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Economical assessment of supplementary irrigation of Olive trees in Jenin District/ Palestine

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Economical assessment of supplementary irrigation of Olive trees/ Palestine

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Economical assessment of supplementary irrigation of Olive trees/ Palestine

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Dedication

To the one who is above all knowledgeable ...Allah

To my heaven on earth... my dear mother ... My father, my brother, my sisters, and their children.

Some debts we cannot pay but we do not forget ... Dr. Bashar Daraghmeh

To those who shared the smile and hope and a beautiful destiny gathered us, dear friends and colleagues…. Thanks a lot.

To my supervisor, this work would not have been complete without your guidance and containment Dr. Amer Marie ….. Special thanks

To the Ministry of Agriculture's staff, all expertise people and everyone who contributed to the success of this work ... Thank you very much

Sabreen,,

Declaration:

I Certify that this thesis submitted for the degree of Master of my own research, except where otherwise acknowledged, and that this thesis (or part of the same) has been submitted for higher degree to any other university or institution.

Signed:………………………..

Sabreen Mohammad Masoud khdour

Date: 3/6/2020

Abstract.

The growth of olive trees in Palestine considers as an important pillar of the Palestinian economy. The value of this sector is contributed to 10, 9 million US$ in 2014. This became sector become more and more fragile during the last three decades, and not profitable during the due to many reasons, one of these is the fluctuation of rainfall while most of the cultivars depend on rain-fed. The study aimed at knowing the economical assessment of supplementary irrigation of olive tree in Jenin District, where the study used the analytical descriptive method in the quantitative and qualitative aspect and the study population consist of all farmers who applied supplementary irrigation in their tree fields in Jenin District in the period 2019/2020, So that the study included a comprehensive survey of the study population of 40 farmers, 36 of whom were reached, and a questionnaire was distributed to them, as well as interviews with each of them separately. The researcher built the questionnaire and component of five paragraphs, after examining several previous studies and the tools used in them, SPSS, feasibility analysis in analyzing the results of the respondents' responses in the interview.

The results showed that supplemental irrigation contributes to the growth of olive trees and increases their productivity. The irrigation of olive fields also gives a very positive economic impact on farmers, as production increases rapidly compared to the traditional one. It was noted that the land planted with irrigated olive trees was not used for cultivation before, and supplementary irrigation allowed being used efficiently. Besides, the production mechanisms used in irrigated agriculture do not differ from the traditional cultivation of olive trees, but there is a difference between irrigated olive fields based on irrigation methods, size of the area, type of tree, and age.

On average 3 m^3 of supplementary water/ tree was applied during the period Jun-September in six irrigation scheduling intervals. The olive oil production increased from 5.6 to 12.5 Kg/tree by using supplemental irrigation.

The sustainability of the project shows that from the third year where the return on investment is 60% for freshwater and 61.5% using treat wastewater. The net profit was 808$/year.dunum for freshwater while using treat wastewater is 704$/year. dunum. The profit margin ratio of 65.5% for freshwater and 66.2% for using treats wastewater. The Net Present Values (NPV) is 3384$ when farmers invest 1,149$ using a freshwater technique with a 2.5% interest rate, for 6 years period, and he has the chance to gain total net profit of

4,470$ /dunum. Also, NPV of 3,187$ when the farmer invests 1145$ using treated wastewater irrigation, but he has the chance to gain a total net profit of 3,178$ /dunum.

The study recommended that the government support land reclamation programs to enable farmers to use them to grow olive trees. Jenin Agricultural Directorate encourages farmers to grow irrigated olive trees by providing seedlings of suitable varieties and equipment, and that the Agricultural Extension Service conducts training courses for farmers on how to maintain and care for irrigated olive fields.

This study recommended an effective, and sustainable method to help poor farmers to overcome the poverty condition, by providing sources of funding by government or NGO-s to irrigate a minimum area of 7 dunums. Also, the study recommended that the olive sector be pursued and led and enhanced cooperation between the public and private sectors, farmers 'associations, cooperatives, investors and NGOs interested in it by supporting wastewater treatment programs to be fit for agricultural use and provision to irrigate olive fields, and support the expansion of supplementary irrigation as much as possible, provided that Farmers follow the sound foundations of the irrigation process. Develop water harvesting techniques to meet their supplementary irrigation water needs.

التقييم الاقتصادي لمشاريع الري التكميلي لاشجار الزيتون في محافظة جنين

إعداد: صابرين محمد مسعود خضور

إشراف: د.عامر مرعي

الملخص:

تعتبر زراعة أشجار الزيتون في فلسطين ركيزة مهمة للاقتصاد الفلسطيني، وقد ساهمت قيمة هذا القطاع بمبلغ 10,9 مليون دولار أمريكي في عام 2014. أصبح هذا القطاع أكثر هشاشة خلال العقود الثلاثة الماضية ولم يكن مربحًا لعدة أسباب أحدها هو تذبذب هطول الأمطار، حيث تعتمد معظم الحقول على مياه الامطار. هدفت الدراسة الى معرفة التقييم الاقتصادي لمشاريع الري التكميلي لأشجار الزيتون في محافظة جنين، حيث استخدمت الدراسة منهج الوصف التحليلي بشقية الكمي والنوعي، وقد تكون مجتمع الدراسة من جميع المزارعين الذين يقومون بالري التكميلي في حقول الاشجار المملوكة لديهم في محافظة جنين في الفترة 2020/2019، بحيث شملت الدراسة مسحا شاملا لمجتمع الدراسة البالغ 40 مزارع تم الوصول الى 36 مزارع منهم، وقد تم توزيع استبيان عليهم و كذلك اجراء مقابلات مع كل مزارع منهم على حدا، وبعد اطلاع الباحثة على عدد من الدراسات السابقة و الأدوات المستخدمة فيها، قامت ببناء الاستبيان والمكون من خمس فقرات وقد تم استخدام برنامج SPSS والتحليل المالي لتحليل نتائج استجابات المبحوثين في المقابلات.

أوضحت النتائج أن الري التكميلي يساهم في نمو أشجار الزيتون ويزيد من إنتاجيتها. كما أن ري حقول الزيتون يعطي تأثيرًا اقتصاديًا إيجابيًا للغاية على المزارعين، حيث يزداد الإنتاج بسرعة مقارنة بالزراعة التقليدية. وقد لوحظ أن الأرض المزروعة بأشجار الزيتون المروية لم تكن تستخدم للزراعة من قبل، وهذا يعطي الري التكميلي الفرصة لاستخدامها بكفاءة. بالإضافة إلى ذلك لا تختلف آليات

الإنتاج المستخدمة في الزراعة المروية عن الزراعة التقليدية لأشجار الزيتون، ولكن هناك اختلاف بين حقول الزيتون المروية بناء على طرق الري وحجم المساحة ونوع الشجرة والعمر.

في المتوسط تحتاج الشجرة في الري التكميلي الى 3 متر مكعب من المياه / الشجرة تم تطبيقه خلال الفترة من يونيو إلى سبتمبر في ست فترات مجدولة للري. زاد إنتاج زيت الزيتون من 5.6 الى 12.5 كجم / شجرة باستخدام الري التكميلي. وتبين ان استدامة المشروع تتحقق من السنة الثالثة حيث يبلغ العائد على الاستثمار 60٪ في تقنية الحصاد المياه العذبة، و 61.5٪ باستخدام تقنية مياه الصرف الصحي المعالجة. وكان صافي الربح 808 دولارًا / سنويًا. دونم لتقنية المياه العذبة، أما باستخدام تقنية المياه العادمة المعالجة فهو 704 دولار / سنة. دونم. تبلغ نسبة هامش الربح 65.5٪ في حالة استخدام المياه العذبة، و 66.2٪ في حالة استخدام مياه العادمة المعالجة.

يبلغ صافي القيم الحالية 3384 دولارًا عندما يستثمر المزارعون 1419 دولارًا أمريكيًا باستخدام تقنية المياه العذبة بمعدل فائدة 2.5٪ ، لمدة 6 سنوات ، ولدى المزارع فرصة لكسب صافي ربح إجمالي 4470 دولار/ دونم. بالإضافة إلى ذلك، بلغ صافي القيمة الحالي المزارع 3187 دولارًا عندها يستثمر المزارعون 1145 دولارًا باستخدام ري مياه العادمة المعالجة ، ولكن لديه فرصة لكسب صافي ربح إجمالي قدره 3178 دولارًا / دونم.

اوصت الدراسة بأن تدعم الحكومة برامج استصلاح الأراضي لتمكين المزارعين من استخدامها في زراعة أشجار الزيتون. و بان تشجع مديرية زراعة جنين المزارعين على زراعة أشجار الزيتون المروية من خلال توفير شتلات من أصناف ومعدات مناسبة، وكذلك ان تقوم خدمة الإرشاد الزراعي بإجراء دورات تدريبية للمزارعين حول كيفية صيانة حقول الزيتون المروية والعناية بها.

اوصت الدراسة بطريقة فعالة ومستدامة لمساعدة المزارعين الفقراء على التغلب على حالة الفقر، من خلال توفير مصادر التمويل من قبل الحكومة أو المنظمات غير الحكومية لري ما لا يقل عن 7

دونم. كما اوصت الدراسة بان يتم متابعة وقيادة قطاع الزيتون وتعزيز التعاون بين القطاعين العام والخاص وجمعيات المزارعين والتعاونيات والمستثمرين والمنظمات غير الحكومية المهتمة به من خلال تشجيع الاستثمار ودعم برامج معالجة مياه الصرف الصحي لتكون صالحة للاستخدام الزراعي وتوفيرها لري حقول الزيتون.

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List of abbreviations

FAO: Food Agriculture Organization

MOA: Ministry of Agriculture

PSC: Palestinian Statistics Center

Farmer: farmer who used supplementary irrigation of olive tree

Field: olive tree farm

Revenue is the income that a business has from its normal business activities, usually from the sale of goods and services to customers. Revenue is also referred to as sales or turnover. Some companies receive revenue from interest, royalties, or other fees (Carcello, 2008) Revenue = Unit Price * total units sold.

Operating Cost are the expenses which are related to the operation of a business, or to the operation of a device, component, piece of equipment or facility (Swain, 2018). Operating cost = Cost of goods sold + Operating expenses

Cost of investment; the amount of money spent for the investment, investment expenditure required to exercise the option (cost of converting the investment opportunity into the option's underlying asset, i.e. the operational project) (Angelou, 2009)

Net Profit is the ratio of net profits to revenues for a company or business segment (Murphy, 2020). Net profit =Total revenue -Total expenses**.**

Profit margin ratio (The gross profit ratio), it is also known as gross profit margin and this ratio expresses the relationship of gross profit to net sales (cash and credit) in terms of percentage (Tulsian,2014).

Profit Margin = Net profits (or Income) / Net sales (or Revenue)

Return on investment is a ratio between net profit and cost of investment. A high ROI means the investment's gains compare favorably to its cost (Investopedia, 2013). Return on investment (ROI) **= (**Net profit / Cost of investment) x 100

Nnet present value (NPV): it applies to a series of cash flows occurring at different times. The present value of a cash flow depends on the interval of time between now and the cash flow. It also depends on the discount rate (Grier and Nagalingam, 2000).

$$NPV = \sum_{t=0}^{N} \frac{Rt}{(1+\mathrm{i})\mathrm{t}}$$

Where: RT = net cash inflow outflows during a single period

i=discount rate or return that could be earned in alternative investments

t=number of time periods

Chapter 1 : Introduction

1.1 Introduction

The agricultural sector, including all its different sectors and sub-sectors, It constitutes one of the most important Palestinian pillars in confronting the policies of the Israeli occupation in Palestine, as it reflected in the popular Palestinian proverb, "If agriculture was fine, then the country is fine" A source of sustenance, employment and food security for a big number of Palestinians, also it is contributed as much as 3.1 % of the economy's GDP and employed 72,000 people in 2016. (PCBS, 2016).

The total area of agricultural land used currently by the Palestinians doesn't exceed half of the Palestinian agricultural land area available for cultivation, while the remaining areas are distributed to lands that can be cultivated but are not used for such agriculture purposes, or lands that need rehabilitation, lands that cannot be rehabilitated (often used for grazing of ruminants), lands used for industrial and urban expansion, as well as areas confiscated by the Israeli authorities for settlement expansion, building the separation wall and the construction of bypass roads (MOA, 2016. 10).

In Palestine, rain-fed agriculture is dominant, occupying nearly 81% of the total area of land used for agriculture, while irrigated areas cover approximately 19% of land used in agriculture, located in the Gaza Strip and the Jordan Valley, as well as in semi-coastal areas in the West Bank only (MOA, 2016). The key challenges associated with land development in Palestine as a result of water scarcity, poor financial resources, and high risk are low soil fertility and weak trends in agricultural land investment (MOA, 2016). Also, the total grain-fed area is around 198,000 hectares, made up of field forages and crops (barley, chickpeas, particularly wheat, lentils, sorghum, vegetables, and vetch), fruit trees (almonds, other nuts, olives, plums, apricots, peaches, cherries, and pears), and grapes. The production of olives is approximately three times that over the crop; while the value of olives is nearly five times that of any other crop, with almost half of this value being produced in Nablus and Jenin (Leipzig, 1996).

The olive sector plays a major supporting role for the local Palestinian agricultural economy, as it brings foreign currencies to the Palestinian government through export revenues, and of course, it has an invaluable value in Palestinian identity and culture. However, this sector has a long way to go to be effective and efficient. All stakeholders are well aware that the improvement of this sector will not take place in light of vision the current trend, and the lack of coordinated and coherent solutions to achieve the required restructuring of this sector (ARIJ, 2015).

Plant production in the Palestinian fluctuated from year to year due to rainfall quantities fluctuation on the one hand, and the high-yield years followed by low-yield years in olive trees. Despite this, plant production has not experienced significant changes over the last decade. No significant change occurred in terms of the relative distribution of varieties of different crops, which is characterized in general and especially in the West Bank- by relatively low values crops and the low percentage of irrigated agricultural areas. Besides, the Palestinian plant production sector, especially in the West Bank, is suffering from low productivity per dunum as a result of the nature of plant production on the one hand, and the low percentage of irrigated crops, on the other hand (MOA, 2016).

The estimated number of families which rely directly or indirectly on olives is 100 thousand of the totals of 4 million people, and a large percentage of these are either poor and/ or female. (MOA, 2013)

An average annual estimate for the value of olive production at farm gate prices is about 45 million dollars, which constitutes 3.5% of the agricultural production value. The contribution of olive-related exports is estimated at 16.5 million dollars annually, which is 13.2% of the total agricultural exports estimated at 125 million dollars in 2011. Olive oil is also used in the production of soap and traditional lamps for light in rural homes (MOA, 2013). In 2014, an estimated 108,000 tons of olives were pressed, which produced 24,700 tons of olive oil, which contributed $ 10,900,000. (PCBs. 2014)

Farmers are interested in increasing irrigated farmland, especially in protected agricultural areas, which still provide a relatively high level of profitability. 95% of the land devoted to vegetable production in the West Bank and almost all land in Gaza are grown using water-efficient micro-irrigation systems (FAO, 2008).

Under the Mediterranean conditions, the fruit crop responds to the water supply and it is important to place the rain-fed olive crop given the crop that can be achieved when it is fully supplied with water (Moriana et al., 2003). Unconventional water resources have the potential for the future, but an important emerging resource is water harvesting (Dwas (100)). In the absence of the inability of the Palestinians to invest in infrastructure to develop water resources because most waste resources located its location in Area C, as well as the lack of large sources of surface water. Groundwater in Palestine is the main source of water recharged through precipitation. Rainfall ranges from 100 mm in the southeast, and at the shoreline of the Dead Sea, to 800 mm in the north. And average rainfall of 550 mm. (Sbeih 1995).

Added to the natural water pressures induced by population increases, and reduce the water available amount to the Palestinians during the occupation. To maintain irrigated agriculture in Palestine, progress must be made in the use of running water and treated wastewater, so supplemental irrigation projects help in using water more efficiently (MOA, 2016).

7.3% of the West Bank cultivated area areas rely on irrigation compared to 67.5% of Gaza strips cultivated that relies on the irrigation source (MEDAWARE1, 2003).

With high unemployment rate reached 26.9% during the year 2016 out of the total participants in the workforce in Palestine, by 22.2% among males compared to 44.7% among females (PCBS,2016), also the poverty rate among individuals according to the patterns of monthly consumption in Palestine was 29.2% in 2017 (PCBS,2017). In addition to food insecurity, yet the availability of land, there are significant opportunities to improve the economic and social wellbeing of farmers and producers through agri-business and development projects based on the contextual realities of the market environment. The Palestinian financial capacity and technology to develop non-conventional resources are not yet sufficient. However, the Water Resources Management Strategy, and the National Water Policy, and the Water Law adopted by the Palestinian Authority, it encourages the preservation of unconventional resources and calls for their development. (IOB,1999)

This research will collect data to build a solid literature review and identify specific existing problems and needs that will be targeted by the research towards effective implementation for supplemental irrigation projects. This will study field crop harvest and production of the supplemental irrigation projects in olives farms, analyze the cost of production, and determine the returns of an investment to assess the percentage of economic sustainability realizing. Some research has been done to develop irrigated olive, however, it does not look exhaustive consider economic variations. This research aims to bridge this gap by a focus on the supplementary irrigation projects, which affect the profitability that can be achieved variables, and analysis of productive factors, as well as cost management practices, to determine recommendations to reach economic sustainability goals.

