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

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Subproject SALAM

Securing Water Availability to the Lower Jordan Valley by Regional Water Resources Management Strategies

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SALAM
in SMART-MOVE

Deliverable No. 5:

Indicator Selection and their Assessment

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

Subproject "Securing Water Availability to the Lower Jordan Valley by Regional Water Resources Management Strategies (SALAM)"

Deliverables DS 5

Title:

Indicator Selection and their Assessment

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1 Introduction

The SALAM initiative is funded by the German Federal Ministry of Education and Research (hereafter BMBF) in the context of the SMART-MOVE IWRM project. This research project investigates the current and future water budgets in Israel, Jordan and Palestine, evaluates the current and expected water deficits and subsequently the additional water resources that will be required to compensate them in the next two decades. It suggests five so-called Water Production and Transport Options (SALAM WPOs, SWPO) to resolve the water deficit problem in the region. All SWPO's will rely on the desalination of seawater at different locations and transport of freshwater to demand centres in the region. The group of experts from the region worked under the leadership of the Georg-August-University of Göttingen and Rusteberg Water Consulting, receiving support from the National stakeholders MWI (Jordanian Ministry of Water and Irrigation), PWA (Palestinian Water Authority) and MEKOROT (Israel National Water Company).

During the last two decades, Israel has engaged into massive seawater desalination and large-scale reuse of treated effluent in irrigated agriculture. These two measures have dramatically improved the water supply situation in Israel. They ensure the matching of the Israeli water demand and supply for the next decades, in a way that is independent of the climatic conditions.

Jordan has done all possible efforts to develop his water resources, including conventional and non-conventional sources of water, but the country is increasingly suffering from water shortages. These shortages will become far more acute in the near future because of population growth, influx of refugees as well as long periods of droughts and dry years, possibly resulting from climate change. The latter has a major impact on the availability of surface and groundwater in the region. Spring discharges, groundwater levels and even the natural inflow to the Lake Tiberius steadily decreases, seriously reducing the water available for abstraction. Palestine, despite all efforts, suffers from similar conditions.

SALAM claims that seawater desalination is the key solution for the water problems in Jordan and Palestine. SALAM WPOs rely on three key concepts: Seawater desalination, transport to demand areas and water swap operation between the three parties to minimize to the maximum extent water transportation costs.

In addition, SALAM addresses the rehabilitation of two key environmental assets of the region: The Dead Sea, whose water level needs to be stabilized and the Lower Jordan River, which for decades lacks base flow with adverse effects on local groundwater flow and the ecosystem in the alluvial plain.

2 The SALAM WPOs

In order to resolve the problem, the SALAM initiative investigates five water production and transport options (listed below). According to table 1, SALAM WPO 1 and 5 further consider 3 different levels of water production by seawater desalination, given in million m³ per year (MCM/a). The SALAM WPOs are:

SALAM WPO 1: Desalination plant(s) at the Red Sea and transport by pipeline to demand areas in Jordan and southern Israel (city of Eilat) , partially in exchange for additional Israeli water supply to the north of Jordan, beyond the already existing water supply from Israel to Jordan amounting to about 50 MCM/a (red arrows). The substantial extension of the seawater desalination plant at Aqaba, currently under tendering, and water transfer to Amman is being taken into consideration by SALAM WPOs 1-1 and 1-2.

SALAM WPO 2: Seawater desalination at the Israeli Mediterranean coast near the city of Netanya, due to the very short distance to the Palestinian territories (less than 10 km), transport by pipeline to the city of Tul-Karem and from there to demand areas in the northern West-Bank.

SALAM WPO 3: Desalination plant at the Mediterranean coast of Palestine (Gaza Strip) for local water supply together with an additional pipeline from the desalination plant to the city of Hebron, crossing Israeli territory, and from there to other Palestinian cities. Due to high water cost (table 1), alternative water SWAP options between Israel and Palestine could be more appropriate and should be studied during the next phase of the project, should it be funded.

SALAM WPO 4: This option refers to the original Dead Sea-Red Sea Canal project as potential long-term solution for the region, aiming at stabilizing the Dead Sea and transporting substantial amounts of drinking water to the area, investigated by the World Bank (Coyne et Bellier, 2012).

SALAM WPO 5: Desalination of seawater in the Western Galilee, north to the city of Haifa, water transport to Lake Tiberius for storage and from there, transport to demand areas and or reservoirs in Jordan and Palestine. The water transport to the Lake may be achieved in different ways: by reverting the flow direction of the Israeli Water Carrier (IWC) between the Haifa area and the Lake, a pipeline parallel to the IWC (using the already allocated land for the IWC) or the construction of a tunnel. This option could result in the production of considerable amounts of water, far larger than the already existing water transfer between Israel and Jordan of 50 MCM/a (red arrows).accordıng Wadı Araba agreement

