Ministry of Water & Irrigation

وزارة المياه والري

Water Substitution and Reuse Policy

2016

This document is an integral part of the National Water Strategy and related policies and action plans.

1. National Water Strategy 2016-2025.
2. Water Sector Capital Investment Program (2016-2025).
3. Water Demand Management Policy.
4. Energy Efficiency and Renewable Energy in the water sector Policy.
5. **Water Substitution and Re-Use Policy.**
6. Water Reallocation Policy.
7. Surface Water Utilization Policy.
8. Groundwater Sustainability Policy.
9. Climate Change Policy for a Resilient Water Sector.
10. Decentralized Wastewater Management Policy.
11. Action Plan to Reduce Water Sector Losses (Structural Benchmark).

Ministry of Water and Irrigation

Contents

List of Tables

Foreword

Jordan is a nation burdened with extreme water scarcity that has always been one of the biggest barriers to our economic growth and development. This crisis situation has been aggravated by a population increase that has doubled in the last two decades alone because of refugees fleeing to Jordan from neighboring countries. We must then add to this the transboundary and climate change issues affecting Jordan's water supplies.

In the face of these challenges, and to achieve our goal of successful integration of Jordan's water resources management, the Ministry of Water and Irrigation has been active in putting forward four new policies that set clearly defined rules to manage the scarce water resources efficiently and sustainably. These new policies lay out the measures and actions required to achieve our national goals for long-term water security. These result-oriented policies are built upon and updated from previously adopted strategies, policies, and plans. Together, they are an integral and ongoing part of the overall management efforts that have already been achieved.

This policy is the result of the efforts of working group to whom I am thankful. My team has been putting great efforts to enhance water governance that support these policies at all levels, which include enforcement of a suitable legal framework and regulatory tools, enhancing efficient institutional capacities, and supporting dynamic management plans that adapt the concepts of participation and decentralizations all under the umbrella of Integrated Water Resource Management which I am sure will show results in the near future.

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Introduction

Jordan is one of the most water deprived countries in terms of fresh water resources. The fresh water share per capita per year has fallen from 1000 m^3 to 500 m^3 then to 140m^3 in the years 1960, 1975 and 2010 respectively1. The share is estimated to be less than 100m^3 for all uses in the year 2014. Factors causing the reduced share are the population growth, climate change, socioeconomic development and the influx of refugees due to political unrest in the region.

Population in Jordan over the last two decades has more than doubled, increased from 4.2 million in 1994 to around 9 million in 2014 (DOS). The huge increase in numbers, despite the declined local growth rate from 3.7% to 2.2% between the two dates (DOS), is attributed to the influx of refugees from other countries mainly from Iraq and Syria following the occupation of Iraq in 2003 and the civil war in Syria 2011. The expanding population placed enormous pressures on the already scarce and depleted water resources. About 80% of the population is located in urban areas concentrated in five Governorates: Amman, Balqa, Zarqa, Mafraq and Irbid.

Climate change has another adverse effect. Ministry of Water and Irrigation (MWI) records shows that precipitation has decreased by 20% over the last eight decades. Jordan’s water strategy prioritized the use of water by putting municipal water needs on top, followed by other economic sectors with the irrigated agriculture as the lowest priority without affecting the current supplies for irrigation in the Jordan Valley (JV). Accordingly, the water used for agriculture was reduced from 80% of the fresh water in the seventies of the last century to around 60% in recent years. This is because of the diversion of most water resources into municipal use. But the irrigated agriculture received attention in the Water Strategy by considering blended treated wastewater effluent with fresh water as a water resource and was added to the water budget for reuse and the priority for its use after blending was given to agriculture. Since then, the substitution of fresh water by treated wastewater started where emphasis in the wastewater management strategy called for treating wastewater in accordance with National, WHO and FAO guidelines and standards as a minimum, towards producing an effluent fit for reuse in irrigation.

Traditional fresh water resources consist of surface and ground-water resources. The available Renewable freshwater resources in Jordan for all uses were 533 million cubic meters (MCM) in 2014 (table 1). This equals to around 7% of the annual rainfall where the rest is lost to evaporation. By the year 2014, about 170 MCM/ year were made available from fossil aquifers and through desalination of brackish water, making the annual freshwater stock about 848 MCM per year.

