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THE ECONOMIC ANALYSIS FOR THE EFFICIENCY OF USING FERTILIZER IN THE PRODUCTION OF VEGETABLES IN GREENHOUSES IN SLEMANI PROVINCE: 2016 BAZIAN CASE

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SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜ'NE

Siirt Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğine göre hazırlamış olduğum "Süleymaniye İlinde Seralarda Sebze Üretiminde Gübre Kullanma Etkinliğinin Ekonomik Analizi: 2016 Bazian Örneği" adlı tezin tamamen kendi çalışmam olduğunu ve her alıntıya kaynak gösterdiğimi taahhüt eder, tezimin kağıt ve elektronik kopyalarının Siirt Üniversitesi Sosyal Bilimler Enstitüsü arşivlerinde aşağıda belirttiğim koşullarda saklanmasına izin verdiğimi onaylarım.

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ÖZET

YÜKSEK LİSANS TEZİ

SÜLEYMANİYE İLİNDE SERALARDA SEBZE ÜRETİMİNDE GÜBRE KULLANMA ETKİNLİĞİNİN EKONOMİK ANALİZİ: 2016 BAZİAN ÖRNEĞİ

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Ekonomik ve teknik kriterlere uygun olmayan üretim unsurları daha az verimliliğe ve yüksek maliyetlere yol açmaktadır. Bu durum kaynakların tam ve optimal kullanım eksikliğine yol açmaktadır. Bu yüzden, tarım sektörü ile ilgili üreticiler verimliliği artırıcı ve maliyetleri azaltıcı yöntemler üzerine odaklanmalıdırlar. Bu statüde tarla yönetiminde bilimsel metot verimliliği arttırmada ve maliyetleri azaltmada etkin bir rol üstlenecektir. Bu anlamda bu tezin amacı üretim fonksiyonundan hareketle salatalık, domates, yeşilbiber gibi sebzelerin yetiştirilmesinde gübre kullanımının etkinliğini belirlemektir. Bu fonksiyondan hareketle sebze üretiminde üretim unsurlarının miktarları ve sebze üretimi arasında pozitif bir korelasyon bulunmuştur. Dahası, veriler sadece pozitif bir etkiye yol açmamıştır aynı zamanda Süleymaniye bölgesinde önemli ölçüde etkin değildir. Bu açıdan bu çalışma Bazian Bölge'sindeki gübrenin kullanma biçimlerini ve bunun etkisini açıklamaktadır.

Anahtar Kelimeler: Etkinlik, Tarımsal Ürün, Üretim Fonksiyonu, Regresyon.

ABSTRACT

MASTERS THESIS

THE ECONOMIC ANALYSIS FOR THE EFFICIENCY OF USING FERTILIZER IN THE PRODUCTION OF VEGETABLES IN GREENHOUSES IN SLEMANI PROVINCE: 2016 BAZIAN CASE

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The use of production elements without relying on economic and technical criteria leads to low productivity and higher costs. This condition leads to a lack of full and optimal utilisation of resources; therefore, for those interested in the agricultural sector should focus their attention on the methods induce to increasing productivity and lower costs of production. In this status, the scientific method in farm management will be the primary and sufficient condition for achieving increased productivity and lower costs. In this sense, the objective of the research is to determine the efficiency of fertiliser use to grow vegetables (cucumber, tomato, green pepper) in greenhouses. However, this study shows that there is a positive correlation between the amount of vegetable production and the quantities of production elements used in vegetable production. Also, the data show that not every increase in use fertiliser always positive effect and shows that the degree of fertiliser use in Slemani Province is not highly efficient, this study has attempted to clarify the impact of this use and how to use fertilisers in Bazian District in the Slemani Province.

Key words: Efficiency, Vegetable Crops, Production Function, Regression.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

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INTRODUCTION

It is possible that agriculture in Slemani Province in general and in Bazian District, in particular, is facing several challenges with the limited use of fertiliser being the most important one in the production of vegetable crops. In this context, this research aims to conduct an econometric analysis of the efficiency of using fertilisers in the production of vegetable crops in greenhouses in the Bazian District in Slemani Province.

In this study, the field study data for the sample of vegetable crops (cucumber, tomato, green pepper) in greenhouses in the Bazian district in Slemani Province is used during the agricultural season 2016. In addition, the objectives of research and the analysis of data for different changes are calculated by using statistical methods related to production costs. Thus, this study attempts to show how fertilisers are used in vegetable production and how efficiently fertiliser use is achieved in the production of vegetables in greenhouses. If the effect of fertilisers is positive or negative, they benefit the Iraq Kurdistan Regional Government (IKRG) in the development of most influential incentive policies. This study suggests that there is a possible long-term balance of efficiency of fertiliser use and the economic growth in vegetable production in Bazian District in Slemani Province since 2016.

