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INSTITUTIONAL SUPPORT & STRENGTHENING PROGRAM

WATER VALUATION STUDY:

DISAGGREGATED ECONOMIC VALUE OF WATER IN INDUSTRY AND IRRIGATED AGRICULTURE IN JORDAN

October 2012

This report was produced for review by the United States Agency for International Development (USAID). It was prepared by International Resources Group (IRG).

INSTITUTIONAL SUPPORT AND STRENGTHENING PROGRAM (ISSP)

ISSP WATER VALUATION STUDY:

DISAGGREGATED ECONOMIC VALUE OF WATER IN INDUSTRY AND IRRIGATED AGRICULTURE IN JORDAN

FINAL REPORT

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ACRONYMS

AFD	AgenceFrançaise de Développement, French Development Agency
CBJ	Central Bank of Jordan
DOS	Department of Statistics
DRC	Domestic Resource Coefficient
EU	European Union
FOB	Free on Board
GDP	Gross Domestic Product
GO	Gross output
GOJ	Government of Jordan
GVA	Gross Value Added
HL	Highland Area
IMF	International Monetary Fund
IRG	International Resources Group
ISIC	Industrial Classification of all Economic Activities
ISSP	Institutional Support and Strengthening Program
JD	Jordanian Dinar (1 JD = 1.41 US$)
JRV	Jordan Rift Valley
JV	Jordan Valley
JVA	Jordan Valley Authority
KAC	King Abdulla Canal
KTD	King Talal Dam
LP	Linear Programming
M^3	meter cubed of water
MCM	Million Cubic Meter
MEMR	Ministry of Energy and Mineral Resources
MJD	Million Jordanian Dinars
MJV	Middle Jordan Valley

MOA	Ministry of Agriculture
MoPIC	Ministry of Planning and International Cooperation
MWI	Ministry of Water and Irrigation
MWS	National Water Strategy
NGO	Non-Governmental Organization
NJV	North Jordan Valley
NRW	Non Revenue Water
NVA	Net Value Added
OS	Operation Surplus
RIM	Residual Imputation Method
RO	Reverse Osmosis
RWC	Royal Water Committee's
TV	Total value
TVP	Total value of output
UFW	Un-Accountant for Water
USAID	The United States Agency for International Development
VA	Value Added
VCA	Value Chain Analysis
WAJ	Water Authority of Jordan
WIS	Water Information System
WTP	Willing To Pay
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The Water Valuation Study undertaken by the USAID/Jordan Institutional Support and Strengthening Program (ISSP) from 2011-2012 assessed the value of water use in different economic sectors, with a highly differentiated and in depth focus on the agriculture sector to determine water's value in different uses and for producing different crops in different locations and for different markets. Insight into the different values of water is essential to support rational decision-making about policies, management, and investments in the water sector. The main objective of this report is to estimate an economic value of industrial and irrigation water in Jordan from value chain perspectives by using appropriate methodology and available data.

In a country facing such a significant imbalance between limited supplies and ever-growing demand, the government must grapple with very difficult policy decisions and trade-offs in order to determine the best ways in which to allocate water across sectors. This is especially true for the agricultural and industrial sectors which consume significant portions of the national water supply and are central to the Jordanian economy. The ISSP Water Valuation Study was undertaken to support ISSP's objectives to improve policy-making in the water sector by providing decision-makers with a much deeper understanding of the productivity of water across sectors.

The total gross agriculturalsector output is estimated at2,268 thousand tons in 2010 with a value of about Jordanian Dinar (JD) 560 million. In physical terms, irrigated agriculture produces about 95 percent of total agricultural production with a value of JD 460 million. Rainfed agriculture produces only about 5 percent of total physical outputs with a value of JD 50 million. This shows that irrigated agriculture contributed to about 90 percent of the total value of gross output in Jordan during 2010. The Jordan Valley(JV) contributed to about 44 percent in gross output (JD 227.8 million), whereas the highlands contributed to about JD 282 million, which represents about56 percent of total gross outputs.

	Area		Value of Production	
	[M Dunum]	%	[M JD]	%
Rainfed Area	1.569	60%	48.9	10%
Irrigated Area	1.025	40%	460.9	90%
Total	**2.594**	**100%**	**509.8**	**100%**

The Residual Imputation Method (RIM) wasused to determine the average economic value of industrial and irrigation water used in agriculture across different geographical location, water qualities and crop types according to market destination of the final commodity.

Data and information were collected through secondary data, i.e. external trade, wholesale prices, retailers prices, annual production and yield, and through primary data,where several questionnaires were designed, pre-tested and fielded. Thefollowing peoplewere interviewed: farmers (producers), local traders, exporters/importers, processors, and retailers.

The average water consumption in special economic zones in Jordan is estimated at83.4 mcm; industry use is estimated at47.3 mcm. The total value added, or the water values onaverage in the national economy is about 118 JD/m^3. Industries and services have the lowest water value atabout 70 JD/m^3. The highest water values are in banks and the financial sector.

Industrial Water Valuations

Water values in industrial and service economic sectors are high, but there is no evidence that currently operating enterprises are water constrained. In many cases, however, the cost of water to industrial enterprises is very low relative to water value, which may encourage future demands for additional water, rather than a more appropriate focus on improved efficiency, recycling, and reuse.

In the industrial sector, water makes up only 0.63 percent of their total costs, with a range of 2.17 percent in the services sector to only 0.25 percent in the insurance and banking sectors. The service sector generates the highest indirect tax per cubic meter. The results show the water use per employee, rangingfrom 29 m³/employeein the insurance sector to 298 m³/employee inthe industrial sector.

	Field Crop	Winter Vegetables	Summer Vegetables	Citrus	Olives	Stone Fruits	Average
JV	0.31	1.55	0.72	0.73	0.35	0.49	0.85
Highland	0.26	0.91	0.51	0.18	0.21	0.34	0.36
Jordan	**0.27**	**1.29**	**0.54**	**0.70**	**0.21**	**0.40**	**0.49**

Industrial and service sector economic activity

Sector	Withdrawals [M m³]	% of Total	Gross Output [JD/m³]	Gross Value Added [JD/m³]
Industry, Mining, Manufacturing	47.3	57%	215.0	77.6
Services	17.0	20%	113.1	71.6
Wholesales, Retail Trade	9.4	11%	218.9	163.6
Transport, Storage, Communication	4.5	5%	820.3	429.2
Construction	4.3	5%	385.9	100.0
Banks, Financial Institutions	0.8	1%	1,612.1	1,308.7
Insurance	0.1	0%	834.8	469.3
Total	**83.4**	**100%**	**250.1**	**118.1**

The results show that, in general, one additional cubic meter allocated to water consuming economic activities generate net additional profit of about JD 57/m³. Hotels have a gross value added of about JD 41/m³. The water value in the tourism sector isabout JD 38.8/m³ with a net operation surplus of JD 4.1/m³. Restaurants have higher water values of about JD 66/m³ with a net operation surplus of JD 15.9/m³. The percentage of water costs to total intermediate consumption reaches 2.6 percent of the total costs. The overall percentage of total costs for water in hotels reaches about 4 percent of the total cost of utilities.

Agricultural Water Valuations

Water value in agriculture varies widely across crops, seasons, and production locations. After dividing crops into four categories – field crops, winter vegetables, summer vegetables, and fruit – winter vegetables are shown to be the crop type with the highest overall water value, while field crops such as maize, barley, and wheat produce the lowest average water value. Among fruits, irrigated olives show consistently low water value, while citrus is only marginally better. A number of specialty crops such as strawberries, Brussels sprouts, and ginger, though presently grown only on a small scale, show high water values and offer potential for expansion.

Disaggregating water value by region, Jordan Valley cultivation shows water values that are almost twice as high as those prevailing in the highlands. One reason for this is that winter vegetables, with their relatively high water value, are grown in the Jordan Valley, while the highlands produces mainly summer vegetables. Another reason is the extensive planting of irrigated olive groves in the highlands, which generally produce very low water values.

Irrigated area in the highlands has expanded steadily over the past 18 years, growing at a rate of about 17,900 dunum per year, despite a 1992 ban on the drilling of new wells. Highland irrigated agriculture is mining aquifers, pushing groundwater levels ever lower and risking their contamination with saline groundwater. This mining also puts at risk a far more valuable use of highland groundwater – urban supplies to Amman and other highland municipalities.

The vast majority of the irrigated agricultural production is in the form of fresh fruits and vegetables. Horticultural crops are grown in about 95 percent of the irrigated areas. The fruits and vegetables produced(e.g. olives and tomatoes) enjoy high local demand. However, they also garnera significant share of the export market. For example, 52 percentof total agricultural exports value (or 7.7 percentof total national export) in 2010 was from horticultural crops.

The results showed that the weighted average of water value used in field crops is JD 0.27/m³ and JD 1.29/m³ for winter vegetable crops, JD 0.54/m³ for summer vegetables, and JD 0.70/m³ for citrus fruit trees. The water value is JD 0.21/m³ for olives and JD 0.40/m³ for stone fruit trees. The overall weighted average water value in irrigation was estimated at JD 0.49/m³.

With regard to individual crops, cucumbers havethe highest water values atabout JD 4.6/m³, followed by strawberriesatJD 4.29/m³, then Brussels sproutsatJD 2.95/m³, string beans atJD 2.98/m³, peas atJD 2.74/m³, and carrotsatJD 2.06/m³. The lowest returns per m³ areprovided by alfalfa, vetch, tobacco, sesame, and barley,at less than JD 0.10/m³.

Winter Vegetables, JV

	Areas [Dunum]	Water Use ['000 m³]	Water Use ['% JV Winter Veg]	Water Use ['% Total JV]	GVA [JD/m³]
Tomatoes	50,356	18,273	38%	10%	1.36
Eggplants	19,493	6,002	12%	3%	1.05
Potatoes	17,735	5,882	12%	3%	0.88
Cucumbers	12,932	4,109	9%	2%	4.60
Squash	16,857	3,919	8%	2%	1.01
Sweet peppers	6,193	2,551	5%	1%	1.70
Broad beans	4,802	1,718	4%	1%	1.03
Lettuce	4,872	1,146	2%	1%	1.47
Cabbages	2,483	747	2%	0%	0.32
Hot peppers	2,522	712	1%	0%	1.68
Total Win Veg	**138,245**	**45,058**	**93%**	**26%**	**1.55**

Winter Vegetables, Highland

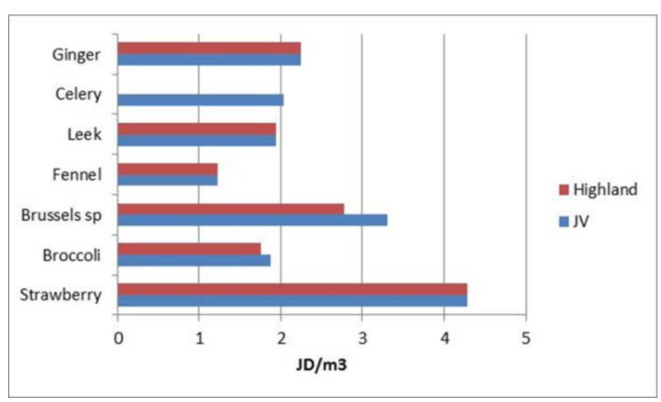
	Areas [Dunum]	Water Use ['000 m3]	Water Use ['% HL Winter Veg]	Water Use ['% Total HL]	GVA [JD/m3]
Tomatoes	24,863	11,257	36%	2.5%	0.71
Potatoes	15,901	5,486	18%	1.2%	1.36
Broad beans	7,663	3,556	11%	0.8%	1.38
Onion, dry	4,422	2,714	9%	0.6%	0.30
Cauliflower	6,263	2,557	8%	0.6%	0.71
Squash	2,359	863	3%	0.2%	0.69
Cabbages	1,985	821	3%	0.2%	0.28
Peas	1,727	771	2%	0.2%	2.02
Lettuce	1,897	500	2%	0.1%	0.70
Cucumbers	1,152	425	1%	0.1%	4.61
Total Win Veg	**68,231**	**28,951**	**93%**	**7%**	**0.91**

Cirtus fruits are among the highest water values in of fruit tress. Valencia oranges at JD 1.36/m³followed by orange and Madarinat JD 1.06/m³ andat JD 0.75/m³.As forother fruit trees,almondsare among the highest at JD 0.95/m³,. Bananasare among the highest water value at JD 0.63/m³ (range JD 0.4 - 1.03/m³). Therefore, the current practice of some banana producers, to install reverse osmosis (RO) desalination units to irrigate banana (desalination cost is between (JD 0.25-0.35/m³),is economically rational since the water value is twice the desalination costs of one cubic meter.

The estimated value added of water by qualities for winter vegetables shows the highest average water values for blended water (JD 1.68/m³) and surface water (JD 1.39/m³) whereas it is the lowest for groundwater (JD 0.88/m³). For summer vegetables, surface water produced the highest water value (JD 0.75/m³), followed byblended water (JD 0.69/m³). Groundwater for irrigation produced the lowest value of (JD 0.48/m³).

For winter tomatoes, the highest water value is in surface water (JD 1.40/m³), followed by blended water (JD 1.31/m³) and the lowest is the tomato cultivated with groundwater (JD 0.53/m³). For summer tomatoes produced in Mafreq region the groundwater value is (JD 0.40/m³) compared with JD 0.65/m³ for surface water and JD 0.54/m³ for blended water. The value of surface water used in fruit trees is (JD 0.69/m³), and for blended water is

Promising high water value vegetables



(JD 0.47/m³). The fruit trees irrigated with groundwater has the lowest water value (JD 0.34/m³).

The water value ofolive trees is JD 0.34/m³ in the Jordan Valley. The lowest value was in the desert areas with less than JD 0.1/m³. In Mafreq areas, the water value generated from olive cultivation wasJD 0.22/m³. Therefore, it is not economically rational to irrigate olives with groundwater in Mafreq areas where the abstraction costs (estimated at JD0.25-0.3/m³) exceeds the water values in olives. Furthermore, the water values of olives cultivated in south Jordan and desert regions does not exceed JD 0.09/m³.

Water values vary from region to region vary dependingon the economic activity, climate zones, production season, soils, and water qualities, in addition to many other factors. The national average water value in the agricultural sector was JD 0.495/m³. Water values in Middle Jordan Valley (MJV) at about(JD1.1/m³), Safi and northern governorates are among the highest (at about JD 1.02 /m³). Production in the North Jordan Valley (NJV) is about JD 0.79/m³. The lowest water value is found in the middle governorates of Amman, Madaba, and Zarka where water values high to low rangedfrom winter vegetables (JD 0.98/m³) to irrigated olive trees (JD 0.12/m³). For the Jordan Valley as whole, the total weighted average is JD 0.85/m³. For the highlands, the total weighted average is JD 0.36/m³.

Relative distribution of Water Use and Employment in JV

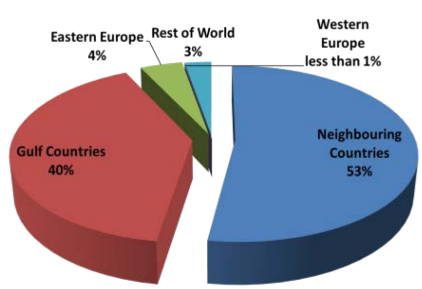
Employment and Electricity Impacts in Agriculture

The employment implications of the agriculture sector were also analyzed. The total hired laborisestimated at13,348 workers in the JV, with most of them working in winter vegetables. Winter vegetables consume 22 percent of water in the JV but providemost of the employment opportunities—53 percent of JV labor—and contribute 52 percent of total value added in the JV. Citrus fruit consumes about 38 percentof water in the JV but provides about 18 percent of the employment opportunities.

The total hired labor is estimated at16,348 workers in the highlands. Summer vegetables consume 23 percent of water in the highlandsand provide40 percent of employment labor and contribute 34 percentof total value added in the highlands. Olive trees consume about 31 percentof water in the highlands but contribute only about 14 percent ofthe employment.

The results indicate that most of the agricultural workers (61percent) are working in winter and summer vegetables. The labor compensation of vegetables is JD 44.1 million, providing employment for 18,379 workers. Vegetables consume 29 percentof the water in but provide 61percentof the labor and contribute 54percentof total value agriculture added in Jordan. Fruit trees consume about 57percentof water but contribute only 28 percentof employment.

Horticulture export destinations



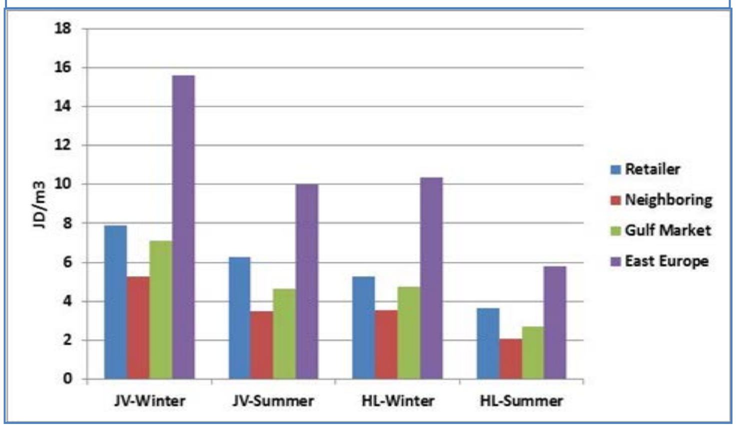
Electricity also plays a significant role in the agriculture sector. For farmers, particularly those pumping groundwater, water is further subsidizes through low electricity prices which make the cost of abstraction lower. Electricity prices are low throughout the agricultural sector, including irrigation, livestock and poultry and bird farms. This additional water subsidy in the form of electricity prices further distorts farmers' perception of water as a scarce and thus valuable resource. Continued low water prices are thus likely to continue to encourage over-pumping and provide no incentive for conservation and water efficiency measures. It is necessary to allow water prices to begin to recover the real cost of water supply and to ensure financial sustainability of water utilities.

Value Chain Analysis

The ISSP Water Valuation Study also employed a Value Chain Analysis on a sample of crops to examine how water value was allocated among enterprises from crop production to the consumer's table. The study examined a few key crops to provide a snapshot of different kinds of products and markets to compare and assess, in particular tomatoes, Medjool dates, strawberries, Brussels sprout and broccoli.

The result of value chain analysis for tomatoes produced in the Jordan Valley hasshown that tomatoes do not generate a significant value added when exported to neighboring markets. This finding contradicts not only the comparative advantages theory but also the logic of resources sustainability. Exporting tomatoes generates lessvalue added compared to local market. The main reason behind this result is that tomatoes are mostly exported when there is excess supply for the local market in peak season when prices are at their lowest.

Value Added for Tomatoes, by Market

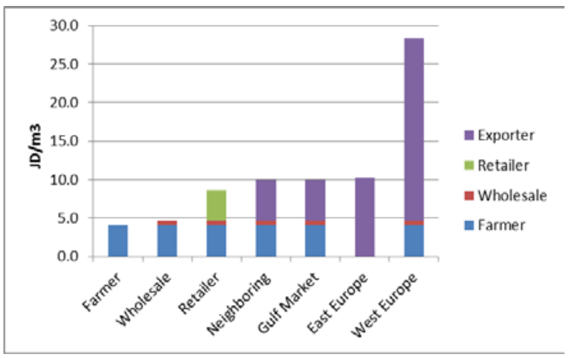


The highest water value is in winter tomatoes produced in the JV for export to the Eastern European market. The value added is JD 1.36/m^3 at the farm level, with further value added by wholesalers of JD0.28/m^3. The retailers value added in the local market is fourfold the value added by farmers (JD 6.26/m^3). Exporting tomatoes to neighboring markets (Lebanon, Syria, and Iraq) have a low level of contribution to value added atonly JD 3.6/m^3. For the tomatoes exported to the Gulf market, the value added by exporters is JD 5.47/m^3. Furthermore, if tomatoesareexported to Eastern Europe markets, the value added by exporters is the highest (JD 13.9/m^3).

In the case of exporting tomatoes, the highest total value added is in winter tomatoes, when they are exported to Eastern European markets, estimated atJD 15.6/m^3. Exporting summer tomatoes for Eastern European markets from the highlands using groundwater yields the lowest water total value added atJD 5.8/m^3. Therefore, exporting tomatoes to neighboring markets(only JD 2.0/m^3) or to Gulf markets (JD 2.7/m^3) does not justify the useof scarce water resources in the highlands to produce a product with low water value added through the value chain.

The value added per m^3 for dates is JD 0.39/m^3 at the farm level, an additional JD 0.23/m^3 at the wholesale level. The retailers' value added in local markets(JD 0.99/m^3)is more than twice the value added by famers. Exporting dates to neighboring markets has a further value added of JD 1.44/m^3 above wholesale value added. Fordates exported to Gulf markets the value added by exporters is JD 1.64/m^3. Furthermore, in the case of exporting dates to Western European markets, the value added by exporters is the highest (JD 3.63/m^3).Table 43Ananalysis conducted on the Medjool variety of dates shows the benefits of choosing the appropriate variety and post-harvest handling. The results fromjumbodates show the water value added per one cubic meter. The value added per m^3 is JD 4.5/m^3 at the farm level with the wholesalers value added of JD 2.67/m^3. Then the retailers' value added in local market is JD 3.25/m^3. Exporting dates to neighboring markets has a value added ofJD 3.25/m³ or the same as local retailers. Forthe jumbo date exported to Gulf market, however, the value added by exporters is JD 5.2/m³. Forjumbo dates exported to Western Europe markets, the value added by exporters is the highest at JD 6.56/m³). As a result, the total value added in to the local economy is JD 10.6/m³. The high water value is gained by exporting dates to western markets.

Water value added for strawberries, by final destination



The water value in winter strawberries produced in the JV has the highest value added. At the start of the value chain, strawberries generate value added of JD 4.02/m³ at the farm level with an additional JD 0.67/m³ at the wholesalers and JD 3.9/m³ at the retailers level. Exporting strawberries to neighboring or Gulf markets increases the total value added JD 5.2/m³. Forthe strawberries exported to Gulf markets the value added by exporters is also JD 5.2/m³. For strawberriesareexported to Western Europe markets, the value added by exporters skyrockets to JD 23.6/m³). Thus the total value added to the Jordanian economy is about JD 28.3/m³ if strawberries are exported to Western Europe markets.

The analysis of the value created by broccoli also showed some positive results. The value added starts at JD 1.87/m³ at the farm level and another JD 1.46/m³ at the wholesalers level. The retailers level produces a further JD 1.08/m³. Exporting broccoli to the Gulf also hasa reasonable contribution to value added atJD 1.39/m³. If broccoli is exported to Western Europe markets, the value added by exporters is the highest at JD 6.56/m³). The total value added from the local market is the JD 4.4/m³compared to the total value added of exporting to Western Europe markets of JD 9.9/m³.

Brussels sproutsis among the highest water values in crops. The value added per m³ at the farm level is JD 3.31, JD 1.76/m³ at the wholesalers level and JD 4.33/m³ at the retailers level. Exporting Brussels sprouts to the Gulf also makesa reasonable contribution to value added atJD 2.08/m³. If Brussels sprouts are exported to Western European markets, the value added by exporters is the highest at JD 21.8/m³. This means that the total value added by the local markets is JD 4.4/m³, whereas it is JD 24/m³ to the Western European market.

Conclusion

In summary, exporting vegetables to neighboring countries and to Gulf stateshasa relatively low value added per cubic meter compared to local markets. Exporting fruits and vegetables to European Union (EU), Balkan, and Russian markets generates three to four times higher water values compared to Jordan's traditional export markets.

Improvements in the quality and marketing of Jordanian horticultural exports to obtain the highest possible value added in high-end markets is necessary to increase competitiveness and to achieve the highest value added per cubic meter of water. It is necessary to reconsider the current production pattern through focusing on high value crops that require lower water requirements

Improving packaging and labeling is a very important step in the whole chain for the competitiveness of final products. While the EU, Balkan, and Russian markets demand quality certified packaging, there are very few certified local producers of food packaging that are applying the necessary safety standards. In addition, retail vs. bulk as a predominant packaging practice needs to be introduced to a greater extent.

Greater value could be pulled from the agricultural sector for local farmers by addressing the high marketing margins currently enjoyed by local retailers. The high marketing margins depend on the current marketing infrastructure and the weakness of the institutional relationships between producers and consumers, which leads to complaints from producers on the huge difference between the prices they get and the prices that consumers pay. The producers' complaints will continue to make the government give them subsidies that are not allowed by the national and regional agreements.The government has an opportunity to identify ways to better target subsidies and support to agriculture to improve irrigation efficiency and income generation in the sector.

Jordan has substantial untapped potential to increase agricultural sector output, particularly by exporting high-value winter vegetables to Europe. However to accomplish this, a coordinated program by various ministries, private sector enterprises, and farmers is necessary. Farmers are in need of better information and technology and access to storage and packaging facilities, particularly smaller farmers who cannot afford to develop these facilities individually. They also need good connections with exporters who can develop and supply markets abroad. Government needs to provide higher-quality, measured irrigation service in the Jordan Valley, establish standards for product quality, provide laboratory facilities for soil, water and product testing, and strengthen farmer organizations that can facilitate joint action by smaller farmers. Private equipment and input suppliers need to do a better job of reaching farmers with information and new technology, while wholesalers and exporters need to invest in storage and packaging facilities and cultivate new sources of supply among small farmers.

Irrigated agriculture is important as a source of rural incomes and employment, improved nutrition, export earnings, and inputs to downstream agricultural processing industries. The Jordan Valley has unique advantages as a supplier of off-season winter vegetables for export and the country should mount a comprehensive multi-actor public and private sector program to enhance and exploit this comparative advantage.

1. BACKGROUND AND TASK

The USAID/Jordan Institutional Support and Strengthening Program (ISSP) works to address key institutional constraints to more effective and efficient management of water resources in Jordan. ISSP is implementing a comprehensive package of institutional reform and restructuring activities to improve transparency and participation in policy and planning, address key institutional conflicts of interest in the management, planning and protection of water resources, improve municipal and irrigation water service delivery across all key institutions and support legislative reform across the water sector.

A critical component of improved resources management is a more informed policy setting process. Jordan's water sector is struggling to keep up with rapid population growth and economic growth. Jordan is one of the most water scarce countries in the world, with very limited quantities of renewable water and high costs for providing water to people and businesses. To help Jordan to face these challenges, ISSP is working with the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ), the Jordan Valley Authority (JVA) and utilities to reform and restructure the water sector to become more efficient, sustainable, and responsive to people's needs. A set of reform goals was developed through an extensive multi-disciplinary Institutional Assessment and were confirmed by USAID and the Ministry of Water and Irrigation in an exchange of letters in April 2012. These reforms will result in a water sector better able to respond to future needs and achieve water security for Jordan.

In a country facing such a significant imbalance between limited supplies and ever-growing demand, the government must grapple with very difficult policy decisions and trade-offs in order to determine the best ways in which to allocate water across sectors. This is especially true for the agricultural and industrial sectors which consume significant portions of the national water supply and are central to the Jordanian economy.

The ISSP Water Valuation Study was undertaken to support ISSP's objectives to improve policy-making in the water sector by providing decision-makers with a much deeper understanding of the productivity of water across sectors. The ISSP Water Valuation Study was designed by Dr. Glen Anderson of International Resources Group (IRG) and Dr. Emad Karablieh of the University of Jordan and implemented by Dr. Karableih and Ra'edDaoud of ECO Consult. Dr. Mark Svendsen of IRG assisted with the analysis, writing, and presentation. This is a Summary Report to highlight the major findings, results and implication s of the study. There is also a detailed report1 which fully explains the study methodology and presents the entirety of the analysis, findings, data and conclusions presented in this summary.

Government policy-makers in the ministries will be able to use the information from this study in assessing and negotiating national decisions about water allocations across economic and social sectors. If, for example, the study determines that an allocation of water to the tourism sector results in twice the return to the economy than allocations to the industrial sector, the government's investment strategy could be adjusted to sectors with high contribution in the water value added per cubic meter.

If the study shows, for example, that continued reliance on groundwater in the uplands to irrigate crops risks economic growth and employment in other sectors, the government may alter agricultural policy. Of course, inherent in all decision-making are risks, especially exogenous risks that could threaten the viability of a certain sector. There is risk, for example, in relying heavily on the tourism sector, as political events can affect travel to the region. However, rationalizing allocation of water resources in a successful and effective manner

[1] Al-Karablieh, Emad. 2012. Disaggregate Economic Value of Water in irrigated Agriculture in Jordan from Perspective of Value Chain Analysis. Draft report. ISSP.

requires multiple interrelated elements, such as: develop the technical expertise to interpret findings of the valuation study; develop a sector-wide allocation plan; and nurture a management structure possessing the political will and capacity to institute, lead, and sustain a major shift in policy setting and implementation.

1.1. THE RATIONALE OF THE TASK

Any society must allocate scarce water resources among uses and users. Those uses have different economic impacts and different social and political implications. The allocation process must balance these factors to divide up a resource that is often scarce and always valuable. Three different types of practices can be identified that are used to make water allocation decisions in different countries and situations: (1) administrative decision-making, (2) rights-based rules for access and use, and (3) transactions based on economic principles.

Jordan is one of the world's most water-scarce countries. Water scarcity is a leading constraint in the agriculture sector. The region is heavily dependent on seasonal rainfall; drought years reduce yields sharply and leave smallholders food-insecure. Desertification is a pronounced problem, largely due to: a) expansion of rainfed farming in marginal areas (the primary driver of desertification in the ecologically fragile steppe), b) water erosion and urbanization, and c) increasing salinity (in irrigated areas of the Jordan Valley). Climate change impact is expected to further exacerbate water scarcity in Jordan, negatively affecting agriculture, a sector that is one of the main consumers of water in the country.

The shift towards irrigated agriculture to meet the country's need forfood needs to be managed very carefully in light of the country's scarce water resources. Currently, irrigated agriculture consumes about 60 percentof the country's water resources. This share is expected to decrease as water will be prioritized for domestic and industrial uses. According to the first national communication report of Jordan to the United Nations Framework Convention on Climate Change (UNFCCC), an increase of temperature by 2ºC would increase irrigation demand by 18 percent while a 10 percent reduction in precipitation would result in an increase of approximately 5 percent in irrigation demand.

These combined effects would aggravate the problems of the agricultural sector and willemphasize the need for adaptation measures. As climate change is expected to have significant impacts on water supplies in Jordan, the competition on water among different sectors will be exacerbated. This could leave low quality water for agriculture and create serious challenges in soil and water management.As the country faces deteriorating water and environmental quality as well as water shortages, increasing the efficiency of water use in agriculture becomes of paramount importance.

1.2. HOW THIS REPORTIS DIFFERENT

The ISSP Water Valuation Study aims to analyze the water values in Jordan from a holistic perspective that takes into account the economic, social, and institutional frameworks as well as the decision-making process around water use and policy within an integrated system of valuation and value chain analysis, providing general guidance and frameworks that can be used when dealing with the economic value of water while also considering a social perspective. The ISSP study was delayed in 2011 in order to allow for the completion of two other valuation studies by the Water Resources Group (led by the McKinsey Group) and the French Development Agency respectively. This report is not intended to provide a review of the water situation in Jordan, which has been addressed by many previous reports and studies, nor is it intended to propose specific policies to deal with the water supply and demand conditions prevailing in Jordan. Readersinterested in the above topic can refer to a recent study on water demand management conducted by the AgenceFrançaise de Développement(AFD),the French Development Agency, in 2011 (AFD, 2011). Instead, this report

The objective of this study is to determine the value of water across the various sectors of Jordanian society and economy. Data and information were collected through external trade, detailed industrial census for 2007-2009 at the detailed level of ISIC 4 of international classifications,farm level enterprise budgets for the cropping season 2011, wholesale prices, retailers prices, annual production, and yield. Primary data was gathered from several questionnaires that were designed and pre-tested in the field. The people interviewed were farmers (producers) in different agro-ecological zones in Jordan, from Ramtha to Aqaba; selected local traders, exporters/importers, processors and retailers were interviewed using rapid appraisal methods.

Previous studies provide an average water value for fruits, vegetable, and field crops at the countrylevel. They do not take into consideration the water value – neither according to different agro-climatological zones nor the type of water used in the production process such as groundwater versus surface or blended waste water with surface water. The major distinction in this report is in the estimation of water value through value chain of produced products (farmers, wholesales, and retailer and export markets).

The detailed collected data allowsus toassess water values that are differentiated according to commodity, adjusted for markets, seasonality, geographic area, and water quality, and to conduct commodities value chain analysis of opportunities to optimize water utilization.

This report will try to answer many questions and challenges facing the estimation the economic value of water in agriculture. These questions and challenges can be summarized as:

- What are the respective contributions of irrigated and rain-fed agriculture?
- What are the direct and indirect contributions of irrigated agriculture in the highlands vs. the Jordan Valley?
- What are the costs of water to farmers in JV and the highlands and theirshare of the operational and capital costs of the system?
- How can the value of water in agriculture and agriculture's contribution to the Jordanian economy be increased?
- What is the social value of water in agriculture?
- What is the value of water through commodity value chain from producers to final consumers?
- What is the value of water within various segments of the industrial sector?
- Is water a limiting factor for industrial growth and economic growth in Jordan?
- What is the lost opportunity to economy and employment?
- How can Jordan increase water use efficiency – increase value to the nation per drop of water?

2. IMPORTANCE OF WATER VALUATION

Water is essential for life and for numerous human activities and industries; water provides a range of ecological life-support systems that are often difficult to value. The economics of water involves understanding its scarcity and its value, as well as human needs, and ensuring that the costs and benefits of choices are clear and that the impacts of alternative pricing schedules are determined.

Natural resources, including water, are one of the most important determinants of economic and social development. Meanwhile,social and economic development attempts to identify different options for efficient, effective, and sustainable management of available natural resources, including water resources. This reflects the tight relationship that exists between "development" in general and water resources. Water resources, in this respect, play a vital role as a basic necessity for life and human health as well as for the natural environment. Along with that, good governance of water is a prerequisite for environmental protections as well as for catering for the evolving socioeconomic needs.

In this context, water scarcity is considered to be one of the most pressing challenges confronting Jordan, which could hamper socioeconomic development in particular as well as human development efforts at large. The evident challenge of the limited quantities of available waters and the continuous deterioration of their qualities, dictate the need for good governance and effective management of these resources. Such inefficiencies can include the excessive use of surface and groundwater in the region as well as the continuing deterioration of these water sources (Brooks, 2007). This makes unsustainable patterns of water use one of the greatest threats to Jordan'snational security at present time

However, even as the nature and needs of economies change, water continues to be allocated to other than high priority uses, water quality continues to decline, environmental uses get inadequate attention, and floods and droughts take an unnecessarily severe toll. One reason for this is that price signals that reflect scarcities of goods and thereby guide investments and resource allocation in the private sector are usually distorted or absent in decision-making relating to water. Therefore, insight into the value of water is essential to support policy decision making about (1) investments in water supply system, (2) investments in the water distribution system and the irrigation system, (3) efficient allocation of water with competing sectors, (4) setting water pricing and tariffs, (5) setting cost recovery (O&M and capital recovery) mechanisms, and (6) determining the socio-economic impacts of water management decisions. However, information on irrigation water values at small-scale schemes is scarce and in general little attention is paid to the determinants of these values.

The choice of appropriate pricing levels, the design of efficient allocation systems, the removal of subsidies that cause high financial costs and adverse environmental impacts, the implementation of new irrigation projects, and the estimation of opportunity costs to industrial and domestic water uses are some of the reasons that justify the necessity for the valuation of irrigation water.

Appropriate water resource allocation in a water-depressed and scarce country is very important for farm management. Although very few systems for water distribution have efficient pricing, water resources should be allocated so that the marginal cost equals the marginal value product of water for all uses and users. When the marginal values are not equal, it is always possible to find a reallocation of water that increases net social benefits. Microeconomic techniques used for estimating the value of water and determining farmers' willingness to pay include: net-back analysis, hedonic models, and optimization models.

The economic value of water is typically unknown and/or not taken into account when developing water-related economic and agricultural policies and trade. Instead, in all cases,attention is usually on financial costs and the attempt to recover the financial costs associated with providing water to different uses. This means that water resources areconsidered a non-economic good; that is, its economic value is equal to zero. This is reflected in Jordan, for example,where scarce water resources are used to produce water-intensive agricultural crops – e.g.,bananas, alfalfa, and some fruit trees regardless of the value-added generated to the society.

Therefore, it is important to introduce the concept of the economic value of water in order to compare the costs and benefits associated with the water policies, and thereafter in program and projects. Integrated water resources management is at the heart of effective water governance – with its emphasis on balancing multi-competitive and sometimes contradictory objectives and bringing together diverse interests and stakes (e.g., satisfying domestic water demand with additional water versus protecting natural flows of river or reducinggroundwater abstractions to maintain aquifer).

Establishing economic value for water is considered to be one of the most discussed and debated issues related to economic efficiency of water use and its allocation (Gibbons, 1986). This task is not a straightforward solution. Young (2005) stated that: "water valuation presents the economic analyst with a wide range of challenging issues and problems, because water values tend to be quite site-specific, spatial, and temporal, and each case confronts its own unique issues and typically requires its own original valuation. Effective measurement of water values demands skill and rigor in application of all the tools of the applied economist's trade. These tools include data collection, statistical analysis, optimization models, and research reporting. Readers interested in water valuation methodologies can refer to Annex I for further elaboration.

3. IMPORTANCE OF VALUE CHAIN ANALYSIS

The importance of the agricultural sector stems from the fact that it is not only the major source of food items, especially fruits and vegetables, but also one of the sources of hard currencythat comefrom exports. In addition, the agro-industrial sector is characterized by a large number of small enterprises. The vast majority of the irrigated agricultural production is in the form of fresh fruits and vegetables. More than 90percent of the irrigated areas in Jordan are oriented for production of fruits and vegetables.

The value chain describes the activities that take place in a business and relates them to an analysis of the competitive strength of the business. Value Chain Analysis is one way of identifying which activities are best undertaken by a business and which are best provided by others ("outsourced"). Theactivities a business chooses to undertake aredirectly linked to achieving competitive advantage. This implies flows of resources, goods, services, knowledge, and information.

Value added ideally represents the value created during the commodity exchange process conducted by each agent in the marketing channels. It is measured as the difference between the value of all goods and services produced and the value of those purchased non-labor inputs which have been used in the production process. This type of measure avoids double counting, since what each firm has purchased from another firm is deducted from the value of its own production. Inputs to be considered may include materials and supplies, fuel, electricity, contract work, repairs, maintenance, and transportation as well as other industrial services. The value at which these inputs were purchased is deducted from total revenue from production in order to obtain the firm's value added. Revenue from production can be reported at basic or producer prices.

Agricultural production in rural areas and consumption in urban centers are increasingly separated geographically. Rural production needs to provide growing cities with affordable,high quality food. Value chains have developed rural-urban linkages to meet these challenges and provide potential benefits for both rural producers and urban consumers, as shown below (Figure 1).

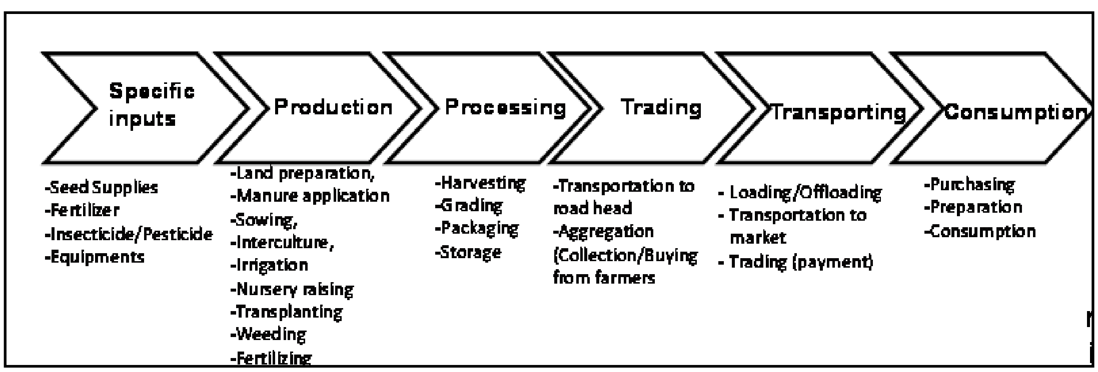


Figure 1: Agricultural Value Chain Analysis

Attempting to analyze the entire food system is an impossible taskgiven limited resources. Thus, the research was narrowed down to concentrate on the major and potential crops. The crops were limited to tomatoes for their increasing coverage vis-à-vis the marketing problem they face, as well as dates, strawberries, broccoli, Brussels sprouts, and baby leeks for their high levels of water productivity combined with high demand in several export markets.

Other vegetable crop types were omitted for a variety of reasons, including: their production is limited; they did not pass through a number of stages; and/or their similarity with tomatoes (e.g. eggplant, squash, and sweet peppers).

Agricultural commodities are produced by large numbers of farmers and consumed by large numbers of households. With the exception of foodstuffs consumed on-farm or sold locally, they are bought and sold a number of times between the farm gate and the final consumer. While moving between these two points, the commodity is loaded, off-loaded, transported, stored, cleaned, graded, and processed. The conduit that runs from a farmer down to a final user, through which the commodity passes and which embodies these transactions and activities, is conventionally referred to as a value chain.

The results of a study conducted by Al-Karablieh et al., (2011) on Jordanian horticultural export competitiveness from a water perspective show that open field tomatoes are ata comparative disadvantage. The value of the Domestic Resource Coefficient (DRC) indicates that the value of domestic resources used to produce tomatoes in an open field is greater than the contribution of its value added to social prices. The finding contradicts not only the comparative advantages theory but also the logic ofresources sustainability.

4. OBJECTIVES OF THE STUDY

The specific objective is to display thevalue of water disaggregated by commodity and sector through value chain analysis and water valuation. The methodology involved the use of industrial and agricultural sector models incorporating water as a scarce input. Therefore, the objective was to estimate the marginal value product of water derived from a Residual Valuation Methodology approach for industrial statistics and from crop budgets and to measure the efficiency of water use. The methodology deducts the contribution of non-water production inputs from the gross output and attributes the remaining value to water.

In Jordan, irrigation in agriculture is seen as an important rural development factor, creating employment opportunities, generating income, and enhancing food security. Therefore, huge investments are made in the sector, construction of a new irrigation project, dams, and rehabilitating the existing irrigation system. On the other hand, the growing water scarcity causes increasing pressure on farmers to allocate water more efficiently. Moreover, to formulate a new water policy, water subsidies currently received by farmers willgradually decrease and become negative, i.e. in the near future, farmers will have to pay for the water they use. In this context, knowledge about water values in the value chain of commodities can contribute to the objective of improving efficiency through better water allocation at the farm level and for society as a whole and furthermore, institutionalize mechanisms for water valuation that will support policy and analytical analysis on water and finally, examine the social and environmental dimensions related to water use and allocation.

4.1. TARGET AUDIENCES

This report is intended for two audience groups.The first is policy- and decision-makers who are working in water resources management as well as water-related sectors. For this group, the report attempts to highlight the value added of dealing with water resources from an economic perspective compared to current approaches employed for policy formulation. The second target group comprises researchers from the public and practitioners in the water resources management field and related sectors. This report could also be of interest to many other parties concerned with the economic value of water, including civil society and its organizations and the private sector.

5. BACKGROUND TO ECONOMY

Jordan is considered to be among the low-middle income countries, with an average per capita gross domestic product (GDP) of about JD 3,069 in 2010, and its population reached 6.11 million inhabitants in 2010 [DOS,2011]. The countrysuffers from a chronic lack of adequate supplies of natural resources, including fresh water, crude oil, and other commercial minerals. Thus, Jordan depends heavily on imports of crude oil, refined products, and natural gas from neighboring Arab countries as main sources of energy.

Fresh water resources in Jordan consist mainly of groundwater and surface water. Treated wastewater and brackish water are other important non-conventional resources that help bridge part of the gap between supply and demand, especially in the agricultural sector. Below is a description of the different available water resources in Jordan.

5.1. JORDAN'S ECONOMY: OVERVIEW

Jordan's economy is among the smallest in the Middle East, with limited water, oil, and other natural resources, underlying the government's heavy reliance on foreign assistance. Other economic challenges for the government include chronic high rates of poverty, unemployment, inflation, and a large budget deficit. Since assuming the throne in 1999, King Abdullah has implemented significant economic reforms, such as opening the trade regime, privatizing state-owned companies, and eliminating most fuel subsidies, which in the past few years have spurred economic growth by attracting foreign investment and creating some jobs. The global economic slowdown, however, has depressed Jordan's GDP growth and foreign assistance to the government in 2009 plummeted, hampering the government's efforts to rein in the large budget deficit.

Jordan has a service-based economy with a moderate GDP per capita of JD 3,069 in2010, which increased from JD 1,647 per capita in 2005. The GDP in 2010 was estimated at JD 18,762.0 million or US$ 26,461.9 million. The services sector accounts for over 70 percentof GDP and more than 75 percentof jobs. Since the late 1990s, Jordan has undertaken broad economic reforms in a long-term effort to improve living standards. Since Jordan's graduation from its most recent International Monetary Fund (IMF) program in 2002, Jordan has continued to follow IMF guidelines, practicing careful monetary policy, making substantial headway with privatization, and opening trade. Jordan's exports have significantly increased under the free trade accord with the United States, which allows Jordan to export goods duty free to the US. Jordan's economic relationship with the US also extends to its currency, the dinar, which is pegged to the US dollar at $1.41 per dinar (DOS, 2010, and World Bank 2010).

Jordan's economy has continued to perform well over the last five years. The GDP growth at market prices reached 11 percent in 2010. The main contributing sectors were services, manufacturing, and producers of government services. The percentage share of agriculture in Jordan's GDP has increased to around 3percent. The agricultural GDP increased from JD 276 million in 2006 to JD 598 million in 2011[2] as shown in Table 1. The per capita GDP has increased from JD1,647in 2005 to JD 3,277 in 2011.

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[2]Central Bank of Jordan (2011).Monthly Statistical Bulletin, Research Department.Volume 47, No. 12, December 2011, Amman, Jordan.

Table 1: Summary Statistics on Jordan's Economy, 2006-2011

	2006	2007	2008	2009	2010	2011
Agriculture [MJD]	276	307	377	459	561	598
Manufacturing [MJD]	1,815	2,295	2,933	3,026	3,146	3,485
GDP at Market Prices [MJD]	10,675	12,131	15,593	16,912	18,762	20,476
Agricultural share of GDP [%]	2.6%	2.5%	2.4%	2.7%	3.0%	2.9%
Manufacturing Share of GDP [%]	17.0%	18.9%	18.8%	17.9%	16.8%	17.0%
Per Capita GDP at Current Price [JD]	1,906	2,120	2,666	2,828	3,069	3,277

Source: CBJ, 2012. Monthly Statistical Bulletin.www.cbj.gov.jo, retrieved May 2012.

5.2. INDUSTRIAL SECTOR IN JORDAN

Industry plays a key role in the process of modernization and economic development as it provides the framework within which national resources and factors of production are utilized, know-how acquired, technology transferred, and new skills developed. It links all the economic activities of society together and interacts with all sections in meaningful ways. Industry is one of the key contributors to economic growth and main generators of national income in Jordan. Some 16.7 per cent of Jordan's GDP in 2010 or US $4.4 billion was contributed by the relatively fast-growing industrial sector (CBJ, 2011). More importantly, industry contributes about 90 percentof the total value of national exports, a very significant and welcome phenomenon for a country keen to establish itself in world markets.

Jordanian industry has also developed a significant degree of diversity. The Amman Chamber of Industry classifies its associated range of productive activities into 10 sub-sectors. These include several traditional sectors, such as the mining of national resources (potash and phosphate), and a number of new ones, such as engineering and manufacturing industries that provide products to meet consumer needs and other requirements, both local and export. The total value of national exports reached about JD 4.22 billion in 2010 of which JD 3.59 billion was made up of industrial products (CBJ, 2011).

Industrial water use includes water used to manufacture products such as steel, chemical, and paper, as well as water used in petroleum and metals refining. Industrial water use includes water used as process and production water, boiler feed, air conditioning, cooling, sanitation, washing, transport of materials, and steam generation for internal use.

Industrial water-use activities include water withdrawal from ground and surface water and deliveries from public water suppliers. Large industrial water users are more likely to obtain water directly from private wells and may supplement this with water purchased from public water suppliers. Small industries, especially in cities, are more likely to obtain water from public water suppliers. Even if water is purchased from a public water supplier, the water may be treated by the industry before use, especially if pure water is required, as in boiler feed.

5.3. AGRICULTURAL SECTOR IN JORDAN

The agriculture sector is a major consumer of water, and the returns to water from crop production tend to be low in comparison to other sectors. Below is a summary of the importance of the agricultural sector to the Jordanian economy. The percentage share of agriculture in Jordan's GDP has increased to around 3percent,as indicated in Table 2. The percentage share of agriculture in Jordan's GDP has stagnated at around 2.8 during the last four years. Table 2 shows that horticultureis becoming the main source of agriculture GDP. The contribution of plants increased from 42 percent in 2001 to68 percentof agricultural GDP in 2008. The annual growth rate of agricultural GDP was fluctuating during the last decade.

The Jordanian agricultural sector is almost divided in half between animal and plant production. Around 54 percentof Jordanian agriculture GDP over the period 2005-2008 consists of horticultural production while the remaining 46 percentis livestock production. About 25 percentof plant production is considered rainfed and the remaining 75 percentis irrigated. The irrigated agriculture is mainly based on marginal water resources in the Jordan valley but in the highlands the irrigation is based on groundwater.

The importance of the agricultural sector stems from the fact that it is the major source of food items, especially fruits and vegetables, and also one of the sources of hard currencies originated from exports. In addition, the agro-industrial sector is characterized by a large number of small enterprises.

Table 2: Plant GDP and Intermediate Consumption at Current Prices

	2002	2004	2006	2008
Cereal	17,208	12,768	16,646	15,606
Vegetables	95,375	122,191	152,875	252,829
Fruits	86,985	105,181	131,602	143,982
Others	24,882	25,261	31,672	38,125
Plant Gross Output	224,450	265,400	332,795	450,541+
Plant Intermediate Consumption	160,943	172,267	202,112	197,870
Plant GDP	63,507	93,133	130,683	252,670
Agriculture GDP	148,990	202,080	275,830	373,610
Percentage of Plant	43	46	47	68

Source: DOS, 2012. Open files, personal communications

+ Plant gross output was estimated at JD 510 million in 2010.

5.3.1. CULTIVATED AREAS

The total area of Jordan is about 89.2 million dunums, and this land area can be divided into seven climatic rainfall zones. In general, Jordan is considered as a low rainfall region, since over 86 percentof its area is a desert and has no economic importance, except for some short-term sporadic grazing at certain times of the year. The level of precipitation decreases from West to East and from North to South and, out of a total cultivable area of about 2.6 million dunums (2.9 percentof the total land area), 1.5 million dunums (60 percent) depend entirely on rainfall to sustain any crops, and only about 1.03 million dunums (40 percent) wereirrigated in 2010. The average cultivated area in the 2000-2009 period isabout 2,403 thousand dunums, representing 2.7 percentof the total Jordanian area and less than 1 dunum per capita. However, the cultivated area varies strongly according to changes in rainfall.

In the last 30years more and more areas, especially in the highlands and the Badia region, have come under irrigation. The total irrigated area was 253,000 dunums in 1983. The irrigated area constantly increased to reach almost 538,000 dunums in 1990 and 739,000 dunums in 1997. Recently, the total irrigated areas in the year 2010 reached about 1,035,000 dunums (DOS, 2012). Thus, more than 40 percentof the total cultivated area is now under irrigation.

Due to variations in rainfall, the increase of irrigated area, the shift to cultivating more profitable crops, and major changes in the traditional markets for Jordan's agricultural products, the irrigation pattern has changed. The area of field crops fluctuates sharply from year to year on a decreasing trend. The irrigated field crops increased from 1.7 percentin 1983 to 8.2 percentin 1997 and then increased to 13 percentof total field crops area in 2007. Due to the profitability and comparative advantage of vegetables in Jordan, especially in the Jordan Valley, the cultivated area under irrigation has increased with an annual growth rate of 5percent to reach 92percent of vegetables area. The drastic change in Jordan occurred in fruit production (olive trees). This area increased continuously to reach 24percent of irrigated areas in Jordan in 2010.