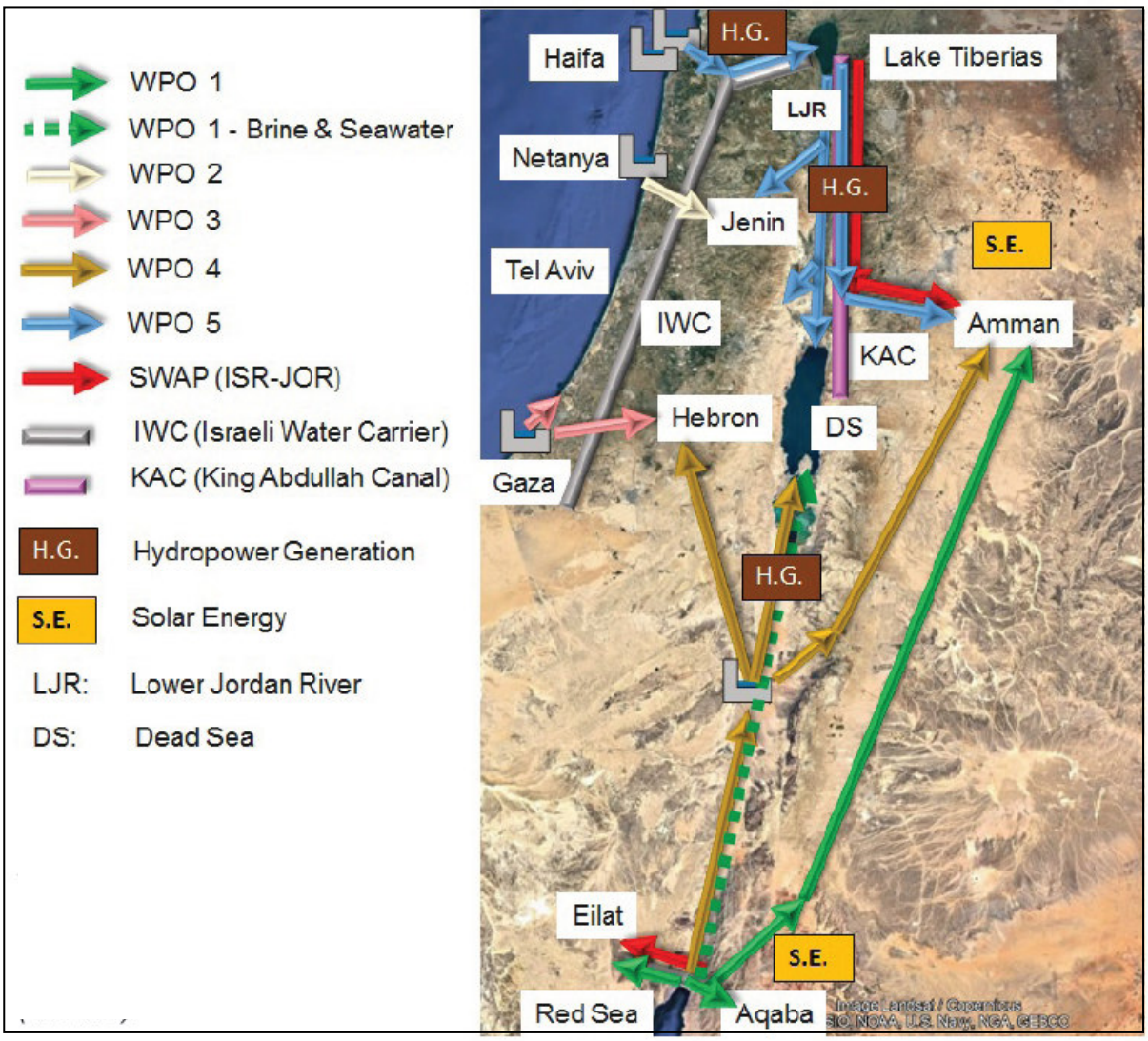

Figure 1: Schematic presentation of the SALAM-WPOs

3 Research Objectives

The SALAM project deliverable DS5 addresses the following objectives:

- Selection and assessment of social, environmental, economic, technical, financial and political indicators in order to evaluate viability and performance of each of the SALAM Water Production and Transfer Options;
- Discussion of the benefits and drawbacks of each of the SALAM WPOs;
- Assessment of water cost (US$/ m³) for each option;
- Development of a performance matrix for option comparison.

4 Indicator Selection

Indicators are produced and used worldwide across all levels and sectors by public, private and civil society for a variety of purposes from knowledge provision to administrative control. Indicators are generally expected to enhance the rationality of policy-making and public debate by providing an objective, transparent, robust and reliable information base (Lehtonen 2015), representing a state or a trend over a given area and time period. Indicators can be any quantitative or qualitative measure used to assess the state of a process, system or entity or its performance relative to a benchmark. They identify relative positions to facilitate comparison and, if measured over time, help identify trends over time and help assess progress of certain interventions, or, on the contrary, inaction (OECD 2008).

The choice of indicators is important as to whether it gives sufficient 'sense of the bigger picture'. Indicators have two core functionalities: providing system information to the project team (responsible organization), the public and policy makers; translating data into policy relevant information. Indicators allow describing, and showing trends and communicating the results of implementing objectives.

Table 1: Indicator Selection

Technical	Financial	Economic	Social	Environmental	Political
Access to water	International donors willingness to support	Affordability	Vulnerability	Dead Sea Rehabilitation	Acceptancy
Risks	International funding opportunity	Water price	Farmers behavior /Attitude ın case the prıce not affordable	Mitigation of climate change	Internal political acceptancy
Implementability	Water cost ($/m^3)	Capital Costs (UD$)	Social conflict	Possible adverse impacts	water independency
Duration of implementation		Economic develop.	Employment		Regional political acceptancy
			Poverty		
			Civil society and stakeholders position		
			Water ownership and water rights		

The selection of the SALAM indicators was done over different stages and intensive discussions between the team members from Jordan Palestine and Israel. A structured questionnaire was prepared so that the respondents could answer the questions

electronically. Each question had a scale of agreement ranging between 1 to 5 (1 for low agreement and 5 for high agreement). Some questions were qualitative such as social aspects and some were quantitative such as the costs (Table 1). Table 1 shows six main groups of the selected indicators (i.e. technical, financial, etc) and within each indicator group different sub-indicators were selected. The respondents were categorized and identified as experts from academy, government officials, mainly, from the relevant ministries or agencies. and experts from the private sector and NGO's. Scores of respondents were registered and entered in a table of Excel and averages for each indicators groups were estimated and normalized to be comparable to other groups.