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[1] World Bank Jordan's population in millions. 1960: 0.884, 1975: 1.81, 2010, 6.0

Treated wastewater generated at existing wastewater treatment plants is an important component of Jordan's water resources. Due to the terrain and the concentration of the urban population above the Jordan Valley escarpment, the majority of treated wastewater is discharged into various watercourses and flows to the Jordan Valley where treated wastewater is being used on an increasing scale for irrigation. In 2014 125 MCM of treated wastewater were reused after being blended with fresh water in irrigation or in specific areas directly without blending

Wastewater quantity is projected to increase to 240 MCM by the year 2025.

History and Development of Treated Wastewater as Substitute to Fresh Water

Wastewater collection has been practiced in Jordan in a limited way utilizing primitive physical processes. Septic tanks and cesspits were mostly used with gray water often discharged to gardens. This practice created major environmental hazards, where many groundwater aquifers were polluted.

Modern technology to collect and treat wastewater was introduced in the late 1960's when the first collection system and treatment plant was built at Ain Ghazal utilizing the conventional activated sludge process. The treated effluent was discharged to Seil Zarqa.

In the 1980's of last century the Government of Jordan carried out significant and comprehensive plans with regard to the different issues of wastewater management primarily related to the improvement of sanitation. Major cities were served with modern sanitation and treatment services where approximately 50% of the population at the time were connected to sewer networks and gained access to wastewater services. The collected wastewater was treated in waste water treatment plants (WWTP's), most of which were utilizing waste stabilization pond method. However, due to the strength of the waste because of the small amount of per capita water use and the salinity in the drinking water, said systems failed to produce effluent qualities suitable for irrigation, especially in terms of high salinity where large volumes of water evaporate causing an increase in the effluent's salinity.

Toxic pollutants (such as heavy metals and toxic organic compounds) do not impose any restrictions to the use of treated wastewater in irrigation given the low level of industrial discharges to sewage treatment plants and enforcement of laws related to industrial discharges to sewers.

During the early 1990's, MWI started to encourage farmers to use the effluent to irrigate the lands around the WWTP's restricting the reuse to fodder crops because the discharged effluent's poor quality. One of the aims for said course of action by MWI was to prevent the effluent from some of the smaller WWTP's to flow into Wadis which would have polluted other surface and ground water sources. Steps toward reusing treated wastewater started by delivering the effluent to farmers' lands adjacent to the WWTP's free of charge. As public acceptance was achieved, the next step is to recover cost of delivery of the effluent.

During the mid-nineties, more WWTP's were constructed, while the old ones were expanded and rehabilitated through introducing mechanical methods which rendered the effluent quality in full compliance with local and international standards for reuse without restriction.

The Policy Rationale:

Adopt a substitution policy by MWI entails the following:

1- Coping with the scarcity situation
2- Protecting the environment
3- Water allocation and movement among sectors have to be driven by economic motives.
4- Applying the IWRM approach and best practices
5- Considering the Policy as part of mitigation measures of the effect of climate change.
6- Increasing the amounts of treated Wastewater (WW) and considering it as a potential water and revenue source.

Currently, there are 33 different WWTP's discharging approximately 137 MCM per year of effluent. This volume, combined with the decreased volumes of fresh water available for irrigated agriculture, caused MWI to adopt the substitution policy which is the subject of this document.

Varieties of crops are grown using irrigated blended wastewater including citrus, vegetables and field crops. Soil characteristics vary widely from sand to clay. Principal concerns in the use of wastewater for irrigation include its salinity, chloride concentrations, and the presence of fecal coliforms and nematode eggs. Concern about heavy metal, has not been substantiated but is an area of public concern warranting monitoring.

The Jordanian standards and regulations specify the quality of treated effluents allowed to be discharged into wadis or destined for reuse in agriculture; where there will be a requirement for a secondary level of treatment. Quality specifications of JS should be in harmony with WHO guidelines for the safe use of treated effluent in irrigation.

Current Water Uses

As a general policy, priority for any water quantity is for drinking and household purposes, followed by other sectors such as industry then tourism and finally agriculture; this is applicable to new agricultural activities in the highland. Table 1 below shows water quantities used for various sectors from various sources with a total of approximately one billion MCM in 2014.

