic scenario are the same because the solution in both scenarios is the same – bringing water from outside sources. However, for the reason of completeness it was decided to add the tables for the optimistic scenario.

Table 21: Optimistic Scenario - Water Demand: Lower Jordan Valley Water Demand (MCM/ year).

	2015			2025			2035		
	Demand [MCM]	Supply [MCM]	Coverage [%]	Demand [MCM]	Supply [MCM]	Coverage [%]	Demand [MCM]	Supply [MCM]	Coverage [%]
Agriculture	45.0	45.0	100	69.0	69.0	100	80.3	80.3	100
Industry	0.1	0.1	100	0.1	0.1	100	0.1	0.1	100
Domestic + tourism	8.6	8.6	100	10.2	10.2	100	12.6	12.6	100
Environment	0.0	0.0		0.0	0.0		0.0	0.0	0.0
TOTAL	**53.7**	**53.7**	**100**	**79.3**	**79.3**	**100**	**93.0**	**93.0**	**100**

Table 22: Optimistic Scenario - Brackish Water in Lower Jordan Valley.

Year	Feasible Potential [MCM/a]	Planned Use [MCM/a]	Degree of Use [%]
2015	6.2	5.3	85.5
2025	7.6	26	100
2035	8.5	32	100

Table 23: Optimistic Scenario – Wastewater in Lower Jordan Valley.

YEAR	Domestic Supply [MCM/a]	Estimated produced Wastewater [MCM/a]	Collected and treated [MCM/a]	Reused [MCM/a]
2015			18.1	18.3
2025			20.4	19.3
2035			22.5	22.1

3.3.4 Water Budget Summary by sources and demand sectors

3.3.4.1 Supplied Water to the LJV from local sources in 2015

Table 24: Sectorial water allocation for the year 2015 corresponding to the Baseline scenario.

	Domestic + Tourism [MCM/a]	Industry [MCM/a]	Agriculture / Irrigation [MCM/a]	Sum of supplied water to sectors	Estimated total water potential** [MCM/a]
Surface Water	0	0	1-2***	**1-2**	0
Desalinated Sea Water	0	0	0	**0**	0
Freshwater Springs	0	0	0	**0**	0
Groundwater	~4	~0.1	~28	**~32**	0
Brackish Water *			~3-5	**~3-5**	0
Treated Wastewater			~10-15	**~10-15**	0
Sum	**~4**	**~0.1**	**~42-50**	**~45-52**	**0**

* according to national classification

** total water potential of the respective source, consider and discuss feasibility

*** Jordan river water flowing

The local supply include wastewater flowing downstream from Jerusalem.

3.3.4.2 Supplied Water to the LJV from remote sources in 2015

There is no supply from external or remote sources.

3.3.4.3 Additional Sources of Water in the Jordan Valley 2025-2035

In the Master Plan the additional water for domestic industry and agricultural will come from outside sources. To the northern and central area, the additional water will come from the north: Sea of Galilee and brackish water from springs in Bet Shean valley. The southern area (Northern Dead Sea) will receive additional water from new wells in Mizpe Jericho well field and from a pipline coming from Male Edumim. This pipline bring water from the National Water Carrier (via Jerusalem).

3.4 Summary of Regional Water Budget

3.4.1 Additional required Freshwater Resources in Palestine and Jordan

In order to be able to substantiate the extent of the water crisis in Jordan and Palestine, water budget calculations have been carried out at the national level within the SALAM subproject. The SALAM initiative can now come up with water budget data which provides an idea about the magnitude of the water deficit problem in Jordan and Palestine, assuming that no counter-measures are undertaken. Since seawater desalination provides high-quality drinking water, the following figures focus on the needs of both countries for additional freshwater resources. Table 25 presents the water budget results for the years of 2015, 2025 and 2035. According to the results, the current freshwater deficit of both countries already amounts to about 783 million m³ per year (MCM/a), despite all the efforts of the water authorities to efficiently manage scarce water supplies.

Table 25: Need for additional freshwater resources (MCM a) in Jordan and Palestine for the planning period from 2015 to 2035

2015	FRESHWATER JORDAN	Nat. Sources	Demand	Deficit	FRESHWATER PALESTINE	Nat. Sources	Demand	Deficit	TOTAL
	Current Production	1.062			Current Production	234			
	Additional Sources	0			Additional Sources	0			
	TOTAL	1.062	1.451	389	TOTAL	234	628	394	783
2025	FRESHWATER JORDAN	Nat. Sources	Demand	Deficit	FRESHWATER PALESTINE	Nat. Sources	Demand	Deficit	TOTAL
	Current Production	1.062			Current Production	234			
	Additional Sources	166			Additional Sources	88			
	TOTAL	1.228	1.783	555	TOTAL	322	910	588	1.143
2035	FRESHWATER JORDAN	Nat. Sources	Demand	Deficit	FRESHWATER PALESTINE	Nat. Sources	Demand	Deficit	TOTAL
	Current Production	1.062			Current Production	234			
	Additional Sources	176			Additional Sources	178			
	TOTAL	1.238	2.030	792	TOTAL	412	1.300	888	1.680

As the water potential of the region is almost exhausted, only a small amount of additional freshwater reserves can be utilized in the coming years, so that the increasing water demand will lead to a permanently rising freshwater deficit, provided that no counter-measures are undertaken.

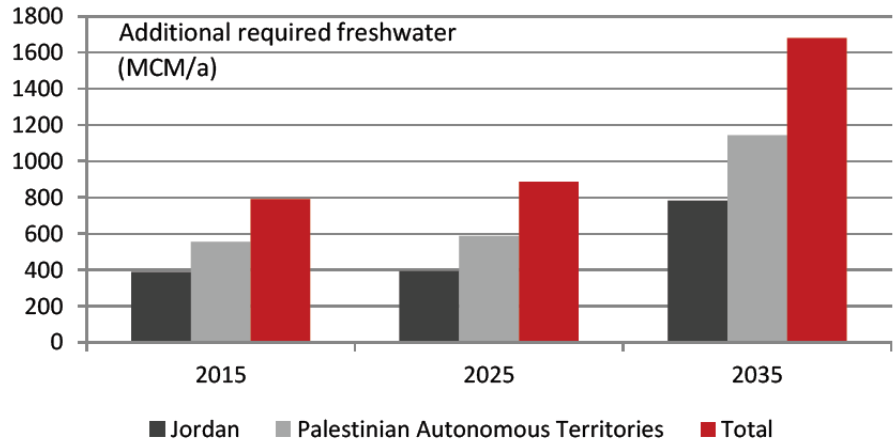

Figure 9: Additional required freshwater resources in 2015, 2025 and 2035

According to SALAM forecasts, both countries will need additional freshwater resources of approximately 1,680 MCM/a by 2035. These amounts of water are not available in the region and must be covered by external water resources by means of water imports. According to SALAM, the enormous amounts of water required can be provided by seawater desalination alone. The solution developed for the imminent water crisis in the Middle East is based on these conclusions of the SALAM research. Figure 9 presents the water budget results graphically. The politically complicated Palestinian water right issue, including water and non-water related measures, has not been considered in the present research and will be discussed between the countries in the final status negotiations.