5 Indicator Assessment

5.1 Qualitative Indicator Assessment for Jordanian Options

This part will discuss the results of respondents scoring for each indicator group separately and for the three different water supply options of Jordan namely SALAM WPOs 1-0, 1-1 and 1-2 (also named as E0, E1 and E2 in DS4). SWPO 1 group concentrates on Desalinated Sea Water (DSW) production at the Red Sea and transfer to Jordan and Israel and to the Dead Sea. There are the above mentioned three different options that can be considered as project development stages. The **WPO 1-0 (E0)** is aiming at desalinating Sea Water at Aqaba and transfer about 30 MCM annually to Aqaba city and 50 MCM to Eilat city in Israel, in addition to this 235 MCM brine and Sea Water to the Dead Sea Via a pipe. The **WPO 1-1 (E1)** is considered a second stage to SALAM WPO 1-0, which aims at desalinating Sea Water at Aqaba and transfer about 30 MCM annually to Aqaba city and 50 MCM to Eilat city in Israel, in addition to this 330 MCM brine and Sea Water to the Dead Sea and additional 150 MCM desalinated Sea Water and transferred to Amman Via a pipe. The third option or stage is the **SWPO 1-2 (E2)** which is the same as SWPO 1-1 (E1) but with an increase in the quantity of the desalinated Sea water that will be 420 MCM and will be pumped to the state capital Amman.

5.1.1 Technical Indicators

The technical indicators for the Jordanian water production options were access to sea water whether it is accessible to be transferred over a certain distance, this indicator was decreased as we move from E0 (transfer it to Aqaba) to E2 (transfer it to Amman). Other indicators were if the project was risky or implementable or not from the technical point of view and again the rating was 4 of 5 for option E0 and decreased as the distance and the quantity of desalinated water increased for E1 and E2. The Last technical indicator was in favor of options E1 and E2 because the respondents think that once E0 implemented the

time needed for implementing E1 and E2 will be relatively shorter from the technical point of view.

Table 2: Assessment of the Technical indicators of Jordan

WPO (Technical Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	E1	E2	E0	E1	E2
Jordanian WPO		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
Access to water	access to water from the sea	0= difficult to access, 5= easy to access	4	2	1	0.8	0.4	0.2
Risks	probability of project failure	0 = High risk failure, 5= low risk failure	4	3	0	0.8	0.6	0
Implementability	easy to implement the project without technical difficulties	0= hard to implement, 5 = easy to implement	4	3	1	0.8	0.6	0.2
Duration of implementation	length of project implementation in years	0= short period, 5= long period	2	3	5	0.4	0.6	1
Normalized Weighted Average						0.7	0.55	0.35
Relative Importance (points)							15.00	
Weighted Scores						10.50	8.25	5.25

5.1.2 Financial Indicators

From the financial point of view, the respondents think that the willingness of the International donors to finance the Dead Sea – Red Sea project over its three phases, will E0, E1 and E2 will decrease as the cost of the project increases especially that these donors are dealing with region with poor natural resources in addition to other factors that reduce the attractiveness of international donors to finance this project. However, when the project's technical and economical feasibilities prove viable, it will be easier for Jordan to get funds to implement E1 and E2 phases of the project (Table 3).

Table 3: Assessment of the financial indicators of Jordan

WPO (Financial Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	**E1**	**E2**	**E0**	**E1**	**E2**
Jordanian WPO		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
International donors willingness to support	degree of International donors willingness to finance the project	0 = Very Low, 5= Very High	**5**	**3**	**2**	1	0.6	0.4
International funding opportunity	attractiveness of International funding of the project	0 = Very Low, 5= Very High	**4**	**3**	**3**	0.8	0.6	0.6
Normalized Weighted Average						0.90	0.60	0.50
Relative Importance (points)							25.00	
Weighted Scores						22.50	15.00	12.50

5.1.3 Economic Indicators

There were four main economic indicators those are: Affordability, water cost, capital costs and the contribution to the economic development. Results shows that the affordability of Jordan to implement this project will decrease as we go from E0 to E2 due to the increased high related capital costs and the need for fund which will consequently increase. On the other hand, the water cost per cubic meter of desalinated water will gradually decease as we move from option E0 to E2 due to effect of the economies of scale where the total fixed costs will decrease per cubic meter of water when the volume of desalinated water increases. As a results the role option E2 will contribute more and more in the economic development of Jordan due to increase of water availability for all economic sectors in the country(Table 4)

Table 4: Assessment of the economic indicators of Jordan

WPO (Economic Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	**E1**	**E2**	**E0**	**E1**	**E2**
		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
Affordability	affordable and capable by country to implement the project	0 = low affordability, 5 = highly affordable	4	3	1	0.8	0.6	0.2
Water price ($/m^3)	the cost of produced water compare to existing alternatives	0= very high, 5= very low to current water price	2	3	4	0.4	0.6	0.8
Capital Costs (UD$)	The magnitude of the capital cost of the project	0 = low CAPEX, 5 = High CAPEX	0.5	3	5	0.1	0.6	1
Economic development	The role and contribution of the project in the economic development	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
Normalized Weighted Average						0.38	0.60	0.75
Relative Importance (points)							25.00	
Weighted Scores						9.38	15.00	18.75

5.1.4 Social Indicators

Table 5 shows the all the social indicators were in favor the E2 option of the project due to the following reasons: (1) the project will compensate to high degree in alleviating the shortages and water quantity will be more stable, (2) Farmers will be supportive to the project because it will share from irrigation water no matter what quality of water is, (3) more employment opportunities in all sectors and as a result poverty will be relatively alleviated and (4) the water security in terms of water rights and ownership will get more stable.

