Pre-Feasibility Study

Soilless Cultivation Project

Zarqa Governorate

April 2017

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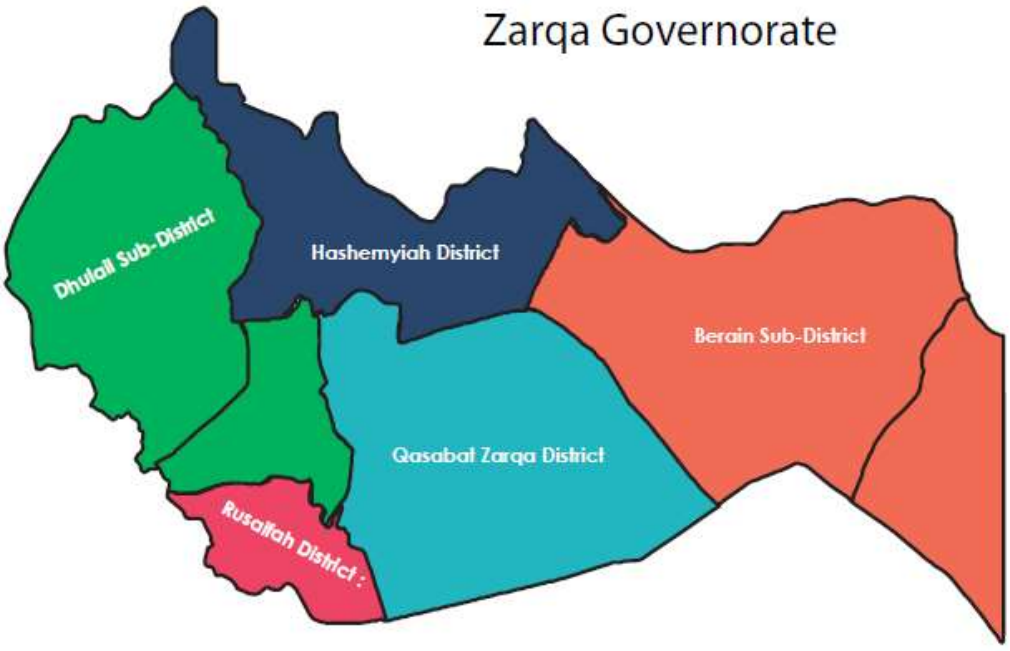

Zarqa Governorate
Dhulail Sub-District
Hashemyiah District
Berain Sub-District
Qasabat Zarqa District
Rusaifah District

1. Executive Summary

This study aims at determining the pre-feasibility study for the Soilless Agriculture which is based on the production of several varieties of agricultural products in Zarqa Governorate, which lacks water resources and suffers from low rainfall rates. Therefore, this project is based on the principles of agriculture that contribute to the increase of agricultural production in the Governorate, through Soilless Agriculture techniques, and the use of these technologies in the cultivation of various crops such as cucumber, aromatic herbs, barley and fruit trees without consuming large amounts of water at lower costs.

Table 1: Initial Indicators of the Project

Project Name	Soilless Cultivation
Sector	Agriculture sector/agriculture production
Governorate	Zarqa
Region	Azraq
Products/Services	In this project, vegetables like cucumber, aromatic herbs like thyme and barley, fruitful trees like pomegranate, grapes and pear will be produced using different methods of soil non-dependent farming, such as: farming in a medium like Pozzolana, and in water whether it is Hydroponic, or Aeroponic.
Project Description	It is an approach for cultivating plants without soil, in which natural soil is replaced by water growing mediums, or solid mediums like Volcanic Tuff (Pozzolana) and Berilight, or Cocabite, or sand, with adding food elements to them in a form of nutrient solution. Through this technique, water amounts, nutrients and environmental circumstances are controlled to be suitable for growing, to achieve maximum production and largest water savings that used in irrigation: *In the case of using Volcanic Tuff in agriculture (arboretums, non soil dependent farming, trees and vegetables' agriculture, and decorating parks) it gives an increase in vitamins of %30, and saves in consuming water, fertilizersand pesticides by %50 with an increase in production that reaches up to %40, and less number of daily workers and agricultural services like plowing and torture, and expels herbs, fungi and insects, and increases fertilizers' efficiency. • In the case of using water growing mediums (Hydroponic) without soil, there are 5 main sorts: – Wick

	- Water Culture - Flood & Drain - N.F.T (Nutrient Film Technique) - Aeroponic The Hydroponic agriculture saves in irrigation water from 70-80%, while the Aeroponic agriculture saves about 90%. The soil non- dependent farming is distinguished by its short time, for example: we need for cultivating lettuce from 25 to 30, while in cultivating in natural soil, it requires 60 to 70 days. In addition, it gives increase in production averages other than traditional agriculture, and less in using pesticides, as there are no pests that should be resisted.
Target Market	• Jordan market in all governorates • Export markets
Investment Cost	The investment cost of the project is JD 2.98 million.
The Average Return On Investment	The average of return on investment during ten years is about 12.4%
Internal Rate Of Return	The average internal rate of return of the project is about 21.8%
Average Added Value Of The Project	The average added value of the project during ten years is about JD 917 thousand
Risk Assessment	The Sensitivity Analysis indicates a low risk in case of 10% increase in investment cost, whereas a high risk in case of 10% decrease in revenues, or 10% increase in operating costs.
The Project Justifications	• Availability of local raw materials in more than one area in Jordan especially; Azraq. • Saving more water as the project does not need the soil in production; subsequently it relatively uses less amount of water. • Increasing the production level of the Governorate and introducing new farming technology. • Employing national workers. • Providing fodders for animal wealth that is available especially in the Governorate, and generally in the kingdom at acceptable prices, which will improve the animal production in quality, amount and prices. • Exploiting dry and desert lands in the Governorate by producing fodders and vegetables by consuming the least amount of rain,

	the case that will increase the green area in the Governorate. • Increasing the added value as it depends on local production elements especially in the case of using Volcanic Tuff. • It is possible to start in any probable size of investment. • Technical support can be achieved from the Ministry of Agriculture, and financial support from International Financing Institutions.
Partners/Stakeholders	• The Ministry of Agriculture • Water Authority • The Ministry of Industry and Trade

2. The Macroeconomic Environment

2.1 An Overview of the Hashemite Kingdom of Jordan

The Hashemite Kingdom of Jordan is a landlocked country surrounded by land except at its southern extremity at the port of Aqaba, where that area is the only sea exit area in Jordan. The Kingdom is bordered at its west side by Palestine and the Mediterranean Sea, at its south and east by the Kingdom of Saudi Arabia, at north east by Iraq and at north by Syria.

Figure 1: Map of the Hashemite Kingdom of Jordan

Jordan is marked by three climatic zones from west to east including the Jordan Valley, most of which lies below sea level and is considered subtropical, and upland areas to the east of the Jordan Valley, ranging in height from 100 to 1500 meters above sea level and this is one of the areas dominated by Mediterranean climate, and the desert areas stretching to the east of the highlands.

The total area of the Kingdom is approximately 89.3 thousand square kilometers, and the semi-desert conditions prevail in over 80% of this area where there are some wet lands settings like Azraq Basin.

The kingdom is divided administratively into twelve governorates distributed into three regions: the Northern Region (includes the governorates of Irbid, Mafraq, Jerash and Ajloun) while the Central Region (includes the governorates of the capital, Zarqa, Balqa, Madaba) and the Southern Region (includes the governorates of Karak, Tafila, Ma'an, Aqaba), and the major cities are Amman (the capital), Zarqa and Irbid.

2.2 Population

Based on the General Census of Population and Housing in 2015, the population in the kingdom amounted to about 9.5 million people with a population density of 107.3 inhabitants per km^2, where the Capital City knocked off other governorates by population amounting to about 4 million people and a population density of 538.8 inhabitants per km2, mainly because Amman is the most attractive governorate for Jordanians and for those coming to Jordan from other countries, followed by Irbid Governorate with a population of 1.8 million people, and then Zarqa Governorate with a population of 1.4 million. Tafila Governorate which is considered to be the least populous governorate whose population is about 96 thousand people.

Table 2: Number of population and population density in the Kingdom for 2015

Governorate	Population (people)	Area (Km^2)	Population density (people/ km^2)
Central Region			
Capital	4007526	7,579	528.8
Zarqa	1364878	4761	286.7
Balqa	491709	1120	439.0
Madaba	189192	940	201.3
North Region			
Irbid	1770158	1572	1126.1
Mafraq	549948	26551	20.7
Jerash	237059	410	578.2
Ajloun	176080	420	419.2
Southern Region			
Karak	316629	3495	90.6
Tafeileh	96291	2209	43.6
Maan	144082	32832	4.4
Aqaba	188160	6905	27.2
Total of Kingdom	9531712	88793.5	107.3

Source: Department of Statistics, Jordan General Population and Housing Census, 2015

On the other hand, the population growth rate has reached about 3% in 2010 and increased to 9% during the years 2013 and 2014 and then dropped a little during 2015 to reach about 8%, according to demographic surveys for the Department of Statistics. The reason for the high growth rates is attributed to the influx of large numbers of refugees from Syria to the Kingdom which resulted in a marked decline in per capita real GDP index by 5.4% to JD 1,197.4, based on the Statements of the Central Bank of Jordan.

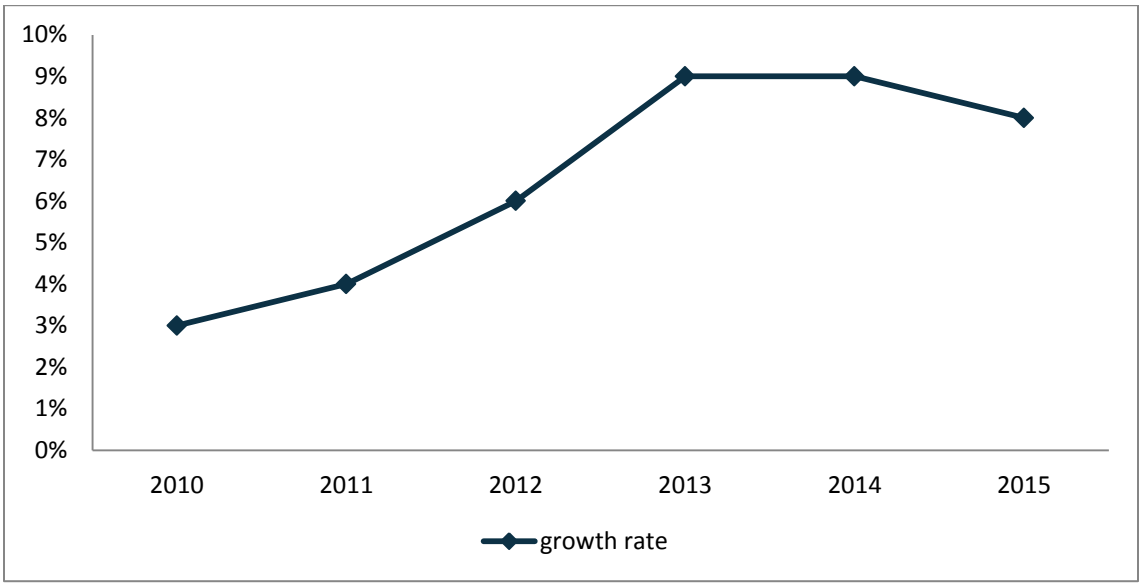
The unemployment rate among Jordanians also witnessed a rise by 1.1 percentage to reach to 13%, due to the structural imbalances that the labor market is suffering from and the acquisition of the low-paid foreign workers on a large number of new jobs in the economy, according to the Central Bank of Jordan.