1.2 Problem Statement

The Jenin District has a large areas spread olive trees, as it is one of the largest governorates producing Palestinian olive oil, and a large number of families work partially in this sector. During the drought prevalence and water scarcity problems in Palestine, farmers find themselves forced to purchase water through tankers to irrigate their trees to reduce production losses. As a means of adaptation to climate change in these olive groves, construction rainwater harvesting well was introduced to conduct supplementary irrigation for these trees through the harvested rainwater, tanks, or used irrigation network. This approach costs them high prices for production compared to traditional rain-fed agriculture.

The study examined the farms that use supplementary irrigation to increase the productivity of olive oil and family income compared to traditional agriculture, so through this research, we will conduct **The economical assessment of supplementary irrigation of olive trees in Jenin District?**

Research Questions

1. What is the effect of supplementary irrigation on the growth and productivity of olive trees in the Jenin District?
2. What are the economic impacts resulting from the use of supplementary irrigation of the olive fields in the Jenin District?
3. What are the characteristics of the lands planted with irrigated olive trees in the Jenin District?
4. What are the supplementary irrigation mechanisms used in the irrigation of olive trees in the Jenin District?
5. What are the production practices and its cost that applied by the farmer to produce olive oil?
6. What is the economic cost of Supplemental Irrigation practices for Olives Oil production?
7. Does economic sustainability differ according to the supplemental project used?

8. Is it feasible for farmers to invest in supplementary irrigation according to cost-benefit analysis under the different scenarios of net present values?

1.3 Hypothesis

1. We assume that the correct agricultural practices in the olive fields irrigated with supplemental irrigation lead to improved tree growth and increase their productivity
2. We assume that supplementary irrigation of the olive tree in the Jenin District is economically feasible and can improve the family income.
3. We assume that a supplemental irrigation project of olive trees funded by the source agency (Government and/or NGOs), can help poor farmers overcomes poverty.

1.4 Research Goals

The main of the research objective is:

1. Determinate the effect of supplementary irrigation on the growth and productivity of olive trees in the Jenin District.

2. Determinate the economic impacts resulting from the use of supplementary irrigation of the olive fields in the Jenin District.

3. Follow up on the characteristics of the lands planted with irrigated olive trees in the Jenin District?

4. Follow up on the supplementary irrigation mechanisms used in the irrigation of olive trees in the Jenin District?

5. Follow up the production practices and its cost that applied by the farmer to produce olive oil

6. The economical Assessment of Supplemental Irrigation practices for Olives Oil production in Jenin District.

7. Knowing if there is economic sustainability differs according to the supplemental project used in Jenin District.

8. Knowing if it is feasible for farmers to invest in supplementary irrigation according to cost-benefit analysis under the different scenarios of net present values.

1.5 Significance of Research (Justification)

Most olives depend on rain-fed except for a few thousand Dunums that are supplementary irrigated, the most important problems affecting the olives sector is the decline in production and increased costs, thus weakening the competitiveness of the Palestinian oil in global markets. The purpose of supplementary irrigation for olive trees is to give one or more water in exact times, suitable quantities with scientific methods to get the best results and the highest investment.

Due to the natural storage of water resources in Palestine, distribution, transport, and increase the production cost. Also, climate change, low rainfall, and poor distribution are causing additional, so the most important measures to face these changes are by using supplementary irrigation.

Most olive studies focus on the field environment, and crop characteristics with little studies talk about productivity and the economical assessment especially in the Middle East, so this research wants' to expand study this topic.

1.6 Limitations

Human determinant: Farmers used supplementary irrigation for olive tree

Time: One Semester 2019\2020

Spatial: Jenin District.

1.7 Research Area

Jenin Governorate is located in the north of the West Bank of Palestine and its center is Jenin. It is located on latitude 32.28 North and 35.18 East Greenwich longitude. The coordinates are 208 widths and 178 meters according to the Palestinian coordinate network. Jenin District constitutes a good larger economic site on its population size about 356,000 people. It has an area of 583 km^2 and accounts for 9.7% of the West Bank area. The town of Jenin follows the Jenin refugee camp and 12 large municipalities. (Jenin Chamber of Commerce and Industry)

Agriculture is a major activity in Jenin, Where most of the population depends on it, directly or indirectly, Jenin has the Marj Ben Amer one of the most fertile regions in the West Bank and the agricultural marketing center in the governorate. It is grown annually with field crops, fruit trees such as olives and vegetables, citrus fruits, and almonds, as well as the widespread use of greenhouses.

The climate of the Jenin region differs from the overall climate of Palestine, to be topographical. It is located at a height of 125 to 225 meters. It is also surrounded by several highlands, which reduced its use of temperate and temperate western and southwestern winds. It has also alienated the climate of Jenin from the Mediterranean climate and made it more extreme (Jenin Chamber of Commerce and Industry)

Chapter 2 : Theoretical Framework & Literature Review

2.1 Introduction

In the past few years, Palestine has faced climate change, which was represented by a decrease in the rate of rainfall and poor distribution. Therefore, one of the most important measures to confront climate changes in the olive sector is the economically – studies supplemental irrigation; as field observations have shown that auxiliary irrigation in the olives has given positive results on productivity, especially when combined with the addition of organic fertilizers where it worked to improve the field capacity of the soil and its ability to retain water and provide nutrients to the tree (MOA, 2016).

The researcher refers to some experts and scholars' opinions and previous studies

2.1.1 Olives & Olive Oil Sector

Olive oil production is usually concentrated in the Mediterranean region (especially Italy and Spain), but its consumption is widespread worldwide. About 71% of olive oil production is of European origin with a dominant position occupation of Spain (1,599 tons) with a global value equal to 3131 tons in 2018. Regarding its consumption, Europe covers about 53% and the first place is again by Spain (525 tons) with a global value equal to 2861 tons (Carranco; et al., 2018).

According to
FAO (FAOSTAT, 2016), the olive harvested area consisted
Of 10,650 thousand hectares, the production was 19,267
A thousand tonnes and the yield was 18,091 hectogram/
Hectare (calculated data), worldwide.
In 2016, FAO reports showed the harvested area of olives in the worldwide consisted of 10,650 thousand hectares, production was 19,267 thousand tons, and the yield was 18,091 hectogram/hectares. (FAOSTAT, 2016) Where olive trees are cultivated on 45% of the West Bank and the olive sector is considered the backbone of the agricultural sector, providing as much as 15-19% of agricultural output. (UNCTAD, 2015)

The number of olive trees reached 969,304,13 trees in Palestine, including 232,304,11 fruitful trees, and 737,000,2 unproductive trees. As for the irrigation pattern, the results showed that the number of rain-fed trees in the Palestine 620,145,11 trees, while the number of irrigated trees reached 349,159,2 trees. The production of fruitful horticulture trees in Palestine amounted to 742,123 tons, of which 422.93 tons were in the West Bank, and 320, 30 tons in the Gaza Strip during the year 2010/2011 (PCBS, 2011)

The importance of olives is on the increase due to increased international demand, especially from EU countries where Palestinian olive oil enjoys the preferential treatment, based on quality and price, and customs clearance. As table 1 showed.

Table 1: The status of olive oil production, consumption, imports, and exports from 1990-2010.

1990-2010	Annual average (1000 ton)	Least (1000 ton)	Most (1000 ton)	Annual growth (%)
Production	2441.2	1453	3174	3.7
	(78%)EU	993.7	2463.7	4.1
Consumption	2436.7	1666.5	2923.5	2.8
	(%70) EU	1214.5	2078.9	2.3
Export	481.9	256.5	662	3.4
	(%54) EU	146.1	352.8	5.2
Import	507.8	288.5	704.5	3.5
	(%32) EU	42.4	231.8	0.2

Table (1): Global Olive oil statistics, 1990-2010 Source: FAO Stat, IOC

Olive production in Palestine is characterized by annual alternation, where one year is low bearing and the following exhibits average to the good bearing. The highest production since 2000 of 156,000 tons was achieved in the season of 1999-2000, while the lowest was in the season of 2000-2001 when production fell to 38,000 tons. Furthermore, productivity was respectively 167 kg/ du and 42kg/ du for the same seasons. (FAO, 2010)

The productivity of olives in Palestine is the highest amongst Arab countries after Jordan (excluding Egypt, as olive production in Egypt is grown under irrigation).

Table 2 explained the Productivity in Palestine reached 242kg/ due in 2010. Moreover, Palestine is ranked twelfth by volume among the world's olive oil-producing countries. (Arab Organization for Agricultural Development, 2010.)

Table 2: Area, production, and productivity for olives in Arab countries

Country	Area: thousand Dunom	Productivity: Kg/ Dunom	Production: thousand tons
Jordan	607.0	283	171.70
Tunis	17634.5	43	750.00
Algeria	2942.0	60	175.31
Syria	6474.6	148	960.40
Palestine	463.0	242	112.00
Lebanon	625.0	156	97.60
Egypt	462.8	1078	499.00
Morocco	7354.0	202	1483.50

Source: Arab Organization for Agricultural Development/ yearly book for agriculture statistics, 2010

2.1.2 Agricultural water security

The water sector is one of the most vital sectors in the sustainable agricultural development process at the national level. The Israeli occupation control over water resources for the benefit of Israeli development needs without considering Palestinian water needs. The critical situation and performance of the water sector are reflected by the limited irrigated agricultural areas in the Palestinian.

In the Palestinian context, irrigated agricultural lands are limited in the Palestinian lands in general, and they constitute 77% in the Gaza Strip compared to only 12% of the agricultural lands in the West Bank. (MOA, 2016).The irrigated agricultural land represented around 19% of the total agricultural area in Palestine – due to the difficult situation of agricultural water- compared with 37% in Jordan and 59% in Israel. Moreover, the field crops represent around 24% and 23% of the total agricultural land in the West Bank and Gaza Strip respectively, which mostly cultivate as a rain-fed. (MOA, 2016)

Palestine is a semi-arid country, with an average rainfall of 450 mm. The availability of water is doubtful. Moreover, the availability of water for agriculture is greatly reduced due to the following:

1. Since rainfall is the only source of water, the amount of rainwater (rain) has decreased in recent years.
2. The quality of groundwater wells, especially in Gaza and Jericho, becomes salty and cannot be provided for agriculture safely.

3. There is a major conflict over water issues between Palestinians and Israelis since Israel occupied Palestine.
4. The natural increase in the rate of growth, the country's population increases, and thus the demand for domestic water increases. This will affect the availability of water for agriculture. (Sbeih, 2004)

The total estimated water used in agriculture does not exceed 150 million cubic meters annually in 90 million cubic meters in the Gaza Strip and the West Bank (60 million cubic meters). This amount represents 45% of the total water consumption, which is reflected directly in the limited prospects for the development of irrigated agriculture that can have an important economic, social and political role in rebuilding the Palestinian economy. (MOA, 2016).

2.1.3 Agricultural economy

The Occupied Palestinian Territory exports on average 4,000 tons of olive oil per year. The main destination of these exports has long been Israel, with imports from the Palestinian market accounting for about two-thirds of Israel's olive oil imports. The significance of the Israeli market was lessened at the turn of the century with the start of the second intifada in 2000. However, in 2007 and 2008, Israel remained the largest market for Palestinian olive oil. Palestinian exports to Israel show marked instability, owing to political conditions and recurring crises. Although Israel imported an average of 890 tons in 2007 and 2008, in 2009 and 2010 it imported only 23 tons of olive oil from the Occupied Palestinian Territory, a small fraction of its total imports. (UNCTAD, 2015)

In 2006, the labor force in the agricultural sector constituted 16.7% of the total labor force (12.6% male, 35.1% female), falling to 10.4% in 2014, and 8.7% in 2015. The percentage of men working in the sector was estimated at 7.8% of the total male workers in 2015, while 13.1% of the total female workers were employed in agriculture, which indicates the relative importance of the agricultural sector to women. (PCBS, 2016)

In 2014, the value of agricultural production at constant prices was $ 540 million, registering a continuous annual decline since the year 2011, which recorded the highest value of agricultural production and rose to $ 721.5 million (PCBS ،National Accounts for the years.4102-4111). Within the same context, the value-added of the agricultural sector in Palestine reached 339.1 million dollars in 2012 at constant prices, representing 4.6% of GDP at that time. This contribution fell to 3.8% in 2014, as the value-added of the agricultural sector reached $ 286.4 million despite its 8.2% contribution to GDP in 2000 (PCBS ‹National Accounts,.4102). Furthermore, the value of agricultural imports and exports was equal in the early seventies of the last century, ranging between 20-30 million dollars (MOA ‹Extension Service Strategy.4102‹ 4102-4102). Over time, the annual agricultural imports increased to exceed exports significantly, as the total agricultural imports amounted to approximately $ 212 million in 2014, while agricultural exports amounted to $ 67 million, accounting for nearly 7% of total exports. (Association Development Agricultural A)

The concept of economic development is all about the work to eliminate hunger and poverty suffered by the majority of the world's population and to improve the living conditions of developing countries so that the gap between the average per capita income in industrialized and developing countries decreases (Waterston, 1965)

Sustainable agriculture is an essential element in sustainable development and necessary for the future of human beings, and sustainability aims to achieve safe and healthy food production that is appropriate (Uwagboe et al., 2012).

2.1.4 Traditional olive farms used rain-fed

The olive tree is considered one of the main crops in Palestine, whose number exceeds ten million trees planted in an area of more than 900 thousand dunums, which constitutes 50% of the cultivated area and occupies most of the mountainous areas. In Palestine, this tree is considered the most widespread compared to other fruit trees; as it constitutes more than 80% of the area of fruit trees. Further, the olive tree is considered one of the seven types of fruit that blessed this sacred country.

Rain-fed olive trees have been traditionally tilled to reduce the competition for water and nutrients. Indeed, the olive tree is spread all over the Mediterranean, especially in Palestine, Jordan, Lebanon, Greece, Italy, France, and Spain. In the period between 6000-8000 years ago, the olives in the eastern Mediterranean were crushed and then used to obtain the oil, which was used in the preparation of food, the manufacture of cosmetics, the manufacture of medicines, and was used as fuel for lighting lamps as well.

There are three main types of olive growing systems: traditional, semi-intensive, and intensive. The traditional system is associated with old or very old orchards, frequently on terraces, and grown with few or no agrochemicals (Duarte, Jones, and Fleskens, 2008). No irrigation, low levels of chemical inputs or none at all, and low annual consistency of yield are also common features of rain-fed areas and help explain their low productivity. While operations like fertilization and pruning are done regularly, in some traditional systems are seldom tilled or pruned, Harvesting is normally manual or semi-mechanized, as these systems are frequently associated with small or very small farms. (Metzidakis, 2004).

Olive trees are grown everywhere in Palestine, but the largest production areas are in the west and north of the West Bank (see map). Production statistics show low yield and alternate cyclical acute behaviors ("on" and "off" years). This phenomenon, which leads to fluctuations in yields of up to 90% between one year and the next, has a complex and multifactorial set (agricultural techniques, pruning practices, biological and climatic trends), of which part may be encountered through the transfer of appropriate know-how. Other practices that go beyond the capabilities of farmers, which are watering trees, and demanding access to irrigation water and/or investments that are difficult for Palestinian farmers to bear. (Qutub, M; Ali, S; Mutawea, M., 2017)

Figure 1: Map- main areas of olive cultivation in the west bank

The density of cultivation varies according to climatic conditions and climatic characteristics of the cultivation area and extends from very few trees/hectares (less than 100 olive trees/hectares can be found on mountain slopes, where the soil is rocky, poor in nutrients and waterless available, or in the region Southern area of Hebron and the Gaza Strip mainly due to climatic conditions) up to 200 trees/hectare, where better climatic conditions permit such densities (Rainfall). (Qutub, M; Ali, S; Mutawea, M., 2017)

The number of olive trees about 895.8 thousand trees, of which 798.7 thousand fruit trees (88%) 4. Olive cultivation is concentrated in the governorates of Jenin, Nablus, Tulkarem and Ramallah, and Hebron, where the olive groves in these governorates amount to 96, 76, 59, 55 and 50 thousand dunums, respectively. (MOA, National strategy for the olive sector In Palestine 2014-2019).

According to the Economy Portal, 14,740 tons of olive oil was Palestine's production for 2018, the productivity of Jenin Governorate increased by 12% over the previous year and produced 4,871 tons in 2018 while it was 4,371 tons in 2017. It is usually 23-25% of the country's production from Olive oil, while its share in 2018 of production was 33%. This year, 58 of the 69 state-owned mills are employed there. Jenin Governorate presses constitute 25% of the national presses.

Olives are picked by hand from the trees, sometimes using sticks with obvious consequences on the fruits and oil quality. The harvest season generally starts in October, officially beginning according to indications of the Ministry of Agriculture, and can last until December. Palestinian olive farming is mainly oriented to processing: a great part of the olive production is channeled to the olive mills for the extraction of olive oil. Data indicate that there are more than 270 olive mills in Palestine, 75% of which are fully automatic, and continuous plants, the remaining ones are half-automatic or traditional mills (PCBS, 2008).