5.3.2. IMPORTANCE OF FRUIT AND VEGETABLE EXPORTS IN JORDAN

Despite its low contribution in the GDP, agricultural exports represent about 14 percent of Jordan's total domestic exports, as shown in Table 3. Vegetable exports represented about 8 percent of total domestic export. The main destinations of most of these exports are United Arab Emirates, Kuwait, Bahrain, Syria, Lebanon, Qatar, and Oman. In contrast to the sophisticated markets in the EU, these destinations do not have high quality and packaging requirements. In the last two years, vegetable and fruit exports have jumped and together they represent almost 70 percent of total agricultural exports. This indicates that there is a high potential for increasing plant exports. This potential can be realized in the future, depending on tackling major obstacles related to water quantity and quality. Expanding plant exports require the availability of additional water resources of high quality to meet sanitary requirements such as the GlobalGap and SPS regulations.

Agricultural production in Jordan has witnessed a tremendous increase during the last two decades. Vegetable production has tripled since 1994. This was mainly due to the expansion in irrigation projects, introduction of plastic houses, and introduction of new hybrid-high yielding varieties. Production has also increased in response to expanding demand for fresh produce, domestically and in neighboring countries. The main vegetable crops produced in Jordan are tomatoes, cucumbers, eggplants, squash, and potatoes. Jordan has two primary production areas – the Jordan Valley, which is a winter crop area, and the uplands, which produce summer crops.

Table 3: Value of Jordan's Agricultural Exports, 2000-2009 (million JD)

	Vegetables	Plant	Live animals & animal products	Food and Live Animals	Beverages and Tobacco	Total Domestic Export	Percent of Vegetable to Total Export
2000	59.1	86.6	22.1	116.4	8.6	1,080.8	5.47%
2001	82.3	112.1	11.5	135.5	22.8	1,352.4	6.08%
2002	95.3	116.9	13.3	141.3	30.3	1,556.7	6.12%
2003	99.5	120.5	18.1	156.6	44.8	1,675.1	5.94%
2004	127.7	158.5	19.9	200.9	41.5	2,306.6	5.54%
2005	158.7	196.3	40.1	275.0	47.9	2,570.2	6.17%
2006	162.1	204.5	78.8	322.6	66.0	2,929.3	5.54%
2007	273.0	334.0	14.4	404.1	68.4	3,183.7	8.57%
2008	291.5	377.2	39.1	507.3	76.0	4,431.1	6.58%
2009	279.8	368.6	51.3	513.2	61.1	3,579.2	7.82%
2010	323.8	425.1	71.9	621.5	62.5	4,216.9	7.68%

Source: CBJ (Central Bank of Jordan),(2011). Monthly Statistical Bulletin, Research Department.Volume 47, No. 12, December, 2011, Amman. Jordan.

Production (harvest) in the Jordan Valley starts in early December and continues untilMay of the following year. In upland areas, such as the Amman-Zarqa Basin, harvest begins in May and continues through October. Recent studies on future adjustments of the Jordan Valley concluded that the potential for increasing vegetable production base there is very promising. This could be accomplished through:

- The intensification of technology and methodology used for vegetable production
- The increase in cropping intensity

- Enlarging the production base capacity of vegetables through changing the cropping pattern

Fruit production has shown upward trends similar to vegetables. The production has steadily increased throughout the period (1994-2010) and amounted in 2010 to about 426,000 tons compared to 366,000 tons in 1994. The most significant increase of fruit trees production in the JV was in citrus and bananas. Citrus are mainly exported to Gulf markets; however, bananas are consumed locally. Olive trees are the main fruit trees cultivated in the highlands under both irrigated and rainfed conditions. Olives are consumed either as pickled fruits or as olive oil. An export of olives and olive oil is limited.

Jordan's indigenous agricultural production provides for food needs and reduces foreign trade deficits in food commodities. It saves on foreign currency demands and improves the current accounts of the country. Agriculture and its downstream activities in Jordan are important employers. Agriculture directly employs about 5 percent of Jordan's labor force but is source to about 29 percent of the country's GDP when downstream activities are included (Ministry of Planning, 2004). Agriculture is the only user of Jordan's "green water" thereby enhancing the efficiency of use of water resources through rainfed farming. The diversity in the Jordan micro-climate allows the production of off-season fruits and vegetables with market advantages for exports. Jordanian agricultural products enjoy status in neighboring countries, especially the Gulf States and Syria. There is inter-annual variability in Jordan's agricultural production owing to the variability in rainfall patterns. Changing political scenes and occasional instability in the Middle East impact the returns from Jordan's agricultural exports.

Jordan is one of the leading countries of the region in plant exports to traditional Arabian Gulf countries and to some EU countries. Total exports amounted to JD 4,217 million whereas agricultural exports amounted to JD 621 million (15 percent of total exports). The value of vegetable exports amounted to JD 324 million (63 percent of total agricultural exports or 7.4 percent of total export) in 2020 (CBJ, 2012). However, the total volume of plant exports amounted to a record figure in 2010, which is755,000 tons of which 685,000 tons are vegetables and 69,000 tons fruits (DOS, 2011). Total agricultural production of vegetables in 2010 amounted to 2,568,000tons of which 31,000 tons is field crops. The vegetable production amounted to 1,790,000 tons of which winter-vegetables amounted to 932,000 tons and summer- vegetables amounted to 858,000 tons, while the production of fruits amounted to 460,000 tons of which one third is olive. In other words, the vegetable exports in 2010 represented 38 percent of Jordan's production of vegetables, while fruit exports constituted only 15 percent of the national production of fruits.

Volume of irrigation water used in the production of the export crops and the value added there for the period (1994-2002) averaged 74 mcm and JD 0.35 m^{-3}, respectively (Haddadin, 2006). Jordan's commodity exports in 2000 earned JD 1,080 million of which agricultural exports accounted for JD 116 million or 10.7 percent of the total. Vegetable export value amounted to JD 59 million or 50 percent of total agricultural exports value in 2000. The picture soon accelerated thereafter – Jordan's commodity exports in 2010 earned JD 4,214 million of which agricultural exports accounted for JD 614 million or 14.5 percent of the total. Vegetable export value amounted to JD 323 million (52 percent of total agricultural exports value) or 7.7 percent of total national export in 2010.

The vast majority of irrigated agricultural production is in the form of fresh fruits and vegetables. As indicated in Table 4, more that 90 percent of the irrigated areas in Jordan is under fruits and vegetables. Therefore the analysis will focus the status of the competitiveness of fresh vegetables.

Table 4: Irrigated and Non-Irrigated Areas under Tree Crops, Field Crops, and Vegetables in 2010

Crops	Irrigated Area (Dunums)	Non-Irrigated Area (Dunums)	Total Area (Dunums)
Tree Crops	447,246	379,882	827,128

Field Crops	128,625	1,156,943	1,285,568
Vegetables	448,851	31,956	480,806
Total	1,024,721	1,568,780	2,593,501

Source DOS, 2010.Annual Agricultural Statistics.

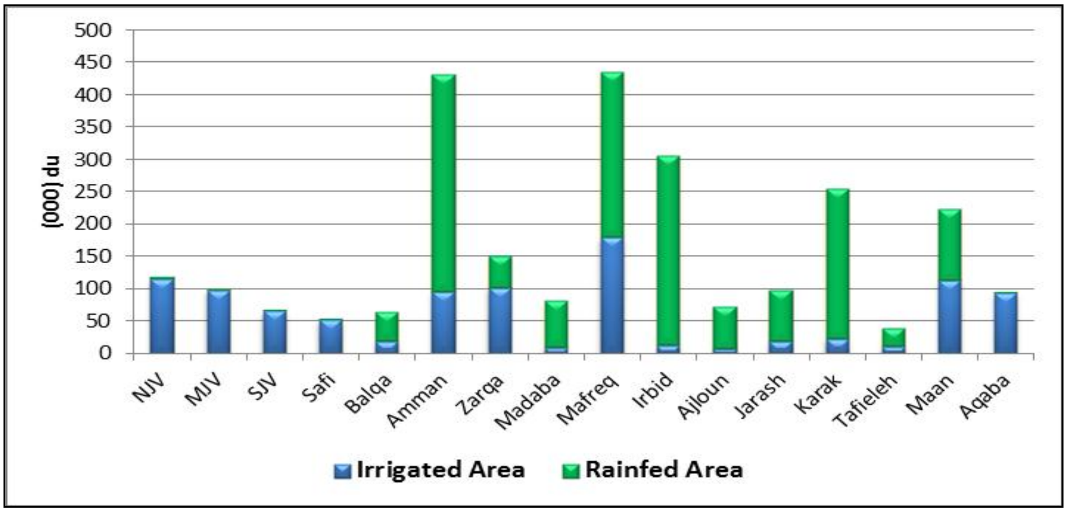


Figure 2: Distribution of Irrigated and Rainfed Areas by Governorates in Jordan

5.3.3. EMPLOYMENT AND AGRICULTURAL LABOR FORCES

Jordan has a total population of6.26 million (Department of Statisticsestimate) in February 2012 with a growth rate of 2.2 percent. The forecasted population is expected to reach 10 million in 2050 assuming a medium declining growth rate. Growing populations, increasing urbanization, increasing economic development, and rising standards of living all ultimately have a variety of environmental impacts onthe agricultural sector. Such impacts include loss of productive land, particularly in urban areas, and degradation of water resources.

The Jordanian labor force was about 1,235,000 in 2010, and unemploymentwas estimated at about 176,000, making the total workforce about 1,412,000. The migrant labor force was estimated at about 298,000. Therefore, the total workforce in Jordan was about 1,710,000in 2010; only about 25,000 are enrolled in agricultural sectors. Some 28.7 percent of the migrants' labor is engaged in the agricultural sector – about 85,623 employees, most of them Egyptian labor.

The share of agricultural labor declined dramatically in subsequent years. Statistics indicate that the number of inhabitants depending on agriculture decreased to 2 percent in 2010. The current agricultural labor market suffers from a shortage of Jordanian labor. Because of the availability of relatively cheap labor from outside, the difficulty of daily mobility of labor to the production regions (mainly the Jordan Valley) and the dominance of subsistence agriculture in the rainfed regions, many Jordanian farmers have become more interested in working on a sharecropping basis or leasing their land.

The permanent guest labor was estimated at about 17,000 in the year 2010 due to the new government regulationsonorganizing the labor market. The guest labor needs permission to work in agriculture. Furthermore, most of the guest labor was as casual labor, moving from one sector to another depending on opportunity. The distribution of hired permanent guest agricultural labor in Jordan Valley was estimated with about 8,000 workers in 2010.

However, the agricultural census in 2007 reported that that about 50 percent of agricultural operations are conducted by family labor. Most agricultural operations are conducted by family labor in the rainfed areas;

only 22 percent of work is performed by hired labor. In irrigated areas most of agricultural operations are conducted by hired labor (78 percent), whereas only 22 percent of agricultural operations are conducted by family labor. These percentages are varying according to holding size as shown in Table 6 below.

It should be notedhere, however, that these figures only included the agricultural workers who received wages. Obviously, these constitute a low proportion in the agricultural sector. The percentage of workers who did not receive wages, i.e., self-employed and family farm workers, reached about 50 percent of the total. The composition of the labor force in the agricultural census of 2007 shows that the predominant form of agricultural labor is family labor, with unpaid family labor being 77 percent of the total in rainfed agriculture. Children under 15 years also contributed to a minor part of farm labor. Socio-cultural values hinder large-scale participation of women in agricultural activities other than family farming. In 2010, female contributions in hired agricultural laborwere very low –of the total paid laborers, 89.4 percent were male and 10.6 percent female In rainfed agricultural production, women contributed less than20 percent of total hours input into agricultural production, whereas households provided 40 percent of total hours worked, and the rest was provided by hired labor (depending on the kind of agricultural operations). Guest labor is mainly engaged in operations that need unskilled labor or physical work.

In order to convert seasonal labor and casual labor to man-equivalent permanent labor, a standardization conversion factor is used. Since, according to the DOS definition of seasonal labor and casual labor, one seasonal laborer is equivalent to half a permanent laborer and one casual laborer is equal to one-quarter of a permanent laborer. Consequently, the total hired labor force engaged in the agricultural sector during 2010 was estimated at 32.1,000 workers, of which 28,700 male workers and 3,400 are female. As shown in Table 5, the total hired labor force engaged in agricultural sector during 2010 wasestimated at32,100 workers, of which 28,700 were male workers and 3,400 female.

Table 5: Distribution of Hired Agricultural Labor by Gender & Nationality in 2010

Distribution of Agr. Labor by Sex	Nationality	Male	Female	Total
Permanent Labor	Jordanian	3,627	679	4,306
	Non-Jordanian	17,338	0	17,338
Seasonal Labor	Jordanian	1,268	17	1,285
	Non-Jordanian	770	84	854
Casual Labor	Jordanian	10,413	8,676	19,089
	Non-Jordanian	16,563	1,920	18,483
Total Labor	Jordanian	15,308	9,372	24,680
	Non-Jordanian	34,671	2,004	36,675
	Total	**49,979**	**11,376**	**61,355**
Standardized total labor (0.5 seasonal, 0.25 casual)	Jordanian	6,864	2,857	9,721
	Non-Jordanian	21,864	522	22,386
	Total	**28,728**	**3,379**	**32,107**

Source: DOS, 2012. Agricultural statistics

Table 6: Percentage Distribution of Holdings Rely mainly on Family or Hired Labor in Performing Agricultural Operations in Jordan in 2007

Holding size categories in dunum	Rainfed Holding		Irrigated Holding		All Holding	
	Family Labor	Hired Labor	Family Labor	Hired Labor	Family Labor	Hired Labor
< 10	93.7	6.3	87.8	12.2	90.7	9.3

29-Oct	89.4	10.6	56.5	43.5	81	19
30-49	87.1	12.9	34.8	65.2	53.4	46.6
50-99	85.2	14.8	35.2	64.8	70.2	29.8
100-199	79.2	20.8	28.6	71.4	62.7	37.3
> 200	61.1	38.9	10.6	89.4	29.3	70.7
Percent	**77.8**	**22.2**	**21.8**	**78.2**	**50.1**	**49.9**

Source: (DOS, 2008). The general results of agricultural census 2007. Department of Statistics, Amman, Jordan.

The distribution of hired labor by governorates shows that most of the hired labor (35 percent) is in Balqa governorates, mainly Middle and South Jordan Valley districts, and about 21 percent of hired labor was in Ibid governorate, mainly Northern Jordan Valley district. Wages in the agricultural sector were forced to go up in recent years, and the scarcity and high cost of hired labor had a discouraging effect on farmers. The shortage had different consequences for rainfed and irrigated agriculture. It reduced the scale of rainfed farming, but most farmers in irrigated areas merely relied more on guest labor. It was estimated that 72 percent of the paid agricultural labor force was guest labor.

5.4. WATER RESOURCES IN JORDAN

Fresh water resources in Jordan consist mainly of groundwater and surface water. Treated wastewater and brackish water are other important non-conventional resources that help bridge part of the gap between supply and demand, especially in the agricultural sector. Below is a description of the different available water resources in Jordan.

Despite Government efforts tomanage the limited water resources and its relentless search for alternative supply, the available water resources per capita are falling as a result of population growth. It is projected that the population will continue to grow from about 5.87 million in 2008 to over 7.8 million by the year 2022 (MWI, 2009).

Annual per capita water availability has declined from 3,600 m^3/year in the year 1946 to 145 m^3/year in the year 2008; this is far below the international water poverty line of 500 m^3/year. As a result of scarcity, the demands and uses of water are far exceeding renewable supply. The deficit is made up by the unsustainable use of groundwater through overdrawing of highland aquifers, resulting in lowered water table in many basins and declining water quality in others. In addition to that, the deficit isalso overcome by supply rationing to the domestic and agricultural sectors. inthe year 2007, water resources were 867 mcm while the demand was 1,505 mcm, thus the deficit was 638 mcm.

The distribution of water supply (allocations) in the year 2007 was as follows: 30 percent for municipal use, 1 percent for tourist use, 5 percent for industrial use, 32 percent for highland irrigation, and 32 percent for irrigation in Jordan Valley (MWI, 2009). The municipal water demand is growing faster than the population growth but due to system capacity and limited supply, the actual demand has never been met. To overcome the shortage and gap between supply and demand, water consumption is rationed by rotating supplies and providing intermittent services during most of the dry months (June –August). The water resources should be developed to 1,662 mcm by the year 2022. The Disi is planned to be operational by the year 2013, the Red Dead conveyance is expected to be operational by the year 2022, and treated wastewater should be fully utilized by the year 2022. Extraction from groundwater should be drastically reduced (MWI, 2009).Jordan's water is derived from surface and underground sources in addition to water reclamation from wastewater treatment plants.

5.5. WATER DEMAND IN JORDAN

A recent study conducted by AFD indicated that the total water use in 2009 amounted to 883 mcm/year, which is probably less than the actual water use due to partially uncontrolled abstraction of groundwater, in particular by agricultural farms in the highlands areas. Recorded water use by agriculture amounted to 537 mcm in 2009, which equaled about 61 percent of the total water use. Water for municipal water use was the second largest position with about 34 percent and water for industry and tourism made up for the remaining 5 percent.

Forecasting techniques usedifferent scenarios to predict the future water demand in different water consuming sectors. The results of the studyshowed that the total water demand in 2025 may vary between 1,219 and 1,620 mcm. Contributions to this growth and its variances differ considerably between the sectors of water demand, using the same approach and data used in the AFD study to forecast the future demand for a longer period (2030-2050). The results showed that the total water demand in 2030 was about 2,080 mcm, in the year 2040 it is expected to be 2,350 mcm, and in the year 2050 it is expected to be 2,530 mcm.

Table 7: Future Water Demand in Million Cubic Meters for Jordan during the Period 2020-2050

Year	2020	2030	2040	2050
Agriculture *	1,049	1,156	1,243	1,374
Municipal	451	704	824	829
Industry	168	212	272	307
Tourism	9	11	14	21
Total	1,677	2,083	2,353	2,531

* by assuming no intervention to curtail water demand and based on past growth rate of irrigated areas

Source: authors' estimate

5.5.1. MUNICIPAL WATER DEMAND

Municipal water use comprises domestic water use at the household level and water for services, such as commerce, health, education, workshop, governmental offices, and communal green spaces. This sector receives water through the public water network which is managed by the WAJ and Jordan's three public utilities. The total municipal water use reached 313 mcm in 2009 and is expected to increase to about 704 mcm in 2030 according to Jordan's water strategy, and is expected to increase to 830 mcm in 2050.

However, assumptions on municipal water demand development vary with regard to nearly all underlying determinants, such as demographic growth, water demand and purchasing power per capita, potential impacts from water savings programs, and water losses.

5.5.2. INDUSTRIAL WATER DEMAND

Industrial water use includes both industries that receive their water from public water network and industries with their own water wells. Groundwater comprisesabout 90 percent the main source of water for industry. Industrial water use increased sharply over the last decade up to around 46 mcm in 2008, but annual growth rates differ considerably.

Jordan's Water Strategy estimated water requirements by industries to reach about 163 mcm in 2022, including the expected demand of oil shale industry, uranium industry, and nuclear energy project. The prognoses by the MWI predictedindustrial water use at 117 mcm in 2025. The estimates on industrial water incorporate the water requirements of current energy production and scheduled new mining activities for oil shale and uranium, which are supposed to start around 2015. Expected water demands and uses of these "new energies" will rise from to 17 mcm/year in the initial year up to 42 mcm/year in 2025. The total industrial water demand is expected to reach 168 mcmin 2020 and 212 mcm2030 and is expected to increase up to about 307mcmin the year 2050.

5.5.3. TOURISM WATER DEMAND

Water use by tourism includes water for hotels, restaurants, and other tourist services and facilities. Water to this sector is supplied by WAJ and the utilities via the domestic water network and is considered administratively as part of the municipal water supply. Touristic water use reached around 10 mcm in 2007 and is expected to reach 29 mcm by 2025 (NWS, 2009). The majority of water use in tourism arises in the three touristic centers Amman, Aqaba, and the hotel resorts along the eastern shore of the Dead Sea. The estimated calculations in the AFD study set the range for 2025 between 11 and 40 mcm. Expected water demands and uses in tourism will rise from to 9 mcm/year in 2020 up to 21 mcm/year in 2050.

5.5.4. AGRICULTURAL WATER DEMAND

Agricultural water use comprises mainly irrigation, where recorded water use was up more than 584 mcm in 2009, and to a far lesser extent intensive livestock husbandry, e.g. poultry farms, with a water use of less than 10 mcm in the same year.

Figures on agricultural water use do not include water use by rainfed agriculture, which makes up for slightly more than half of Jordan's 260,000 hectares of cultivated areas. About 70 percent of Jordan's agricultural holdings have access to irrigation for at least parts of their cultivated areas.

The sources for irrigation water and challenges in water supply distinguish two major regions of agricultural water use. Irrigated agriculture in the Jordan Valley relies predominantly on surface water, which includes water from the tributaries to the Jordan River, water flows from the side Wadis, and treated wastewater from the urban areas in the highlands.

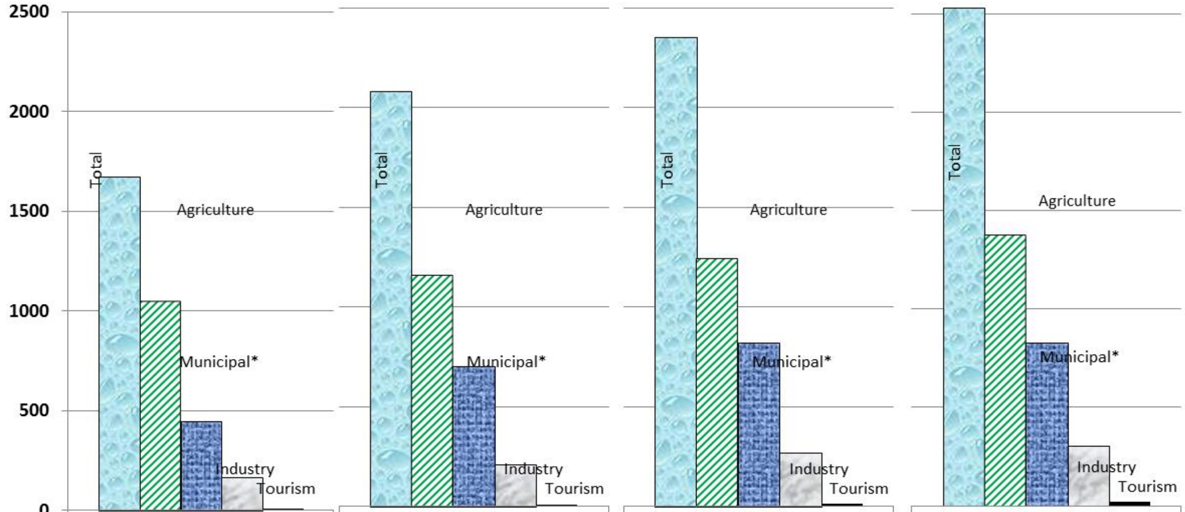
Irrigated agriculture in the highlands east and south of the Jordan Valley relies predominantly on groundwater and is thus a direct competitor for the current major water source of municipal and industrial water supply.

Recorded water abstraction for agriculture amounted to 537 mcm in 2009 according to the MWI, while estimates based on CRWs amounted to about 960 mcm for the same year. Assumed reasons for the difference are a combination of unrecorded groundwater abstractions and depressions or even failure of yields.

Both figures indicate that irrigated agriculture is the largest water user in Jordan. In 2007, 64 percent of the annual total water use was for irrigated agriculture (NWS, 2009). Irrigated agriculture used 50 percent of the pumped groundwater for all purposes which summed up to 216 mcm for that year and equaled about 79 percent of the total renewable groundwater resources.

Agricultural production contributes only about 3 percent to Jordan's GDP and employs 2 percent of its labor force, but 30 percent of Jordan's population lives in rural areas. Arguments for water supply to agriculture thus do not only rely on production values but also on functions of agriculture in the preservation and development of rural systems and areas.

The estimated water demand is based on the current cropping pattern on Jordan's cultivated areas as well as the current trends of expansion in the irrigated areas. The total agricultural water demand is expected to reach 1050 mcmin 2020 if no restrictions aremade on groundwater abstractions. Furthermore, irrigation water demand is expected to increase to 1,156 mcmin 2030 and is expected to increase up to about 1,374 mcmin 2050.



2020	2030	2040	2050
1677	2083	2353	2531
1049.4	1155.9	1242.8	1373.5
450.8	704.2	823.7	829.4
167.8	211.6	272.3	306.7
8.8	10.9	13.9	20.9

Figure 3: Future Water Demand (2020-2050)

6. ECONOMIC VALUE OF WATER

Scarcity of resources, relative to human needs and wants, means that individuals have to make choices between different goods and services. Making such choices, for goods and services traded in the markets, is usually based on comparing their market prices with the satisfaction gained from their consumption. However, making choices concerning public goods, such as water, which are not traded in the marketplace and have no prices to guide choices, is rather difficult. In such cases, it is important to find ways for putting a value to these goods and services.

The limited water availability and the basic tendency for demand to outstrip supply ensure competition between the different water use sectors. The response of water management has been to provide some water for all and a little more for some, depending on the priorities developed by governments. The necessary reallocation of water supplies from one sector to others has been argued for as a macro-economic necessity.

The idea of water as an economic good is simple. Water has a value to users who are Willing To Pay (WTP) for it. Like other goods, consumers will use water as long as the benefit derived from the use of an additional cubic meter exceed the costs so incurred, i.e. until the marginal value product of water equals its price. The various methods for economic valuation of water arediscussed in the following section.

The price of water in a water market should reflect water's economic value. Because water is usually supplied by public agencies who price water at its average financial delivery cost rather than its value to producers, water is rarely priced at its marginal economic value (Young, 2005). Water can be valued from a supply (i.e. depending on the cost of water provision) or demand perspective (value added due to water use in productive activities), resulting in a supply curve or a demand curve. When water is an input to a production process (an "intermediate good"), such as in irrigated agriculture or in industrial use, water demand is derived from the demand for the final output and from water's role in producing this output; thus it is a derived demand function. In this case, water demand is a function of the price of water and the price of the final product produced. Estimating water's economic value is equivalent to isolating the marginal contribution of water to the total output value. (Young, 2005, Turner, et al, 2004)

In general, the most scientifically accepted methods are those based on actual market behavior and information (Hussain et al., 2007). In the case of Jordan, since farmers in the Jordan Valley are paying for water – a neglected portion of production costs, it is difficult to establish a relationship between price and demand from actual behavior to generate demand functions.

Moreover, the fact thatwater is provided by the government with heavy subsidies, strategic biases or simply the belief among farmers that water is a free gift from God (Abu-Zeid, 2001), could probably lead to erroneous estimations of water values when using direct methods such as contingent valuation (Salman et al. 2004; Wasike& Hanley, 1998). Therefore, following Lange (2007), Speelman, et al., 2008), the Residual Imputation Method was used in this study. Although this method clearly has its shortcomings, which are discussed in the Annex I, it was considered the most suitable technique to estimate water values for the studied irrigation schemes.

Agudelo (2001) classified water valuation methods into three categories:

1) Methods that infer value from information regarding markets of water and water-related benefits

2) Methods that estimate values from the derived demand for water, where water is used as an intermediate good

3) Methods that estimate the value of water from a direct consumer demand, as in the case where water is used as a final good

As a market good, value is derived from rentals and sales of water rights or land in case of a riparian ownership of water. As an intermediate good, value is derived from the producers' demand function, residual imputation, value added or alternative costs of water use. If used as a final private good, the value of water is determined from the consumers' demand function. If water is used as a public final good, its value is derived from the embedded travel costs or as bundle of other goods in a hedonic property value or the use of contingent valuation method to determine the value consumers place on the its use (Agudelo, 2001).

This study focuses on the use of water as an intermediate good, used as an input in the production of other goods and services. When used as an intermediate good, the value of water must be assessed from the producers' point of view. The conceptual valuation framework for the welfare benefits of increases or decreases in water use is provided by the producers' demand for inputs, including water. Annex I presents a review of most valuation methods that can be used to assess the value of water, as an intermediate input in an ill-defined or dysfunctional water market, used in the domestic sector and the agricultural and industrial sectors respectively.

6.1. ADOPTED METHODOLOGIES IN DETERMINING WATER VALUE

The total value of a product can be divided into shares, such that each resource is paid according to its marginal productivity and the total product is completely exhausted. If appropriate prices can be assigned to all resources but one, the remainder of total value of product is imputed to the remaining (or "residual") input. This residual imputation method is most suitable where the residual claimant (water in our case) contributes the largest fraction of the value of output. This method requires the subtraction of the economic cost of all the other production inputs except water from the sales revenue. The difference becomes the value of water in the production of commodity. Since we will apply this method to estimate the value of water in the commodities value chain analysis, a detailed elaboration was made on this method to be very clear to the readers.

6.2. METHODOLOGY OF VALUATION OF WATER USED IN INDUSTRY

A variety of approaches can be used to estimate the value of water in industry: estimating the water demand function, production function approach, optimization using mathematical programming approach, residual imputation methods, and financial and economic returns. Each of them has its own context of applicability, which depends largely on the nature of the data available for performing the valuation exercise.

For the same reasons explained earlier for the applicable method of agricultural water valuation, the RIM based on the gross value added technique (GVA) will be extensively applied in this study. The GVA estimates will be compiled through product approach.

Accordingly, gross output/gross sale of product plus other income will be taken as gross output on basic prices. Intermediate consumption (purchaser prices) will be deducted from gross output to arrive at gross value added at basic prices.

We measure the economic contribution of water to industry according to a "value-added" concept using RIM methods. This contribution is assessed as the monetary value of industrial production that is attained per unit of water used or consumed throughout the production process.

In economics, the difference between the sale price and the production cost of a product is the value added per unit. The summation of the value added per unit for all products is the total value added for the products group. Total value added is equivalent to revenue less outside purchases (of materials and services). Value added is a higher portion of revenue for integrated companies, e.g., manufacturing companies, and a lower portion of revenue for less integrated companies, e.g., retail companies. Total value added is very closely approximated by total labor expense (including wages, salaries, and benefits) plus "cash" operating profit (defined as operating profit plus depreciation expense, i.e., operating profit before depreciation). The first component (total labor expense) is a return to labor and the second component (operating profit before depreciation) is a return to capital (including capital goods, land, and other property). National accounts,which are used in macroeconomics, refer to the contribution of the factors of production, i.e. land, labor, and capital goods, inraising the value of a product and corresponds to the incomes received by the owners of these factors. The national value added is shared between capital and labor (as the factors of production), and this sharing gives rise to issues of distribution.

Gross value added provides a dinar value for the amount of goods and services that have been produced, less the cost of all inputs and raw materials that are directly attributable to that production.

a) Water values based on the GVA: The GVA represents the difference between the gross output of an industrial sector minus the intermediate consumption. The resulting water productivity allows for the comparison with values from the previous studies of USAID and with water productivities in other countries.

b) Water values based on the net value added (NVA): NVA is the value of output less the values of both intermediate consumption and consumption of fixed capital. NVA is obtained by deducting consumption of fixed capital (or depreciation charges) from GVA. NVA therefore equals gross wages, pre-tax profits net of depreciation, and indirect taxes less subsidies

c) Water values based on the operating surplus (OS): The OS is the measure of the surplus accruing from production before deducting property income and thus a proxy for total pre-tax profit income. The resulting water productivity gives an indication about the economic efficiency of water consumption with regard to the profitability of specific industries in Jordan.

d) It should be emphasized that both types of water productivity display only the outcome under a given set of inputs in existing industrial production processes. The allocation of additional water to industry will yield comparable economic returns only under the assumptions of:

   - An adequate, simultaneous increase of all other production factors, i.e. goods, rights and services, for the specific industries
   - Asimilar market environment in terms of costs for inputs, prices and possibilities for sales of additional product amounts from these industries

6.3. METHODOLOGY OF VALUATION OF WATER USED IN AGRICULTURE

A variety of approaches can be used to estimate the value of water in agriculture. These approaches are explained in Annex I, which can be used for both industry and agriculture and any other water-consuming activities – activities that used water as intermediate input. Given the availability of many methods used to estimate the economic value of water with different data requirement, the Residual Imputation Method and the value added approaches will be extensively applied in this study.

The RIM approach is a very frequently used approach to estimate the value of water for irrigation and industry. By this method, the total value of output is allocated among each of the resources (inputs) used in the production process. If appropriate prices can be assigned (presumably by market forces) to all resources but one, the remainder of total value of product is imputed to the remaining (or "residual") input. This residual imputation method is most suitable where the residual claimant (water in our case) contributes the largest fraction of the value of output.

The total value (TV) of a product can be divided into shares, such that each resource is paid according to its marginal productivity and the total product is completely exhausted. (This is satisfied when the total value function is a linear homogeneous production function. There is a standard mathematical result, called Ruler's theorem, which saysthat if a production function involves constant returns to scale, the sum of the marginal products will actually add up to the total product [Baumol 1977]).

This method requires the subtraction of the economic cost of all the other production inputs except water from the sales revenue. The difference becomes the value of water in the production of the commodity. In the case where just one commodity is produced, the use of the RIM is based on the theory that the sales revenue exactly equals the total cost of production. This implies that the sales revenue (TV= price multiplied by the quantity sold) exactly equals the sum of the inputs used, multiplied by their respective prices.

The residual method is used to determine the values of water to each individual crop within a region. Young (2005) provides details of this methodology. In this approach the value of water used to produce a particular crop is determined by taking the costs of all inputs except water needed to produce an individual crop (labor, seed, fertilizer and pesticide costs) from the total value of the crop in question (i.e. its price multiplied by the quantity produced) and then divided by the water applied to that particular crop.

The RIM determines the incremental contribution of each input in a production process. If appropriate prices can be assigned to all inputs but one, the remainder of total value of product is attributed to the remaining or residual input, which in this specific case is water (Young, 2005; Ashfaq et al. 2005, Lange and Hassan, 2007, Speelman et al., 2008, Hellegers and Davidson, 2010). Residual valuation thus assumes that if all markets are competitive, except the one for water, the total value of production (TV= $P_y.Y$) equals exactly the opportunity costs of all the inputs

$$TV = \sum_{i=1}^{n} VMP_i X_i + VMP_w X_w \qquad \text{Equation 1}$$

It is assumed that the opportunity costs of non-water inputs are given by their market prices (or their estimated shadow prices). Therefore, the shadow price of water can be calculated as the difference (the residual) between the total value of output (TVP) and the costs of all non-water inputs to production. The residual, obtained by subtracting the non-water input costs from total annual crop revenue and can be interpreted as the maximum amount the farmer could pay for water and still cover costs of production. It represents the at-site value of water:

The monetary amount, divided by the total quantity of water used on the crop, determines the marginal value for water (VMPw), corresponding to the irrigator's maximum willingness to pay per unit of water for that crop (Agudelo, 2001). Average values were used in this study as a proxy of the marginal ones.

$$VMP_w = (TV - \sum_{i=1}^{n} P_i X_i)/Q_w \qquad \text{Equation 2}$$

Where:

TV =total value of the commodity produced

VMPi = value of marginal product of input i

Qi = quantity of input i used in production, w for water

The above equation will be used to estimate the economic value of water in each commodityor division of industry. To have an estimate at the aggregate industry or group of plant products this method is extended to a multi-input and multi-product situation as in our case, in which different sectors compete for the use of the scarce resources (production inputs) and sell their products in a non-differentiated market. This implies that the firms are in perfect competition. The residual value of water in the ith sector producing the jth commodity is;

$$P_{wj} \,.\, Q_{wj} = \sum_{i=1}^{n} Py_{ij} \,.\, Y_{ij} - \sum_{i=1}^{n} Px_{ij} . X_{ij} \qquad \text{Equation 3}$$

For a sector with n inputs and m outputs, using a different nomenclature the residual calculation can be expressed as follows:

$$Pw^* = \frac{\left(\sum_{j=1}^{m} \mathbf{Y_j} * \mathbf{P_j} - \sum_{i=1}^{n} \mathbf{X_i} * \mathbf{P_i}\right)}{\sum \mathbf{Q_w}} \qquad \text{Equation 4}$$

where: Xi stands for quantity of input I, i=l,2,...,n; Yj refers to quantity of product j, j=1,2,...,m; Py, and Pxi are the prices of products and inputs respectively; Qw denotes the quantity of water input.

The Pw* will represent is the shadow price of water, i.e., the net benefit imputed as the value per unit of water input.

Young (2005) describes the solution to Equation (4) as the "value of water" per unit or the"net unit return to water" for crop "Y." It is, in the parlance of economics, the "residual value." It is the average value of water used in the crop in question. This can be compared to the total value of water used in a crop, which is equal to this value multiplied by the quantity of water used (i.e. Pw.Qw). Once the value is established for each crop in each region, the values are weighted by the areas of each crop irrigated to obtain a total value for agriculture for each demand center. For more details on this process refer to Hellegers and Davidson (2010).

To estimate the water value in a specific commodity group such as field crop we use the following formula to get an weighted average water value in the entire sector as:

$$Pwj = \frac{\left(\mathbf{P_{w_i}} * \mathbf{Q_{w_i}}\right)}{\sum \mathbf{Q_w}} \qquad \text{Equation 5}$$

wherePwi is the estimated water value in crop i, Qwi is the quantity of water use to produce crop I, and Qw is the total amount of water used in the group j.

The assumptions of the RIM are not overly restrictive, but care is required to assure that conditions of production under study are reasonable approximations of the conceptual model. Interested readers in the shortcomings of RIM approach can refer to Annex I for more elaboration on this issue.

6.4. WATER VALUES IN VALUE CHAIN ANALYSIS

Value chain analysis is a process for understanding the systemic factors and conditions under which a value chain and its farm can achieve higher levels of performance. The term value added implies that agents realize a profit margin that depends on their ability to manage the linkages between all activities in the value chain. In other words, the agent is able to deliver a product for which the customer is willing to pay more than the sum of the costs of all activities in the value chain.

A marketing chain analysis is used to describe the numerous links that connect all actors and transactions involved in the movement of agricultural products from the farm to the consumer. It is the path one couldfollow from their source of original production to ultimate destination for final use. Functions conducted in a marketing chain have three things in common: they use up scarce resources, they can be performed better through specialization, and they can be shifted among channel members.

The term supply chain refers to the entire vertical chain of activities: from production on the farm, through processing, distribution, and retailing to the consumer. In other words, it is the entire spectrum, from gate to plate, regardless of how it is organized or how it functions.

Value added ideally represents the value created during the follow-up to product marketing in the marketing process conducted by each enterprise or establishment. It is measured as the difference between the value of all goods and services produced and the value of those purchased non-labor inputs which have been used in the production process.

This type of measure avoids double counting, since what each enterprise or agent has purchased from other agents is deducted from the value of its own production. Inputs to be considered may include materials and supplies, fuel, electricity, contract work, repairs, maintenance, and transportation as well as other industrial services. The value at which these inputs were purchased is deducted from total revenue from production in order to obtain the agent's or enterprise's value added. Revenue from production can be reported at basic or producer prices. The difference is that the latter includes indirect taxes and excludes subsidies.

Therefore, in a commodity subsystem approach, the analysis is based on the identification of the marketing channels. This approach includes the analysis of marketing costs and margins. A marketing margin can be defined as a difference between the price paid by consumers and that obtained by producers or as the price of a collection of marketing services that is the outcome of the demand for and supply of such services. It measures the share of the final selling price that is captured by a particular agent in the marketing chain.

Marketing margin is most commonly used to refer to the difference between producer and consumer prices of an equivalent quantity and quality of a commodity. However, it may also describe price differences between other points in the marketing chain, for example between producer and wholesale, wholesale and retail prices

In its simplest form, it can be defined as the difference between prices paid for a commodity (e.g. tomato) by consumers at a retail level and prices received by farmers when they sell their commodity to assemblers or other first handlers. Measured in this form, the margins reflect the amount of services added to a commodity once it leaves the farm and sits on a shelf in a retail outlet in a form that is acceptable, useful, and appealing to consumers. In this analysis we used the two simplest forms of commodity movement, which is:

Farmer →Rural assembly market→ Wholesaler →Retailer → Consumers

Farmer →Rural assembly market → Wholesaler →Exporter→Export market

Within the whole value system, there is only a certain value of profit margin available. This is the difference of the final price the customer pays and the sum of all costs incurred with the production and delivery of the product. It depends on the structure of the value system, how this margin spreads across the suppliers, producers, distributors, customers, and other elements of the value system. Each member of the system will use its market position and negotiating power to get a higher proportion of this margin.

The value chain analysis is performed in the following steps:

- Analysis of the flow of the commodity from primary producer (farmers) to final consumer
- Determination of the costs are related to every single activity in value chain
- Identification of additional cost of to provide the additional service by value chain agents
- Identification of potential value added for the customer

The production costs in value chains are calculated by aggregating costs incurred by enterprises in each segment of the chain. A further step in calculating production costs relates to each function within the chain.

As an example, in the case of the date value chain, these costs will be broken down to account separately for all activities required to produce and market a product: production, storing, grading, transport, packing, marketing, and distribution operations. Such information does not illustrate the enterprise accounting details, but rather the costs along the sequence of production and marketing operations within a value chain. The cost of each activity can be combined with the measurement of productivity and converted into a production cost per unit of output (i.e., JD per ton of date).

Value chain analysis and value-added analysis are related to one another. After conceptually breaking up the marketing activities into a value chain, we can then try to understand how those activities generate value for the firm.

The incremental increases in value addition for each stage along the chain are divided by water quantities consumed to reach the commodity to local consumers or export market. The values added in each step in value chain were divided to the corresponding water quantities used in the whole production process per ton of produced product. The value of water from value chain perspectives was estimated using the following formula

Water Value Added (JD/m3) for chain (i) $= ((\mathrm{Ps} - (\mathrm{Pp} + \mathrm{Cost}))/(\sum \mathrm{Q\_w}))$ in chain (i)

where SP is selling price per ton to the next chain, PP is the purchasing price per ton fromprevious chain and input cost is the costs of associated with providing services such as additional raw material inputs, intermediate consumption of utilities and processing costs such as packing, handling etc.

In reality, value chains tend to be more complex, to involve numerous interlinked activities and industries with multiple types of firms operating in different regions of one country or in different countries around the globe. For instance, agro-food value chains encompass activities that take place at the farm as well as in rural settlements and urban areas. They require input supplies (seeds, fertilizers, pesticides, etc.), agricultural machinery, irrigation equipment and manufacturing facilities, and continue with handling, storage, processing, and packaging and distribution activities.

7. DATA COLLECTION

Data collection and databases accessed in the framework of this study relied predominantly on primary and secondary information from official Jordanian sources, which included the Ministry of Water and Irrigationand the Department of Statistics, Ministry of Agriculture (MOA) and other relevant ministries and administrative units. The current state of official data sources includes data from 2010 for agricultural sector and data for the year 2007-2009 of industrial and services sectors.

Data and information were also collected for external trade by market destinations, wholesale prices, retailers' prices, export prices are collected for DOS, annual production and yield for cereal crops, fruits and vegetable are collected form agricultural annual statistics. Primary data on the production costs were collected from different geographical location in Jordan that represent different production systems. Several questionnaires weredesigned, pre-tested and collected from the field. Many personnel interviewees wereconducted with farmers (producers), agents in assembly markets, and agents in wholesale market, transporters, and processors in the packing and grading houses, local traders, exporters, and retailers.

7.1. DATA OF THE INDUSTRIAL, TOURISM, AND SERVICES SECTORS

The DOS published the result of an economic survey by showing different performance indicators in the sectors of industry, services, and tourism. These data are the result of annual sample surveys, which rely on stratified sampling plans according to geographic locations and characteristics of enterprise size. The purpose of these data collections is to provide the basis for National Accounts according to United Nations standards. Data on the industrial sector comprise the following sub-sectors: (1) mining and quarrying, (2) manufacturing, and (3) production and distribution of electricity. Information on this sector is complemented by separate data on the following sectors:

- Industrial Sector
- Wholesale and Retail Trade
- Services
- Construction: Contractors, Transport, Storage and Communication
- Insurance
- Banks and financial institutions

The data of the Economic Survey are classified according to the United Nations International Standard Industrial Classification of all Economic Activities (ISIC).Results can be generated for most sectors' tables for the ISIC four-digit level (quite detailed) or on the two-three digit level (less detailed). Data on the touristic sector, i.e. hotels and restaurants, are included in the records of the DOS survey on the sector of services, which covers profit and non-profit oriented establishments.

DOS data used in this study are drawn from the data bases of the recent economic surveys. The survey data provide information about characteristics of the main industry classified as a homogenous group of industry according to ISIC3 (two-three digit level) for the last three years 2007-2009 and the result are presented as an average for this period.

Published information from DOS allows for analyses of water productivities in the concerned sectors, but is too highly aggregated for in-depth analyses of water values within the individual production processes. Consistency checks during the analysis of the accessible data bases indicated the occurrence of some probable data problems, which should be subject to closer inspection before more detailed calculations take place.

7.2. DATA ON THE AGRICULTURAL SECTOR

The basic source of data was the records of the Department of Statistics' agricultural survey. Data on producer prices (farm gate price) and production also included most recent and hitherto unpublished information on the year 2010. Further information on production costs was obtained from field surveys using structured questionnaires of the enterprise budget.

The estimation of the value of water for agriculture wasperformed on a disaggregated level on crop basis. The values of water wereexpected to vary by Location (JV vs. highlands), Time (winter vs. summer), and Water Quality (surface, groundwater and blended water). The main field crops, vegetables, and fruit trees in Jordan werestudied. A total of 104 crops were classified to (winter, summer, permanent crops) are used in the analysis.

7.2.1. DATA FOR FARM AND VALUE CHAIN ANALYSIS

A value chain analysis starts from construction of an enterprise budget at farm level to value added per ton. The flows of the commodity fromfarm gate to consumer were followed by collection of additional costs incurredby market agents starting from containers, cooling, storage, transport, handling, packing, etc. up tothe commodity in retailer stores. The total transaction costs were estimated excluding the profit margin and labor cost. The wholesale price, retailers' prices, and export price by market destinations werecollected to estimate the value added by each agents in the marketing channels

The value chain describes the activities that take place in a business and relates them to an analysis of the competitive strength of the business. The Value Chain Analysis is one way of identifying which activities are best undertaken by a business and which are best provided by others (outsourced). Whichactivities a business undertakes is directly linked to achieving competitive advantage. In order to estimate the value of water from value chain perspective it was necessary to collect the following plant prices:

- Farm gate price disaggregated by winter and summer season and disaggregated by Jordan Valley and highlands farmgate prices. (JV, highlands)
- Wholesale price of plant crops in disaggregated by winter and summer season
- Retailers'price
- Average export "Free on Board" (FOB)price for commodities exported to neighboring countries (Iraq, Syria, Lebanon)
- Average export FOB price for plant commodities exported to Gulf states
- Average export FOB price for plant commodities exported to Eastern European countries
- Average export FOB price for commodities exported to Western European countries

In addition to the above plant prices, it is necessary to collect data on the associated costs occurred by agents on the commodities chain starting from farmgate, transport, assembly markets, local transportation, containers and packing, processing, sorting and grading activities, wholesales marketing activities, storage and cooling, and international transportation.

1. HORTICULTURAL AND FIELD CROPS

The estimation of the value of water for agriculture is performed on a per crop basis. The crops selected for the application are those for which available information exists on cultivated areas, production, yields, and yield-response factors.

However, there are differences in water availability within regions – in Jordan, there are regions with surplus and other with deficit. There are differences in water quality – farming of various crops can be with different quality. Therefore, the value and use of water are varies and dependent on:

- Location (JV, highlands, desert)
- Time (winter vs.summer)
- Quality (surface, groundwater, blended treated wastewater)

Crop production is then a dynamic process in which decisions about inputs are made sequentially as crops are planted, grown, and harvested. Linking water supply and agricultural production is a complex issue. Each farmer's decision in this process is contingent upon results of past decisions, past events, and information regarding future events. Thus, the character of thedecisions could be either extensive (as for land devoted to a crop) or intensive (as for application of fertilizers, water, etc.).

A total of 104 crops wasused in the analysis. These are:

a) The field crops consist of 16 crops: wheat, barley, lentils, vetch, check-peas, maize, sorghum, broom millet, tobacco, local, tobacco, red, garlic (garlic classified by dos in field crops list), vetch-common, sesame, clover trefoil, alfalfa, and other field crops

b) The winter vegetables consist of 32 crops:tomatoes, squash, eggplants, cucumbers, potatoes, cabbages, cauliflower, hot peppers, sweet peppers, broad beans, string beans, peas, cow-peas, Jew's mallow, okra, lettuce, sweet melons, watermelons, spinach, onion-green, onion-dry, snake cucumbers, turnip, carrots, parsley, radish, broccoli, fennel, leek, celery, ginger, and other winter vegetables

c) The summer vegetables consist of 29 crops: tomatoes, squash, eggplants, cucumber, potato, cabbage, cauliflower, hot pepper, sweet pepper, broad beans, string beans, peas, cow-peas, Jew's mallow, okra, lettuce, sweet melon, water melon, spinach, onion green, onion dry, snake cucumber, turnip, carrot, parsley, radish strawberry, Brussels sprouts, and other vegetables crops

d) Citrus fruits consist of 12 crops:lemons, oranges-local, oranges-navel, oranges-red, oranges-Valencia, oranges-French, oranges-shamouti, clementine, mandarins, grapefruits, medn. mandarins, and pummelors

e) Fruit trees consist of 14 crops:olives, grapes, figs, almonds, peaches, plums, prunes, apricots, apples, pomegranates, pears, guava, dates, and other fruit trees as well as bananas

2. THE CROP COEFFICIENTS

The crop water requirements are gatheredfrom the literature available in MWI and Faculty of Agriculture; more specifically, the data on net water requirements for crops cultivated in different agro-climatological zones in different season (winter and autumn) are collected and aggregated to represent each agro-ecological zone. It is not possible to take into account the influence of aspects such as the varieties that could be used by the farmers or differences in irrigation technologies used by farmers.

The net irrigation water requirement is used instead of crop water requirement to measure the value of irrigation water and to subtract the contribution of effective rainfall precipitation from irrigation requirements. These data on crop water requirements are also obtained from different sources available at the

Faculty of Agriculture, MWI, and Ministry of Agriculture. In this case, it is preferableto estimate the net irrigating crops water requirements for the crops not the gross water requirements. The average irrigation crop-water requirements for main crops produced in Jordan are shown in Annex II.

3. CROP PRODUCTION

Data on 2010 crop production are fully available from the DOS database for each crop considered in each of the 12 governorates and foursub-governorates in Jordan Valley. These data encompass cultivated areas in dunums, total production in tons, and yield (kg/du) by season.

4. CULTIVATION METHODS

Data on 2010 crop production are fully available from the DOS database for each crop; it does not distinguish between crops cultivated under irrigation or underrainfed conditions. It was necessary to determine the crops cultivated using different irrigation technologies, since the net irrigation requirement will be different. We used the results of agricultural census conducted in 2007 to estimate the cultivated area under irrigation for different crops by different governorate and fourdistricts in Jordan Valley.

5. AGRICULTURAL PRICES

The term "prices received by farmers" as a farm-gate price was used to estimate the agricultural national account available from DOS database; it should in theory refer to the regional average of individual crops comprising all grades, kinds, and varieties. These prices are determined by the farm gate or first-point-of-sale transactions when farmers participate in their capacity as sellers of their own products.

Wholesale prices were obtained from the DOS and the Marketing Directory in the Ministry of Agriculture. The DOS provided the author with the consumer's price of fruit and vegetable that was used in national accounts in the household expenditures and income survey. The exported prices were obtained by dividing the exported values by exported quantities of specific crop. The lists of crop prices are provided in Annex III.

6. PRODUCTION COST

The gross margins needed to be calculated for each crop grown in Jordan in order to analyze the value of water for these crops. The main components of the gross margin analysis are the total return, which is the field production in kg/du multiplied by the farm gate price JD/kg minus the variable cost and the cost of water in JD/du.