Table 3: Number of population and population growth in the Kingdom, thousand

	2010	2011	2012	2013	2014	2015
population	6698.0	6993.0	7427.0	8114.0	8804.0	9531.7
growth rate	%3	%4	%6	%9	%9	%8

Source: Department of Statistics

Figure 2: population growth rate in the Kingdom



2.3 Economic Indicators in the Kingdom [1]

Countries across the Middle East are still suffering from instability and closure or partial closure of borders; including the borders of important markets for the Kingdom's products. These factors led to a decline in the performance of many of the economic sectors, including the external sector, national exports, touristic income, and Foreign Direct Investment (FDI), and they contributed to a slowdown in the economic growth to about 2.4% in 2015, compared to 3.1% in 2014. The growth achieved in 2015 came from growth across several economic sectors, especially in the finance, insurance, and real estate services; the transport, storage, and communications services; the mining industry; the manufacturing industry; and the agriculture sector. These sectors contributed a combined 1.8 percentage points (or 75%) of the growth rate achieved during 2015, reflecting the diversity of the economic growth sources in the Kingdom.

Additionally, the general price level registered a decline in the prices of oil, commodities, and other related services in the global markets. Therefore, the general price level, measured by the relative change in the average consumer price index deflated by 0.9% in 2015, compared to the inflation of 2.9% in 2014.

The budget deficit, after aid, increased by 1.2% to a record 3.5% of GDP, compared with 2.3% in the previous year. In addition, the Balance of Payments' Current Account recorded a deficit of 8.9% of GDP, compared with 7.3% in 2014. At the end of 2015, the net public debt amounted to 22,847.5 million Jordanian Dinars (85.8% of the GDP), with an increase of 5.0% of the GDP. However, the total public debt reached 24,876.5 million Jordanian Dinars (93.4% of GDP). This increase resulted from financing both the general budget deficit and the guarantees for loans for the National Electricity Company and the Water Authority, as well as the slowdown of economic growth during 2015. The indebtedness of the National Electricity Company and the Water Authority recorded 6.7 billion Jordanian Dinars at the end of 2015.

On the monetary and banking front, most monetary indicators experienced positive development in performance in 2015, primarily in the Central Bank's foreign reserves, which maintained comfortable levels that amounted to about $14.2 billion. The dollarisation rate decreased, which reflected positive demand for Jordanian Dinars in comparison to other major foreign currencies. With regards to the activities of licensed banks, the outstanding balance of credit increased by 9.5%, to reach 21,103.5 million Jordanian Dinars at the end of 2015. The total deposits registered with licensed banks increased by 7.7%, to reach 32,598.5 million Jordanian Dinars at the end of 2015. The increase in deposits came as a result of the high dinar deposits, which increased by 2,001.4 million Jordanian Dinars (8.3%), and higher foreign currency deposits, which increased by 336.1 million Jordanian Dinars (5.4%).

[1] The Central Bank of Jordan

Furthermore, many of the external sector indicators registered a drop in performance in 2015 due to the deepening instability in the region and almost full closure of the borders with Iraq and Syria. However, the drop in oil prices in the global markets contributed to the decline in the Kingdom's imports bill for energy, as it dropped by 40.6%, which in turn contributed to a decline in total imports and the trade deficit by 11.4% and 14.0%, respectively. Thus, the Current Account, excluding aid, declined to 11.9% of GDP, compared to 12.4% in 2014.

The Current Account deficit increased after aid, to reach 2,365.6 million Jordanian Dinars (8.9% of GDP) in 2015, compared with a deficit of 1,851.7 million Jordanian Dinars (7.3% of GDP) in 2014. This decline is due mainly to the decline in total exports by 6.6% and the decline in surplus in the services account by 27.7%, as touristic income decreased by 7.1%, and the decline in the surplus in the current transfers account decreased as a result of reduced foreign aid.

Capital and financial accounts resulted in a net inflow of 1,593.7 million Jordanian Dinars in 2015, compared to 909.0 million Jordanian Dinars in 2014; this was due to the Kingdom's higher net obligations towards the outside world. Foreign Direct Investment registered a net inflow of 909.4 million Jordanian Dinars, and the reserved investment registered an inflow of 918.4 million Jordanian Dinars due to the Kingdom issuing Eurobonds that are worth $2.0 billion in the global markets. The withdrawal of bank loans on behalf of the Central Bank increased the use of funds from the International and Arab Monetary Funds by 543.3 million Jordanian Dinars. This led to the registration of a surplus in the overall Balance of Payments of 328.7 million Jordanian Dinars during 2015, compared to a surplus of 1,550.7 million Jordanian Dinars during 2014.

According to the Central Bank of Jordan, the increased international investment at the end of 2015 showed an increase in the external net liabilities of the Kingdom, which reached 24,357.5 million Jordanian Dinars, compared with 22,578.8 million Jordanian Dinars at the end of 2014. This was due to an increase in the external balance of assets and financial liabilities for all of the economic sectors in the Kingdom, which reached to 18,657.9 million Jordanian Dinars and 43,015.5 million Jordanian Dinars, respectively, during 2015.

Table 4: main economic indicators 2011 to 2015 in millions of dinars

	2011	2012	2013	2014	2015
Population (millions)	6.993	7.427	8.114	8.804	9.532
Unemployment rate	12.9	12.2	12.6	11.9	13.0
Production and Prices					
GNP at current market prices	20,288.8	21,690.0	23,611.2	25,141.2	26,289.6
GDP at current market prices	20,476.6	21,965.5	23,851.6	25,437.1	26,637.4
The rate of growth in GDP at constant market prices (%)	2.6	2.7	2.8	3.1	2.4
The total national disposable income at current prices	23,743.5	24,774.9	28,424.5	30,302.1	30,234.7
The rate of growth in gross national disposable income at current prices (%)	4.7	–0.2	8.6	3.1	–2.4
Change in the index of consumer prices (%)	4.2	4.5	4.8	2.9	–0.9
The change in the GDP deflator (%)	6.4	4.5	5.6	3.4	2.3
Money and Banking					
Exchange rate of the Jordanian dinar to the US dollar	1.410	1.410	1.410	1.410	1.410
Money supply (P2)	24,118.9	24,945.2	27,363.4	29,240.4	31,605.5
Net foreign assets of the banking system	9,370.1	6,665.5	6,923.4	7,932.3	8,137.3
Net domestic assets of the banking system	14,748.8	18,279.7	20,440.0	21,308.1	23,468.2
Net debt of the government	6,701.4	9,461.3	10,494.8	10,473.9	11,386.4
Private sector debts (Residents)	14,925.0	15,953.6	17,222.5	17,852.8	18,704.5
Other factors [1]	–6,877.6	–7,135.2	–7,277.3	–7,018.5	–6,622.7
Deposits in dinars at licensed banks	19,119.1	17,711.1	21,003.0	24,013.1	26,014.5
Foreign currency deposits at licensed banks	5,258.8	7,258.6	6,590.2	6,247.9	6,584.0
Rediscount rate (%)	4.50	5.00	4.50	4.25	3.75
Treasury bills interest rate for 6 months (%)	3.232	3.788	-	-	-
Public Finance					
Total revenue and foreign aid	5,413.9	5,054.2	5,758.9	7,267.6	6,796.4
Ratio to GDP (%)	26.4	23.0	24.1	28.6	25.5
Total spending	6,796	6,878.2	7,077.1	7,851.1	7,722.9
Ratio to GDP (%)	33.2	31.3	29.7	30.9	29.0
Overall deficit/savings (on an accrual basis)	–1,382.7	–1,824.0	–1,318.2	–583.5	–926.5
Ratio to GDP (%)	–6.8	–8.3	–5.5	–2.3	–3.5
Net outstanding balance of the domestic public debt	8,915.0	11,648.0	11,863.0	12,525.0	13,457.0
Ratio to GDP (%)	43.5	53.0	49.7	49.2	50.5
Outstanding external public debt [2]	4,486.8	4,932.4	7,234.5	8,030.1	9,390.5
Ratio to GDP (%)	21.9	22.5	30.3	31.6	35.3
Foreign Trade and Balance of Payments					
Current account	–2,098.8	-3,344.9	-2,487.7	-1,851.7	-2,365.6
Ratio to GDP (%)	–10.2	–15.2	–10.4	–7.3	–8.9
Trade balance (Deficit)	–6,261.7	–7,486.6	–8,270.1	–8,495.6	–7,249.3

	2011	2012	2013	2014	2015
Ratio to GDP (%)	–30.6	–34.1	–34.7	–33.4	–27.2
Commodity exports	5,684.5	5,599.5	5,617.9	5,953.6	5,558.3
Imports of goods (FOB) [3]	11,946.2	13,086.1	13,888.0	14,449.2	12,807.6
Balance of services (net)	896.0	1,332.3	1,209.5	1,778.9	1,286.4
Income account (net)	–187.8	–275.5	–240.4	–295.9	–347.8
Current transfers (net)	3,454.7	3,084.9	4,813.3	5,160.9	3,945.1
Capital and financial account (net)	2,298.9	3,808.9	1,811.1	908.9	1,593.7
Direct foreign investment in Jordan (net)	1,055.0	1,074.3	1,281.2	1,426.7	905.1

Source: Monthly Statistical Bulletin, Central Bank of Jordan

1. Includes the debts of public and financial institutions and other factors, as shown in the Monetary Survey Agenda.
2. This represents the total balance of drawn loans, minus total repayments.
3. Does not include imports of non-resident entities.

2.4 The Jordanian Investment Environment

Investment Law No. 30 for 2014

Investment Law no. 30 for 2014 is considered an appropriate legislative framework to attract foreign investments and stimulate local investments. It is considered a competitor to other investment laws in the region because it contains many advantages, incentives, and guarantees, and it offers a range of incentives and benefits in and outside the Development and Free Zones. The law includes a series of public provisions, such as foreign investment guarantees (depositing and withdrawal of capital, investment management, and transfers) and the inadmissibility of the disbarment of investment property. The law offers provisions to settle investment disputes, protection, and encouragement of mutual investment agreements between the Kingdom and other countries.

The following shows the major incentives granted by the law:

❖ **Incentives and Benefits outside the Development and Free Zones**

- The production inputs for the industrial and crafts sectors are exempted from customs duties.
- The return of the general sales tax on the production inputs for the industrial and crafts sectors within 30 days.
- Production inputs and fixed assets of the industrial and crafts sectors are exempted from customs duties and are granted a reduction in general sales tax to 0%.
- Returning to the sales tax on the services needed to practice economic activity within 30 days.
- The goods that are necessary for the economic activities of the following sectors are exempted from customs duties and are subject to 0% general sales tax:
  - Agriculture and livestock, hospitals and specialised medical centres, hotels and touristic facilities, touristic entertainment and recreation centres, call centres, scientific research centres and laboratories, art and media production, convention centres and exhibitions, transfers and/or distributions and/or extraction of water, gas and oil derivatives, air transport, maritime transport, and railways.

❖ **Incentives and Benefits inside the Development and Free Zones**

- 5% income tax on the income generated from economic activity within the Development Zone.
- 5% income tax on income generated from economic activity in the industrial sector.
- Tax exemptions that are granted in the Kingdom on goods and services exports.

- Reduction of sales tax to 0% on goods and services that are used by the establishment in order to exercise its activity inside the Development Zone.
- 7% sales tax on specific services provided by a registered company in the zone when these services are consumed in the zone.
- Exemptions from customs duties except for a specified number of goods.

❖ **The Reduction of Income Tax in the Least Developed Areas for Regulation No. 44 for 2016**

- The reduction of income tax in the least developed areas for Regulation No. 44 for 2016 was approved. It aims to create an attractive environment for investments that promote economic development through the reduction of income tax outside the Development Zones and in the least developed areas in the Kingdom. The regulation specified the areas that are considered least developed and identified the activities that are excluded from this reduction.
- Under the provisions of Articles 4 and 5 of this regulation, the areas that were categorised as least developed and enjoy the reduction in income tax are divided into four categories; each category enjoys a reduction in income tax on their activities for a period of 20 years.
- Category A includes the Northern Valley District, Deir Alla District, Shouneh Al-Janoubieh District, the Southern Valley District, Rweished District, the Northern Desert District, the North Western Desert District, Al-Azraq Province, Al-Jiza District except for the borders of the new Al-Jiza municipality, Al-Moakar District except for the borders of Al-Moakar municipality, and the Governorate of Aqaba except for the Aqaba Special Economic Zone. The reduction rate for this category is 100%.
- Category B includes the Governorates of Maan, Tafileh, Karak, and Ajloun. The reduction rate for this category is 80%.
- Category C includes the Governorates of Jarash, Mafraq, and Irbid except the borders of the Greater Irbid Municipality. The reduction rate for this category is 60%.
- Category D includes the Governorates of Madaba, Balqa, Amman except for the Greater Amman Municipality, and Zarqa except for the borders of Zarqa Municipality and Russaifeh Municipality. The reduction rate for this category is 40%.