The study uses both quantitative methods and descriptive analysis for the primary collected data from a field study based on questionnaires designed particularly for agricultural producers owning greenhouses about the extent of utilising fertilisers such as the optimum costs, economic and actual quantities. In addition, both production and cost functions for these crops is analysed, production and cost analysis of these crops as well as explore the temporal change of production for the Statistical Package for the Social Sciences (SPSS) the standard analysis of those variables on the significance or non-significance of the relationship among economic variables that affecting each other.

All of the research sample studied is using farmers producing vegetables in greenhouses in the Bazian area because it represents about 48% of the total of greenhouses in Slemani Province. The population samples are taken about 200 farmers observation, who represent 75% of the total growing vegetables in greenhouses. They range from 80 farmers producing cucumber, and 70 farmers producing tomato, and 50 farmers producing green pepper. The questionnaire was prepared for the most critical questions to be answered by farmers to obtain the most critical information requiring the research plan. The questionnaire was filled out by the personal meeting of the farmers.

During this study, it was difficult to deal with some issues including scarcity of sources in Arabic literature, the lack of data, information and the financial crisis. In addition, the lack of transparency in the provision of data, especially the data about revenue, production and the amounts of real costs was a problem.

The study structure is based on the distribution of the research to three main chapters. Each chapter is divided into three topics, as follows:

The first chapter explains the theoretical framework with three subsections. The first one deals with the initial concepts of economic and technical efficiency, efficiency and efficiency indicators; the second focuses the basic concepts of the use of fertilisers in the production of vegetables, and the last subsection summarises preliminary concepts of the use of greenhouses for the production of vegetables.

The second chapter analyses the agriculture sector in the Slemani Province and the production of vegetable crops in greenhouses through three subsections. The first subsection deals with an overview of agricultural resources and agricultural production with a focus on the production of vegetables between 2005 and 2015 in Slemani Province. In the second subsection, the development of greenhouses and the production of vegetables in greenhouses in Slemani Province with a focus on the area of Bazian 2007-2015. The third subsection deals with some of the productive indicators of vegetable crops in Slemani Province through 2007-2015.

The third chapter deals with an economic analysis of the production functions and the cost of vegetable crops produced in greenhouses in Bazian District in Slemani Province. The section deals with the standard estimation of the production functions of the main vegetable crops produced in the greenhouses in Slemani Province in the area of Bazian.

SECTION ONE

1. THE THEORETICAL FRAMEWORK FOR THE STUDY

This chapter includes the theoretical framework of the study and explains the central concept of efficiency and fertiliser in greenhouses. The first subsection deals with the initial concepts of economic and technical efficiency, efficiency and efficiency indicators; the second focuses the basic concepts of the use of fertilisers in the production of vegetables, and the last subsection summarises preliminary concepts of the use of greenhouses for the production of vegetables.

1.1. Primary Concepts of Economic Efficiency

This chapter generally deals with the different concepts related to efficiency. These concepts are used to analyse the agricultural process. They also provide to develop the explanation of the methods and criteria for efficiency analysis in section three.

1.1.1. Definitions of Economic Efficiency and Agricultural Productivity

It is vital to define the economic efficiency to solve the agricultural productivity. Several agricultural economists draw attention to the definitions about efficiency in the agricultural sector. In this sense, according to Schmidt, Lovell, and Fried (2008) the formal definition of technical efficiency is when a producer is technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output. Thus, a technically inefficient producer could produce the same outputs with less of at least one input or could use the same inputs to produce more of at least one output.

Similarly, the productivity is a relationship between the quantity produced by a particular commodity and some production factors used to achieve this production. The continuous increase in productivity reflects the improvement in the standard of living as well as the efficiency in the use of different production elements (Al-Zahra, 2008). Thus, it might distinguish two basic types of concepts of efficiency such as productive and price. In productive efficiency, it has two components. The purely technical or physical component refers to the ability to avoid waste by producing as much output as input usage allows, or by using as little input as output production allows. Thus, the analysis of technical efficiency can have an output enlarging orientation or an input conserving orientation. The allocative or price component refers to the ability to combine inputs and outputs in optimal proportions in light of prevailing prices (Fried, Lovell, & Schmidt, 1993).