The general components of the variable cost are water (which is subtracted later from calculation), fertilizers (trace elements, organic and compound or chemical fertilizer), pesticides and herbicides., containers and threads, plastic mulch used in vegetable production with drip irrigation, and under plastic houses, plastic sheet and cover used in plastic tunnels crop enterprises, fuel and electricity.

The costs of hired machinery and seasonal hired labor expressed in hours, which includes planting, spraying, tillage, land preparation, rearing, and crop harvesting, have been calculated for all these operations. The gross margins were calculated without including irrigation water cost in the total variable cost.

7. ENTERPRISE BUDGET MODEL

Enterprise budgets that could be served as a guide to the local entrepreneurs are estimated for most of the fruits, field crops, and vegetable crops grown in Jordan in different agro-ecological zones. The estimated enterprise budgets are based on the best and most accurate estimates on returns and costs available in 2011. Value chain analysis is applied on the selected crops to show the possible range of value added per ton and crop production

Enterprise budgets represent estimates of returns, costs, and net returns associated with the production activities of crops. Such information is highly valued byfarm producers and entrepreneurs, extension specialists, governmental agencies, and decision-makers. Enterprise budgets are used mainly to itemize returns of an enterprise's products and costs of inputs required for production activities; evaluate enterprise efficiency; estimate benefits and costs for major changes in production activities; provide the basis for a total farm plan; and provide non-farmers with costs incurred in producing crops (Greaser and Harper, 1994). Enterprise budgets could serve as a management and decision-making guide for current and prospective entrepreneurs of such enterprises (Powers, et al., 1998). Working on a farm level, enterprise budgets are desirable as an estimate of returns and costs for the same farm. However, the enterprise budgets should reflect average or typical conditions when working on national or regional level (Kletke, 1989).

Estimates are represented in terms of Jordanian Dinar per dunum. Gross returns of the crop enterprise budget are the product of the average seasonal production per dunum and the prevailing farmgate prices per ton of the products. Table 8 shows the enterprise budget of selected crops grown in Jordan Valley for demonstration purposes. Costs of the selected greenhouse vegetable include several components reflecting variable and fixed costs. Variable costs include expenses of all varying inputs used to produce the products. Examples include expenses for fertilizers, seeds, pesticides, water, labor, electricity, and repairs. Fixed costs include land rent or quasi-land rent in the case of the land owned by farmer, depreciation of capital, building, machinery, irrigation networks, plastic houses, amortization of seedlings in the case of fruit trees, and interest on capital investment.

The next step in value chain analysis is to consider the expenses of marketing channels, including transport, refrigerated transport, loading, containers, packing, packaging, sorting, grading, waxing, hauling, labor, and post-harvest losses.

Fixed costs include expenses of all non-varying inputs required for the production process. Examples include depreciation of the machinery, irrigation system, building and greenhouse module. The annual depreciation expenses for the crops are varying according to production systems. Total costs are the sum of both cost components, variable and fixed costs. Net returns of the selected enterprises were obtained through deducting the total costs from the gross returns for each crop. The enterprise gross returns should cover the variable costs in the short run to be able to continue.

The required data for each crop are:

Crop Yield	(Kg/du)
Producer prices (Farmgate Price)	JD/kg
Production Cost	JD/du
(a) intermediate costs (operational)	JD/du
(b) labor cost	JD/du
(c) water costs	JD/du
(d) depreciation costs	JD/du
The Crop Net Irrigation Water Requirements (NIR)	m^3/du

Table 9 shows an example of an enterprise budget model developed in this study to determine the value of water across different crops cultivated in different regions using different water qualities. Results for most vegetable crops in Jordan Valley showed promising enterprises activity, generating positive net returns covering all the expenses in the short and long runs. Based on the net returns figures, Brussels sprouts, strawberries, and cucumbers are the most profitable in the Jordan Valley. Generating about JD 1,426/du for Brussels sprouts, JD 1,298/du for strawberry and about JD 956/du for cucumbers. However, turnip and cabbage crops would generate the least net returns out of the selected crops, JD 45 and JD 68/du. respectively. Bananas generate the highest net profit per dunum in the fruit trees atabout JD 593/du,followed by grapes at about JD 515/du and oranges of about JD 445/du.

Table 8: An Example of Enterprise Budget for Selected Crops Grown in MJV

Cost and Return	Crop & Technology	Pepper (Plastic House)	Tomatoes (Plastic House))	Eggplant (Open Field)	String Beans (Open Field)	Sweet Melon (Open Field)
A- Production Cost (JD/du)	**Unit**					
Tillage & preparation	JD/du	15	15	12	12	12
Solar Sterilization	JD/du	70	70			
Manure	JD/du	60	60	40	40	40
Water	JD/du	12	12	12	12	12
Mulch	JD/du	20	20	16	18	12
Moslen	JD/du	55	55			35
Seed & Seedling	JD/du	180	180	40	36	100
Rope	JD/du	18	18			
Pesticides	JD/du	170	170	120	60	50
Fertilizers	JD/du	160	160	100	80	80
Fuels & Lubricants	JD/du	15	15	12	10	10
Labor	JD/du	400	400	150	180	80
Miscell. & Maintenance	JD/du	35	35	20	20	20
Interest on Working Capital	JD/du	97	97	42	37	36
Total Variable Cost (JD/du)	JD/du	1161.8	1161.8	511.76	453.44	435.08
Land Rent	JD/du	60	60	50	50	50
Depreciation of Plastic Cover	JD/du	100	100			
Depreciation of Plastic Houses	JD/du	120	120			
Depreciation of Irrig. Network	JD/du	34	34	30	34	30
Depreciation of Rooms & storage	JD/du	3	3	3	3	3
Interest on fixed Capital 8%	JD/du	25.4	25.4	6.6	7.0	6.6
Total Fixed Cost (JD/du)	JD/du	342	342	90	94	90
Total Cost (JD/du)	JD/du	1504.2	1504.2	601.4	547.4	524.7
B- Sales & Revenues						
Total Production	Kg/du	7500	16500	7000	2500	3600
Average Selling Price	JD/Kg	0.300	0.167	0.143	0.500	0.208
Total Sales Revenue	JD/du	2250	2750	1000	1250	750
C- Marketing Costs	JD/du					
Cost of Empty Container	JD	0.24	0.24	0.24	0.24	0.24
Transportation Cost	JD/box	0.08	0.08	0.08	0.08	0.1
Containers Costs	JD	360	528	240	120	72
Transportation Cost	JD	120	176	80	40	30
Middlemen Commissions (5% of sales)	JD	112.5	137.5	50	62.5	37.5
Municipality Commissions 2%	JD	45	55	20	25	15
Total Marketing Costs	JD/du	637.5	896.5	390	247.5	154.5
Net Sales (Total Sale-Marketing Cost)	JD/du	1612.5	1853.5	610	1002.5	595.5

Cost and Return	Crop & Technology	Pepper (Plastic House)	Tomatoes (Plastic House))	Eggplant (Open Field)	String Beans (Open Field)	Sweet Melon (Open Field)
Net Profit (Net Sales- Total Costs)	JD/du	108.34	349.34	8.6	455.1	70.78
Breakeven Analysis						
Average Variable Cost per Kg	JD/Kg	0.155	0.070	0.073	0.181	0.121
Average Fixed Cost per Kg	JD/Kg	0.046	0.021	0.013	0.038	0.025
Average Total Cost per Kg	JD/Kg	0.201	0.091	0.086	0.219	0.146
Average Marketing cost per Kg	JD/Kg	0.085	0.054	0.056	0.099	0.043
Average Production & Marketing cost	JD/Kg	0.286	0.145	0.142	0.318	0.189
Average Selling Price	JD/Kg	0.300	0.167	0.143	0.500	0.208
Net Profit per Kg	JD/Kg	0.014	0.021	0.001	0.182	0.020

Table 9: An Example of Enterprise Budget Model for Selected Crops Grown in NJV

Crop	Tomatoes (OF)	Squash (OF)	Cucumbers (PH)	Potatoes (OF)
Total Production (ton)	16,206	5,029	9,738	20,054
Total Planted Areas (du)	2,706	2,798	2,133	6,883
Yield (ton/du)	**5.988**	**1.798**	**4.566**	**2.914**
Farm Gate Price Jordan 2010 (JD/ton)	112.0	258.9	232.1	208.9
Irrigation Water Requirement (m³/du)	301	215	298	322
Water Price JD/m3	0.03	0.03	0.03	0.03
Total Return (JD/Dunum)	**671**	**465**	**1,060**	**609**
Intermediate Consumption (JD)	198	228	318	286
Labor (JD)	100	56	158	110
Water Cost JD/du	9	6	9	10
Depreciation (JD)	63	23	99	30
Total Cost (JD/du) with Water	369	314	584	436
Total Cost (JD/Dunum) without water	**360**	**307**	**575**	**426**
Net Profit (JD/Dunum) with Water	301	152	476	173
Net Profit (JD/Dunum)	310	158	485	183
Value Added (JD/du)	473	237	742	323
Net Value Added (JD/du)	410	214	643	292
Operation Surplus (JD/du)	310	158	485	183
Water content (m³/ton)	50.23	119.63	65.26	110.64
Water Efficiency (ton/m³)	0.020	0.008	0.015	0.009
Gross Output (JD/ m³)	2.230	2.164	3.557	1.888
Gross Value added (JD/M3)	**1.573**	**1.104**	**2.490**	**1.001**
Net Value Added (JD/m³)	1.364	0.996	2.157	0.906
Operation Surplus (JD/m³)	1.032	0.736	1.627	0.566

Crop	Tomatoes (OF)	Squash (OF)	Cucumbers (PH)	Potatoes (OF)
Percent of Water Cost	2.4%	2.1%	1.5%	2.2%

8. RESULTS AND FINDINGS: WATER VALUATION ANALYSIS

The value of water of each sector will be presented separately with a variety of approaches used to estimate thisvalue. We start from the value of water in industry, services, and the whole economy, then move onto irrigation water value in different agro-climatological zones, and finally, water value in the value chain.

8.1. VALUE OF WATER IN INDUSTRY

The total gross output in the industrial sector wasestimated atabout JD 10 billion; the intermediate consumptions is about JD 6.5 billion. Therefore, the estimated gross value added is about 3.6 billion. The operations surplus of Jordan's industries amounted to aboutJD 1.9 billion on average for the period 2007-2009, which corresponded to an average operation surplus of about JD 40.3 /m³. The total employment is about 182,000 employees, where the total paid employee is 185,600 and the difference is the self-employed, as shown in Table 10.

Table 10: Economic Indicators for Industrial and Food ManufacturingSectors in Jordan

Economic Indicators	Mining and Quarrying	Manufacture of Food Products and Beverages	Total Industry	Total Economy
Gross output (MJD)	896	1,489	10,173	20,853
Intermediate Consumption (MJD)	277	1,066	6,500	11,001
Gross value added (MJD)	619	423	3,673	9,852
Compensation of employees (MJD)	74	111	744	2,719
Intermediate consumption of goods (MJD)	146	970	5,912	8,214
Other production expenditures M JD)	131	96	587	2,846
Depreciation (MJD)	43	43	342	947
Taxes on production (M JD)	58	92	678	1,433
Net Value Added (MJD)	577	380	3,331	8,906
Operation surplus (MJD)	445	177	1,908	4,754
No. of employees (No.)	7,334	34,397	182,880	749,271
No. of paid employees (No.)	7,160	30,336	158,643	590,970
Water Costs (1000 JD)	8,695	6,679	38,031	69,645

About half of this water went to large industries, e.g. mining and chemicals, which may possess the required financial background for their own wastewater treatment and water recycling facilities. Major consumers include the petrol refineries in the governorate of Zarqa, potash, and phosphate mining in Karak and phosphate mining in Ma'an, which make up about 75 percent of the water use in large industries.

Water, like any good or service, simultaneously hasa number of values. This holds not only for the allocation to different sectors of water consumption but also with regard to the goals that decision-makers pursue with the distribution of water. Amongst the multiple goals of a national economy, the following analysis of water values focuses solely on the economic value of water in different production processes.

The available information on the sectors of industry and tourism allows for the assessment of water productivity, which is basically a technical parameter, but helps in decisions on the distribution of scarce resources between the economic sectors of a national economy. However, partial productivities,such aswater productivity, neglect impacts on entrepreneurial income and returns to water use in the context of overall production factor inputs. The estimation of such suitable economic steering criteria for decision-making on the reallocationof water between sectors would be desirable, but goes beyond the scope and capacities of this study.

The following assessment of water productivities in industry and tourism puts water consumption in relation to three measures of national accounting: The available time series for this study differed between data on GVA, NVA, and OS. Data on water consumption and related GVA covered the three-year period from 2007 to2009.

8.1.1. INDUSTRIAL WATER VALUES BASED ON GROSS VALUE ADDED

Jordan's industries consumed approximately 47.3 mcm of freshwater according to an estimation based on water bills and a tariff ofJD 1/m³ in 2009, which constitutes the last year for which comprehensive data are currently available.[3] The water price in mining and quarrying is JD 0.48 /m³ and for chemical and fertilizer is 0.25 JD/m³, which is equivalent to groundwater abstraction costs.

The GVA by industries, i.e. their monetary output minus intermediate consumption, during the same year amounted to about JD 3.6 billion. This yielded a ratio of about JD 77.6 in GVA per m³ of water consumed, which was considerably low annual water productivity in comparison with other services sectors. Figure 4 shows the average water values productivity for the main industrial sectors using twoISIC digits over the period from 2007 to 2009. The water value ranges from about JD 35 to 37 of GVA per m³ of water in the sectors of mining and chemicals up toJD 1,980/m³ in the sector of tobacco products.

The arithmetic average is JD 338/m³. However, this average is misleading. Instead, a weighted average by water use is used to represent the value in industrial sector. The weighted average is JD 77.6/m³.Annex IVdisplays the water values in industrial, services, and other economic sectors disaggregated by ISIC 4 classifications.

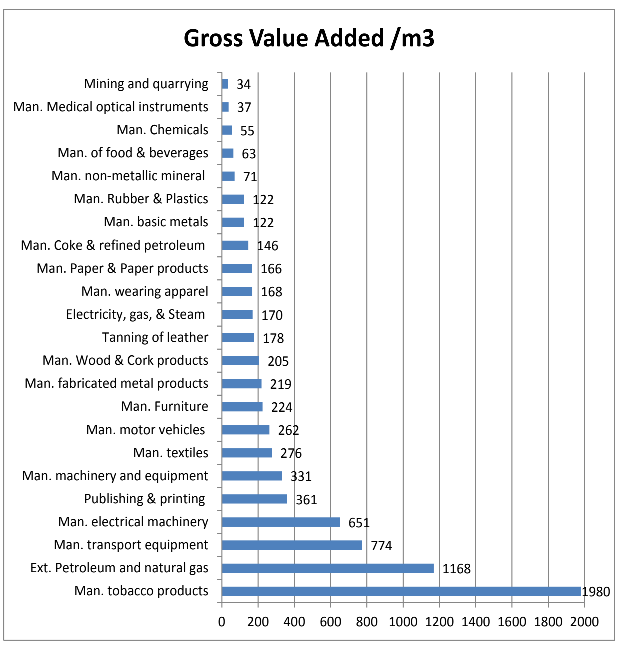
The high confidence intervals for the average water value for the sectors with high water productivities indicate significant variations between the years under consideration. The major reason for these fluctuations is the strongly varying contribution of the individual sectors to Jordan's GVA.

The comparatively low overall water productivity of large consuming industries below 30 JD/m³ is due to the high contribution of industries with low water productivity to the GVA. Mining, chemical, food, and non-metallic mineral product industries, i.e. the four sectors with the lowest water productivity, make up about half of the total industrial GVA (Figure 4) as shown in Table 11.

[3] This figure for consumption might be slightly underestimated, since water from own wells are charged with a lower tariff.

Table 11: Water Values in Top and Lowest FiveIndustries according to ISIC 4 Classifications

ISIC-Cd.	Economic Activity	Water Use (m³)	GVA/m³	NVA/m³	OS/m³
Top 5	Manufacture of tobacco products	132,033	1,980.10	1,921.80	112.9
	Manufacture of machinery for food beverage	833	1,881.40	1,869.90	1,189.00
	Manufacture of machine - tools	1,500	1,610.50	1,587.20	1,254.60
	Extraction of crude petroleum	8,900	1,167.90	1,031.10	881
	Manufacture of agricultural and forestry machinery	4,467	1,139.40	1,113.20	972.2
Lowest 5	Manufacture of other non-metallic mineral products	85,267	31.1	28.4	8.6
	Cutting, shaping and finishing of stone	1,213,900	29.6	26.1	10.5
	Manufacture of articles of concrete and plaster	3,580,400	24.2	20.2	8.9
	Manufacture of fertilizers and nitrogen compounds	4,612,933	19.5	18.2	13.5
	Quarrying of stone sand and clay	2,413,733	6.7	5	1.6



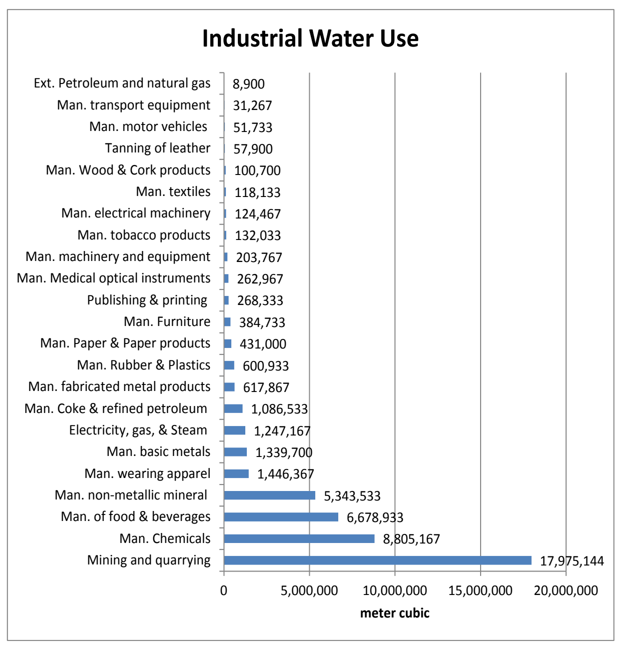


Figure 4: Water Values in Jordan's Industrial Sector based on Gross Value Added

Figure 5: Industrial Sectors' Water Withdrawal, Averages (2007-2009)

8.1.2. INDUSTRIAL WATER VALUES BASED ON NET VALUE ADDED

Net value added is the value of output less the values of both intermediate consumption and consumption of fixed capital. Net value added is obtained by deducting consumption of fixed capital (or depreciation charges) from gross value added. The value of water in the net value added therefore refers to wages, pre-tax profits, and indirect taxes.

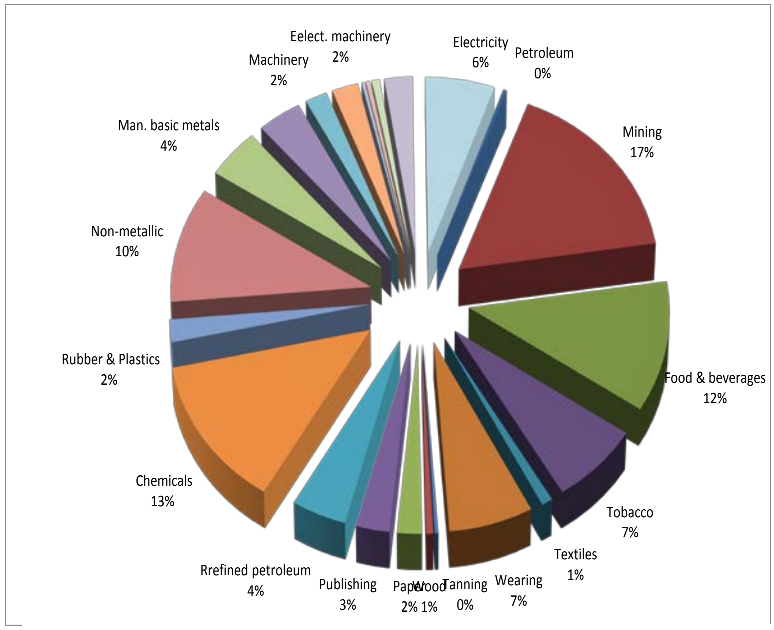


Figure 6:Industrial Sectors' Contribution to Industrial GDPs

Water values vary highly between industries and are naturally lowest in sectors with high water consumption (Figure 4; Figure 5). Industrial sectors with the lowest profits per m³ in the inflation-adjusted three-year average were mining and quarrying, chemicals, and food products, which are simultaneously the largest industrial water consumers. Their weighted NVA per cubic meter is for mining and quarrying,atJD 32.1/m³ and manufacturing of medical optical instruments atJD 32.7/m3. Sectors on the upper end of profits per m³ include oil, gas, coke, and petroleum products with JD 1,031m³ up to more than JD 1,920/m³ for tobacco products, but consume less than 1 percent of the total water for industries.

8.1.3. INDUSTRIAL WATER VALUES BASED ON OPERATION SURPLUS

The OS of Jordan's industries, i.e. the approximate pre-tax profit income,[4] amounted to about 1.908 million JD on average for the three-year period from 2007 to 2009, which corresponded to a related water productivity of about 40 JD/m³. This weighted average varies from industry to industry as shown in Figure 8. Industrial sectors with the lowest profits per m³, as in the case of water value based on GVA, are manufacturing of medical optical instruments, mining and quarrying, chemicals, and food products. Industries in the sector of "petroleum and natural gas" have the highest rank of about JD 881/m³, followed by "manufactured transport equipment" atabout JD 405.7/m³ and

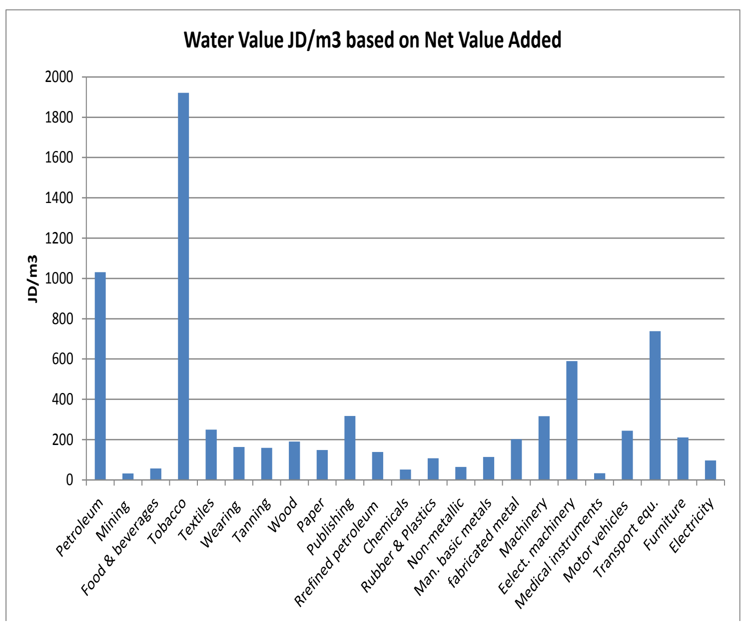
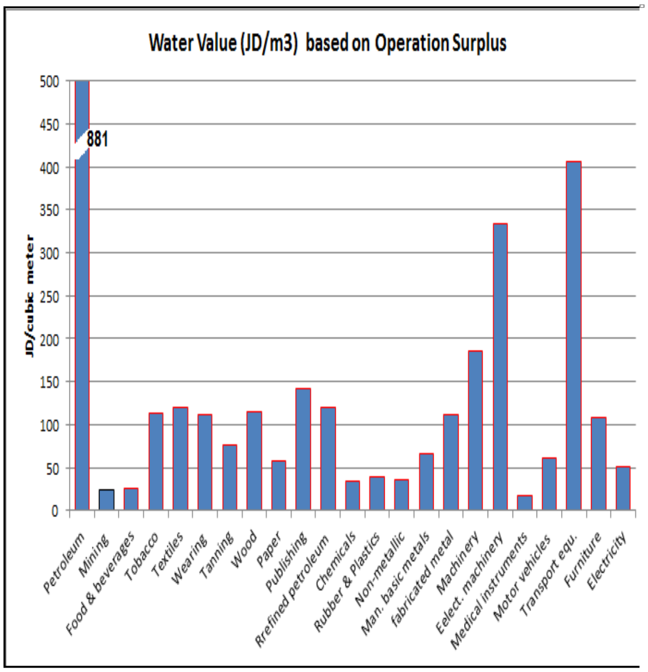


Figure 7: Water Values in Jordan's Industrial Sector based on NVA

[4] The operation surplus represents the difference between the GVA including producer subsidies minus (1) the consumption of fixed capital, (2) compensation for employees, and (3) indirect taxes (definition according to the United Nations System of National Accounts, UNSNA).

“manufactured electrical machinery,” of about JD 333/m³.

Major differences between the sectoral water productivities based on OS and on NVA and GVA apply to “tobacco products” and “manufacturing of electrical and transport equipment “and “publishing and printing.” These industries rank considerably higher in their contribution to the GVA per m³ of water than they do with regard to the generated entrepreneurial profit, which holds particularly true for tobacco industries. The reverse applies to industries in the sectors “wood,” “metal products,” and “apparel,” which contribute comparatively less to the GVA from Jordan’s industries but allow for higher entrepreneurial profits per consumed m³ of water.



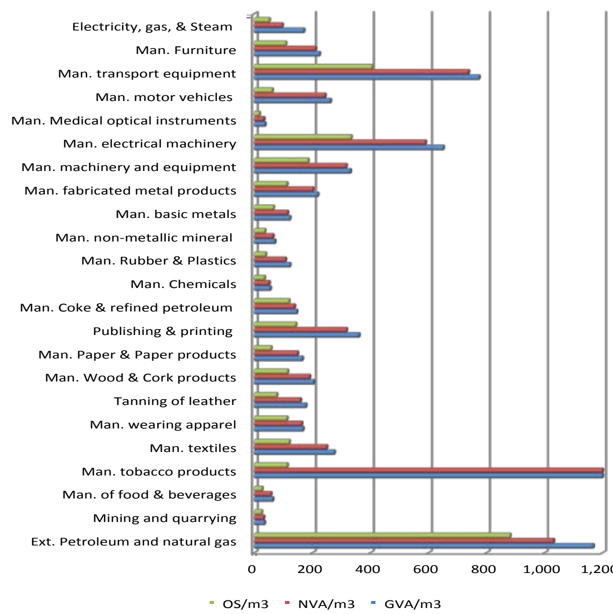


Figure 8: Water Value in Jordan’s Industrial Sector based on OS

Figure 9: Water Value in Jordan’s Industrial Sector based on Three Indicators

Table 12 shows the value of water in industrial sector in relation to the gross output (GO) the GVA, the NVA, and the OS on average over the period 2007 to 2009. The water values based on current prices range from about JD 34 to 70of GVA per m³ of water in the sectors of huge water consumers such mining and chemicals, food and beverage, and manufacturing of non-metallic mineral up to JD 1,168/m³ in the sector of extraction of petroleum and natural gas, tobacco products. The weighted average of water values in the industry, weighted by water consumption, is JD 77.6/m (Table 13) sorted the Jordan’s industry according to their gross output per cubic meter in a correlation with value added and operation surplus.

8.2. VALUE OF WATER IN WHOLESALERS AND RETAILERS

Jordan’s wholesalers and retailers activities consume about 9.3 mcm of water, mainly consumed in retail trade and repair of personnel and household goods. The GVA ofthe water value ranges from about 42 per m³ in maintenance andrepair of motor vehicles to JD 1527 of GVA per m³ of water in the electronic andtelecommunications parts andequipment.

The weighted average represented the water value in the wholesale and retailers' activity is 163.6 JD/m³. The weighted NVA per cubic meter is JD 156 m³. The water values based on OS of Jordan's wholesalers and retailers amounted to about JD 64.7 m³ as shown in

Table 14.

Table 12: Water Values in Jordan's Industrial Sector Averages (2007-2009)

Economic Activity	Water UseM³	Gross Value Added per M³	Net Value Added per M³	Operation Surplus per M³	M³ per Employee
Ext. Petroleum and natural gas	8,900	1,167.9	1,031.1	881.0	61.1
Mining and quarrying	17,975,144	34.4	32.1	24.8	2,510.6
Man. of food & beverages	6,678,933	63.3	56.9	26.4	220.2
Man. tobacco products	132,033	1,980.1	1,921.8	112.9	84.5
Man. textiles	118,133	275.5	249.2	120.1	36.3
Man. wearing apparel	1,446,367	167.8	163.2	112.1	65.3
Tanning of leather	57,900	177.5	158.8	76.9	58.8
Man. Wood & Cork products	100,700	205.1	190.4	114.3	51.3
Man. Paper & Paper products	431,000	165.5	148.8	57.2	123.6
Publishing & printing	268,333	360.7	317.2	142.6	45.3
Man. Coke & refined petroleum	1,086,533	146.0	138.2	119.2	322.3
Man. Chemicals	8,805,167	54.8	50.9	34.3	602.2
Man. Rubber & Plastics	600,933	122.1	107.3	38.5	105.6
Man. non-metallic mineral	5,343,533	70.6	64.4	35.9	346.2
Man. basic metals	1,339,700	122.3	114.2	65.6	306.2
Man. fabricated metal products	617,867	218.5	202.3	112.0	65.9
Man. machinery and equipment	203,767	330.8	316.4	185.2	48.0
Man. electrical machinery	124,467	651.1	589.5	333.3	31.2
Man. Medical optical instruments	262,967	36.9	32.7	17.0	271.3
Man. motor vehicles	51,733	262.3	243.9	61.6	31.7
Man. transport equipment	31,267	774.2	737.7	405.7	40.1
Man. Furniture	384,733	224.2	211.0	107.9	42.6
Electricity, gas, & Steam	1,247,167	170.2	96.2	51.0	152.7
Total industry	47,317,277	77.6	70.4	40.3	298.3

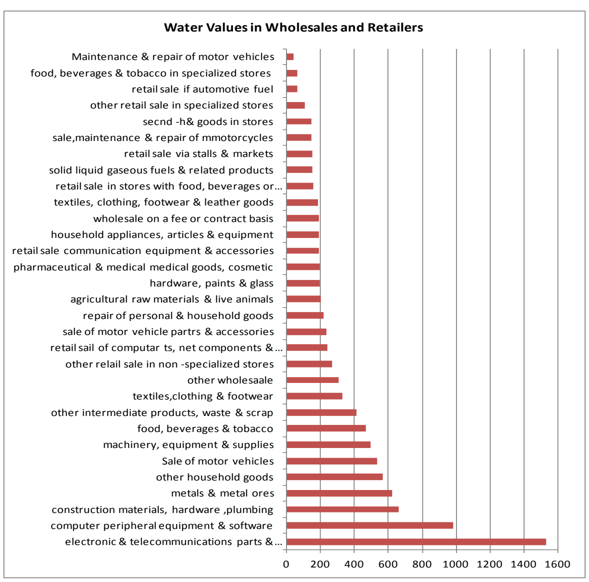
Table 13: Water Values in 10 Largest Industrial Water Consumers

ISIC-Cd.	Economic Activity	GVA/m³	NVA/m³	OS/m³	Water Use (m³)
14	Mining and quarrying	34.4	32.1	24.8	17,975,144
24	Man. Chemicals	54.8	50.9	34.3	8,805,167
15	Man. of food & beverages	63.3	56.9	26.4	6,678,933
26	Man. non-metallic mineral	70.6	64.4	35.9	5,343,533

ISIC-Cd.	Economic Activity	GVA/m³	NVA/m³	OS/m³	Water Use (m³)
18	Man. wearing apparel	167.8	163.2	112.1	1,446,367
27	Man. basic metals	122.3	114.2	65.6	1,339,700
40	Electricity, gas, & Steam	170.2	96.2	51.0	1,247,167
23	Man. Coke & refined petroleum	146.0	138.2	119.2	1,086,533
28	Man. fabricated metal products	218.5	202.3	112.0	617,867
25	Man. Rubber & Plastics	122.1	107.3	38.5	600,933

Table 14: Water Values in Jordan's Wholesalers and Retailers Sector Averages (2007-2009)

Economic Activity	Sale, Maintenance,andRepair of Vehicles, Retail Sales	Wholesale Trade and Commission Trade	Retail Trade andRepair of Household Goods	Total Wholesalers andRetailers
Water Use (m³)	2,533,800	1,275,933	4,021,500	9,360,167
GVA (JD/m³)	125.9	502.4	142.1	163.6
NVA (JD/m³)	120.8	482.3	134.5	156.2
OS (JD/m³)	62.8	138.8	66.9	64.7
m³ per employee	116.8	40.2	61.8	79.0
% Cost of Water	2.98	0.73	1.56	1.51
GVA/employee (JD)	7,804	16,473	3,781	6,632



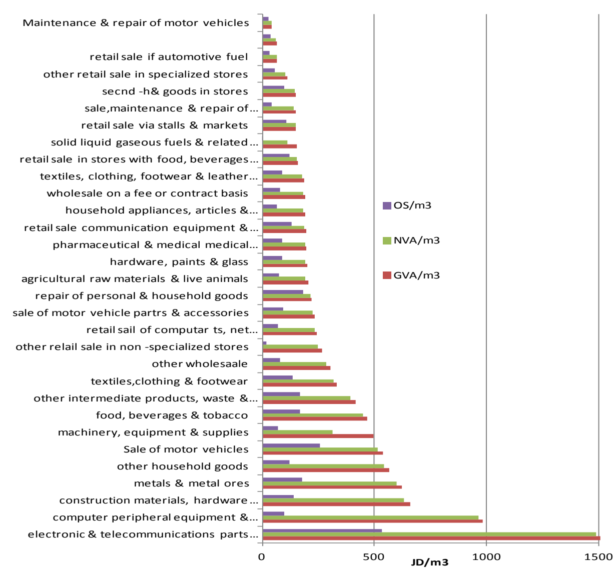


Figure 10: Water Values in Jordan's Wholesalers and Retailers based on GVA

Figure 11: Water Values in Jordan's Wholesalers and Retailers based on Three Indicators

8.3. VALUE OF WATER IN TOURISM AND SERVICES

The tourism sector remains an important element of the Jordanian economy, directly employing about 41,662 Jordanians and contributing 11.6 percent to GDP in 2009. Recent data show a rise in revenues generated by the tourism sector by 28 percent during the first six months of 2010, amounting to JD 1,088.9 million compared to JD 850.7 million in 2009.

The tourism receipts in 2009 totaled JD 2,067 million. The number of tourists visiting the country continued to increase, with overall arrivals during the first six months of 2010 rising 24 percent compared to the same period of 2009. The total arrival in 2009 was 7,084,552 persons. The rising number of arrivals to the Kingdom increased the demand for accommodation and hotels. The number of hotels in Jordan increased from 177 in 1998 to 487 at mid-2010, increasing the number of rooms and beds to 23,867 rooms and 45,877 respectively as of June 2010. Therefore, the tourism sector contributes positively to the Jordanian economy.

Tourists usually usethe capital as the starting pointof their trip around Jordan. Amman provides better services and quality of accommodation compared to other cities that visitors are considering visiting, such as Madaba, Jerash or Irbid. Nights spent in Amman reached 3,491,162 nights compared to 715,496 nights at the second highest city of Aqaba. Amman is home to the majority of hotels at 321 hotels, followed by Aqaba with 45, Petra with 38, and the Dead Sea with five hotels. However, despite the rapidincrease in developing new hotels across the Kingdom, the rise has been insufficient to cover the increasing demand.

The three-year average indicates that in the year 2009, hotels consumed about 6.7 mcm whereas restaurants consumed about 2.26 mcm. The water values in the tourism sector were about JD 38.8/m^3 with a net OS of JD 4.1/m^3. Other services sectors such as restaurants have higher water vales of aboutJD 66/m^3 with a net operation surplus of JD 15.9/m^3. The percentage of water costs to total intermediate consumption reaches to 2.6 percent of the total costs. The percentage costs of water are hotels reach to about 3.97 percent of the total cost of intermediate consumption.

8.4. VALUE OF WATER IN SERVICES SECTOR

Jordan has become an important exporter of educational services to businesses. Furthermore, by regional standards, Jordan has a well-developed healthcare system, some elements of which are considered world-class. However, it still suffers from inefficiencies in both the financing and delivery of certain services. As part of its ongoing efforts to improve the well-being of Jordanians, the government is in the process of expanding and improving healthcare provision to Jordan's poor. The government is also keen to build on Jordan's reputation for quality service to attract more patients from the Arab world (and beyond).

Despite notable improvements in recent years, Jordan's poor infrastructure remains a huge problem. For Jordan, as for much of the region, transport remains an area where there is a lot of room for improvement. Inefficiencies in the transport sector are reflected in high freight costs, both in absolute terms and relative to other countries with similar locations. The country's high freight transport costs are due to inadequate facilities and lack of consolidated and efficient transport and logistics services, which serve as barriers not only to increasing trade flows, but also to attracting foreign direct investment. Table 15 shows the average water values in the services sector for the period 2007 to 2009. The average water values for other sectors range from 49.7JD/m^3 in non-profit-sporting activities to 604 JD/m^3 in renting of machinery. Main water consumers in other sectors are education with about 1.75 mcm, health care activities with about 2.1 mcm, and extra-territorial organization.

The value of water in higher education sector is amounted to JD 209/m^3, for primary education amounted to JD 99/m^3, and JD 154/m^3 for secondary education, andJD 70.8/m^3 for the health sector in hospitals and 114 in medical and dentalclinics. The weighted average values of water in services sector amounted to JD 71 /m^3 as shown in Table 15.

8.5. VALUE OF WATER IN OTHER SECTORS

Incontrast to the situation in the transport sector, Jordan has made considerable progress in reforming the telecommunications sector. The key steps were taken under Law 13/1995 with the establishment of a regulator of the sector and which opened all non-fixed line services to the private sector. Jordan has made solid progress in the monetary and financial sectors by implementing comprehensive economic adjustment and reform. This has resulted in a well-developed financial sector as evidenced by a number of factors, such as financial deepening and the overhaul that took place in modernizing the legal environment, thus placing Jordan among those Arab countries with the highest financial development scores. The banking system in particular is currently more prudent and disciplined, with better risk-return trade-offs, and the system has become more transparent as Jordan has achieved reasonable progress in the area of financial data dissemination.

Table 16 shows the average water values in the construction sector for the period 2007 to 2009. The average water values are about JD 100/m^3. The water values in transport sector range from re range fromJD 1,237/m^3 in air transport to JD 2,708/m^3 in land transport. The highest water existed in the post and telecommunications sector with a value ofJD 2,718/m^3.

Table 15: Water Values in Jordan's Services Sectors, Three-Year Averages (2007-2009)

ISIC-Code	Economic Activity	Water Use (m^3)	GVA/m^3	NVA/m^3	OS/m^3	Percent of Water Cost
55	Hotels and restaurants	6,714,533	41.2	31.6	8.1	2.58
70	Real estate activities	465,000	77.5	68.6	40.8	3.75
71	Renting of machinery	91,900	604.6	577.8	223.7	0.62
72	Computer and related activities	132,467	419.5	400.9	155.2	0.62
73	Research and development	13,600	457.5	344.1	37.5	0.33
74	Other business activities	473,833	370.5	352.8	132.3	0.78
80	Education	1,754,233	161.7	143.3	27.2	1.62
85	Health activities	2,114,700	80.9	68.1	31.1	1.90
92	Recreational, cultural and sporting	617,767	49.7	35.1	-1.4	2.24
93	Other service activities	982,400	50.0	47.8	29.2	3.42
a	Total activities of for-profit	15,097,100	72.9	62.6	20.1	2.07
85	Social work activities	62,400	74.2	60.7	0.0	2.07
91	Membership organization.	142,867	138.2	113.0	0.0	0.83
92	Sporting activities	100,100	49.3	38.3	0.0	2.53
99	Extra-territorial organization	1,137,633	76.2	73.4	0.0	4.51
B.	Total: Private non-profit institution	1,893,833	61.3	56.6	0.0	3.24
C.	**Total Services**	**16,990,933**	**71.6**	**61.9**	**17.8**	**2.17**

Table 16: Water Values in Other Sectors, Averages (2007-2009)

ISIC-Code	Economic Activity	Water Consumption m^3	GVA per m^3	NVAper m^3	OSper m^3	Percentage Cost of Water
D.	Total Construction	4,338,000	100	88	39	0.35
60	Land transport	244,767	2,708	2,274	1,837	0.05
61	Water transport	22,033	1,490	1,262	888	0.05
62	Air transport	117,600	1,237	981	192	0.02
63	Supporting transport activities	2,586,467	121	116	70	1.00
64	Post and telecommunications	287,933	2,718	2,343	1,532	0.08

ISIC-Code	Economic Activity	Water Consumption m³	GVA per m³	NVAper m³	OSper m³	Percentage Cost of Water
E.	Total Communications	4,514,567	429	371	247	0.18
65	Financial intermediation g	647,567	1,381	1,307	872	0.32
67	auxiliary to financial intermediation	106,567	1,100	1,051	752	0.33
F.	Total Financial	772,667	1,309	1,241	835	0.32
66	Insurance and pension funding,	66,267	605	572	114	0.20
G.	Total Insurance	103,600	296	271	71	0.25

The average water consumption in economic activities in Jordan was estimated at83.4 mcm, and industry use was estimated at47.3 mcm. The total value added or the average water values in the national economy is about JD 118/m³. Industries and services have the lowest water value of about JD 70/m³. The highest water values are in banks and the financial sector. The percentage of water costs to total utilities costs is about 0.63 percent, ranging from 2.17 percent in the services sector to only 0.25 percent in insurance and banking sector. The service sector generates the highest indirect tax per cubic meter. The results show the water use per employee. It ranges from 29 m³/person in the insurance sector to the highest in industrial sector amounted with 298 m³/employee. Water costs are the highest. The results show that allocation of one additional cubic meter to water consuming economic activities will generate a net additional profit (operating surplus) of about JD 57/m³ as shown in Table 17.

Table 17: Summary of Water Values in National Economy, Averages (2007-2009)

	Economic Activity	Water Use (M³)	GVA per M³	NVA per M³	OS per M³	Indirect Tax per M³	M³ per Employee	Percentage Cost of Water	GVA per Employee (in JD)	AverageAnnual Employee Salary (in JD)
A.	Industry	47,317,277	77.6	70.4	40.3	14.3	298.3	0.59	20,086	4,692
B.	Wholesales & Retail	9,360,167	163.6	156.2	64.7	49.1	79.0	1.51	6,632	3,352
C.	Services	16,990,933	71.6	61.9	17.8	5.2	86.6	2.17	5,746	3,366
D.	Construction	4,338,000	100.0	88.2	38.9	2.6	100.3	0.35	9,713	4,681
E.	Transport & Comm.	4,514,567	429.2	370.7	246.7	39.8	95.2	0.18	37,179	8,023
F.	Banks & Financial	772,667	1,308.7	1,240.6	834.9	16.9	33.0	0.32	43,045	12,809
G.	Insurance	103,600	469.3	441.7	93.0	23.4	29.4	0.25	13,687	9,561
H.	**Total Economy**	**83,397,210**	**118.1**	**106.8**	**57.0**	**17.2**	**141.1**	**0.63**	**13,149**	**4,601**

8.6. VALUE OF WATER IN AGRICULTURE

The residual value is assumed to equal the returns to water and represents the maximum amount the producer would be willing to pay for water and still cover input costs. The approach is sometimes categorized as a farm crop budget technique in applications to agriculture. A difficulty is that the residual return (after subtraction of the costs of all measured non-water inputs) is the return to water plus all unmeasured inputs, and hence will result in overstatement of the value of water. The approach is also extremely sensitive to small variations in assumptions concerning the nature of the production function or prices.

However, the approach assumes homogeneity in land, crops, husbandry, quality of produce, and price between irrigated and non-irrigated production. The heterogeneity that occurs in these factors in reality brings into question use of the difference in net returns as the net willingness to pay for irrigation water. Therefore, in our analysis, the crops are disaggregated according to crop group (field crops, vegetables, and fruit trees) and furthermore disaggregated by location and production season.

We have to remember that crop production is a dynamic process in which decisions about inputs are made sequentially as crops are planted, grown, and harvested. Linking water supply and agricultural production is a complex research issue, as it integrates different dimensions of water supply and several decisions taken by farmers at different periods of time (planning of farming activities, water scheduling, water use, etc.). Each farmer's decision in this process is contingent upon results of past decisions, past events, and information regarding future events.

8.6.1. IRRIGATION DEVELOPMENT IN JORDAN

Recently, in 2010, the total irrigated area in Jordan reached 1,024 thousand dunums – 333,000 dunums in the Jordan Valley and 691,000 dunums in the upland and the desert as shown in Table 18.

Irrigated production is the major subsector of Jordanian agriculture. Large volumes of vegetables are produced in the Jordan Valley and the highland.

Table 19 and Table 20 show the cropping patterns at the national level distributed by irrigated and non-irrigated areas in the Jordan Valley and highlands areas. It should be noted here that the majority of non-irrigated area is cultivated by tree crops (mainly olives) and rainfed field crops such as wheat and barley.

Error! Reference source not found. In general, the total irrigated areas increased from 666,000dunums in 1994 to 1,024,000 dunums in 2010. The main increase was in the highlands areas. This expansion resulted in excessive groundwater abstractions from the different aquifers, and have resulted in a decline of groundwater levels and degradation of water quality of some aquifers in the country. Prohibition of well drilling for agriculture in 1992 has been taken as a measure to reduce abstractions from the depleting groundwater resources. In the immediate future, it is expected that other measures and actions undertaken by MWI will also assist to remedy the groundwater depletion problem.

Table 18: Total Cropped Area by Crop Type and Irrigation System in Jordan, 1994, 2010 (dunums)

	1994			2010		
Crops	Total Area	Irrigated Area	Non-Irrigated Area	Total Area	Irrigated Area	Non-Irrigated Area
Tree Crops	695,924	224,097	471,826	827,128	447,246	379,882
Field Crops	1,177,201	139,269	1,037,932	1,285,568	128,625	1,156,943
Vegetables	313,243	302,665	10,578	480,806	448,851	31,956
Total	2,186,368	666,031	1,520,337	2,593,501	1,024,721	1,568,780

Source: Department of Statistics (2011), Amman, Jordan

Table 19: Total Cropped Area by Crop Type in the Jordan Valley,1994& 2010 (dunums)

	1994			2010		
Crops	Total Area	Irrigated Area	Non-Irrigated Area	Total Area	Irrigated Area	Non-Irrigated Area

	1994			2010		
Crops	**Total Area**	**Irrigated Area**	**Non-Irrigated Area**	**Total Area**	**Irrigated Area**	**Non-Irrigated Area**
Tree Crops	80,525	80,525	0	106,592	105,212	1,380
Field Crops	43,550	42,142	1,407	33,337	31,508	1,829
Vegetables	152,552	152,434	118	196,946	196,910	36
Total	276,627	275,101	1,525	336,875	333,630	3,245

Source: Department of Statistics (2011), Amman, Jordan

Table 20: Total Cropped Area by Crop type in the Highlands,1994& 2010 (dunums)

	1994			2010		
Crops	**Total Area**	**Irrigated Area**	**Non-Irrigated Area**	**Total Area**	**Irrigated Area**	**Non-Irrigated Area**
Tree Crops	615,399	143,572	471,826	720,536	342,034	378,502
Field Crops	1,133,652	97,127	1,036,525	1,252,230	97,116	1,155,114
Vegetables	160,691	150,231	10,460	283,861	251,941	31,920
Total	1,909,741	390,930	1,518,811	2,256,627	691,092	1,565,535

Source: Department of Statistics (2011), Amman, Jordan

The total gross plant output was estimated at 2,268,000tons with a value of JD 510 million in 2010. The irrigated agriculture produced about 95 percent of total agricultural production in Jordan with a value of JD 460 million. This shows that irrigated agriculture contribute to about 90 percent of the total value of gross output in Jordan during 2010 as shown in Table 21. The JV contribute to about 44 percent in gross output (JD 227.8 million), whereas the highlands contribute to about (JD 282 million) which represent about56 percent of total gross outputs.

Table 21: Contribution of Rainfed and Irrigated Areas in Plant Gross Output in 2010

	Production (000 ton)			Value of Production (MJD)		
	Non-Irrigated	**Irrigated**	**Total**	**Non-Irrigated**	**Irrigated**	**Total**
Field Crops	24.7	292.9	317.5	8.3	47.0	55.3
Vegetables-W	5.6	926.3	931.9	1.8	155.1	156.8
Vegetables-S	10.7	847.6	858.3	3.3	108.2	111.5
Tree Crops	85.0	375.2	460.2	35.5	150.6	186.1
Total	126.0	2,441.9	2,567.9	48.9	460.9	509.7

Source: Department of Statistics (2011), Amman, Jordan

8.6.2. VALUE OF WATER IN FIELD CROPS

Field crops accounted for 50 percent of the total cultivated area, but only 8 percent of total production in 2010. In 2010, 44 percent of the cropped area was under wheat and barley and 3 percent under fodder crops; in the irrigated areas, field crops account forabout 10.4 percent of cultivated areas (134,000dunums out of 1,285,000dunums) as shown in Table 22.

The estimated quantities of water consumed by field crop are about 114.7 mcm of which 17.3 mcm is in the Jordan River Rift Valley (JRV) and about 97.4 mcm in the highlands. Clover for livestock feed consume about 84 mcm or about 70 percent of water used in field crops followed by sorghum, and maize with about 11.5 mcm and 10.8 mcm or (10. percent) and (9.5 percent) respectively, followed by wheat and barley with a percent of 3.1 percent and 2.8 percent of total water used in field crop production, respectively. The irrigated field crops represent only about 10 percent of total cultivated areas of field crops in 2010 but production about 90 percent of total field crop production. The irrigated areas in the highland are threefold the irrigated areas in the Jordan Valley as shown in Table 23.

Table 22: Areas and Production of Field Crops by Irrigation System in 2010

	Area (du)			Production (ton)		
	RJV	Highlands	Jordan	RJV	Highlands	Jordan
Rainfed	2,990	1,157,835	1,151,399	104	28,365	24,666
Irrigated	30,347	94,395	134,169	45,094	243,964	292,862
Total	33,337	1,252,230	1,285,568	45,198	272,330	317,528

Table 24 shows that the value of water range from the highest of JD 1.35/m^3 for garlic, followed by chickpeas atJD 0.41 /m^3. The lowest, less than JD 0.1/m^3, is for irrigated sesame, lentils, tobacco, vetch, common vetch, and alfalfa. Water values in barley ranged between (JD 0.12-0.18/m^3) in the Jordan Valley and JD 0.02/3 in the highlands. The cost of water used to produce these crops in JV is JD 0.012 /m^3. Therefore, it is still profitable for farmers to produce these crops under irrigation. The highest water values were for chickpea produced in the highlands.

The water values ranged from between JD 4.18-4.81/m^3 for chickpea cultivated in north and northeast of Jordan under irrigation. The chickpeas produced in these regions are sold as green chickpeas. Furthermore, water values in garlic are higher in the highlands and desert areas (JD 1.7/m^3) compared with JV at about JD1/m^3. However, the weighted average for water value in field crop production isJD 0.27/m^3. It is worth mentioning that garlic is classified as field crop according to the DOS database; it might be that historically,as garlic has beencultivated in an open field in highlands areas.