❖ **Trade and Free Trade Agreements**

The most important agreements are:

- Jordan joining the World Trade Organisation in 2000, which led to the opening of the markets of 150 countries for Jordanian exports in goods and services, and provided new opportunities of access to other countries within a clear and transparent environment of laws, regulations, and procedures.
- A series of regional trade agreements, such as the Jordan Partnership Agreement with the European Union, Agadir Agreement, Free Trade Arab Agreement, the free trade agreement between Jordan and the European Free Trade Association, and the adoption of the Euro-

Mediterranean simplification of the rules of the Origin System, which includes the decision to simplify the rules of the origins of Jordanian products between Jordan and the European Union came into effect on July 19, 2016, and will remain in effect until December 31, 2026.

- A series of bilateral trade agreements with many countries, such as the free trade agreement between Jordan and the United States of America, the Qualified Industrial Zones Agreement, the free trade agreement between Jordan and Singapore, the free trade agreement with Turkey, the free trade agreement with Canada, and many other agreements.
- Jordan has signed more than 35 agreements with Arab and foreign countries in order to prevent double taxation between Jordan and these countries, thus protecting investors' rights.
- The Agreement of Promotion and Protection of Investments and the Movement of Capital between the Arab Countries was signed in 2000 with 11 Arab countries who are members of the Arab Economic Unity Council, in order to establish an appropriate environment for investments and economic cooperation between investors in the Arab countries, thus pushing and stimulating investment activities by providing encouragement and mutual protection for Arab investments.

Human Development Report for 2015

The Human Development Report that was issued by the United Nations Development Program in 2015 showed that Jordan fell 3 points to number 80. Please note that Jordan's place on the Human Development Report index value has improved slightly.

Global Competitiveness Report

The Kingdom's rank has improved by one point in the Global Competitiveness Report for the year 2016/2017, at 63 out of 138 countries compared to 64 out of 140 countries in the 2015/2016 report. It is considered an insignificant improvement, especially because of the reduction in the number of countries participating in this year's report. Amongst the Arab countries, Jordan was ranked after the United Arab Emirates, Qatar, the Kingdom of Saudi Arabia, Kuwait, and Bahrain, who were ranked 16, 18, 29, 34, and 39, respectively.

Doing Business Report

In the Doing Business Report that was issued by the World Bank Group, Jordan is still ranked 118, up one rank from the 2016 report, because of the variation in the performance of the different sub-indicators. Jordan ranked ninth among the Arab countries; the United Arab Emirates was ranked first among the Arab countries at 26, followed by Bahrain at 63 and Oman at 66.

2.5 The Economic Environment in the Short and Medium Term

Risks analysis implemented by BMI indicates that the Jordan's political and economic risks in the short and medium term are less than the overall average of the world and the Middle East. The state's risks and the operational risk are estimated to be within the acceptable levels. The international institutions' forecasts point out that the economic and foreign trade indicators are expected to achieve acceptable rates of growth with the exception of the continued increase in internal and external indebtedness.

Table 5: Assessment of short and long-term risks

	Long term		Short term		Operational risks	State risks
	political	Economic	political	economic		
Jordan	63.1	39.2	66.6	46.2	58.7	55.4
Turkey	60.2	49.4	58.4	56.9	55.9	56.1
Egypt	53.3	45	52.4	48.7	42.9	47.5
Lebanon	45.8	54	55.4	53.5	44.2	49.5
West Bank and Gaza	33.1	38.1	32.2	36.5	32.5	34.3
Syria	22.9	24.4	22.4	23.6	29.3	26.1
Regional average	49.4	46.9	51.2	48.7	46.6	48.3
global average	64.1	50.7	61.3	51.9	49.8	54.6

Source: the economy and state risks, IHS, 15/09/2016

Table 6: The most important key economic indicators 2016-2020

Indicator	2016	2017	2018	2019	2020
The growth rate of GDP	2.6	2.7	2.8	3.2	3.1
GDP (in USD billions)	39.6	42.1	44.8	47.8	50.9
Population (In millions)	9.8	10.1	10.4	10.7	11.0
Consumer Price Index (% change)	-0.7	1.8	3.3	4	3.2
Exports (in USD billions)	7.3	7.6	8.2	8.8	9.6
Imports (in USD billions)	18.3	19.2	20.1	21.3	22.8
Foreign direct investment, the net value (in USD billions)	1.5	1.5	1.6	1.6	1.7
Foreign direct investment, the net value (% of GDP)	3.7	3.7	3.6	3.4	3.3
Foreign exchange reserves (in USD billions)	13.9	14.9	15.7	16.8	17.7
Total external debt (in USD billions)	24.4	27.8	30.7	33.7	36
Total external debt (% of GDP)	61.6	66	68.6	70.4	70.6
Total external debt (% of foreign currency earnings)	127.3	138.3	143.6	147.5	147.8

Source: the economy and state risks, IHS, 15/09/2016

3. Market Study

3.1 Project Description

The project is the establishment of a farm for the cultivation of vegetables, fruits and aromatic plants using the Soilless cultivation techniques in Azraq, in order to reduce the water usage in agriculture to the maximum extent possible. Since Azraq is one of the poorest areas of the Governorate and the Kingdom regarding low rainfall rates which doesn't exceed 80 mm per year. It is known that Soilless cultivation improves the quality and productivity of agricultural crops.

Several Soilless cultivation methods have been chosen to diversify agricultural options and products, thus keeping pace with the local market facts and weather fluctuations in the first place, in order to reduce the negative impacts of market fluctuations in general and to reduce the risk of this method, especially in the years of establishment and at the beginning of production process as it needs more attention and expertise than traditional cultivation method.

3.2 Expected Products Description

Expected project products include:

- Cucumber (normal and baby) by using Pozzolans as cultivation media. There is a possibility of a future production of other varieties of vegetables, such as peppers, sweet and hot peppers, marrow, okra, etc. It should be noted that the choice of cucumber was due to several reasons, such as that it did not require much attention and labor costs to be collected compared to other varieties, in addition to the product good prices most days of the year.
- Barley using Pozzolans at the end of the summer season to take advantage of soil fertility on one hand and to clear the soil of salts resulted from cucumber cultivation.
- Cultivation of fruit trees such as pomegranates, grapes and pears using Pozzolans. There is a possibility of a future expansion of growing Kumquat trees (golden or Japanese oranges).
- Cultivation of thyme among fruit trees using Pozzolans.
- Cultivation of thyme using Hydroponic and Aeroponic, as thyme has a high productivity and high quality.
- Cultivation of cultured Barley using the Hydroponic and Aeroponic, as Barley has a high productivity, high quality and high nutritional value; thus increasing the demand for it by livestock breeders at a price that may reach a higher limit of normal barley.

It is also possible to think of planting some leaf vegetables in the Pozzolans, such as parsley, watercress, lettuce, etc., in later years, despite that the challenges of growing them are high, as

they may wilt quickly and may therefore lose if prices are low. This is a matter to consider when thinking about planting them.

3.3 Agricultural Sector

According to Central Bank studies, the agriculture sector showed a slowdown in performance in 2015, as it grow by 5% against 7.6% in 2014. This sector contributed to raising gross domestic product (GDP) growth by 0.2 percentage points, as well as its relative importance in product has increased by 0.1 percentage points from its level in 2014 to reach 4%.

The following table shows the main economic indicators for the agricultural sector during 2012-2015.

Table 7: Main indicators in the Agriculture Sector for the Years 2012-2015

Indicator	2012	2013	2014	2015
Value added at current prices (million dinars)	604.5	713.7	845.4	566.1
Growth rate at fixed prices (%)	-9.4	-3.5	7.6	5.0
GDP reduction for the agriculture sector (1994 = 100)	172.8	211.5	232.9	257.2
Quantitative index of agricultural exports (1994 = 100)	263.9	296.3	303.4	296.7
Price index for agricultural exports (1994 = 100)	329.9	334.5	344.5	341.7
Number of registered agricultural companies	707	687	751	720
Capital of registered agricultural companies (JD million)	53.3	29.3	30.4	12.5
Balance of the credit facilities granted by the licensed banks (JD 1 million)	254.9	235.7	243.4	217.1

Source: Monthly Statistical Bulletin / Central Bank of Jordan

The slowdown in growth in the agriculture sector, both its plant and animal sections, is attributed to the unfavorable weather conditions prevailing in the Kingdom at different seasons of the year. In addition, it is affected by the closure of some export markets due to the instability in some neighboring countries. It is also reflected by the decline in agricultural exports by 4.8%, and the credit facilities granted to the agriculture sector has also declined by 10.8% compared to 3.3% in 2014. In contrast, loans from the Agricultural Credit Corporation increased by 7.5% compared to 2014 to reach 37.1 million JD.

3.4 Market Size

Although the project uses new techniques and methods in agriculture, the agricultural products that will be produced even though have a higher quality, maturity and freshness, more than those produced by ordinary methods, they will eventually compete with these types in the market. Therefore, the size of the market will be calculated based on the types currently on the market.

There are three main markets in the Kingdom: Amman, Zarqa and Irbid Central Markets, as all locally produced agricultural products and imports are transferred into these markets and sold to wholesale markets and traders. Statistics from the Central Markets can account for 80% of the local market size of the varieties to be cultivated in the project, due to the existence of small markets in some regions of the Kingdom where the remaining quantities may be sold, in addition to consumption of part of these products in the villages and cities surrounding the place of their production.

The following tables show the sales of the types to be produced by the project in the last three years, and the price at which it was sold as wholesale all year, including sales from local production and imports.

Table 8: Sales (ton) and the price (fils/kg) in the Amman Central Market for 2013-2014, 2015

Type	2013		2014		2015	
	Quantity (Tons)	Price (fils / kg)	Quantity (Tons)	Price (fils / kg)	Quantity (Tons)	Price (fils / kg)
Cucumber	62698	352	74785	349	67494	346
Pears	5773	1211	5189	1560	4726	1605
pomegranate	4494	536	5515	350	5879	225
Grapes	14826	922	11646	1033	13223	1136
Green Thyme	873	830	909	533	945	0

Source: Annual Reports of Jordanian Agricultural Markets, Ministry of Agriculture

Table 9: Sales (ton) and the price (fils/kg) in the Zarqa Central Market for 2013-2014, 2015

Type	2013		2014		2015	
	Quantity (Tons)	Price (fils / kg)	Quantity (Tons)	Price (fils / kg)	Quantity (Tons)	Price (fils / kg)
Cucumber	2769	282	3454	249	2958	288.178
Pears	274	682	159	920	135	987
pomegranate	286	722	319	778	301	698
Grapes	465	670	382	776	379	687
Green Thyme	84	765	73	777	112	935.268

Source: Annual Reports of Jordanian Agricultural Markets, Ministry of Agriculture

Table 10: Sales (ton) and the price (fils/kg) in the Irbid Central Market for 2013-2014, 2015

Type	2013		2014		2015	
	Quantity (Tons)	Price (fils / kg)	Quantity (Tons)		Quantity (Tons)	Price (fils / kg)
Cucumber	21117	304	26220	319	23400	342
Pears	1296	907	884	1233	12054	591
pomegranate	701	750	964	797	1249	741
Grapes	3709	686	2718	882	4060	839
Green Thyme	56	361	24	640	13	869

Source: Annual Reports of Jordanian Agricultural Markets, Ministry of Agriculture

The following table shows the total quantities sold in all Central Markets in the Kingdom, and the annual growth rates and the average sold quantities of the proposed types of the project, which represents the volume of demand for the project products.