1.1.2. Methods of Measuring the Efficiency of Agricultural Production

Studies on the evaluation of production efficiency are important to demonstrate their direct relations to the level of optimal exploitation of economic resources. Thus, production efficiency is reduced whenever there is an abuse of resources, and it will be to increase production costs. Therefore, the assessment of production efficiency in the agricultural sector requires accurate, which is a direct cause of the impact on the measurement of the level of production efficiency, there are two things, such as (Shams S. S., 2000);

- The method of identifying or characterisation of the factors of production and method of collecting data for these factors.

- The degree of availability of the special factors of production and assembly-level data in this data.

It is possible to measure the productivity effects of agricultural resources in several styles.

1.1.2.1. Measuring Productivity Efficiency of Agricultural Production Style Functions

The maximum amount of agricultural output, Q, defined by agricultural production function it is produced from certain amounts of an agricultural resource group (X_1,X_2,....,X_n), as following mathematical formulation:

$$Q = f(X_1, X_2, \ldots, X_n) \quad (1.1)$$

The production function is assumed a single-valued and continuous differential function, and agricultural production functions are used to measure the efficiency of agricultural production and agricultural productivity under the rule of full competition. The optimal agricultural supply combination possible reached, if

- To produce as much as possible of the agricultural production in a certain level of agricultural costs.

- To minimise the agricultural costs, it is necessary to produce a certain amount of agricultural outputs.

- To maximise net agricultural income thus maximise the difference between total agricultural income and total agricultural costs (Al-Sharif, 1997).

For attaining the necessary conditions to produce as much as possible of the agricultural output in a certain amount of agricultural resources use the Lagrange Multiplier to link the previous production function and the function of the following costs:

$$TC = P_1X_1 + P_2X_2 + FC \quad (1.2)$$

Where:

TC: Total Costs

P_x: Resource Prices for 1, for 2

FC: Fixed Costs

We get the following function:

$$L_1 = f\,(X_1, X_2, ..., X_n) + \lambda_1\,(TC - P_1X_1 - P_2X_2 - FC) \quad (1.3)$$

The equation is taking the partial derivatives for the used resources. The necessary condition to maximise agricultural output is equal to the ratio among the marginal outputs of any suppliers with the price. The marginal rate of technological substitution among suppliers is equal to the price for each one. In the same way, the necessary condition can be achieved in the case of producing a certain amount of agricultural output with the minimum amount of agricultural resources using the Lagrange Multiplier in linking the production function with the cost function as follows: (Shams S. S., 2000).

$$L_2 = P_1X_1 + \ldots\ldots + P_nX_n + TC + \lambda_2\{Q - f(X_1, X_2, \ldots\ldots, X_n)\} \quad (1.4)$$

Also, the equation by the taking partial derivatives for the resources used, we obtain the same necessary previous condition, which is equal to the marginal products of the suppliers with the price ratio. To provide the sufficient condition in both cases, take the second partial derivatives - Hession determinant to ascertain the negative condition (Shams S. S., 2000).

As Shams shows to achieve the requirement to maximise profit, partial derivatives for agricultural resources taken in the following function:

$$\pi = p\,F(X_1, X_2, \ldots\ldots, X_n) - P_1X_1 - P_2X_2 - FC \quad (1.5)$$

The unit price of the output, p, the value of the marginal output = unit price of the element is obtained ($p\,MC_1 = P_1$, $p\,MC_2 = P_2$)

Thus, according to Shams (2000), the necessary condition is achieved in maximising the profit. In the same way, the second partial derivative is taken to determine the positive condition. This means realising the efficiency of the income producing and thereby increasing the agricultural income.

1.1.2.2. Measuring Productivity Efficiency Using the Farrell Style of the Output Curves of ISO-Quant

As Al-Feil (1997) evaluates that when researchers talk about the productive efficiency of a particular establishment, they mean to grossly eliminate as much output as possible from a certain amount of available economic production resources. They assume that all resources and products can be measured and therefore called technical efficiency. For simplicity:

A. There is one facility, use the two production resources, and used to produce one product.
B. Stability of return.
C. Knowledge of efficient production function, the assumption of constant return of capacity means that all knowledge available on the output curve. As for the

assumption of knowledge of the efficient output function, the effective output level is obtained from any combination of production resources.

Production symmetry curve is linear lines that are considered to the relationship between all possible combinations of the production components that lead to getting a constant level of production. So, the level of production changes when moving from one curve to another, while there is no change in the level of output when changing the percentages of the composition. The function of the output symmetry curve between two production elements (X_1,X_2) can be explained in the case of the Cobb-Douglas production function by imposing the constant of the output (Q) at level ($\bar{Q}$).