Agriculture in the South of the West Bank (Bethlehem and Hebron) is mainly rain-fed. There are 375,726 dunums of agricultural land, of which only 1807 dunums are irrigated. Hence, its contribution to the total irrigated agriculture in the West Bank is 1.8%. As for agricultural water use, the South consumes 0.54 MCM for irrigation, which is 0.6% of the West Bank total. Further, the North of the West Bank (Ramallah, Jenin, Tulkarm, and part of Nablus) is quite varied in the types of crops produced. It has good fertile soil, a suitable climate, fair amounts of irrigation water, and relatively high annual rainfall. All of these factors contributed to prosperous rain-fed farming and irrigated agriculture in the North. There are 1,262,637 dunums of agricultural land, of which 56,088 dunums are irrigated farmland. This makes the North contribution to the total irrigated agriculture in the West

Bank 55.2%. Similarly, the North uses 36.83 MCM for irrigation, which is 39.6% of the total West Bank irrigation water (Agricultural Department of the West Bank 1994)

Olive trees are the main crops in the Palestinian territories, where they are mostly cultivated to produce olive oil. It is estimated that olive production represents 57% of the cultivated land in the Occupied Palestinian Territories, where there are 7.8 million olive trees in 2011. In 2014, an estimated 108,000 tons of olives were pressed, which produced 24,700 tons of olive oil, which contributed $ 10,900,000. There are about 100,000 families who depend on olives for a basic income (Lodolini, E.M.; et al,2014) "Complementary irrigation for sustainable production in olive groves in Palestine". Agricultural Water Management. 134: 104–109)

In modern agricultural science, technical specialists of several generations were given to over-generalization about the decline of rainfed production. Arnon (1992) stated in his foundational agronomic work on dryland agriculture, “The dry lands of a great number of countries are now usually vast empty areas. A large proportion is a desert, and its contribution to food production is minimal. Other vast areas, on the fringes of the deserts, in Africa and Asia, with a rainfall that is just sufficient or even adequate to grow a single adapted crop, are still cultivated by primitive methods that have not changed since biblical days - with resultant low yields” (Arnon 1992, p. vi).

To claim that rain-fed agriculture remained unchanged over some time, in the case of Arnon, of 2,000 years, requires critical examination. Most of this literature emphasizes the "primitive" practices of cultivators and sometimes extends into the primitive nature of the cultivators themselves (Davis, 2016). Within the case of Palestine, which has been the site of a steady modern settler-colonization for over 100 years, this belief remains widespread. For example, when discussing the technological innovations brought by European Jewish settlement, a leading environmental historian of Israel stated, “In practice, the new century did little to change the traditional, subsistence farming practices of the locals" (Tal 2002, p. 49). It should be noted that the Palestinian culture considered the olive tree as a national symbol and his identity. Olive trees are cultivated on 45% of the West Bank and the olive sector is considered the backbone of the agricultural sector, providing as much as 15-19% of agricultural output. According to local research, the production of olives is nearly three times that of the next crop; while the value of olives is approximately five times that of any other crop, with almost half of this value being produced in Jenin and Nablus. The total rain-fed area is around 198,000 hectares, made up of field crops and forages (particularly wheat, barley, chickpeas, lentils, sorghum, vetch, and vegetables), fruit trees (olives, almonds, other nuts, plums, apricots, peaches, pears, and cherries), and grapes.

2.1.5 Supplemental Irrigation for olive tree

There is interest in and recognition of the potential of the Palestinian olive subsector. For instance, among other studies and reports, the UNCTAD report in 2011 on the Palestinian tradable goods sector highlighted olive oil as a strong candidate for export promotion (UNCTAD, 2012). Besides, since the establishment of the Palestinian National Authority, special efforts have been accorded to increasing cultivated areas and the production of olive trees, mainly through land reclamation and water harvesting projects. (UNCTAD, 2015)

The supplemental irrigation Olive oil projects play a significant role in the agricultural development process in general. It is not possible to imagine agricultural development without water, which means that achieving sustainable agricultural development and sustainable economic development in the olive sector is based on the use of water resources that are the main source of agriculture.

Definition ICARDA Supplemental Imaging (SI) is defined as adding mainly rain-fed crops to small amounts of water during times when the rain fails to provide sufficient moisture for the plant's natural growth, to improve and stabilize yields. Accordingly, the concept of SI in regions with limited water resources is based on three rules: Water is applied to rain-fed crops, which usually produce some crops without irrigation. (Sabih, 2004).

Water harvesting and supplementary irrigation can be used in rain-fed areas to increase land and water productivity. Supplemental irrigation involves the use of small amounts of water during the critical growth stages of crops that can significantly enhance water productivity (ensuring more sustainable use of groundwater) and enhance yields. (P. Parvatha Reddy, 2016)

Researchers found that the quality of olive oil is affected by irrigation. The phenolic compounds of olive oil appear to be most affected by irrigation, as the effect varies with the amount and time of water applied to trees (including irrigation management type), climatic conditions, and variety (Patumi et al., 2002; Rico et al., 2006; Stefanoudaki et al.,2009)

There is an increasing global trend for supplemental irrigation in most of the world's olive producing countries in general and in Palestine in particular. In this context, several recommendations were emphasized in many countries that use the supplemental irrigation process to ensure adherence to the irrigation factors and thus the success of the experiment.

Harvesting by farmers in dry areas showed significant increases in crop yields in response to the application of relatively small amounts of supplementary irrigation. This increase covers cases with low and high rains. (Sbeih, 2004)

Reuse of treated wastewater for irrigation as supplementary irrigation will increase the irrigated area in Palestine and replace freshwater that can be used for domestic purposes. (Sbeih, 2004)

A large proportion of the agricultural sector projects is funded and overseen by donors and international institutions, through project-based arrangements. These projects are often implemented, either by state institutions or by Palestinian civil society organizations or foreign NGOs that are registered in Palestine. Although sectorial and cross-sectorial coordination, the agricultural sector working group is an important mechanism to coordinate stakeholders' efforts in the agricultural sector. The group includes Palestinian and international organizations, as well as donors.

2.1.6 The olive oil production process used supplementary irrigation

The researcher made an interview with agricultural experts and supervisors on supplemental irrigation projects, to understand the mechanism of supplemental irrigation, and she observed that when farmers start supplemental irrigation, they must take into consideration the olive oil production system include: field characteristics, production chain (pre-harvest process, harvest process, and post-harvest process), irrigation factors and the yield.

2.1.6.1 The Growth Stages of the Olive Fruit

- Fertilization: Most types of olive trees are self-fertile, meaning that you can get fruits by having only one tree. Pollen is transferred from (the male part of the plant) to (the female part of the plant) from the same tree. However, some types of olive trees are not self-fertile. These varieties need another tree or sometimes more than one tree for pollination, and not of the same variety. The olive tree pollen is transported primarily by wind. Research results recommend that farmers manufacture at least three varieties of olives in the vicinity of their farms to promote some cross-pollination operations, which have been shown to increase yields by at least 10 percent.

- Flowering: Flowering time variation in plants is important for local adaption. The timing of flowering initiation has a large impact on mating success and seed production and viability in any given environment (Barrett, 1998; Roux et al., 2006; Elzinga et al., 2007).

This stage is one of the key stages, through which the olive tree passes in its annual cycle. In this stage, the olive tree, like any plant of sexual reproduction, shows a great number of flowers whose objective is to be fertilized thus becoming new fruits.

Flowering can be seen in mid-May and its duration will not be more than a week, although it must be borne in mind that since the first flower opens up to the last one, it may take more than three weeks. In the end, there will be very few flowers that will be fertilized and become fruits. In an estimated calculation, it will be about one or two percent, but in any case, they will be enough to offer us a good amount of olives every year.

- The Stage of Fruit Setting: It is the stage of turning the flower into a fruit. After fertilization, the petals wither and fall off, and the cells of the ovarian wall begin to divide by secreting growth hormones after they feed on amino acids, sugars, and organic acids that travel from the leaf to the contract fruit.

Further, the fetal cells continue to synthesize, and through The hormone-carrying seed leaks these hormones, such as the hormone oxine, gibberellin, and cytokine to the ovary wall, which continues to divide and elongate until the fruit develops and growth is complete, and its size increases as the number of seeds increases in it. It should be noted that the reason for not carrying some of the fruits within the seeds is the presence of a defect in the fetal cyst, where the fetus atrophy and dies. However, the ovary wall continues to grow until the fruit is formed, as is the case in some fruits, such as banana, pineapple, and orange.

- The Stage of Completion of Growth and Ripening of the Fruit: The stage of completion of growth and ripening of the fruit is the arrival of the fruit to its final size, and its ripeness is completely in terms of taste, quality, and odor, meaning that it has become suitable for picking and human consumption.

2.1.6.2 Field characteristics

When farmers used supplemental irrigation they must take into consideration the field characteristics; the slope of the field and the rainfall rate -according to the soil type, several trees per donum, tree age, and type.

First: the slope of the field and the rainfall rate -according to the soil type

According to an interview with Mr. Fares Aljabi, 2018 The quantity of water required depends in: climatic conditions (quantity of rainwater, evaporation rate, wind speed, the temperature during the year), soil type, depth and natural characteristics (field capacity, wilt and permeability point), olive variety and the type of cultivar.

Crop growth is dependent upon the water which is generally derived from soil moisture reserves. These reserves may be built up by rain or irrigation. To achieve maximum plant growth, soil moisture levels should fluctuate only within a narrow range between field capacity and permanent wilting point (cetin, 2003)

According to Owen's research, when rainfall is low, more water is needed but the response is greater, but yield increases are noticeable even when rainfall is as high as 500mm. He found that the response is higher when the rain distribution during the season is weak. Soil moisture stress usually begins in March and April of May, if the total annual rainfall received is low, medium, or high, respectively. (Oweis 2001). Also, according to the Palestinian Olive Council, the olive tree succeeds in most types of soils, as it is known as a tree tolerant to poor soils, but it gives better results in fertile soil with good drainage and lime content, as it should contain 10-15% clay and 10-20% silt and 20- 50% sand. (an interview with Fayad Fayad). According to Alabi experiment 2011, the amount of supplementary water indeed related soil type, whether coastal or semi-coastal soil per dunum, which needs 500 cubic meters for full irrigation. As for the Ghor area, it needs 800 cubic meters for full irrigation. Also, the areas with rainfall rates more than 400-450 mm needs from 10 to 100 cubic meters per dunum. As Table (3) showed

Table 3: Amount of supplementary water indeed per dunom according to the soil type

The area	/ Donum
Fully irrigation	
Coastal and semi-coastal areas	500 m^3
Ghor areas	800 m^3
Supplementary irrigation	
Areas with the amount of rainfall more than (400-450) mm	10-100 m^3

Source: Aljabi experiment 2011

The Effect of Soil on Olive Productivity

The olive tree needs terrestrial moisture all days of the year because it carries its fruits eight months in a year; therefore, olive trees should not be planted except in areas that contain a suitable water reserve in the land throughout the year, whether the source of that rain or other than that. The olive tree grows successfully in various types of soils, provided that good drainage should be available. With that said, it succeeds in light, medium, and calcareous clay soils (in which the proportion of lime is 70%.), as well as the depth of the soil, should be sufficient to accommodate all amounts of rain.

It is worth mentioning that irrigation can often harm the properties of the soil and hence the productivity (Henr & Hogg 2003).

In conclusion, light, medium, and well-ventilated soils help with early ripening of olive, while heavy, low-ventilated soils cause delayed ripening in topsoil with thin soils. It should be noted that the best lands for olives are medium deep lands with good drainage and ventilation, preferably less lime and salt. Olive trees bear more soil salinity than most other fruits, but olive cultivation is not recommended in lands where salinity is greater than 10 mm/cube, and the tree roots can extend and deepen to search for water and food in, whose infrastructure is made of stone and rocks cracked and interspersed with areas containing good soil where the trees grow well.

The Effect of Climate on Olive Productivity

Climate change is undoubtedly the most imminent environmental issue the world is facing today. The rise in climate temperature will have certain major effects on ecosystems, wildlife, food chains, and eventually human life (Appels et al., 2011). The climate of the Mediterranean basin is characterized by the growth of fruit trees, which have the property of resisting drought, especially olives, figs, and grapes, which resist drought by deepening its roots in the soil. Indeed, climate does not only affect olive trees directly but changing temperatures also influence insect diversity and frequency for a given area. Rising carbon dioxide levels will 67 exacerbate most insect and pest problems. This is particularly relevant to the olive fly, olive's most notorious and costly pest, but studies show that this effect may operate in a counter-intuitive way (Moran, 2014). It should be noted here that the largest part of the West Bank lands is located within the Mediterranean climate. It includes the governorates of Tulkarm, Qalqilya, Jenin, Nablus, Salfit, Jerusalem, Ramallah, and Hebron, where the annual rainfall ranges between 400-700 mm, which are the governorates famous for oil, land, production, and productivity.

Second: number of trees per donum

In Jenin District, each donum normally contains between 12-14 trees, with an average of 8x8. (An interview with Ashraf Faleh, 2019)

Third: tree age and type

Most of the trees in Jenin District are Nabali and Baladi Mohasan and aged between 30-60 years (an interview with Ashraf Faleh, 2019).

The olive variety affects the physical, chemical, and sensory properties of the oil. The acidity of olive oil and the content of olive oil and the increase in the value of peroxide in the varieties Nabali, the benefactors of Nabali and Abu Shouka due to the progress of maturity (Al-Maaitah et al., 2009)

Olives must be harvested from mature trees in the ripening stage to obtain a satisfactory level of oil quality, while olives should be harvested from young trees in the black ripening stage. (Chtourou, et al., (2017).

2.1.6.3 Irrigation factors

Supplemental irrigation process the most important of which are the following: The Irrigation tools used the start and end date of irrigation, the irrigation times, the amount of water used, and the method of irrigation.

2.1.6.3.1Irrigation tools

According to an interview with Mohammad Jarrar. There are three tools used in the supplemental irrigation process; they are as follows:

- Harvest well; It imitates in under land in the field and used to harvest freshwater from rainfall water. Crop water needs, whether met by fain-fed or by irrigation, are of central interest to the agronomist. (Seckler, et al., 2000)
- Tank barrel; It is used for treated wastewater to distribute it through net irrigation in which tank barrels are used and placed next to trees. The use of treated wastewater to maintain in dry areas will reduce the impact of extensive erosion (desertification) (MEDAWARE, 2004).
- Irrigation network; Its usually used to distribute water in the field.

2.1.6.3.2Types of supplemental irrigation:

Most farmers use drip irrigation because it absorbs water directly from the soil to the tree roots. Surface irrigation is used by a small number of farmers. However, the tree doesn't fully absorb water; as there is a loss in the water quantity due to evaporation and water remains on the surface level and doesn't reach the tree roots. (An interview with Mohammad Jarrar, 2019).

2.1.6.3.3Date, times and period for irrigation

The amount of water required for watering an olive tree depends on the size and type of the bowl that was used to grow olive trees if the trees are planted in ponds. Generally, the watering of the olive tree is done if it becomes dry at a depth of 5-7.6 cm from the top of the soil.

Olive trees are drought-tolerant trees, and the drying of the soil will not affect their growth, and when watering them, none of the water should remain without drainage, as the tree must be planted in soil with good drainage of water, otherwise, the soil saturated with water will lead to the death of olive trees.

Many factors control the amount of water needed by the olive tree; the most important of which are as follows:

- The climatic conditions of the region, especially the amount of usual precipitation in the area of agriculture, for example, irrigation is necessary for areas where the rainfall rate is less than 500 mm/year, and in these areas, irrigation is recommended once a month, especially in hot months.
- The nature of the soil to be planted, and the depth of the roots of the olive tree.
- Conditions related to olive cultivation, such as the age of the planted tree, pruning, soil preparation, and tree density in the cultivation area. It is worth noting that excessive irrigation of the olive tree may strangle the roots and limit their absorption of water, especially in clay soils; as it leads to fertilizer leaking down if the soil of cultivation is sandy.

The best start date of the irrigation process is the end of June and the ending date is by the first of October to get positive results and benefits. (An interview with Fares Aljabi, 2018).

According to an interview with Fares Aljabi, the number of supplemental irrigation must be 6 times, with an average period of two weeks per time to get positive results and recommend the following irrigation schedule date. As table 4 showed.

Table 4: Irrigation schedule date in West Bank- Palestine

Irrigation Num.	First irrigation	Second Irrigation	Third Irrigation	Fourth Irrigation	Fifth irrigation	Sixth irrigation
Date	1st – mid-July	mid-end July	1st - mid -Aug	mid-end Aug	1st - mid -Sep	mid-end Sep

The critical periods for olive water are

a) The bud and flower formation differentiation period (January - February),

b) The flowering period and the fruit group (in April - May) and

c) The hardening period of the hole and the rapid increase of fruit (August - September).

When winter rains are limited, watering is necessary before the start of blooming (April), to ensure adequate soil moisture when blooming and the fruit group. (Chartzoulakis, 2017)

Figure 1 showed the period 4 after the hardening of the nucleus until the ripening stage, in this period the fruits resume their growth after the completion of the hardening of the nucleus. The oil must be given more than one irrigation and stopping at least two weeks before harvesting to benefit from irrigation water and the fruits do not contain large quantities of water. Irrigation helps in this period to increase the amount of the yield. (Ajabi experiment 2011)

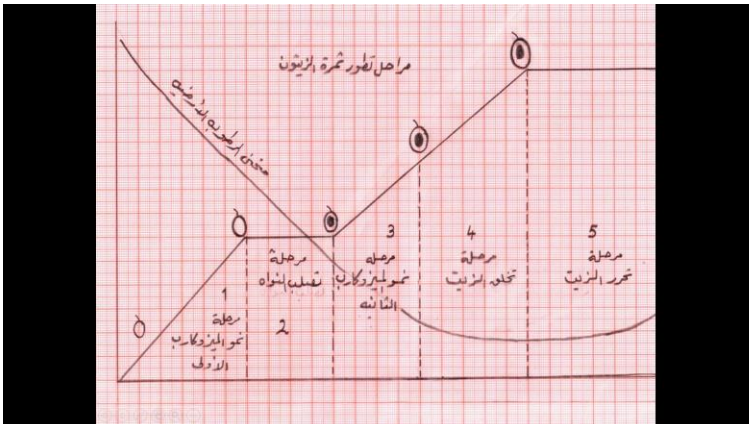

Figure 2: Stages of the development of the fruit in the olive from Ajabi experiment 2011

The critical growth stages of olive water are:

1) Differentiation of buds

2) Group of flowers and fruits

3) Rigidity and rapid development of fruits.