Table 11: Total quantities sold in the Kingdom, annual growth rates and average sold quantities for the last 3 years (Market Size)

Type	Quantity (Tons)			Growth rate		General Average (%)	Average Quantity ((tons
	2013	2014	2015	2014	2015		
Cucumber	86,584	104,459	93,852	20.64%	-10.15%	5.25%	94,965
Pears	7,343	6,232	16,915	-15.13%	171.42%	78.15%	10,163
pomegranate	5,481	6,798	7,429	24.03%	9.28%	16.66%	6,569
Grapes	19,000	14,746	17,662	-22.39%	19.77%	-1.31%	17,136
Green Thyme	1,013	1,006	1,070	-0.69%	6.36%	2.84%	1,030

Source: Annual Reports of Jordanian Agricultural Markets, Ministry of Agriculture, Calculating of Study Team

In addition to the previously mentioned varieties, barley is expected to be grown in the project. The following tables show the quantities of barley and cultivated areas in Zarqa and the Kingdom. The Ministry of Agriculture purchases and distributes this product to farmers and livestock breeders.

Table 12: Production quantities (ton) and cultivated areas (acres) of irrigated and non-irrigated barley for the years 2014-2015

Statement		The kingdom	Zarqa
2014	Cultivated area (acres)	405,253	4800
	Production (tons)	28,065	901.9
2015	Cultivated area (acres)	392856	28720
	Production (tons)	41624	901.9

Source: Ministry of Agriculture, Annual Report 2014, 2015

Import and Export

The following tables show the quantities of imports and exports of the varieties to be cultivated in the project during the period (2012-2015).

Table 13: Kingdom's exports of types to be cultivated in the project during the period 2012-2015

Type	Quantity (tons)		
	2013	2014	2015
Cucumber	27573.6	46473.0	32732.3
Pears	350.3	285.0	170.5
pomegranate	2131.4	2144.6	189.5
Grapes	912.3	1092.1	770.0
Green Thyme	49.5	209.0	208.0

Source: Annual Reports of Jordanian Exports and Imports, Ministry of Agriculture

Table 14: Kingdom's imports of the types to be cultivated in the project during the period (2012-2015)

Type	Quantity (tons)		
	2013	2014	2015
Cucumber	25.865	0.21	0.1
Pears	6398.911	3836.9	3999.7
pomegranate	1369.624	1331.04	2291.6
Grapes	4623.659	1188.343	926.2
Green Thyme	0	0	0

Source: Annual Reports of Jordanian Exports and Imports, Ministry of Agriculture

Overview of the Main Competitors

There are many individuals and local companies that grow products similar to the project products. In general, there are no big competitors in the absolute sense, but we will cover an overview of the main competitors, and the size of their farms as possible, and of each products of the project.

The following table summarizes the main competitors in the production of varieties to be cultivated in the project, and the contribution of each in the production of these varieties, depending on the cultivated area of each competitor.

Table 15: Main Competitors for Project Products

Type	Competitor / farm	Area in Acres	Location
Grapes	Samara	150	-
	A large number of farmers but limited production	Small areas	Different regions of the Kingdom
pomegranate	Abu Jaber	200	Al-Mugharbi (Mafraq)
	Al-Saudi	115 and is in the process of adding another 40 dunums this year	Azraq near the Saudi border
	Al-Qadi	35	Azraq
Pears	Al-Saqal	200	Mafraq
	Al-Masri	200	Shobak
	The rest are small competitors	Small spaces	Different regions of the Kingdom
Cucumber	There are no major competitors	The largest area of 35 dunums	Different regions of the Kingdom
Thyme **	There are currently no major competitors	Small areas	The majority in Thiban
barley	There is currently no specific competitor	20-40	Southern Kingdom, Ajloun, Irbid, Madaba

Source: - Field studies and multiple interviews of the study team.
*When the threat of importation from Syria increased, the major competitors above uprooted their trees and moved to other varieties of fruit, such as peach. Therefore, there are currently no major competitors in the absolute sense.
** The current trend towards expanding the cultivation of thyme, as the local and Arab demand has increased.

3.5 Price Analysis

The average prices of the products to be grown in the Kingdom for all the varieties that will be produced by the project are determined by the annual reports of Jordanian Agricultural Markets (Amman, Irbid and Zarqa) under the prevailing price for the years 2013-2015, listed above.

3.6 Marketing Strategy

Target Market

The project targets the following categories:

- The Jordanian market in all Governorates.
- Export markets, especially Arab countries.

Expected Prices

Despite the quality and freshness of the products produced by the project, they will sold at competitive prices close to the last three years price. The following table shows the average prices at which the project will sell its products in the local and export markets.

Table 16: Main competitors for project products

Type	Price (JD / ton)
Fruit trees (grapes, pomegranates, pears)	700
Small Cucumber (Baby)	650
Average Cucumber price	425
Green Thyme	700
Hay and barley	According to prices determined by the Government (often: 350 for barley and about 500 for Hay). The average revenue of the dunums is 250 JD.

Expected Services and Products

- Cucumber (normal and baby) by using Pozzolans as cultivation media. There is a possibility of a future production of other varieties of vegetables, such as peppers, sweet and hot peppers, marrow, okra, etc. It should be noted that the choice of cucumber was due to several reasons, such as that it did not require much attention and labor costs to be collected compared to other varieties, in addition to the product good prices most days of the year.
- Barley using Pozzolans at the end of the summer season to take advantage of soil fertility on one hand, and to clear the soil of salts resulted from cucumber cultivation.
- Cultivation of fruit trees such as pomegranates, grapes and pears using Pozzolans. There is a possibility of a future expansion of growing Kumquat trees (golden or Japanese oranges).
- Cultivation of thyme among fruit trees using Pozzolans.
- Cultivation of thyme using Hydroponic and Aeroponic, as thyme has a high productivity and high quality.
- Cultivation of cultured Barley using the Hydroponic and Aeroponic, as Barley has a high productivity, high quality and high nutritional value; thus increasing the demand for it by livestock breeders at a price that may reach a higher limit of normal barley by.

Promotion

The project's promotional strategy includes:

- Designing an attractive website and using social media.
- Filming videos describing the production process and products quality and their distinctiveness from their counterparts in the market, despite their competition in prices and displaying them on the website.
- Participating in local and international exhibitions of the most important products of the project.
- Direct marketing to major consumers, such as restaurants, factories, hotels, mills, and spice shops.
- Selling through Central Markets, when prices are appropriate.

Selling

The selling strategy of the project is as follows:

- Direct selling to wholesalers and retailers.
- Selling to other factories that depend on small cucumber on their production.
- Selling to foreign markets (export).

3.7 The Expected Market Share

The following table shows the expected market share of the project in the first ten years of the farm establishment, for each of the types to be produced.

Table 17: Project market share of cucumber production

Statement	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Seven s year	Eighth year	Ninth year	Tenth year
Production Capacity (Ton)	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333
Market Size (ton)	118,706	124,642	130,874	137,417	144,288	151,503	159,078	167,032	175,383	184,152
Market share (%)	4.5%	4.3%	4.1%	3.9%	3.7%	3.5%	3.4%	3.2%	3.0%	2.9%

Table 18: Market share of green thyme production

Statement	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Sevens year	Eighth year	Ninth year	Tenth year
Production Capacity (Ton)	396	636	636	636	636	636	636	636	636	636
Market Size (ton)	1,287	1,416	1,557	1,713	1,884	2,073	2,280	2,508	2,759	3,035
Market share (%)	31%	45%	41%	37%	34%	31%	28%	25%	23%	21%

Table 19: Market share of fruit trees production (pomegranate)

Statement	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Seven s year	Eighth year	Ninth year	Tenth year
Production Capacity (Ton)	0	28	56	84	112	140	140	140	140	140
Market Size (ton)	6,569	6,898	7,243	7,605	7,985	8,384	8,804	9,244	9,706	10,191
Market share (%)	0.0%	0.4%	0.8%	1.1%	1.4%	1.7%	1.6%	1.5%	1.4%	1.4%

Table 20: Market share of fruit tree production (grapes)

Statement	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Sevens year	Eighth year	Ninth year	Tenth year
Production Capacity (Ton)	0	28	56	84	112	140	140	140	140	140
Market Size (ton)	17,136	17,993	18,892	19,837	20,829	21,870	22,964	24,112	25,318	26,584
Market share (%)	0.0%	0.2%	0.3%	0.4%	0.5%	0.6%	0.6%	0.6%	0.6%	0.5%

Table 21: Market share of barley and hay production

Statement	First year	Second year	Third year	Fourth year	Fifth year	Sixth year	Sevens year	Eighth year	Ninth year	Tenth year
Production Capacity (Ton)	28	28	28	28	28	28	28	28	28	28
Market Size (ton)	702,116	716,158	730,481	745,091	759,992	775,192	790,696	806,510	822,640	839,093
Market share (%)	0.004%	0.004%	0.004%	0.004%	0.004%	0.004%	0.004%	0.003%	0.003%	0.003%

4. Technical study

4.1 The Designed Project Capacity

As mentioned previously, the project is based on soilless agriculture (cultivation) using three methods (techniques):

- Cultivation using a medium (Pozzolans).
- Hydroponics Cultivation.
- Aeroponics Cultivation.

Each of these methods has its own requirements and equipment (for further details refer to Annex 1). The following table shows the details of the requirements for each type of agriculture from the land and the designed capacity of the project.

Table 22: the design capacity of the project

Method Of Agriculture (Cultivation)	Area (Dunums)	Agricultural Product Details
Pozzolans	40	▪ Normal and small cucumber (Baby) for a period of 8/9 months during the year, production begins from the first year ▪ Barley to improve soil properties after the end of the summer, the production begins from the first year
	40	▪ Fruit trees of pomegranates and grapes, 70 trees in the acre, production begins from the second year at a rate of 20 kg per tree, and increase to reach 100 kg in the sixth year and mostly remain the same. ▪ Green thyme to exploit the spaces between trees, beginning in the second year with a fixed productivity of 6 tons per acre.
Hydroponics	5	▪ Green thyme cultivation, with a production rate of 120 tons per acre.
Aeroponics	5	▪ Green thyme cultivation, with a production rate of 120 tons per acre

The following table shows the required areas of the project. in order to reach the designed capacity, it requires the purchase of a land with an area of 150,000 m^2 that contains a water well, and the establishment of buildings and warehouses and prepairing for the land for cultivation , ... etc.

Table 23: Details of the construction works required for the project and their cost and area required.

Item	Area m^2	Cost (JD)	Total costs (JD)
Preparation of Pozzolans	80,000	1.65	132.00
Warehouses Building	1,000	100	100,000
Administration Building and Services Workers Building (Concrete)	150	200	30,000
Preparing a water pool for the well			20,000
External Works			
Asphalt	2,000	10	20,000
Metal fence	1,300	35	45,500
Sewage installment (Brick & Plastic)	40,000	2	60,000
Other	-	-	30,000
Total costs			305,632

4.2 The Required Fixed Assets

The following table shows the required fixed assets for the project.

Table 24: Required fixed assets for the project

Item	Unit	unit price	Value (JD)
Land (dunum)	150	2,000	300,000
Construction works	-	-	305,632
equipment and tools	-	-	1,729,000
Transportation vehicles	4	25,000	100,000
IT	-	-	20,000
Furniture	-	-	30,000
Other	-	-	25,000
Total			2,509,632

* The figures were estimated from the Market Study

The following table shows details of equipment and tools needed.

Table 25: Details of equipment and devices required for the project

Item	Unit	unit price	Value (JD)
Pumps, plastic water tanks and plastic for the greenhouses (JD/ dunum)	80 dunum	8,000	640,000
Capital costs for the preparation of the hydroponic system, the preparation of the greenhouse layers (with all equipment and connections including cooling network, reservoirs, backup pumps and desert air conditioning system) (JD / dunum)	5 dunum	85,000	425,000
Capital costs for the preparation of the Aeroponic system, the preparation of the greenhouse isolated from the Sanwich Panel layers, with all equipment and connections, which include cooling network, reservoirs and pumps, air conditioning and humidity control system (JD / dunum)	5 dunum	100,000	500,000
Nutrition control system, measuring tools and compensation of thyme trays.	2	-	20,000
Plastic for the greenhouse (6th year)	2	-	4,000
Scales and packing equipment	-	-	5,000
Pallets and tables and shelving storage	-	-	20,000
Electromechanical works	-	-	50,000
Water purification plant 30 m^3 / day	1	-	50,000
Drip irrigation system	-	-	15,000
Total			1,729,000

4.3 The Required Human Resources

The following table shows the human resources required for the project. The number of employees required is 56 employees with a total salary of 255,600 JD annually.