The level of production efficiency is estimated by measuring the method of the efficient production function and the method of the output function. The efficient output function illustrates the relationship between the output and the common production elements. To compare the average production of each farm with the estimated output size of the production function and eliminate the farms that achieve negative results and re-estimate the function until reaching the efficient stage of the function in which the farmer achieved positive results (Shams & Ghareeb, 1999).

1.1.2.3. Measuring Productivity Efficiency Using Agricultural Cost Functions

The cost of production is one of the methods for measuring efficiency productivity where the efficiency is about reducing production costs, which increases the difference between the value and expense of production. The cost study provides farm managers with the criteria on which they can judge the efficiency of their production processes. Means increasing the number of production resources used in the production of that unit to a certain extent, leading to the more efficient use of these resources and thus can reduce the production costs of the productive unit (Shams S. S., 2000).

The cost function shows the relationship between the different output quantities and the possible costs of obtaining these quantities. The estimation of agricultural production costs is aimed at appraising the optimal stock combination. It is equal to marginal cost and marginal revenue in the short term. However, in the long run, the optimal production capacity can be estimated in the short term, the cost function takes the following mathematical form:

$$TC = VC + FC \tag{1.6}$$

There is a relationship between the production functions and the cost functions. The cost function can be derived from the production functions by selecting a point on the optimal expansion path. By multiplying the resource levels in the unit price for each one, total costs can be obtained by adding fixed costs to variable costs; the total costs can be obtained (Henderson & Quandt, 1971).

1.1.3. Agricultural Productivity Efficiency Criteria

There are many criteria to evaluate the degree of production efficiency according to many factors including the style or method of measuring the efficiency of production, the degree of evaluation, the nature of measurement of inputs and outputs, and the quality of production elements to measure the efficiency. There are many criteria for measuring the agriculture productivity efficiency such as productivity standards according to the measurement method, criteria for efficient use of production elements and efficiency criteria by type of unit of measurement.

1.1.3.1. Productivity Standards According to the Measurement Method

There are three types of measurement methods such as the measurement production efficiency using production functions. The measurement of the production efficiency using the cost of agricultural production. The measurement production efficiency in the form of the farm budget.

1.3.1.1.1. Measurement of Production Efficiency Using Production Functions

It might be dealt with following criteria, such as productivity elasticity, marginal productivity, equal production curve, and the marginal rate of substitution.

Productivity Elasticity: It is a relative change in production attributable to the relative change in the production component. If greater than one or less than one or equal to one, each of which is reflected in the law of decreasing yield. If the bigger than one it means the state of increasing yields and if it is less than one it means the state of declining yield, also if it is equal one the state is yield fixed. It is useful to know the type of flexibility when trying to reach the optimum size of the farm, which is the size that allows achieving economic productivity. This is because the first type gives an advantage to large production units, while the second type does not give any advantage to these large production units (Nayem, Fadhelia, & Zanboua, 2014).

Equal production curve: It is a curve that expresses the level of production of a commodity at the same level (the same quantity) on all the points on it but in different combinations of units of labour and capital. According to Al-Agily (2000), an equal production curve represents combinations of inputs whose quantities have been changed and produce the same size of the output. Which includes different combinations of two production elements that represent a fixed level of output and achieve the maximal output and thus net farm income (profit)

The marginal rate of substitution MRS: The rate of marginal substitution can be estimated by the inverse ratio of the marginal curves that is always preceded by a negative. There are two commodities (x, y). If sacrifice one unit of x to achieve an additional unit of y, provided that the same level maintains if the utility function of a consumer with two goods is the same (Mustafa, 2014):

$$MRS_{x,y} = \frac{MUx}{MUy} = \frac{-dy}{dx} \tag{1.7}$$

1.3.1.1.2. Measuring Production Efficiency Using the Cost of Agricultural Production

It includes the main of cost conception, such as total cost function, marginal costs, and alternative opportunity cost.

Marginal Costs (*MC*): The increase in total costs as a result of the increase in the volume of productivity in one unit. Begg , Dornbusch, and Fischer (1997) explains, the marginal costs which are the increase in total costs as a result of increasing the volume of productivity in one unit, it is used in judging the efficiency of using the productive elements. If this is equal to the marginal revenue, it indicates that the production level achieves economic productivity.

Total cost function (*TC*): The total cost function is the relationship between the quantities of agricultural production and the costs of obtaining them. The study of farm costs is based on the estimation of the optimal stock. These are the ones that are equal when the marginal costs and the marginal revenue (price) in the short term due to the dominance of full competition in the agricultural structure. In the long run, they are useful in estimating optimal production capacity. In both cases, economic productivity can be achieved through the use of farm resources (Andrea & Istvan, 2013).