Table 23: Areas and Water Use of Irrigated Field Crops in 2010

	Area			Water use			Percent of Water Use
Crop	RJV	Highlands	Jordan	RJV	Highlands	Jordan	
Wheat	7,469	2,248	17,094	2,528	1,013	3,541	3%
Barley	3,353	8,086	12,623	1,232	2,027	3,259	3%
Lentils	0	0	71	0	102	102	0%
Vetch	13	26	78	3	470	473	0%
Check-peas	403	401	1,801	142	128	270	0%
Maize	14,249	714	14,963	10,434	465	10,899	9%
Sorghum	852	19,151	20,003	518	10,985	11,503	10%
Broom millet	11	0	11	6	0	6	0%
Tobacco	0	142	0	0	47	47	0%
Garlic	64	147	149	34	69	102	0%
Vetch	5	1,259	1,251	2	201	203	0%
Sesame	162	10	83	66	253	318	0%

Clover	3,735	62,036	65,771	2,370	81,607	83,977	73%
Alfalfa	7	0	7	6	0	6	0%
Other FC	26	175	265	9	47	56	0%
Total Field Crops	30,347	94,395	134,169	17,349	97,415	114,764	100%
% FC of Total	9%	14%	13%	10%	23%	19%	

Table 24: Computed Water Values (JD/m³) for Field Crops in Different Regions in Jordan, 2010

	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Avg.
Wheat	0.41	0.22	0.16		0.36	0.30	0.31	0.30	0.20	0.33
Barley	0.17	0.18	0.12		0.02	0.00	0.01		0.26	0.10
Lentils					0.26		0.06			0.08
Vetch	0.06				0.27		0.04			0.05
Check-peas	0.28	0.31	0.35		4.18	4.81	0.19	0.23		0.41
Maize	0.24	0.27	0.24	0.27	0.30	0.36	0.32			0.26
Sorghum	0.14	0.13	0.14			0.16	0.20		0.18	0.16
Broom millet	0.18		0.18							0.18
Tobacco							0.07			0.07
Garlic	0.97	1.23		1.09		1.70	1.34		1.62	1.35
Vetch-	0.08						0.03			0.03
Sesame	0.07		0.06		0.11					0.10
Clover	0.64	0.60	0.63		0.57	0.38	0.29	0.20	0.22	0.29
Alfalfa	0.01									0.01
Other FC		0.04	0.02		0.02	0.02	0.02		0.01	0.02
W. Avg	0.402	0.326	0.259	0.278	0.296	0.330	0.244	0.202	0.221	0.267

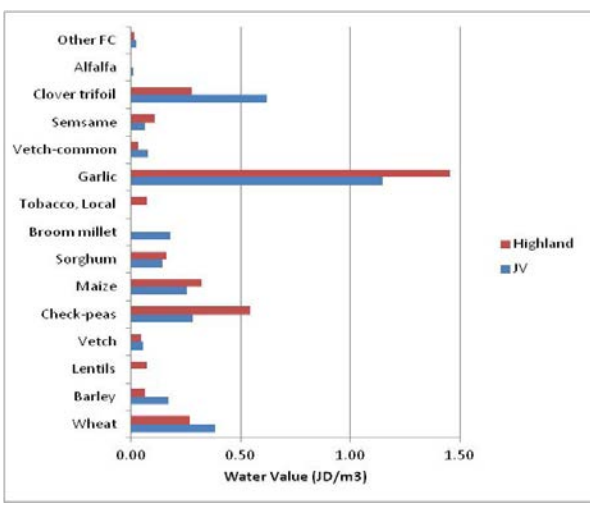


Figure 12: Water Values in the Highlands and JV Field Crops

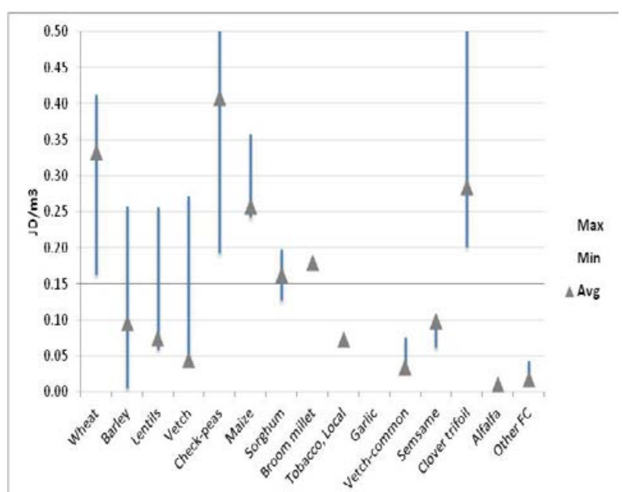


Figure 13: Variation of Water Values in Field Crops (except Chickpea and Garlic)

8.6.3. VALUE OF WATER IN VEGETABLES

Vegetables were produced in about 16 percent of the total cultivated area in 1995. The percentage increased to 19 percent of the cultivated land in 2010 –nearly 70 percent of total production. The main vegetables produced were tomatoes, cucumber, potatoes, eggplants, and melons. Together, these vegetables accounted for 70 percent of the total production in 2010. Most of vegetables(99 percent)are produced under irrigation systems. Only small portions of vegetables are produced in rainfed conditions such as okra and snake cucumber.

From a total of 480,000dunums cultivated with vegetables in Jordan during 2010 about 460,000dunums are irrigated. About 196,700dunums in Jordan Valley (58 percent of the total JV area) and 260,000dunums in the highlands (13 percent of the total cultivated area in the highlands). About 150,000dunums are cultivated for winter vegetables in the Jordan Valley (44 percent of total JV area) and 201,000dunums are cultivated with summer vegetables in the highlands (9 percent of total cultivated areas in the highlands).

1. VALUE OF WATER IN WINTER VEGETABLES

The quantities of water consumed by winter vegetables are shown in Table 25. It clearly shows that tomatoes consume 29.5 mcm or about 37 percent of water used in winter vegetable production followed by potatoes with about 11.3 mcm (14 percent), followed by eggplants (8 percent), broad beans (7 percent), and squash (6 percent). However, winter vegetable consume nearly 80 mcm, which represents about 17 percent of total use in the agricultural sector (660 mcm).

Irrigation water values are calculated per crop for vegetables in Jordan according to different geographical locations. Results of the RIM calculations of water value per crop are presented in Table 26. Cucumbershavethe highest water values (JD 4.4/m^3) with a range of (JD 2.49-6.47/m^3), followed by strawberries (JD 4.3/m^3), string beans (JD 3.0/m^3), followed by Brussels sprouts (JD 2.95/m^3), and carrots (JD 1.94/m^3).

Tomatoeshavemoderate water values of about (JD 1.0 /m^3). The highest water value in tomatoes was found in NJV (JD 1.57/m^3) and the lowest was in Desert areas in Disi and Moudawa with an average ofJD0.54/m^3. In Safi Area, withthe most cultivated areas with tomato, the average water values isJD1.39/m^3. One can conclude that the average water value of winter tomato is higher in JV (JD 1.37/m^3) compared with highlands (JD 0.73/m^3).

The lowest return to one cubic meter was found for cabbage (JD 0.32/m^3), Jew's mallow (JD 0.40/m^3), and dry onion (JD 0.52/m^3). Figure 14 shows the variation in water values for winter vegetables. Cucumbers, string beans, and broad beans have the highest variation in water values between the JV and the highlands. However, the weighted average for water value in winter vegetables is JD 1.286/m^3. The water values in winter vegetable is higher in the JV (JD 1.49/m^3) compared to water value in thehighlands (JD 1.04/m^3).

Table 25: Areas and Water Use of Irrigated Winter Vegetables in 2010

	Area			Water use			Percent of Water Use
Crop	RJV	Highlands	Jordan	RJV	Highlands	Jordan	
Tomatoes	50,359	24,929	75,301	18,273	11,257	29,530	37%
Squash	16,857	2,050	18,934	3,919	863	4,782	6%
Eggplants	19,496	86	19,581	6,002	31	6,032	8%
Cucumbers	12,932	1,187	14,120	4,109	425	4,535	6%
Potatoes	17,735	15,901	33,637	5,882	5,486	11,368	14%
Cabbages	2,483	1,985	4,468	747	821	1,568	2%
Cauliflower	2,690	6,134	8,835	670	2,557	3,227	4%
Hot peppers	2,522	109	2,630	712	35	747	1%
Sweet peppers	6,194	99	6,293	2,551	34	2,585	3%

Crop	Area			Water use			Percent of Water Use
	RJV	Highlands	Jordan	RJV	Highlands	Jordan	
Broad beans	4,802	9,354	15,251	1,718	3,556	5,275	7%
String beans	1,987	184	2,171	513	68	581	1%
Peas	162	1,321	1,796	54	771	826	1%
Cow-peas	4	56	59	1	21	22	0%
Jew's mallow	70	0	70	26	0	26	0%
Okra	109	2	83	41	0	41	0%
Lettuce	4,872	1,897	6,769	1,146	500	1,646	2%
Sweet melons	30	2	32	11	217	228	0%
Watermelons	0	550	550	0	193	193	0%
Spinach	376	1,336	1,713	79	330	409	1%
Onion, green	478	191	739	199	399	597	1%
Onion, dry	651	5,327	6,785	236	2,714	2,951	4%
Snake cucumbers	8	0	4	2	1	3	0%
Turnip	35	349	385	9	97	106	0%
Carrots	909	167	1,076	226	43	269	0%
Parsley	835	76	911	207	24	231	0%
Radish	460	820	1,281	123	228	350	0%
Other Veg Winter	2,021	1,938	3,990	774	679	1,452	2%
Vegetables – Winter	149,075	76,051	227,464	46,237	32,680	78,917	100%
Vegetables – Winter	45%	11%	22%	28%	7%	13%	

Table 26: Computed Water Values (JD/m^3) of Winter Vegetables in 2010

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Tomatoes	1.57	1.74	0.79	1.39		1.14	0.69	0.58	0.52	0.995
Squash	1.10	1.15	0.95	0.79	1.54		0.72	0.56	0.85	1.004
Eggplants	1.04	1.26	0.94	0.59				0.51	1.12	1.000
Cucumbers	2.49	4.72	3.89	6.47			4.95	4.68	4.35	4.391
Potatoes	1.00	1.09	0.85	0.88	1.20		1.22		1.45	1.245
Cabbages	0.32	0.34	0.33	0.24	0.20		0.35		0.57	0.328
Cauliflower	0.79	0.57	0.45	0.41	1.24	0.73	0.64	0.36	0.69	0.669
Hot peppers	1.56	1.87	1.47	1.48			1.69	1.07	2.59	1.689
Sweet peppers	1.62	2.32	1.60	1.42			1.52	0.93	0.67	1.866
Broad beans	1.85	1.68	1.06	0.53	4.19	1.74	1.20	0.45	0.51	1.619
String beans	2.67	4.00	3.02	1.46	2.24		3.47	1.11		2.989
Peas	4.71	4.10	3.59		3.18		2.32			2.747
Cow-peas				0.62	2.11		0.97			1.916
Jew's mallow	0.35	0.46								0.402
Okra	1.02	1.32		1.07						1.126
Lettuce	1.33	1.74	1.30		1.04	1.32	0.56			1.217

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Sweet melons	1.05	1.65		1.43				1.25	1.21	1.206
Spinach	0.83	0.75	0.73	0.76			0.62		1.17	0.652
Onion, green	2.15	1.04	1.26	0.65			1.02		0.61	0.999
Onion, dry	1.71	0.60	1.06	0.75	2.13	0.14	0.42		0.19	0.523
Snake cucumbers			1.33					1.32		1.329
Turnip	0.87						1.28		0.48	1.144
Carrots		1.96	1.77				1.97			1.942
Parsley	0.86	0.78	0.84	0.60		0.62	0.55			0.811
Radish	1.03	1.74	0.97	0.71			0.99			1.010
Other W Veg	0.25	0.53	0.47	0.31	0.11	0.25	0.80	0.67		0.465
Strawberry	4.05	4.53					4.29			4.29
Broccoli	1.87						1.85	1.67		1.80
Brussels sprouts	3.31						1.94	3.60		2.95
Fennel	1.23	1.23					1.23	1.23		1.23
Leek	1.94						1.94	1.94		1.45
Celery	2.04									1.02
Ginger	2.25							2.25		1.50
Weighted Avg.	**1.348**	**2.139**	**1.033**	**1.408**	**2.224**	**1.494**	**0.985**	**0.714**	**0.769**	**1.286**

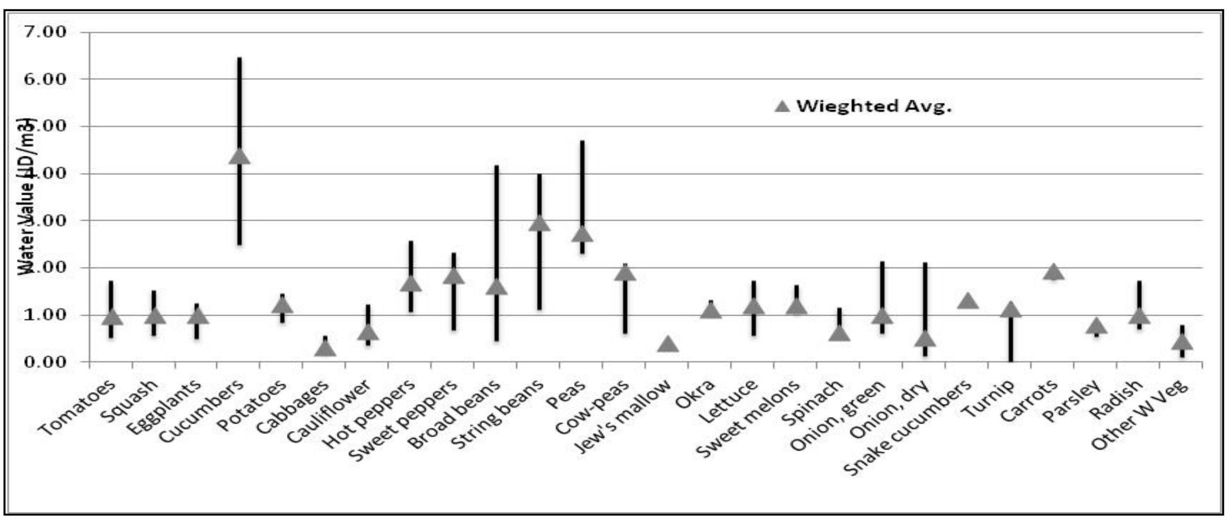


Figure 14: Variation of Water Values in Winter Vegetables (JD/m³)

2. VALUE OF WATER IN SUMMER VEGETABLES

The total cultivated areas of summer vegetables are about 232,600dunums (22 percent of total cultivated areas) in 2010. In the Jordan Valley, about 47,600 compared to 183,400 in the highlands (27 percent of total cultivated area in the highlandsis under irrigation). With a total production of 847,500 tons, 138,300 tons produced in JV and 704,000 tons are produced in thehighlands.

The quantities of water consumed by summer vegetables are shown inTable 27. This clearly shows that tomatoes consume 44 mcm or about 37 percent of water used in summer vegetable production followed by watermelon at 14.5 mcm (12 percent), followed by sugar melon with about 6.6 mcm (6 percent). In general, summer winter vegetables consume nearly 120 mcm, which represents about 18 percent of total use in the agricultural sector (660 mcm).

Irrigation water values are calculated per crop for summer vegetables in Jordan according to different geographical locations. Results of the RIM calculations of water value per crop are presented in Table 28. Carrotshave the highest value (JD 2.06/m^3) followed by cowpeas (JD 1.97/m^3) with a range of (JD 0.9-9.93/m^3), followed by cucumbers (JD 1.37/m^3),with the highest of (JD 2.74/m^3) in Mafreq areas and lowest (JD 0.52/m^3 in Safi, followed by snake cucumbers (JD 1.37/m^3).

Watermelons, tomatoes, Jew's mallows, cabbages, and dryonions have the lowest water values in summer vegetables atless than 0.55 JD/m^3. However, the weighted average for water value in summer vegetable is 0.544 JD/m^3. The water values in summer vegetables is higher in JV (0.71 JD/m^3) compared to water value in the highlands (0.52 JD/m^3). The highest water value in tomatoes was found in Safi (0.69 JD/m^3) and the lowest was in Mafreq with an average of (0.27 JD/m^3).

In Mafreq, where most of the cultivated areas aresummer tomatoes, the average water value is the lowest (JD 0.27/m^3). One can conclude that the average water value of winter tomato is higher in the JV (JD 0.57/m^3) compared with the highlands (JD 0.41/m^3). Figure 15 shows the variation in water values for summer vegetables,cow-peas, string beans, cucumbers, and squash have the highest variation in water values between JV and the highlands.

Figure 15 and Figure 16 show a comparison of water values between winter and summer vegetables grown in the JV and the highlands.

Table 27: Areas and Water Use of Irrigated Summer Vegetables in 2010

	Area			Water Use (000 m3)			Percent of Water Use
Crop	RJV	Highlands	Jordan	RJV	Highlands	Jordan	
Tomatoes	7,913	57,900	65,911	3,567	40,995	44,562	37%
Squash	4,424	9,715	14,059	1,137	3,783	4,920	4%
Eggplants	3,034	7,446	10,489	1,120	4,507	5,627	5%
Cucumbers	324	5,601	5,927	108	2,494	2,602	2%
Potatoes	1,797	22,535	24,332	617	13,188	13,805	12%
Cabbages	43	1,818	1,861	15	778	793	1%
Cauliflower	340	8,851	9,190	109	3,784	3,894	3%
Hot peppers	1,134	4,058	5,193	422	2,368	2,790	2%
Sweet peppers	694	4,136	4,833	338	2,538	2,875	2%
Broad beans	80	142	215	24	79	103	0%

	Area			Water Use (000 m3)			Percent of Water Use
Crop	**RJV**	**Highlands**	**Jordan**	**RJV**	**Highlands**	**Jordan**	
String beans	1,196	2,232	3,432	273	1,079	1,352	1%
Peas	11	39	50	3	0	3	0%
Cow-peas	431	26	397	127	6	133	0%
Jew's mallow	12,392	337	12,727	5,979	90	6,069	5%
Okra	6,873	579	7,337	2,918	442	3,360	3%
Lettuce	631	6,945	7,575	138	2,076	2,213	2%
Sweet melons	2,300	5,784	8,080	797	5,845	6,642	6%
Watermelons	2,936	33,929	36,866	1,353	13,204	14,557	12%
Spinach	27	385	412	6	91	97	0%
Onion, green	81	25	97	47	18	66	0%
Onion, dry	153	1,653	1,805	58	1,165	1,223	1%
Snake cucumbers	267	1,934	3,166	70	120	190	0%
Turnip	5	0	5	2	0	2	0%
Carrots	50	508	558	13	136	149	0%
Parsley	15	54	69	4	19	23	0%
Radish	86	320	406	27	103	130	0%
Other Veg – Summer	430	6,493	7,630	159	1,236	1,394	1%
Vegetables-Summer	47,661	183,443	232,620	19,429	100,143	119,572	100%
Vegetables-Summer	**14%**	**27%**	**22%**	**11%**	**23%**	**20%**	

Table 28: Computed Water Values (JD/m³) of Summer Vegetables in 2010

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Tomatoes	0.64	0.61	0.37	0.69	0.57	0.27	0.30	0.56	0.36	0.352
Squash	0.69	1.69	1.35	0.52	2.86	0.63	0.33	0.41	0.44	0.544
Eggplants	0.38	0.88	0.67	0.44	0.66	0.36	0.36	0.42	0.44	0.441
Cucumbers	1.54	3.10	2.90	0.52	1.77	2.47	1.35	1.21	1.45	1.372
Potatoes	1.46	1.66			0.52		0.76		0.68	0.714
Cabbages	0.68	0.69				0.35	0.24		0.19	0.306
Cauliflower	1.07	1.20	0.90			1.04	1.15	0.51	0.56	1.113
Hot peppers	1.33	1.75	1.03	1.24	0.38	0.45	0.36	0.62	0.53	0.562
Sweet peppers	0.77	2.43	0.78	0.46	0.36	0.64	0.35	0.57	0.43	0.573
Broad beans	0.93				0.41		0.53		0.69	0.698
String beans	1.83	2.23	3.19	1.83	1.52	1.69	0.90	0.59	0.81	1.122
Peas	1.24									1.239

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Cow-peas	2.03	1.81	1.64	1.81	9.93		0.90			1.971
Jew's mallow	0.22	0.25	0.19	0.64	1.04		0.50			0.320
Okra	0.92	1.04	1.02	0.73	1.63		1.16	1.17	0.69	1.004
Lettuce	0.79	1.31	0.53		1.65	1.15	1.01	0.74	1.57	1.177
Sweet melons	1.11	1.47	1.65	1.05	1.22	0.44	0.41	0.35	0.84	0.703
Watermelons	0.77	0.90		0.55	0.52	0.47	0.32	0.47	0.40	0.417
Spinach	1.51						1.12			1.146
Onion, green	0.79				1.69		1.62			1.024
Onion, dry	0.76	0.24		0.33	0.81		0.24		0.30	0.302
Snake cucumbers	1.37	1.15	1.14	1.14		1.65	1.58	1.18	1.96	1.255
Turnip	0.89									0.894
Carrots			2.19		1.18		2.74			2.061
Parsley	0.98		0.58		0.55	0.52	0.35			0.498
Radish	0.98	0.91	0.89		1.08		1.17		0.62	1.036
Other Summer Veg.	0.37	0.49	0.37		10.26	0.33	0.75			1.401
Weighted Avg.	**0.795**	**0.695**	**0.665**	**0.698**	**1.339**	**0.361**	**0.619**	**0.602**	**0.486**	**0.544**

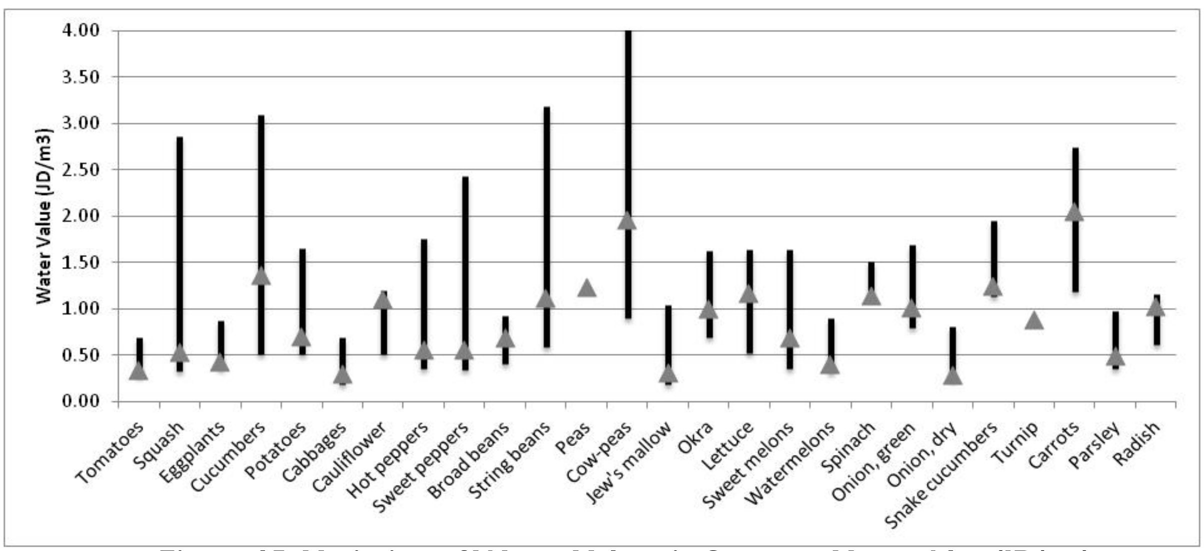


Figure 15: Variation of Water Values in Summer Vegetables (JD/m³)

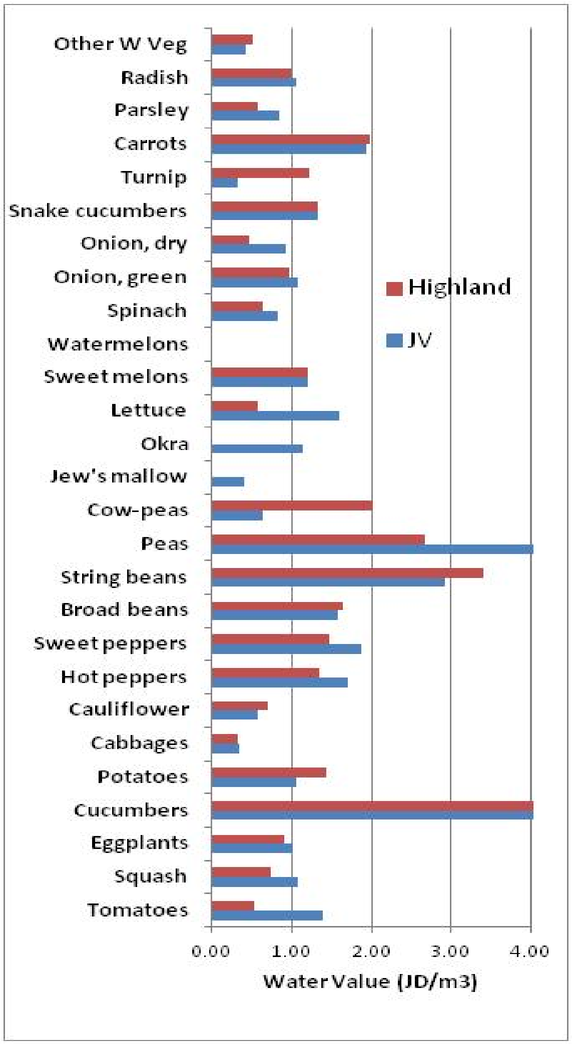


Figure 16: Water Values in the Highlands and JV Winter Vegetables

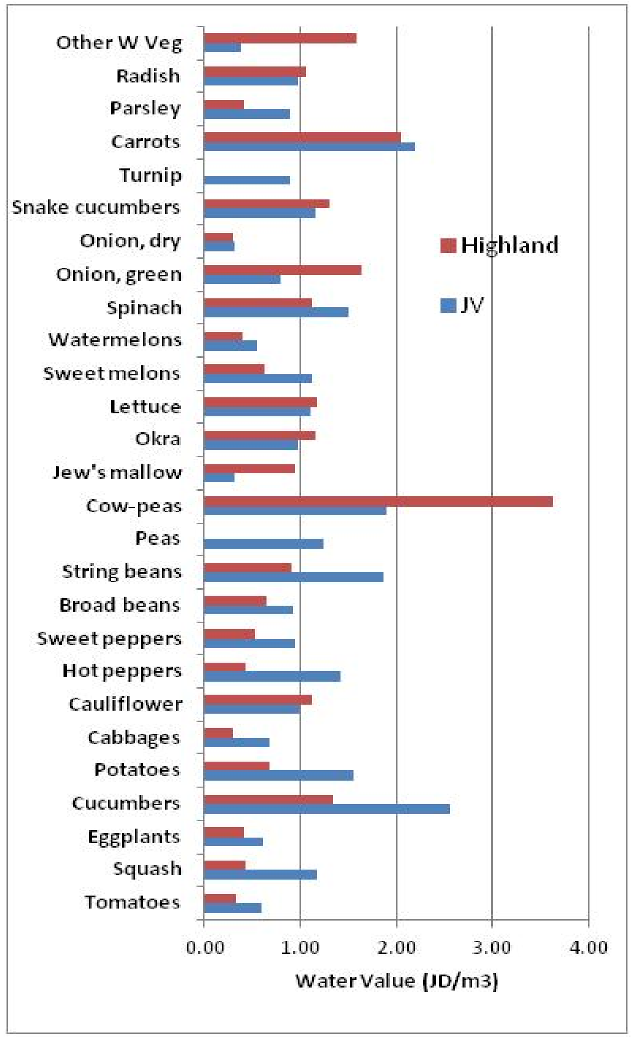


Figure 17: Water Values in the Highlands and JV Summer Vegetables

8.6.4. VALUE OF WATER FRUIT TREES

The total cultivated areas with fruit trees (rainfed and irrigated) is about 827,000dunums, of which about 441,000dunumsareirrigated (43 percent of total irrigated areas) (most of them in the highlands), 104,7000dunums are in JV and 336,500dunums are in the highlands. The cultivated areas of olive trees are about 608,000dunums, of which 250,000dunumsareirrigated mainly in highlands areas as shown Table 29. Fruit trees accounted for 43 percent of the total cultivated area in 2010.

The quantities of water consumed by fruit trees are shown in Table 29. Fruit trees consume about 346 mcm (52 percent of total water use in agricultural sector), of which 215 mcm is in the highlands and 130 mcm in the JV. It clearly shows that olive trees consume 141 mcm or about 41 percent of water used in fruit tree production. Most of the water used in olive cultivations is used in highlands areas, about 138 mcm. Bananas use about 25 mcm (7 percent of water use in fruit trees), whereas date palms consume about 23 mcm (7 percent of water use in fruit trees), followed by lemon 20.7 mcm (6 percent).

In 2010, about 73 percent of the tree crop area was under olive trees (93 percent in the rainfed area), 6 percent under citrus (47 percent in the Jordan valley), and 3.8 percent for grapes, 8 percent for stone fruit. Considering the soil, topography, and climate conditions, fruit trees have the greatest potential to be developed. Over the past five decades, substantial investments have been made in fruit trees in the highlands. The production of olives is highly variable, with a good crop every other year.

Table 29: Areas and Water Use of Irrigated Fruit Trees in 2010

	Area			Water use (000 m³)			Percent of Water Use
Crop	RJV	Highlands	Jordan	RJV	Highlands	Jordan	
Lemons	15,395	1,539	17,261	7,719	1,510	9,229	3.2%
Oranges, local	1,643	246	1,943	851	239	1,089	0.4%
Oranges, navel	11,782	125	11,898	5,899	120	6,020	2.1%
Oranges, red	3,189	5	3,181	1,575	5	1,579	0.5%
Oranges, Valencia	2,820	34	2,860	1,395	33	1,428	0.5%
Oranges, French	1,780	6	1,779	883	6	889	0.3%
Oranges, shamouti	4,227	87	4,316	2,117	84	2,201	0.8%
Clementines	12,984	86	13,081	6,488	83	6,571	2.3%
Mandarins	6,266	59	6,320	3,136	57	3,193	1.1%
Grapefruits	1,933	29	1,966	961	28	989	0.3%
Medn. mandarins	60	0	60	30	0	30	0.0%
Pummelors	3,492	54	3,544	1,774	53	1,827	0.6%
Sour oranges	178	0	177	89	0	89	0.0%
Olives	3,347	246,297	249,729	2,756	129,051	131,806	45.7%
Grapes	2,787	19,017	21,660	1,806	12,760	14,567	5.0%
Figs	86	987	1,051	68	859	927	0.3%
Almonds	39	1,219	1,260	29	1,067	1,097	0.4%
Peaches	37	15,944	15,982	28	13,413	13,441	4.7%
Plums, Prunes	3	2,859	2,863	2	2,393	2,395	0.8%
Apricots	47	8,328	8,376	33	6,957	6,990	2.4%
Apples	0	17,825	17,826	0	15,006	15,006	5.2%
Pomegranates	875	1,269	2,138	628	1,125	1,753	0.6%
Pears	0	3,022	3,023	0	2,693	2,693	0.9%
Guava	1,652	506	2,155	1,242	442	1,685	0.6%
Dates	10,101	6,979	17,079	15,531	9,050	24,582	8.5%
Banana	18,434	93	18,527	26,523	123	26,647	9.2%
Other Fruits	1,568	9,917	11,347	933	8,946	9,879	3.4%
Tree Crops	104,726	336,532	441,406	82,498	206,102	288,599	100%
% Tree Crops	32%	49%	43%	50.8%	46.8%	47.9%	

The aggregate average water value for the citrus fruit trees is JD 0.70 /m3 (JD 0.18/m3 in the highlands and JD 0.73/m3 in JV). Water value in Olive is JD 0.31/m3 (JD 0.34/m3 in JV and JD 0.21/m3) in the highlands. From the perspective of improving water allocation, farmers should prefer the crops with higher water value. The average water value in Banana is (JD 0.63/m3) it ranged from (JD 0.4/m3 in the North Jordan to a high of JD 1.03/m3 MJV, The Banana zone in NJV and SJV is (JD 0.82/m3) and (0.64 JD/m3), respectively. Looking to the net profit to one cubic meter, it was found it is about JD 0.51/m3 for banana crops. Therefore, it is economically rational for banana producers to install RO units to irrigate bananas, since the cost of desalination of one cubic meter is about the half of net profit from one cubic meter

For citrus fruit, the highest water value was found in Valencia oranges (JD 1.36 /m3), red oranges (JD 1.06/m3), French orange (JD 0.80/m3) rank second among the highest value, followed by Shamouti orange ((JD 0.77/m3) and Madarin ((JD 0.70/m3). For other stone fruit tress, the highest water value was found in Almond (JD 0.95/m3). In Safi Area, as shown in Table 30, the grapes cultivated in Safi areas yield a water value of JD 17.4 /m3, but with a lowest value in north (JD 0.17 /m3). One reason for this could be the higher intensity in terms of labor and inputs, which generally leads to higher gross margins and consequently higher irrigation water values., followed by apples (JD 0.48/m3) and apricots (JD0.41 /m3).

The lowest return to one cubic meter was found for olive trees with only (JD 0.09/m3) in the desert areas and (JD 0.22/m3) in Mafreq areas. Furthermore, pomegranates, grapefruits, dates,olives, and pummels have a water value below 0.25 JD/m3.Figure 18 shows the water value of fruit trees in the Jordan Valley and the highlands and Figure 19 shows the variation in water values of citrus fruits.

Table 30: Computed Water Values (JD/m^3) of Fruit Trees in 2010

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Lemons	0.824	0.453	0.406	0.250	0.216	0.050	0.099	0.056	0.194	0.667
Oranges, local	0.313	0.606	0.098	0.186	0.203		0.160	0.154	0.034	0.343
Oranges, navel	0.694	0.486	0.605	0.392	0.126		0.183			0.656
Oranges, red	1.070	0.694			0.349		0.590			1.064
Oranges, Valencia	1.416	0.677	0.378		0.347					1.367
Oranges, French	0.831	0.489	0.198		0.167		0.370			0.801
Oranges, shamouti	0.817	0.716	0.516		0.186		0.213			0.771
Clementine	0.716	0.536	0.417		0.348		0.280	0.148	0.232	0.681
Mandarins	0.790	0.376	0.367		0.195		0.198		0.159	0.705
Grapefruits	0.396	0.229	0.229		0.139		0.153			0.372
Medn. mandarins	0.598	0.352								0.579
Pummels	0.540	0.281	0.346	0.135	0.126		0.239		0.129	0.442
Olives	0.42	0.36	0.22	0.08	1.27	0.22	0.12	0.09	0.09	0.215
Grapes	0.50	0.80	0.52	17.40	0.17	0.30	0.27	0.52	0.26	0.350
Figs	0.19	0.19	0.02	0.03	0.08	0.16	0.26	0.08	0.32	0.203
Almonds	0.39	0.31			3.98	3.08	0.21	0.21	0.19	0.956
Peaches	0.21	0.21			0.15	0.45	0.21	0.13	0.44	0.409
Plums, Prunes	0.33				0.36	0.22	0.36	0.12	0.30	0.253
Apricots	0.27				0.14	0.26	0.33	0.08	0.24	0.255
Apples					0.14	0.39	0.13	0.11	0.57	0.479
Pomegranates	0.36	0.45	3.62	0.11	0.07	0.16	0.04	0.36	0.02	0.169
Pears					0.36	0.54	0.17	0.21	0.54	0.308
Guava	0.58	0.17	0.20	0.30	0.36		0.16	0.06	0.16	0.383
Dates	0.38	0.39	0.36	0.32	0.25	0.17	0.22		0.19	0.214

Crop	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	Weighted Average
Bananas	0.82	1.03	0.64	0.53	0.40					0.633
Other Fruits	0.57	0.41	0.13	0.09	0.36	0.50	0.23	0.07	0.06	0.316
Weighted Average	**0.721**	**0.382**	**0.507**	**0.539**	**0.881**	**0.304**	**0.143**	**0.104**	**0.265**	**0.351**
W. Average Citrus	**0.782**	**0.473**	**0.411**	**0.238**	**0.212**	**0.050**	**0.134**	**0.087**	**0.192**	**0.696**
W. Stone Fruits	**0.535**	**0.335**	**0.517**	**0.555**	**0.314**	**0.404**	**0.228**	**0.238**	**0.342**	**0.398**

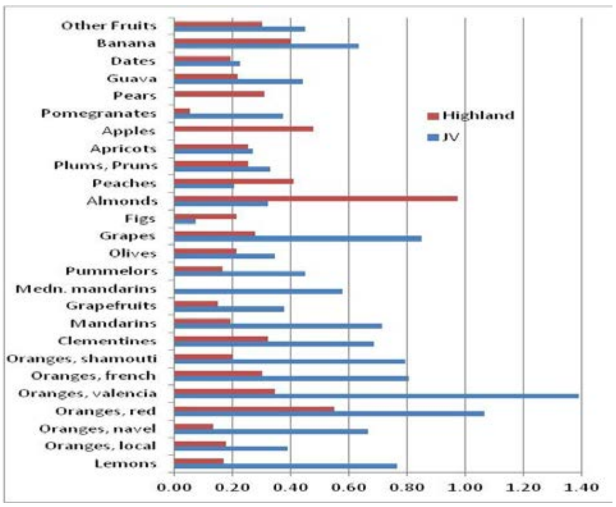


Figure 18: The Value of Water in Fruit Trees in Jordan for the year 2010

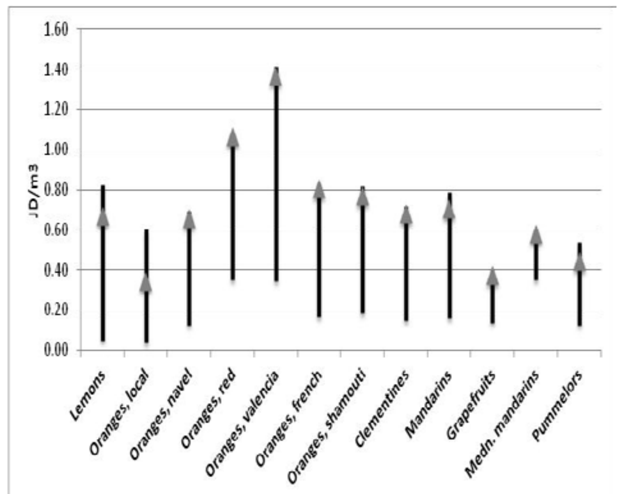


Figure 19: Variation of Water Values in Citrus fruit (JD/m³)

8.6.5. VALUE OF WATER IN CASH CROPS

In agriculture, a cash crop is a crop which is grown for profit and represents a small portion of farming areas. In Jordan cash crops are usually crops which attract demand in foreign countries and produced for export purposes.

Examples of cash crops arestrawberries, broccoli, and Brussels sprouts. The non-exported quantities find theirway to local markets. The area cultivated by strawberries in Jordan can be estimated at250 to 300 dunums in the Jordan Valley and 300 dunums in the highlands. The production can be estimated between 2,000 to 2,500 tons a year with an annual export of about 500 tons mainly to Gulf States during summer and a small portion to Western Europe during winter. Being an expensive product for the major part of the population, the local market is relatively small. To be added to the fresh market, there are some possibilities of processing. Strawberriesareconsidered as a promising crop that could be developed in Jordan for export purposes to support development of export from Jordan to Europe.

The highest water value among cash crops was found in strawberries (JD 4.29/m³) as shown Table 31. The highest water value for strawberry was in MJV (JD 4.53/m³) and the lowest was in NJV,followed by Brussels sprouts (JD 2.95/m³),ginger (JD 2.25/m³), celery (JD 2.04/m³), leek (JD 1.94/m³), and broccoli (JD 1.79/m³). The lowest return to one cubic meter was found for fennel with only (JD 1.23/m³). Figure 18 shows the water value of fruit trees in Jordan Valley and the highlands and Figure 20 shows the water value in cash crops in the Jordan Valley and the highlands.

Table 31: Computed Water Values (JD/m³) in Cash Crops in 2010

Crop	NJV	MJV	Middle HL	South HL	Average
Strawberry	4.05	4.53	4.29		4.29
Broccoli	1.87		1.85	1.67	1.79
Brussels sprouts	3.31		1.94	3.6	2.95
Fennel	1.23	1.23	1.23	1.23	1.23
Leek	1.94		1.94	1.94	1.94
Celery	2.04				2.04
Ginger	2.25			2.25	2.25

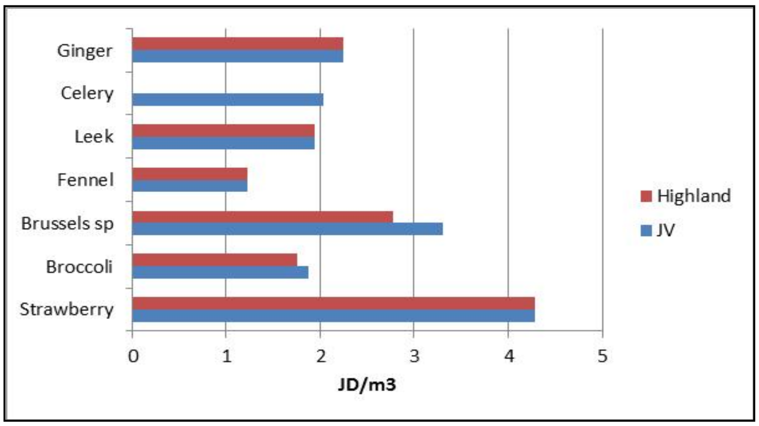


Figure 20: Water Values in the Highlands and JV Winter Vegetables

8.7. VALUE OF WATER BY WATER QUALITIES

The value of water quality can be looked at in several ways; poor water quality, for instance, can limit the crops a farmer is able to grow or reduces water use efficiency and yield (Carr et al., 2011, Majdalawi, 2003; Bazza, 2003). Therefore, water quality is multi-dimensional, as it includes concentration of certain chemicals, level of salinity, concentration of bacteria and organic matter, as well as temperature.

Fresh water is used in Northern Jordan Valley and uplands. The surface water, which appears overall to be of acceptable quality, faces important problems of salinity and bacteriological contamination of a localized nature, which, due to impacts on human health and agriculture, are of strategic significance. Regarding groundwater, evidence suggests a simultaneous trend of declining water tables and increasing salinity in most aquifers, with resulting higher extraction costs (in terms of pumping as well as accelerated well replacement). Due to the increasing problem with water shortages experienced in Jordan, the utilization of brackish water which was once not an attractive option has gained in prominence. The cost per unit of desalinated water has been dropping as advances have been made in desalination technology. Introducing innovations that could allow use of brackish or saline water in irrigation without the need for prior treatment is an attractive concept for Jordan.

Treated wastewater plays a major role in narrowing the gap between supply and demand in the agricultural sector in Jordan. In Jordan there are more than 40 wastewater treatment plants (public and private) distributed spatially all over the country. However, the one which treats a major portion of the wastewater generated in the largest two cities in Jordan, namely Amman and Zarqa, is As Samra WWTP. The effluent of As Samra WWTP for the year 2008 is estimated at 63 mcm. The effluent of As Samra WWTP is discharged to Zarqa River where it is used for restricted irrigation upstream of King Talal Dam (KTD) and for unrestricted irrigation downstream of KTD after mixing with its water. Several brackish springs have been identified in various parts of the country. Estimates of stored volumes of brackish groundwater for the major aquifers suggest huge resources, but not all of these quantities will be feasible for utilization. The main environmental concern for all desalination projects is the disposal of the brine in addition to their energy consumption.

Poor water quality can limit the crops a farmer is able to grow. Low water quality also reduces water use efficiency and thus may reduce yield but increase water use. Water quality is multi-dimensional as it includes concentration of certain chemicals, level of salinity, concentration of bacteria and organic matter, as well as temperature. The choice of which water quality indicators are meaningful depends on the activities the water is used for. For example, production of certain crops depends on salinity levels. So, if one switches from high quality to more saline water, it may imply a necessary transition between crops. In cases where the quality of water is an input of a production process one can measure it values using markets; several methods have been developed to estimate these values such as the contingent valuation method. This method consists of surveying farmers on their willingness to pay for improved water quality, and using those responses to estimate in addition to economic benefits the societal benefit of improving water quality.

Annex V shows the value added of water by qualities in field crops. The average water values for surface water isis the highest with (JD 0.36/m^3) and blended water is JD 0.29/m^3 whereas it reaches about JD0.26/m^3 for groundwater. The highest water value was for chickpeas cultivated in under irrigation in North Jordan using groundwater with a value of JD3.75/m^3. Garlic produced with blended water has higher water values compared with surface water. Nevertheless, garlic grown with groundwater has a value of JD 1.67/m^3. On the other hand, wheat produced under surface irrigation has a value of JD 0.41/m^3 compared to wheat grown using groundwater (JD 0.25/m^3).

The estimated value added of water by qualities for winter vegetable is shown in Table 32. The highest average water values for blended water is JD 1.67 /m^3, and for surface water it is(JD 1.38 JD/m^3, whereas it is the lowest for groundwater (JD 0.88/m^3). For tomatoes, the highest water value in surface water (JD 1.40/m^3), followed by blended water (JD 1.31/m^3) and the lowest is the tomato cultivated with groundwater (JD 0.53/m^3). The water values in cucumber is the highest with groundwater and blended water (JD 4.63 /m^3), but lower in surface water with JD 2.93/m^3.

For summer vegetables, surface water produces the highest water value (JD 0.75/m^3), followed byblended water (JD 0.68/m^3). The groundwater produces the lowest value of JD0.48/m^3. For summer tomato produced in Mafreq region the groundwater values is JD 0.33 /m^3 compared with JD 0.65/m^3 for surface water and JD0.54/m^3 for blended water. The value of surface water used in fruit trees is JD0.70/m^3, and for blended water isJD 0.47 /m^3. The fruit trees irrigated with groundwater has the lowest water value (JD 0.33/m^3).

Table 32: Estimated Water Value by Water Qualities

Crop	Surface Water (NJV & Safi)	Blended Water (MJV& SJV)	Groundwater (Highlands except Amman & Zarka gov.)
Field Crop	0.365	0.291	0.261
Winter Vegetables	1.387	1.678	0.879

Crop	Surface Water (NJV & Safi)	Blended Water (MJV& SJV)	Groundwater (Highlands except Amman & Zarka gov.)
Winter Tomatoes	1.403	1.313	0.534
Summer Vegetables	0.754	0.687	0.485
Summer Tomatoes	0.651	0.545	0.336
Citrus	0.782	0.462	0.205
Olive	0.387	0.282	0.312
Stone Fruits	0.544	0.475	0.368
Dates	0.203	0.231	0.187
Banana	0.621	0.639	
Total Fruits	0.695	0.468	0.338
Weighted Average	**0.864**	**0.836**	**0.395**

8.8. DIFFERENTIATE WATER VALUES BY REGION

Water values vary from region to region dependingon economic activity, climate zones, production season, soils and water qualities, in addition to many other factors. Table 33 shows the weighted average of water values in different regions. It is only a summary of previous tables. The highest water value is found in Northern governorate (Irbid, Ajloun, Jerash). The irrigated winter vegetables have a value of (2.22 JD/m^3). This might be because the winter production in these governorates falls between two peak production seasons (LH and JV production season). Therefore they receive the highest price of produce. The production in these governorates comes after theend production season of the Jordan Valley where production drops down.

However, water values in MJVhas the highest value of about(JD 1.1/m^3), Safi, and northern governorates are among the highest value of about (JD 1/m^3). NJV is half of MJV with about JD0.79/m^3. This might be because of the dominance of citrus fruits in NJV, which require a high amount of water compared with MJV where vegetables are the dominantcropping pattern. The lowest water value is found in middle governorates of Amman, Madaba, and Zarka. The water values ranges between JD0.98/m^3 for winter vegetables to the lowest of JD0.12/m^3 for irrigated olives.

Table 33: Water Value by Production Regions in Jordan

Crop group	NJV	MJV	SJV	Safi	North	North East	Middle	South	Desert	W. Avg.
Field Crop	0.40	0.33	0.26	0.28	0.30	0.33	0.24	0.20	0.22	0.27
Winter Vegetables	1.35	2.14	1.03	1.41	2.22	1.49	0.98	0.71	0.77	1.29
Summer Vegetables	0.80	0.70	0.66	0.70	1.34	0.36	0.62	0.60	0.49	0.54
Citrus	0.78	0.47	0.41	0.24	0.21	0.05	0.13	0.09	0.19	0.70
Olive	0.42	0.36	0.22	0.08	1.27	0.22	0.12	0.09	0.09	0.21
Stone Fruits	0.53	0.33	0.52	0.56	0.31	0.40	0.23	0.24	0.34	0.40
Fruits	0.72	0.38	0.51	0.54	0.88	0.30	0.14	0.10	0.27	0.35
Weighted Average	**0.79**	**1.10**	**0.61**	**1.01**	**1.04**	**0.34**	**0.29**	**0.38**	**0.37**	**0.49**

8.9. AN AGGREGATE VALUE OF IRRIGATION WATER IN JORDAN VALLEY

To get insight about water values in the Jordan Valley at aggregate level for policy recommendations, the list of the top 10 cultivated crops was chosen for further detail analysis. Table 34 shows the sorted list of the top 10crops in the Jordan Valley in terms of cultivated areas. Winter tomatoesare cultivated in about 50,000dunumsand produce 314,000 tons of which 183,000 are exported to different markets. The total value of produced tomato is about JD 35 million at farmgate price. The salaries of hired labor are estimated atJD 5.3 million. The estimated water consumption is 18.3 mcm with a water value of JD1.37/m^3; on the aggregate level, the total water use in the Jordan Valley is estimated at162 mcm. The JVA released 172.3 mcm from water system for irrigation purposes in 2010.[5] The billed water quantities are 155.81 mcm. The difference inwater quantities between our estimated level of 215 mcm based on enterprise budget and JVA data (172.3 mcm) is about 43 mcm. This difference is attributed to groundwater abstraction in the JV, which is not included in the JVA budget. Personal communications with JVA staff reported that they estimate the groundwater abstraction of 50 mcm annually from shallow aquifers, mainly brackish water. The total value of agricultural production was estimated at JD 209 million, the labor compensations are estimated with JD 32.0 million. The weighted average water value was estimated at 0.85 JD/m^3.

8.10. AN AGGREGATE VALUE OF IRRIGATION WATER IN HIGHLANDS AREAS

A water value in the highlands is twice as low as the water value in the JV. Table 35 shows the sorted list of the top 10crops in the highlands areas in Jordan in terms of cultivated areas. Olives occupy about 250,000dunums, producing 100,000 tons of olives, mainly for local market; about 60 percent are used to produce olive oils and the remaining are used for pickled olives. The olives consume about 138 mcm of water, mainly groundwater. Olives have the lowest value in terms of water value (JD 0.21/m^3).

Table 34: Main Economic Indicators for Agriculture in Jordan Valley

Crop	Planted Areas (000,du)	Production (000,ton)	Gross Output (million JD)	Labor Compen-sation (million JD)	Water Use (mcm)	Water Values (JD/m^3)	Exported Quantities (000 ton)
Tomatoes-Winter	50.4	314.0	35.2	5.2	18.3	1.3782	182.9
Eggplants-Winter	19.5	66.5	10.0	2.2	6.0	1.0005	52.9
Banana	18.4	43.6	21.0	3.4	25.0	0.6338	
Potatoes-Winter	17.7	47.0	9.8	1.8	5.9	1.0458	11.7
Squash-Winter	16.9	30.0	7.8	0.9	3.9	1.0627	23.1
Lemons	15.4	27.3	9.7	1.4	19.2	0.3822	1.9
Maize	14.2	27.7	5.6	0.8	10.4	0.2553	3.3
Clementine	13.0	24.7	6.5	1.1	16.2	0.3429	3.3
Cucumbers-Winter	12.9	116.4	27.0	4.0	4.1	4.3491	53.6
Jew's mallow	12.4	34.7	2.8	0.2	6.0	0.3097	
Other Crops	141.3	292.9	73.1	10.9	47.3	0.5377	101.0
Total	332.1	1,024.7	208.6	32.0	162.3	0.6808	433.7

[5] MWI,2010. Annual report. pages 44

The total value of products produced in the highlandswas estimated at JD 262 million by using 444 mcm of water, mainly fresh groundwater. The salaries of hired labor are estimated with JD 39.2 million. An aggregate level, the weighted average of water value was estimated at total water use in the highlandswas estimated at (0.37 JD/m³).