Water shortages may lead to a decrease in the number of inflorescences, the production of heterogeneous flowers, a decrease in flowers, and a decrease in the percentage of the fruit group. Moreover, it reduces the annual snapshot length, leaf area, number of sheets, and yield for the next year. Sufficient soil water increases the number of fruits. (Chatzoulakis, 2017)

2.1.6.3.4Quantity of water per Tree and per time

Irrigation requirements for the olive tree vary according to variety and growth stage. (Chartzoulakis, 2017) Overall, the tree needs 3 m^3 in the sixth irrigation, meaning that 0.5 m^3 per time (an interview with Fares Aljabi, 2018).

2.1.6.4 Production life

It includes (Pre-harvest process, harvest process, and post-harvest process)

2.1.6.4.1Pre-harvest process

When farmer will use supplemental irrigation he must take into consideration the following pre-harvest practices:

First: pruning trees, tillage land, and fertilizers used

There are two types of pruning the first used annually to prune trees during the production period to help the tree increase the vegetative system by removing some branches, the second is called re-age, which is used for aging trees to restore their activity and increase their production (an interview with Ashraf Faleh, 2019). In irrigated fields, pruning is begun after one month of the harvest to the maximum until the beginning of April, and in warm areas, it is necessary to stop pruning at the beginning of the month of March, and the amount of rain does not exceed 100 mm, (An interview with Fares Al Jabi, 2018). Also, the olive trees showed a high degree of plasticity or tolerance to pruning, as olive production did not decrease in response to light or moderate pruning systems. (Rodrigues, et al., 2018)

The first tillage before the harvest in the autumn season and this tillage are deep up to 30cm, while the second tillage is the beginning of the month of March, depending on the need of the soil (An interview with Fayyad Fayyad, 2019).

Most farmers use natural fertilizers. As table 6 showed; fertilizing olive that irrigated with drip as; the first irrigation adds 2 kg of ammonia sulfate + 1/2 kg of magnesium sulfate. The second irrigation adds 3 kg of NPK 19-19-19 fertilizer. The third irrigation adds 3 K potassium sulfate. Once a month add 2 liters of humus. Once every 15 days, add one liter of phosphoric acid alternately with one liter of nitrate (An interview with Fayyad Fayyad, 2019).

Table 5: Amount per donum of fertilizing used in olive tree irrigated with drip

Date	Activity
First irrigation	add 2 kg of ammonia sulfate + 1/2 kg magnesium sulfate
The second irrigation	add 3 kg of fertilizer NPK 19-19-19
The third irrigation	add 3 k potassium sulfate
Once a month	Add 2 liters of a humic lion
Once every 15 days	Add 1 liter of phosphoric acid alternating with 1 liter of nitrate

Source: (Palestinian olive oil Council, Fayyad Fayyad)

Second: disease types and methods of control

Olive trees are under attack by more than 255 types of pests, however, only a few of these pests (such as olive fruit fly, celluloid, and mites) can cause severe damage to olive trees which greatly reduces the quantity and quality of olive oil and / Or table olives around the world. The management of olive pests is undoubtedly one of the most important agricultural practices that farmers must follow. (Al-Zyoud, 2017)

Pesticides have helped the world meet the growing demand for food by increasing agricultural productivity through agricultural pest control. Chemical control has been the method used over the past several years, ensuring the yields and benefits of olive farmers (Daane and Johnson, 2010; Al-Zyoud, 2014b). Integrated pest management is used to manage pest damage by the most economical means and the least risk to humans and the environment (Ofuoku et al., 2009). The amount of information available in the literature indicates that the replacement of toxic insecticides with environmentally safe methods to control olive pests is now possible (Mazomenos et al., 2002).

2.1.6.4.2Harvest process

The harvest practices factors which are:

First: picking types and tools

There are many types of olives picking. The most important of which are: manual (by hand) and mechanism. In Palestine, the popular picking tool is the family and the less known picking style is the workers. (An interview with Fayyad Fayyad, 2019)

Second: picking period

The pricking start date is October, with an average of four workers in one day for one dunom (an interview with Ashraf Faleh, 2019)

2.1.6.4.3 Post-harvest process

The factors for the post-harvest process:

First: press type

In the old years, the manual press was used. Now, automatic and semi-automatic are heavily used for pressing (an interview with Ahmad Abu Farha, 2019)

Second: yield packing

The faster the yield transportation is the best quality is gained. Further, the olive oil should be saved and packed in metal covers rather than the plastic ones to preserve its quality (an interview with Fayyad Fayyad, 2018) also, Dark storage helps to retain the chemical and sensorial olive oil quality (Mele, e al. (2018).

2.1.6.5 The yield

Through the results in supplementary irrigation experiments, the field production rate is much higher than those trees which use rainfall water (an interview with Fares Aljabi, 2018). The gains in supplemental irrigation production especially applied during the first period of fruit growth, augur well for the enhancement of this technique in many drops of rainfed olive groves. (Razouk, et al., (2013).

2.1 Literature Review

First Study

This study conducted by Patumi, et al., in 1999. The main purpose was to evaluate the quantitative and qualitative yield in response to irrigation of the olive trees in the southern parts of Italy. There are three types of olives in Italy. These types are called Nocellara Del Belice, Ascolana Tenera, and CVS Kalamata, and they were tested by using four irrigation levels. The levels are three treatments T1, T2, T3, and rain-fed control. Further, they are daily irrigated with a crop evapotranspiration amount of respectively 33%, 66%, and 100%

Soil water content stayed close to handle limit in treatment T3 with no distinction as for treatment 2 (T2). In the treatment type 0 and 1, the dampness of the soil diminished throughout the mid-year with the most reduced worth (20.8%) found on 12 August and in T0. As a consequence, precipitation reestablished the soil dampness (moisture) to handle limits and to the field capacity. During the season, as the relative water content in the leaves was higher in irrigation medicines (treatments) than in the downpour took care of control. Hence, yields were also much top in all varieties with these irrigated treatments and medicines than in the downpour took care of control.

In conclusion, the results of the aforementioned study indicated that that the yield raised in general when using treatment 1 in `Nocellara Del Belice', which was 200% compared to the rain-fed control. With that said, the yield was 233% and 47% much more in the rain-fed control, with Treatment 2 (T2) in `Kalamata' and `Ascolana tenera'. Accordingly, the higher oil yield acquired in the irrigation process was principally because of the expansion in natural product yield (fruits), given the fact that since the pulp-stone proportion and the number of triglycerides accumulated in the fruits were comparative for all treatments.

Second study

This study conducted by Patumi, D'Andria, and Marsilio, in 2002. Where the consumption of olive oil in Italy has steadily increased, though they do not have such a tradition.

Based on this study, irrigation didn't have a minimum effect on the composition of Olive oil, aside from the absolute phenols, which diminished. Recovering of 66% of harvest evapotranspiration (ETc) was adequate to accomplish great yields, while higher water amount (100% of ETc) gave minimal extra yield raised. Thus, Olea europaea L. cv. 'Kalamata' of Olive trees - oil and pickling cultivar- were tried in 2 years (1997 and 1998) of study.

Irrigation is daily used; 4 l/h/tree utilizing a framework with 4 drip nozzles (2 for each side). The fruits were reaped in the first decade of Nov. when they were appropriate for table utilization; natural product means weight and fruit number per tree were resolved, while the natural product (fruits) readiness was assessed by Piedra (1987). This search reports the aftereffects of an investigation in an escalated mono-cone plantation of Olea europaea L. cv. Kalamata, a double reason (olive oil and table olives) assortment, to examine the impact of various irrigation systems on profitability and quality of olives and olive oil.

The experimental design was a complete randomized block, replicated four times. Each plot consisted of seven trees surrounded by ‘‘strip’’ trees to avoid interferences among treatments. ETc was estimated according to class ‘A’ pan evaporation.

In the following year, mechanical and ultra-structural properties, as well as the chemical composition of olives were studied. Plant profitability was significantly influenced by irrigation. In the first exploratory year, an irrigation volume of 66% of ETc (T2) demonstrated a fundamentally better return than the rain-fed took care of control (T0); be that as it may, contrasts were not clear between treatments (T2 and T3). In the dry atmosphere of 1998, treatment 1 accomplished a better return than treatment0, just as treatment 3 versus treatment 2, even though contrasts between the last two treatments were not noteworthy. The expanded yield was expected, both to the expansion in mean weight of fruit and the number per tree.

In conclusion, the results of this study indicated that irrigation systems didn't influence the sugar composition of the field products, while the substance of the phenolic mixes shifted. In the water pressure condition, the olive product demonstrated a higher cuticular thickness to forestall the loss of water, supplements, and nutrients as well.

Third study

This study conducted by Cetin, Yazgan, and Tipi, in 2004. Was led to enable olive cultivators to settle on choices in regards to interests in trickle water system frameworks. This investigation was focused on the farm business level to give a financial method of reasoning for putting resources into drip irrigation systems.

The cultivators need investment and cost rules for a dribble irrigation system to assess the financial matters of getting crops into creation as fast as it could reasonably be expected and to limit economic losses from the dry season during the beneficial existence of an olive plantation. The advantages of irrigation may incorporate; better olive endurance, prior harvest creation, more prominent yields, and effective supplement appropriation, less plant pressure, diminished yield inconstancy, and improved yield quality.

The Net Present Value (NPV) basis was utilized to decide the limited earn backs the original investment speculation results from distributed reactions to drip irrigation systems. Cultivators with common dribble water system frameworks can expect investments of US$ 2244 ha^{-1} with 1.6 ha blocks of olives.

In conclusion, the results of this study show that the net present value was US$ 3464 ha−1 after an investment of US$ 2244 ha−1.

Fourth study

This study conducted by Duarte, Jones, and Fleskens, in 2008. The traditional olive plantations represent an enormous portion of the zone under olives in the EU, especially in marginal areas. When all is said and done, traditional olive development can be depicted as a low-force production framework, related with old trees, developed at low thickness, giving little yields and getting low contributions of work and materials.

Even though such frameworks are environmentally maintainable, their financial suitability has become an issue, since EU arrangements and policies favor progressively concentrated and competitive frameworks. Orchards that have not been strengthened appear to be undermined by the ongoing change of the EU olive and olive oil approach; as income support has been decoupled from production. The primary aim behind this study is to distinguish the present requirements of traditional olive developing and to prescribe some private and open intercessions to forestall its deserting.

In conclusion, the causes and results of abandonment are talked about and discussed, given the examination of the expenses and returns, which showed that these frameworks are scarcely financially maintainable. Their reasonability is possibly guaranteed whenever decreased opportunity costs for family work are acknowledged, and the olive growing is part-time. In light of these outcomes, recommendations are made to forestall and prevent the abandonment of traditional olive growing and to safeguard its ecological advantages.

Fifth study

This study conducted by Mesa-Jurado, Berbel, and Orgaz, in 2010. Emphasized that the use of marginal values enables policy analysts to anticipate and evaluate the impacts of future policy proposals. These authors also stated that average values, while being attractive for its ease of calculation and simplicity, might be misleading since they are typically much larger than marginal ones and value only the existing uses tending to over-estimate the impacts of changing the current uses.

The economic valuation of the irrigation water system is done using production capacities for the instance of the olive grove. As to do so, the integration of an agronomic model (in light of the production function) and a monetary model connected to the productivity of the yield (the proportion of income and working expenses) in the area under investigation is proposed. The case study includes the Guadalbullon River Sub-basin territory, having a place with the Guadalquivir River Hydrologic Demarcation (the southern part of Spain).

Net Marginal Value of water obtained (having deducted the variable expenses of production including irrigation water system and harvesting) is € 0.60 m–3 for the designation of 1,000 m3 ha–1 and € 0.53 m–3 for the water right stipend of 1,500 m3 ha–1 (normal for period 2005/2008).

In conclusion, the results obtained bolster the recommendation by different authors recommending the utilization of deficit irrigation in olive. Also, the high value of water assessed contributes to clarifying the significant increase in irrigated olive areas in Andalucia.

Sixth study

This study conducted by Freixa, Gil, Tous, and Hermoso, in 2011. Spain is the main olive oil and table olives producing and exporting countries around the world. This study is all about a comparative analysis, aimed at evaluating the economic situation of execution of two alternative production frameworks in the olive and olive oil sector that have gotten a lot of consideration in the most recent years, from the two specialists and olive oil choice gatherings, named intensive/high-density (HD) and super-high-density (SHD) frameworks. With that said, in normal terms, intensive/high- density plantations are described by densities somewhere in the range of 250 and 700 trees for each ha, super-high- density plantations can display densities of more than 1,500 trees/ha (the hedgerow framework).

Additionally, the normal full yield in high- density frameworks is around 6,000 kg/ha in rain-fed plantations coming to around 10,000 kg/ha in irrigated land (regularly utilizing mechanical reaping by trunk shakers). Further, the Internal Rate of Return (IRR, %) and the Net Present Value (NPV) are used to evaluate the economic assessment, taking into consideration that the economic lives of the different alternatives are not the same.

In the subsequent other option (SHD), comparative yields are acquired albeit sooner than in the first framework. Nevertheless, the monetary existence of the SHD is shorter (around 15 years, while in the intensive framework, it may be over 30 years) because of the absence of space and the competition among trees for light and ventilation inside the shades. The information utilized right now is from three optional sources: 1) bibliographic audit;

2) a questionnaire routed to the farmers and 3) individual meetings with experts in olive growing. These significant data sources permitted the researchers to gather the expenses and income from four production frameworks: one intensive plantation (collected with trunk shakers), two high-density plantations (gathered with Colossus and Colossus S) and one super-high-density field with a grape reaper.

In conclusion, the findings of the study showed that the super-high-density rates are less profitable than high-density rates. However, the super-high-density rates could be the most profitable option in large orchards with reduced labor requirements short-term investments, and full harvest mechanization.

Seventh study

This study conducted by Caruso, Rapoport, and Gucci, in 2013. Was conducted on young Olea europaea L. trees for 4 years to explore the impact of the shortfall water system (deficit irrigation) that begins from the beginning of the production of fruits. Sub-surface drip irrigation water system was utilized to supply 100% (FI), 46–52% (DI), or 2–6% (SI) of tree water needs. Tree development was diminished by irrigation deficiency, while, and return bloom was not. Per tree fruit yield of DI trees were 68% that of FI, yet the crops proficiency, which is dependent on tree size, was comparative between the treatments. Moreover, the crops set and the number of fruits of FI trees were like those of DI trees and altogether higher than in SI trees.

In conclusion, the findings of the study showed that there are no significant differences in fruit fresh weight were among DI and FI. The oil yield and oil yield proficiency of the DI treatment were 82 and 110% that of FI trees, separately. A degree of about half deficiency demonstrated maintainable to the irrigated trees for the production of oil.

Eighth study

This study conducted by Fernandes-Silva, in 2013. A test was done in a high-density olive, which is called "Olea europaea L. cv. Frantoio" plantation to decide the impact of various irrigation water systems (complimentary, full, and deficit) on virgin olive oil (VOO) quality for more than three successive years.

Trees with high water status yielded oils with lower centralizations of absolute phenols and O-diphenols regarding oils from seriously focused and stressed on trees. The concentrations of secoiridoids, similar to the dialdehydes type of decarboxymethyl elenolic acid are connected to (3,4-dihydroxyphenyl) ethanol (3,4-DHPEA-EDA), the isomer of the oleuropein aglycon (3,4-DHPEA-EA) and the dialdehydic type of decarboxymethyl elenolic acid is connected to (p-hydroxyphenyl) ethanol (p-HPEA-EDA), were lower in completely irrigated trees than in those trees which are under shortfall water system (irrigation) or those that got complementary irrigation. In conclusion, the results also showed that the concentrations of lignans (+)-1-pinoresinol and (+)-1-acetoxipinoresinol were unaffected by the irrigation system. Also, Volatile compounds, evaluated on the virgin olive oil headspace, seemed to be more consistently impacted by the year rather than the availability of soil water.

Ninth study

This study conducted by Hijazi, Doghoze, Jouni, Nangia, Karrou, and Oweis, in 2014. The main study objective is to study the relationship between yield and water for different irrigation treatments.

This study was completed for a long time (2006-2010); for five years in the Nashabia agricultural research station in the Province of Damascus. It has a place within the General Commission for Scientific Agricultural Research (GCSAR), which is located 16 km in the eastern part of the city of Damascus. This experiment intended to identify olive water requirements and irrigation water system continuously utilizing exact and accurate irrigation "number of days between water systems" under various irrigation procedures based on the phonological stages, to discover crop coefficient (Kc), irrigation proficiency, as well as water use efficiency (WUE).

The Simple Randomized Blocks Design (SRBD) was used in this study, which included 4 treatments: surface irrigation system by soil rings which was considered as a control (with a diameter of soil ring around a tree of 4.5 m, which receives irrigation water from a channel on the top of the field), drip irrigation system (6 drippers per tree, with the discharge of 8 L/ho for each), surface irrigation system by border strips (100 x 3 m, with a discharge of 2 L/Sec/m on the head of the stripe), and mini-sprinkler irrigation system (2 mini-sprinklers/tree, with the discharge of 55 L/ho for each).

In conclusion, the results of the study showed that drip irrigation was superior to other irrigation systems in the field of fruit yield, with 8532 kg/ha compared with 7155 kg/ha for the control. Accordingly, there are no significant differences between the treatments of drip and mini-sprinkler, with 8384 kg/ha for the mini-sprinkler treatment. Further, the treatment of drip irrigation was superior to other treatments, in the domain of WUE with 2.36 kg/m3, in comparison with 1.30 kg/m3 for the control.