Table 1: Water Uses for the Various Sectors (2014)

Water Source	Sector			Total Figures in MCM
	Municipal	**Industrial**	**Agriculture**	
Ground Water	325	32.2	231.3	589
Surface Water	103.8	4.8	150	259
Treated Wastewater	0	1.7	123.3	125
TOTAL	429	39	505	972
Percentage of total	44.1%	4%	51.9%	100%
Rain-fed agriculture consumes around 100 MCM per year.				

Source: Ministry of Water and Irrigation (MWI) 2014

Water Economics of Non Domestic Sectors

Industry uses almost 4% of the surface and ground waters total, whereas agriculture uses almost 45% of the same sources. The percentage of the water used for agriculture has fallen from 80% in 1970’s down to around 60% by virtue of competition between economic sectors, new irrigation technologies, efficiencies and banning ground water wells digging

Tourism, on the other hand, consumes no more than few million cubic meters as most of the touristic activities take place in the cities where said activities draws water from the networks so quantities consumed are considered within the Municipal share. Estimates indicate that the economic return of the water consumed for municipal and industrial purposes are many times more than irrigated agriculture. Additionally, industry and tourism creates more jobs for Jordanians than agriculture. In 2006, 56% of the labor forces working in agriculture were non Jordanians with 89% of the permanent agricultural work force being foreign labor. Therefore, water allocation and movement among sectors have to be driven by economic motives.

Considering the importance of these sectors, table 2 shows the financial return for each sector and its effect in creating job opportunities, where industry comes first followed by tourism then agriculture.

Table 2: Economic Effect per Cubic Meter by Sector

Sector	**Financial Return JD/m^3**	**Job Opportunities Person/Cubic Meter of Water**
Agriculture	0.36	148
Tourism	25	1,693
Industry	40	3,777

Source: Dept. of Statistics 2011

Water in Agriculture

Sixty percent of the agriculture in Jordan depends on rain water and 40% is irrigated agriculture in highlands and the Jordan valley. This 40% contributes by 90% to the total agricultural products. Moreover, agriculture in the Jordan valley contributes to the total agricultural products by 70% while consuming only 35% of the irrigation water. This is indicative of the large productivity brought about to the cultivated lands by irrigation water, and the significance of irrigation in the Jordan Valley, agriculture type and value is presented in table 3.

Table 3: Irrigated Areas

Type of Agriculture	**Area**		**Value of products**	
	Million Donum	**Percentage (%)**	**JD Million**	**Percentage (%)**
Rain fed	1.569	60	48.9	10
Irrigated	1.025	40	460.9	90
Total	2.594	100	509.8	100

Source: Ministry of Agriculture, 2012 Annual Report

The reason for the low value of the rain fed agriculture is that 75% of it is field crops such as wheat, barley and fodder.

Irrigated Agricultural lands in Jordan have increased during the past two decades especially in the high lands as shown in Table 4, despite the cut down on wells digging in 1992, and the implementation of the ground water Bylaw in 2002.

Table 4: Increase in Irrigated Areas (Donums) from Ground Water in High Lands, and Surface Water in the Jordan Valley.

Area	**1994**	**2004**	**2010**	**2013**	**Percentage Increase between 1994 & 2013**
High Lands	390,930	479,971	691,092	701,814	80%
Jordan Valley	275,101	300,102	333,630	358,940	30%
Total	666,031	780,073	1,024,722	1,060,574	59%

Source: Annual reports of: Dept. of Statistics, Jordan Valley Authority, MWI & MOA

As a result of this increase, two thirds of irrigated agriculture became concentrated in the highlands using 56% of the pure ground water. Put in better terms, the Jordan Valley consumes less than 40% of the irrigation water consumed by the high lands, and produces double their products. Table 5 shows the average price of one cubic meter of water for the various crops and the quantities of water used for each type of the main crops plus the total price of the water.