Table 35: Main Economic Indicators for Agriculture in Highlands areas

Crop	Planted Areas (000,du)	Production (000,ton)	Gross Output (million JD)	Labor Compen-sation (million JD)	Water Use (mcm)	Water Values (JD/m³)	Exported Quantities (000 ton)
Olives	248.0	99.1	45.6	5.5	138.212	0.2122	4.1
Clover	62.0	210.5	34.0	5.8	81.607	0.2761	0.0
Tomatoes – Summer	58.1	255.4	19.7	2.9	40.995	0.3333	114.9
Watermelons	27.8	114.9	10.5	2.3	13.204	0.4015	24.0
Tomatoes – Winter	24.9	127.5	11.3	1.7	11.257	0.5344	78.4
Potatoes – Summer	22.5	71.3	14.6	2.6	13.188	0.6833	0.8
Grapes	19.2	18.6	7.3	0.6	12.839	0.2795	1.3
Sorghum	19.2	24.4	3.0	0.4	10.985	0.1631	0.0
Apples	17.8	26.5	9.3	1.1	15.601	0.4793	0.4
Peaches	15.9	22.0	8.6	1.2	13.964	0.4091	30.6
Others crops	173.2	438.0	98.1	15.0	92.691	0.6322	67.3
Total	688.7	1,408.3	262.2	39.2	444.545	0.3667	321.7

8.11. AN AGGREGATE VALUE OF IRRIGATION WATER IN JORDAN

The weighted average of water value in Jordan was estimated atJD0.49/m³. Table 36 shows the sorted list of the top 15 crops in Jordan in term of cultivated areas. Olives occupy about 252,000dunums consume about 167 mcm, followed by tomatoes (winter and summer) with about 141,000dunums consume about 69 mcm of water. The total value of products produced in Jordan was estimated at JD 479 million by using 651 mcm of water. The salaries of hired labor are estimated with JD 72.6 million.

Table 36: Main Economic Indicators for Agriculture in Jordan.

Crop	Planted Areas (000,du)	Production (000,ton)	Gross Output (million JD)	Labor Salaries (million JD)	Water Use (mcm)	Water Values (JD/m³)	Exported Quantities (000 ton)
Olives	251.9	102.7	46.0	5.5	167.1	0.2149	4.1
Tomatoes-Win	75.2	441.5	44.3	6.6	30.7	0.9951	261.3
Tomatoes-Sum	66.0	294.0	21.7	3.2	38.2	0.3519	114.9
Clover	65.8	223.6	35.5	6.2	64.1	0.2850	0.0
Potatoes-Win	33.6	99.2	23.7	4.3	11.4	1.2452	11.7
Watermelons-Sum	30.8	127.0	14.5	3.2	14.4	0.4169	24.0
Potatoes-Sum	24.3	75.7	18.1	3.3	11.3	0.7138	0.8

Crop	Planted Areas (000,du)	Production (000,ton)	Gross Output (million JD)	Labor Salaries (million JD)	Water Use (mcm)	Water Values (JD/m³)	Exported Quantities (000 ton)
Grapes	21.4	23.6	12.0	1.0	16.1	0.3501	1.3
Sorghum	20.0	25.5	3.1	0.4	11.8	0.1622	0.0
Eggplants-Win	19.6	66.7	10.2	2.3	6.5	1.0001	52.9
Squash-Win	19.2	34.4	9.0	1.1	5.7	1.0038	23.1
Banana	18.5	43.8	21.1	3.4	25.2	0.6327	0.0
Apples	17.8	26.5	9.3	1.1	19.2	0.4793	0.4
Dates	17.1	11.2	6.7	0.7	22.5	0.2140	1.4
Other crops	339.5	837.5	203.5	30.4	158.7	0.6109	259.5
Total	1,020	2,433	478.8	72.6	602.8	0.495	755.4

8.12. WATER AND AGRICULTURAL EMPLOYMENT

Labor statistics are not consistent in Jordan, even fromthe same source. For example, Table 37 shows the distribution of hired labor in the agricultural sector in Jordan during 2000-2010. The total labor is not stable during the period. The reported figures for total agricultural labor in either 2006 or 2007 are not logical as they are inconsistent with the figures in other years. The permanent guest labor increased from 12,000 in 2000 to 25,000 in 2007 then decreased to 17,000 in 2010. This might be due to the new government regulation onorganizing the labor market. Table 38 shows that agricultural labor decreased from 32,900 in 2006 to 25,000 in 2010. This indicates that the contribution of the agricultural sector to employing manpower declined from 3.1 percent in 2006 to only 2 percent in 2010.

The Ministry of Labor indicates that migrant labor force is estimated about 298,000 employees. The total workforce in Jordan is about 1,710 thousand in 2010.[6] About 28.7 percent of the migrants labor are engaged in the agricultural sector or about 85,623 employees, most of them Egyptian labor. The source of this data is the Ministry of Labor, which is the sole government body responsible for issuing work permits. Migrant workers did not take the place of skilled Jordanian expatriates but of unskilled non-migrants who experienced professional upward mobility, leaving agriculture and moving from rural areas to the cities, and contributing to the growth of the capital, Amman.

Wahba (2012)[7] analyzes the Jordan Labor Market Panel Survey of 2010 (JLMPS 2010) which shows that Jordan is exporting high-skilled workers but importing low-skilled labor. There is evidence that immigrant workers undercut Jordanian wages. The immigrant workers are employed in low-skilled jobs in the informal sector with very little benefits or security.

The non-Jordanians do not benefit from paid vacations (almost 80 percent do not have this benefit). Non-Jordanians are employed in trade, services, construction, manufacturing and agriculture and are heavily concentrated in unskilled occupations: elementary, craft workers, services and sales workers reflecting again their low education. Thus the evidence suggests that immigrants are employed in less attractive jobs compared to natives. By comparing the median monthly wage from the primary job, suggests that immigrants earn less than on average than Jordanians. The median wage for an immigrant worker is JD 200 compared to JD 280 for Jordanian

[6] 1,235,000 employee, 176,000 unemployed, 298,000 guest migrant labor.

[7] Wahba J. (2012). Immigration, emigration and the labor market in Jordan. The Economic Research Forum (ERF).Working Paper 671. Egypt. www.erf.org.eg.

The national account statistics published by DOS[8] show that agricultural labor compensation is JD 82.6 million in 2008 for both livestock and plant sectors. The labor compensation for plant sector is JD 65.1 million in 2008. Using the enterprise budget model developed for this study the labor compensation is estimated atJD 72.6 million in 2010. Section 5.3.3 discuss the employment in the agricultural sector in Jordan. As shown in Table 5 the total hired labor force engaged in agricultural sector during 2010 was estimated at 32,100 workers

Table 37: The Distribution of Hired Labor in Agricultural Sector in Jordan, 2000-2010

	Permanent Labor		Seasonal Labor		Casual Labor		Total		Total Labor in Agr.
Year	Jordanian	Non-Jordanian	Jordanian	Non-Jordanian	Jordanian	Non-Jordanian	Jordanian	Non-Jordanian	
2000	3,034	12,104	191	803	59,982	37,867	63,207	50,774	113,981
2001	4,872	11,367	157	1,904	10,667	17,710	15,696	30,981	46,677
2002	4,781	10,788	217	590	12,847	34,828	17,845	46,206	64,051
2003	3,186	14,791	622	869	8,055	8,427	11,863	24,087	35,950
2004	3,992	21,461	134	638	28,248	19,451	32,374	41,550	73,924
2005	3,474	19,094	756	1,379	24,791	19,522	29,021	39,995	69,016
2006	2,990	24,152	1,808	4,787	57,057	51,510	61,855	80,449	142,304
2007	6,374	25,750	924	10,516	120,528	102,778	127,826	139,044	266,870
2008	2,646	17,273	470	4,113	14,830	28,367	17,946	49,753	67,699
2009	3,389	18,449	1,131	1,617	18,042	25,020	22,562	45,086	67,648
2010	4,306	17,338	1,285	854	19,089	18,483	24,680	36,675	61,355

Source: DOS, (2000-2010). Annual agricultural Statistics, Department of Statistics, Amman, Jordan.

Table 38: Employment by Current Economic Activity in 2006-2010

Year	2006	2007	2008	2009	2010
Agriculture, Hunting and Forestry	32,941	30,283	29,933	34,103	25,015
Mining and Quarrying	8,414	8,164	8,483	10,746	11,106
Manufacturing	118,739	126,379	124,348	129,524	129,131
Electricity, Gas and Water Supply	17,521	17,508	18,355	16,361	11,715
Construction	66,115	76,255	75,250	82,195	79,607
Wholesale and Retail Trade**	183,408	192,626	194,352	199,703	199,559
Hotels and Restaurants	27,437	28,796	26,722	25,617	124,192
Transport, Storage and Communications	100,740	100,603	107,795	115,571	27,354
Financial Service Provision	21,602	23,479	26,088	22,591	20,379
Real Estate, Renting and Business Activities	41,329	46,754	51,357	54,507	50,947

[8] DOS, 2010.National Account. Table 20.Compensation of Employees by Kind of Economic Activity at Current Prices, 1976-2008 (Million JD).

Year	2006	2007	2008	2009	2010
Public Administration and Defense	196,217	218,421	234,068	240,232	297,448
Education	124,073	140,514	140,249	143,317	150,145
Health and Social Work	50,753	58,192	59,525	61,208	63,169
Other Community, Social Services Activities	59,909	63,821	69,868	74,951	36,389
Employment in Private Households	3,314	5,140	3,636	6,131	5,368
Employment in an International Organization	3,336	3,512	2,673	3,764	4,425
Total	1,055,847	1,140,446	1,172,701	1,220,520	1,235,948

Source; DOS, 2011.Labor Statistics in Jordan 2006-2010.Department of Statistics.Amman, page 10-11.

8.12.1. WATER AND AGRICULTURAL EMPLOYMENT IN THE JORDAN VALLEY

One can estimate the total number of hired labor in the agricultural sector by dividing the labor compensation by annual average labor salaries. Assuming that the annual salary of workersisJD 2,400 with an average monthly salary of JD 200,the total labor compensation in 2008 is reported in national accountsatJD 82.6 million. Dividing the last number by JD 2,400 resulted in 34,416 workers in 2008. Using a similar procedure, by dividing labor compensation resulted from the enterprise budget model, one can estimate the agricultural labor engaged in each sub-sector in agriculture by region.

The total hired labor was estimated at 13,348 workers in the JV as shown in Table 39. Most of them are working in winter vegetables. This does not mean that the workers who work in winter vegetables do not work in summer vegetables, but it shows that the labor compensation of winter vegetables is JD 17.0 million, providing an employment opportunity for 7,099 workers all year round with a monthly salary of JD 200.

Figure 21 shows the relative distribution of water use in crops by employment opportunities they provide. Winter vegetables consume 28 percent of water in the JV but provide employment opportunities of 53 percent of labor in the JV and contribute 52 percent of total value added in the JV. Citrus fruit consumes about 38 percent of water in the JV but contributes to employment opportunities of about 18 percent.

Table 39: Agricultural Employment by Water Use in Jordan Valley in 2010

Crop	Planted Areas (000 du)	Value Added (MJD)	Labor Compen-sation (MJD)	Number of Laborers	Percent Distri-bution of Labor	Water Use (mcm)	Percent Distri-bution of Water	Water Value JD/m^3
Field Crops	30.6	4.9	1.4	569	4%	15,731	10%	0.316
Winter Vegetables	149.1	71.9	17.0	7,099	53%	46,237	28%	1.532
Summer Vegetables	47.7	12.8	3.4	1,415	11%	17,842	11%	0.718
Citrus Fruits	65.7	24.0	5.7	2,389	18%	32,917	20%	0.730
Olives	4.0	1.0	0.2	79	1%	2,756	2%	0.345
Stone Fruits	35.0	23.1	4.3	1,796	13%	46,824	29%	0.493
Total JV	**332.1**	**137.7**	**32.0**	**13,348**	**100%**	**162,307**	**100%**	**0.849**

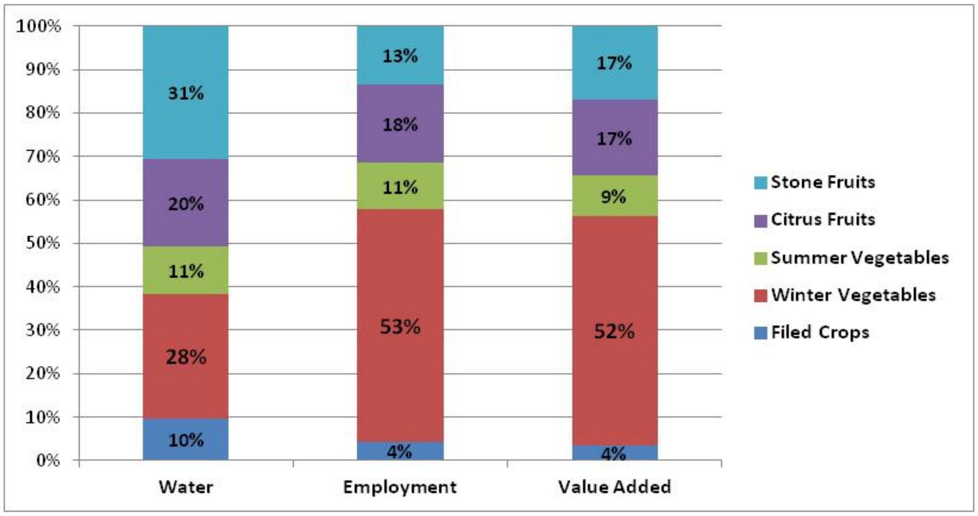


Figure 21: Relative Distribution of WaterUse and Employment in JV

8.12.2. WATER AND AGRICULTURAL EMPLOYMENT IN HIGHLANDS AREAS

The total hired labor was estimated at 16,348 workers in the highlands as shown in Table 40. The total labor compensation was estimated at JD 39.2 million. Most of them are working in summer vegetables. The labor compensation of summer vegetables is JD 15.6 million providing an employment opportunity for 6,483 workers allyear round with an average monthly salary of JD 200 and consuming about 100 mcm of water.

Figure 22shows the relative distribution of water use in crops by employment opportunities they provide. Summer vegetables consume 23 percent of water in the highlands but provide employment opportunities of 40 percent of labor and contribute with 34 percent of total value added in the highlands. Olive trees consume about 31 percent of water in the highlands but contribute to employment opportunities of only about 14 percent.

Table 40: Agricultural Employment by Water Use in the Highlands, 2010

Crop	Planted Areas (000 du)	Value Added (MJD)	Labor Compen-sation (MJD)	Number of Laborers	Percent Distribu-tion of Labor	Water Use (mcm)	Percent Distri-bution of Water	Water Value (JD/m3)
Field Crops	95.0	26.2	6.4	2,681	16%	97.4	22%	0.258
Winter Vegetables	74.8	29.6	7.1	2,938	18%	31.2	7%	0.966
Summer Vegetables	179.3	56.1	15.6	6,483	40%	100.1	23%	0.523
Citrus Fruits	2.3	0.4	0.1	38	0%	2.4	1%	0.180
Olives	248.0	27.4	5.5	2,282	14%	138.2	31%	0.212
Stone Fruits	89.3	25.3	4.6	1,927	12%	75.3	17%	0.342
Total HL	**688.7**	**165.1**	**39.2**	**16,348**	**100%**	**444.5**	**100%**	**0.367**

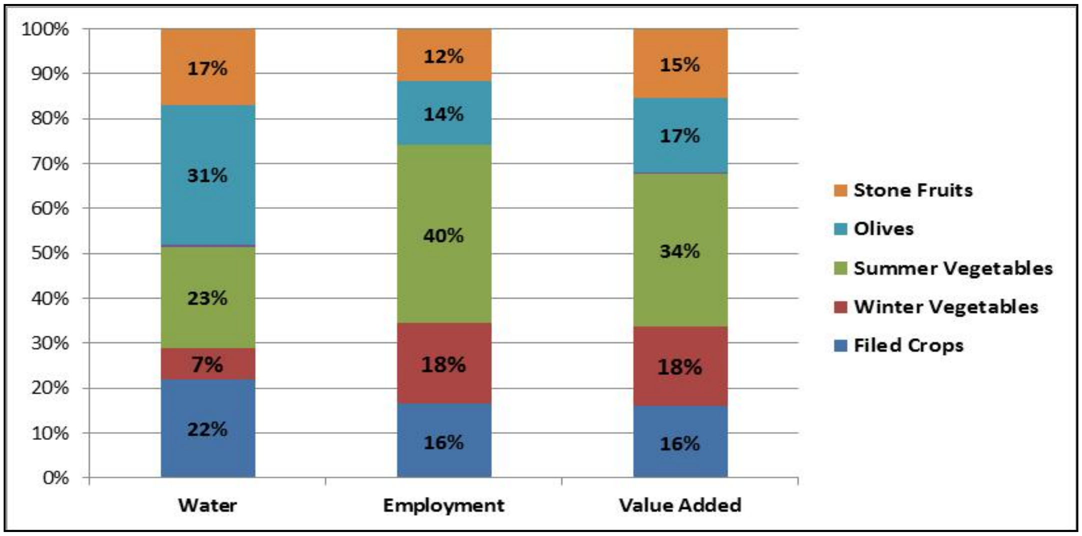


Figure 22: Relative Distribution of WaterUse and Employment in Highlands Areas

8.12.3. WATER AND AGRICULTURAL EMPLOYMENT IN JORDAN

Based on the enterprise budget model developed in this study the total hired labor was estimated at 30,255 workers in Jordan, as shown in Table 41. The total labor compensation was estimated at JD 72.6 million in 2010. The national account published by DOS indicates that the labor compensation for the plant sector wasJD 65.1 million in 2008 with an annual increase of about JD 5 million from last year 2007. As shown in Table 5, the total hired labor force engaged in agricultural sector reported by DOS during 2010 was estimated at32,100 workers. The above discussion indicates that the enterprise budget model can be used with confidence as a simulation model for agriculture employment in Jordan.

The result indicates that most agricultural workers (61 percent) are working in winter and summer vegetables. The labor compensation of vegetables is JD 44.1 million providing an employment opportunity for 18,379 workers.

Figure 23 shows the relative distribution of water use in crops by employment opportunities they provide. Vegetables consume 33 percent of water in but provideemployment opportunities of 61 percent of labor and contribute with 56 percent of total value added in Jordan. Fruit trees consume about 48 percent of water in but it contributes to employment opportunities is only 28 percent.

Table 41: Agricultural Employment by Water Use in Jordan, 2010

Crop	Planted Areas (000 du)	Value Added (MJD)	Labor Compen-sation (MJD)	Number of Laborers	Percent Distri-bution of Labor	Water Use (mcm)	Percent Distri-bution of Water	Water Value JD/m³
Filed Crops	125.6	30.8	7.9	3,281	11%	116,755	19%	0.27
Winter Vegetables	223.9	101.2	24.0	10,011	33%	78,917	13%	1.29
Summer Vegetables	227.0	72.7	20.1	8,368	28%	118,600	20%	0.54
Citrus Fruits	68.0	25.7	6.1	2,521	8%	35,134	6%	0.70
Olives	251.9	27.6	5.5	2,298	8%	131,806	22%	0.21
Stone Fruits	124.4	49.2	9.1	3,777	12%	121,659	20%	0.40
Jordan	**1,020.7**	**307.2**	**72.6**	**30,255**	**100%**	**602,872**	**100%**	**0.49**

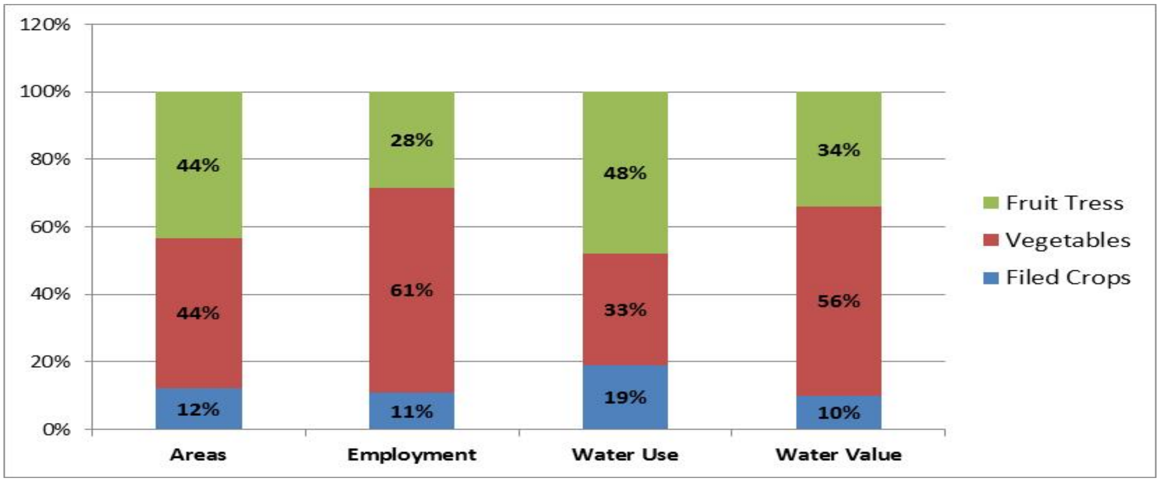


Figure 23: Relative Distribution of WaterUse and Employment in Highlands Areas

In summary, there is a noticeable lack of motives and involvement of the youth (men and women) in agriculture. A significant proportion of the Jordanian agricultural labor force is migrant foreigners. This is a matter of great concern that impacts on the social strength as well as the food security of the nation, and must be addressed through a multi-pronged and concertedeffort of the highest decision makers through specific policy initiatives.

There are many reasons that youth employment in agriculture is very challenging to address. The problem stems from a number of different reasons and so there is no simple way or sole program or strategy that can be the answer. The most important root causes are: (i) many young peopleplace little or no value in field work, especially university graduates, who think that they should not be engaged on manual tasks; (ii) with the declinein family labor, the youth and especially the women are losing the traditional farming knowledge and are not culturally motivated to travel to work in remote farms and field works compared to foreign labor, who are involved mainly in these physically demanding works; (iii) compared to other types of employment, agricultural jobs do not seem to reward for the hard physical labor, they lack compensation for travelling to other locations, and do not offer insurance and pensions whereas the unemployed receive social security compensations; (iv) there is an absence of awareness of attractive agricultural employment opportunities as well as training facilities, and; (v) youth are reluctant to work on family farms because of land fragmentation, low return, and poor incentives in the predominantly subsistence agriculture in the rainfed areas.

9. RESULTS AND FINDINGS: VALUE CHAIN ANALYSIS

Commodity chain analysis is used to refer to the overall group of economic agents (or the relevant activities of those agents) that contribute directly to the determination of a final product. Thus, the chain encompasses the complete sequence of operations which, starting from the raw material, or an intermediate product, finishes downstream, after several stages of transformation or increases in value, at one or several final products at the level of the consumer. More precisely, the term "chain of traditional agricultural commodities" is used to mean the group of agents that contribute directly to the production, then to the transformation and delivery to the final market of a single commodity. The commodity chain analysis aims at describing the commodity chain, type of actors, and their roles; identifying the potential for improving the chain to increase market shares in domestic and export markets, and identify new markets.

9.1. JORDANIAN HORTICULTURAL EXPORT COMPETITIVENESS

Jordan is one of the leading countries inthe region in horticultural exports to traditional Arabian Gulf countries and to some EU countries. Total exports amounted to JD 4,217 million whereas agricultural exports amounted to JD 621 million (15 percent of total exports). The value of vegetable exports amounted to JD 324 million (63 percent of total agricultural exports or 7.4 percent of total export) in 2010 (CBJ, 2012). However, total volume of horticultural exports amounted to a record figure in 2010 which is 755,000 tons, of which 685,000 tons are vegetables and 69,000 tons are fruits (DOS, 2011). Total agricultural production of vegetables in 2010 amounted to 2,568,000 tons of which 318,000 tons EW field crops. The vegetables production amounted to 1,790,000 tons of which winter-vegetables amounted to 932,000 tons and summer-vegetables amounted to 858,000 tons,while the production of fruits amounted to 460,000 tons, of which one-third is olives. In other words, the vegetable exports in 2010 represented 38 percent of Jordan's production of vegetables, while fruits exports constituted only 15 percent of the national production of fruits (CBJ, 2011).

Vegetables exports represented about 7.4 percent of total domestic export. The main destinations of most of these exports are United Arab Emirates, Kuwait, Bahrain, Syria, Lebanon, Qatar, and Oman, as shown in Table 42. In contrast to the sophisticated markets in the EU, these destinations do not have high quality and packaging requirements. In the last two years, vegetable and fruit exports have jumped and together they represent almost 70 percent of total agricultural exports. This indicates that there is a high potential for increasing horticultural exports. This potential can be realized in the future dependingon tackling major obstacles related to water quantity and quality. Expanding horticultural exports requires the availability of additional water resources of high quality to meet sanitary requirements such as the Global Gap and SPS regulations.

The food industries represented 12 percent of the value added, and 20 percent of the total labor in 2009 (DOS, 2010), and 12 percent of the value added and 16.4 percent of compensation of employees in 2009. Food industries arebasically flour milling and bakeries, dairy products, cooking oil, meat products, chocolate and sugar confectionery, canning and preserving food products, juices, and tomato pastes.

Table 42: Exported Quantities of Jordanian Vegetables in 2011 by Market Destination

Country	Tomatoes	Cucumbers	Eggplant	Sweet & Hot Pepper	Squash	Cauliflower	Lettuce
Bahrain	17,502	2,010	1,001	1,999	1,397	1,755	1,621
Iraq	88,116	67,291	20,086	3,654			20
Kuwait	37,925	0.876	2,184	4,176	3,145	4,245	3,818
Lebanon	10,073	2,519	2,327		1,751		138
Oman	16,484	319		1,360	1,037	2,194	1,381
Qatar	32,200	1,400	1,737	3,666	1,922	3,409	3,013
Syria	122,401	25,663	35,562	2,629	12,907		741
UAE	94,314	2,269	1,261	5,472	5,447	13,701	12,093
Turkey			556				
Russia		12,655					
British					837		
Germany					90		
Hungarian				3,218			
Romania				4,475			
KSA							20
Total	433,85	124,096	65,164	33,867	28,753	25,346	22,809
Export Value (MJD)	160	71	26	24	15	12	5

Jordanian agricultural production, including those destined for export, does not receive any incentives except the price of irrigation water and the cost of pumping, and the willingness to ban exports temporarily in the face of perceived scarcities on the domestic market. Extra costs on the production and marketing chain are imposed in the form of requirements to use municipal markets, even in the case of exports and even when direct sales to retailers could be made by farmers or farmer organizations.

Current import tariff policy encourages resource allocation to crops that represent inefficient uses of water, in terms of income generated per cubic meter of irrigation water: bananas, apples, and oranges. In addition, at least in the case of apples and oranges, it is clear that Jordan does not have a comparative advantage in production. (Syria produces oranges and apples of equal or higher quality at a much lower price.)

In the marketing area, the problem of a "weak marketing system and its failure to direct production towards demand," The National Strategy for Agricultural Development recommendations are limited to concluding bilateral agreements for market opening without addressing regulations requiring all sales, including exports, to go through municipal markets paying a 4 percent municipal sales tax, a 4 percent market tax, a 5 percent commission agent fee, and a sales tax on the commission of 16 percent of it. This requirement also affects producers who wish to sell directly to retailers.

Government policies have long considered marketing only as a supplementary service for production despite the fact that marketing starts before production, its creation of greater economic benefits, and its importance in determining economic returns. Most policies have focused on developing production, which resulted in over-supply of some products, and wasting large quantities of horticultural produce because of imbalance between supply and demand. The lack of organized production plans and weak farmer organizations also adds to the problem of poor marketing. The marketing infrastructure suffers from clear weaknesses, especially in the fruit and vegetable sectors. Fruit and vegetable wholesale markets do not represent real markets, with the exception of the one in Amman, which still lacks the essentials of supply and demand data for price formation.

Infrastructure for post-harvest operations also suffers from shortages in the areas of pre-cooling, grading, packaging, refrigerated transport and storage, and processing of products. There is an absence of technical support to small farmers groups (farmers' organizations)to enhance their production capacities and to enhance vertical integration along the food supply chain (e.g. cooperatives that are capable to acquire cold chains, packaging facilities) which could significantly increase value to the sector.

Significant weaknesses also exist in the provision of marketing support services, including market research, agricultural extension services, market information, and to a lesser extent, in the area of financing. There are few policies for direct economic market intervention; those that exist are characterized by their temporary nature and instability, such as in the case of protecting local production, or by the unsuitability of the mechanism used for their objectives, such as in the subsidies provided to sheep and goat breeders. It is recommended to have a comprehensive marketing policy to address all the gaps previously mentioned.

9.2. VALUE OF WATER IN TOMATOES BY VALUE CHAIN

The main vegetable crops produced in Jordan are tomatoes, cucumbers, eggplants, squash, and potatoes. Tomatoes are produced in three main production areas(Safi, JV and Mafreq) as shown in Figure 24, the Jordan Valley, which is a winter crop area, and the uplands, which produce summer crops. Harvest in the Jordan Valley starts in early December and continues until May of the following year.

In upland areas, such as the Mafreq and Amman-Zarqa Basin, harvest begins in May and continues through October. The wide variation in climatic conditions between the Jordan Valley and the uplands allows agricultural production in Jordan to continue almost all year round, which is considered a major advantage to the country.

Tomatoes are planted in Jordan throughout the year with different varieties; it represents about 30 percent of the whole area planted with vegetables and its production represents about 41 percent of the whole vegetable production in Jordan.

Figure 24 shows that tomatoes are mainly produced in threedifferent geographical locations in Jordan allyear round. Early winter tomatoes in November and December are produced in South Jordan Rift Valley (Safi Areas, then the beginning of January start the production from South Jordan Valley (North Dead Sea), a month later production begins in Middle JV and a month later production begins in North JV. Beginning inMay, the highlands start to produce tomatoes, intersecting with tomatoes produced in the JV.

This intersection extends about three months, leading to a reduction in thefarmgate and wholesale price of tomatoes, as shown in Figure 25. However, one can notice that tomatoes are available over the whole year. In spite of the fact that these marketing channels are short and the low level of services that the middlemen can provide, one can see that the marketing margins are relatively high, which makes the difference between the farmgate price and the consumer price high.

The farmgate price is considered as one of the most important measures for determining the value of agricultural return in addition to the prices of agricultural inputs and the marketing costs, costs of uploading, transportation costs and market costs, which can reach about 31 percent of the selling price in the retailers markets. This can be clearly presented in the high profits achieved by the middlemen at the account of farmers and consumers and to the increase in the post-harvest losses, which shows clearly a low efficiency in the marketing system.

Figure 25 also shows that the highest wholesale price in during September whiles the lowest one is during June-July. However Figure 26 shows average monthly prices for tomatoes during the year 2010.

On the other hand, Jordan exports 434,000 tons of tomatoes, mainly to Syria, UAE, and Iraq. The neighboring market occupies 50 percent of tomatoes export as shown inFigure 27. The tomatoesexported to EU amounted to 5.6 thousand tons, of which 3,300 tons were exported to Romania, and about 1,100 tons to the former Soviet Union.

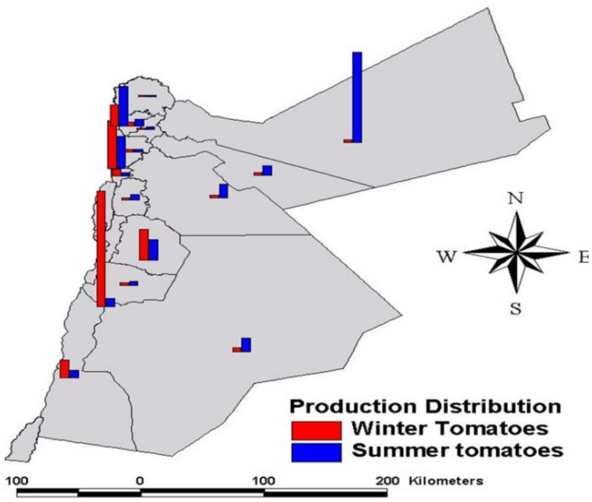


Figure 24: Main Production Locations of Winter and Summer Tomatoes

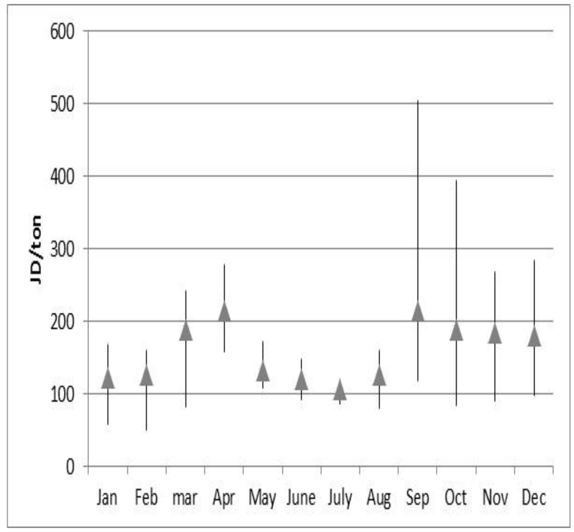


Figure 25: Long-term Average of Farmgate Price of Tomatoes in Jordan

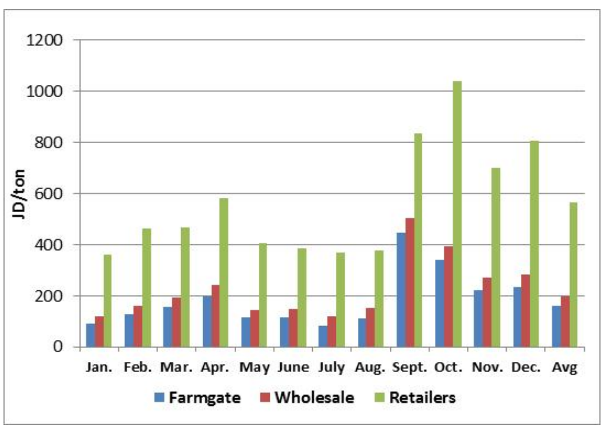


Figure 26: Farmgate, Wholesale, and Retailers'Price of Tomatoes in Jordan during 2010

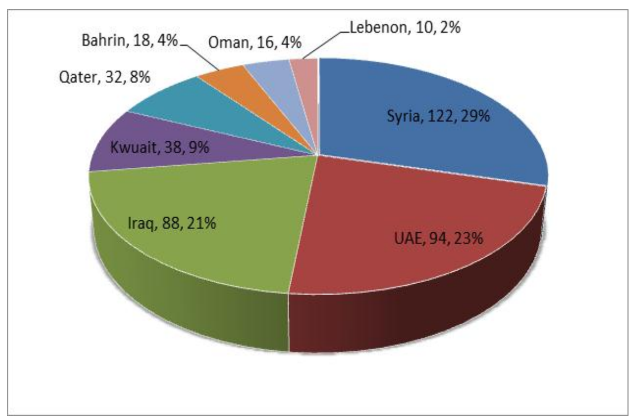


Figure 27: Quantities of Exported Tomatoes in Thousand Tons by Market in 2011

The production costs in value chains are calculated by aggregating costs incurred by enterprises in each segment of the chain. A further step in calculating production costs relates to each function within the chain. These costs will be broken down to account separately for all activities required to transfer the produce from farm to consumer or to export market, including storing, grading, transport, packing, marketing, and distribution operations.

The result of value chain analysis for tomatoes produced in the Jordan Valley shows that tomatoes do not generate a significant value added when exported to neighboring countries. The finding contradicts not only comparative advantages theory but also resources sustainability logic. Exporting tomatoes generates lessvalue added compared to local markets. This conclusion is derived from the large volume of exports of tomatoes during the peak production season, which is in excess of the local market needs. Exporting thus occurs when the product is priced lowest and merely as a means to offload excess product to avoid marketing bottlenecks.

The individual results of value added for each agent in the value chain analysis for tomatoes is shown in Figure 28. Farmers' value added is about JD 79/ton for farmers and retailers. The value added by exporters to Eastern Europe reached about JD 814/ton. The total value added for local and export market is shown in Figure 29. The value added to neighboring countries and the Gulf market is lower than the local market (JD 460/ton). The highest value added is in the export market to Western Europe, which amounted to JD 909/ton compared to JD 308/ton to neighboring markets and JD 414/ton for the Gulf market.

The incremental increases in value addition for each stage along the chain are divided by water quantities consumed to reach the commodity to local consumers or export market. The values added in each step in the value chain were divided into the corresponding water quantities used in the whole production process per ton of produced product. Table 43 show the water value added per one cubic meter for individual stakeholders in the value chain for tomatoes by production season and production locations. The highest water value is in winter tomatoes produced in the JV for export to the eastern Europe market, the value added per m^3 is JD1.36 /m^3 at the farm level, the wholesalers value added is JD0.28 /m^3, the retailers value added in local market is four timesthe value added by famers (JD 6.26 /m^3). Exporting tomatoes to neighboring market (Lebanon, Syria, and Iraq) have a low contribution to value added with only JD3.6/m^3. For tomatoes exported to the Gulf market the value added by exporters is JD5.47/m^3. Furthermore, if tomatoes are exported to Eastern Europe markets, the value added by exporters is the highest (JD 13.9/m^3).

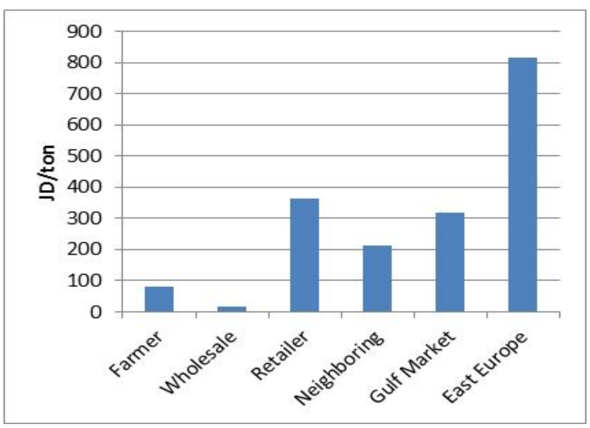


Figure 28: Value Added by Individual Agent in Marketing Channel (JD/ton) for Tomatoes in JRV

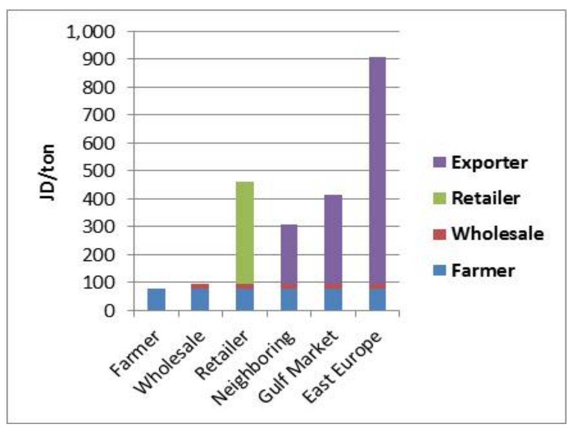


Figure 29: Value Added through Marketing Channel by Final Destination Market (JD/ton) for Tomatoes in JRV

The total value added for each final market is the value added at farm level, plus the value added by wholesalers in addition to value added by retailers or exporters. The highest value added is for winter vegetables produced in the JV. The total value added in the local market is JD7.9 /m^3. The lowest is for summer tomatoes produced in the highlandsat JD 3.6 /m^3.

In the case of exporting tomatoes, the highest value added is in winter tomatoes exported to the Eastern Europe market, which was estimated atJD15.6 /m³. Exporting summer tomatoes for the Eastern European market from the highlands using groundwater yields the lowest water value added at JD5.8 /m³. Furthermore, exporting tomatoes to neighboring markets (JD 2.0/m³) or the Gulf market (JD 2.7/m³) does not justify using of scarce water resources in the highlands to produce a product with low water value added through the value chain.

Figure 30 shows the contribution of individual stakeholders in value chain in water values for tomato produced in Jordan Valley and the highlands. It clearly shows the low contribution of farmers in the value chain compared with local retailers or exporters. Figure 31 shows the total water values in tomatoes according to market destination. The highest value is for European market, local market rankssecond. The analysis shows that exporting tomatoes to the Arab market in general relieson excess of local markets.

Table 43: Water Value by Individual Agent in Marketing Channel (JD/m³) for Tomatoes in JRV and the Highlands by Season

	Jordan Valley		Highlands	
	Winter	Summer	Winter	Summer
Farmer	1.36	0.54	0.71	0.34
Wholesale	0.28	0.18	0.17	0.16
Retailer, Local Market	6.26	5.56	4.41	3.13
Neighboring Market	3.65	2.78	2.68	1.55
Gulf Market	5.47	3.92	3.88	2.21
Eastern Europe market	13.99	9.28	9.49	5.30

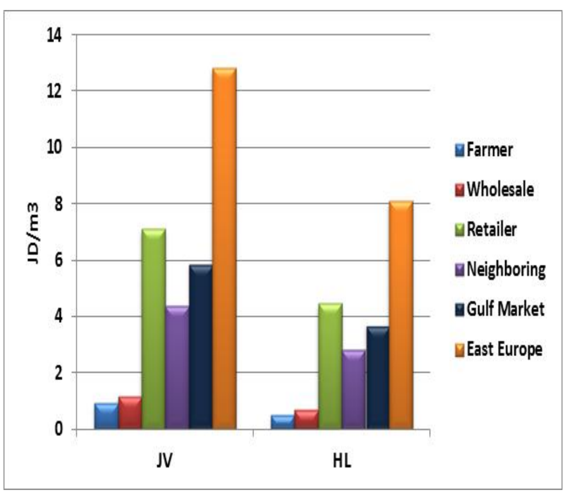


Figure 30: Value of Water (JD/m³) by Individual Stakeholder in Value Chain for Tomatoes

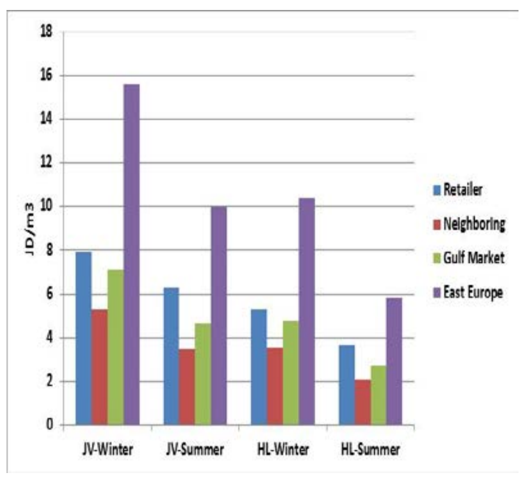


Figure 31: Total Value of Water (JD/m³) in Value Chain for Tomatoes by Market Destination

9.3. VALUE OF WATER IN DATE BY VALUE CHAIN

The commercial cultivation of date palm trees in Jordan is considered new, but it increased over the past 10years; it isalso a successful sector in many regions in Jordan especially in the Jordan Valley. The most important varieties of date palms grown in Jordan are Medjool and Barhi, which constitute about 85 percent of the cultivated varieties – the most demandedvarieties internationally and globally.

The cultivated areas increased over the past 10years; the cultivated areas with date palms is about 17,000 dunums in 2010 compared to 2,100 dunums in 1995. This sector is considered a small sector and it is concentrated in the Jordan Valley in the first place with about 10,000 dunums and the Aqaba about 4,000 dunums. These two areas accounted for 85 percent, the rest (i.e. 15 percent) are planted in the following areas: Al-Azraq area, Zarqa and the southern Jordan Valley area and other areas.

Since this crop can tolerate drought and salinity. Jordan imported dates mostly from Saudi Arabia, Iraq, and the Gulf States, while it exported dates to many European and Arab countries. According to the Ministry of Agriculture statistics, the total imports and exports in 2009 amounted to 9,700 tons, and 1,900 tons, respectively. In the Jordan Valley date palm cultivation is concentrated in Deir Alla, where the number of bearing trees is 62,348 within an area of 4,600dunums, and the production was3,390.50 tons in 2010. The area planted with dates palm trees in Deir Alla and occupies the highest percentage is 45.4 percent of the total area planted with dates palm trees in the Jordan Valley.

Dates in the wholesale market are distributed to more than one destination, but most of dates go to retailers (73.3 percent). The retailers are divided into two types:groceries and supermarkets and vegetables and fruit shops. The other dates go to exporters (only 26.7 percent).

Purchasing and selling prices varies according to variety; moreover,prices of different varieties vary according to region. The average purchasing and selling prices of Barhi variety (Tamr) are JD 2.20/kg and JD 2.80/kg respectively, while Barhi variety (Rutab, Balah) average purchasing and selling prices or JD 0.95/kg and JD 1.15/kg. The average purchasing and selling prices of paste dates are JD 0.95/kg and JD 1.20/kg respectively;Khodari variety average purchasing and selling prices are JD 2.30 kg and JD 2.70/kg respectively

Usually, the dates are exported either directly from the farms or through food exporting companies. These companies purchase the dates from the farms directly or from the wholesale market. A small percentage of exported dates (26.7 percent) is exported through exporters, while the rest (73.3 percent) is exported directly from the farm. Dates are exported to the Arab countries, especially the Gulf States, and also to foreign countries.especially Europe. Table 43 shows the water value added per one cubic meter for individual stakeholders in the value chain for dates by locations. The highest water value is in winter dates produced in the JV for export to Western European markets – the value added per m^3 is JD 0.39 /m^3 at the farm level, the wholesalers value added is JD 0.23 /m^3, the retailers value added in local market is more than twice the value added by famers (JD 0.99 /m^3). Exporting dates to neighboring markets has a value added of JD1.44 /m^3. Fordates exported to the Gulf market, the value added by exporters isJD 1.64 /m^3. Furthermore, if datesareexported to Western European markets, the value added by exporters is the highest (JD 3.63/m^3). The total value added in local market is JD1.6/m^3. Figure 32 shows the total water values in dates according to market destination. The highest value is for European markets, with local markets ranking second. The analysis shows that exporting dates to Arab markets in general relieson the excess of local market. Figure 33 shows the contribution of individual stakeholders in value chain in water values for dates produced in the Jordan Valley and the highlands. It clearly shows the low contribution of farmers in the value chain compared with local retailers or exporters. The high water value is gained by exporting date to western markets.

Table 44: Water Value by Individual Stakeholder in Marketing Channel (JD/m^3) for Dates in JRV and the Highlands

Market Destination	Jordan Valley	Highlands
Farmer	0.39	0.26
Wholesale	0.23	0.14

Market Destination	Jordan Valley	Highlands
Retailer, Local market	0.99	0.11
Neighboring market	1.44	0.42
Gulf Market	1.643	0.268
Western Europe market	3.631	1.347

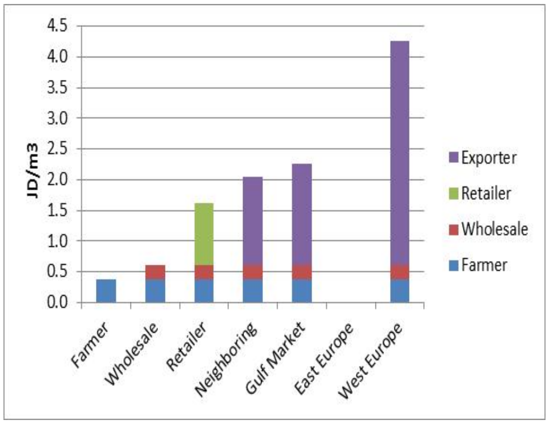


Figure 32: Total Value Added in Value Chain by Market Destination (JD/m³) for Dates in JV

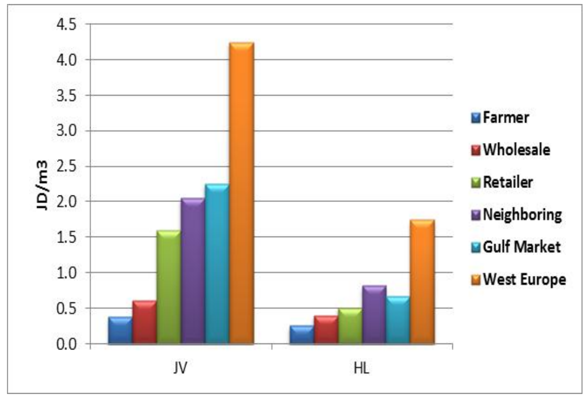


Figure 33: Total of Value of Water (JD/m³) in Value Chain for Dates in JV and the Highlands

9.4. VALUE OF WATER IN MEDJOOL DATE VARIETY BY VALUE CHAIN

The Medjool date palm is also the kind of palm tree found lining avenues in hot, dry climates. The appropriate growing conditions mean hot, sunny, and less humid and with a good, steady supply of water to the roots. It is also known as the "King of Dates," due to its rich taste, size, and texture. It is marketed as a semi-dried fruit. A large, oval-shaped, soft date, with a meaty fruit, fruit length is 3.7 cm, and diameter is 2-3 cm, and fruit weight between 20 - 34 g. There are three sizes: jumbo, large, and medium (fancy). There is not really a specific quality standard for Medjool. It normally has its best degree of maturity and full flavor when it turns dark brown, almost black, and is soft to the touch.

The Medjool variety accounts for 43.3 percent of cultivated dates in Jordan Valley. Only 55 farmers have grading and packing lines. The highest percentage of the Medjool variety sales are sent to the wholesale market (52 percent), then to exporters and retailers.

Medjool dates are exported to European countries and some Arab countries. In Europe, Medjool dates have been known since the early 1990s and it is only in the last three to four years that they have really taken off atapproximately 1,800 tons per year. In the coming years, it could be a major product in the range of dates on offer. The exported quantities of Medjool variety are divided equally between the Arab countries and foreign countries. On the other hand, the quantities of exported dates to the European market wereabout 146 tons in 2010.

Dates prices vary according to variety, grade, quality, and destination. The Medjool variety varies in prices; its farmgate price is JD 3.50/kg, the price at the wholesale market ranges between JD 4-8/kg and its average price is JD 5-6/kg for the second and third class, the average price charged by retailers isJD 8/kg, the exporting prices are the highest with JD 12/kg. in some cases, with an average price of JD 8 /kg.

In the European markets, the date prices vary depending on the origin, the manufacturer, the size, and the means of transport. While in the UK the CIF price was €6.37/kg.,in Germany and France, the price of the second type of Medjool was €6.18/kg and 6.86/kg respectively. The CIF price of jumbo type ranged between Euro €10-14/kg. The first limit on the development of Medjool stems from the low quantities currently produced. The direct consequence of this small volume of supply is the high price of the product, which, after the succession of margins applied to it within the distribution system and to which taxes are to be added, reaches the consumer at €15 or 18 per kilo.

The challenge for Jordanian producers/exporters is the penetration on the European market. In order to penetrate in the European market, Jordanian producers/exporters have to deal with some problems that prevented the increase of Jordanian date exports and, often, have been the cause of rejections at the import stage.

The main problems are the weakness in identifying demand as well as weakness in fulfilling sophisticated market needs of the European markets. In fact, Jordanian producers/exporters did not successfully exploited European markets because of the lack of efficient export control and lack of knowledge about certification documents and procedures, information and communication.

The enterprise budget for the jumbo type of Medjool date was prepared as shown in Table 45:the estimated gross output, intermediate consumption and fixed costs, net income, and break-even figures on an annual basis for crop. The information in an enterprise budget can be organized in different ways but it typically includes sections on gross income, variable costs, fixed costs, and net income above selected costs.

Gross income consists of the level of output and price per unit of output. Variable costs depend on the level of output produced. They include items such as fertilizer, fuel, lubricants, chemicals for weed, disease and insect control, purchased services, and others. Water cost was excluded in order to quantify water value added.

Fixed costs are those costs incurred regardless of whether or not output is produced. Building and machinery fixed costs include depreciation and interest on average investment. Land is an important input and should be valued. If someone owns the land, he or she should charge an opportunity cost against the land.