Table 5: Assessment of the Social indicators of Jordan

WPO (Social Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	E1	E2	E0	E1	E2
Jordanian WPO		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
Vulnerability	The role of project to alleviate water vulnerability of people in the country	0 = Very Low, 5= Very High	2	4	5	0.4	0.8	1
Farmers behavior /Attitude	farmers' attitudes toward project	0 = Very Low, 5= Very High	0	3	5	0	0.6	1
Social conflict	reducing social conflict between stakeholders	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
Employment	Increasing employment opportunities	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
Poverty	Role of project in poverty alleviation	0 = Very Low, 5= Very High	2	3	5	0.4	0.6	1
Civil society and stakeholders position	attitudes of civil society toward project	0 = Very Low, 5= Very High	3	4	5	0.6	0.8	1
Water ownership and water rights	degree of securing water ownerships and water right	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
Normalized Weighted Average						**0.29**	**0.66**	**1.00**
Relative Importance (points)							**10.00**	
Weighted Scores						**2.86**	**6.57**	**10.00**

5.1.5 Environmental Indicators

Results in Table 6 shows that From the environmental point of view, the implementation of the E2 option of the project will rehabilitate the Dead Sea and this would compensate in saving the tourism sector not only in the Jordan rift valley but also in Jordan. I addition E2 option proves that there will almost no possible adverse impacts on the environment of the Dead Sea area or any possible damage of subsequent pollution of fresh and brackish water aquifers.

Table 6: Assessment of the environmental indicators of Jordan

WPO (Environmental Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	**E1**	**E2**	**E0**	**E1**	**E2**
Jordanian WPO		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
Dead Sea Rehabilitation	The degree of the project in Dead Sea Rehabilitation and raising sea level	0 = Very Low, 5= Very High	2	4	5	0.4	0.8	1
Mitigation of climate change	The role of the project on climate change mitigation and adaptation	0 = Very Low, 5= Very High	1	3	4	0.2	0.6	0.8
Possible adverse impacts	area of seismic activity possible damage to channel and subsequent pollution of fresh and brackish aquifer.	0 = high adverse impact, 5= very low impact	3	4	5	0.6	0.8	1
Normalized Weighted Average						0.40	0.73	0.93
Relative Importance (points)							5.00	
Weighted Scores						2.00	3.67	4.67

5.1.6 Political Indicators

From the political point of view, results show that all project options are accepted (i.e especially option E2) at national level and regional level as well, because this project will increase the availability of water to Jordan. In addition, the nature of project will compensate to high degree in stabilizing water security and independency of decision making for water as well (Table 7).

Table 7: Assessment of the political indicators of Jordan

WPO (Political Indicators)	Explanation	Score explanation	E: DSW production at RS and transfer to Jordan and Israel			Normalization of the indicators		
			E0	**E1**	**E2**	**E0**	**E1**	**E2**
Jordanian WPO		see figure 1	1-0	1-1	1-2	1-0	1-1	1-2
Acceptancy	acceptability of decision makers	0 = Very Low, 5= Very High	2	3	5	0.4	0.6	1
Internal political acceptancy	acceptance of local civil society of the project	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
water independency	independent in decision making	0 = Very Low, 5= Very High	5	4	4	1	0.8	0.8
Regional political acceptancy	acceptance of regional society of the project	0 = Very Low, 5= Very High	1	3	5	0.2	0.6	1
Normalized Weighted Average						0.45	0.65	0.95
Relative Importance (points)							20.0	
Weighted Scores						9.0	13.0	19.0

5.1.7 Summary and Conclusions

Table 8 shows that the economic, financial and political factors are the most important factors the determine the implementation of SALAM WPO 1 (Figure 2). In general, Option 1-2 (E2) will have the greatest impact in solving water scarcity and its related water issues in Jordan. 3 shows that all E option has more than 50% scores, however this percentage increases as water availability increases and in this case option E2 has registered 70% score.

Table 8: Summary of WPO indicators of Jordan

WPO Indicators	Relative Importance	E0	E1	E2
Jordanian WPO		1-0	1-1	1-2
Technical	15	11	8	5
Financial	25	23	15	13
Economic	25	9	15	19
Social	10	3	7	10
Environmental	5	2	4	5
Political	20	9	13	19
Project Ranking	**100**	56	61	70

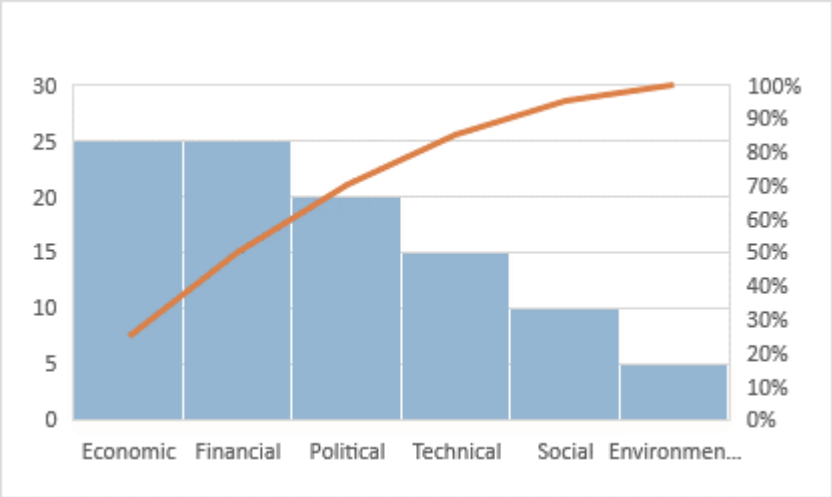

Figure 2: Relative importance of different indicator Groups of Jordanian SWPO 1 (E)

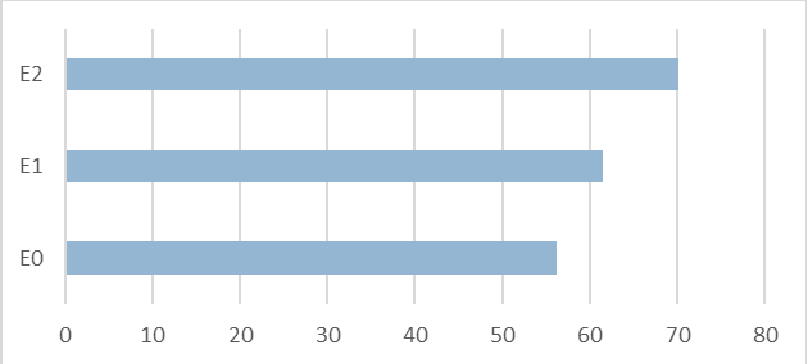

Figure 3: Effectiveness and performance of 1-0, 1-1 and 1-2 (E0, E1 & E2) project options including all project WPO indicators for Jordan

5.2 Qualitative Indicator Assessment for Palestinian Options

This section will clarify the technical, financial , social , environmental and political indicators from the Palestinian perspective towards the C1: Extension of the existing Hadera desalination plant in the Mediterranean coast of Israel, pipeline to the city of Jenin along the Hadera River. C2 : Desalination plant in the Mediterranean coast of Palestine at Gaza to attend to local demand of the strip and water swap between Gaza and Israel in benefit of Hebron, However the social and economic indicators highly depends on the political atmosphere at local and regional levels .