Table 26: Human resources required for the project

Item	Number of Employees	Monthly Salary (JD)	Total Annual Salary (JD)	Operational Salary Annual (JD)	Administrative Salary Annual (JD)
Director General	1	1500	18,000	18,000	0
Technical Manager	1	1000	12,000	12,000	0
Administrative and Financial Manager	1	1000	12,000	0	12,000
administrative employee	1	350	4,200	0	4,200
Driver	4	350	16,800	0	16,800
General safety and security	2	400	9,600	9,600	0
Accountant	2	400	9,600	0	9,600
Procurement and warehouse employee	3	350	12,600	0	12,600
Maintenance manager	1	400	4,800	4,800	0
Maintenance technician	1	300	3,600	3,600	0
Marketing Manager (Agricultural Engineer)	1	1000	12,000	0	12,000
Marketing employee	3	400	14,400	0	14,400
worker	35	300	126,000	126,000	0
Total	56	7,750	255,600	174,000	81,600

It is worth mentioning that there are a number of activities requiring seasonal human resources to be contracted with to accomplish certain activities when required, such as tillage, harvesting, collecting, packaging, transporting and distributing. The following table shows the general job description of the main permanent jobs required in the project.

Job	Job Description
Farm Manager (General Supervisor)	Works independently and within the authority vested in him/her. Planning and managing the farm works, and controlling production processes and quantities. Following-up sales and marketing and development of production quality and specifications. Working to develop plans for production, sales and marketing of products. He/she also oversees the maintenance of farm installations, buildings and facilities and their readiness for operation, and implements programs to combat palm diseases and pests.
Agricultural engineer	Following-up work on the farm as directed by the Farm Manager and supervising the workers. Preparing daily and monthly plans for the implementation of the annual plan prepared by the Director. In addition, training workers on new works.
Financial and Administrative Director	The Financial Director performs the following tasks: ▪ Following-up to the preparation, reviewing, amending and adopting the administrative system and organization, which includes the procedures, rules regulations, organizational and functional structure, tasks, competencies, job description cards and a powers list. ▪ Budget preparation, including salaries, allowances, operating expenses, maintenance and operation programs, finished products and products under manufacturing. ▪ Following-up accounts and records and preparing budgets and financial statements. ▪ Following-up staff and reviewing payroll and their payment.
Marketing manager	Developing marketing policies and following up various sales processes and directing the Marketing Employee, as well as following-up central markets locally and export prices for. Following-up the Kingdom's imports of competitive products and developing plans and alternatives to cope with imports, as well as plans to cope with local competitors.
Worker	Caring of plant and tree varieties and fertilizing them, and providing special conditions for their growth and care. Implementing measures to prevent agricultural diseases and pests affecting plants and trees. Spraying and treating infected part with insecticide and appropriate plant medicines. Following-up the tillage, harvesting, packaging and other activities that are contracted seasonally.
Sub-Contracted Activities	▪ Tillage ▪ Harvesting and collecting. ▪ Packaging. ▪ Transport and distribution

4.4 The Required Licenses

The following table shows the necessary licenses from different parties to implement the project.

Table 27: Licenses required for the project

Statement	Analysis
Farm Registration	▪ Ministry of Industry and Trade ▪ Ministry of Agriculture
Farm Establishment	▪ Concerned Municipality
The exploitation of the well (underground water) and allow pumping with salt water purification	▪ Water Authority

4.5 Project Timetable

The following figure shows the project implementation period of 12 months, noting that the production of the fruit trees will start in the second year after establishment. As follows:

Stage	First year (months)												Second Year
	1	2	3	4	5	6	7	8	9	10	11	12	
Studies													
Purchase land and registration													
Land preparation and cultivation													
Employment and commissioning													
The start of production													
Total Duration	12 months												

5. Financial Study

5.1 Financial Assumptions

The following table illustrates the financial assumptions of the project.

Table 28: The Financial Assumptions of the Project

Item	Assumption
Inflation Rate	3%
Financing Structure	Equity constitutes 75% of the investment and loans constitute 25%
Interest Rate	9%
Production costs (saplings, seeds, fertilization, etc.)	49% of total revenues
Cost of Electricity and Diesel	5% of total revenues
Maintenance Cost	1% of total investment
Working Capital	JD 414 thousand
Pre-Operating Expenses	2% of total investment
Tax Rate	0%
Exemptions	Tax exemptions on the project
Assets Depreciation Rate	4%-20% of the asset value
Cumulative Depreciation	JD 210 thousand annually
Annual Salaries Increase	7%
Staff Benefits	35% of salaries
Accounts Receivable	Two months
Accrued expenses	16.8% of operation costs

5.2 Investment Cost

The project's Investment cost is estimated at JD 2.98 million distributed among fixed assets of JD 2.5 million, working capital and pre-operating expenses totaled of JD 474 thousand. The following table shows the project's Investment cost.

Table 29: the project's investment cost

Item	Value (in thousand JD)
Fixed assets	2,510
Pre-operating expenses	60
Working capital	414
Total	2,984

5.3 Financing

The project will be financed with the shareholders by 75% which is estimated at about JD 2.2 million, while the other 25% of the project investment cost will be financed through bank loans of about JD 745.9 thousand.

The following table shows the financing structure for financing the project, where:

- The interest rate is 9%.
- The loan will be paid during 5 years.

Table 30: Project financing schedule

Item	Value (in thousand JD)	%
Equity	2,237.8	75%
Loan	745.9	25%
Total	2,984	100%

5.4 Revenues

The following table shows the total revenues of the project, where it is noted that the revenues in the first year amounts to about JD 2.2 million, and increased to reach up to JD 3.3 million in the tenth year.

Table 31: The Expected Revenues

Statement	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenues- Cucumber Cultivation Using Pozzolans										
Production quantity (Ton)	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333	5,333
Average selling price	313	322	332	342	352	362	373	384	396	408
revenues	1,666,987	1,716,996	1,768,506	1,821,561	1,876,208	1,932,494	1,990,469	2,050,183	2,111,689	2,175,039
Statement	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Revenues- Fruit trees (pomegranate and grapes) using Pozzolans										
Production quantity (Ton)	–	56	112	168	224	280	280	280	280	280
Average selling price	700	721	743	765	788	811	836	861	887	913
revenues	–	40,376	83,175	128,505	176,480	227,218	234,034	241,055	248,287	255,736
Statement	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Production Quantities Of Green Thyme										
Production quantity (Ton)	396	636	636	636	636	636	636	636	636	636
Average selling price	700	721	743	765	788	811	836	861	887	913

Statement	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
revenues	277,200	458,556	472,313	486,482	501,077	516,109	531,592	547,540	563,966	580,885
Revenues From Cultivated Barley										
Production quantity (Ton)	508	508	508	508	508	508	508	508	508	508
Average selling price	400	412	424	437	450	464	478	492	507	522
revenues	203,200	209,296	215,575	222,042	228,703	235,564	242,631	249,910	257,408	265,130
Total Revenues										
Revenues from cucumber cultivation	1,666,987	1,716,996	1,768,506	1,821,561	1,876,208	1,932,494	1,990,469	2,050,183	2,111,689	2,175,039
Revenues from Fruit trees cultivation using Pozzolans	–	40,376	83,175	128,505	176,480	227,218	234,034	241,055	248,287	255,736
Revenues from Green Thyme	277,200	458,556	472,313	486,482	501,077	516,109	531,592	547,540	563,966	580,885
Other revenues (from selling Barley and thyme saplings)	24,302	27,699	29,050	30,457	31,922	33,448	34,451	35,485	36,549	37,646
Revenues From Cultivated Barley	203,200	209,296	215,575	222,042	228,703	235,564	242,631	249,910	257,408	265,130
Total Revenues – Thousand JD	2,172	2,453	2,569	2,689	2,814	2,945	3,033	3,124	3,218	3,314

5.5 The Projected Costs

Operating Costs

The following table shows the project's operating costs.

Table 32: Operating Costs

Operating Costs (in thousand JD)										
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Salaries	174	186	199	213	228	244	261	279	299	320
Staff Benefits	61	65	70	75	80	85	91	98	105	112
Cultivation requirements (saplings, fertilizers and nutrients, wages of care of fruit, packaging ...)	1,064	1,202	1,259	1,318	1,379	1,443	1,486	1,531	1,577	1,624
Electricity and diesel	109	123	128	134	141	147	152	156	161	166
Depreciation	210	210	210	210	210	210	210	210	210	210
Maintenance	25	27	29	31	33	35	38	40	43	46
Others	15	16	17	18	20	21	23	24	26	28
Total	1,658	1,829	1,912	1,999	2,090	2,186	2,261	2,339	2,420	2,505

Administrative Expenses

The following table shows the projected administrative expenses of the project.

Table 33: General and Administrative Expenses

General and Administrative Expenses (in thousand JD)										
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Salaries	81.6	87.3	93.4	100.0	107.0	114.4	122.5	131.0	140.2	150.0
Staff Benefits	28.6	21.8	23.4	25.0	26.7	28.6	30.6	32.8	35.1	37.5
Staff Incentives	2.2	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3
Stationery	5.0	5.3	5.5	5.8	6.1	6.4	6.7	7.0	7.4	7.8
Professional Fees	4.0	4.2	4.4	4.6	4.9	5.1	5.4	5.6	5.9	6.2
Marketing Expenses	65.2	73.6	77.1	80.7	84.4	88.3	91.0	93.7	96.5	99.4
Other Expenses	15.0	15.8	16.5	17.4	18.2	19.1	20.1	21.1	22.2	23.3
Amortization	59.7	–	–	–	–	–	–	–	–	–
Total	261.2	210.4	222.9	236.1	250.1	265.0	279.3	294.4	310.5	327.5

5.6 Projected Financial Statements

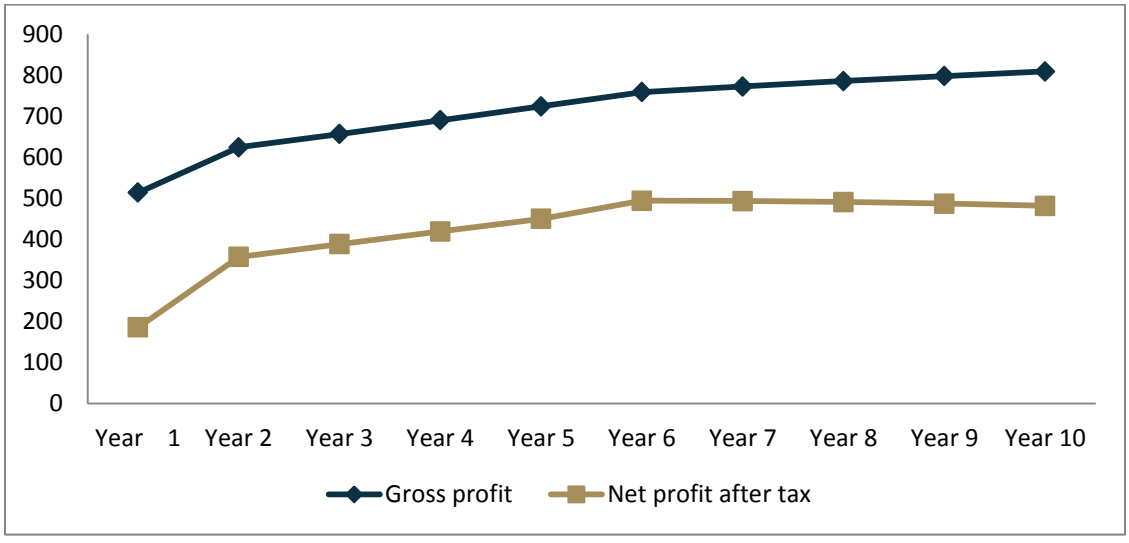
Income Statement

The following table shows the projected income statement of the project. It indicates that gross profit will increase from JD 514 thousand in the first year to JD 809 thousand in the tenth year. The net profit before tax is equal to the net profit after tax due to the lack of taxes for this project, where the net profit after tax will increase from JD 186 thousand in the first year to JD 481.4 thousand in the tenth year.