Table 45: Enterprise Budget for Dates (Medjool Varieties, Jumbo Type)

Production	Yield (ton/du)	1.149
	Farm Gate Price (JD/ton)	3,500
Gross Output	Total Return (JD/Dunum)	4,023
	Tillage, Land Preparation	10
	Fertilizer	125
	Manure	60
	Pesticide	25
	Fuels	30
	Plant Husbandry material	50
	Miscellaneous	40
Intermediate Consumption	Total Intermediate Consumption (JD)	340.0
	Gross Value added (JD/du)	3,683.2
Labor Compensation	Labor (JD/du)	213.8

Production	Yield (ton/du)	1.149
	B. Fixed Cost	
	Land Rent	84.0
	Capital interest @5%	40.7
	Depreciation of Irrigation Network(JD)	80.0
	Depreciation of Seedling Investment (JD)	60.0
	Asset Depreciation (JD)	149.1
Capital Costs	Total Fixed Costs (JD/du)	413.8
Water Cost	CWR m^3/du	817.9
	Water Price JD/m^3	0.030
	Water Cost JD/du	24.5
Financial Feasibility	Total Cost (JD/du) with Water	992.2
	Total Cost (JD/Dunum) without water	967.6
	Net Profit (JD/Dunum) with Water	3031.0
	Gross Value added (JD/du)	3683.2
	Net Value Added (JD/du)	3269.3
	Operation Surplus (JD/du)	3055.5
Water Values indicators	Water content (m^3/ton)	711.51
	Water Efficiency (ton/m^3)	0.0014
	Gross Output (JD/m^3)	4.9191
	Gross Value added (JD/m3)	4.5034
	Net Value Added (JD/m^3)	4.2419
	Operation Surplus (JD/m^3)	3.7360
	Percent of Water Cost	2.47%

Table 46 shows the water value added per one cubic meter for individual agents in the value chain for jumbo dates. The value added per m^3 is JD4.5 /m^3 at the farm level, the wholesalers value added is JD2.67 /m^3, the retailers value added in local market is JD3.25 /m^3. Exporting dates to neighboring markets has a value added of JD3.25 /m^3. For the jumbo date exported to Gulf market the value added by exporters is JD5.20/m^3. Furthermore, if jumbo datesare exported to Western Europe markets, the value added by exporters is the highest (JD 6.56 /m^3). The total value added in local markets is JD10.59/m^3.

Figure **34** shows the total water values in dates according to market destination. The highest value is for European markets, with Gulf markets ranking second. Table 47 shows the contribution of individual stakeholders in the value chain in water values for medjool dates produced in the Jordan Valley. It clearly shows the high contribution of farmers in the value chain. The high water value is gained by exporting date to western markets.

Table 46: Value Chain analysis for Medjool Dates (Jumbo) in Jordan

	Wholesale Market	Local Market	Neigh-boring Market	Gulf Market	Western Europe Market	Rest of World Market
Purchasing Price (JD/ton)	3,500	6,000	6,000	6,000	6,000	6,000

	Wholesale Market	Local Market	Neigh-boring Market	Gulf Market	Western Europe Market	Rest of World Market
Washing, Grading	20	5	30	30	40	30
Pre-cooling, Packing	25	10	20	70	130	90
Sorting & Loading	5	10	10	10	100	50
Losses	10	55	30	40	60	60
Transportation, cooling	10	20	100	150	1000	750
Total Transaction cost	70	100	190	300	1330	980
Selling Price	6,000	8,000	8,500	10,000	12,000	10,000
Value Added JD/ton	2,430	1,900	2,310	3,700	4,670	3,020
Water content (m3/ton)	711.5	711.5	711.5	711.5	711.5	711.5
Water Value Added (JD/m^3)	3.42	2.67	3.25	5.20	6.56	4.24

Table 47: Total Value Added of Medjool Dates (Jumbo) by Market Destination

	Local Market	Neighboring Market	Gulf Market	Western Europe Market	Rest of World Market
Farmer	4.50	4.50	4.50	4.50	4.50
Wholesaler	3.42	3.42	3.42	3.42	3.42
Retailer/Exporter	2.67	3.25	5.20	6.56	4.24
Total Value Added	10.59	11.17	13.12	14.48	12.16

Figure 34: Total Value Added of Medjool Dates (Jumbo) by Market Destination

9.5. VALUE OF WATER IN STRAWBERRY BY VALUE CHAIN

Strawberries have been produced ona significant scale in Jordan for 25 years. Before1986, when Jordan University farm launched strawberryproduction in Jordan, it was almost unknown in the country. The market expanded slowly and attracted some other growers to begin production in the Middle Jordan Valley. Jordan strawberry production is now counts some 25-30 growers all around the country (Jordan Valley and the highlands). The area cultivated by strawberry in Jordan can be estimated to 250 to 300 dunums in the Jordan Valley and 300 dunums in the highlands.

The production can be estimated between 2,000 to 25,00 tons a year with an annual export of about 500 tons, mainly to Gulf States during summer and a small portion to Western Europe during winter. The main exported strawberries come from the Northern Jordan Valley during December, January, and February. The highlands production is marketed partly in Jordan and partly in the Gulf area. The production is centralized in spring between March and May, mainly coming from the Jordan Valley. Duringthe peak period, the prices collapse to aroundJD 1/kg in the local market, whereas they are about JD 3 or 4/kg in low production periods.

Strawberries are considered promising, and could be developed in Jordan for export purposes to support the development of exports from Jordan to Europe. There are several strawberry production systems in Jordan:

- Early production from the Jordan Valley from November to March
- Late production from the Jordan Valley from the end of January to April
- Late production from the highlandsfrom March to May
- Continuous production from the highlands with day-neutral varieties, based on a two-year production cycle
- Soilless production planned to supply the market during low production period (mainly autumn)

The results of individual value added for each agent in the value chain analysis for strawberriesareshown in Figure 35. Farmers' value added is about JD 800/tons for farmers and retailers. The value added by exporters to East Europe reached about JD 880/tons. The total value added for local and export markets is shown in Figure 36. The value added to neighboring markets and the Gulf market is lower than the local market. The highest value added is in the export market to Western Europe. The total value added for Western Europe is about JD 1,848/tons compared to JD 1,093/tons for Eastern Europe and JD 1,042/tons for markets in theGulf.

Table 48shows the water value added per one cubic meter for individual stakeholders in the value chain for strawberries by production in the JV and the highlands. The highest water value is in winter strawberries produced in the JV for export to the Western Europe market, the total value added per m^3 is JD4.02/m^3 at the farm level, the wholesalers value added is JD0.67/m^3, the retailers value added in local market is approximately equal the value added by famers (JD3.92/m^3). Exporting strawberries to neighboring or Gulf markets has a low contribution to value added with only JD5.23/m^3. For strawberries exported to Gulf markets, the value added by exporters is JD5.2/m^3. Furthermore, forstrawberries exported to Western Europe markets, the value added by exporters is the highest (10.3 JD/m^3).

The total value added will be about JD23.6/m^3forstrawberries exported to Western Europe markets, as shown in Table 48. Strawberries are not exported during the summer season to European markets; export is oriented to neighboring and Gulf markets. The total value water value in local markets (JD 9.3/m^3) is approximately the total water value in export markets to neighboring (JD10.3/m^3) or Gulf markets (JD 10.35/m^3). Figure 37 shows the contributions of individual stakeholders in value chain in water values for strawberry produced in the Jordan Valley and the highlands. It clearly shows high contributions of farmers in the value chain compared with local retailers or exporters. Figure 38 shows the total water values in strawberries according to market destination. The highlands strawberry has higher value added compared to the JV in local markets.

Table 48: Water Value by Individual Stakeholder in Marketing Channel (JD/m³) for Strawberries in JRV and the Highlands

Market Destination	Jordan Valley	Highlands
Farmer	4.02	4.29
Wholesale	0.67	0.69
Retailer, Local market	3.92	4.05
Neighboring market	5.23	5.40
Gulf Market	5.20	5.37
Eastern Europe market	10.30	
Western Europe market	23.64	

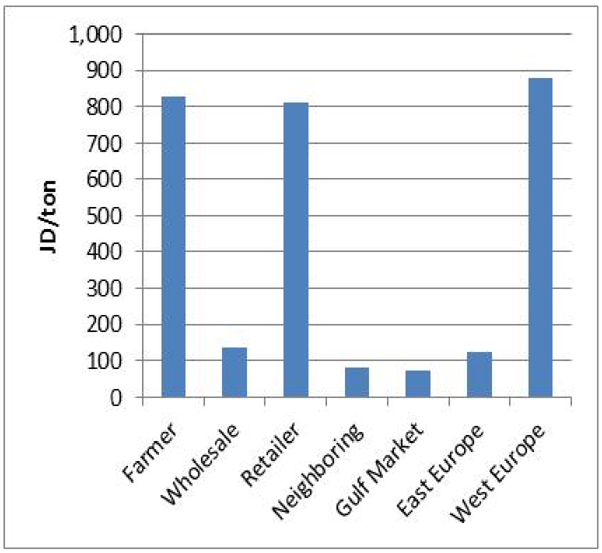


Figure 35: Value Added by Individual Agent in Marketing Channel (JD/ton) for Strawberries

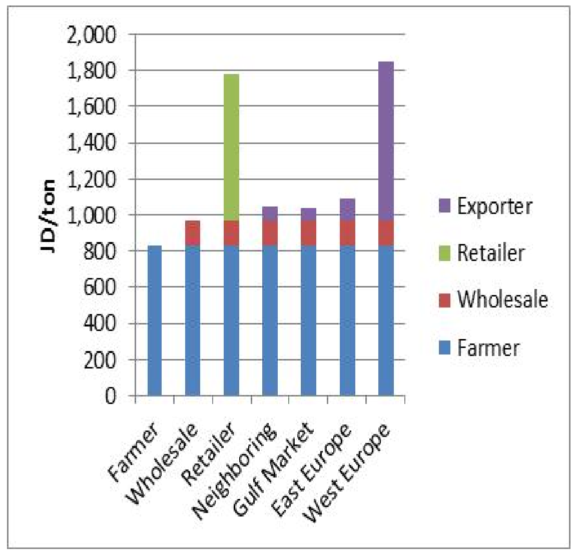
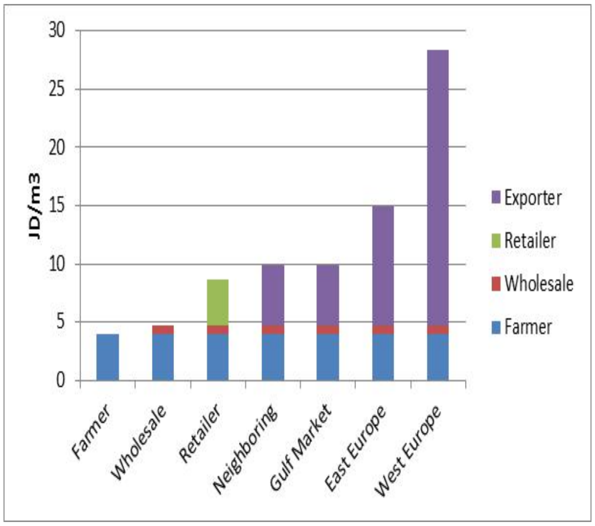


Figure 36: Value Added through Value Chain by Destination Market (JD/ton) for Strawberries



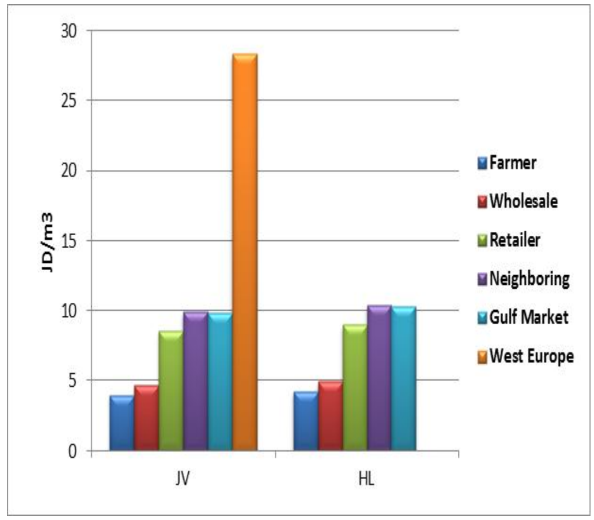


Figure 37: Water Value Added through Marketing Channel by Final Destination Market (JD/m³) for StrawberriesGrown in JV

Figure 38: Total Value of Water (JD/m³) in Value Chain for Strawberries in JV and the Highlands

9.6. VALUE OF WATER IN BROCCOLI CASH CROPS

In Jordan, broccoli is cultivated on a limited area estimated at2,300 dunums, mainly cultivated in plastic houses in JV and partially in the highlands. However, due to increase in its popularity, there is a trend to increase cultivation by farmers as well as consumption by consumers. Broccoli is an important vegetable crop and has high nutritional and good commercial value. The total production of broccoli was estimated at 750 tons in 2010. The exported amount of broccoli amounted to 44 tons during December to May in 2010, of which about 20 tons wereexported to the UK. Broccoli is exported to UAE, Bahrain, Israel, and Sweden. The imported quantities amounted to 0.6 tons, mainly during October.

The analysis of the value created by the broccoli chain showed a satisfactory result, since farmers' value added is about JD 504/ton, wholesalers JD 191/ton, and for retailers JD 498 JD/ton. The total value added in local market was estimated at JD 1,194 JD/ton.

Table 49 shows the water value added per one cubic meter for individual stakeholders in the value chain for broccoli produced in the JV and the highlands. The value added per m^3 is (JD 1.87/m^3) at the farm level, the wholesalers value added is JD1.46 /m^3, the retailers value added in local market is reasonable (JD1.08/m^3). Exporting Broccoli to Gulf also have a reasonable contribution to value added with (JD 1.39/m^3). If the Broccoli is exported to Western Europe markets, the value added by exporters is the highest (JD 6.56/m^3). The total value added in local market is JD4.4/m^3, whereas the total value added is JD9.9/m^3 in the case of exporting broccoli to Western European Market as shown in Figure 39.

Table 49: Water Value by Individual Stakeholder in Marketing Channel (JD/m³) for Broccoli in JRV and the Highlands

Market Destination	Jordan Valley	Highlands
Farmer	1.87	2.96
Wholesale	1.46	0.64
Retailer, Local market	1.08	0.13

Market Destination	Jordan Valley	Highlands
Neighboring market		1.79
Gulf Market	1.397	
Eastern Europe market	1.675	
Western Europe market	6.567	

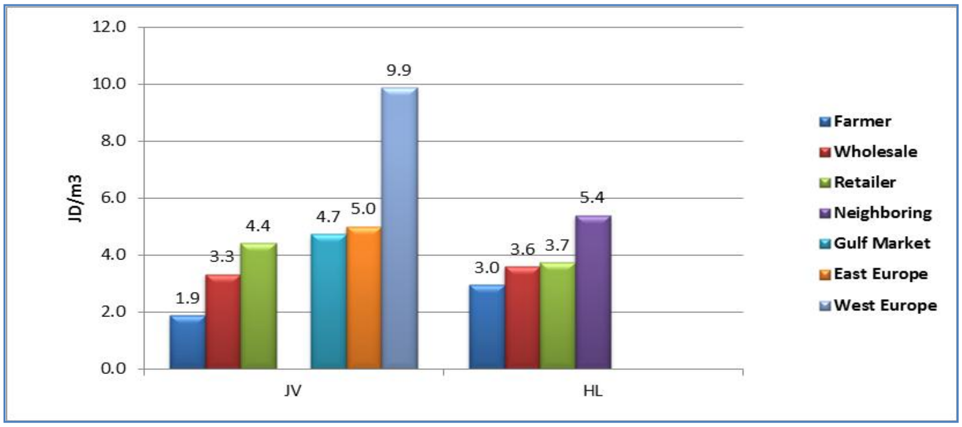


Figure 39: Total Value of Water (JD/m³) in Value Chain for Broccoli in JV and the Highlands

9.7. VALUE OF WATER IN BRUSSELS SPROUTS CASH CROPS

Brussels sproutsis a high-value cash crop grown in greenhouse condition in the JV. Because this crop enjoys higher prices and better profit margins, it has the potential to expand incomes along the whole supply chain, from the farmer to consumer. Encouragement will be given to diversifying producers' income to meet market demand. Brussels sproutsaregrown on asmall scale in the Jordan Valley by afew experienced high-level farmers. This crop is considered to be one of the promising export crops. The cultivation periods extends from October to January in the Jordan Valley.

The analysis of the value created by the Brussels sprouts value chain showed a remarkable result, since farmers' value added is about JD 537/ton, wholesalers JD 304/ton, and for retailers JD 750 /ton. The total value added in local market was estimated at JD 1,627/ton.

The value chain from water perspective is shown in

Table 50. The value added per m^3 at the farm is JD3.31/m^3), the wholesalers' value added is JD1.76 /m^3, and the retailers' value added in local market is high at JD 4.33/m^3. Exporting Brussels sprouts to Gulf markets also had a reasonable contribution to value added at JD2.08/m^3. If the Brussels sprouts are exported to Western Europe markets, the value added by exporters is the highest (JD 21.8 /m^3). The total value added in local market is JD4.4/m^3, whereas, in the case of exporting Brussels sprouts to Western European markets, the value added per m^3 is JD27/m^3, as shown in

Figure **40**.

Table 50: Water Value by Individual Stakeholder in Marketing Channel (JD/m³) for BrusselsSprouts in JRV and the Highlands

Market Destination	Jordan Valley	Highlands
Farmer	3.31	5.31
Wholesale	1.76	3.16
Retailer, Local market	4.33	0.65
Neighboring market		5.01
Gulf Market	2.079	
Eastern Europe market	3.537	
Western Europe market	21.880	

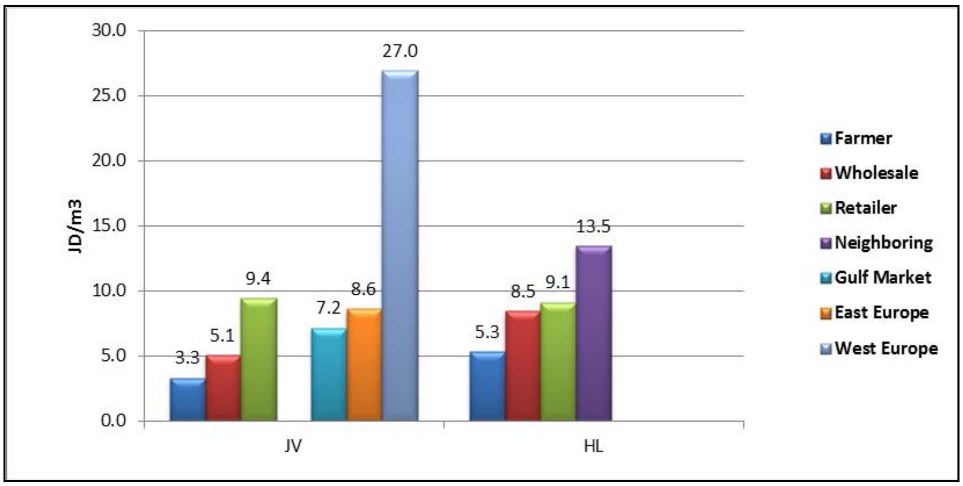


Figure 40: Total Value of Water (JD/m3) in Value Chain for Brussels Sprouts in JV and the Highlands

9.8. VALUE OF WATER IN LEEK CASH CROPS

Leek is a biennial crop. Its long leaves form a sheath of shaft at lower end of the plant, which is valuable part. In its second year, a large, tough and woody stalk grows from the center of the plant rendering the leek inedible. Leek has a mild onion-like taste. In its raw state, the vegetable is crunchy and firm. The edible portions of the leek are the white base of the leaves (above the roots and stem base), the light green parts, and to a lesser extent the dark green parts of the leaves. One of the most popular uses is for adding flavor to stock. The dark green portion is usually discarded because of its tough texture. The total exported quantities of leek in 2008 were about 200 kg, only to Arab countries. Leeks can be produced during December to February in the Jordan Valley and between October and November and March and June in the highlands.

The analysis of the value created by the leek value chain showed a satisfactory result. The farmers' value added is about JD 242/ton, wholesalers JD 130/ton, and for retailers JD 346/ton. The total value added in local market was estimated at JD 719/ton.

The value chain from water perspective is shown in Table 51. The value added per m³ at the farm is JD1.94/m³, the wholesalers' value added is JD1.05 /m³, and the retailers' value added in local markets is double at JD2.77/m³. Exporting leeks to the Gulf also hasa reasonable contribution to value added with JD3.13/m³. If the leeksare exported to Western Europe markets, the value added by exporters is the highest (JD 15.7/m³). The total value added in local markets is JD5.8/m³, whereas the total value added is JD18.8/m³ in the case of exporting leeks to the Western European market, as shown in .

Table 51: Water Value by Individual Stakeholder in Marketing Channel (JD/m³) for Leeks in JRV and the Highlands

Market Destination	Jordan Valley	Highlands
Farmer	1.94	2.26
Wholesale	1.05	0.25
Retailer, Local market	2.77	2.77
Neighboring market		1.95
Gulf Market	3.127	
Eastern Europe market	2.793	
Western Europe market	15.780	

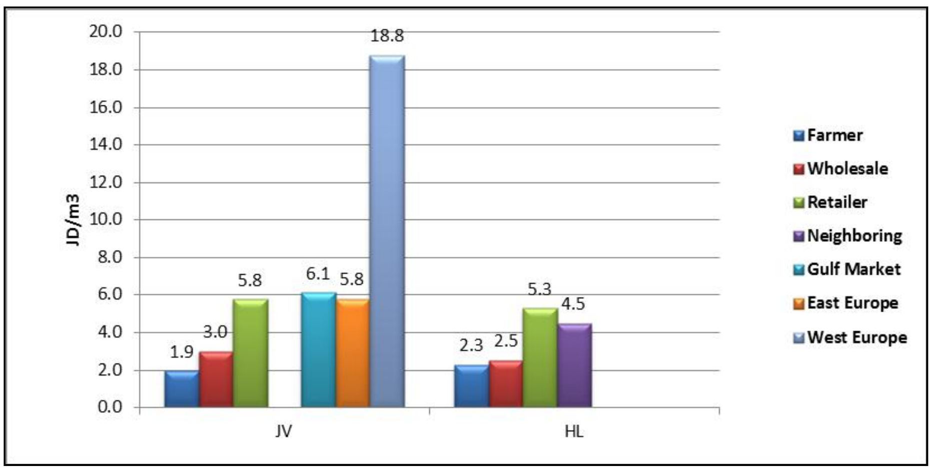


Figure 41Total Value of Water (JD/m3) in Value Chain for Leeks in JV and the Highlands

9.9. VALUE OF WATER IN HOT PEPPER

The total area cultivated with hot peppers is 7,768 dunums, of which 2,630 dunumsare cultivated in winter and 5,138 dunums in summer. The cultivated area in the JV is 3,655 dunums and about 4,113 dunums in the highlands. The total hot pepper production is about 7,000 tons in winter and about 11,300 tons in summer. The DOS and Ministry of Agriculture data do not distinguish between sweet peppers and hot peppers in recording the export statistics. In 2010 the exported peppers (sweet and hot) is about 36,400 tons with a value of JD 21 million. The MOA data report that the peppersexported to different countries amounted to 33,800 tons with a value of JD 24 million.

The value chain analysis was conducted for hot peppers produced in the JV and the highlands by production season. The results presented in Table 52 show the value added by different agents in the marketing channel. **Error! Reference source not found.** shows that the highest value added per cubic meter is in the crop exported to Western Europe with a total accumulated water value through marketing channel of JD 10.8/m³.

The result shows that exporting hot peppers to neighboring countries or to Gulf markets is relatively low compared with local marketsorother markets. Water value in winter peppers is superior to summer pepper.

Table 52: Water Value by Individual Stakeholder in Marketing Channel (JD/m³) for Hot Peppers in JV and the Highlands by Season

Season	Winter		Summer	
Region	JV	HL	JV	HL
Farmer	1.68	1.64	1.33	0.45
Wholesale	0.27	0.15	0.10	0.00
Retailer	4.77	2.57	2.46	1.97
Neighboring market	1.59	0.41	0.69	0.93
Gulf Market	1.01	0.01	0.14	0.61
Eastern Europe	7.09	4.21	4.34	3.03
Western Europe	8.81	5.40	5.49	3.69
Rest of World	5.35	3.01	3.35	2.46

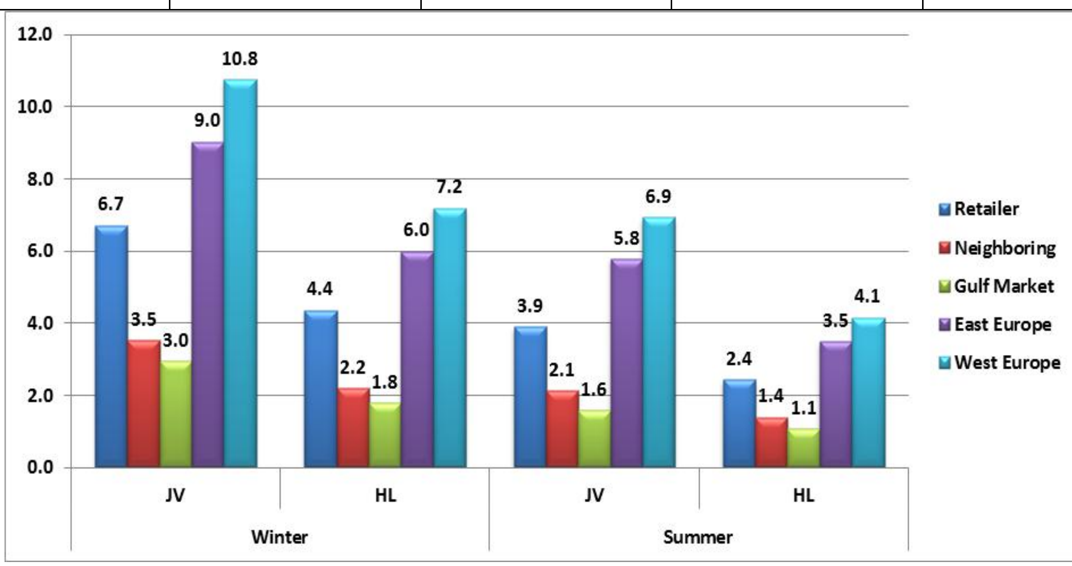


Figure 42: Total Value of Water (JD/m3) in Value Chain for Hot Peppers

9.10. OTHER HIGH VALUE FRESH VEGETABLES

Fresh perishable vegetables produced in protected areas have a high value added, such as celery, ginger, peas, asparagus, bean, fennel, garlic, leek, lettuce with different varieties, okra, and onionsdue to the low supply on the local market and relatively high demand during the off-season. These vegetables represent important market opportunities that may be relatively easy for the improvement opportunities to support. These products are demanded by consumers shopping in Jordan supermarket chains and green markets. They are also much in demand in foreign markets, such as the Russian vegetable market and Balkan markets. Considerable additional sales have been achieved recently on these markets.

Storable vegetables such potatoes, carrots, onions, and beanscould allow more efficient marketing as fresh, with proper storage spaces and ventilation. It is a new opportunityto invest in such new types of storage capacities to gain a competitive edge on the market. However, most existing storage capacities are not suitable, and farmers must be trained to become more efficient in safekeeping vegetables and preventing losses.

Vegetables for industrial processing could be enhanced. This includes gherkins, baby cucumbers, peppers, peas, green beans, corn, potatoes, and carrots. Some of the storable vegetables have a significant share in the industrial processing as well. All the above-mentioned products are sold frozen, dried, or pasteurized on domestic and export markets

In recent years, few agribusinesses in vegetables have seen their sales grow, with larger volumes, higher prices, and better profit margins. With growing revenue available for agribusinesses to reinvest in increasing output, these agribusinesses have already expanded vegetable plantings toward newer vegetables that earn higher profits, switching away from less profitable "traditional" types of vegetables. The introduction of advanced technology for vegetable production, certification (traceability, etc.), and packaging are the main activities that may be undertaken to boost sales of such cash crops.

10. CONCLUSIONS

Plant production can offer high returns and Jordan may have a comparative advantage in fruits and vegetable production. Given its natural resources and climate, one might expect Jordan to be capable of producing a variety of high-quality fruits and vegetables to meet stringent consumer demands in both domestic and international markets

Vegetable production has a significant role in reducing poverty through employment generation, improving the feeding behavior of the people, and creating new opportunitiesfor poor farmers. Cultivation of vegetables allows productive employment as the labor/land ratio is high. Depending on the crop, production of horticulture crops require at least twice the labor, and up to five times the labor days per hectare as compared to cereal crops. Increasing horticultural production thus contributes to commercialization of the rural economy and creates many off-farm jobs.

The fertile Jordan Valley enjoys a subtropical climate allowing for winter cultivation of fruit and vegetables. The highlands' fertile soils allow for specific summer crops cultivation. The differentiation between agricultural zones is based on different altitudes, climate, soil type and water resources. Combining the natural qualities with the best agricultural practices and water management techniques gives Jordan the unique advantage of producing high quality crops year-round.

The results showed that the weighted average of water value used in field crops is JD 0.27 m^{-3} and JD 1.29 m^3 for winter vegetable crops, JD 0.54 m^{-3} for summer vegetables, and JD 0.70 m^{-3} for citrus fruit trees, about JD 0.215m^{-3} for olives and JD 0.40 for stone fruit trees. The overall weighted average water value in irrigation was estimated at JD 0.49m^{-3}.

Water value in agriculture varies widely across crops, seasons, and production locations. After dividing crops into four categories – field crops, winter vegetables, summer vegetables, and fruit – winter vegetables are shown to be the crop type with the highest water value (JD 1.30/m^3), while field crops such as maize, barley, and wheat produce the lowest average water value (JD 0.26/m^3). Among fruits, olives show consistently low water value (JD 0.21/m^3), while citrus is only marginally better (JD 0.70/m^3).

With regard to individual crops, cucumbers had the highest water values with about JD 4.39 m^{-3}, followed by strawberry with JD 4.3 m^{-3}, then Brussels sprouts with JD 2.95 m^{-3}, String beans JD 2.98 m^{-3} Peas with JD 2.74 m^{-3}, carrotswith JD 2.06 m^{-3}. The lowest returns per m^3 were provided by alfalfa, vetch, tobacco, sesame, and barley with less than JD 0.10 m^{-3}.

Amongfruit trees,Valencia oranges is among the highest (JD 1.36 m^{-3}), followed by red orange(JD 1.06 m^{-3}). Almond is among the highest in stone fruit (JD 0.95 m^{-3}), followed by Banana is among the highest water value (JD 0.63 m-3) (range JD 0.4 - 1.03 m-3). Therefore, the current practice of some banana producers is economically rational by installing RO unit to irrigate bananas (desalination cost is between (JD 0.25-0.35 m-3), since water value is twice the desalination costs of one cubic meter.

Water values vary from region to region dependingon the economic activity, climate zones, production season, soils, and water qualities. Water values in MJV, Safi, and northern governorates have the highest value of about JD1.1/m^3. NJV is about JD 0.793/$m^3$and SJV is half of MJV with about JD0.61 /m^3. This might be the dominance of citrus fruits in NJV, which requires a high amount of water compared with MJV where vegetables are the dominantcropping pattern. The lowest water value is found in middle governorates of Amman, Madaba, and Zarka. The water values ranges between JD0.98/m^3 for winter vegetables to the lowest of JD0.12/m^3 for irrigated olives.

Disaggregating water value by region, Jordan Valley cultivation shows water values that are almost twice as high (JD 0.85/m^3) as those prevailing in the highlands (JD 0.37/m^3). The average water values for surface water is JD 0.86/m^3 and blended water is the highest with JD 0.83 JD/m^3, whereas it reaches about JD0.40/m^3 for groundwater

The total hired labor force engaged in agricultural sector during 2010 was estimated at 32,100 workers, of which 28,700 are male workers and 3,400 female. The distribution of hired labor by governorates shows that most hired labor (35 percent) are in Balqa governorates, mainly Middle and South Jordan Valley districts. About 21 percent of hired labor is in Ibid governorate, mainly Northern Jordan Valley district.

The total hired labor was estimated at 13,348 workers in the JV, most of them working in winter vegetables. Winter vegetables consume 22 percent of water in the JV but provide employment opportunities of 53 percent of labor in the JV and contribute 52 percent of total value added in the JV. Citrus fruit consumes about 20 percent of water in the JV but contributes to employment opportunities of about 18 percent.

The total hired labor was estimated at 16,348 workers in the highlands. Summer vegetables consume 23 percent of water in the highlands but provide employment opportunities of 40 percent of labor and contribute 34 percent of total value added in the highlands. Olive trees consume about 31 percent of water in the highlands but contribute to employment opportunities of only about 14 percent.

The result indicates that most of agricultural workers (61 percent) are working in winter and summer vegetables. The labor compensation of vegetables is JD 44.1 million, providing an employment opportunity for 18,379 workers. Vegetables consume 29 percent of water in but provide employment opportunities of 61 percent of labor and contribute with 54 percent of total value added in Jordan. Fruit trees consume about 57 percent of water but contribute only 28 percentto employment opportunities.

The results of value chain analysis for tomatoes produced in the Jordan Valley show that tomatoes do not generate a significant value added when exported to neighboring countries. Exporting tomatoes generates lessvalue added compared to local markets. The highest water value can be generated from winter tomatoes produced in the JV for the purposes of exporting to Eastern European markets. The value added per m^3 is JD1.36/m^3 at the farm level, JD0.28/m^3 in wholesale market, the retailer's value added in local market is four timesthe value added by famers (JD 6.26/m^3). Exporting tomatoes to neighboring markets has a low value added with only JD3.6/m^3. In the case of exporting tomatoes to Gulf markets, the value added by exporters is JD 5.47 /m^3. Furthermore, if tomatoes are exported to Eastern European markets, the value added by exporters is the highest (JD 13.9/m^3).

Exporting summer tomatoes for Eastern European markets from the highlands using groundwater yields the lowest water total value added at JD 5.8 /m^3. Therefore, exporting tomatoes to neighboring markets with a total value added ofonly JD 2.0/m^3 or to Gulf market (JD 2.7/m^3) does not justify using scarce water resources in the highlands to produce tomatoes with low water value added through value chain.

This conclusion is derived from the large volume of exports of virtual water via tomatoes with low profitability from the producers' perspective. The recommendation of the study was to improve the quality of Jordanian horticultural exports to obtain the highest possible value added in high-end markets to increase competitiveness and to reconsider the current production pattern through focusing on high value crops that require lower water requirements.

Jordan Valley irrigated agriculture has much higher water value than does irrigated agriculture in the highlands. Winter vegetable production in the Jordan Valley stands out as generating the largest value per cubic meter of water used. Vegetables such as celery, peas, asparagus, beans, fennel, leaks, and lettuce have high value in local and export markets during the off season. Their production has been expanding and presents continuing opportunity for growth. Olives, field crops, and citrus, on the other hand, in both the Jordan Valley and the highlands, produce relatively low water values and their production with scarce irrigation water should generally be discouraged.

The lack of organized production plans and weak farmer organizations also adds to the problem of poor marketing. The marketing infrastructure suffers from clear weaknesses, especially in the fruit and vegetables sectors. Fruit and vegetables wholesale markets do not represent real markets, with the exception of the one in Amman, which still lacks the essentials of supply and demand data for price formation. In spite of the shortage of the marketing channels and the modest services offered by intermediaries through these channels, marketing margins are considered unjustifiably high and which constitutes nearly the entire difference between the farm gate price and much higher consumer prices in most of the products. The high marketing margin indicates that high profits go to the intermediaries in the marketing channels over producers and consumers

The producers' complaints will continue to make the government to give them subsidies that are not allowed by the national and regional agreements and the government cannot continue to offer them indefinitely.

The promotion and dissemination of appropriate knowledge and technologies, mainly those related to water management, farm and herd management, marketing and processing, is important for all sub-sectors (field crops, vegetables and fruits, and agro-food businesses). This could be achieved through: (i) provision of appropriate agricultural services, infrastructure and enabling environment, such as finance, labs, quarantines, quality assurance, roads, transportation, storage, extension and research; (ii) cost reduction and return maximization to farmers through the promotion of farmer's cooperatives, reduction of post-harvest losses, diversification of production, reducing marketing margins and enhancing farmers capabilities; (iii) improved competitiveness of the agricultural products in the local and foreign markets by producing quality certified products at right prices benefiting from Jordanian comparative and competitive advantages; (iv) introduction ofalternative non-perishable high value added crops, such as broccoli, Brussels sprouts, baby leeks, and celery.

11. POLICY CONSIDERATIONS

Industrial and service sectors currently use less than 10% of Jordan's annual water withdrawals, and while the computed gross value added of that water use is large, there is little evidence that a lack of water is currently constraining these sectors. Consequently allocating additional water to them is unlikely to add significantly to their output. At the same time, the price industries pay for that water is very low relative to the value added, which may lead to future demands from these sectors for additional water, without encouraging the improvements in water use efficiency and recycling which should precede any additional water allocations. Water pricing policy for these sectors should be revised to provide incentives which favor increased recycling and improved efficiency over supply expansion.

Irrigated agriculture generates 90% of all agricultural value in Jordan from the 40% of national cropland which is irrigated. In addition, it provides significant rural employment, improves nutrition, generates substantial export earnings, and serves as the backbone of the Jordan Valley economy. At the same time, it uses more than half of the Kingdom's annual water withdrawals. Irrigated area has expanded more than 50% over the past 16 years, driven by growth in groundwater irrigation in the highlands, where it plays a major role in depleting the high-value water resource stored in highland aquifers.

Value added to the Jordan economy from water use varies considerably among crops, and, particularly, among destination markets. For many vegetables, markets in Eastern Europe provide the highest value to Jordan per cubic meter of water used in producing them. Neighboring country and Gulf State markets serve as "relief valves" for production that local markets can't absorb, as with tomatoes for example, and so often provide lower value added. Further study could also be required to better determine lifecycle water valuations within Jordan for some fodder crops that have low water values but are essential inputs into livestock and hatchery industries thus creating additional value not captured in this study.

Local marketing margins for most crops are very high, and deliver large profits to retailers at the expense of both farmers and consumers. The inefficient local marketing system creates dissatisfaction on the part of farmers, who see huge gaps between farmgate prices, on the one hand, and retail prices in consumer markets on the other. Local market reforms which would increase farmers' share of the value of agricultural products sold in local consumer markets could go a long way towards offsetting the water price increases which are an important part of any agricultural reform package.

Jordan Valley irrigated agriculture has much higher water value than does irrigated agriculture in the highlands. Winter vegetable production in the Jordan Valley stands out as generating the largest value per cubic meter of water used. Perishable vegetables such as celery, peas, asparagus, beans, fennel, leaks, and lettuce have high value in local and export markets during the off season. Their production has been expanding and presents continuing opportunity for growth. Olives, field crops, and citrus, on the other hand, in both the Jordan Valley and the highlands, produce relatively low water values and their production with scarce irrigation water should generally be discouraged. Cultivation of vegetables requires between 2 and 5 times the labor days per dunum that cultivation of cereal crops does, and can generate additional off-farm jobs as well.

Consideration should be paid to the situation in the highlands that olive tree production is often undertaken more to significantly increase property values than for any revenues or value generated from the crop production. This creates a counter-incentive to water efficiency and reducing groundwater abstraction. It also means that different policy interventions could be required to address the problem.

Export of vegetables, particularly winter vegetables to Europe, has considerable upside potential. However to realize this potential actions are needed to raise the quality of produce destined for export, introduce new high-demand crops into the pattern, and improve packaging, storage and transportation facilities. Government should not act alone in attempting this, since it lacks a comparative advantage in performing a number of these activities. Its role should be focused on setting quality and sanitary standards, providing analytic services, supporting agricultural research, providing farmers with new information, regulating the quality of treated wastewater returned to the Valley, providing the necessary transportation and communications infrastructure, and similar activities. Government must partner with private sector enterprises to deliver new irrigation and agricultural technology to farmers, and to provide the information, storage, transportation, grading, and international marketing services required to expand export volume to high value markets.

Much of the export of horticultural crops is undertaken directly by large growers. This should be encouraged; however it is equally important to facilitate the entry of smaller farmers into export-oriented production. Promoting and disseminating appropriate knowledge and technologies, providing access to processing and packaging facilities, and promoting farmer-based cooperative organizations to facilitate joint action are steps that could lead in this direction. Water User Associations, which have recently been established across the Jordan Valley, may be able, in some cases, to take on such additional, production-related functions more effectively than atrophied agricultural cooperatives.

Water provided by the JVA in the Jordan Valley is vastly under-priced. Current prices charged for water are substantially below both the average value of water for producing crops and JVA's cost of service provision. Higher water prices could (a) encourage more efficient water use by farmers, (b) encourage shifts to higher value crops, (c) encourage private development of desalinated brackish water sources and(d) provide funds for better irrigation system maintenance and more effective operation. Note, however, that more efficient water use in response to higher prices would only occur if water is billed by volume rather than by area. Returning to a system of volumetric billing in the JVA service area would require retrofitting all connections with reliable meters and reestablishing a meter-reading and billing system, a process which should be closely integrated with the newly-established WUAs.

Highland agriculture continues to expand rapidly, despite an ostensible ban on new wells in place since 1992. This has led to serious over-exploitation of highland groundwater and to a growing risk of saline aquifer contamination, as water levels fall toward the bottom of the aquifer. At the same time, highland irrigated agriculture is far less productive, per cubic meter of water used, than is Jordan Valley agriculture, creating a lose-lose scenario from the nation's point of view. The failure to charge most farmers a water resource fee, the below-cost electricity they receive for pumping, and ineffectual regulation of drilling and extraction has created a set of highly perverse incentives that encourage this inefficient and damaging situation to continue and expand. Tariff and subsidy policies are in urgent need of reassessment and revision, and regulatory enforcement must be stiffened significantly.

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13. ANNEXES

ANNEX 1: WATER VALUATION METHODOLOGIES

ECONOMIC VALUE OF WATER

The key question for water resources, from an economic perspective, is that despite its importance and being essential for human life and most human activities, why do we find it among the most undervalued resource in the world? (NWRI, 2003) It should be noted in this context that the true economic value of water are linked - not just the price or cost associated with its production – but also the services provided and benefits obtained from these resources (NWRI, 2003). In addition, the economic value of water is affected by their context, for instance, economic value of water is usually lower in humid areas than in arid areas. This is due to the fact that in arid areas water resources are scarcer and thus face more competition between different sectors and users (Taylor, 2003).

It is worth mentioning, in this context, that it is relatively easy to estimate the financial costs needed to maintain currently available quality of water resources. Nevertheless, it is difficult, in many cases, to identify the resulting benefits from such schemes, despite that these benefits are considered as basic input for the development of any sound policies or making any decisions regarding water management and allocation of water resources to achieve the maximum net benefit to society in the long term. In order to be able to answer this question we need to know, not only the context, but also to know the answer the following questions: "Who" are the users or beneficiaries of the water? And "What" is the final use of water because the value of water closely associated with water value-added or productivity, for each use is different from that of other uses? It also requires identification of water quality and quantities required for each use (NWRI, 2003).

This means estimating the economic value of water resources should take into account not only each use of water, as each use can achieve different economic values, but also the different spatial, economic and social contexts. For example, hydroelectric power generation companies estimate the value of water stream on the basis of the quantity of electricity it can produce. Fishermen, meanwhile, assess the value of water and water quality in water bodies, on the basis of the number and size of the fish they can catch.

Scarcity of resources, relative to human needs and wants, means that individuals have to make choices between different goods and services. Making such choices, for goods and services traded in the markets, is usually based on comparing their market prices with the satisfaction gained from their consumption. However, making choices concerning public goods, such as water, which are not traded in the marketplace and have no prices to guide choices, is rather difficult. In such cases, it is important to find ways for putting a value to these goods and services.

- Total Economic Value of Water

The total economic value of the environment and natural resources encompasses the benefits that could be derived from the environment. The economic value of the environment is the sum of use and nonuse value (Figure 1). The use value in turn is sub-divided into direct and indirect as well as option values. Direct use of the goods offered by the environment, for example, crops, fish, timber, hydropower and industrial production. It also includes the economic value associated with the benefits derived from the indirect use the environment in terms of ecosystems functions, for example, flood control, water storage, waste disposal and dilution and biodiversity (Briol et al, 2008).. There is also the value associated with the decision to preserve and maintain the resource for anticipated possible future use, they include for example discover medications in the future, having the opportunities to take advantage of the genes of aquatic organisms. In exchange for the economic values associated with the use, there is the economic value not associated with any present and/or future use and this is typically related to moral benefits derived from the existence of the resource itself, for instance, historically important water bodies, or water bodies with great heritage importance (Hutton and Haller, 1992).

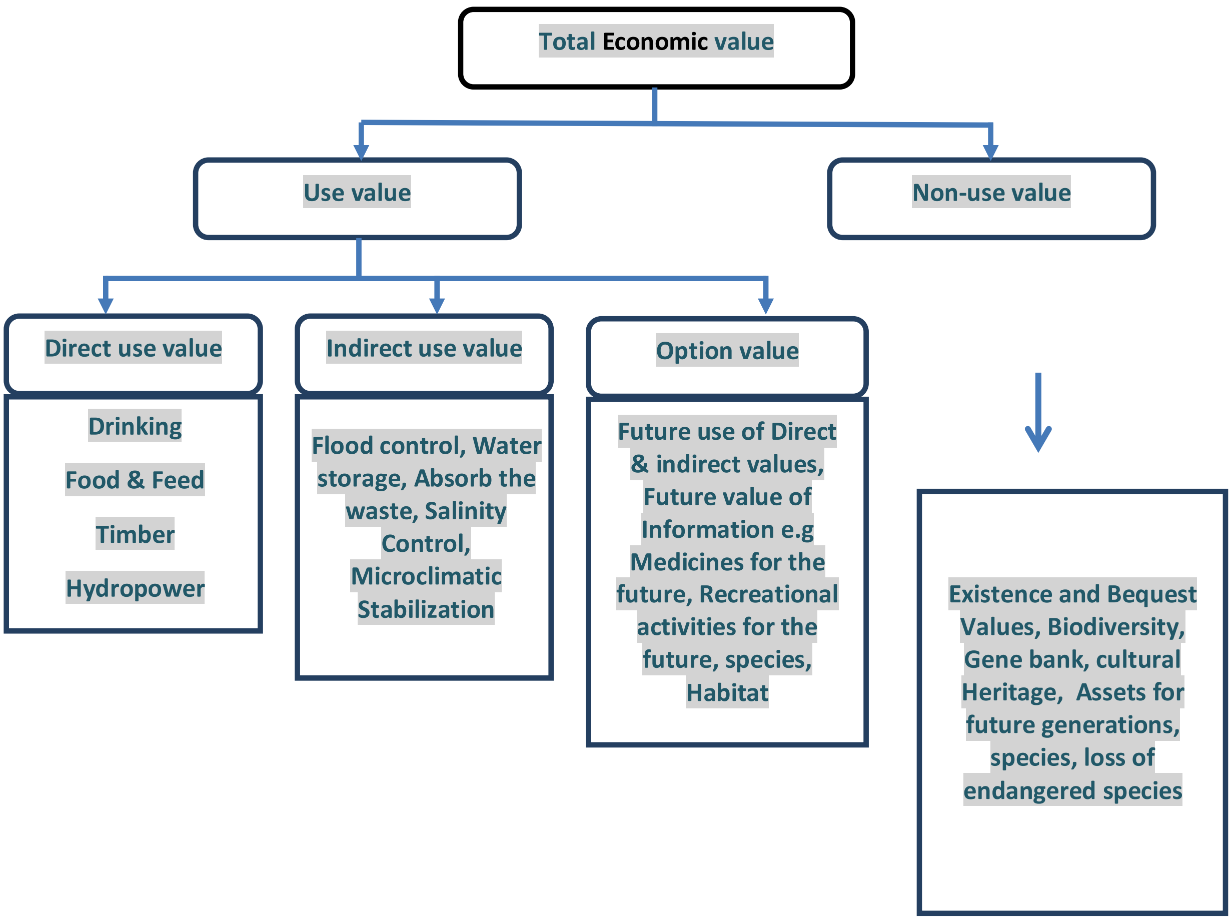

Figure 43: total economic value of the environment and water resources

It is necessary to introduce some basic definition used to determine the total economic value of water such as:

Direct Use values: Outputs that can be consumed or processed directly, such Drinking, Food, timber, fodder, fuel, Industrial products

Indirect Use values: Ecological services, such as flood control, regulation of water flows and supplies, nutrient retention, climate regulation, etc

Option values: Premium placed on maintaining resources and landscapes for future possible direct and indirect uses, some of which may not be known now.

Existence values: Intrinsic value of resources and landscapes, irrespective of its use such as cultural, aesthetic, bequest significance, etc.

It should be stressed that determining the economic value of water is crucial in order for water management to determine the basis for the allocation of those resources between different uses and even within single-use. This means that there is a need for governments to intervene, through management and policy making, in the water sector in order to ensure that that water resources are allocated and used efficiently, usually take into consideration the environment, as it is considered a high priority, despite the fact that environment is the context within which water resources exist and thus can have impact on water resources. But usually the government has a stronger incentive to intervene in order to provide the population with clean water (Briol et al, 2008).

- Political and Social Values

The challenge of supplying safe drinking water to escalating populations is demanding ever more the attention of water policy makers and managers. The limited water availability and the basic tendency for demand to outstrip supply ensure competition between the different water use sectors. The balancing response of the water management has been to provide some water for all and a little more for some, depending on the priorities developed by governments. The necessary reallocation of water supplies from one sector to others has been argued for as a macro-economic necessity. The implications of such decisions go far beyond economics, though, are highly contested and come with considerable potential political and social costs. This is especially so where there are strong advocacy groups for the different water use sectors (Molle and Berkhoff, 2005). The political cost of water shortage will be very high including civil unrest and complaints, mass migration and economic recession and collapse of social order. Water pollution event in Jordan during 1998 force the water minister to resign as a results of mass critic to government performance during the crisis

The growing demand for water in Jordan potentially lead to over-exploitation of natural resource and a decline in availability for agricultural sector. This inevitably leads to loss of production, both industrial and agricultural, and also affect public health - all of which in turn will ultimately lead to an economic downturn

The Jordan where the population is going to double to around 12 million people by 2050, and where the country already face very severe water shortages. e.g., Jordan with 12 main aquifers, 9 are over-exploited. The forecasted expenditure on water and sanitations projects cannot be funded from monthly municipal water fees, which don't even cover operating expenses. Furthermore, drinking water and sanitation tariff system did not raise enough revenue to cover the cost of water distribution, much less the maintenance of capital equipment. Local governments often contract with private firms to replace infrastructure and provide financing

In order to ensure safe, sufficient and relatively inexpensive water supplies in the future, Jordan water delivery system must change. Historically, municipal water authorities have been underfunded and many have been unable to keep water delivery systems operating safely and efficiently. The gap between needed resources and investments could grow due to the recession. Accordingly, the move to private finances and public-private partnership in water supply and sanitation project already taking place and should be encouraged with care.

Waterborne disease outbreaks are the most obvious manifestation of the impacts of contaminated water on human health. The vast majority of outbreaks occur in rural areas in Jordan, but without necessarily being recognized as such. The number of recorded instances waterborne disease outbreaks in recent years demonstrates that access to safe drinking water and recreational waters remains a problem in Jordan .

The political costs can be display in two example in Jordan. For Example, after a major drinking water pollution outbreak occurred in Amman in the summer of 1998 due to a malfunction of the capital's major drinking water treatment plant, the government advised people "to take more precautionary measures and boil water for at least one minute before drinking it." In response to a drinking water crisis, The USAID provided emergency assistance to help bring the Zai Water Treatment Plant serving 40% of Amman's population back into operation after it had been temporarily shut down because of an instance of contamination. This water crisis in Jordan led to the spread of small and medium Reverse Osmosis (RO) units in the market. Vendors currently sell and/or distribute treated water on demand. In Amman City alone, more than 120 small businesses are in operation (Al-Jayyousi and Mohsen, 2001). Many households have installed small RO units to ensure adequate quality of drinking water. The capacities of these units are in the range of 1–5 m^3/d. The annual average value of import of machinery and apparatus for filtering or purifying water, most of them 1.5 m^3/d, jumped from US 2.08 million during the period (1995-1998) to US 10.5 million during the period (2007-2011). People are losing the trust in water provided by the public network for drinking purpose. .