5.2.1 Technical Indicators

The technical indicators for the Palestinian water production options were extension of the desalination plant of Hadera . the construction of sea water desalination plant in Gaza .regarding the access of water from Hadera plant technically is possible and feasible to be implemented since the distance from the supply to demand center very short distance , no need to high pumping cost. In case of C2 option the high elevation differences (Gaza – Hebron) needs high cost of pumping which make the water cost vey high and the duration of implantation in case of C1 is shorter than C2 (table 9).

Table 9: Assessment of the Technical indicators of Palestine

WPO (Technical Indicators)	**Explanation**	**Score explanation**	**C1: Netanya C2: Gaza**		**Normalization of the indicators**	
			C1	**C2**	**C1**	**C2**
Palestinian WPO		see figure 1	2	3	2	3
Access to water	access to water from the sea	0= difficult to access, 5= easy to access	4	4	0.8	.08
Risks	probability of project failure	0 = High risk failure, 5= low risk failure	2	3	0.4	0.8
Implementability	easy to implement the project without technical difficulties	0= hard to implement, 5 = easy to implement	5	2	1	0.8
Duration of implementation	length of project implementation in years	0= long period, 5= short period	2	1	0.4	0.4
Normalized Weighted Average					**0.65**	**0.5**

Relative Importance (points)						**15**
Weighted Scores					**9.75**	**7.50**

5.2.2 Financial Indicators

The financial indicators highlights the willingness of international community to fund the options and the indicators of funding opportunities.

The evaluation of two financial indicators showed that the international donors willing to support both options but they prefer the C1 slightly more than C2 since the donors they willing to increase the cross- borders cooperation and the sustainability of C1 is more solid , since Gaza is very fragile situation.

Table 10: Assessment of the financial indicators of Palestine

WPO (Financial Indicators)	**Explanation**	**Score explanation**	**C1: Netanya C2: Gaza**		**Normalization of the indicators**	
			C1	**C2**	**C1**	**C2**
Palestinian WPO		see figure 1	2	3	2	3
International donors willingness to support	degree of International donors willingness to finance the project	0 = Very Low, 5= Very High	**4**	**3**	1	1
International funding opportunity	attractiveness of International funding of the project	0 = Very Low, 5= Very High	**4**	**3**	.8	1
Normalized Weighted Average					**0.8**	**0.6**
Relative Importance (points)						**25.00**
Weighted Scores					**20.00**	**15.00**

5.2.3 Economic Indicators

Since the option C2 will create high cost of water (AIC.0,47 US$/m$^{3)}$) due to the long distance and pumping cost , the affordability of people will be so low ,

The C1 option cost wise is affordable (AIC.0,31 US$/m$^{3)}$), the capital cost of C2 around 600 Million US$ and around 200 Million Pipelines and storage facilities in addition to the M&O costs . The Palestinian decision makers preferring the C2 option to remain in Gaza to meet the growing demand (table 11).

Table 11: Assessment of the economic indicators of Palestine

WPO (Economic Indicators)	**Explanation**	**Score explanation**	**C1: Netanya C2: Gaza**		**Normalization of the indicators**	
			C1	**C2**	**C1**	**C2**
Palestinian WPO		see figure 1	2	3	2	3
Affordability	affordable and capable by country to implement the project	0 = low affordability, 5 = highly affordable	3	1	0.6	0.2
Water cost ($/m^3)	the cost of produced water compare to existing alternatives	0= very high, 5= very low to current water price	3	2	0.8	0.6
Capital Costs (UD$)	The magnitude of the capital cost of the project	0 = low CAPEX, 5 = High CAPEX	3	3	0.6	1
Economic development	The role and contribution of the project in the economic development	0 = Very Low, 5= Very High	3	3	0.6	0.8
Normalized Weighted Average					0.65	0.45
Relative Importance (points)						25.00
Weighted Scores					**16.25**	**11.25**

5.2.4 Social Indicators

The desalination Plant in Gaza will really improve the social indicators in Gaza itself however to transfer water to demand center in Hebron will have very minor impact, the fragility of social situation in Gaza will impact negatively the project,

Regarding C1 will contribute to solve the social conflict and the unjust water distribution among Palestinian, which will lead to reduce the social conflict; however the public awareness and intensive consultation with stakeholders will improve the social acceptance of C1 option (table 12).

Table 12: Assessment of the Social indicators of Palestine

WPO (Social Indicators)	Explanation	Score explanation	C1: Netanya C2: Gaza		Normalization of the indicators	
			C1	C2	C1	C2
Palestinian WPO		see figure 1	2	3	2	3
Vulnerability	The role of project to alleviate water vulnerability of people in the country	0 = Very Low, 5= Very High	1	3	0.2	0.8
Farmers behavior /Attitude	farmers' attitudes toward project	0 = Very Low, 5= Very High	2	1	0.4	0.6
Social conflict	reducing social conflict between stakeholders	0 = Very Low, 5= Very High	2	2	0.4	0.6
Employment	Increasing employment opportunities	0 = Very Low, 5= Very High	3	3	0.6	1
Poverty	Role of project in poverty alleviation	0 = Very Low, 5= Very High	2	3	0.4	0.8
Civil society and stakeholders position	attitudes of civil society toward project	0 = Very Low, 5= Very High	1	1	0.2	1
Water ownership and water rights	degree of securing water ownerships and water right	0 = Very Low, 5= Very High	3	2	0.6	1
Normalized Weighted Average					**0.40**	**0.43**
Relative Importance (points)						**10.00**
Weighted Scores					**4.00**	**4.29**

5.2.5 Environmental Indicators

Since Gaza people has a narrow coast to do fisheries (according Oslo Agreement) the environmental impact of damping Brine water (produced by desalination plants) at long run will have high impact on ecology of the cost and un-predictable impact on fisheries, both C1 and C2 wll be a good measure measures to adapt climate change and these measures will optimized if the solar energy has been introduces as integrate to the water measures (for production and pumping).