Table 5: Quantities of Water Used in Irrigation and the Financial Return for Each Cubic Meter per Crop Type

Area	Value of Cubic Meter of Water							Water Quantity Used MCM	Water Value in (JD Million)
	Winter Vegetable	Summer vegetables	Citrus	Olives	Trees	Herbs and Fodder	Average		
Jordan Valley	1.53	0.72	0.37	0.35	0.49	0.32	0.68	178.34	121.27
High Lands	0.97	0.52	0.18	0.21	0.34	0.25	0.37	325.22	120.33
Average	1.3	0.56	0.36	0.22	0.4	0.26	0.48*		

Source: Water Valuation Study/Institutional Support and Strengthening Program-USAID

Note: The average price of one cubic meter indicated in this table considers the crops in the JV while the average price shown in table (2) considers the crops in high lands only.

As a result of the facts above, it is possible to confirm that focusing on the Jordan Valley in agriculture is extremely important, thus satisfying the water requirements in the Valley is a priority. Therefore, ground water must be liberated as much as possible for drinking purposes paying special attention to the underground basins capacity and safeguarding farmers' rights.

An evident fact that supports the notion of concentrating at the reuse of effluents in the Valley is the fact that almost 91% of the WWTP plants discharge to wadis that eventually flows to the Valley. This indicates a potential increase in water quantities available from future flows that can be utilized for agribusiness in the Valley.

As for the quality of water used for agriculture, it has a big effect on agricultural products. Table 6 below compares the average price of one cubic meter of water according to its quality for different crops. Northern Jordan Valley, for instance uses pure surface water from Yarmouk and northern dams, and the middle and southern parts of the valley use surface water blended with treated wastewater, whereas high lands and Disi use pure ground water.

Table 6: Net Financial Return of every Cubic Meter According to the Source

Area	Value of Each Cubic Meter According to the Water Quality (JD)		
	Surface Water	**Surface Water Blended with Treated Wastewater**	**Ground Water**
Northern Valley	0.86	---	---
Middle and Southern Valleys	---	0.84	---
High Lands and Disi	---	---	0.4

Source: MOA and the Vegetables and Fruits Exporters Society

Numbers in this table exhibit the necessity to spare ground water for drinking purposes and economic sectors that have a high return, and optimize the use of wastewater after treating it to standards compatible with all health and agricultural standards especially those standards relating to the issue of salinity which limits cultivating crops of high return such as strawberry, asparagus, leek, etc. The high salinity resulting from treated wastewater is also one of the reasons for the low price of the cubic meter of surface water blended with treated wastewater.

Another supportive fact to preserve ground water is the over abstraction from ground water reservoirs over the last four decades. Annex 2 demonstrates the danger facing the water future where many aquifers were depleted to almost irrecoverable status if the current practice continues.

Water Situation in the Jordan Valley and Current Substitution Process

In the 1980's, the urban areas of Amman and Zarqa began sourcing water from the Jordan Valley. This water supply caused reduction in the available water resources used for irrigation in the Valley. The supply of water from the Valley to the cities of Amman and Irbid for domestic purposes started in mid-eighties after the completion of Deir Alla-Amman and Wadi Arab-Irbid Domestic Water Supply Projects. An average of 40 MCM per year is supplied to Amman from King Abdullah Canal in Deir Alla, and 20 MCM to Irbid from Wadi Arab well field.

In order to cope with the situation, the Jordan Valley Authority (JVA) launched projects to change all the open channel irrigation systems into pressurized systems and introduced pilot projects to help farmers using modern irrigation technologies and systems in their farms to raise the water use efficiency and reduce losses.

In 2014, the total available fresh water in the valley was 180 MCM, out of which 106 MCM surface water is coming from northern resources. Sixty MCM originated from northern resources is treated and pumped to Amman, Although the capacity of Zai treatment plant exceeds current quantity, through the last ten years, the amounts taken from the valley was around 60 MCM because of the decreasing amount of water coming from the Yarmouk River, another 30 MCM are treated and pumped to Amman through Mujib/Zara-Maien. And in the northern Valley, around 20 MCM is taken to Irbid. Hence the total amount of the Valley's fresh water taken to urban areas for domestic uses was around 110 MCM.

The existing As-Samra plant serving Amman and Zarqa areas is currently treating around 100 MCM, more than 80 MCM of which is used in the Jordan Valley in exchange of the amount pumped from the valley, while the other 30 MCM is used for agriculture around the plant and in the area between the plant and the Zarqa Valley.

To maximize the amount released to the valley, the Water Authority signed an agreement with the Jordan Valley Authority to monitor and organize the use of the water between the plant and the Dam.