In November 2007, thousands of Jordanians have been rushed to hospitals over the past few months suffering from illnesses related to water contamination in villages and towns across the kingdom. Experts fear the worst is yet to come unless a lasting solution is found to the kingdom's water shortages. The latest incident involved a refugee camp near Irbid, 120km north of Amman. People reported that their taps had turned yellow and feared their health was at risk. The government immediately shut down the water supply after experts realized the water had been contaminated by sewage. In July, 2009 nearly about 1,000 people from a village near the northern city of Mafraq were rushed to hospital suffering from severe diarrhea and high fever caused by a parasite, Cryptosporidium made its way into the local water system. Investigations showed the source of the disease was the worn out water network supplying the town.

- The Moral and Ethical Value

The health impacts of water-related diseases, among others diarrheal, have a significant economic cost, mainly in developing countries, but also in developed countries. Given their relative importance, the economic valuation of the health benefits associated with improved water supply and sanitation is necessary in order to determine whether or not the interventions are efficient in an economic sense (OECD, 2007).Reports shows that for 16% of deaths in children under five in the Eastern Mediterranean region are due to diarrheal disease.Provision of safe water could reduce incidence of diarrheal disease by an estimated 21% while improved sanitation could reduce diarrheal disease by 37.5%. (WHO, 2011).

In Jordan the lack of accessibility of water for the poor and disadvantaged groups may create serious societal problems and in the long run will affect the domestic stability in the different rural areas in the country. Therefore water as a human right is an explosive issue in national and international respect and has an impact on the questions of social justice and political stability as well as the regional peace dynamics. Therefore, solving the water crisis is a moral imperative and that access to water resources was a fundamental human rights.

The importance of access to water and sanitation is recognized by the international community. Access to a reliable safe water supply is a human right as defined in the General Comment on the Right to Water and the Declaration on the Rights of the Child. The Millennium Development Goals, governments pledged to halve the number of people without clean water and adequate sanitation by 2015. The decade of 2005-2015 has been declared by the United Nations as the Decade of Water for Health. Both national and local governments can strive to fulfill these commitments by investing in water and sanitation infrastructure, setting and enforcing water quality requirements and standards, and by promoting inexpensive and effective solutions like household water treatment and safe storage.

- Prices as Optimal Allocation Mechanisms

The idea of water as an economic good is simple. Water has a value to users who are Willing To Pay (WTP) for it. Like other goods, consumers will use water as long as the benefit derived from the use of an additional cubic meter exceed the costs so incurred, i.e. until the marginal value product of water equals its price. The various methods for economic valuation of water is discussed in the following section.

The price of water in a water market should reflect water's economic value. Because water is usually supplied by public agencies who price water at its average financial delivery cost rather than its value to producers, water is rarely priced at its marginal economic value (Young, 2005). Water can be valued from a supply (i.e. depending on the cost of water provision) or demand perspective (value added due to water use in productive activities), resulting in a supply curve or a demand curve. When water is an input to a production process (an 'intermediate good'), such as in irrigated agriculture or in industrial use, water demand is derived from the demand for the final output and from water's role in producing this output and thus it is a derived demand function. In this case, water demand is a function of the price of water and the price of the final product produced. Estimating water's economic value is equivalent to isolating the marginal contribution of water to the total output value. (Young, 2005, Turner, et al, 2004)

The value of water quality can be looked at in several ways, poor water quality for instance can limit the crops a farmer is able to grow or reduces water use efficiency and yield (Carr et a., 2011, Majdalawi, 2003; Bazza, 2003). Therefore, water quality is multi-dimensional, as it includes concentration of certain chemicals, level of salinity, concentration of bacteria and organic matter, as well as temperature.

In an economic system most goods are allocated according to its highest value use. In other words, those who are willing to pay the most for it should have first claim to its use. While one price may exist for water (be it the cost of the last unit supplied to a region or an administered price) there is no reason to believe that all users of that water value it to the same degree, or think of it as being of infinite value. In theory water managers could achieve a better allocation of water, one that improves social net welfare, if they know the value of water by use, region and season as they can distribute water in a manner that society values it or at the very least calculate the foregone benefits of allocating water in some less optimal manner (Hellegers and Davidson, 2010). Young (2005) and Turner et al. (2004) have undertaken comprehensive reviews of the methods employed to calculate the value of water to various users. While both these studies highlight the limitations of the residual method, they emphasize the fact that the approach goes someway towards solving the problems regarding complexity and a lack of data

The value producers place on water can be thought of as being derived from what they use it for. Given that a variety of crops are produced over a wide area and at different times, determining a single value for such a complex production process is a difficult task. In addition there is often a lack of data to make definitive estimates and crop prices vary over time (Turner et al., 2004).

Neoclassical economic theory predicts that, in a competitive market, the economic value of a good corresponds to its market price, which reflects individuals' willingness to pay for that good. For water, however, due to the limited role played by markets, valuation techniques must be used. Several methods for estimating the value of water have been developed. They can be grouped according to whether they rely on observed market behavior and data to infer economic value (indirect techniques), or alternatively use survey methods to obtain valuation information directly from water users (direct techniques) (Turner et al., 2004). A detailed discussion of water valuation methods can be found in Young (2005) and more recently in Lange & Hassan (2007).

In general, the most scientifically accepted methods are those based on actual market behavior and information (Hussain et al., 2007). In the case of Jordan, since farmers in the Jordan Valley are paying for water a neglected portion of production costs, it is difficult to establish a relationship between price and demand from actual behavior to generate demand functions. Moreover, because water is provided by the government with heavy subsidy, strategic biases or simply the belief among farmers that water is a free gift from God (Abu-Zeid, 2001), could probably lead to erroneous estimations of water values when using direct methods such as contingent valuation (salman et a. Wasike& Hanley, 1998). Therefore, following Lange (2007), Speelman, et al., 2008), the Residual Imputation Method (RIM) was used in this study. Although this method clearly has its shortcomings, which are discussed in the next section, it was considered the most suitable technique to estimate water values for the studied irrigation schemes.

Therefore, this study describes and analyzes some of the existing methods of estimating the value of water in inter-sectoral economic activities. Agudelo (2001) categorized water valuation methods into three

1. Methods that infer value from information regarding markets of water and water-related benefits
2. Methods that estimate values from the derived demand for water, where water is used as an intermediate good, and
3. Methods that estimate the value of water from a direct consumer demand, as in the case where water is used as a final good.

As a market good, value is derived from rentals and sales of water rights or land in case of a riparian ownership of water. As an intermediate good, value is derived from the producers' demand function, residual imputation, value added or alternative costs of water use. If used as a final private good, the value of water is determined from the consumers' demand function. If water is used as a public final good, its value is derived from the embedded travel costs or as bundle of other goods in a hedonic property value or the use of contingent valuation method to determine the value consumers place on the its use (Agudelo 2001). This study focuses on the use of water as an intermediate good, used as an input in the production of other goods and services. It also attempts to analyze the benefits of inter-sectoral water use in a country where water markets are ill-defined and prices are distorted, because of government intervention or because of the absence of completely defined user rights.

When used as an intermediate good, the value of water must be assessed from the producers' point of view. The conceptual valuation framework for the welfare benefits of increases or decreases in water use is provided by the producers' demand for inputs, including water. Subsections present a review of some of the valuation methods that can be used to assess the value of water, as an intermediate input in an ill-defined or dysfunctional water market, that isused in the domestic sector and the agricultural and industrial sectors respectively. However and before describing those methods, it is worth to explain the principle of economic water value in the following section.

- Principle of Economic Water Value

Water value is estimated through the value in use of water which consists of two components: The use values, which is known as the economic values or (extrinsic values and direct use values), and from non-use values, which is called intrinsic values, passive use values, or existence values). Use values come mainly from the use of water in the different sectors such as agriculture, industry, hydropower, navigation and households. Non-use values come mainly from not using water through aesthetics, culture, religion, geomorphology and nature (Agudelo, 2001). The intrinsic values are hard to estimate and thereby will not be evaluated nordiscussed further.

- Market Failure in Determining the Real Value of water

Resource allocation decisions and identify patterns of uses, from an economic perspective, reply usually either on market, central or decentralized planning systems or a combination of both market mechanism and planning. It is worth mentioning that neither the market mechanism nor the central planning systems are used individually when it comes to the field of water resources management and allocation. This is due to the inability of any of them to achieve, by itself, the optimal allocation of water resources that is the allocation that can achieve maximum net benefits to society.

Given prevailing patterns of allocation and use of water resources, it could be argued that they usually involve over-use and/or pollution of these resources. This reflects what is called from an economic perspective the phenomenon of "market failure", meaning the inability of the market and/or the planning systems to achieve the optimal allocation of these resources between different sectors and/or between various uses within the same sector. Furthermore, water rates set by the market and/or the planning systems in the case of water resources are not usually at their optimum level, which leads to the misuse of those resources (Abdrabo, 2003).

Such market failure to achieve optimal allocation and price of water resources could be attributed to several factors; including for instance ignoring the external costs, whether environmental or social, associated with any water management, allocation or use decisions (Taylor, 2003). We find, for example, that surface and ground water, in many cases, are used without paying the real economic value of the resource (in terms of both quality and quantity). Rather, concern of policy and decision makers focus on covering at least partially the financial costs of provision, which leads to misuse, as well as exposure to high levels of pollution (Koundouri, 2000). It could be argued that failure to take into account in an effective and integrated manner into the decision-making process can cause considerable and unexpected adverse social/cultural, economic and environmental outcomes (NWRI, 2003).

Another factor that could contribute to market failure is the lack of or vague property rights. For example, vague or lack of precise property rights or absence of specific rules governing the patterns of exploitation of groundwater sources can lead to excessive use of groundwater. Furthermore, water sector is also known as a natural monopoly, which can also lead to market failure, that is water projects require typically huge investments, for example in the case of the establishment of networks of safe water and sanitation, which reduces the chances of a real competition to provide those services. This had led most governments in the world usually to create bodies responsible for monitoring and controlling these sectors.

Non-internalization of external cost and/or benefits associated with a particular activity can also lead the failure of the market mechanism in achieving optimal allocation and price of water resources. External costs or benefits are those costs or benefits borne/obtained by a third party not directly involved in market transactions (the parties involved in the market exchange are producers and consumers). Third parties are therefore not taken into account by the market system except where the government intervenes and force the exchange parties to bear those costs through the imposition of fines or taxes or provide them with subsidies in the case of external benefits. Lack of clean water, for example, can generate multiple and varied external costs including negative effects on public health, high mortality rates, low productivity of society in general (Hutton and Haller, 2004).

METHODOLOGIES USED FOR VALUING WATER

Rational decision making about water management issues requires reliable estimates of the economic value of water (Hellegers& Perry, 2006; Hussain et al., 2007). Knowledge of this value is necessary when, for instance, making investment decisions concerning water resources development, policy decisions on sustainable water use and water allocations, or when the socio-economic impacts of water management decisions must be determined (Hussain et al., 2007). Specifically for the agricultural sector, this knowledge is important to design fair, informed and rational pricing systems, providing incentives to irrigators to use water rationally and efficiently and allowing recovering operation and maintenance costs (Lange, 2007; Perret& Geyser, 2007).

Young (2005) provide the most comprehensive exposition to-date of the application of nonmarket economic valuation methods to proposed water resources investments and policies. He provides a conceptual framework for valuation of both commodity and public good uses of water, addressing valuation techniques appropriate to measuring public benefits--including water quality improvement, recreation and wildlife habitat enhancement, and flood risk reduction. However, we will emphasis on the commodity uses of water by agriculture, industries, and households.

- Methods of economic valuation of water as a Final Goods

Economic valuation means simply eliciting measures of human preferences for or against changes in environmental conditions. It represents an essential step in incorporating environmental considerations into economic work. Economic valuation is of tremendous importance in different contexts, for instance, appraisal of projects or programs cannot be comprehensive or adequate without economic valuation of their environmental impacts. Also, setting national priorities for environmental policy is better informed if economic values of environmental resources impacts are known with some degree of certainty. Moreover, the entire objective of sustainable development could not be interpreted without some idea of the value of various environmental assets. This means that economic valuation can provide the potential for more cost-effective public choices, so that limited public funds can be spent to the community's best advantage.

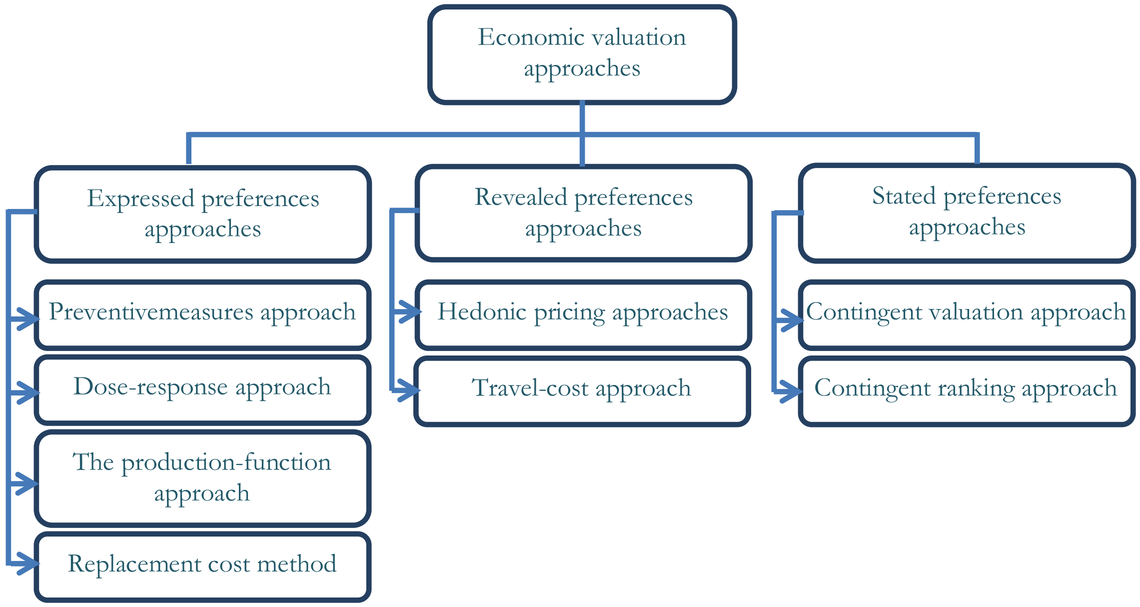

Figure 44: : Categories of economic valuation approaches

It should be noted that each of these approaches can be appropriate for some cases and others, meaning they are not alternatives to each other in all cases. Furthermore, some of these approaches can measure total economic value of the environment, while others can estimate the some components of this value, e.g. direct economic use or the indirect one, and not others. These approaches can be divided into three main groups depend on the markets of traditional, implied or hypothetical, as briefly discussed below.

MARKET VALUATION OF PHYSICAL EFFECTS (MVPE)

The most straightforward way of valuing environmental change is to observe physical changes in the environment and estimate what difference they will make to the value of goods and services. For instance, acid rain causes damage to trees and plants, which reduces their market value. Soil erosion reduces the yield of crops grown on site, and may cause downstream farmers and reservoir owners to spend more on removing silt from their property. Within the MVPE category, several techniques are available:

a. Preventive measures approach: It is known that human beings in general prefer to avoid risk, which means that they give priority to measures that can protect them from potential damages as a result of contamination of drinking water, for example. In such a case, the value of such an environmental problem is the costs borne by individuals to prevent being harmed by this contamination, as it reflects their assessment of this problem and their preferences.

b. Dose-response approach: it attempts to estimate the physical impact of an environmental change on a receptor, such as water pollution on crop yield (EDIWB, 1995). This method is based on a regression relationship between the level of contamination of an environmental compartment (dose) and the quantitative impacts on the productivity of factors of production (a receptor). This method is usually based on field or laboratory experiments to assess this regression relationship. For example, it can estimate the regression relationship between different levels of water pollution of a particular type and the impact on the health of individuals or certain agricultural crops productivity. The identified impacts can be valued using market prices.

b. Under the production-function approach: a production function typically represent the relationship between quantity of production of a crop for example and the inputs into the production process; such as employment and capital. This approach considers environmental quality such as soil fertility and water quality as inputs in the production of agriculture crops and thus can be related through econometrics techniques to output, this would enable economists to estimate the impacts of changes in any environmental input and then utilize market prices to derive a value for that change in economic terms.

c. Replacement cost method: estimates the cost of environmental damage by using the costs which the injured parties incur in putting the harm right. The value of low quality domestic water provision, for instance, is the cost borne by individuals and families buying personal water purification devices.

Obviously, not all these methods should be pursued in each case; the choice should be made according to:

- Which type of impacts are more prominent;
- What information is available and feasible; and
- What are the resources available to the analyst? (EDIWB, 1995)

REVEALED PREFERENCES APPROACHES

Revealed preferences approaches attempts to estimate the economic value of an environmental quality or a resource from customers' revealed preferences on goods and services encompassing this environmental quality or resource.

HEDONIC PRICING APPROACHES:

They are based upon the assumption that goods and services are usually defined in terms of their attributes. When goods or services contain an environmental characteristic the same logic follows -the market value of the environmental characteristic is "embedded" in the market price of the good or service which contains the characteristic. The hedonic methods include two valuation techniques: *property-value approach,* and *wage- differential approach.*

a. property and real estate valuation approach:rely on real estate prices as an implicit measure of the indirect effects of changes in environmental quality. The theoretical grounds is that, people tend, all other things being equal, to prefer homes in quiet, clean neighborhoods to those in polluted, congested and noisy ones (Daly, 2001).

Accordingly, they are typically willing to pay a premium for a home meeting their preferences. As, market prices for housing reflect the aggregate value that people place on all housing attributes, including environmental ones, the value of the environmental quality is implicit in the housing prices. Such value could be determined by controlling for other relevant housing characteristics, which influence housing prices. For example, the market price of a property would encompass the value of accessibility to domestic water networks.

b. Wage differential: The wage-differential approach is similar to the property-value approach, except that it attempts to place values on the incremental value of morbidity and mortality associated with certain risk-prone jobs. This information can then be combined with the dose-response functions to estimate the benefit of specific reductions in pollution levels. These functions, derived from epidemiological data, relate the level of pollution exposure to the degree of morbidity - mortality (Freeman, 1993).

TRAVEL COST APPROACH:

The premise of TCM is that users travel from various places to spend time at a site. Although no fee is charged to access the site, there is a cost involved in traveling to and from the site. This cost, which is the amount of time and money individuals spend getting to and from a site, can be used to derive a demand function for the site. Once demand has been derived, it is possible to estimate the benefits (including consumer's surplus) associated with the site (Boardman and Weimer, 1996).

CONTINGENT VALUATION APPROACH:

Contingent Valuation approaches are used to obtain values for non-market goods or services. It is a survey technique that attempts to elicit information about individuals' (or households') preferences for a good or service by asking an individual a question or a series of questions about how much they value a good or service, for instance, the value they are willing to pay for domestic water provision or improving water quality. The contingent valuation approaches questionnaire forms typically consists of three parts: (a) a detailed description of the environmental situation being valued, b) a series of questions about the socioeconomic and demographic characteristics of the respondent; and c) one or more questions that determine how much the respondent is wining-to-pay for the good or service if confronted with the opportunity to obtain it under the specified terms. The most important concern when employing CVM is the high risk of receiving biased answers. Such bias include: (a) strategic bias, b) information bias, (c) starting point bias, and (d) hypothetical bias (Mitchell and Carson, 1989)

STATED PREFERENCE APPROACH: CONTINGENT VALUATION METHOD

This method is based on the use of survey techniques to directly estimate benefits based on the willingness to pay for an improved water supply as stated by water users in a questionnaire. The stated preference approaches, including contingent valuation and conjoint analysis. Contingent valuation is based on discrete choice responses that reflect estimated willingness to pay. Conjoint analysis is based on survey responses to pick the most desirable alternative out of a set of alternatives that have a variety of characteristics.

Willingness to pay is the price (JD amount) that a buyer is willing to give up (opportunity cost) to acquire a good or service. The willingness of consumers to pay for a reliable, good quality water supply depends on the satisfaction or utility they obtain from the service as well as the utility consumers obtain from all other goods and services, constrained by available income. Therefore, willingness to pay takes preferences and income constraints into account. Willingness to pay is reflected through the demand curve for that good or service. The supply curve for a good or service reflects the marginal cost of providing that service and represents the minimum price required to bring an additional unit of output into the market.

Using willingness to pay as a measure of benefit presents some potential equity issues. First, willingness to pay is constrained by ability to pay, so households with high incomes will appear to place a higher value on water service than those with low incomes. This may conflict with some ideas of fairness or justice (Pearce, 1994).

In addition to the equity issues presented above, there are also practical problems in measuring the willingness to pay of water users for a water supply. Due to limited information available on how much water users will pay for water supplies with differing levels of quality and reliability along with the non-competitive nature of some water supply markets, it may not be possible to derive a demand curve from actual market data.

The Value of water can be approximated by consumer surplus and producer surplus. Consumer surplus is the difference between what consumers are willing to pay for water (as reflected by the demand curve) and what that consumer actually has to pay (as reflected by the market price). Consumer surplus is represented as the area under the demand curve and above market price in the supply and demand curve.

The stated preference approach can be used to directly estimate M&I water supply benefits based on preferences reflected through responses to water user surveys. There are two methods that can be used to estimate natural resource values in terms of stated preferences, the contingent valuation method (CVM) and conjoint analysis (CA). The two methods are similar in that they are based on the use of surveys to estimate willingness to pay. However, the two methods are different in the way the water being valued are presented in the survey questionnaires .The differences in the two methods can lead to a divergence in the estimates of willingness to pay using CVM and CA.

The benefits from a water supply improvement can be measured using either CVM or CA by 1) asking water users their willingness to pay for increased water supplies, improved reliability of service or improved water quality by presenting a range of scenarios that include different characteristics and asking for a ranking of scenarios (CA

There is disagreement among economists regarding the accuracy of value estimates derived from contingent valuation based analyses. Potential biases exist in the presentation of information in a survey, the hypothetical nature of contingent valuation questions, and the sampling methods used. However, CVM has been applied to a wide variety of resource valuation situations.

CHOICE EXPERIMENT METHOD (CEM)

CEM is a survey-based technique which can estimate the total economic value of an environmental stock/flow or service and the value of its attributes, as well as the value of more complex changes in several attributes. e.g: Each respondent is presented with a series of alternatives of the environmental stock/flow or service with varying levels of its price and non-price attributes and asked to choose their most preferred option in each set of alternatives. The counted problems are the simplified version of reality, but CEM eliminates or minimises several of the CVM problems (e.g. strategic bias, yea-saying bias, embedding effects).

META-ANALYSIS METHOD (MAM)

Meta-analysis is the statistical analysis of the summary of findings of empirical studies: i.e. the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings. e.g: freshwater fishing meta-analysis of Total cost valuation studies conducted by Sturtevant et al. (1996). Meta-analytical research seems to have been principally triggered by: Increases in the available number of environmental valuation studies. However, large differences in valuation outcomes as a result of use of different research designs.

Another valuation approach is based on the type of water final uses. These are: (1) Methods that infer value as a market good, where value is derived from rentals and sales of water rights,(water-related benefits.) water valued as (full Cost recovery, rental value , profit margin). (2) Methods that estimate values from the derived demand for water, where water is used as an intermediate good, (agriculture, industry, tourism, services sector). (3) Methods that estimate the value of water from a direct consumer demand, where water is used as a final good. (e.g. drinking &domestic use)

There are various techniques are used to estimate the e economic values of water include the estimation of demand curves, analysis of market-like transactions, use of production approaches that consider the contribution of water services to the production process, estimation of the costs of providing alternative sources of water, as well as other techniques used to estimate water related ecosystem services to environment. The techniques reflect the extent to which the goods and services provided by water services touch on the welfare of society either as direct determinants of individuals' well-being (e.g. as consumer goods) or via production processes (e.g. as intermediate goods). They are grouped here according to whether the techniques rely on observed market behaviour to infer users' value of water resource functions (indirect techniques), or on whether they use survey methods to obtain valuation information directly from households (direct techniques) (Tuner et al., 2004).

Another classification of water valuation approach is suggested by Young (2005) who classified according to the quantitative techniques employed. Most methods of water valuation fit into two broad categories that differ in the basic mathematical procedures and types of data employed in the valuation process. The inductive techniques, employs inductive logic, statistical or econometric procedures, to infer generalizations from individual observations to generalization. Inductive techniques often applied to valuation of public environmental goods, involve a process of reasoning from the particular to the general (e.g., from responses to questionnaires, or from secondary data from government reports). The accuracy of inductive techniques depends on several factors, including the representativeness and validity of die observational data used in the inference.

Most inductive techniques, as represented by formal statistical analysis, can also provide measures of variance and goodness of fit. A corresponding limitation is that this observed behaviour is historical; future behaviour and valuation may need to be forecast by assuming out-of-sample parameters. It may be difficult or inappropriate to infer future demands and values from past conditions. For example, for producers' goods, the estimated value or shadow price depends greatly on assumptions about product prices, prices of other inputs, and technological progress. In addition, inductive methods tend to demand statistical and computational skills on the part of the analyst.

The deductive method, involves logical processes to reason from general premises to particular conclusions. Deductive techniques employ constructed models comprising a set of behavioural postulates (i.e. profit or utility maximization) and empirical assumptions appropriate to the case at hand. The deductive techniques are the most used for valuing water in its producers' good manifestations. This general approach involves reasoning from the general to the particular. The data to fit a deductive model will typically include assumptions about technology of production or consumption and the relevant price or prices. The data for constructed models may be provided by empirical studies of production or consumption processes. The accuracy of the results of deductive reasoning depends on the validity of the premises and the appropriateness of the model specification. Examples of deductive techniques applied to valuing water as producers' goods range from simple budgeting via spread sheet to dynamic Optimization models. Deductive techniques offer the- advantage of flexibility, as they can be constructed to reflect any desired future economic and technological conditions. (Table 2, Annex)

- Demand Curve Estimation

An estimate of the price elasticity of demand and supply for municipal can be quantified water along with current quantities and prices in the market. This demand relationship can then be used to estimate benefits. Using price elasticity of demand estimates applicable to the study area along with current quantities and prices for water in the study area to derive a demand curve from which water values can be estimated.

In many cases it may not be possible to estimate demand curves from which water supply can be estimated due to the time and costs associated with gathering the amount of data needed to estimate these curves. However, in many cases estimates are available on a regional basis for the price elasticity of demand for municipal water supplies.

If the price elasticity of demand for a good is known, along with the current quantity exchanged in the market, then the effect of relatively small changes in the quantity supplied on prices can be predicted.

Price elasticity of demand is a measure of the change in the quantity of a good or service obtained as a result of a change in the price of the good or service. A related measure is income elasticity of demand, which can be defined as the change in the quantity of a good or service obtained as a result of a change in the income of the individual obtaining the good.

For a normal good price elasticity is negative (a higher price results in less purchased) and income elasticity is positive (a higher income results in more purchased). Demand for a good with an absolute value of elasticity greater than 1 is said to be elastic, meaning that the quantity demanded is very responsive to a change in price. An absolute value of elasticity less than 1 is inelastic demand, where a change in price results in a relatively small change in the quantity of a good demanded. Given that water does not have any good substitutes and generally represents a small percentage of total household expenditures and business operating costs, demand would be expected to be price inelastic.

Price elasticity of demand is a useful measure because it can be used to estimate demand curves when sufficient price and quantity data are not available to estimate a demand curve. If the price elasticity of demand for water is known, along with the current quantity exchanged, then the effect of relatively small changes in the quantity supplied on prices can be predicted.

- Benefits Transfer Approach

Using the results from previously completed studies is used to estimate benefits at the study site under consideration. The application of the benefit transfer method assumes that a general relationship exists between various socio-economic variables and the value of a resource. It is further assumed that this relationship can be estimated and applied to another geographic area. Potential benefit transfer problems that must be considered include differences in water supply problems between sites and differences in socio-economic characteristics

- The opportunity cost of the most likely alternative

Using the resource cost of the water supply alternative that would be implemented in the absence of any an estimate of benefits. Estimates of benefit should be based on the cost of the most likely alternative only if there is evidence that the alternative would be implemented. In other words, the procedure should only be used in cases where preferences for an alternative that would provide a service are revealed to support the alternative.

VALUING WATER AS INTERMEDIATE GOODS

Approaches for the management of these water demands in order to achieve an efficient and cost-effective water use require an at least approximate guideline on the economic performance and competitiveness between the sectors of water consumption. The idea of such valuations is to provide a basis for the estimation of trade-offs between the degrees of achievement of social and political objectives of equivalent importance, and to delimit the range of potential WDM measures, such as economic incentives, water rationing, technological upgrading and rehabilitation. A precise water valuation requires an assessment on the margin, i.e. for the last m^3 that goes to a sector of water consumption under a specific set of circumstances. The value of water is derived from the producers' demand function, the following valuation methods could be used to assess the value of water as an intermediate input.

- Estimating the producers Water Demand Functions,

Water demand function can be deduced from historical water use statistics or calculated from the analysis of optimum water consumption patterns, to determine the schedule of increases or decreases in net income accruing from changes in the level of water use. In estimating the producers' demands function, other variables such as the prices and quantities of other inputs are included. These variables generally cause the demand curve for water to shift over time, because the demand for water depends onthe degree of variability in the demand for other inputs.

- Production Function Approach

In this approach the functional relationship between output and all the inputs including water is estimated as $Y=f(L, C,E, W)$ In an attempt to maximize profits, the producers select inputs such that the value of the marginal product is equal to the price of the product. That is; $Pw= Py. dy/dw$. This implies that the level of water W is increased until the value of the additional unit of water used () just equals the cost of using an additional unit of water (Pw).

Optimum condition requires that this must hold for all the inputs used and that the ratios of the marginal value to the marginal cost of an input must be the same for all inputs.

- Mathematical Programming

The mathematical programming approach follows a linear or no-linear programming model, which is an optimization model that combines unit processes of water utilization systems in the form of linear inequalities. These models are developed to represent the optimum allocation of water and other inputs so as to maximize profits, subject to constraints on resource availability and institutional capabilities. The procedure usually follows the construction of a flow diagram of sectoral activities, linking up the components of the flow diagram, algebraically formulating linear inequalities and constraints, and estimating the coefficients of the decision variables. This approach articulates the links between water input alternatives, their prices, other input choices and output, and identifies the best or optimal input strategies or the profit maximizing production path that could be followed by firms. In effect, it identifies the most efficient water utilizing options by the production sectors in terms of cost effectiveness and output maximization. The variables are the levels of the systems' operations and the inequalities express constraints of the overall system (Salman, et al. 2001; Doppler et al. 2002; Salman and Al-Karablieh, 2004; A-Karablieh et al., 2006). The use of mathematical programming is quite advantageous in a situation where a wide range of technological options is to be studied. In such a situation, it is important that the marginal productivity, which is represented by the net profit coefficients, is accurately calculated. However, this valuation method requires detailed data at the farm/firm/industry level and is most suitable for the individual sector or country level inter-sectoral water use analysis; but it is expensive and time consuming.

Mathematical programming models tend to be static one-period models. They model economic problems in which the economic agent (consumer, central planner, or firm) seeks to optimize (maximize or minimize) a single objective function (e.g. surplus, costs, profit or revenue) over a specific time period, while facing constraints that restrict choice to certain levels of inputs or outputs. The models can determine marginal or non-marginal values for use of water as an input. Water enters mathematical programming models as an input constraint, such that its marginal value is found by relaxing the water constraint by adding a unit to the water available for production and calculating the difference between the optimal value before and after relaxing the constraint. This marginal value of water is also known as the 'shadow value' of water. Non-marginal changes can be evaluated similarly, and also changes in the shadow value of water can be calculated for exogenous changes in output prices, input prices, or constraints. Mathematical programming models are often used to determine the value of irrigation water and groundwater in situations where detailed data are available for a few representative agents (Turner et al . 2004)

- The Residual Imputation Method (RIM),

The total value of product can be divided into shares, such that each resource is paid according to its marginal productivity and the total product is completely exhausted. If appropriate prices can be assigned to all resources but one, the remainder of total value of product is imputed to the remaining (or "residual") input.This residual imputation method is most suitable where the residual claimant (water in our case) contributes the largest fraction of the value of output. This method requires the subtraction of the economic cost of all the other production inputs except water from the sales revenue. The difference becomes the value of water in the production of commodity. Since we will apply this method to estimate the value of water in the commodities value chain analysis, a detail elaboration was made on this method to be very clear to the readers.

- The Value Added Method

The difference between the value of a firm's output and the value of inputs purchased from other firms; the value contributed by the firm's production process; often used in regional economics. Labor, land, and capital are treated as owned or internal, rather than externally purchased inputs. Usually done by constructed General Equilibrium Models (GEM) of net producers' income or rents attributable to water via value-added measure from input-output models. One of the shortcomings is seriously biased (overestimate) method that has been used mainly in off stream intermediate goods (agriculture and industry). Furthermore, this approach could be used in any situation that requires the estimation of economic benefits derived from the use of water as an intermediate input in sectoral production activities. Value added refers to net payments to the primary factors of production such as wages and salaries, rents and other natural resources, interest or depreciation on capital. Value added is measured on a sector-by-sector basis through an input-output model representing the economic structure of a country, region or water management area. The framework of the input-output model, which is a static model, is used to estimate the direct and indirect impacts. This framework based on the linear structure of inter-industry production linkages. The input-output coefficient matrix is used to calculate the direct and indirect intermediate inputs requirements per extra unit of output or value added in a specific sector. This coefficient matrix, which is also referred to as the Leontief inter -industry transactions matrix, defines the amount of the output from each production sector which is required as an intermediate input used to produce a unit of an output in a specific sector. The model illustrates the interdependence nature of the production sectors in an economy, hence the inter-sectoral forward and backward linkages. With the incorporation of water into the inter-sectoral production framework, the input-output model can be used to investigate the economy-wide contribution of water to inter-sectoral production activities and the impact of investment in water infrastructure on output growth and value added. It can also be used to evaluate the economy-wide impact of inter-sectoral water pricing, re-allocation and other managerial policies.

- The Alternative Cost Method

The cost of something in terms of an opportunity foregone (and the benefits that could be received from that opportunity), or the most valuable foregone alternative.The value attributable to cost savings from next best alternative source of service (e.g. electricity, transportation).At-site or at-source valuation of intermediate goods off-stream (agriculture, industry) and in-stream (hydropower, transportation).Also for water as private and collective consumption good by households.

The alternative cost approach is appropriate when estimates of direct demand schedules or functions are difficult to be computed because of data unavailability or other reasons. This approach is based on the assumption that the maximum willingness to pay for a publicly supplied good or service is not greater than the cost of providing it. That is, if a given project, with a specified output costs is less than the next best project with the same output level, then the former is preferred to the alternative. The present value of the total costs of each alternative is calculated on the basis of commensurate planning period, price level, and discount rate (Agudelo, 2001). The analysis must verify that the highest-cost alternative would actually be constructed in the absence of the project under consideration. The alternative cost approach is very useful when the demand for water is price inelastic and when the objective of a public project is to reduce the cost of producing an output which could otherwise be provided at a higher cost to the consumer. The approach has the advantage of permitting benefits evaluation without actual estimation of the demand curve

VALUING WATER AS PRIVATE GOODS

- Financial and Economic Returns

Economic efficiency could therefore 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. There are, for this purpose, two approaches for economic assessment, namely: Cost - Benefit (CBA) and Cost-Effectiveness analysis (CEA) (Gerasidi et al, 2003).

Economic assessment is based on the notion that available resources are not sufficient to meet all the needs and wants of different goods and services of the community and thus available resources should be utilized in an efficient way so that to allow for maximizing community welfare. The principle of economic efficiency could be seen from two perspectives; the first is based on maximizing the quantities produced of good 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, meanwhile, 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, with first approach is cost-benefit analysis, which is based on the first perspective, while cost-effectiveness is based on later perspective of economic efficiency. Each of these two approaches for economic assessment is considered in the following section.

COST-BENEFIT ANALYSIS (CBA)

Cost-benefit analysis is carried out in order to compare the economic efficiency implication of alternative options available to decision makers. Economics contributes towards improved allocations of financial resources by informing decision-makers of the full costs of each alternative option with the full benefits of the goods and services generated from that alternative.

The benefits from an action are compared to the associated costs (including the opportunity costs) within a common analytical framework. The direct benefits are usually measured physically in widely differing units, for instance quantities of water generated by desalinization plants. Other benefits are intangible and difficult to estimate in physical or monetary terms; for example reduction in mortality rates due to improved water provision from these plants. The same concepts apply to the cost side of water options (direct and/or indirect cost). . Comparison is enabled through use of the common monetary term. Thus benefits and costs of each option should be converted to monetary values in a given time period and compared to the common scenario that would prevail if no action was taken. The net benefit of each alternative option is given by the difference between the costs and benefits. The most economically efficient option is that with the highest present value of net benefits, i.e. net present value (NPV). Economic efficiency requires selecting the option with maximum NPV, assuming that various options involve equal investments. Options are economically viable only where the NPV that they generate is positive or the present values of total benefits equal or exceeds the present values of total cost. (B/C => 1) at a given opportunity cost of invested capital.

COST-EFFECTIVENESS ANALYSIS (CEA)

Cost-effectiveness analysis (also known as least cost analysis) is used to identify the most cost-effective option for achieving a pre-set of defined objectives. The most cost-effective option is identified as that with the lowest present value of costs to meet the same level of objective. Cost-Effectiveness Analysis (CEA) is a tool that can help to ensure efficient use of investment resources in sectors where benefits are difficult to value, or when the information required is difficult to determine or, in any other cases, when any attempt to make a precise monetary measurement of benefits that would be tricky or open to considerable dispute. It is a tool for the selection of alternative projects with the same objectives quantified in physical terms. It can identify the alternative that, for a given output level, minimizes the actual value of costs, or, alternatively, for a given cost, it maximises the output level

Cost-effectiveness analysis can be used to compare between a range of available alternatives that have the same effect or objective. Unlike the cost-benefit analysis, cost-effectiveness analysis does not depend on an absolute standard for the acceptance or rejection of any action, policy or program (COAG, 2007). Rather, it selects the least cost alternative that can attain the intended objective. Therefore, cost-effectiveness analysis could be used in the water management sector, especially in the context of water management in urban areas when a large number of alternatives are compared to each other.

Using CEA approach, lists of costs and benefits of potential intervention options is needed to solve one of water and sanitation problem. The cost-effectiveness of each option or measure is derived by dividing the costs by the expected benefits of the individual options. The individual options are then ranked to derive the marginal cost curves (additional cost of one additional unit), allowing for the selection of the least costly combination of measures to achieve water governance objectives.

Therefore, it is important to introduce the concept of the economic value of water in order to compare between the costs and benefits associated with the water policies, and thereafter in programs and projects. Integrated water resources management is at the heart of effective water governance – with its emphasis on balancing multi competitive and sometimes contradictory objectives and bringing together diverse interests and stakes (e.g. satisfying domestic water demand with additional water versus protecting natural flows of river or reduce ground water abstractions to maintain aquifer). Establishing economic value for water is considered to be one of the most discussed and debated issue related to economic efficiency of water use and its allocation (Gibbons, 1986). This task is not and straight forward solution. Young (2005) stated that: "water valuation presents the economic analyst with a wide range of challenging issues and problems. Because water values tend to be quite site-specific, spatial and temporal and each case confronts its own unique issues and typically requires its own original valuation. Effective measurement of water values demands skill and rigueur in application of all the tools of the applied economist's trade. These tools include data collection, statistical analysis, optimization models and research reporting."

Cost-effectiveness analysis provides an opportunity to evaluate not only different alternatives and policies of different but also the least-cost and marginal (incremental) alternatives. For example it can assess the implementation of drinking water or sewerage systems to provide services in phases, providing the opportunity to choose the least-cost alternatives in each phase (NWRI, 2003).

It is worth mentioning that cost-effectiveness approach can play an important role in the case of dealing with the implementation of a series of measures to achieve long-term objectives and to identify the least cost measures that can achieve those objectives. For instance, it can study and assess alternatives of water and/or sewage provision in a certain area during a specified period of time and determine the percentage of provision and the incremental cost for each phase, respectively, which means that it can be used to formulate long-term water management plans the long term (Gerasidi et al, 2003).

It should be noted that the economic assessment of different alternatives, both using the cost - benefit or cost-effectiveness analysis, requires knowledge of both direct and indirect costs and benefits. The difficulty in this case that some of these costs and benefits are not related to goods or services that are traded in the markets and thus have no prices that can be used in the assessment process. In other cases, markets sometimes fail to determine the real prices of some goods and services. In order to deal with such cases where prices are either non-existent or highly-distorted, the next section is considering these cases as well as their causes. This is followed by considering the concept of the economic value of environment and resources and then reviewing the various methods used to estimate such economic value.

Inductive Methods of Nonmarket Water Valuation, Their Characteristics, and Uses

	Valuation Method	*Description of the Method*	*Computation and Data Sources*	*Usefulness for Valuing Water as:*
1	Observations of Water Market Transactions	When market prices are available in a competitive market. Marginal productivity could be approximated using market price of close substitute. Includes transactions in water rights. May require shadow pricing	Observed prices from transactions for short-term leases or permanent sales of rights to water. Prices are adjusted for any distortions. Market prices are adjusted from any distortions (subsidies, taxes) and converting them to shadow prices that reflect the true economic value to society	Actual at-source or at-site WTP manifested by transactions within or between agricultural, industrial, municipal, and environmental uses

2	Estimation of Production and Cost Functions	Equation that expresses the physical relationship between the quantities of inputs used (e,g water) and the amount of product obtained. The production function can thus measure the marginal productivity of a particular input to determine the cheapest combination of inputs that can be used to produce a given level of output	Econometric Estimation using primary or secondary data on industrial and agricultural inputs and outputs analyzed with statistical (usually regression) techniques	Producers' (agricultural or industrial) at-site valuations
3	Estimation of Water Demand Functions	A behavioral relationship between quantity consumed and a person's maximum willingness to pay for incremental increases in quantity of water. It is usually an inverse relationship where at higher prices, less quantity is consumed. Other factors which influence willingness-to-pay are income, tastes and preferences, and price of substitutes.	Econometric Estimation using primary or secondary of household, industry, agriculture data analyzed with statistical methods	At-site demands for municipal sector (including residential, commercial, and government) deliveries
4	Travel Cost Method (TCM)	Estimates economic values associated with water services or sites that are used for recreation. Assumes that the value of a site is reflected in how much people are willing to pay to travel to visit the site	Revealed preference approach using econometric analysis to infer the value of recreational site attributes from the varying expenditures incurred by consumers to travel to the site	Valuation of recreational services and derived at-source valuations for changes in water supply
5	Hedonic Price Method (HPM)	Estimates economic values for water services that directly affect market prices of some other good. Most commonly applied to variations in housing prices that reflect the value of local environmental attributes	Revealed preference approach using econometric analysis of data on real property transactions with varying availability of water supply or quality	At-source demands for changes in water quantity or quality revealed by transactors in residential or farm properties
6	Defensive Behavior Method	Costs incurred in mitigating the effects of reduced water services to ecosystem. Represents a minimum value for the environmental function	Revealed preference method using reductions in the costs of actions taken to mitigate or avoid incurring an external cost as a partial measure of the benefits of policies from reducing the externality.	Valuation of reduced water pollution from biological or chemical contaminants
7	Damage Cost Methods	estimate values of water services based on either the costs of avoiding damages due to lost in services, the cost of replacing water services, or the cost of providing services from substitute resources	Maximum willingness to pay given as monetary value of damages avoided	Valuation of reduced water pollution or Hood damages

8	Contingent Valuation Method (CVM)	An expressed preference method which asks individuals the value (in monetary terms) of specified changes in quantities or qualities of environmental goods and services; especially useful where nonuse values are important.	Expressed preference method using statistical techniques for analyzing responses lo survey questions asking for monetary valuation of proposed changes in goods or services.	At source valuations of environmental (e.g. In-stream) water supplies. Also al-site valuations of changes in residential water supplies.
9	Choice Modeling (CM)	An expressed preference method that infers willingness to pay in absence of markets by directly asking a sample of respondents to make choices among alternative proposed water option; assumes preferences are based on several attributes of product or situation, and values proposals by assessing tradeoffs among attributes.	Expressed preference method using statistical techniques to infer WTP for goods or services from survey questions asking a sample of respondents to make choices among alternative proposed policies.	Valuations of environmental (e.g. in stream) water supplies. Also at-site valuations of changes in residential water supplies.
10	Benefit Transfer	The procedure by which water values estimated for a site are employed to assign benefits or value to another site	Benefits estimated for one or more sites or policy. Proposals employed to assign benefits or value to other sites or policy proposals	Adaptable In principle for any case: producers' or consumers' goods; and collective environmental goods including nonuse values
11	Benefit Function Transfer/ Meta-Analysis	Statistical analysis of the results of previously reported research studies; for the purpose of improving research methods by determining the effects of differing research techniques or model specifications	Statistical synthesis of the results of previously reported studies of the same phenomenon or relationship to distill generalizations.	A potential basis for benefit transfer in all producers' and consumers' valuation contexts. Also valuable for assessing role of methodological assumptions in research results

Source: Young, A. Robert (2005). Determining The Value of Water : Concepts and Methods. RFF Press, Resources for the Future, February 2005/340 pages ISBN 1-891853-97-X

Mostly Deductive Methods of Nonmarket Water Valuation, Their Characteristics, and Uses

	Valuation Method	*Description of the Method*	*Computation and Data Sources*	*Usefulness for Valuing Water as:*
1	Imputation Residual Approach	Methods used for valuing intermediate goods; by approximating the net rent or value marginal product of a non-priced productive input by subtracting all other estimated costs of production from total value of output. The remaining (residual) value is assigned to the non-priced input (e.g. water).	Constructed models for deriving point estimate of net producers' income or rents attributable to water via budget or spread sheet analysis	At-site or at-source estimates for off-stream intermediate goods (agriculture, industry) for single-product case

2	Change in Net Rents	The value contributed by a partial change in intermediates goods by allowing changes in the amounts of other inputs used in production process.	Constructed residual models for deriving interval estimate of net producers' income or rents attributable to increment of water via budget or spreadsheet analysis.	At-site or at-source estimates for off-stream intermediate goods (agriculture, industry) for multiple-product, multiple-technology cases.
3	Mathematical Programming	An operations research technique that solves problems in which an optimal value is sought subject to specified constraints. Mathematical programming models include linear programming, quadratic programming, and dynamic programming	Constructed residual models for deriving net producers' rents or marginal costs attributable to water via (usually) fixed-price optimization models.	At-site or at-source valuation of off-stream intermediate goods (agriculture, industry) for multiple-product, multiple-technology cases.
4	Value-added Method	The difference between the value of a firm's output and the value of inputs purchased from other firms; the value contributed by the firm's production process; often used in regional economics. Labor, land, and capital are treated as owned or internal, rather than externally purchased inputs.	Constructed models of net producers' income or rents attributable to water via value-added measure from input-output models	Seriously biased (overestimate) method that has been used mainly in off stream intermediate goods (agriculture and industry).
5	Computable General Equilibrium (CGE) Models	Empirical model of a region, or subdivision designed to determine domestic prices, supplies, and incomes jointly via a system of nonlinear simultaneous equations	Constructed models for deriving net producers' income or rents attributable to water via price-endogenous optimization models.	Recently adapted method used mainly for off-stream intermediate goods (agriculture and industry).
6	Alternative Costs Methods	the cost of something in terms of an opportunity foregone (and the benefits that could be received from that opportunity), or the most valuable foregone alternative	Value attributable to cost savings from next best alternative source of service (e.g. electricity, transportation).	At-site or at-source valuation of intermediate goods off-stream (agriculture, industry) and in-stream (hydropower, transportation). Also for water as private and collective consumption good by households.