Table 13: Assessment of the environmental indicators of Palestine

WPO (Environmental Indicators)	**Explanation**	**Score explanation**	**C1: Netanya C2: Gaza**		**Normalization of the indicators**	
			C1	**C2**	**C1**	**C2**
Palestinian WPO		see figure 1	2	3	2	3
Dead Sea Rehabilitation	The degree of the project in Dead Sea Rehabilitation and raising sea level	0 = Very Low, 5= Very High	0	0	0	0
Mitigation of climate change	The role of the project on climate change mitigation and adaptation	0 = Very Low, 5= Very High	4	1	0.8	0.4
Possible adverse impacts	area of seismic activity possible damage to channel and subsequent pollution of fresh and brackish aquifer.	0 = high adverse impact, 5= very low impact	3	2	0.6	0.8
Normalized Weighted Average					**0.47**	**0.20**
Relative Importance (points)						**5.00**
Weighted Scores					**2.33**	**1.00**

5.2.6 Political Indicators

The political indicators are highly depending on the negotiation between Palestinian and Israelis and at the situation at regional levels, However the Palestinian decision makers are working to construct Gaza desalination plant to meet growing demand and they consider this project is a top priority. Nowadays there are no plans to transfer it to Hebron , currently both sides have low profile negotiations for C1 with minor modifications such as to import mix water (ground water and desalinated)

Table 14: Assessment of the political indicators of Palestine

WPO (Political Indicators)	Explanation	Score explanation	C1: Netanya C2: Gaza		Normalization of the indicators	
			C1	C2	C1	C2
Palestinian WPO		see figure 1	2	3	2	3
Acceptancy	acceptability of decision makers	0 = Very Low, 5= Very High	2	3	0.6	0.6
Internal political acceptancy	acceptance of local civil society of the project	0 = Very Low, 5= Very High	2	3	0.4	0.6
water independency	independent in decision making	0 = Very Low, 5= Very High	2	3	0.4	0.6
Regional political acceptancy	acceptance of regional society of the project	0 = Very Low, 5= Very High	2	4	0.4	0.8
Normalized Weighted Average					**0.45**	**0.65**
Relative Importance (points)						**20.00**
Weighted Scores					**9.00**	**13.00**

5.2.7 Summary and Conclusions

The following table 15 indicates that the political and economic and financial indicators are the most important without underestimate the environmental and social indicators ,

However , based on the willingness of both sides (Palestinians and Israelis) to meet the water demand of Palestinians , in addition to the willingness of international community and donors to reduce the conflict on water and to support the cross-border cooperation and to meet the Palestinian demand the C1 and C2 are acceptable options ,

The C1 will contribute remarkably the water demand in north of Palestine and C2 in cas4 of implemented will meet Gaza demand however C2 is not an option to transfer water to Hebron due to the high cost and low affordability

Table 15: Summary of WPO indicators of Palestine

WPO Indicators	Relative Importance	C1	C2
Palestinian WPOs		**2**	**3**
Technical	15	10	8
Financial	25	20	15
Economic	25	16.25	11.25
Social	10	4	4
Environmental	5	2	1
Political	20	9	13
Project Ranking	**100**	**61**	**52**