Table 34: The Projected Income Statement

Income Statement (in thousand JD)										
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenues	2,171.7	2,452.9	2,568.6	2,689.0	2,814.4	2,944.8	3,033.2	3,124.2	3,217.9	3,314.4
Operating costs (cost of sales)	1,657.8	1,828.9	1,912.0	1,999.1	2,090.4	2,186.0	2,260.7	2,338.8	2,420.3	2,505.5
Gross profit	513.9	624.0	656.6	690.0	724.0	758.8	772.4	785.4	797.6	808.9
Administrative expenses	261.2	210.4	222.9	236.1	250.1	265.0	279.3	294.4	310.5	327.5
Net profit	252.7	413.6	433.7	453.9	473.9	493.8	493.2	491.0	487.1	481.4
financial expenses	67.1	56.3	45.5	34.7	23.9			-	-	-
Amortization	-	-	-	-	-	-	-	-	-	-
Net profit before tax	185.6	357.3	388.2	419.1	450.0	493.8	493.2	491.0	487.1	481.4
Tax	-	-	-	-	-	-	-	-	-	-
Net profit after tax	185.6	357.3	388.2	419.1	450.0	493.8	493.2	491.0	487.1	481.4

Figure 3: Projected Income Statement



Projected Balance Sheet

The following table shows the projected balance sheet of the project during the first ten years. It indicates that total assets will increase from JD 2.9 million in the year of incorporation to about JD 3.9 million in the tenth year. The Total liabilities will decrease from JD 904 thousand in the first year to about JD 421 thousand in the tenth year. Moreover, the Shareholders' Equity will increase from JD 2.2 million in the year of incorporation to reach JD 3.5 million in the tenth year.

Table 35: Projected Balance Sheet

Projected Balance Sheet (in thousand JD)											
Statement	Year of incorporation	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Assets											
Cash	414	404	566	761	964	1,101	1,299	1,650	2,000	2,348	2,695
Receivables	-	362	409	428	448	469	491	506	521	536	552
Inventory	-	89	100	105	110	115	120	124	128	131	135
Pre- Paid Expenses	-	43	49	51	54	56	59	61	62	64	66
Total Current Assets	414	898	1,124	1,345	1,576	1,741	1,969	2,340	2,711	3,081	3,449
Fixed Assets	2,569	2,569	2,569	2,569	2,569	2,644	2,644	2,644	2,644	2,644	2,644
Cumulative Depreciation	-	270	480	690	900	1,110	1,320	1,531	1,741	1,951	2,161
Pre- operating expenses	-	-	-	-	-	-	-	-	-	-	-
Net Fixed Assets	2,569	2,300	2,089	1,879	1,669	1,534	1,324	1,114	904	694	483
Total Assets	2,984	3,198	3,214	3,224	3,245	3,275	3,293	3,454	3,614	3,774	3,933
Shareholders Equity and Liabilities											
Accrued Expenses and Payables	-	279	307	321	336	351	367	380	393	407	421
Long Term Loans	746	626	506	386	266	146	-	-	-	-	-
Total Liabilities	-	904	813	707	602	497	367	380	393	407	421
Shareholders Contributions	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238
Retained Earnings	-	56	163	279	405	540	688	836	983	1,130	1,274
Shareholders' Equity	2,238	2,293	2,401	2,517	2,643	2,778	2,926	3,074	3,221	3,367	3,512
Shareholders Equity and Liabilities	2,984	3,198	3,214	3,224	3,245	3,275	3,293	3,454	3,614	3,774	3,933

Cash Flow Statement

The following table shows the projected cash flow statement of the project during the first ten years. It indicates that the cash flow from operation will increase from JD 240 thousand in the first year to JD 684 thousand in the tenth year; while the Cash at the ending period will increase from JD 414 thousand in the year of incorporation to JD 2.7 million in the tenth year.

Table 36: The Expected Cash Flows Statement

Cash Flow Statement (in thousand JD)											
Statement	Year of incorporation	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Operation Activities											
Net Profit	-	186	357	388	419	450	494	493	491	487	481
Depreciation	-	270	210	210	210	210	210	210	210	210	210
Change In Working Capital	-	(216)	(35)	(12)	(13)	(13)	(14)	(8)	(8)	(8)	(8)
Cash Flow From Operation	-	240	532	586	616	647	690	696	694	690	684
Investing Activities											
Fixed Assets	(2,569)	-	-	-	-	(75)	-	-	-	-	-
Cash From Investing Activities	(2,569)	-	-	-	-	(75)	-	-	-	-	-
Financing Activities											
Capital (Equity)	2,238	-	-	-	-	-	-	-	-	-	-
Loan	746	(120)	(120)	(120)	(120)	(120)	(146)	-	-	-	-
Dividends	-	(130)	(250)	(272)	(293)	(315)	(346)	(345)	(344)	(341)	(337)
Cash Flow From Financing Activities	2,984	(250)	(370)	(392)	(413)	(435)	(492)	(345)	(344)	(341)	(337)
Net Cash Flow	414	(10)	162	194	203	137	199	351	350	349	347
Cash At The Beginning Period	0	414	404	566	761	964	1,101	1,299	1,650	2,000	2,348
Cash At The Ending Period	414	404	566	761	964	1,101	1,299	1,650	2,000	2,348	2,695

5.7 Financial, Economic and Social Analysis

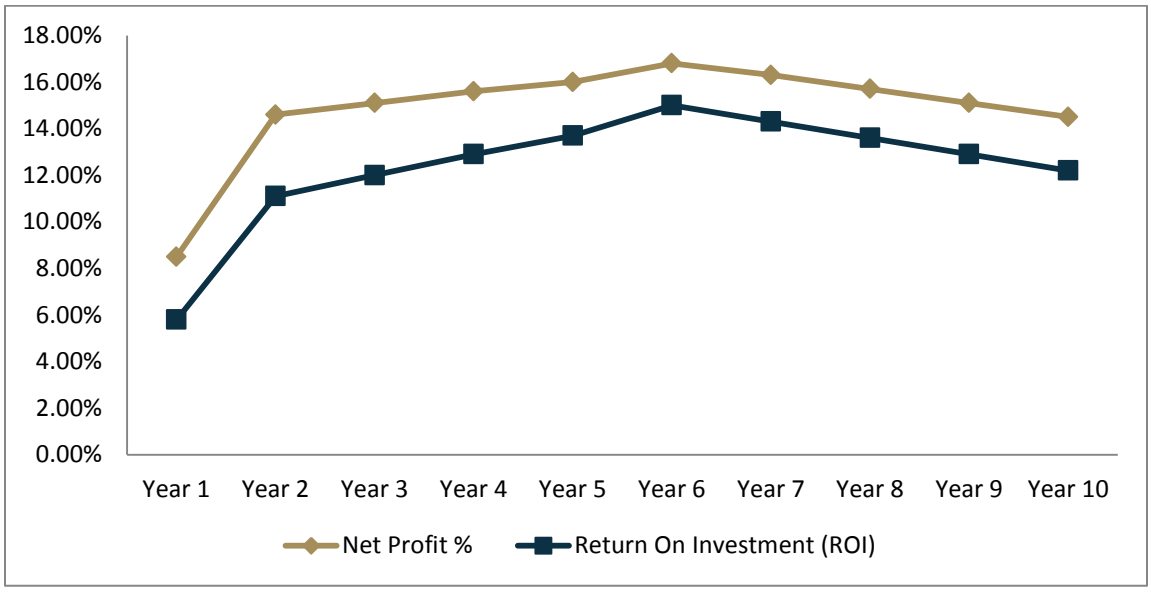
Financial Analysis

The following table shows the financial analysis of the project. It indicates that the net profit ratio will increase from 8.5% in the first year to 14.5% in the tenth year, and the return on investment will increase from 5.8% in the first year to 12.2% in the tenth year.

Table 37: Financial Analysis

Financial Analysis (In Thousand JD)										
Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Assets	3,198	3,214	3,224	3,245	3,275	3,293	3,454	3,614	3,774	3,933
Revenues	2,172	2,453	2,569	2,689	2,814	2,945	3,033	3,124	3,218	3,314
Profits	186	357	388	419	450	494	493	491	487	481
Capital (Equity)	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238	2,238
Net Profit %	8.5%	14.6%	15.1%	15.6%	16.0%	16.8%	16.3%	15.7%	15.1%	14.5%
Return On Investment (ROI)	5.8%	11.1%	12.0%	12.9%	13.7%	15.0%	14.3%	13.6%	12.9%	12.2%
Return On Capital (ROC)	8.3%	16.0%	17.3%	18.7%	20.1%	22.1%	22.0%	21.9%	21.8%	21.5%
Net Profit On Revenues	8.5%	14.6%	15.1%	15.6%	16.0%	16.8%	16.3%	15.7%	15.1%	14.5%
Assets Turnover (Time)	0.68	0.76	0.8	0.83	0.86	0.89	0.88	0.86	0.85	0.84

Figure 4: The Financial Analysis



Economic Analysis

The following table shows the economic analysis of the project during the first ten years, we conclude that:

- The Internal rate of return is 21.8%. It exceeded five times the return on assets, which means the economic feasibility of the project
- The present value of the project reached about JD 3.6 million. It exceeds the investment value with JD 642 thousand, which means the economic feasibility of the project.
- The profitability index of the project reached 1.62 times, which means that the expected value of the project will increase by two times the investment value, which proves that the project is feasible.
- The project payback period is 5.4 years.

Table 38: the Economic Analysis

Economic Analysis (in Thousand JD)											
Statement	Year of incorporation	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net cash flow from operating and investing activities	(2,238)	120	412	466	496	527	544	696	694	690	684
terminal value	-	-	-	-	-	-	-	-	-	-	3,512
Net Cash flow	(2,238)	120	412	466	496	527	544	696	694	690	4,196
Internal Rate of Return (IRR)	21.8%										
present Value	3,626										
Net present value	1,388										
Profitability Index (Time)	1.62										
Payback period (Year)	5.40										

Social Analysis

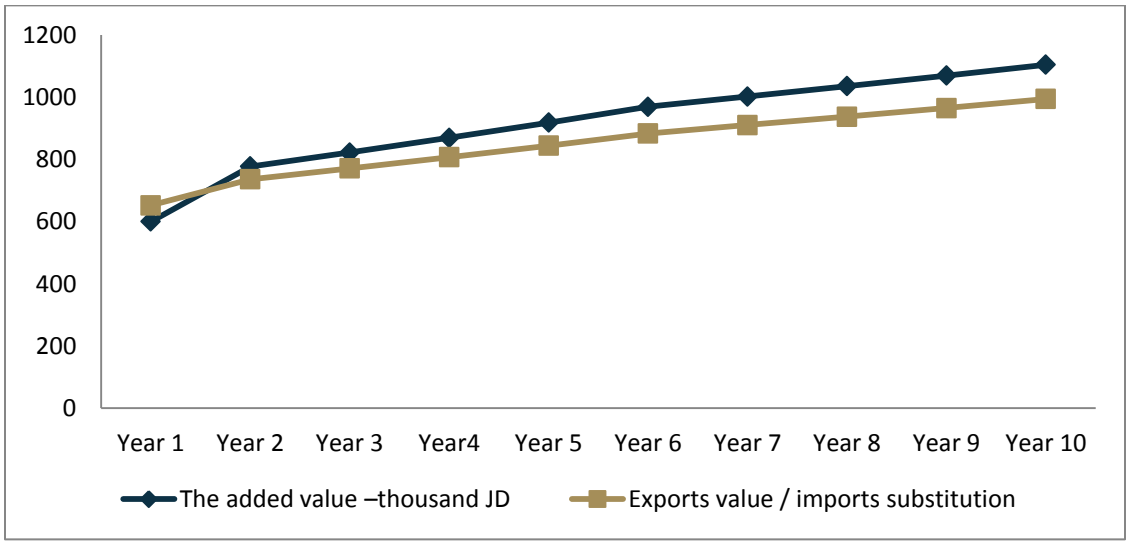
The following table shows the social analysis of the project. It is noticed that the number of staff required for the project will increase from 56 employees in the first year to 87 employees in the tenth year. The Jordanian employees represent 70% of total employees in the project.