Normally, during March of every year JVA and WAJ agree on the quantities of raw fresh water to be delivered by JVA as bulk water for domestic purposes through Zai intake and Mujib/Zara-Maien carrier to Swaimah. JVA in coordination with water users can plan their crop pattern. JVA then implements the agreed allocation, while WAJ monitor the quality of water resources feeding Zai intake and Mujib/Zara-Maien carrier throughout the Jordan Valley and commits to substitute the quantity by the treated wastewater at As-Samra plant through King Talal Reservoir.

Constraints Facing Water Substitution

Water substitution is more complicated than substituting other economic goods because water has exceptional characteristics. Water is a common resource, bulky and expensively stored and transported. These characteristics make water substitution somewhat problematic and complex in addition to economic, cultural, social and political interrelationships considerations. Despite the facts illustrated earlier concerning the value of treated wastewater, little research has examined micro and macro policy interventions for water substitution. Many studies attempt to resolve water substitution issues and suggest market-based solutions for the constraints.

Cultural, political, environmental and fiscal constraints make fresh water substitution more difficult than theories based on simplified assumptions. Following are some of the most commonly recognized constraints which affect fresh water substitution:

1. Substitute water quality: Despite the availability of fertilizing minerals (Nitrogen, Phosphorus and Potassium- NPK) in treated wastewater and water impounded in dams, many crops and plants cannot tolerate irrigation water that contains over 1000 mg TDS/l. However, the TDS is not the only parameter of concern in terms of irrigation water quality. Boron or borate levels in the effluent could also limit the agricultural use especially in areas of very low precipitation (borates are herbicides). Chloride and Sodium are also having measurable effects on irrigated crops. Most plants cannot tolerate chloride levels more than 250 mg/l;
2. Soils quality: disparity between soils characteristics imposes some restrictions on effluent reuse. Alkalinity, sodicity, pH, salinity, SAR of soils could limit the reuse unless effluent quality fits the soils and crops requirements;
3. Financial constraints: Considerable investment in water development infrastructure will be needed to meet future water needs. Policy-makers need to consider the fiscal implications of such large investments;
4. Transformation and transportation: There is a transformation process to convert untreated wastewater to treated water, for use in the agricultural sector. Water losses are associated with transformations and transportation and thus it is rarely that 100 % of water is retained during transformation and transportation processes specially when the water gravitates long distances;
5. Water prices: Prices are an important part of the efficiency principle. Lack of information limits the market’s ability to set a permanent and unified price for water. One of the conditions for market competition is setting a rational water price. Decision-makers have to be able to find information about prices and cost-saving innovations in substitution projects;
6. Efficiency constraints: Efficiency is achieved when the marginal value of water among competing uses is equal. But in reality it is difficult to discover the marginal values because of other constraints;
7. Incomplete information: Incomplete information will mislead decision-makers. Quantities of fresh ground water used are estimated and there are no definite figures that can be relied on;
8. Institutional constraints: There are formal constraints (e.g., rules, laws or regulations) and informal constraints (e.g., behaviors, or self-imposed codes of conduct) that limit the efficient substitution of fresh water resources. Again the number of governmental entities involved in agricultural sector especially irrigated agriculture aggravates the control and management of water usage. Among these are the Ministries of Agriculture (MOA), labor (MOL), and Environment (MOE) in addition to the Ministry of Water and irrigation and the Water and Jordan Valley Authorities.

Two studies performed in 2015 "The government program to monitor pollutants on fresh vegetables irrigated with blended treated water in the Jordan Valley" under GIZ support and WHO/University of Jordan study "Stakeholder Analysis and Pilot Study for Safe Use of Treated Wastewater in Agriculture" confirmed the importance of behaviors of farmers, irrigation techniques and handling of produce when treated effluents are used as irrigated water source.

Moreover, decision makers have to be able to learn about profitable opportunities in other water based and water related sectors and industries.

Quality Considerations

Table 7 shows the irrigable land, water used, soil salinity and some major water characteristic affecting soil structure and plants nutrients uptake.