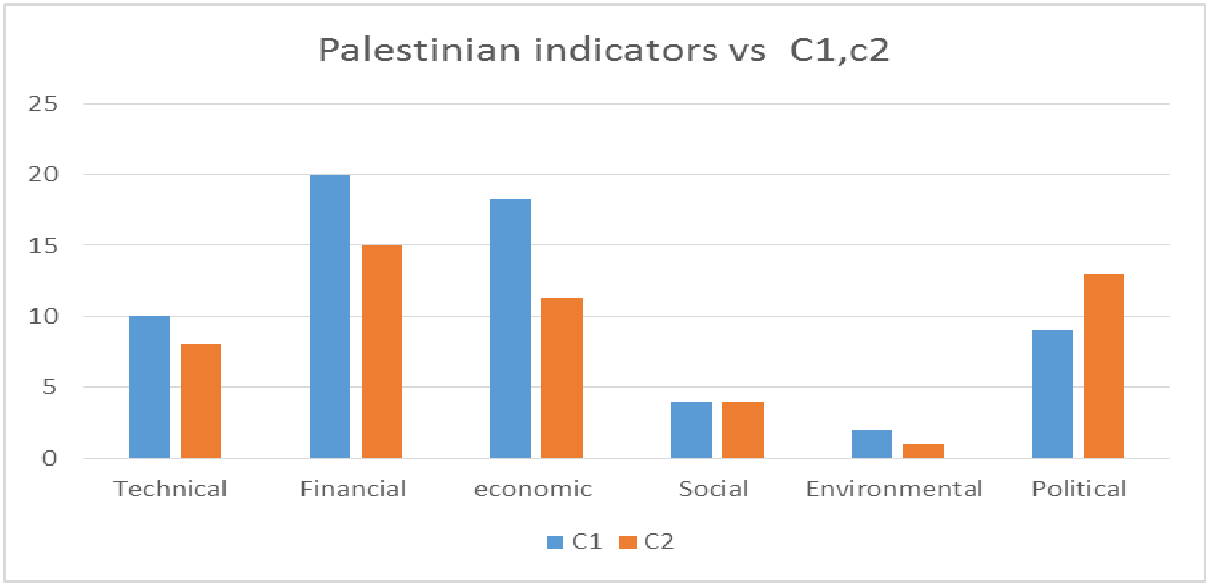

Figure 4: Indicator Analysis for Palestinian Options

5.3 Qualitative Indicator Assessment for Israeli Options

The so-called Israeli options are basically plans for providing freshwater at large scale to the LJV, where most of the consumers are not Israelis. They rely on the desalination of seawater in the northern part of the Israel Mediterranean coast, transport of the desalinated water via a tunnel to Lake Tiberius for temporary storage and from there to large consumer areas in Jordan and Palestine. It is on par with the solutions suggested by the Dead Sea – Red Sea canal, as the investigated amounts of water range between 250 and 1,000 MCM/Yr. The Israeli demand for fresh water all demand types included (from domestic to agricultural) are far smaller than the considered volumes. Consequently, there is no point in ranking the Israeli WPOs from an Israeli perspective, in a way parallel to the evaluation and ranking done for the other WPOS (Palestinians and Jordanians). They key issues related to the implementation of the Israeli WPOS are:

1. The location of the desalination plant (north of Haifa). There is a substantially high opposition from the population living in this area to large infrastructure projects, which needs to be addressed;
2. The path of the tunnel transporting water from the desalination plant to the Lake Tiberius. It must be refined so to avoid any conflict with the constraints set by natural reservations areas.
3. The power production plant near the lake will required the allocation of land.

From Palestinian perspective, in spite of the fact that the Israeli options are technically feasible, however, the water price for consumer and the impact on socio-economic conditions of the household economy are the major concerns. From the political economy point of view, the type of social agenda of the Palestinian Authority will be important (such as subsidy, fair and just water tariff system, pro-poor water pricing) .

However, all those concerns can be solved in the framework of long term cooperation agreement and stability conditions. In this case, the socioeconomy of Palestinians will be able to accommodate the anticipated price of water .

The Palestinian long term water sector strategy highlighted the possibility of regional cooperation and cross-bounder water SWAP in order to enable the Palestinians to meet the growing water demand due to the expansion of agriculture and high population growth.

6 Estimation of Average Incremental Costs (AIC)

6.1 Economic Background

Decision makers in the water sector are continuously faced with the problems of water scarcity and management difficulties to meet the increasing demands. Often, decisions are based on how to increase the supply of waters in quantitative and qualitative terms or the better management of existing supply. In most cases, financial assessment is the major determinant. Unfortunately, these financial assessments for decision-making often forego the economic dimensions as well as environmental costs of suggested activities, particularly in relation to efficiency and effectiveness (Gerasidi et al., 2003). Benefit cost analysis and cost effectiveness are argued to be one of the most suitable "tools" for helping planners and decision makers identify the most suitable and effective approaches and strategies for addressing the various water management related problems. It is to be stressed that effectiveness should be addressed from economic, social, and environmental perspectives.

From an economic perspective, efficiency could be achieved when "social net benefits" (social benefits minus social costs) of an economic activity are at their maximum. However, identifying the total social cost is not easy. In many cases, the real value might not be properly calculated and, hence, we might end by either overvaluing or undervaluing the various components involved. Economists believe that water resources misuse and over-exploitation, and ultimately prevalence of inadequate governance, is mainly due to ignoring the real value of water. It is widely argued that economic efficiency, that takes into account the real value of water, would prevent excessive use of water resources and deterioration of quality (Birol et al, 2006). Adoption of appropriate economic analysis approaches can provide the decision makers with an effective tool for measuring the various alternatives they have in governing the water sector and hence in formulating their strategies and plans.

Economic efficiency could assist water-related policy and decision makers in selecting more economically efficient options and alternatives to meet the water needs at present and in the future. From an economic perspective, assessment is based on the notion that available resources are not sufficient to meet all the needs and requirements of different goods and services of the community, and thus available resources should be utilized in an efficient way so that to allow maximizing community welfare. The principle of economic efficiency could be seen from two perspectives; the first is based on maximizing the quantities produced of goods and services using available resources (i.e., maximizing the difference between available resources used and the goods and services produced). The second perspective is concerned with attempting to achieve a certain level of production using minimum resources possible (i.e., attaining the needed goods and services using fewer resources). It should be noted that there are two approaches depending on the perspectives presented above; the first approach, the cost-benefit analysis, is based on the former perspective, while the

second approach, the cost-effectiveness, is lying on the latter perspective of economic efficiency.

The basic concerns of economic analysis are the allocation of scarce resources and the relation of the value of those resources to their scarcity and allocation. The fact that water is essential for human life makes it and its allocation critical, but that does not exempt it from the applicability of the principles of economics. There are differences worldwide between those who would treat water as a private economic commodity and those who insist that it is a public good with a critical social dimension. The defenders of the first notion advocate the transfer of water to private sector, whereas the defenders of the second defend keeping water within the realm of the public sector (Cloran and Willamette, 2011; Gies, 2009). The standard answer given by economists to the question of the best allocation of a natural resource is that it should be made through the mechanism of the private markets. That answer is often correct, but only if certain conditions hold: 1) The market for the resource must be competitive, with many buyers and sellers; 2) All social costs and benefits involved in the use of the resource must be accounted for, so that they are reflected in the profit-and-loss decisions of firms and the economic choices of consumers; and 3) the rate at which future costs and benefits are discounted by society must also coincide with the private discount rate. At least, the first two of these conditions, and quite possibly, the third, do not hold in the case of water, and definitely not for water in most of the Middle East countries that face severe water scarcity.