The added value of the project will also increase from JD 600 thousand in the first year to JD 1.1 million in the tenth year. The exports value will also increase from JD 652 thousand to reach JD 994 thousand in the tenth year.

Table 39: the Social Analysis of the Project

Social Analysis										
Statement	Year 1	Year 2	Year 3	Year4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Number of Employees	56	59	62	65	68	71	75	79	83	87
Jordanian employees	39	41	43	45	48	50	53	55	58	61
The added value –thousand JD	600	777	822	869	918	969	1,002	1,035	1,069	1,104
Income tax –thousand JD	-	-	-	-	-	-	-	-	-	-
sales tax value –thousand JD	-	-	-	-	-	-	-	-	-	-
Exports value / imports substitution	652	736	771	807	844	883	910	937	965	994

Figure 5: The Social Analysis



6. Risk and Sensitivity Analysis

6.1 Risk Analysis

The following table shows the risk matrix analysis that may face the project.

Table 40: Project Risk Matrix

Risks	Type of Risks	Risk Assessment
Financial Risks	▪ **Credit Risk** Credit risk represents the risk of the company's financial loss as a result of the customer's default of the contractual obligation or that of the party dealing with the company through a financial instrument. These risks are mainly caused by trade receivables and others. ▪ **Liquidity Risk** Liquidity risk is the risk resulting from the company's inability to meet its financial obligations at time. The company's liquidity management is to ensure as much as possible that the company always maintain enough liquidity to meet its obligations as they become due and payable in normal and emergency conditions without incurring unacceptable losses or risks that affect the company's reputation. ▪ **risk of currency fluctuation** Currency risk is the risk of the	▪ The financial risks that may face the company are moderate, because there is accounts receivables in the market amounted to 2 months ▪ There is no risk of currency exchange, because the company sales and purchases by local currency ▪ There is no risk of inflation because the company's pricing is based on a periodic basis

Risks	Type of Risks	Risk Assessment
	fluctuation of the value of financial instrument, due to fluctuations in foreign currency exchange rates. ▪ **inflation risk** It is the risk associated with the possibility that the inflation or the rise in the cost of living might lead to the decrease the real value of the investment.	
Business risk (sector risk)	▪ **Strategic Risk** It is the risk resulting from taking bad decisions by the company's management, or implementing the decisions in a wrong way, or not taking the decisions at the right time; which leads to losses or causes loss of alternative opportunities. ▪ **Legal and Regulatory Risks** These risks are reflected as a result of non-compliance with laws, guidelines and instructions governing the work. Legal risks are caused by the company's break of the laws governing the work in the state in which the company operates. While regulatory risks arise from the company's violation of laws and standards issued by the regulatory authorities. ▪ **Reputation Risk** Reputation risk arises from	▪ The risks are considered very low before the company's establishment, because of getting the approval of the official authorities such as municipality and ministry of agriculture ▪ Reputational risk is moderate, ▪ Market risk in the short term will be moderate because of the competition from other companies

Risks	Type of Risks	Risk Assessment
	influential negative public views which result in great losses of customers or money. It includes the actions of the company's management or its employees which project a negative image of the company, its performance and its relationships with customers and other stakeholders. Reputation risk also results from circulating rumors about the company and its activities. ▪ **Competition Risk** Competition risk results from domestic and external competitors and reduces sales and profits.	
Operational Risk	Operational risk involves losses resulting from the failure of internal operations, human resources and systems. It includes: ▪ **IT Risks** They are losses arising from downtime or systems failure due to the infrastructure, information technology, or the lack of systems, and any failure or malfunction in the systems. They include: the crash of computer systems, breakdowns in communication systems, programming errors, computer viruses and opportunities losses due to	▪ Operational risks are moderate for the company, due to the shortage in water ▪ Marketing risks ▪ The risk of plant dieses ▪ IT risks is very low ▪ Human resources is very low

Risks	Type of Risks	Risk Assessment
	breakdown. ▪ **Human Resources Risk** Losses caused by employees or related to them (intentionally or unintentionally). It also includes acts that are intended as methods of cheating, abusing property or circumvent the law, regulations or company policy by officials or employees, as well as losses arising from the relationship with the customer, shareholders, regulators and any third party.	
State Risk	State Risk includes politicians' interference, civil unrest, wars, financial and monetary policies and high level of debts.	▪ State Risk is considered to be low, due to security and political stability; international reports indicate that State Risk is low both in medium and long terms

6.2 Sensitivity Analysis

First: Increase of Investment Cost By 10%

The following table shows the results of the sensitivity analysis when investment cost increases by 10%.

Table 41: Investment Increase by 10%

Index	Base	Impact	Change
Internal Rate of Return (IRR)	21.8%	19.8%	2.0%
The Present Value at a discount rate of 13% (in Thousand JD)	3625.9	3629.0	-3.1
Net Present Value at a discount rate of 13% (in Thousand JD)	1388.1	1162.3	225.8
Profitability Index (Time)	1.6	1.5	0.1
Payback period (Year)	5.4	6.0	-0.6
The Net Profit Ratio – an average of 10 years	14.8%	14.7%	0.2%
Return on Investment - an average of 10 years	12.4%	11.4%	1.0%
Return on Capital – an average of 10 years	19.0%	17.1%	1.9%
Net Profit On Revenues - an average of 10 years	14.8%	14.7%	0.2%
Assets Turnover (Time) – an average of 10 years	0.8	0.8	0.1
The added value - an average of 10 years (in thousand JD)	916.6	916.0	0.6
income tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0
sales tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0

The above analysis refers to the feasibility of investment in the project, in light of the high cost of the total investment of the project, which increased by 10%. It is noted that:

- The internal rate of return reaches 19.8%, which is considered high for investment purposes
- The new payback period is 6 years, and it is reasonable for recovery purposes
- The return on capital is 17.1%, which is suitable for investment purposes

Second: Reducing Revenues by 10%

The following table shows the results of the sensitivity analysis when reducing revenues by 10%.

Table 42: Reducing Revenues 10%

Index	Base	Impact	Change
Internal Rate of Return (IRR)	21.8%	11.0%	10.8%
The Present Value at a discount rate of 13% (in Thousand JD)	3625.9	1950.7	1675.3
Net Present Value at a discount rate of 13% (in Thousand JD)	1388.1	-287.2	1675.3
Profitability Index (Time)	1.6	0.9	0.7
Payback period (Year)	5.4	9.1	-3.7
The Net Profit Ratio – an average of 10 years	14.8%	5.4%	9.5%
Return on Investment - an average of 10 years	12.4%	4.8%	7.6%
Return on Capital – an average of 10 years	19.0%	6.3%	12.7%
Net Profit On Revenues - an average of 10 years	14.8%	5.4%	9.5%
Assets Turnover (Time) – an average of 10 years	0.83	0.86	-0.03
The added value - an average of 10 years (in thousand JD)	916.6	633.3	283.3
income tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0
sales tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0

The above analysis shows the low sensitivity of the project in case of reducing the revenues or demand by 10%. It indicates that:

- The internal rate of return is 11%, which is considered high for investment purposes
- The new payback period is 9.1 years, which is considered long period for recovery purposes
- The return on capital reaches 6.3%, which is low for investment purposes

Third: Increasing the Operating Costs by 10%

The following table shows the results of the sensitivity analysis when increasing the operating costs by 10%.

Table 43: Increasing the Operating Costs by 10%

Index	Base	Impact	Change
Internal Rate of Return (IRR)	21.8%	13.7%	8.2%
The Present Value at a discount rate of 13% (in Thousand JD)	3625.9	2336.6	1289.3
Net Present Value at a discount rate of 13% (in Thousand JD)	1388.1	98.8	1289.3
Profitability Index (Time)	1.6	1.0	0.6
Payback period (Year)	5.4	8.1	-2.7
The Net Profit Ratio – an average of 10 years	14.8%	7.3%	7.5%
Return on Investment - an average of 10 years	12.4%	6.9%	5.5%
Return on Capital – an average of 10 years	19.0%	9.5%	9.5%
Net Profit On Revenues - an average of 10 years	14.8%	7.3%	7.5%
Assets Turnover (Time) – an average of 10 years	0.83	0.92	-0.09
The added value - an average of 10 years (in thousand JD)	916.6	704.6	212.0
income tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0
sales tax - an average of 10 years (in thousand JD)	0.0	0.0	0.0

The above analysis shows the feasibility of the project in light of increasing the operating costs of the project by 10%. It indicates that:

- The internal rate of return is 13.7%, which is considered high for investment purposes
- The new payback period is 8.1 years, and it is reasonable for recovery purposes
- The return on capital is 9.5%, which is low for investment purposes

7. Annex 1: Soilless Cultivation

Soilless Agriculture is a method of cultivating plants without soil, where the natural soil is replaced by a water growth media or solid media, such as volcanic tuff or Perlite and others, with the addition of nutrients in the form of nutrient solution. Through this technique, the quantities of water, nutrients and environmental conditions are controlled to be suitable for growth in order to maximize production and saving more water for irrigation. Although the idea of using hydroponics has been hundreds of years, interest in the use of this technology in agriculture has developed rapidly over the last twenty years, after showing their economic feasibility, especially in the cultivation of vegetables, cut flowers and green fodder.

Hydroponics technology is currently used in many countries of the world for commercial agricultural production, as the area has now reached more than 120 thousand acres in the world, including the United Arab Emirates, Egypt and Sudan. There have been attempts to use such technology in Jordan for more than 15 years but have not continued. On the other hand, the Ministry of Agriculture in Jordan encourages the use of this type of agriculture through the Directorate of Land and Irrigation, as the Ministry trains people on the production of Hydroponics products using Aquacorp.

Features of soilless agriculture compared to traditional soil agriculture

- Efficiency in rationalizing water use in irrigation, due to lack of steam loss or drainage in the soil, with recycling of water use. Thus maximizing water use efficiency.
- High efficiency of soilless productivity, because of the availability of nutrition and water near the roots. Thus reducing root growth and directing nutrition to vegetative and fruit growth. In addition, the productivity of the area unit increases with vertical cultivation.
- High efficiency in fertilizer use, due to the ease of adjustment of its concentration, with no loss or fixation in soil. Thus increasing the nutritional efficiency of the plants.
- Reducing the use of chemical pesticides significantly with the possibility of protecting crops in ways other than chemicals, and thus have a higher crop quality and environmental protection.
- It is considered one of the most efficient methods used to solve soil issues, such as the high salinity issue, weeds, soil diseases and pests such as nematodes, insects or others.
- Savings in labor due to the lack of need for many agricultural processes in soilless agriculture, such as tillage, weeding and others.
- Agricultural intensification and increasing the number of plants in the area unit, which leads to an increase in crop production and early harvest, and thus leads to higher yield of the crop. In addition, there is a possibility of increasing the number of agricultural varieties per year.
- The possibility of agricultural production in areas where agriculture is impossible by other methods.