Table 7: Soil characteristics in the Jordan valley

Parameters	Measurement	Northern Valley	Middle Valley	Southern Valley
Irrigable Land	Donum	360000		57000
Water Used	MCM	130		35
TDS	Mg/l	700-850	900-1150	500-600
Cl	Mg/l	200	350	150
SAR	NA	2-2.5	4	4.5
pH	NA	8.0	8.7	8.0

Source: Soil Salinity Changes in the Jordan Valley Potentially Threaten Sustainable Irrigated Agriculture Volume 23, Issue 3, June 2013

Limited water quantity in the Valley necessitate that irrigation water has to be used more efficient and therefore more and more farmers switched to drip irrigation. This means field-wide leaching is no longer possible and therefore salt accumulation became a potential risk. Continuous Drip irrigation lead to alkali soils formation in the absence of leaching / drainage water from the field.

Therefore, it is important to make sure that the soil salinity threshold is not reached for the crops growing there. This can be done only with sufficient amount of water with certain quality to leach out the salts accumulated during the drip irrigation extended periods or by using water with low salinity which is not available.

As shown in Table 9 above, soil in the JV is characterized as being alkaline with pH ranging between 8 and 8.7. This is another limitation using treated wastewater with Chloride content of more than 350 mg/l. Although Chloride is an essential micronutrient and all crops require Chloride in small quantities, Chloride, at high concentrations, is toxic to many crops and contributes to the overall salinity.

Salinity and chloride strongly interact with more than additive effects in decreasing crop's yields. Both 2010 and 2011 year data showed that low EC (0.9 dS/m) irrigation water with high chloride is more damaging than high EC (1.5 dS/m) water at the same Chloride level.

Results of many studies including Royal Scientific Society's yearly reports, indicated that about 63% of soils in the JV are indeed saline, out of which almost 46% are moderately to strongly saline. The major chemical components of soil salinity; i.e., Ca, Mg, and Cl, also showed a similar increase along the North-South transect of the valley. Moreover, compared to previous field sampling, results showed that changes in soil salinity in the JV were dramatic. In addition, it was found that Cl imposed an existing and potential threat to sensitive crops in 60% of the soils in the JV, where Cl concentrations were greater than 710 mg/l.Under the prevalent arid Mediterranean conditions, improving the management of irrigation water, crops, and nutrient inputs and increasing water and fertilizer use efficiencies should be indispensable measures to conserve and sustain the already fragile agricultural soils in the JV.

Using water that contains Chloride requires appropriate practices in order to keep the Chloride level in the soil below the threshold level tolerated by the crop. Excess Chlorides should be leached below the active root zone.

Moreover, the SAR in the middle and southern Ghores are higher than in the northern Ghore with alkaline soils in both areas, and this imposes more restrictions on water salinity.

Soils in highlands are more tolerant to higher salinity except in areas where Calcium concentration is high (Calcareous soils).

For the above reasons and facts, and in addition to the limited water resources, it is not recommended that more surface water be drawn from the valley.

The Policy "Moving from Theory to Action"

This policy is intended to direct the water sector towards more efficient use of water resources. It details the intention to reuse treated wastewater in irrigation that enables freeing fresh water to be utilized for municipal uses. It also provides for using the treated wastewater in other economic activities. It calls for expanding collection and treatment of wastewater, updating and development of standards and practices for substituting fresh water used in irrigation by treated wastewater after blending it. The policy aims also at increasing surface water utilization for municipal uses and thus decreasing the strain on groundwater. This specific part of the policy is more detailed in the Surface Water Utilization Policy.

Although this policy can be better implemented through centralized wastewater collection and treatment systems, the decentralized systems are still needed to suit different locations. Local reuse systems should also accompany the decentralized systems.

Objectives of the policy

The objectives of this policy document are:

- managing the scarce water resources efficiently, maximizing the benefits and returns, and proposing actions required for implementation,
- enhancing economic efficiency,
- ensuring sustainability and preserve fresh water, and
- Protecting the environment and nature.

Policy Bases

- The main pillars of this policy are:
- Water needs and competition between economic centers;
- Environmental considerations;
- Availability of infrastructure;
- Public acceptance;
- Suitability and adequacy of high quality water;
- Sustainability and enforcement of regulations, and adequate collaboration with research and development departments.

Policy Statements

On Substitution Priorities

1. MWI will work on increasing amounts of treated wastewater reaching 240 MCM by 2025 through developing existing and new facilities.