Tenth study

This study conducted by AIT HMIDA, SIKAOUI, KARROU, NANGIA, and OWEIS, in 2015. This study was conducted in Morocco, where the olive trees cover more than 950,000 ha. Also, the irrigated olive fields are 230,000 ha, but only around 24,000 ha are conducted under drip irrigation. This study aimed to assess the productivity of olive trees, the production cost, and the economic profitability of the orchards in an intensive system under the drip irrigation with full (100% ETc) and deficit (70% ETc) water treatments in the Haouz region.

During 2012 and 2013, this experiment was conducted on 1 ha and in an experimental field in the Haouz. Haouz is characterized by a semi-arid climate with a rainfall of about 240 mm/year. The density of orchards studied is 156 trees/ha (8m x 8m) of the "Picholine Marocaine" variety. The amount of irrigation water applied is 6,490 and 4,920 m3 in 2012 and 5,560 and 3,890 m3 in 2013, respectively for full and deficit drip irrigation. The yield of olives was 8.06 and 8.31 tons/ha. The production cost is 2.47 and 2.32 MAD4/Kg of olives and gross margin of production of olive oil is 26,980 and 28,700 MAD/ha respectively for the two irrigation treatments.

In conclusion, the findings of this study present recommendations to reduce the irrigation water doses of the olive trees while ensuring the sustainability of the olive orchards in the intensive system in semi-arid regions.

Eleventh study

This study conducted by Dr. Jahgah, Dr. Hayfa, and Ehsaineh, in 2016. Was aimed at studying the economic effectiveness of olive mill wastewater (OMWW) use in fertilizing olive trees. The study sample was 294 of farmers from Lattakia Governorate, based on the descriptive-analytical method.

In conclusion, the results of the study showed that fertilizing the olive trees with olive mill wastewater gives a high productivity rate; as it posted a net profit of (33,668) SP/acre/year, while gross margin stood at (61 235) SP. The coefficient of profitability compared to the cost of production was about 41.32%, while the profitability coefficient compared to the capital invested was approximately 42.98%.

Twelfth study

This study conducted by Baghouthi, Alimari, Qurie, Amereih, and Al-Dadah, in 2017. The response of olive plantation of the same kind and age to irrigation treated civil wastewater and freshwater was acknowledged in three years. Substance and physical properties of the treated city wastewater reuse in farming (the effluent) created by the Sheik Ejleen wastewater treatment plant in Gaza Strip. Freshwater, soil and olive oil were contrasted and decided and Palestinian and worldwide standards. The Biological Oxygen Demand (BOD) of Sheik Ejleen effluent is 60 $mg \cdot l^{-1}$, which shows low-quality effluent.

In conclusion, the findings of the study show that there is no significant difference between effluent quality and freshwater low quality which can be considered as brackish water. Further, the vast majority of olive oil quality parameters, including overwhelming metals and trace components for the two irrigated with freshwater or treated wastewater, fall in the adequate standard limit values. Furthermore, the analysis of soil shows that natural substance and cation trade limits were improved in soil irrigated with treated wastewater in correlation with that irrigated with fresh water.

A comparison between the previous literature and our study.

Table 6: a comparison between the previous literature and this study

Study number	The main idea	A comparison study
First study	Evaluate the qualitative and quantitative yield in response to the irrigation of the olive trees in the southern parts of Italy.	Evaluate the irrigation of the olive trees in response to quantitative yield in the Jenin District of Palestine.
Second study	Examine the impact of different irrigation systems quality and on the profitability of olives and olive oil (Olea europaea L. cv. 'Kalamata' of Olive trees).	Assess the impact of supplemental irrigation of olives oil tree on the yield and profitability.
Third study	Enable olive cultivators on choices in regards to water system frameworks.	Enable olive cultivators on choices in regards to irrigation water projects used.
Fourth study	Identify the current requirements for developing traditional olives, and describe some private and open mediation to thwart its migration.	Determining the current requirements for developing the traditional olive oil production line.
Fifth study	Valuation of the irrigation water system through the use of production capacities for the instance of the olive grove economically	Economic valuation of the irrigation water system through the use of production capacities
Sixth study	Assess the economic situation of the execution of two alternative production frameworks in the olive and olive oil sector.	Assess the economic situation of supplemental irrigation projects in the yield production of the olive oil sector
Seventh study	Discover the effect of the water shortage system (irrigation with a deficiency) that starts from the beginning of fruit production.	Describe the impact of irrigation water cases on the production of olive oil.
Eighth study	Determine the effect of different irrigation systems (complimentary, full, and deficit) on the quality of virgin olive oil (VOO) for more than three consecutive years.	Determine the impact of various supplementary irrigation water on olive oil yield production
Ninth study	Identifying olive water requirements and irrigation water systems continuously utilizing exact and accurate irrigation under various irrigation procedures based on the phonological stages.	Identifying olive tree irrigation water utilizing supplemental irrigation to assess irrigation proficiency.
Tenth study	Assessing the productivity of olive trees, the production cost, and the economic profitability of the orchards in intensive system irrigation.	Assessing the productivity of olive trees, the production cost and the economic profit-ability of the in supplemental irrigation system
Eleventh study	Studying the economic effectiveness of olive mill wastewater (OMWW) use in fertilizing olive trees.	Studying the economic effect harvest freshwater and Treated wastewater use in irrigation olive trees.
Twelfth study	To identify the effects of non-conventional water in irrigation of olive trees on the properties of olive oil	To identify the effects of water in irrigation of olive trees on the yield production of olive oil

Chapter 3 : Material & Method

3.1 Introduction

Research studies the economical assessment of supplementary irrigation of olive oil in Jenin District.

Throughout analysis the results of the supplementary irrigation carried out in the olive groves and historical studying of the production of these projects.

Previous studies in this field will also be reviewed

Collecting agricultural data from the fields in order to build a solid literature review for the topic, to identify specific existing problems and needs that targeted by the agriculture projects towards effective implementation.

3.2 Population & Sample

The number of farmers using supplementary irrigation of olive trees in the study area reached (40) farmers, the number of which was limited by the Agricultural Directorate of Jenin Governorate, and the Agricultural Society, The researcher intended to conduct the study by means of a comprehensive survey of all members of society, as its number is small, However, it was not possible to reach them all for various reasons, including two outside the country, one refused to cooperate with the researcher, and another could not reach it, and therefore the study was conducted on the available community of (36) farmers only, the sample members who were examined were distributed according to demographic variables as follows:

3.2.1 Distribution of the sample population according to gender

Table (7) Distribution of the sample population according to gender

Gender	Frequency	Percent
Male	34	94.4
Female	2	5.6
Total	36	100.0

The table shows the distribution of the members of the sample, gender, where the results show that the vast majority of the sample members are male. Their number in the sample was (34) with a representation of (94.4%), while the sample had two female that represented only (5.6%).

3.2.2 Distribution of the sample population according to age

Table (8) Distribution of the sample population according to age

Age	Frequency	Percent
Less than 35year	1	2.8
From 35-50 year	16	44.4
More than 50 year	19	52.8
Total	36	100.0

The table shows the distribution of the sample population by age, and the results show that the largest representation of the large age group who are over the age of (50) years, as their number in the sample (19) has a representation of (52.8%) approximately, while the lowest representation was for the small age group who are less Their age is about (35) years, as their number in the sample (1) reached by approximately (2.8%), while the rest of the sample is of middle ages, with their number (16) with a representation of (44.4%).

3.2.3 Distribution of the sample population according to project age

Table (9) Distribution of the sample population according to project age

Agriculture experience	Frequency	Percent
Less than 10 year	18	50
From 10-20 year	16	44.4
More than 20year	2	5.6
Total	36	100.0

The table shows the distribution of the sample members according to project age, and the results show that the largest representation of those with average age ranging between (10-20) years, as their number in the sample (16) has a percentage of representation (44.4%) approximately, while the lowest representation was for those with short experience Which is less than (10) years, as their number in the sample (18) has a rate of (approximately 50%), while the remaining members of the sample have long age of more than (20) years, where their number (2) has a representation rate of (5.6) %).

3.2.4 Distribution of the sample population according to income depend on agriculture

Table (10) Distribution of the sample population according to income depend on agriculture

Agriculture experience	Frequency	Percent
Basic	8	22.2
Alternative	10	27.8
Partial	18	50
Total	36	100.0

The table shows the distribution of the sample members according to income depend on agriculture, and the results show that the largest representation of those with average partial depends , as their number in the sample (18) has a percentage of representation (50%) approximately, while the lowest representation was for those basic depends, as their number in the sample (8) has a rate of (approximately 22%), while the remaining members of the sample have alternative depends, where their number (10) has a representation rate of (27) %).

3.3 Research Area (specific)

During the research, in the Jenin district 36 farms were surveyed and data collected through interviews with farmers, distributed as (Jenin City, Aqaba, Burqeen, Faquaa, Jalameh, Bit-Qad, Arrabah, Qabaitah, Maythalon, Sanour, Seris, Anza, Zabouba, and Meslyah).

3.4 Research Design

The research design used descriptive analysis with two side qualitative and quantitative in study the economical assessment of supplementary irrigation of olive oil in Jenin District, Where the quantitative descriptive approach was used to estimate the degree of respondents' response to the effect of supplementary irrigation to increase olive production, and to estimate the economic return of olive cultivation using supplementary irrigation. While using the qualitative descriptive approach to describe the nature of olive fields that depend on complementary irrigation, the role of complementary irrigation in the speed of tree growth and their needs for fertilizers and insecticides and fungicides that may be exposed to olive trees, and to identify the types of olives that use the supplementary irrigation process, and its characteristics. Analyzed the 2019/2020 semester data, and considered the information from PCBS, and Ministry of Agriculture reports.

3.5 Research Tools

To collect the information and data necessary to achieve the aims of the study, the following tools were used:

First: the personal interview: The researcher worked to interview (36) farmers to collect the information necessary to achieve the goals, where an appointment was made with the targeted farmers, and they were interviewed separately, and a special form was prepared for this purpose, containing research questions identified by the researcher, to benefit from it in collecting the necessary information on the characteristics of the land cultivated with irrigated olives, its types, diseases that may affect it, and its fertilizer needs, in addition to calculating its costs and economic feasibility.

Second: The questionnaire: The researcher prepared a questionnaire to collect data that includes research clauses distributed in two areas:

First: It includes (13) research items to measure the effect of supplementary irrigation on production.

The second: It includes (15) research clauses to measure the feasibility of supplementary irrigation economically.

Validity of the tool: To verify the validity of the tool, it was presented to two arbitrators who specialize in the agricultural field, to express their views on the integrity and comprehensiveness of the vertebrae to measure what is actually intended. After expressing their views on the questionnaire, it was reformulated again to be valid for the performance of the actual study.

The stability of the tool: The stability of the questionnaire paragraphs was confirmed by calculating the stability factor (Kronbach Alpha), where the stability factor (0.811), which is a good percentage in the humanities.

3.6 Research procedures

The study was conducted according to the following steps:

1. Determining the study community, where a researcher identified the community, which is the farmers who use supplementary irrigation of the olive trees to which the study will be applied, and then obtain permission to apply the study tools from the university.

2. Determining the study sample, for selection, as the researcher coordinated with the university, and informing them of the date of conducting the study.

3. Building study tools through reviewing previous studies published in this field, and the appropriate procedures that the researcher undertakes.

4. Apply tools to the study sample.

5. Data collection, especially on the details of the study community, data processing and extracting findings, recommendations and proposals.

3.7 Variables

Independent variable: sustainability of production of olive tree

Dependent variable: supplementary irrigation of olive tree

Constant variable: Economical assessment of olive tree

3.8 Methods of collection data

Collection of data, reports, and literature about supplementary irrigation in Palestine and the region.

- Reports of supplementary irrigation projects for olive trees
- Cconduct interview with farmers
- Reports of the Ministry of Agriculture
- Reports of the Ministry of Economy

- Case study (rain-fed and supplementary comparison)

3.9 Methods of data analysis

After collecting the study data, the researcher reviewed it in preparation for entering it into the computer. The researcher explained the answers in all the interview questions, then answered the study questions, and tested their hypotheses using financial analysis.

Chapter 4 : Results & Discussion

Answer to study questions: to answer the questions of the first and second study, the mean and deviation of the respondents' answers were calculated, in order to estimate the degree of response to achieve the goals.

4.1 Answer first research question

What is the effect of supplementary irrigation on the growth and productivity of olive trees in Jenin District?

To answer this question, the mean and the standard deviation for each of the items in this field were calculated, and the total score for all items is as shown in the following table:

Table: 11 the effect of supplementary irrigation on the growth and productivity of olive trees

#	Statement	Mean	standard deviation	Degree of response
1	Supplemental irrigation helps tree growth	4.5789	.6069	Very high
2	Supplemental irrigation contributes to stabilizing the fruits after they are formed	4.1053	.6578	High
3	Supplemental irrigation makes the olive tree more able to protect fruits from withering during extreme heat waves	4.5789	.6069	Very high
4	Supplemental irrigation prevents the fruits from falling off at the beginning of their formation due to the quintet climate	3.9474	.6212	High
5	Supplemental irrigation helps trees resist various diseases	3.4211	.6924	High
6	Supplemental irrigation enables the trees to feed more fruits than the irrigated trees	4.0526	.5242	High
7	The timing of supplemental irrigation of olive trees helps in the safety of the trees	3.5263	.5129	High
8	The productivity of the olive tree is affected by the number of irrigation times	4.0526	.5242	High
9	Supplemental irrigation helps reduce the period required for production (traditional cultivation. The tree takes 5-5 years to produce, while irrigation reduces the period from 3-5 years).	4.4737	.5129	Very high
10	Olive tree productivity is affected by the time between irrigation	3.4737	.5129	High
11	The productivity of the olive tree is affected by the amount of	4.4211	.5072	Very high

	water needed each time			
12	The amount of water in the irrigation process during the season affects productivity	4.3158	.5823	Very high
13	Increasing the amount of water in the irrigation process to a certain extent will negatively affect the crop	4.0000	.4714	High
Total fields		4.1202	.6370	High

Table (11) shows the results of the respondents' answers about the effect of supplemental irrigation of olive trees on tree growth, safety, worm and increased production, where the degree of response was between very high and high.

The highest degree was in response to paragraph of the effect of supplementary irrigation of olive trees on their growth, with an average of (5.788). and this indicates that the trees that are irrigated during the summer period after the rain fall, keep the trees in a state of growth, unlike the trees that depend entirely on the rainy areas, which are going through a state of stagnation and stopped growing in the summer and autumn periods due to drought and the cause and evaporation of the soil.

The paragraph that constitutes supplementary irrigation that makes the olive tree more able to protect fruits from withering during heat waves is very severe, with a mean (4.5789). There is no doubt that fruit trees, including olive trees, need water in the summer period, so that the leaves do not wither and wither due to drought and extreme heat that leads to the evaporation of the soil, and reduces the proportion of water in the soil.

Likewise, the degree of respondents' response was very high to the paragraph related to the supplementary irrigation helps reduce the period required for production (traditional cultivation takes a tree for production from (5-8) years, while in irrigation the period shrinks from (3-5) years where the average of answers reached (4.4737).

It is logical that the trees grow according to the conditions available to them for continuous growth without reaching a state of stagnation, and water is one of the most important elements that help the continuation of the growth process, since water helps to analyze the soil and contain the elements necessary for growth, and therefore the growth process remains It continues throughout the year, helping to reach production stage in a relatively short time compared to trees that depend only on monsoon rains during the autumn and winter periods, and interruption during the summer.

The respondents also see that supplemental irrigation affects the productivity of the olive tree with the amount of water used each time, as the response rate was very high with an arithmetic average (4.421). They also affirm that the amount of water in the opinion process during the season affects productivity very highly, with an average of (4.315).

This is confirmed by the agricultural extension agents who supervise the irrigated olive fields, as they stressed that the timing of the irrigation process, the amount of water through which the trees are irrigated, and the interval between each irrigation process, has a fundamental role in increasing productivity. Irrigation in periods of very close, or very far apart, may not lead to good results, as well as choosing the time period for irrigation has significance in increasing production, and agricultural guides are advised to use supplemental irrigation immediately after the formation of the fruits, so that the tree helps to stabilize the fruits, as well as after the emergence of the fruits and before ripening.

In the total field, the respondents assert that supplemental irrigation greatly helps the growth and quality of olive trees and increases their productivity, compared to traditional agriculture that relies entirely on rain water.

4.2 Answer second research question

What are the economic impacts resulting from the use of supplementary irrigation of the olive fields in Jenin District?

To answer this question, the mean and the standard deviation for each of the items in this field were calculated, and the total score for all items as shown in the following table:

Table 12: The effect of supplementary irrigation of olive fields

#	Statement	Mean	standard deviation	Degree of response
1	The quantities of water used for supplemental irrigation increase the costs of olive oil production	3.3158	.6710	High
2	Supplemental irrigation results in the use of fertilizers, which increases costs	3.2105	.5353	High
3	Water prices, if purchased for irrigation, increase production costs	3.2105	.6306	High
4	Extracting water and transporting it to the field increases costs	2.8947	.6578	High
5	The net yield of irrigated trees is better than that of non-irrigated	4.5789	.6069	High

	trees, despite higher costs for the first			
6	Collecting the crop from irrigated trees provides jobs for family members	3.7895	.7132	High
7	The farmer's income increases as the area planted with irrigated trees increases	4.3684	.6839	Very high
8	The marketing of the production of irrigated tree yield is more easy compared to the rain-fed trees being more quality	3.3684	.7608	High
9	Agricultural guides are available to help farmers guide farmers about irrigation for olive trees	4.1053	.4588	High
10	Supplemental irrigation can be done on the density of tree planting in one dunum	4.3684	.5972	Very high
11	Supplemental irrigation assists with production quality, which allows easy marketing	3.1053	.5671	High
12	Supplemental irrigation enables cultivation of land that cannot be used with rain-fed olive trees	4.4737	.6117	Very high
13	Supplemental irrigation enables vertical expansion of olive trees	4.6316	.4955	Very high
14	Supplemental irrigation allows cultivation of varieties that cannot be grown solely on rainwater	4.5263	.5129	Very high
15	Supplemental irrigation encourages the reclamation of new lands for cultivation with olive trees	4.4211	.6069	Very High
Total fields		3.8996	.9000	High

Table (12) shows the results of the respondents' answers on the economic impact of the use of supplementary irrigation of the olive fields, where their answers ranged between very high and high.