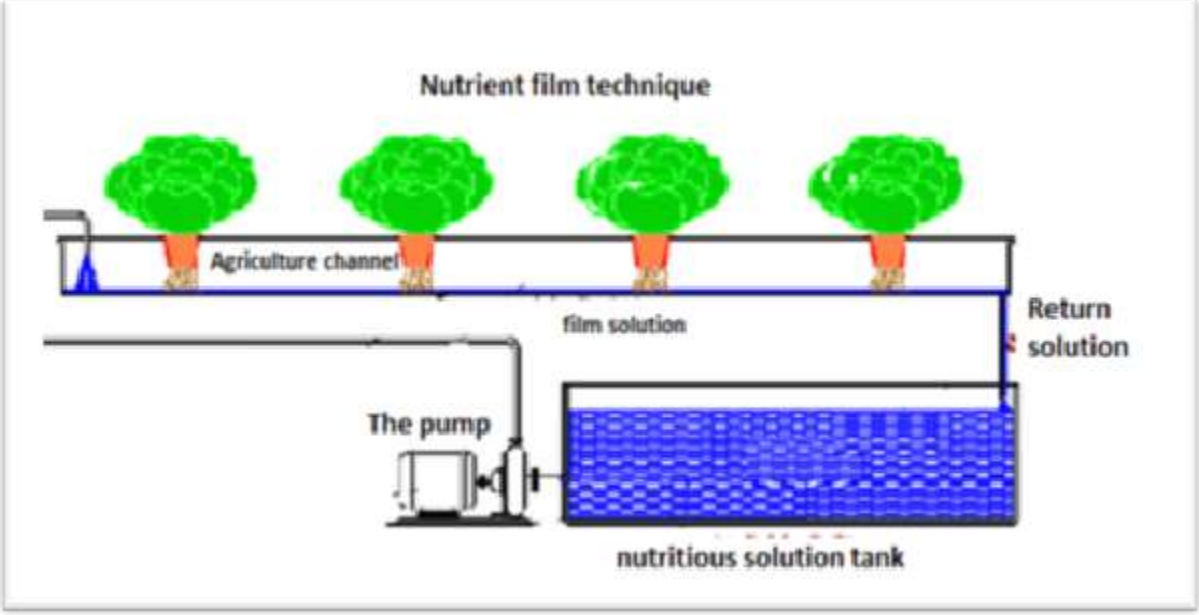
- The quality of the produced crops is higher, as the only the fertilizer needed by the plant is used and from natural elements. The Hydroponics product contains all the major elements needed by the human body, because they are all being supplied to the plants in a soluble way and available to the plant.
- Environmentally friendly since the residues of fertilizers are recycled, while in traditional soil agriculture, fertilizers are discharged into the lower layers of the soil leading to contamination of the groundwater.

Constraints of Soilless Agriculture

- Any failure of a hydroponics system leads to rapid plant death due to the lack of soil acting as an insulator.
- Infection with pathogens, such as wilt and verticillium caused by high humidity levels, which requires more control.
- Requires more energy.
- High establishment cost.
- The need for skilled and trained management and manpower to ensure the success of the project.

Soilless Agriculture System

- **Hydroponics:** is the real hydroponics system where plants are grown in a watery medium that has all nutrients, where part of the roots grows while providing ventilation for root growth, and is similar to the nutrient film. This method is often used for Leaf Crops such as lettuce and others.



- **Agriculture in Solid Media**: Plants are grown in solid media such as volcanic tuff, Perlite and sand, which are placed in basins, pots or other, and considered the most prevalent in agriculture systems. The closed system is usually used to rotate the nutrient solution and reuse it several times.

- **Aerobic Agriculture**: The most important feature of this type is that the plant receives 100% of the oxygen available to the roots and carbon dioxide. This will increase biomass growth (80-100%), and reduce root growth time and accelerate production (40-60%), and reduce nutrient consumption by 75% compared to hydroponic.

- **Vertical Agriculture:** This technique is characterized by taking advantage of the space to the maximum extent, By placing the pots on top of each other in a double way to reach up to 8-12 pots per column. Irrigation is done from top to bottom in this technique, so the irrigation water leaking from the pots to the reservoir will be collected and used again in irrigation through recycling. One of the most important features of this system is the increase in productivity in the area unit, as 8,000 plants can be planted in a protected greenhouse (360 m2), compared to 1000 plants in the same area using the horizontal system.

Crop Types Suitable for Soilless Agriculture

In general, all crops are suitable for cultivation by Soilless Agriculture, but the goal of agriculture remains the determinant of the type of crop. Among the main cultivated crops is Soilless Agriculture are flowers, tomatoes, cucumber, sweet peppers, fruit trees, fodder, especially barley, and others.

Table 44: Production and efficiency of water use in some crops by using Soilless Agriculture compared to soil agriculture

Crop	Soilless Agriculture		soil agriculture (traditional)	
	Production (kg / m^2)	Water use efficiency (kg / m^3 water)	Production (kg / m^2)	Water use efficiency (kg / m^3 water)
Tomatoes	12.5	48	5.4	7
Cucumber	10.4	80.6	2.1	6.8
Watermelon	8.7	77.4	3.1	4.2
green pepper	8.3	71	4.2	9.2
Beans	6.3	75	3.5	8.2
Lettuce	9.5	72	4.1	7

These data concerning agriculture using hydroponics and aerobics

Requirements for Establishing a Soilless Agriculture Project

- Establishing a protected greenhouse, and its accessories from cooling systems, irrigation tanks and others.
- Establishing systems of agriculture inside the greenhouse, and accessories of irrigation systems and others.
- Nutrient solution (fertilizer and water) for irrigation.
- Agriculture environments (media).
- Supplies of plant services of fastening strings, traps and other
- Production of seedlings for agriculture.

Protected Greenhouse

The protected Greenhouse is the facility used to grow crops of vegetables, flowers and others. It has a controlled indoor climate using cooling, ventilation and heating devices to ensure optimum conditions for optimal plant growth such as heat, humidity and lighting, as well as protection of plants from wind, sand storms, rain and others.

Conditions to consider when building a protected Greenhouse

- Choosing the appropriate direction for protected Greenhouse that allow maximum access of sunlight (North-South).
- It is recommended to have natural windbreaks on site.
- A permanent source of water shall be provided.
- Raising the protected Greenhouse location from the level of the surrounding land, to facilitate the rapid discharge of rainwater and others.
- The Greenhouse coverings shall be able to withstand the prevailing environmental conditions, taking into consideration light permeability (polycarbonate)
- Providing a two-door entry, to reduce insect entry and avoid exposure to direct winds into the houses.
- The length of the protected Greenhouse shall not exceed 36 m and a width of 8 m, for the efficiency of cooling and ventilation at high temperatures, an a height of 3.5-4 m.

Components of the protected Greenhouse

The protected Greenhouse consists of the following main parts:

- The Structure (ceilings, pillars, arches, columns).
- The foundations - facades and doors – sides.
- Covers (plastic - polycarbonate - glass ...).
- Ventilation – Cooling Equipment.
- Shading Materials
- Irrigation and fertilization systems.

The Shape of the Protected Greenhouse

There are two common forms in dry areas:

1. It has a curved roof (semi-circular), and is the most common to reduce the sun's acute entry and heat accumulation.
2. The ceiling is in the form of gable.

Ventilation and Cooling System

- Cooling of greenhouses is an indispensable necessity, especially during the summer months, when the average monthly rate of temperature is 37.
- Cooling system with humidification (desert) is used, because it is less expensive than other systems. It is made up of two suction fans, while on the other side there are Evaporative Cooling Pads. The Pad is about 180 cm high and at least 4 inches thick, and almost the same width of the house from the inside. The bottom edge of the Pad shall be about 30 cm high on the house floor, to minimize the possibility of soil entering into the Pad. The cooling system is operated automatically by an electric plate attached to a special heat regulator.

Agriculture Environments (Growth Media)

There are many materials that can be used as a media (environment) for soilless agriculture, and the materials vary among themselves by their nature and natural properties. Due to the diversity of the forms and types of the materials in the environment, a set of foundations must be set to choose the appropriate material to be an agricultural environment.

Conditions to be met in Soilless Agriculture environments:

- The environment shall have the ability to retain water. The ability of the environment to retain water and discharge excess water depends on the size, shape and pores of the environment. The smaller the granules, the greater the capacity of the environment to retain water, as the irregular form granules have a larger surface area than the smooth and round ones, thus having a higher water retention capacity. Therefore, the size of the granules should be suitable to keep adequate water proportion suitable to the type of crop to be cultivated.
- The environment shall have good drainage and ventilation: The environment shall have good drainage, as it facilitates the excess water drainage that the environment cannot hold, to ensure good ventilation in the environment of root growth. Thus, it must be avoided that the environment granules are very soft as this will reduce ventilation.

Conditions to be met in Soilless Agriculture Environments

- The environment shall be free from harmful or toxic substances that can damage plant roots or affect plant growth in this environment.

- The environment shall support plants that grow in them: The ability of the environment to strength roots depends on either the environment to be heavy, or to be linked strongly to the plants roots, and works to stabilize the plant.
- The environment shall be free of pathogens: The environment shall be free of pests and insects when used, so as not to be a source of infection for their plants with different diseases.
- The environment shall be free from salinity.
- The environment shall be free of weed seeds.
- The environment shall be slow decomposition: to remain as long as possible with the best specifications. This reduces the costs of changing the environment annually.
- The ease of transporting and circulating the environment, and the low prices of the environment.
- The substance shall be inert, and does not interact with the nutrients, and it shall have neutral acidity (PH).
- Can be recycled for repeated use, or easily disposed of without environmental impacts (for example, the volcanic tuff can be used).

How to Establish a Soilless Agriculture System

To establish a Soilless Agriculture project, we do the following:

- Determining the used Soilless Agriculture system (for example in cement basins, bricks, pots, etc.)
- Leveling the Land and making the slope.
- Designing and establishing the agricultural basins.
- Preparing the nutrient solution tank.
- Distributing the growth media in agricultural basins.
- Design and install the irrigation system.
- Planting in basins.

Establishment of a Soilless Agriculture System / Cement Basins and Bricks

- Land leveling and making the slope: To determine and make the slope we need a transparent water pipe and water balance, as the the degree of inclination is 1:50.
- Bricks basins: The slope of the channel in the soil is determined first so that the slope is 100:1. The bricks (4 inches) are then installed on both sides of the channel and on the same slope, so that the internal distance between the lines of the blocks is 20cm. The house is divided into four basins (longitudinal lines) for cultivation.
- Covering the basins with black plastic: the bricks basins are covered with black plastic with a thickness of 100-120 microns and a width of 100-150 cm, and have the same length of the house from one end to the other, and installing black plastic inside the basin. It is preferable to install two layers of plastic to prevent any leakage of the solution to the bottom of the basin.

- The growth medium is placed directly in the basins.

Model for the Irrigation and Drainage Network

- Irrigation and fertilization system: The adopted system is the drip irrigation system containing a main PVC pipe with eight dripping lines 4 liters per hour, and the distance between the points is 30 cm. in addition, a polyethylene spigot to be installed at the beginning of each line.
- The nutritious solution tank is placed inside the protected greenhouse.
- Operating panel: Irrigation system operating panel consists of:
  - Contacter.
  - Overload Relay.
  - Timer.

Other Used Devices

- Programmer
- Irrigation Pump

Planting Process

- Seeds of some crops are planted directly, such as melons and muskmelon, or produce seedlings of some crops, such as tomatoes and peppers.
- In order to produce the seedlings, the seeds are planted in agricultural trays filled with a mixture of Peat moss and Perlite. After the complete growth of the seedlings in the nursery, they are transferred and cultivated in the growth media.

Agricultural house in Hydroponic and Aeroponic consists of several layers (6 layers)

- The production of flowers and roses by using the Hydroponic method is considered one of the high-yield crops with high financial returns. This method can also produce fruit trees, such as Raspberry or Blackberry trees and others.
- The cultivation of strawberries using the Hydroponic method can produce 25 kg per year of 1 m2 compared with no more than 10 kg per year in two seasons with traditional agriculture.
- Hydroponics Agricultural saves 70% -80% of irrigation water, while aerobics saves about 90%. In addition, saltwater can be desalinated, and water-depleting farms can be shifted to use hydroponics and aerobics Agricultural, with the lowest amount of water and the highest amount of production.

How to Prepare a Nutrient Solution

- Solution A is mixed by dissolving 1003 g of calcium nitrate in water, and then adds 79 grams of Iron Chelate and stir until dissolution.
- Solution B is mixed by dissolving each of the following substances: 263 g of dipotassium phosphate, 583 g potassium nitrate, 513 g magnesium sulphate, 6.1 g manganese sulphate, 0.39 copper sulphate, 1.7 g boric acid, 0.37 g of ammonium molybdate and 0.44 g of zinc sulphate.
- Mixing the nutritious solution for use: In order to obtain the solution ready to use, the concentrated solution (A) and (B) are diluted 100 times, which means adding 10 liters of solution A and 10 liters of solution B to 1000 liters of water.