2. Priority for substitution shall be given to irrigated and irrigable lands with high productivity potential, Jordan valley is the priority.

3. Reclaimed water shall be used for industry and agriculture as much as possible in order to save the fresh water for domestic uses.

4. Water quantities for agriculture in highlands shall be determined and tied to the area allowed to be irrigated from ground waters. Substituting the groundwater with blended (treated wastewater or surface water) shall be a major principle.

5. Lands adjacent or close to the substitute water shall have priority in exchange for fresh underground water.

6. Priority utilization and use shall apply to impounded waters in reservoirs; such waters shall be treated for its intended use.

On Institutional and Administrative Arrangements

7. A mechanism to price (tariff setting) treated wastewater, as well as blended treated wastewater will be developed taking into consideration fairness, cost recovery and economic activities support. Consideration shall be given to suitability, quality, and percentage of fresh water, location and reducing freshwater usage. This will reduce groundwater over-abstracting. A robust mechanism to adjust the prices shall be explored and agreed upon.

8. Technical, financial, economic and legal capacities shall be rebuilt under strong administrative body responsible for water substitution plans implementation. Responsibilities shall focus on change management and capacity building.

9. In cooperation with MOA (ministry of agriculture), farmers in the Jordan Valley shall be assisted to choose the right types of produce and adopt the best irrigation and marketing practices.

10. The Water Users Associations shall have a role in implementing this policy. The ministry will work with this association by building their capacities toward better implementation.

11. Monitoring programs shall be crafted and implemented. The reuse of sewerage effluent is in wide use across Jordan and gaining an acceptance by government, farmers and communities, and cannot be disputed. Nevertheless, there are areas within the regulatory processes that need to consider a uniform approach to acceptable guidelines, such as the requirements for disinfection and monitoring of indicators (quality and characteristics) at particular times and intervals.

12. The ministry will adopt and implement a National Plan for Operation and Maintenance of WWTP aiming at achieving efficiency. The plan will include best available models including private sector participation.

13. Private sector participation in reuse plans will be introduced; community based initiative organizations (CBO's) and Nongovernmental organizations (NGO's) will also be part of the process.

On Resource Management

14. Rain water harvesting in desert areas in northern parts of Jordan shall be expanded to collect and impound rain water that can be used as substitute water directly and indirectly through ground injection.

15. Wastewater collection and treatment shall be expanded in all parts of the country and according to priorities; substitution requirements is part of.

16. Irrigation schemes at the Jordan Valley shall be rehabilitated and expanded.

17. Ground Water Users Associations will be established in the High Lands. Farmers, being the recipients and prime beneficiaries, shall participate in managing and monitoring the ground water used, treated wastewater use and possibility of blending.

18. Fresh water allocated to irrigated agriculture in the high lands shall be capped and eventually reduced according to medium and long term plans to be prepared and implemented after which the reallocation plan can be updated accordingly.

19. A dynamic and sustainable economic development plan coupled with investment program shall be formulated and implemented for the use of surface waters and treated wastewater efficiently.

On Legislations

20. Treated wastewater specifications and standards shall be amended to ensure a safe reuse and to produce high economic return products since the current specs and standards to treat and dispose of water are incompatible with the substitution goals and development requirements in a country suffering from water scarcity.

21. Strict regulatory measures to manage the use of reclaimed water for agriculture or other purposes shall be followed.

22. An integrated approach to water resources management (IWRM), combined with locally appropriate and sustainable risk reduction measures, and the active involvement of stakeholders from different sectors shall be established.

On Public Acceptance and Awareness

23. Awareness and educational programs and campaigns shall be crafted and implemented. These shall target farmers in high lands and grouping them via unions according to their areas so that the amount of ground water pumping is reduced and benefits and economic return per cubic meter are optimized.

24. The programs should take into consideration belief and perception of public based on scientific and logical proofs.

On Technology, Research and Development

25. Modern treatment technologies shall be employed that produce reclaimed water directed towards maximizing saving and replacing freshwater for municipal consumption.

26. The Effluent quality standards shall be revised to suit various reuse purposes.

27. Domestic wastewater shall be treated and purified for full utilization for industrial, agricultural, cooling and other uses.

28. The related data and information will be tabulated and organized for easy use and reference. It will be part of the information system that will facilitate research.