6.2 Average Incremental Cost (AIC)

The AIC of water benefits is the present value that reflects the incremental cost to the economy of supplying additional demand. The AIC allows for the efficient allocation of resources and hence this approach is widely used to priorities between development programs where more than one investment option is available to meet a deficit.
The AIC of water reflects the incremental cost to the economy of supplying additional demand. The AIC is calculated as the discounted project capital and operating costs over the project life divided by the discounted output or yield from the project over the project life. The AIC allows for the efficient allocation of resources and hence this approach is widely used to priorities between development programs where more than one investment option is available to meet a deficit.

After determining the scope of the project on the basis of demand and other factors, and having defined, quantified, and valued the costs and benefits of the project alternatives, the next step is to identify the least cost or the most cost-effective alternative to achieve the purpose of the project. The least-cost analysis aims at identifying the least-cost project option for supplying output to meet forecast demand.

The average incremental economic cost, on the other hand, is the present value of incremental investment and operation costs, with and without the project alternative, divided by the present value of incremental output, with and without the project alternative.

$$\text{Average Incremental Cost (AIC)} = \frac{\sum_{t=0}^{n} \frac{C_t}{(1+r)^n}}{\sum_{t=0}^{n} \frac{W_t}{(1+r)^n}}$$

where Ct: is incremental investment and operation cost in year t, Wt: is incremental water output in year t, N: is the project life in years and r: is the discount rate.

If the effect or outcome of project alternatives is a homogeneous product of the same quantity and quality the AIC can be estimated. Consideration of the AIEC aims to establish the project alternative with the lowest per unit costs. Least-cost analysis applies to projects where the benefits can be valued or to projects where the benefits take the form of a single commodity, such as treated water. Cost-effectiveness analysis also deals with alternative means of achieving given ends. However, the ends may be estimated only indirectly. The costs associated with each alternative can be calculated on a without project/with project basis.Whatever the approach to reducing costs is, uncertainty in both costs and effectiveness has to be taken into account. There should therefore be the possibility to check the chosen approach for its actual appropriateness and to revise it after a certain time. Simulating and stochastic approach are included in both operational cost and physical benefits.

Table 16: SALAM WPOs: Water production in MCM/a and water cost as average incremental cost in US$/m³

SALAM-WPO	1-0	1-1	1-2	2	3	4	5-0	5-1	5-2
Water Prod. (MCM/a)	80	230	500	50	50	850	250	500	1,000
Water Cost (US$/m³)	0.64 / 0.80*	1.57 / 1.61*	1.36 / 1.38*	0.73	2.16	- **	0.79	0.67	0.61

* Brine disposal in the Red Sea (/) versus brine disposal in Dead Sea, mixed with seawater
** RSDS-canal project studied by the World Bank (Coyne et Bellier, 2012).

In the Palestinian case the options are Extension of the existing Hadera desalination plant in the Mediterranean coast of Israel, pipeline to the city of Jenin along the Hadera River (C1) and Desalination plant in the Mediterranean coast of Palestine at Gaza to attend to local demand of the strip and water swap between Gaza and Israel in benefit of Hebron (C2) the AIC for C1, C2 are 0.31 $/m^3 and 0.47 $/m^3 .The main parameters for this calculations are the duration 30 years the discount rate 0.02 with 5% of operation cost . It is very clear that the C2 is more expensie because the cost of energy and land.

7 Performance Matrix

The below performance matrix shows that the financial and economic indicators are the most important. Social and political concerns exist but the willingness to solve water problem and the spirit of regional cooperation can reduce the weight of the concerns. However the importance of public debate and awareness to the public and decision makers should focus on the socioeconomic and stability positive impact of proposed strategies. The performance indicators should be part of other parameters such as the produced amount of water and engineering criteria , the potential environmental Impact.

Tabel 17: Performance Matrix of SALAM WPOs

Summary of WPO indicators of Jordan, Palestine ,Israel									
		Jordan			Palestine		Israel		
WPO Indicators	Relative indicator	E0	E1	E2	C1	C2	B0	B1	B2
Technical	15	11	8	5	10	8	the israeli options the technically feasabile		
Financial	25	23	15	13	20	15	from Palestinian and Jordanian persepective , the validity of these options highly depand on water price and affordability of the people , long Term agreement and improving the socioeconomic conditions of the Two countries will make the Israeli options a		
Economic	25	9	15	19	16	11			
Social	10	3	7	10	4	4			
environmental	5	2	4	5	2	1			
Political	20	9	13	19	9	13			
Project Ranking	100	56	61	70	61	52			
Duration of the implementation		5	5	5	2	3			
AIC (US$/M3)				0.31	0.47				
water Production(Million cubic meter)		80	230	500	50	50	250	500	1500
added value (energy Production)		+++							
rehabilitation of dead sea									

8 Final Considerations and Conclusions

Based on the above analysis of the indicators the following conclusions and considerations can be drawn:

- All WPOs are attractive in view of the increasing gaps between the water demand and water availability. The affordability and costs of options are the most important indicators it is clear from the economic analysis that SALAM WPO 2 (C1) for Palestinians and 1-2 (E2) for Jordanians the with the highest ranking scores.
- Water pricing will be of key importance as at least the running costs of the project should be paid by the income from the water supply.
- The water produced via the suggested WPOs will be rather expensive (due to desalination and transport) and therefore it is questionable that it could be affordable for agriculture without heavy subsidies. A maximum utilization of high quality effluent in agriculture instead of freshwater is, therefore, suggested.
- In case of SWPO 3 (C2) for Palestinians (Gaza desalination plant) is preferable to serve Gaza water demand and not feasible to transfer it to Hebron mountains (Cost wise)
- It is clear that all options need cross- border cooperation and positive attitudes in addition to international guaranties.
- The environmental indicators should be taken into consideration for all options, particularly the mitigation of the Dead Sea degradation.
- All proposed options would contribute to the regional efforts to deal with climate change impact and may be part of a transboundary climate change adaptation strategy.
- Water SWAPs have the potential to substantially reduce costs (transportation infrastructure and energy) and should be put forward.

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