The highest degree of response was to the paragraph regarding the fact that supplementary irrigation helps vertical expansion of olive trees, where the degree of response was very high with an average score of (4.631). The researcher see that this result is logical, as supplemental irrigation allows farmers to grow more trees per dunum compared to traditional agriculture that depends only on rainfall. This is because supplementary irrigation enables the supply of trees with chemical fertilizers and other elements that can be added during the irrigation process.

The respondents also see that supplementary irrigation enables the farmer to grow varieties of olive trees that cannot be cultivated by relying on rainwater only. Such as the (k17), and the Nabali Mohasan, Where the degree of response on this paragraph was very high, with an average (4.526).

The respondents also see that the use of supplementary irrigation can enable the cultivation of land with olive trees, not suitable for agriculture that relies only on rainwater, their degree of response to this paragraph was very high, with an average score of (4,473). There is no doubt that there are lands that lack deep soil and do not contain sufficient elements for the growth of olive trees, and you need water continuously throughout the year, and this enables with supplementary irrigation, where farmer can irrigate the trees at any time he wants, and in the appropriate amount, thus compensating the soil poverty in this case.

Thus, supplementary irrigation helps and encourages farmers to reclaim lands for olive trees, the respondents ’answers to this paragraph were very high, with a mean (4.42). The very high degree of response to this paragraph is explained, considering that it is possible to increase the areas of land cultivated with olives and to benefit from its return if water is available for irrigation, instead of being barren land without interest, there are many olive fields that were cultivated on lands that were not previously used for agricultural purposes, where supplementary irrigation encouraged its reclamation and utilization. In the total score for all items in this field, the response was high, with an average score of (3.9), this indicates that supplemental irrigation reflects positive economic effects on farmers if it is used to irrigate trees, as it can increase the areas planted with olive trees.

4.3 Answer third research question

What are the characteristics of the lands planted with irrigated olive trees in Jenin District?

To answer this question, the frequency was calculated for each paragraph in this field, as shown in the following table:

Table 13: The characteristics of the lands planted

Statement		Frequency	Percent
Slope	Less than 200 m	6	0.167
	From 200-350 m	25	0.694
	400 m and more	5	0.139
Area size	Less than 5 dunum	11	0.306
	From 5-10 dunum	18	0.50

	More than 10 dunum	7	0.194
Nature of land	Deep plain	14	0.389
	Plain light soil	14	0.389
	Mountain	8	0.222
Tree type	Baladi	8	0.222
	Nabali	17	0.474
	Syrian	11	0.308
Olive tree age	Less than 10 years	13	0.361
	From 10-20 year	11	0.306
	More than 21 year	12	0.333
Number of tree / dunum	Less than 10 tree	5	0.139
	From 10-15 tree	16	0.444
	More than 15 tree	15	0.417

Table (13) shows the results of the respondents' answers about the characteristics of the irrigated olive fields, in terms of the slope, and the area size, the nature of the land, the type of trees planted, the number of trees per dunum, and the age of the olive trees until this study was conducted.

In terms of the slope of olive fields, the majority of the respondents, numbering 25, mentioned that represents (69%) of the respondents, their fields slope ranges between (200-350) meters. While (6) of the respondents mentioned that represents (17%) of the respondents, that the olive fields they own slope less than (200) meters. While the remaining members of the sample, who number (5), which represents a percentage of (14%), their fields slope for more than (500) meters.

As for the area size of the fields owned by the farmers who applied the irrigated fields projects, they mentioned (11) of the respondents, which represents (31%) of the respondents, the area size is small (5) dunums or less, while (18) of them mentioned, which represents (50%) that the area of their fields ranges between (6-10) dunums. While the remaining members of the sample, who number (7), representing (19%) of the sample, that the area size of their fields exceeds (10) dunums.

As for the nature of the land used for the cultivation of irrigated olive fields, (14) of the respondents stated that they represent (39%) that they have applied their projects in deep plain lands, and they are similar in light soil. While the rest of the sample, whose number is (8), which represents (22%) of the sample, they established their projects on barren lands.

As for the type of trees they planted in irrigated olive fields, Eight (8) of the respondents mentioned that they represent (22%) that they planted their fields from the Baladi olive cultivar. While (17) of them mentioned, which represents (47%), that they planted their fields with Nabali olives. While the remaining members of the sample, who number (11), representing a percentage of (31%), planted their fields with the Syrian variety.

Regarding the of olive trees age in irrigated olive fields, (13) mentioned that the sample represents 36% of the olive trees age in their fields less than (10) years old. While (11) of them mentioned, which represents (31%) of the sample, that the age of olive trees in their fields ranges between (10-20) years. While the rest of the sample (12), which represents 33% of the sample, indicated that the age of olive trees in its fields exceeds (20) years.

Finally about the number of trees planted with irrigated olives per dunum, Five of the farmers mentioned, which represents (14%), that they planted (10) trees and less per dunum. While (16) of them mentioned that represents (44%), that they planted between (10-15) trees per dunum. While the rest of the members of the sample, whose number is (15), meaning 42% of the sample, they planted more than (15) trees per dunum.

4.4 Answer fourth research question

What are the supplementary irrigation mechanisms used in irrigation of olive trees in Jenin District?

To answer this question, the frequency was calculated for each paragraph in this field, as shown in the following table:

Table 14: The supplementary irrigation mechanisms

Statement		Frequency	Percent
Source agency	Civil society organizations	10	0.278
	Self-financing	25	0.694
	Lending institutions	1	0.028
Project age	Less than 10 year	21	0.583
	From 10-20 year	12	0.333
	More than 20 year	3	0.083

Water source	Rain-fed	20	0.556
	Freshwater (groundwater)	8	0.222
	Treated wastewater	8	0.222
Harvest water tools used	Irrigation network	7	0.194
	Harvest well	18	0.50
	Tank barrels	11	0.306
Irrigation way	Direct	11	0.306
	Drip	22	0.611
	Transport tanks	3	0.083
Number of irrigation times	1-3 times	25	0.714
	4-6 times	7	0.175
	More than 6 times	4	0.111
The time period between irrigation	Two weeks	12	0.333
	Three weeks	13	0.361
	Four weeks and more	11	0.306
Irrigation period	Jun-July	1	0.111
	Jun-Aug	7	0.278
	Jun-Sep.	3	0.222
	July-Aug	7	0.278
	July-Sep	18	0.50
Water need per tree per time	0.5 m3 and less	22	0.611
	1-1.5 m3	10	0.278
	1.5 m3 and more	4	0.111
Water need per tree for all period	1-3 m3	18	0.50
	4-6 m3	9	0.25
	More than 6 m3	9	0.25

Table (14) shows the results of the respondents' answers about the mechanisms of supplemental irrigation, their answers were about the agency source for the project, where (25) of them, representing 69%, stated that they worked on establishing the project with self-financing, while (10) of them, representing a percentage of (28%), received funding from civil society organizations to finance their projects, , While only one project was funded through a loan institution.

On the project age, the results showed that most of the irrigated olive fields projects are recent, where (21) which represents (58%) was established during the past ten years, whereas (12) projects represented approximately 33%, their establishment was between 10-20 years, while the rest of the projects and their number (3) only, that is (8%), are old, since it was established more than (20) years ago.

On the water source used for irrigation, it is noted that there is more than one source used for the water harvest to irrigate the irrigated olive fields in Jenin District. Where there are (20), or approximately (57%), dependent on rainfall water harvesting, and (8) represent approximately (22%), depends on freshwater (groundwater) by won well or selling water. While (8) represent approximately (22%), depends on treated water.

As for the water harvesting tool for storing water, (7) mentioned what represents (19%), that they use irrigation network, while (18), i.e. (50%), they mentioned that they use harvest wells to store and conserve water, while (11) mentioned (31%) that they use tanks barrels.

On the irrigation method that farmers use to irrigate irrigated olive fields, (22) mentioned what represents (61.1%), that they use the drip method to irrigate the fields, while (11) what represents the percentage (30.6%) that they use the direct irrigation method for irrigation, while the remaining (3) members of the sample represent (8%), they use water tanks to irrigate the olive fields. According to the study titled "Economics of drip irrigation of olives in Turkey" agricultural technology has created opportunities for crop production which markedly increase the potential returns on investments in irrigation. A controlled water supply produces the highest yield response when used in conjunction with other inputs such as the cultivar, fertilizer, and crop protection from pest and disease, high quality land preparation, and timely weeding and harvesting (Cetin, 2003).

As for the number of irrigation times during the season, (25) mentioned what represents (71%) that they irrigate their fields from (1-3) times during the season, while (7) of them mentioned, that is, what represents (18%) that they water their fields (4-6) times during the season, while the rest, which number (4), representing 11%, stated that they irrigate their fields more than (6) times during the season.

In the time period between each irrigation process, (12) of the farmers mentioned what represents (33%) that they see their fields every two weeks, while (13) mentioned what represents (36%) that they perform the irrigation process every three weeks, while the remaining (11) farmers (31%) stated that they irrigate their fields every month.

Regarding the date of irrigation of olive fields during the season, half of the respondents mentioned that they are irrigating their fields from July until two weeks before the date of harvest. While (10) (28.5%) of the farmers mentioned that they irrigate their fields in the period between June and August. While the remaining (8) sample members (22%) irrigate their fields in the period from June to mid-September.

While on the water needs per tree per time, (22) mentioned what represents (61%) of the respondents, that the needs of the tree for each irrigation case are less than (0.5) m^3. While (10) reported a rate of (28%) that the needs of each tree range from (1-1.5) m^3. . While the remaining members of the sample, who number (4), increased by (11%), they stated that the needs of each tree for each irrigation case exceed (1.5) m^3.

As for the water needs of the tree during the season, (18), which represents (50%) of the respondents, stated that the needs of the tree during the season consist of (1-3) m^3. While (9) reported a rate of (25%) that the needs of each tree during the season range from (4-6) m^3. While the remaining members of the sample, who number (9), which represents (25%), they stated that the needs of each tree during the season were more than (6) m^3.

4.5 Answer fifth research question

What is the production practices and its cost that applied by the farmer to produce olive oil ?

To answer this question, the frequency was calculated for each paragraph in this field, as shown in the following table:

Table15: The olive oil production practices

Statement		Frequency	Percentage
Fertilizers used	Organic fertilizers	13	0.361
	Chemical fertilizers	14	0.389
	Natural fertilizer	8	0.222
	Mixed	1	0.028
Tree diseases	Peacock	14	0.389
	Olive fly	12	0.333
	Fibrosis	8	0.222
	More than one disease	2	.056
Methods of disease control	Fly traps	23	0.639
	Insecticides	7	0.194
	Mixed	6	0.167
Picking tools used	Manual	23	0.639
	Mechanism	10	0.278
	Mixed	3	.082
Labor type	Worker Daily	7	0.194
	Percentage	5	0.139
	Family	24	0.667
Press type	Ancient	2	0.056
	Automatic	9	0.250
	semi-automatic	25	0.694

Table (15) shows the results of the respondents' answers about the practices they use in production, whether in terms of the types of fertilizers used, or the diseases that affect trees and ways to control them. As well as the tools used for fruit harvesting, the type of labor used, and the type of press.

As for the type of fertilizer used, (13) mentioned what represents (36%) of the respondents that they use organic fertilizers, while (14) mentioned what represents (39%) that they use chemical fertilizers, and (8) farmers representing 22% of the farmers use organic fertilizers, while only one farmer uses a mixture of organic, chemical and natural fertilizers. Pruning is usually practiced during olive harvest. Olive farming in Palestine is a low-input cultivation: very few farmers broadcast chemical fertilizers; manure or olive pomade are applied in few quantities. Pests and diseases control is not a common practice; the main olive pests/diseases are the olive fly (Bactrocera oleae Gmel.) and the peacock eye spot (Spilocaea oleagina Cast). Other pests or diseases are less wide spread. (Qutub, M; Ali, S; Mutawea, M. , 2017) With regard to fertilization, farmers could be recommended to apply fertilizer in accordance with the nutrient needs revealed by plant and soil chemical analysis. It appears to be possible to increase olive production by 900 kg/ha, the equivalent of h 345 in SMOPS PT1, by changing fertilization practices and applying herbicides instead of two tillage operations per year. The extra costs of this improvement would be less than h 30 ha/yr. (a 4% increase of total costs), plus the additional harvesting costs according to study of Duarte, Jones, and Fleskens, 2008.

On the diseases that afflict the olive fields, (14) mentioned what represents (39%) that eye Peacock is the most common disease affecting the fields, while (12) of the farmers mentioned, which represents (33%), that olive fly disease is spread in the olive fields, (8) of the farmers, which represents (22%) that the fibrosis is most prevalent in their fields. While only two of them, which represent a percentage (6%), stated that their fields are exposed to more than one disease at the same time.

To overcome the diseases that afflict the olive fields, (23) of the farmers mentioned what represents (64%), that they use fly traps, While (7) of them reputed that represents (19%) that they use pesticides, while (6) of them mentioned what represents (17%), that they use fly traps and pesticides to eliminate diseases that affect their fields. The researcher has noted that in some fields, traps are supplied by the Ministry of Agriculture, and this is a good thing to help farmers reduce costs.

Regarding the tools used to harvest the fruits, (23) of the farmers mentioned, which represents (64%), that they use manual methods to collect the fruits, while (10) of the farmers mentioned, which represents (28%), that they collect the fruits by means of an automated method specially prepared for this purpose, while (3) farmers mentioned what represents

(8%) that they collect the fruits using the manual and automatic methods, there is no doubt that the method used for harvesting is manual using combs prepared specifically for this purpose, in order to avoid breaking tree branches, and the traditional method of using long sticks to collect the crop was no longer acceptable for harvesting irrigated crops in the fields . That is, not to use it as in rain-fed fields. Also the most picking crop tools was by family work, and the little was used a worker, the collection of the crop is carried out by the owners of the projects and their families, or through workers, but in some years it is agreed to harvest the crop with other contractors in return for giving them a share of the agreed upon crop such as half, a third or a quarter, depending on the intensity of production. As for the type of labor used to harvest olives, 7 percent mentioned (19%) that they were using worker to harvest the fruits, while (5) of the farmers mentioned what represents (14%) that they used to include the crop for contractors or families, whether with sums or on a percentage of production. While (24) of farmers mentioned what represents (67%) that they depend on their families to pick the fruits.

As for the olive fruit presses machine, 25 of the farmers, i.e., representing (69%), mentioned that they are using modern automatic presses, while (9) of the farmers mentioned, which represents (25%), that they use semi-automatic presses to squeeze the olive fruits. While the remaining members of the sample (2) mentioned only what represents (8%) of the respondents that they use the old presses.

4.6 Answer sixth research question

What is the economic cost of Supplemental Irrigation practices for Olives Oil production?

To answer this question, the production cost was calculated for each stage in this field, as shown in the following tables:

First: Irrigation tools cost

Table16: Irrigation tools cost

Irrigation tools type	Av. Price / du
Tank barrels	885$
Harvest well	2610$
Irrigation network	785$

Table (16) shows the irrigation tools type; first tool is harvest well, where the average harvest well price 2610$ per dunum, second tools was tank barrel, where the average price 885$ per dunum. Also, third tools was irrigation network with average price 785$ per dunum. But in some fields they didn't used network irrigation because they irrigated in direct way. Researcher observed that in most fields the irrigation tools offered by founded institutions as part of agricultural projects, so the farmers didn't bay any cost of irrigation tools. Also, the size was constraint in most fields related to the projects instructions, but the cost of irrigation tools per dunum depend on the number of tree and the total water needed per dunum.

Second: Water cost

Table 17: Water cost

water cost	water price/ m^3	water price/ du	Transportation cost/du	Power diesel cost/du	Maintenance cost	Total Av price
Harvest rain water	-	-	-	25$	24.68$	50$
Freshwater Ground water	0.85$	33.8$	62$	-	12$	108$
Treated wastewater	0.05$	3.56$	42$	-	25$	70$

Table (17) show the water cost, there's no cost for rainwater here because its harvest in well from rain fall, but still need power diesel used to pump freshwater irrigation from harvest well the with an average cost 25$ per dunum with average maintenance cost 24.68$. In average the total average water cost for freshwater irrigation 50$. The average water price per 1Cubic meter for freshwater 0.85$, with average water cost 33.8$ per dunum and the average water transportation cost 62$ per dunum with average maintenance cost 12$. In total water cost for treated was 108$. The average water price per 1Cubic meter was 0.05$ for treated wastewater, with average water cost 3.56$ per dunum and the average water transportation cost 42$ per dunum, with average maintenance cost 25$. In total water cost for treated was 70$. Researcher noted that the price of treated water varies according to the membership of the Water Refining Association in the Jenin region, so researcher see that belonging to the association provides a better price for the farmer.