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ANNEX II: ANNUAL AVERAGE NET IRRIGATION REQUIREMENTS(M3/DU) IN JORDAN BY AGRO-ECOLOGICAL ZONES

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
1	Wheat	Year	157	273	401	527	296	303	366	370	495	340	366	354	200
2	Barley	Year	204	249	315	577	281	298	246	318	450	336	318	326	130
3	Lentils	Year	330	350	365	373	281	303	306	318	335	354	308	329	250
4	Vetch	Year	236	250	261	267	281	303	281	318	335	253	303	281	150
5	Chick-peas	Year	330	350	365	373	281	303	306	318	335	354	308	329	250
6	Maize	Year	681	723	754	771	643	591	600	789	632	732	651	687	300
7	Sorghum	Year	565	600	625	640	534	493	500	718	624	608	574	589	350
8	Broom millet	Year	565	600	625	640	534	690	700	1006	624	608	710	665	300
9	Tobacco,local	Year	339	360	375	384	320	276	280	402	374	365	330	346	200
10	Tobacco, red *	Year	330	350	365	373	311	286	290	417	364	354	333	343	200

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
11	Garlic	Year	493	523	545	540	465	423	423	608	416	525	467	493	300
12	Vetch, common	Year	302	320	334	341	285	296	300	431	333	324	329	327	300
13	Sesame	Year	377	400	417	427	356	345	350	503	416	405	394	399	429
14	Clover, trifoliate	Year	598	624	650	665	565	1605	1414	1654	1340	634	1315	1013	300
15	Alfalfa	Year	698	728	759	1338	659	1605	1414	1654	1430	881	1352	1143	300
16	Others FC	Year	471	442	778	811	444	246	250	359	790	625	418	510	359
17	Tomatoes	Win	301	354	447	350	284	394	400	575	611	363	399	413	250
18	Squash	Win	215	204	248	263	337	337	389	383	383	233	366	307	200
19	Eggplants	Win	370	279	338	245	346	346	351	504	238	308	357	335	252
20	Cucumber	Win	298	343	381	249	337	337	407	383	383	318	369	346	253
21	Potato	Win	322	252	415	337	302	315	320	460	328	332	345	339	254
22	Cabbage	Win	269	291	288	356	231	459	424	608	347	301	414	364	255
23	Cauliflower	Win	147	243	279	328	231	459	424	608	319	249	408	338	256
24	Hot pepper	Win	298	259	358	215	279	323	328	471	209	282	322	304	257
25	Sweet pepper	Win	380	305	511	451	356	270	274	394	440	412	347	376	258
26	Broad beans	Win	214	218	303	697	226	394	420	603	679	358	464	417	259
27	String beans	Win	281	200	271	281	231	428	376	540	274	258	370	320	260
28	Peas	Win	222	235	229	644	257	428	378	543	627	332	447	396	261
29	Cow-peas	Win	262	278	272	282	231	428	400	574	274	273	381	333	262
30	Jew's mallow	Win	422	349	471	227	395	238	242	348	221	367	289	324	263

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
31	Okra	Win	357	379	373	386	380	390	379	545	376	374	414	396	264
32	Lettuce	Win	231	211	220	279	216	325	207	297	272	235	263	251	265
33	Sweet melon	Win	336	356	369	413	372	337	489	383	383	368	393	382	266
34	Water melon	Win	336	356	369	382	337	337	489	383	383	360	386	374	267
35	Spinach	Win	196	208	215	223	183	325	208	299	217	211	247	231	268
36	Onion green	Win	210	453	349	651	196	423	532	764	634	416	510	468	269
37	Onion dry	Win	209	484	349	457	196	423	823	1182	445	375	614	508	270
38	Snake cucumber	Win	237	252	260	270	222	244	248	356	263	255	267	261	271
39	Turnip	Win	234	248	257	328	219	244	248	356	320	267	277	273	272
40	Carrot	Win	223	237	245	289	209	233	237	341	281	249	260	255	273
41	Parsley	Win	231	245	254	263	216	316	321	461	256	248	314	285	274
42	Radish	Win	234	248	257	328	219	244	248	356	320	267	277	273	275
43	Others W Veg	Win	536	235	368	393	501	246	250	359	383	383	348	363	276
44	Tomatoes	Sum	353	411	500	539	794	740	800	500	693	451	705	592	164
45	Squash	Sum	224	211	230	363	321	738	269	387	354	257	414	344	131
46	Eggplants	Sum	364	276	349	489	643	796	629	500	500	369	613	505	165
47	Cucumber	Sum	291	308	316	418	440	585	308	500	408	333	448	397	166
48	Potato	Sum	206	274	333	560	545	654	628	599	500	343	585	478	166
49	Cabbage	Sum	296	342	380	389	347	322	343	565	565	352	428	394	167
50	Cauliflower	Sum	246	261	380	402	347	322	343	565	565	322	428	381	167

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
51	Hot pepper	Sum	378	279	478	354	612	729	617	500	500	372	591	494	168
52	Sweet pepper	Sum	450	221	500	774	678	781	588	500	500	486	609	555	169
53	Broad beans	Sum	204	244	294	474	408	519	335	645	512	304	484	404	169
54	String beans	Sum	273	225	206	210	343	597	243	715	512	229	482	369	170
55	Peas	Sum	233	247	253	415	343	568	247	554	565	287	456	381	171
56	Cow-peas	Sum	276	293	299	306	343	458	293	565	565	294	445	378	171
57	Jew's mallow	Sum	583	446	666	235	241	251	255	366	229	482	268	364	172
58	Okra	Sum	376	399	408	512	378	393	399	573	499	424	448	437	173
59	Lettuce	Sum	205	218	223	228	206	215	218	313	222	219	235	228	173
60	Sweet melon	Sum	409	319	295	363	526	541	607	872	354	346	580	476	174
61	Water melon	Sum	455	386	422	580	321	574	375	538	565	461	474	468	175
62	Spinach	Sum	206	219	224	229	207	216	219	314	223	220	236	229	175
63	Onion green	Sum	528	560	573	679	530	551	560	804	661	585	621	605	176
64	Onion dry	Sum	210	459	424	434	768	500	812	1166	260	382	701	559	177
65	Snake cucumber	Sum	246	261	267	273	247	257	261	375	266	262	281	273	177
66	Turnip	Sum	246	261	267	480	247	257	261	375	468	314	322	318	178
67	Carrot	Sum	235	249	255	261	236	246	249	358	255	250	269	261	179
68	Parsley	Sum	243	258	264	270	320	333	338	485	263	259	348	308	179
69	Radish	Sum	246	261	267	480	247	257	261	375	468	314	322	318	180
70	Others S Veg	Sum	336	240	445	456	249	259	263	378	444	369	319	341	181

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
71	Lemons	Year	986	1046	1292	1659	961	973	1202	988	1055	1246	1036	1129	320
72	Oranges, local	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
73	Oranges, navel	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
74	Oranges, red	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
75	Oranges, valencia	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
76	Oranges, french	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
77	Oranges, shamouti	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
78	Clementines	Year	986	1046	1292	1659	961	973	1202	988	1055	1246	1036	1129	320
79	Mandarins	Year	986	1046	1292	1659	961	973	1202	988	1055	1246	1036	1129	320
80	Grapefruits	Year	986	1046	1292	1659	961	973	1202	988	1055	1246	1036	1129	320
81	Medn. mandarins	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
82	Pummelors	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
83	Sour oranges	Year	987	1047	1293	1661	962	974	1203	989	1056	1247	1037	1130	320
84	Olives	Year	660	700	735	983	375	517	500	695	700	769	557	652	281
85	Grapes	Year	780	811	1004	753	677	636	709	659	663	837	669	743	295
86	Figs	Year	707	750	787	1027	803	954	826	913	810	818	861	842	285
87	Almonds	Year	707	750	787	1027	798	941	826	913	810	818	858	840	280
88	Peaches	Year	707	750	787	1477	804	1026	826	913	810	930	876	900	280
89	Plums, prunes	Year	707	750	787	1007	829	917	826	913	810	813	859	838	280
90	Apricots	Year	707	750	787	1027	798	954	826	918	810	818	861	842	280

No.	Crop	Season	NJV	MJV	SJV	Safi	North	Middle	NorthEast	South	Desert	JV	Highland	Jordan	Rainfed
91	Apples	Year	1516	1459	934	1218	798	954	901	913	810	1282	875	1056	300
92	Pomegrantes	Year	707	750	787	1027	798	954	826	913	810	818	860	841	250
93	Pears	Year	707	750	787	1027	798	954	826	913	810	818	860	841	281
94	Guava	Year	707	750	787	1027	798	954	826	913	810	818	860	841	280
95	Dates	Year	1315	1395	1820	1431	1025	985	1000	1354	1385	1490	1150	1301	280
96	Bananas	Year	1071	1298	1461	1596	1327	1381	1200	1388	1503	1356	1360	1358	900
97	Others Fruit	Year	566	600	738	989	650	725	694	857	1160	723	817	775	280

Annex III: Farmgate, Wholesale and Retailers and Exported Prices by market destination of horticultural product in Jordan during 2010.

No.	Crop	Season	Jordan	JV	Highland	JV Wholesale	Highland Wholesale	Consumer Price	Neighboring Export Price	Gulf Export Price	East Europe Export Price	West Europe Export Price	Rest of the World Export Price
1	Wheat	Year	376.5	320.9	432.0	410.0	445.0	461.5	0.0	0.0	0.0	0.0	0.0
2	Barley	Year	242.6	242.6	242.6	275.0	275.0	335.3	0.0	0.0	0.0	0.0	0.0
3	Lentils	Year	490.0	490.0	490.0	602.7	615.9	807.6	0.0	0.0	0.0	0.0	0.0
4	Vetch	Year	300.0	300.0	300.0	369.0	377.1	590.4	0.0	0.0	0.0	0.0	0.0
5	Chick-peas	Year	600.0	600.0	600.0	738.0	754.2	639.0	0.0	0.0	0.0	0.0	0.0
6	Maize	Year	203.9	203.8	209.1	264.4	225.9	661.0	283.3	296.8	0.0	0.0	0.0
7	Sorghum	Year	110.0	120.0	125.0	165.0	165.0	221.9	0.0	0.0	0.0	0.0	0.0
8	Broom millet	Year	95.0	150.0	177.5	216.0	220.0	173.0	0.0	0.0	0.0	0.0	0.0
9	Tobacco,local	Year	400.0	400.0	400.0	492.0	540.8	1180.8	0.0	0.0	0.0	0.0	0.0
10	Tobacco, red *	Year	450.0	450.0	450.0	553.5	608.4	1405.9	0.0	0.0	0.0	0.0	0.0
11	Garlic	Year	459.5	459.5	459.5	565.2	604.2	2891.0	0.0	0.0	0.0	0.0	0.0
12	Vetch, common	Year	250.0	250.0	250.0	307.5	317.0	487.1	0.0	0.0	0.0	0.0	0.0
13	Sesame	Year	650.0	650.0	650.0	799.5	824.2	1867.3	0.0	0.0	0.0	0.0	0.0
14	Clover, trifoliate	Year	145.0	156.0	161.5	198.4	193.7	331.7	0.0	0.0	0.0	0.0	0.0
15	Alfalfa	Year	150.0	160.0	165.0	184.5	190.5	273.8	0.0	0.0	0.0	0.0	0.0
16	Others FC	Year	150.0	150.0	150.0	184.5	181.7	366.2	0.0	0.0	0.0	0.0	0.0
17	Tomatoes	Win	101.1	112.0	88.9	138.5	114.7	514.3	377.6	487.0	1002.6	0.0	0.0
18	Squash	Win	259.1	258.9	263.5	304.0	296.6	523.3	531.3	459.9	0.0	0.0	0.0

No.	Crop	Season	Jordan	JV	Highland	JV Wholesale	Highland Wholesale	Consumer Price	Neighboring Export Price	Gulf Export Price	East Europe Export Price	West Europe Export Price	Rest of the World Export Price
19	Eggplants	Win	148.6	150.7	154.3	191.0	207.7	572.7	380.0	338.6	1000.0	0.0	0.0
20	Cucumber	Win	228.1	232.1	287.6	270.3	321.9	528.3	466.1	359.9	0.0	1000.0	1002.3
21	Potato	Win	243.0	208.9	270.0	248.7	318.2	548.6	451.0	417.6	1004.9	1006.2	0.0
22	Cabbage	Win	55.8	36.0	62.4	66.5	80.6	302.4	171.3	183.7	0.0	0.0	1000.0
23	Cauliflower	Win	152.2	78.4	155.0	108.3	185.1	486.4	337.5	377.8	0.0	3541.2	0.0
24	Hot pepper	Win	262.7	267.2	377.0	341.8	446.1	866.9	533.9	450.0	1130.5	1360.4	1000.0
25	Sweet pepper	Win	326.0	335.8	231.7	393.9	290.0	866.8	0.0	0.0	0.0	0.0	0.0
26	Broad beans	Win	549.0	564.2	560.9	632.5	636.3	1357.0	1005.5	682.1	0.0	0.0	0.0
27	String beans	Win	624.6	625.3	485.5	703.7	545.7	1375.3	1085.7	856.3	0.0	0.0	0.0
28	Peas	Win	981.3	873.0	981.3	973.0	1043.0	1648.0	0.0	0.0	0.0	3464.9	0.0
29	Cow-peas	Win	533.6	533.6	646.0	611.7	952.0	1396.3	0.0	0.0	0.0	0.0	0.0
30	Jew's mallow	Win	111.0	111.8	111.0	317.0	247.0	452.4	0.0	190.0	0.0	0.0	0.0
31	Okra	Win	1429.0	1266.3	1356.0	1400.0	1450.0	1820.6	0.0	1623.1	0.0	0.0	0.0
32	Lettuce	Win	115.8	138.3	115.8	274.0	136.7	364.9	0.0	0.0	0.0	0.0	0.0
33	Sweet melon	Win	291.0	291.0	215.0	348.7	452.0	848.0	460.8	262.3	0.0	0.0	0.0
34	Water melon	Win	136.0	137.0	135.0	175.0	168.0	461.0	314.0	176.9	1000.0	1000.0	1000.0
35	Spinach	Win	97.2	85.9	97.3	97.9	115.2	384.3	0.0	210.0	0.0	0.0	0.0
36	Onion green	Win	272.9	327.0	273.4	372.0	286.0	1148.9	0.0	0.0	0.0	0.0	0.0
37	Onion dry	Win	207.1	232.0	182.2	251.0	217.0	512.1	442.9	542.8	0.0	0.0	0.0
38	Snake cucumber	Win	339.0	339.3	339.5	387.0	387.0	812.7	0.0	656.7	0.0	0.0	0.0

No.	Crop	Season	Jordan	JV	Highland	JV Wholesale	Highland Wholesale	Consumer Price	Neighboring Export Price	Gulf Export Price	East Europe Export Price	West Europe Export Price	Rest of the World Export Price
39	Turnip	Win	111.0	111.0	111.0	900.0	950.0	507.0	0.0	750.0	0.0	0.0	0.0
40	Carrot	Win	161.8	157.8	162.5	186.0	186.0	594.2	0.0	0.0	0.0	0.0	0.0
41	Parsley	Win	124.1	120.0	124.1	100.0	144.7	169.6	0.0	206.9	0.0	0.0	0.0
42	Radish	Win	152.0	151.6	151.0	276.0	195.0	531.7	0.0	220.0	0.0	0.0	0.0
43	Others W Veg	Win	145.0	145.0	145.0	250.0	260.0	500.0	0.0	0.0	0.0	0.0	0.0
44	Tomatoes	Sum	76.8	70.5	77.1	94.3	102.2	616.8	377.6	487.0	1002.6	0.0	0.0
45	Squash	Sum	193.1	232.2	196.2	296.8	234.3	568.8	531.3	459.9	0.0	0.0	0.0
46	Eggplants	Sum	115.3	89.7	121.0	136.9	170.5	563.3	380.0	338.6	1000.0	0.0	0.0
47	Cucumber	Sum	128.6	139.9	129.1	183.8	161.1	590.3	466.1	359.9	0.0	1000.0	1002.3
48	Potato	Sum	208.6	274.2	204.7	311.4	239.7	577.4	451.0	417.6	1004.9	1006.2	0.0
49	Cabbage	Sum	78.7	78.7	78.7	166.0	89.9	363.1	171.3	183.7	0.0	0.0	1000.0
50	Cauliflower	Sum	181.6	180.1	181.6	350.0	219.7	685.8	337.5	377.8	0.0	3541.2	0.0
51	Hot pepper	Sum	187.2	320.0	189.8	398.8	253.3	815.1	533.9	450.0	1130.5	1360.4	1000.0
52	Sweet pepper	Sum	162.4	186.7	160.9	248.1	223.0	823.5	0.0	0.0	0.0	0.0	0.0
53	Broad beans	Sum	388.4	388.4	388.4	563.0	416.8	1574.9	1005.5	682.1	0.0	0.0	0.0
54	String beans	Sum	435.3	435.1	436.3	496.0	488.1	1426.3	1085.7	856.3	0.0	0.0	0.0
55	Peas	Sum	402.1	402.1	402.1	952.0	465.0	1625.0	0.0	0.0	0.0	3464.9	0.0
56	Cow-peas	Sum	650.9	732.7	592.7	790.5	662.0	1649.4	0.0	0.0	0.0	0.0	0.0
57	Jew's mallow	Sum	111.8	80.0	175.4	317.0	186.0	408.8	0.0	190.0	0.0	0.0	0.0
58	Okra	Sum	922.5	872.6	1080.2	934.1	1202.5	2246.9	0.0	1623.1	0.0	0.0	0.0

No.	Crop	Season	Jordan	JV	Highland	JV Wholesale	Highland Wholesale	Consumer Price	Neighboring Export Price	Gulf Export Price	East Europe Export Price	West Europe Export Price	Rest of the World Export Price
59	Lettuce	Sum	120.7	120.7	120.7	140.0	150.7	413.0	0.0	0.0	0.0	0.0	0.0
60	Sweet melon	Sum	151.7	219.2	149.2	258.4	177.8	517.6	460.8	262.3	0.0	0.0	0.0
61	Water melon	Sum	91.8	135.9	91.8	180.0	117.5	323.6	314.0	176.9	1000.0	1000.0	1000.0
62	Spinach	Sum	137.0	158.8	148.0	186.0	167.0	430.4	0.0	210.0	0.0	0.0	0.0
63	Onion green	Sum	617.4	364.3	617.4	465.0	646.3	1554.2	0.0	0.0	0.0	0.0	0.0
64	Onion dry	Sum	147.7	147.5	137.3	165.2	165.6	428.2	442.9	542.8	0.0	0.0	0.0
65	Snake cucumber	Sum	306.8	303.6	407.0	341.0	465.0	716.1	0.0	656.7	0.0	0.0	0.0
66	Turnip	Sum	111.0	105.0	119.0	130.0	135.0	813.1	0.0	750.0	0.0	0.0	0.0
67	Carrot	Sum	213.8	213.8	213.8	335.0	243.6	645.2	0.0	0.0	0.0	0.0	0.0
68	Parsley	Sum	120.0	130.0	110.0	160.0	180.0	181.5	0.0	206.9	0.0	0.0	0.0
69	Radish	Sum	182.5	151.0	182.5	190.0	204.7	700.2	0.0	220.0	0.0	0.0	0.0
70	Others S Veg	Sum	145.0	150.0	140.0	185.0	190.0	375.0	0.0	0.0	0.0	0.0	0.0
71	Lemons	Year	349.7	354.3	334.4	400.3	386.9	1136.5	891.0	714.4	0.0	0.0	0.0
72	Oranges, local	Year	350.5	357.5	350.8	392.3	400.3	850.0	0.0	0.0	0.0	0.0	0.0
73	Oranges, navel	Year	360.0	342.0	360.0	450.0	450.0	974.7	850.0	832.2	0.0	0.0	0.0
74	Oranges, red	Year	423.0	380.0	380.0	536.0	536.0	1161.0	0.0	0.0	0.0	0.0	0.0
75	Oranges, valencia	Year	423.0	423.0	423.0	545.0	545.0	1180.5	0.0	0.0	0.0	0.0	0.0
76	Oranges, french	Year	295.0	295.0	295.0	316.0	316.0	684.5	0.0	0.0	0.0	0.0	0.0
77	Oranges, shamouti	Year	330.0	330.0	330.0	350.0	350.0	758.1	0.0	0.0	0.0	0.0	0.0
78	Clementines	Year	283.7	264.7	359.3	310.2	401.1	710.7	0.0	0.0	0.0	0.0	0.0

No.	Crop	Season	Jordan	JV	Highland	JV Wholesale	Highland Wholesale	Consumer Price	Neighboring Export Price	Gulf Export Price	East Europe Export Price	West Europe Export Price	Rest of the World Export Price
79	Mandarins	Year	290.0	289.0	289.0	395.0	395.0	831.7	617.7	674.7	0.0	0.0	0.0
80	Grapefruits	Year	188.9	172.4	208.5	207.7	253.0	657.9	1050.2	553.0	0.0	0.0	0.0
81	Medn. mandarins	Year	252.3	238.0	289.0	280.6	325.5	607.8	0.0	0.0	0.0	0.0	0.0
82	Pummelors	Year	285.0	276.3	302.5	308.8	361.2	805.9	0.0	0.0	0.0	0.0	0.0
83	Sour oranges	Year	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
84	Olives	Year	381.0	434.0	460.5	807.0	770.0	1301.7	0.0	1086.1	0.0	0.0	1047.9
85	Grapes	Year	668.0	629.8	390.6	746.0	446.6	1175.3	1250.0	1071.1	1000.0	0.0	556.7
86	Figs	Year	420.0	420.0	420.0	930.0	930.0	1645.7	0.0	992.5	0.0	0.0	1790.4
87	Almonds	Year	780.0	780.0	780.0	980.0	980.0	1283.8	2500.0	0.0	0.0	0.0	2081.8
88	Peaches	Year	329.0	390.1	390.1	458.1	458.1	1386.6	1127.0	1024.9	0.0	0.0	951.0
89	Plums, prunes	Year	918.0	918.0	918.0	937.0	987.0	1935.4	1380.4	1259.4	0.0	0.0	1279.9
90	Apricots	Year	426.4	426.4	426.4	544.2	544.2	1789.0	1859.5	1782.4	0.0	0.0	2000.0
91	Apples	Year	351.9	351.9	351.9	429.0	429.0	1425.9	1265.0	1345.0	0.0	0.0	1100.0
92	Pomegrantes	Year	447.0	302.1	229.7	816.0	816.0	1306.4	0.0	689.1	0.0	0.0	1793.3
93	Pears	Year	663.0	663.0	663.0	1519.0	1519.0	2074.5	0.0	1837.6	0.0	0.0	1777.0
94	Guava	Year	451.0	451.0	451.0	958.0	958.0	1942.1	0.0	0.0	0.0	0.0	0.0
95	Dates	Year	600.0	600.0	600.0	925.0	925.0	1163.0	689.5	1431.2	0.0	3418.8	3408.7
96	Bananas	Year	481.7	481.7	481.7	506.0	506.0	730.9	0.0	600.0	0.0	0.0	0.0
97	Others Fruit	Year	395.0	385.0	380.0	478.0	478.0	696.2	0.0	251.4	0.0	0.0	0.0

Source: Department of Statistics 2011, Agricultural Price Survey & Ministry of Agriculture, Marketing Directorate

ANNEX III: ISIC REV.3. INTERNATIONAL STANDARD INDUSTRIAL CLASSIFICATION OF ALL ECONOMIC ACTIVITIES, REV.3

Click on any code to see more detail. Click link for top level only.

- A - Agriculture, hunting and forestry
  - 01 - Agriculture, hunting and related service activities
  - 02 - Forestry, logging and related service activities
- B - Fishing
  - 05 - Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
- C - Mining and quarrying
  - 10 - Mining of coal and lignite; extraction of peat
  - 11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
  - 12 - Mining of uranium and thorium ores
  - 13 - Mining of metal ores
  - 14 - Other mining and quarrying
- D - Manufacturing
  - 15 - Manufacture of food products and beverages
  - 16 - Manufacture of tobacco products
  - 17 - Manufacture of textiles
  - 18 - Manufacture of wearing apparel; dressing and dyeing of fur
  - 19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
  - 20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
  - 21 - Manufacture of paper and paper products
  - 22 - Publishing, printing and reproduction of recorded media
  - 23 - Manufacture of coke, refined petroleum products and nuclear fuel
  - 24 - Manufacture of chemicals and chemical products

- 25 - Manufacture of rubber and plastics products
    - 26 - Manufacture of other non-metallic mineral products
    - 27 - Manufacture of basic metals
    - 28 - Manufacture of fabricated metal products, except machinery and equipment
    - 29 - Manufacture of machinery and equipment n.e.c.
    - 30 - Manufacture of office, accounting and computing machinery
    - 31 - Manufacture of electrical machinery and apparatus n.e.c.
    - 32 - Manufacture of radio, television and communication equipment and apparatus
    - 33 - Manufacture of medical, precision and optical instruments, watches and clocks
    - 34 - Manufacture of motor vehicles, trailers and semi-trailers
    - 35 - Manufacture of other transport equipment
    - 36 - Manufacture of furniture; manufacturing n.e.c.
    - 37 - Recycling
- E - Electricity, gas and water supply
    - 40 - Electricity, gas, steam and hot water supply
    - 41 - Collection, purification and distribution of water
- F - Construction
    - 45 - Construction
- G - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
    - 50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
    - 51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
    - 52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
- H - Hotels and restaurants
    - 55 - Hotels and restaurants
- I - Transport, storage and communications
    - 60 - Land transport; transport via pipelines
    - 61 - Water transport
    - 62 - Air transport
    - 63 - Supporting and auxiliary transport activities; activities of travel agencies
    - 64 - Post and telecommunications
- J - Financial intermediation
    - 65 - Financial intermediation, except insurance and pension funding
    - 66 - Insurance and pension funding, except compulsory social security
    - 67 - Activities auxiliary to financial intermediation
- K - Real estate, renting and business activities
    - 70 - Real estate activities
    - 71 - Renting of machinery and equipment without operator and of personal and household goods
    - 72 - Computer and related activities
    - 73 - Research and development
    - 74 - Other business activities
- L - Public administration and defence; compulsory social security
    - 75 - Public administration and defence; compulsory social security
- M - Education
    - 80 - Education
- N - Health and social work
    - 85 - Health and social work
- O - Other community, social and personal service activities

- 90 - Sewage and refuse disposal, sanitation and similar activities
- 91 - Activities of membership organizations n.e.c.
- 92 - Recreational, cultural and sporting activities
- 93 - Other service activities
- P - Private households with employed persons
  - 95 - Private households with employed persons
- Q - Extra-territorial organizations and bodies
  - 99 - Extra-territorial organizations and bodies

ANNEX IV : WATER VALUES IN INDUSTRIAL, SERVICES AND OTHER ECONOMICAL SECTORS DISAGGREGATED BY ISIC 4 CLASSIFICATIONS

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
1110	Extraction of crude petroleum and natural gas	8,900	1,222.7	1,167.9	1,031.1	881.0	61.1	1.83	71,346
1410	Quarrying of stone sand and clay	2,413,733	15.6	6.7	5.0	1.6	2,146.5	2.81	12,400
1421	Mining of chemical and fertilizer	15,561,410	55.2	38.8	36.3	28.4	2,578.5	3.17	99,957
1511	Production processing and preserving of meat products	485,933	575.9	122.1	103.0	45.0	105.7	0.22	12,892
1513	Production and preserving of fruit and vegetables	235,067	251.4	65.7	57.4	29.4	201.0	0.54	13,021
1514	Manufacture of vegetable and animal oils and fats	557,933	307.9	90.0	86.2	61.0	518.7	0.46	42,162
1520	Manufacture of dairy products	602,867	211.5	52.7	45.4	17.5	170.5	0.63	7,647
1531	Manufacture of grain mill products	204,167	496.7	69.1	51.5	22.9	195.2	0.23	12,098
1533	Manufacture of prepared animal feeds	48,333	1,827.7	378.3	354.8	171.7	62.7	0.07	21,734

ISIC-Cd.	Economic Activity	Water Consum ption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operatio n surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
1541	Manufacture of bakery products	1,529,500	151.0	45.1	41.6	18.4	144.3	0.94	5,346
1543	Manufacture of cocoa chocolate and sugar confectionery	155,500	381.8	87.5	70.8	14.7	103.6	0.34	8,459
1549	Manufacture of other food products	311,100	361.7	110.4	101.2	52.5	134.9	0.40	11,803
1551	Distilling rectifying and blending of spirits ethyl alcohol production from fert	107,867	446.8	300.4	288.4	99.4	257.0	0.68	77,214
1554	Manufacture of soft drinks : production of mineral waters	2,440,667	85.8	34.5	31.2	13.4	737.2	1.95	24,774
1600	Manufacture of tobaccoproductss	132,033	2,952.0	1,980.1	1,921.8	112.9	84.5	0.10	166,059
1711	preparation and spinning of textiles fibers : weaving of textiles	27,733	593.2	243.2	226.1	91.6	69.7	0.29	16,449
1721	Manufacture of made-up textile articles, except apparel	16,400	584.6	258.6	249.6	157.3	47.6	0.31	4,707
1722	Manufacture of carpets and rugs	47,800	757.4	322.0	284.8	162.6	61.5	0.23	19,453
1729	Manufacture of other textiles n e c	9,200	658.8	315.1	287.6	125.3	21.2	0.29	5,488
1730	manufacture of knitted and crocheted fabrics and articles	17,000	462.7	192.6	165.3	8.0	13.1	0.37	2,307
1810	Manufacture of wearing apparel, except fur apparel	1,446,367	317.9	167.8	163.2	112.1	65.3	0.67	9,918
1911	tanning and dressing of leather	8,067	288.5	72.8	67.0	3.9	91.5	0.46	4,159
1912	Manufacture of luggage -hand bags and like saddlery and harness	2,733	628.2	290.2	284.3	163.3	17.1	0.30	3,393
1920	Manufacture of footwear	47,100	476.7	189.0	167.2	84.4	63.9	0.35	10,562
2010	sawmilling and planing of wood	41,300	331.4	117.9	116.0	76.7	109.6	0.47	11,167
2022	Manufacture of builders' carpentry and joinery	47,667	609.1	263.1	246.6	163.5	46.7	0.29	5,395
2023	Manufacture of wooden containers	4,533	561.6	139.0	126.8	30.2	25.4	0.24	2,773
2029	Manufacture of other articles of cork straw and plaiting materials	7,200	857.3	363.2	284.9	57.8	18.6	0.20	4,702
2101	Manufacture of pulp paper and	53,433	684.6	182.2	163.4	79.1	81.0	0.20	14,619
2102	Manufacture of corrugated paper and paper board	199,933	373.2	150.7	129.8	65.2	167.9	0.45	23,898
2109	Manufacture of other articles of paper and paperboard	177,633	543.8	177.2	165.8	41.6	108.6	0.27	18,733
2212	Publishing of newspapers journals and periodicals	137,300	749.4	463.4	421.3	213.1	42.3	0.35	18,828

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
2221	Printing	125,700	626.4	253.5	209.5	69.9	50.2	0.27	10,082
2222	Service activities related to printing	5,333	534.2	243.7	176.2	37.8	30.8	0.34	6,275
2320	Manufacture of refined petroleum	1,086,533	1,842.6	146.0	138.2	119.2	322.3	0.06	47,043
2411	Manufacture of basic chemicals except fertilizers and nitrogen	2,924,967	67.6	34.0	30.8	26.5	2,582.1	2.97	86,163
2412	Manufacture of fertilizers and nitrogen compounds	4,612,933	77.2	19.5	18.2	13.5	2,940.3	1.73	57,447
2413	manufacture of plastics in primary forms and of synthetic rubber	140,567	232.6	76.9	67.1	21.3	156.1	0.64	11,063
2421	Manufacture of pesticides and other Argo- chemical products	19,233	1,180.3	376.6	339.3	236.4	60.0	0.12	22,583
2422	Manufacture of paints varnishes and similar coatings printing ink and ma	99,567	1,176.7	285.4	268.8	93.3	62.0	0.11	17,026
2423	Manufacture of pharmaceuticals medicinal chemicals and botanical	688,633	588.1	282.4	265.4	178.5	122.7	0.33	34,630
2424	Manufacture of soap and detergents clearing and polishing preparations	289,900	443.5	158.7	148.2	69.8	90.2	0.35	13,901
2429	Manufacture of other chemical products n e c	29,367	626.8	211.5	189.4	91.2	110.0	0.24	23,274
2511	Manufacture of rubber tires and tubes retreading and rebuilding of rubber	5,700	790.5	223.7	178.7	50.1	49.6	0.18	10,378
2519	Manufacture of other rubber products	2,733	421.9	235.7	218.4	110.2	54.9	0.54	9,500
2520	Manufacture of plastics products	592,500	429.3	120.6	106.2	38.0	107.2	0.32	12,348
2610	Manufacture of glass and glass products	37,067	437.3	199.0	176.9	67.7	56.9	0.42	8,642
2691	Manufacture of non -structural non refractory ceramic ware	25,567	196.3	119.4	106.9	53.5	82.6	1.30	9,179
2693	Manufacture of structural non - refractory clay and ceramic products	127,200	113.7	46.7	37.0	2.0	144.0	1.49	6,591
2694	Manufacture of cement lime and plaster	274,133	1,305.5	859.5	816.4	519.8	142.2	0.22	121,312
2695	Manufacture of articles of concrete cement and plaster	3,580,400	72.6	24.2	20.2	8.9	581.0	2.07	11,394
2696	Cutting, shaping and finishing of stone	1,213,900	82.5	29.6	26.1	10.5	232.9	1.89	5,717
2699	Manufacture of other non metallic mineral products n,e,c	85,267	92.2	31.1	28.4	8.6	297.7	1.64	9,244

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
2710	Manufacture of basic iron and steel	1,149,900	350.6	114.3	108.2	62.2	449.3	0.42	51,224
2720	Manufacture of basic precious and non ferrous metals	98,833	562.7	229.6	197.0	104.3	91.9	0.30	21,102
2731	Casting of iron and steel	90,967	203.1	106.8	100.2	67.3	122.8	1.04	12,756
2811	Manufacture of structural metal products	231,967	718.0	262.5	244.9	133.7	40.7	0.22	6,405
2812	Manufacture of tanks, reservoirs and containers of metal	4,833	505.4	199.6	190.5	117.8	46.6	0.33	4,621
2892	Treatment and coating of metals; general mechanical engineering on a fee or contract basis	42,233	360.7	195.3	173.6	83.5	56.2	0.60	4,935
2893	Manufacture of cutlery, hand tools, hardware	71,467	293.7	126.1	119.5	73.8	156.4	0.60	16,787
2899	Manufacture of other fabricated metal products n.e.c.	267,367	578.0	209.0	192.2	107.8	113.1	0.27	20,827
2915	Manufacture of lifting and handling equipment	8,033	2,142.1	454.3	430.7	77.5	21.2	0.06	8,938
2919	Manufacture of other general purpose machinery	43,967	1,239.8	529.2	508.1	323.7	28.5	0.14	14,652
2921	Manufacture of agricultural and forestry machinery	4,467	4,149.1	1,139.4	1,113.2	972.2	19.5	0.03	15,534
2922	Manufacture of machine - tools	1,500	3,278.0	1,610.5	1,587.2	1,254.6	9.5	0.06	11,633
2924	Manufacture of machinery for mining quarrying	10,367	872.6	444.5	429.0	305.7	50.8	0.23	14,345
2925	Manufacture of machinery for food beverage and tobacco processing	833	5,768.0	1,881.4	1,869.9	1,189.0	14.6	0.03	20,121
2929	Manufacture of other special purpose machinery	4,833	1,173.3	475.3	430.5	281.0	36.2	0.14	15,166
2930	Manufacture of domestic appliances n.e.c.	129,767	574.2	188.9	179.0	85.9	84.0	0.26	15,268
3110	Manufacture of electricity motors generators and transforms	8,233	2,243.6	386.2	343.4	230.0	56.4	0.05	20,521
3120	Manufacture of electricity distribution and control apparatus	12,367	1,854.0	928.6	906.1	671.6	23.5	0.11	20,147
3130	Manufacture of insulated wire and cable	64,267	3,922.2	806.1	709.1	377.1	23.8	0.03	19,158
3150	Manufacture of electric lamps and lighting equipment	39,600	899.8	368.0	347.9	178.2	65.0	0.19	18,583
3311	Manufacture of medical and surgical equipment and orthopedic appliance	262,967	77.3	36.9	32.7	17.0	271.3	2.48	7,942
3410	Manufacture of bodies (coachwork)for	35,333	787.2	227.7	214.7	30.4	33.8	0.18	5,987
3430	Manufacture of parts and accessories for motor vehicles	16,400	957.4	337.1	306.8	128.7	27.9	0.16	8,412

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
	and their engines								
3512	Building and repairing of pleasure and sporting boats	31,267	1,241.8	774.2	737.7	405.7	40.1	0.21	30,683
3610	Manufacture of furniture	274,333	587.2	260.9	245.0	114.3	34.1	0.31	5,916
3691	Manufacture of jeweler and related	93,367	286.6	67.0	64.4	52.6	244.9	0.46	13,436
3699	Other Manufacturing n,e,c,	17,033	998.8	496.6	468.2	307.2	27.8	0.20	12,150
4010	Production collection and distribution of electricty	1,247,167	334.2	170.2	96.2	51.0	152.7	0.61	25,984
5010	Sale of motor vehicles	324,033	649.6	536.6	513.4	254.5	72.1	0.88	29,094
5020	Maintenance and repair of motor vehicles	1,611,200	59.1	42.5	41.3	27.6	148.3	6.02	2,920
5030	sale of motor vehicle parts and accessories	219,767	308.4	234.3	224.4	92.4	60.5	1.35	6,208
5040	sale, maintenance and repair of motorcycles and related parts and access	1,933	244.9	148.8	139.2	39.4	42.0	1.04	4,900
5050	retail sale if automotive fuel	376,867	79.6	66.0	62.5	31.3	141.7	7.32	8,022
5110	wholesale on a fee or contract basis	87,367	246.8	189.9	183.7	80.7	47.1	1.76	6,860
5121	wholesale of agricultural raw materials and live animals	42,200	254.1	203.1	189.2	73.0	68.4	1.96	8,523
5122	wholesale of food, beverages and tobacco	355,833	606.0	466.1	448.8	167.1	52.2	0.72	20,878
5131	wholesale of textiles, clothing and footwear	73,833	416.6	331.0	319.7	132.8	47.9	1.17	10,858
5139	wholesale of other household goods	261,000	744.9	566.8	544.4	119.1	30.4	0.56	15,378
5141	wholesale of solid liquid gaseous fuels and related products	5,100	247.1	155.4	110.5	-40.7	34.5	1.09	4,073
5142	wholesale of metals and metal ores	5,333	710.1	623.7	598.3	175.3	59.1	1.16	26,184
5143	wholesale of construction materials, hardware ,plumbing and heating equip	135,467	783.7	661.4	631.2	138.2	43.1	0.82	21,197
5149	wholesale of other intermediate products, waste and scrap	48,533	524.9	415.1	390.5	167.4	38.3	0.91	10,974
5151	wholesale of computer peripheral equipment and software	41,333	1,168.2	982.5	961.7	99.7	25.6	0.54	23,506
5152	wholesale of electronic and telecommunications parts and equipment	33,433	1,865.4	1,527.4	1,489.7	532.1	24.6	0.30	37,106
5159	wholesale of machinery, equipment and supplies	120,750	634.0	493.9	313.2	70.9	38.4	0.71	14,210

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
5190	other wholesale	106,000	416.1	305.5	286.3	81.0	40.9	0.90	9,547
5211	Retail sale in non -specialized stores with food, beverages or tobacco.	560,600	226.9	159.3	153.4	119.9	85.9	1.48	2,708
5219	other retail sale in non -specialized stores	292,967	358.5	268.2	245.3	16.0	52.0	1.11	13,873
5220	Retail sale of food, beverages and tobacco in specialized stores	1,301,167	96.2	64.1	60.9	36.0	109.6	3.11	3,444
5231	retail sale of pharmaceutical and medicalmedical goods, cosmetic	170,833	269.4	198.2	189.4	89.6	38.7	1.40	5,430
5232	retail sale of textiles, clothing, footwear and leather goods	387,567	296.3	188.7	177.2	86.2	30.2	0.93	3,008
5233	retail sale of household appliances, articles and equipment	315,367	286.0	190.4	180.3	64.6	45.3	1.05	4,263
5234	retail sale of hardware, paints and glass	182,867	274.1	199.2	189.8	87.9	56.4	1.34	4,557
5235	retail sale communication equipment and accessories	142,300	283.3	194.3	188.0	128.1	44.9	1.12	3,195
5236	retail sale of computer its, net components and accessories	48,233	312.3	241.4	232.2	71.5	47.6	1.41	6,741
5239	other retail sale in specialized stores	499,033	169.7	111.6	104.0	54.4	68.1	1.72	3,341
5240	retail sale of second -hand goods in stores	52,800	231.1	148.0	143.2	95.9	43.0	1.20	1,904
5252	retail sale via stalls and markets	15,533	232.0	150.9	148.9	107.8	51.8	1.23	1,590
5260	repair of personal and household goods	52,233	289.9	220.4	216.8	179.8	88.2	1.44	3,818
5510	hotels,camping sites and other provision of short- stay accommodation	4,455,567	64.0	38.8	25.8	4.1	295.6	3.97	11,148
5520	Restaurants, bars and canteens	2,258,967	111.2	45.9	43.1	15.9	93.3	1.53	3,665
7010	Real estate activities with own or leased property	345,667	106.7	84.0	73.1	41.2	197.0	4.41	13,517
7020	Real estate activities on a fee or contract basis	119,333	96.9	58.7	55.9	39.8	97.7	2.62	6,556
7111	renting of land transport equipment	36,733	439.9	266.9	177.2	57.9	67.2	0.58	14,525
7122	renting of construction & civil engineering machinery and equipment	2,900	332.7	225.5	149.8	83.3	32.0	0.93	4,768
7129	renting of other machinery and equipment n.e.c	1,600	291.9	180.5	148.1	85.4	38.8	0.90	3,603
7130	Renting of private and household goods n.e.c.	29,667	257.0	166.5	137.7	74.5	36.5	1.11	3,702

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
7221	software publishing	38,867	1,030.6	833.9	810.8	411.7	21.0	0.51	18,930
7229	other software consultancy and supply	22,633	810.9	550.6	528.3	63.4	19.4	0.38	10,420
7250	Maintenance and repair of office, accounting and computing machinery	13,200	239.3	167.2	160.6	97.8	40.8	1.39	4,414
7290	Other computer related activities	57,767	264.3	146.9	130.0	31.7	23.5	0.85	2,889
7310	research and experimental deve in natural sciences and engineering (NSE)	10,533	872.5	524.3	386.3	53.0	26.5	0.29	13,655
7320	research and experimental developments on social science and humanities	3,067	395.9	228.1	199.3	-15.6	28.4	0.60	5,077
7411	legal activities	162,967	226.2	162.1	152.9	101.8	61.3	1.56	6,753
7412	accounting, book - keeping and auditing activities tax consultancy	26,867	584.5	455.2	435.2	104.7	22.0	0.77	9,280
7413	market research and public opinion polling	4,867	673.9	489.0	476.6	113.7	5.8	0.54	2,771
7414	business and management consultancy activities	13,567	715.2	458.1	411.3	55.2	25.0	0.39	10,346
7421	architectural and engineering activities and related technical consultancy	82,900	807.8	656.5	628.9	205.5	20.7	0.66	11,724
7422	technical testing and analysis	767	2,025.8	1,345.3	1,296.1	486.7	33.0	0.15	42,265
7430	advertising	33,333	770.4	443.3	423.0	199.7	42.2	0.31	14,878
7491	labor recruitment and provision of personnel	20,367	315.2	191.4	179.9	24.1	14.3	0.81	2,523
7492	investigation and security activities	11,100	1,790.8	1,650.0	1,638.2	89.5	0.9	0.71	1,501
7493	building -cleaning activities	16,667	941.2	719.8	684.2	89.9	2.8	0.45	1,959
7494	photographic activities	32,500	302.9	179.0	156.2	84.3	40.4	0.81	5,338
7495	packaging activities	1,767	190.2	107.3	101.0	55.0	41.1	1.21	3,666
7499	Other business activities n.e.c.	66,167	370.2	270.1	255.7	183.1	34.4	1.00	7,898
8010	primary education	541,667	143.1	99.1	87.3	10.7	26.4	2.27	2,559
8021	secondary education	480,367	204.5	153.9	136.7	15.8	32.6	1.98	5,013
8030	higher education	674,300	297.7	219.0	195.0	48.5	59.9	1.27	14,689
8090	adult and other education	57,900	271.6	146.6	120.3	26.5	26.4	0.80	3,000

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
8511	hospital activities	1,705,033	119.5	70.8	58.6	23.0	119.3	2.05	8,440
8512	medical and dentine practice activities	349,600	178.8	114.1	99.6	64.9	99.3	1.55	8,120
8519	other human health activities	44,200	331.9	219.4	193.2	84.4	43.1	0.89	8,296
8520	veterinary activities	1,867	228.8	146.5	138.6	85.9	55.4	1.22	6,572
8531	Social work with accommodation	42,000	66.8	39.3	11.2	0.0	120.9	3.64	4,754
9211	Motion picture and video production and distribution	22,467	713.8	513.1	466.8	271.9	33.1	0.50	16,421
9212	motion picture projection	2,333	1,736.8	814.6	759.4	354.2	11.6	0.11	9,078
9213	radio and television activities	122,500	113.0	32.4	-7.2	-89.3	43.1	1.24	1,398
9214	dramatic arts, music and other art activities	1,033	370.5	235.7	179.9	80.9	52.0	0.74	10,594
9219	Other entertainment activities n.e.c.	110,367	82.0	44.4	34.9	11.4	90.0	2.66	3,503
9233	botanical and zoological gardens and nature reserves activities	17,267	33.7	13.3	7.4	1.8	577.0	4.91	6,888
9249	other recreational activities	341,800	41.8	23.1	18.0	5.2	217.4	5.35	3,467
9301	Washing and (dry-) cleaning of textile and fur products	243,900	55.0	31.7	29.0	13.1	153.4	4.30	3,448
9302	hairdressing and other teatment	702,033	89.9	57.8	55.8	35.8	112.8	3.12	4,265
9303	funeral and related activities	2,567	146.7	92.2	80.2	29.3	53.8	1.84	4,274
9309	other service activities n.e.c.	33,900	25.7	14.9	13.8	6.5	390.6	9.25	4,295
8532	Social work without accommodation	62,400	122.5	74.2	60.7	0.0	29.2	2.07	2,166
9111	Activities of business and employees organization	54,000	214.8	130.4	95.9	0.0	22.0	1.18	2,870
9112	actives of professional organizations	24,200	360.7	169.9	145.3	0.0	36.4	0.52	6,183
9120	actives of labor unions	16,167	593.9	275.7	246.6	0.0	29.6	0.31	8,150
9191	activities of religious organizations	7,300	240.2	134.8	118.5	0.0	26.7	0.95	3,593
9192	activities of political organizations	20,300	95.2	61.7	46.8	0.0	33.5	2.98	2,065
9199	activities of other membership organizations	20,900	156.1	90.9	78.7	0.0	16.1	1.53	1,463
9241	sporting activities	100,100	88.8	49.3	38.3	0.0	52.5	2.53	2,588

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
9900	extra- territorial organizations and bodies	455,300	68.7	48.3	46.9	0.0	54.4	4.89	2,626
	Total activities of not-for-profit	1,237,000	75.1	52.3	50.2	0.0	94.5	4.39	4,944
4510	Site preparation	3,647	3,364.3	880.3	731.4	329.6	12.3	0.04	10,401
4520	Building of complete constructions partsthereofcivilengineering	4,065,367	364.0	92.9	81.3	35.9	109.2	0.37	9,841
4530	Building installations	232,600	717.2	213.1	198.4	88.0	44.4	0.20	9,032
4540	Buildings completion	36,333	419.4	95.6	86.0	30.6	76.2	0.31	6,937
6010	Transport via railways	59,133	218.3	110.8	83.9	10.2	54.9	0.93	6,086
6021;6022	Other scheduled and non-scheduled passenger land transport	102,700	4,698.0	2,568.8	2,171.4	1,738.6	30.5	0.05	72,984
6023	Freight transport by road	82,600	7,112.9	4,519.4	3,787.3	3,101.7	21.9	0.04	97,840
6030	Transport via pipelines	1,000	295,065.0	57,668.0	15,803.3	14,233.3	0.9	0.00	4,000
6110	Sea and coastal water transport	22,033	3,646.3	1,490.0	1,261.6	887.8	41.8	0.05	61,820
6210; 6220	Scheduled and non-scheduled air transport	117,600	6,014.3	1,237.0	981.1	192.1	14.3	0.02	17,690
6301;6303	Other supporting transport activities including cargo handling	28,000	1,015.4	811.0	244.0	130.0	4.9	0.49	10,925
6302	Storage and warehousing	169,000	206.8	175.9	155.1	117.4	137.1	3.23	23,861
6301;6303	Other supporting transport activities including cargo handling	18,900							
6304	Activities of travel agencies and tour operator	131,600	1,416.0	291.2	278.3	78.0	21.3	0.09	5,501
6309	Activities of other transport agencies including clearance Co.	2,263,933	144.5	99.7	96.3	62.0	163.3	2.23	15,839
6411; 6412	National and private post activities	37,767	447.5	267.6	239.9	-7.0	21.9	0.56	5,863
6420	Telecommunications	250,167	4,574.0	3,088.1	2,660.7	1,763.8	56.5	0.07	174,325
6519	Other monetary intermediation(1)	590,767	1,696.2	1,387.1	1,310.0	860.7	31.0	0.32	43,013
6591	Other credit granting	19,050	897.3	793.2	522.2	485.7	373.8	0.96	296,496
6592	Other credit granting	18,067	1,128.4	911.0	885.5	511.4	15.6	0.46	14,221
6599	Other financial intermediation n.e.c.	26,033	2,401.6	1,844.8	1,793.4	1,459.9	31.5	0.18	58,076

ISIC-Cd.	Economic Activity	Water Consumption M3	Gross Output per M3	Gross value added Per M3	Net value added Per M3	Operation surplus Per M3	M3 per employee	%Cost of Water to total cost	GVA per employee (in JD)
6711	Administration of financial markets	13,333	2,733.0	2,559.9	2,489.1	2,048.6	69.0	0.58	176,587
6712	Security dealing activities	38,533	2,293.1	1,696.1	1,632.8	1,162.1	46.1	0.17	78,044
6719	Activities auxiliary to financial intermediation n.e.c.	54,700	446.5	323.9	290.1	147.3	40.5	0.82	12,731
6603	Non-Life Insurance(1)	66,267	1,109.6	604.7	572.1	114.4	24.3	0.20	14,723
6720	Activities auxiliary to insurance and pension funding	28,933	447.7	295.6	271.3	70.9	36.0	0.66	10,293
H.	**Total Economy**	83,397,210	250.1	118.1	106.8	57.0	141.1	0.63	13,149

ANNEX V: WATER VALUE BY WATER QUALITIES

Table 53: Computed water values (JD/m3) by water qualities for Filed Crops in 2010

Crop	Surface Water (NJV & Safi)	Blended Water (MJV & SJV)	Ground Water (Highland except Amman & Zarka Gov)
Wheat	0.413	0.219	0.257
Barley	0.171	0.172	0.192
Lentils			0.256
Vetch	0.056		0.271
Check-peas	0.280	0.325	3.735
Maize	0.263	0.254	0.349
Sorghum	0.145	0.130	0.163
Broom millet	0.175	0.185	
Garlic	1.091	1.229	1.676
Vetch-common	0.076		
Sesame	0.067	0.061	0.109
Clover	0.639	0.608	0.274
Alfalfa	0.011		
Other FC		0.023	0.017
Field Crop	**0.365**	**0.291**	**0.261**

Table 54: Computed water values (JD/m3) by water qualities for Winter Vegetables in 2010

Crop	Surface Water (NJV & Safi)	Blended Water (MJV & SJV)	Ground Water (Highland except Amman & Zarka Gov)
Tomatoes	1.403	1.313	0.534
Squash	1.103	1.055	0.784
Eggplants	0.873	1.007	0.900
Cucumbers	2.931	4.628	4.640
Potatoes	0.999	1.084	1.453
Cabbages	0.324	0.336	0.268
Cauliflower	0.780	0.494	0.937
Hot peppers	1.547	1.790	1.097
Sweet peppers	1.607	2.003	0.860
Broad beans	1.659	1.534	1.920
String beans	2.059	3.885	2.176
Peas	4.705	4.086	3.183
Cow-peas	0.624		2.105
Jew's mallow	0.348	0.465	
Okra	1.059	1.320	
Lettuce	1.334	1.697	1.184

Sweet melons	1.138	1.652	1.206
Watermelons			
Spinach	0.826	0.737	1.172
Onion, green	0.982	1.065	0.615
Onion, dry	1.106	0.738	0.505
Snake cucumbers		1.332	1.322
Turnip	0.868	0.016	0.477
Carrots		1.936	
Parsley	0.856	0.837	0.619
Radish	1.034	1.111	
Other W Veg	0.253	0.484	0.200
Winter Vegetables	**1.387**	**1.678**	**0.879**

Table 55: Computed water values (JD/m3) by water qualities for Summer Vegetables in 2010

Crop	Surface Water (NJV & Safi)	Blended Water (MJV & SJV)	Ground Water (Highland except Amman & Zarka Gov)
Tomatoes	0.651	0.545	0.336
Squash	0.679	1.467	1.012
Eggplants	0.379	0.783	0.447
Cucumbers	1.395	3.048	1.248
Potatoes	1.464	1.660	0.682
Cabbages	0.679	0.692	0.325
Cauliflower	1.065	0.932	0.904
Hot peppers	1.326	1.642	0.464
Sweet peppers	0.759	1.083	0.609
Broad beans	0.928		0.656
String beans	1.832	2.436	0.918
Peas	1.239		
Cow-peas	1.987	1.805	9.931
Jew's mallow	0.447	0.241	1.040
Okra	0.915	1.037	1.169
Lettuce	0.794	1.247	1.216
Sweet melons	1.052	1.605	0.681
Watermelons	0.551	0.902	0.406
Spinach	1.509		
Onion, green	0.794		1.693
Onion, dry	0.730	0.243	0.307
Snake cucumbers	1.205	1.143	1.259
Turnip	0.894		
Carrots		2.192	1.185
Parsley	0.980	0.580	0.533
Radish	0.977	0.895	0.799
Other S. Veg	0.375	0.381	2.620
Summer Vegetables	**0.754**	**0.687**	**0.485**

Table 56: Computed water values (JD/m3) by water qualities for Citrus Fruit Trees in 2010

Crop	Surface Water	Blended Water	Ground Water

	(NJV & Safi)	(MJV & SJV)	(Highland except Amman & Zarka Gov)
Lemons	0.822	0.441	0.206
Oranges, local	0.312	0.485	0.199
Oranges, navel	0.694	0.511	0.126
Oranges, red	1.070	0.694	0.349
Oranges, valencia	1.416	0.643	0.347
Oranges, french	0.831	0.465	0.167
Oranges, shamouti	0.817	0.696	0.186
Clementine	0.716	0.515	0.342
Mandarins	0.790	0.375	0.192
Grapefruits	0.396	0.229	0.139
Medn. mandarins	0.598	0.352	
Pummels	0.538	0.289	0.127
Citrus	**0.782**	**0.462**	**0.205**

Table 5: Computed water values (JD/m3) by water qualities for Stone Fruit Trees in 2010

Crop	Surface Water (NJV & Safi)	Blended Water (MJV & SJV)	Ground Water (Highland except Amman & Zarka Gov)
Olives	0.387	0.282	0.312
Grapes	1.019	0.700	0.285
Figs	0.094	0.073	0.177
Almonds	0.387	0.315	1.749
Peaches	0.212	0.206	0.432
Plums, Pruns	0.331		0.235
Apricots	0.269		0.242
Apples			0.515
Pomegranates	0.361	0.492	0.070
Pears			0.489
Guava	0.529	0.177	0.261
Dates	0.203	0.231	0.187
Banana	0.621	0.639	0.400
Other Fruits	0.558	0.375	0.311
Stone Fruits	**0.544**	**0.475**	**0.368**
Total Fruits	**0.695**	**0.468**	**0.338**

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