Third: Pre-harvest cost

Table 18: Pre-harvest cost

Pre-harvest cost	Av cost/ du
Fertilizer Av cost	23$
Diseases control Av cost	9$
Pruning trees Av cost	20$
Tillage land Av cost	50$
Total Av Pre-harvest cost	102$

Table (18) show the average pre-harvest cost as: the average cost of fertilizer was 23$ per dunum, and the average cost of disease control 9$ per dunum. Where farmers scatter the fertilizer in a balanced manner around the tree, slightly away from the stem, which contributes to raising soil fertility and reducing pests. Previous experiments (according to farmers) farms that depend on organic fertilizers confirm that the effect of these fertilizers on productivity remains for several seasons later. As for those that depend on chemical fertilizers, their benefit is limited to the current agricultural season. Prices also vary, depending on the source of the provision of these fertilizers. As for diseases, the most prevalent disease is the eye of peacocks and insects that feed on plant sap, such as the olive fly, and some types of worms, which requires spraying the plant with insecticides and the necessary medicines determined by the agricultural engineer who supervises the farm.

The pruning olive tree average cost 20$ per dunum, researcher noticed that the trees that are pruning in a correct way where the level of ventilation is good, and The strength of the tree is an important factor in the degree of pruning as well as the tillage land that is tillage and cared for, where the trees are more vital and their leaves are green and healthy where average cost was 50$ per dunum, the. In conclusion total average pre-harvest cost was 102$ per dunum.

Fourth: Harvest cost

Table 19: Harvest cost

Harvest / dunum	$/du
Worker wages/day	29$
Number of worker /du	4 worker
Number of work day	1 day
Total harvest cost/ du	100$

Table (19) show the average harvest cost, where the daily worker wage average range 29$ per day, and the average number of worker 4 worker, where the average number of one day work. In conclusion the total average harvest cost 100$ per dunum.

Fifth: Post-harvest cost

Table 20: Post-harvest cost

Post-harvest / dunum	$/du
Press Cost / yield	6%
Press Cost / du	91$
Crop packing Cost /du	24$
Other costs / $	3.4$
Av post-harvest cost /du	120$

Table (20) show the post-harvest cost, where researchers note that the process of extracting the oil from the olive harvest takes place in local presses owned by the shareholders, the most press was automatic type with little used a half automatic press type. The cost per dunum of the product era can be estimated with average 6% of yield with an average cost 91$ per dunum. Most fields packing crop with an average cost 24$ per dunum. Researcher search for any additional cost and found that in average there is other cost with 3.5$ per dunum. In conclusion the total average post-harvest 120$ per dunum.

4.7 Answer seventh research question

Does economic sustainability differ according to the supplemental project used ?

Researcher analyses all these results into feasibility study to assess the supplemental irrigation in raising economic sustainability of olive tree, based on investigate feasibility study. Hence, the research analyzes two different supplementary irrigation, and finds different results by reviewing yield, revenue, operating cost, cost of investment, net profit, return on investment and profit margin ratio.

We can observe different economic sustainability according to the supplemental project used, as:

Frist : yield and revenue

Table 21: Average yield and revenue per dunum based on irrigation method

Revenue/ du	Av quantity of olive oil/ tree	Av quantity of olive oil/ du	Av price / Kg	Av revenue/ du
For fields used freshwater irrigation	12.42Kg	154 Kg	8$	1232$
For fields used treated wastewater irrigation	12.46Kg	133Kg		1064$

Table (21) show the average revenue per dunum based on irrigation method, the results showed the supplemental irrigation olive oil has yielded very positive results on productivity and can gain good revenue for the farmer. The yield production growth when using the supplemental irrigation for olive tree, the average tree production olive oil is 12.5Kg for olive tree, where the average production of olive tree depends on rain-fed is 5.6Kg olive oil (MOA, 2018), The main intervention to improve productivity would be irrigation, but in many traditional systems this practice is difficult to implement due to the financial investment needed and the lack of irrigation infrastructure.(Duarte, Jones, and Fleskens, 2008). The revenue, in the supplemental irrigation for olive tree depends freshwater irrigation is give in average 1232$ annually per dunum, and 1064$ for treated wastewater irrigation annually per dunum.

Second: Operating Cost (OC)

Table 22: Operating cost/ dunum

Operating cost	/du
Freshwater irrigation (using harvest well)	352$
Freshwater irrigation (using tank barrel)	424$
Treated wastewater irrigation (using irrigation network)	360$

Table (22) show the operating cost, by calculated all cost included (pre-harvest cost, water cost, harvest cost, and post-harvest cost). The growth in yield is also reflected in raising the value of expenses, as operating expenses are 352$ annually per dunum for freshwater irrigation using harvest well, and 424$ annually per dunum for freshwater irrigation using tank barrel, where the operating cost 360$ annually per dunum for treated wastewater irrigation.

According to the study titled "Economics of drip irrigation of olives in Turkey" the variable costs are proportional to the amount of water pumped. Labor is used for monitoring, repair, maintenance and any required hose or pipe moving. Fixed costs occur regardless of water quantity used and generally consist of depreciation and interest costs based upon the amount of investment (Cetin, 2003).

All this, in turn, is reflected in the agricultural system, by increasing the demand for basic materials and employing a larger proportion of workers, which enriches the economy in the olive oil production sector.

Third: Cost of investment

Table 23: Cost of investment/ dunum

Cost of Investment	/du
Freshwater irrigation (using harvest well)	3072$
Freshwater irrigation (using tank barrel)	1419$
Treated wastewater irrigation (using irrigation network)	1145$

Table (23) show cost of investment, by calculated all cost included operating cost, and irrigation tools cost which include (harvest well , tank barrel for freshwater irrigation, and irrigation network for treated wastewater irrigation, in addition to net irrigation add in both). Where the cost of investment in freshwater irrigation used harvest well 3072$, and 1419$ when used tank barrel, the cost of investment 1145$ in treated wastewater used irrigation network. This cost of investment amount reflects in the net profit per dunum. However, if the harvest tools cost paid from the founded institutions, the farmer will not paid for cost of investment, he just he paid for operating cost.

Fourth: Net Profit (NP)

Table 24: Net profit /Dunum

Net Profit/du	First year	Second year	Third year	Fourth year	Fifth year
Freshwater irrigation (using harvest well)	-1840$	-960$	-80$	800$	880$
Freshwater irrigation (using tank barrel)	-186.5$	621.5$	808$	808$	808$
Treated wastewater irrigation (using irrigation network)	-80.5$	624$	704.5$	704.5$	704.5$

Table (24) show the net profit, where in all cases there is loss in first year of the project, then stat gain profit in second year when using treated wastewater by irrigation network, until suitable profit in third year with 704.5$, also the farmer start gain profit from second year when using freshwater by tank barrel with 621.5$ until suitable profit from third year with 808$. The loss when using freshwater by harvest well continue to second year, then in third year farmer start gain profit until suitable in fourth year with 880$. Despite the relatively high initial investment, drip irrigation for olive production in the study area is profitable, given the high market price of olives. Our analysis showed that drip irrigation system would be profitable investment. The system reached a discounted payback in the fourth year after the investment. (Cetin, 2003). The reason for the loss in the first year is due to its impact of cost of investment costs, as well as in the second year. But form third year, there is no investment cost because it was covered in the first and second years of the life of the project. In a nutshell, there is an increase in yield production that leads to an increase in revenue and net profit, thus raising investment in the sector that helps achieve the sustainability of olive oil production. According to the study Mesa-Jurado et al. Span J Agric Res (2010) the economical assessment of irrigation method will support decision making both at farm level and policy makers as the increase in olive irrigation is presently the main pressure on water resources.

The results indicate that the average cost of producing one dunum of olive oil in traditional agriculture does not exceed 100$, and the average production does not exceed 250$ in the good year, (MOA- Jenin, 2020). while the average cost of producing one dunum of olive oil in irrigated agriculture with supplementary irrigation is about 350-400 $. And the average production is about 700-800$ annually.

Fifth: Profit margin ratio

Table 25: Profit Margin Ratio/dunum

Profit Margin Ratio	First year	Second year	Third year	Fourth year	Fifth year
Freshwater irrigation (using harvest well)	-	-	-	64.9%	71.4%
Freshwater irrigation (using tank barrel)	-	50.4%	65.5%		
Treated wastewater irrigation (using irrigation network)	-	58.6%	66.2%		

Table (25) show the profit margin ratio, where the profit margin ratio in freshwater irrigation using tank barrel was loss in first year, then raising approximately 50.4% at second year, until suitable to 65.5% from third year. But when using harvest well the loss continue to third year, then raising approximately 64.9% at fourth year, until suitable to 71.4% from fifth year. Also, the profit margin ratio in treated wastewater using irrigation network was loss in first year then raising approximately 58.6% at second year, until suitable to 66.2% from third years. Which clearly that using supplementary irrigation is profitable whither used the profit margin percentage losing in first year less than the losing using freshwater supplementary irrigation. Also, the profit margin percentage in second year more than freshwater supplementary irrigation. While the percentage in next years are very close. Also, we observe the differ in the return on investment

Sixth: return on investment

Table 26: Return on investment/ dunum

Return on Investment	First year	Second year	Third year	Fourth year	Fifth year
Freshwater irrigation (using harvest well)	-	-	-	26%	28.6%
Freshwater irrigation (using tank barrel)	-	43.8%	56.9%		
Treated wastewater irrigation (using irrigation network)	-	54.5%	61.5%		

Table (26) show the return on investment, where the return on investment in freshwater irrigation using tank barrel was minus in first year, then raising approximately 43.8% in second year, until suitable to 56.9% from third year, and when using harvest well 26% in third year, 28% from fourth year. Also, the return on investment minus in treated wastewater using irrigation network was 54.5% in second year, then suitable at 61.5% from third year.

All these economic differences result from the difference in the supplemental project used. Based on all this results researcher nominates the best is using irrigation neither freshwater by tank barrel nor treated wastewater by irrigation network. Nevertheless, the best result is using irrigation treated wastewater not only economically, but also from an environmental perspective, where better treated wastewater is used sustainable to increase production yields and provide freshwater in other health fields.

4.8 Answer Eighth research question

Is it feasible for farmers to invest in the supplementary irrigation according to cost benefit analysis under the different scenario of net present values?

To answer this question, the net present values were calculated for each stage in this field, as shown in the following table:

Table 27: Net present value for freshwater irrigation fields and treated eastewater irrigation field

Net Present Value	Case 1 Scenario 1	Case 1 Scenario 2	Case 2 Scenario 1	Case 2 Scenario 2
Annual Amount	360	360	424	424
Ratio	1.5%	2.5%	1.5%	2.5%
Period per year	5	5	5	5
Present Value	1145	1145	1419	1419
Future Value End Period	$3,088	$3,187	$3,173	$3,834
Total profit for 6 years	$4,851		$5,470	

Table show the results of a comparison of net present value and total net profit with 1.5% and 2.5% bank interest rate, 6 years period, and there is a present value and annual amount.

The results show when farmer invest 1145$ and paid annual cost 360$ in case using treated wastewater irrigation, the NPV 3,088$ in rate 1.5% , and the NPV 3,187$ in rate 2.5%, but farmer can gain total net profit 4,850$ per dunum, Also, when farmer invest 1419$ and paid annual cost 424$ in case freshwater irrigation, the NPV 3,173$ in rate 1.5%, and the NPV 3,384$ in rate 2.5%, but farmer can gain total net profit 4,470$ per dunum. Which clearly that the farmer can gain more of profit if he investment in supplemental irrigation in his farms.

This comparison under different NPV scenarios showed clearly that the farmer can gain more than profit if he invests in neither freshwater nor treated wastewater irrigation in his field, and give us the fact that investing in supplemental irrigation for farmers it's feasible, and can give him a good profit, with suitable using of land source.

4.9 Interpretation of the research Hypotheses1

Hypothesis 1: We assume that the correct agricultural practices in the olive fields irrigated with supplemental irrigation lead to improved tree growth and increase their productivity

To answer this hypothesis, the effect of supplementary irrigation on the sustainability of production was calculated in this field, as shown in the following table:

Table 28: Model Summary

	Pearson	R^2
Independent variable: supplementary irrigation of olive tree	0.926	0.857
Dependent variable: sustainability of production of olive tree		

Table (28) shows the results of measuring the extent of the impact of the correct agricultural practices on olive fields irrigated with supplemental irrigation on tree growth and productivity, As the test results indicate that there is a strong degree of influence between them, As the value of the coefficient of determination(R2) is (85.7) which is the very high degree.

To examine the hypothesis, which states: Correct agricultural practices for olive fields irrigated with supplementary irrigation lead to improved tree growth and increased productivity? The Pearson test results show a strong correlation, as the value of the correlation coefficient (0.926) reached, and the level of significance reached (.002) which is less than the moral assumption (0.05). Therefore, we reject the null hypothesis and accept the alternative hypothesis, that is, the correct agricultural practices for olive fields irrigated with supplemental irrigation lead to improved tree growth and increased productivity.

4.10 Interpretation of the research Hypotheses 2

Hypothesis 2: we assume that supplemental irrigation of olive tree in Jenin District is economically feasible and its can improve the family income

It is economically feasible, back to the results there is a yielded when using the supplemental irrigation for olive tree. While the operating cost increase, but by comparing the amount of yields produced its raises revenue up in favor of supplementary irrigation whether freshwater or treated wastewater. According to the study Mesa-Jurado et al. Span J Agric Res (2010) work can be used to analyze the value of water for the irrigation of olive grove. The combined application of agronomic and economic models gives relevant results for analysis of water demand in the Guadalbullon River basin. The Guadalbullon Basin has been used as an example of the impact of this method in hydrological resources;

after developing an agronomic model that relates irrigation and olive production, and another economic model that relates olive production with revenue and farming costs.

Hence, this increase in revenue per dunum make jump in the net profit and profit margin ratio to approximately 808$, 65.5% from third year for the freshwater by tank barrel, and to approximately 704.5$, 66.2% from third year for the treated wastewater by irrigation network.

Given the fact there is a return on investment 60% from third year when using freshwater by tank barrel, and 61.5% from third year when using treated wastewater supplemental irrigation.

All these enrich the economically agriculture in olive oil sector, the tree yield production will be high, this means the demand for the production input will increase, and the revenue increase with net profit increase and profit margin ratio increase this improve the irrigation environment and encourages investors to expand in this field. Also, using rainfall by harvest well or using treated wastewater in the supplementary irrigation process for olive trees constitutes a perfect use of resources.

Besides that, it is can improve the family income as a part-time job, by the following: the yield production is high, meaning the existence of high revenues and net profits. Thus, there should be an expand in the investment in order to increase the profits. This leads to a constant attempts to develop the product in particular and eco-system in general. Consequently, there will be a great demand of labor force and then incorporate a large number of Palestinian families, which will eventually improve the family income. In addition, the high production means filled the gap between the supply and demand and expands the exports channels, which contributes to increasing the gross national income and raising the efficiency of the agricultural sector as a whole and the olive oil production sector in particular. Hence, this eventually leads to the economic sustainability of the sector.

4.11 Interpretation of the research Hypotheses 3

Hypothesis 3: We assume that supplemental irrigation project of olive tree funded by source agency (Government and/or NGOs), can help poor farmers overcomes a poverty.

To answer this hypothesis, the family income was calculated in this field, as shown in the following table:

Table 29: Improving family income

Improving family income	Poverty line	Annual income	Net profit / du	Num. need /du
Amount /$	478$	5736$	808$	7 du

Table (29) show the improving family income, where the poverty line for the reference family (consisting of five individuals, two adults and three children) in the Palestinian Territories during 2010 was approximately 2,237 NIS (approximately $609).While it reached the extreme (extreme) poverty line for the same reference family 1,783 NIS (approximately $478). (PCBS, 2009-2010)

From research results, we can investigate this case into freshwater supplementary irrigation because of its shows more yielded and efficient water source use in agriculture sector, based on that we can determinate the number of dunum family needs to invest on it, to survive themselves from poverty level, as PCBS the required income for family monthly need is around 478$, which means need 5736$ yearly.

Our research find that farmer can gain net profit from third year with 808$ per dunum when using freshwater by tank barrel, which means family need to invest into 7 Dunum to gain the yearly income needed.

Research conducted by the PSCB shows that the holdings contribution to the total income of the family by area categories. Where it is noted that the tenure income in the occupied Palestinian territories as a whole is a major part of the total family income in large-scale agricultural holdings, while the share of holdings in the total family income decreases as the size of the area decreases. Specifically, 29% of the area of large holdings, 10 dunums or more, contributes to more than 50% of the family's income, and this percentage drops to 16% in the case of holdings within the area size (5-99.9) dunums, and to 13% within the category of area size (3-99.4) dunums, to 11% in the area of area (2-99.2) dunums, and to 9% in the area size (1-99.1) dunums, to return and rise until they reach 18% in the area size less than one dunom. (PSCB, 2013). In Jenin the family in average holding olive tree fields with an approximately 4-5 dunums (an interview with Asharf Faleh, 2019). If they investment there land through supplemental irrigation using treated wastewater thus, will partially or completely help family to exit from poverty line.

Table 30: Investment cost

Investment cost	CI /du	CI total needs	OC /du	OC total need
Amount /$	1419$	1436$	424$	2985$

Table (30) show the investment cost, research find the cost of investment 1419$ per dunum, and operating cost 424$ per dunum, when using freshwater by tank barrel, while family will invest into 7 dunum, family need a cost of investment amount 1436$ for first year, and pay operating cost with 2985$ annually.

For poor families this amount of the cost of investment is not available. So government funding source and non-Governmental Organization (NGO) play a core role in providing the tools and cost of investment to the poor farmer to help him invest in his land. Unfortunately most of those NGOs provide support for a small area of the land where not exceeding 1-2 dunom (an interview with Mohammad Jarrar, 2019). This partially helps poor farmers improve their incomes, but keeps them in poverty.

Through research we studied an effective support context that helps poor farmers completely overcome the poverty line. Urging the government and NGOs to support poor farms and fund 7 dunum, so that he can use the supplementary treated wastewater irrigation. Which leads to the effectiveness and efficiency of projects funded by international organizations, support, improve family income, reduce the proportion of poor families, which is reflected in the GDP, and raise the economic sustainability of the olive oil sector in the Jenin District.

5: Conclusion and Recommendations

5.1 Conclusion

The results show that supplemental irrigation contributes to the growth of olive trees and increases their productivity. Also, irrigation the olive fields given very positive economic impact for the farmers, where the production increase rapidly compared to the traditional depend on rain-fed. It's observed that the land planted of irrigated olive tree was not used for agriculture before and the supplemental irrigation given the opportunity to used it in efficient way. In addition the production mechanisms used in irrigated agriculture do not differ from the traditional cultivation of olive trees, in terms of (pre-harvest, harvest, and post-harvest practices) except for the irrigation process. But there is an differ between irrigated olive fields based on irrigation methods, area size, tree type and age.

In results the supplemental irrigation for olive oil showed has yielded very positive results on productivity in Jenin District. Accordingly, substantial increases were achieved in yields, in response to the addition of exact amount of water for tree within irrigation period, this increase can be achieved in conditions of both low and high rainfall. There is an increase in the percentage of olive oil production to around 12.5Kg per tree in used supplemental irrigation compared to 5.6 Kg per tree in fields used traditional rain-fed. The revenue increase response to production increase, this increase in revenue is also reflected in raising the value of net profit.

Also, the research comparing between supplemental irrigation of water used, and find there is growth in yield and revenue whether using freshwater or treat wastewater. As well was the cost of investment differ and this reflected in return on investment, where the return on investment using freshwater by tank barrel is 60% from third year, the return on investment using treat wastewater by irrigation network is 61.5% from third year.

The research show a differences in economic sustainability according to the supplemental irrigation used, this is clearly evident when calculating net profit and profit margin ratio, where net profit for irrigation using freshwater by tank barrel are 808$ annually per dunum, and the profit margin ratio suitable to 65.5% from third year. Also, the net profit for irrigation using treat wastewater by irrigation network 704.5$ annually per dunum, and the profit margin ratio suitable to 66.2% from third year. With all this results with conclusion, there is an good economical of supplemental irrigation for Olive tree . Also, there is an economical differ according to the supplemental project used.

Additionally, the comparison under different present value scenarios showed that the used supplemental irrigation in fields can improve profit and feasible to invest on it for farmers, as the results showed when farmer invest 1145$ in case using treated wastewater irrigation, the NPV 3,187$ in rate 2.5%, but farmer can gain total net profit 4,850$ per dunum, Also, when farmer invest 1419$ in case freshwater irrigation, the NPV 3,384$ in rate 2.5%, but farmer can gain total net profit 4,470$ per dunum during 6 years.

The researcher showed that the supplementary irrigation serve the farms significantly, which increases productivity, reduces farmers' overall costs and allows them to make the best use of their lands planted with olive trees.

In addition, research studied an effective support context that helps poor farmers overcome the poverty line. Urging the government and NGOs to support poor farms and fund 7 dunum, so that he can use the supplementary treated wastewater irrigation. Which leads to the effectiveness and efficiency of projects funded, support, improve family income, reduce the proportion of poor families, which is reflected in the GDP, and raise the economic sustainability of the olive oil sector in the Jenin District.

To conclude, the results show that supplementary irrigation of olive tree in Jenin District is economically feasible and can improve the family income. So the researcher herself is encouraging the investment in supplemental irrigation of the olive sector especially use treated wastewater.

5.2 Recommendations

From the results and discussed of the research, the researcher recommends the following:

- Study recommend that the government support land reclamation programs to enable farmers to use them land in olive trees.
- Study recommend that the Jenin Agriculture Directorate encourage farmers to grow irrigated olive trees by providing seedlings of suitable varieties and equipment.
- Study recommend an effective, and sustainable method to help poor farmers to overcome the poverty condition, by providing sources of funding by government or NGO-s to irrigate a minimum area of 7 dunums.

- Supporting wastewater treatment programs to be suitable for agricultural use and providing them for irrigation of olive fields
- Supporting the expansion of supplementary irrigation as much as possible, provided that farmers follow the sound foundations of the irrigation process in time and quantities and in the correct way to obtain the economic viability.
- Developing water harvesting techniques to meet their supplementary irrigation water needs to reduce the cost of production and enhance the role of olives in improving family income, and investing in olive cultivation in areas with a rainfall of at least 450 mm annually
- We recommend that the Agricultural Extension Service conduct training courses for farmers on how to maintain and care for irrigated olive tree fields. By Providing training courses on proper ways and methods of supplementary irrigation. To maintain pruning and tillage, and increase the number of olive trees planted with dunums as much as possible, and provide fertilizers and disease control with safety methods to achieve the maximum sustainable benefit to the sector.
- Encouraging investment in supplementary irrigation used for treated wastewater due to its high economic profitability results and optimal use of resources, which serves the economic and environmental sustainability of the agricultural sector as a whole.
- Follow up and leadership of the olive sector, and enhance cooperation between the public and private sectors, farmers' associations, cooperatives, donors and NGOs interested in it.
- Encouraging stakeholders to activate the role of technology in the economic evaluation of the olive oil production chain, by creating an application by entering the cost of production inputs reviewed by the research, that helps farmers determine profitability and assessment the economical of supplementary irrigation of olive tree in his farm.

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- Mr. Fayyad Fayyad , Palestinian Olive Oil Council, Ramallah -Palestine , 2019
- Eng. Ashraf Faleh, Director of Agriculture, Jenin -Palestine , 2019
- Mohammed R. Jarrar, Palestinian Center for Economic and Social Development, Tubas- Palestine, 2019

Mr. Ahmad Abo Farha, Director of Canaan Holding Company, Jenin-Palestine, 2019

Appendix1: List of arbitrators

#	Name	Specialization	Workplace
1	Prof. Noor abo Alroub	Economics	President of Alkhdouri University
2	Prof. Shaher Obaid	Economics	Alquds open University
3	D. Abdelhamed Shaaban	Agriculture	Alquds open University
4	D. Saed Rabaya	Agriculture	Alquds open University
5	Mr. Bilal Nazzal	Agriculture	MOA –Jenin

Appendix2: Study tools after arbitration

كلية الدراسات العليا

أخي المزارع. ..أختي المزارعة

تحية طيبه وبعد،،،

تقوم الباحثة بإجراء دراسة بعنوان **(التقييم الاقتصادي لمشاريع الري التكميلي لأشجار الزيتون في محافظة جنين)**، وذلك استكمالاً لمتطلبات الحصول على درجة الماجستير في التنمية المستدامة/تخصص بناء المؤسسات والتنمية البشرية في جامعة القدس، فيرجى الإجابة على فقرات هذه الاستبانة باهتمام وموضوعية، علماً بان إجاباتك ستستخدم لأغراض البحث العلمي فقط.

شاكر لكم حسن تعاونكم

الباحثة/صابرين خضور

إشراف/ الدكتور: عامر مرعي

الأهداف

- ✓ قياس عمليات الري التكميلي وتأثيره على إنتاج الزيتون في منطقة الدراسة
- ✓ قياس الاثر الاقتصادي للري التكميلي على استدامة حقول الزيتون في منطقة الدراسة
- ✓ التقييم الاقتصادي للري التكميلي لحقول الزيتون في منطقة الدراسة.

تعليمات للمبحوثين:

- ✓ يرجى وضع إشارة (√) أمام الخيار الأكثر ملائمة بك حسب خبرتك في مجالات الدراسة

✓ يرجى الاجابة الخطية على الاسئلة حسب خبرتك في مجالات الدراسة في القسم الثالث.

✓ يرجى مراعاة الدقة في قراءة بنود الاستبانة.

أولاً: البيانات الشخصية الخاصة بالمزارع

1. **الجنس:** □ ذكر □ أنثى.

العمر: □ أقل من 30 سنة □من 40 إلى اقل من 50 سنة

□ من 50 سنة فاكثر.

سنوات الخبرة: □ أقل من10 سنة □ من 10− 20 سنة

□ كثر من 20 سنة

2. **طبيعة الاعتماد على انتاج زيت الزيتون في الدخل**

□ اساسي □ ثانوي □ مشترك

ثانياً: قياس خصائص حقل الزيتون

1. ارتفاع الحقل عن سطح البحر:

□ اقل من200 م □ من200 الى اقل من 350 م

□ من 350 الى 500 م □ اكتر من 500م.

2. مساحة حقل الزيتون:

□ اقل من2 دونم □ من2 الى اقل من 5 دونم

□ من 5 الى 10 دونم □ اكتر من 10 دونم.

3. طبيعة الارض المزروعة:

□ سهل □ عميقة سهلية خفيفة □ وعرية □ غير ذلك(حدد)..............

4. نوع اشجار الزيتون في الحقل:

☐ بلدي ☐ نبالي

☐ سوري

5. عمر اشجار الزيتون في الحقل:

☐ اقل من 10 سنة ☐ من 10 الى اقل من 20 سنة

☐ من 20 الى اقل من 30 سنة ☐ من 30 سنة فأكثر.

6. عدد اشجار الزيتون في الدونم الواحد:

☐ 10-12 شجرة ☐ 13-15 شجرة

☐ اكثر من 15 شجرة

ثالثاً: معلومات عن الري التكميلي

1. مصدر تمويل مشروع الري التكميلي لأشجار الزيتون:

☐ منظمات المجتمع المدني ☐ مؤسسات الاقراض لدعم المشاريع الصغيرة

☐ تمويل ذاتي ☐ مشترك

2. عمر مشروع الري التكميلي لأشجار الزيتون:

☐ من 1 الى اقل من 3 سنوات ☐ من 3 الى اقل من 5 سنوات

☐ من 5 الى اقل من 10 سنوات ☐ اكثر من 10 سنوات

3. مصدر المياه المستخدم في الري التكميلي لأشجار الزيتون:

☐ مياه الامطار ☐ مياه الصرف الصحي المعالجة ☐ المياه الارتوازية

4. اداة الحصاد المائي المستخدمة في الري التكميلي لأشجار الزيتون:

□ خزان بلاستيكي (برميل) □ بئر جمع

□ خزان معدني

5. نوع الري المستخدم لأشجار الزيتون:

□ بالتنقيط □ الري المباشر

6. عدد مرات الري خلال الموسم:

□ 1–3 مرات □4–6 مرات □ اكثر من 6 مرات

الفترة الزمنية بين عمليات الري:

□ اسبوع □ اسبوعين

□ ثلاث اسابيع □ أربع أسابيع فأكثر

7. موعد استخدام الري التكميلي:

□ بين شهر (6– 7) □ بين شهر 6(– 8) □ ين شهر (6– 9)

□ بين شهر (7– 8) □ بين شهر (7 – 9)

8. كمية المياه التي تحتاجها شجرة الزيتون في كل مرة:

□0.5–1.5 كوب □ 1.5–3 كوب □ اكثر من 3 كوب

9. كمية المياه التي تحتاجها شجرة الزيتون في الري التكميلي خلال الموسم:

□1–3 كوب □ 3–5 كوب □ أكثر من 5 كوب

رابعاً: معلومات عن ممارسات الانتاج

1. الاسمدة المستخدمة في تسميد اشجار الزيتون:

□ اسمدة عضوية □ اسمدة طبيعية

□ اسمدة عضوية وكيماوية

2. اكثر الامراض التي تصيب اشجار الزيتون:

□ عين الطاووس □ تليف الاوارق

□ ذبابة الزيتون □ اكثر من مرض من المذكور

3. الطرق المستخدمة في مكافحة الامراض التي تصيب اشجار الزيتون:

□ مصائد الذباب □ مبيدات حشرية

□ مصائد ذباب ومبيدات حشرية □ الجير

4. نوع الاداة المستخدمة في قطاف ثمار الزيتون:

□ يدوي □ آلي

□ استخدام العصي

5. نوع العمالة المستخدمة في قطاف ثمار الزيتون:

□ عمال بالاجر □ ضمان على حصة □ العائلة

6. ما هو نوع المعصرة المستخدمة في عصر زيت الزيتون

□ قديم □ اوتوماتيك □ نصف اوتوماتيك

خامساً: قياس الري التكميلي اقتصاديا

الرقم	النوع	درجة التقييم				
		عالي جداً	عالي	متوسط	ضعيف	ضعيف جداً
المجال الاول : تأثير الري التكميلي على انتاج الزيتون						
1	الري التكميلي يساعد على نمو الاشجار					
2	يساهم في تثبيت الثمار بعد تكوينها					
3	تجعل شجرة الزيتون اكثر قدرة على حماية الثمار من الذبول اثناء موجات الحر الشديد					
4	تحول دون تساقط الثمار في بداية تكوينها بسبب الاجواء الخماسينية					
5	تساعد الاشجار على مقاومة الامراض المختلفة					
6	تمكن الاشجار من تغذية كمية اكبر من الثمار مقارنة بالأشجار الغير مروية					
7	توقيت الري التكميلي لأشجار الزيتون يساعد في سلامة الاشجار					
8	انتاجية شجرة الزيتون تتأثر بعدد مرات الري					
9	يساعد الري التكميلي على تقليل الفترة اللازمة للإنتاج(الزراعة التقليدية تستغرق الشجرة للإنتاج من(5-8)سنوات، بينما باستخدام الري تقلص الفترة من(3-5) سنوات					
10	تتأثر إنتاجية شجرة الزيتون حسب المدة					

	الفاصلة بين عمليات الري					
11	تتأثر إنتاجية شجرة الزيتون بكمية المياه المستخدمة في كل مرة					
12	كمية المياه في عملية الرأي خلال الموسم تؤثر على الانتاجية					
13	زيادة كمية المياه في عملية الري عن حد معين تؤثر سلبا على المحصول					
المجال الثاني: الاثر الاقتصادي لمشاريع الري التكميلي						
14	كميات المياه المستخدمة في الري التكميلي تزيد من تكاليف انتاج زيت الزيتون					
15	الري التكميلي يترتب عليه استخدام الاسمدة مما يزيد من التكاليف					
16	أسعار المياه في حال شراءها للري تزيد تكاليف الانتاج					
17	استخراج المياه ونقلها إلى الحقل تزيد من التكاليف					
18	صافي مردود إنتاج الأشجار المروية افضل من مردود الاشجار الغير مروية رغم ارتفاع التكاليف للأولى					
19	جمع المحصول من الأشجار المروية يوفر فرص عمل لأفراد الاسرة					
20	يزداد دخل المزارع مع زيادة المساحة المزروعة بالأشجار المروية					

21	تسويق انتاج محصول الاشجار المروية اكثر سهولة مقارنة بالأشجار البعلية كونها اكثر جودة					
22	يتوفر مرشدين زراعيين لمساعدة المزارعين في إرشاد المزارعين حول عمليات الري لأشجار الزيتون					
23	يمكن الري التكميلي على كثافة زراعة الاشجار في الدونم الواحد					
24	الري التكميلي يساعد في جودة الانتاج مما يتيح سهولة عملية التسويق					
25	يمكن الري التكميلي من زراعة اراضي بأشجار الزيتون غير صالحة للزراعة البعلية					
26	يمكن الري التكميلي من التوسع العمودي في زراعة اشجار الزيتون					
27	يتيح الري التكميلي زراعة أصناف لا يمكن زراعتها بالاعتماد على مياه الأمطار فقط					
28	يشجع الري التكميلي على استصلاح أراضي جديدة لزراعتها بأشجار الزيتون					

Appendix3

اسئلة المقابلة: التقييم الاقتصادي لمشاريع الري التكميلي في مزارع الزيتون في محافظة جنين

أولاً: قياس التكاليف لمشروع الري التكميلي لأشجار الزيتون

1. تبلغ التكلفة الكلية لإنشاء اداة الحصاد المائي........... شيقل/ دونم
2. تبلغ التكلفة الكلية لإنشاء شبكة الري.............. شيقل/ دونم
3. تبلغ التكلفة الكلية لصيانة السنوية لأداة الحصاد المائي .... شيقل/ دونم
4. يبلغ سعر المياه المستخدمة في الري التكميلي لكامل المدة ....شيقل/ دونم
5. تبلغ التكلفة الكلية لنقل المياه المستخدمة في الري التكميلي لكامل المدة ....شيقل/ دونم
6. تبلغ التكلفة الكلية للطاقة المستخدمة (ديزل) في ضخ المياه في الري التكميلي لكامل المدة............ شيقل/ دونم

ثانياً: قياس التكاليف لعملية الانتاج

1. الكلفة الكلية للأسمدة المستخدمة في تسميد اشجار الزيتون .... شيقل/ دونم
2. الكلفة الكلية لمكافحة امراض اشجار الزيتون .... شيقل/ دونم
3. الكلفة الكلية لتقليم أشجار الزيتون .... شيقل/ دونم
4. الكلفة الكلية لحراثة حقل اشجار الزيتون .... شيقل/ دونم
5. الكلفة الكلية للعمالة المستخدمة في قطاف ثمار الزيتون .... شيقل/ دونم
6. الكلفة الكلية لعصر زيت الزيتون .... شيقل/ دونم
7. الكلفة الكلية لتعبئة الانتاج من زيت الزيتون .... شيقل/ دونم

8. تكاليف تشغيلية اضافية اذكرها .... شيقل/ دونم

ثالثاً: قياس الانتاجية

1. كم بلغت كمية انتاج زيت الزيتون لكل دونم .... كغم/ الدونم

2. كم بلغت كمية انتاج زيت الزيتون لكل شجرة .... كغم/ الشجرة

3. ما هو سعر كغم من زيت الزيتون الذي باع به المزارع .... شيقل/ دونم