Alternative opportunity cost: The term of the opportunity cost to produce a particular commodity to the value of alternative products that could have been produced if the resources used in the production of the alternative commodity. It is used as a measure for economic productivity efficiency, involving the use of the marginal output to alternative costs. If it is equal to the one, it indicates that the use of the element is by the principles of efficiency. However, if increase or decrease of the one, this is evidence of the use of less or more quantities to be used and therefore not to achieve the efficiency of economic productivity in the use of this resource (Rizk, 2010).

1.3.1.1.3. Measuring Production Efficiency in the Form of Farm Budget

The estimated productivity efficiency criteria for the unit of time are included in the agricultural budget method. The total margin is above the direct variable costs, such as the minimum production efficiency of the productive activity and calculated from the deduction of the direct variable costs of the total revenue.

Net farm income: the net return after deducting the fixed and direct variable production costs of the total income. Which reflects the total share of the capital invested by the owners of the farm, family work and the net profit (Al-Kaisy & Al-Izzy, 2010).

Net farm profit: The amount of profit that farmer achieves from agriculture production defined by deducting the total fixed and indirect variable costs from net farm income (Shukur, 2015). It reflects the share of the farmer, and this indicator is used to indicate the incentives that encourage the possibility of expansion of a particular production under full competition.

Margin product: Output that results from one additional unit of a factor of production. As a definition the margin which is a relative measure of the market incentives for the production and represents the ratio of the net profit of the unit produced at the sales price of the unit at the farm gate (Shams S. S., 2000).

1.1.3.2. Criteria for Efficient Use of Production Elements

It includes elements used in the production process, such as Human labour efficiency criteria, capital efficiency criteria, and criteria for efficient use of water resources.

1.1.3.2.1. Human Labour Efficiency Criteria

To measure the efficiency of the work component in particular production activity, as follows:

A. Factor productivity based on factor cost = production value at factor cost / average number of farm workers.
B. Factor productivity based on market price = total production value at market price / average number of farm workers.
C. Wage productivity based on production cost = production value at factor cost/value of wages.
D. Productivity wage based on market price = total production value at the market price/value of wages.
E. Labour productivity index = the index of the rest of the total production at the market price/index of the average number of workers on the farm.
F. Employee productivity index = Average wage/worker productivity index.
G. Work hour productivity = (output size/working hours) * 100 A significant indicator is the employment of human labour in a given production activity. (Mashur, 1995).

1.1.3.2.2. Capital Efficiency Criteria

This component includes an estimate of the set of fixed and current capital resources. The first contains mechanical power inputs represented in the value of the consumption and maintenance of machinery, such as the value of fuel, oil and grease. The second which is the current expenditure includes items of capital expenditure on each of the pesticides, seeds, organic fertilisers, chemical fertilisers. The value of this portal is estimated at its various components at the current market price (Shams S. S., 2000).

The component is often measured in the form of an investment analysis or a capital budget to determine the profitability of investments through criteria including:

A. Capital recovery period: The number of years required to recover the capital invested through revenue earned after deduction of expenses, through the net proceeds generated (Lajos, 2011).
B. Simple rate of return**:** Calculated as a percentage of annual net return divided by investment costs (Al-Kaisy & Al-Izzy, 2010).
C. Net present value (*NPV*) = calculated from the following equations:

$$NPV = \frac{M^1}{(1+r)^1} + \frac{M^2}{(1+r)^2} + \ldots + \frac{M^n}{(1+r)^n} + C \quad (1.10)$$

Where:

M: Net cash flow per year

r: discount rate

C: costs for investment. (Lajos, 2011)

D. Internal Rate of Return (IRR): The most commonly used measure of project valuation as the discount rate at which the present value of net additional benefits is zero, or the discount rate at which the current benefit ratio of the current costs is equal to the right one (Attia, 2008).

1.1.3.2.3. Criteria for Efficient Use of Water Resources

The waters resource which is exposed to loss through many methods such as evaporation and leakage to the ground and the absorption of weeds and also loses after being added to the field by leading surface or deep leakage. Reducing this resource and trying to measure leads to higher efficiency in the use of this resource in agriculture. It is essential that the economic criteria used to measure the efficiency of water resource use be, as follows:

A. Production of a cubic meter of irrigation water = quantity of physical output/quantity of water used for irrigation (Ali A. A., 1988).
B. Total revenue from water unit = total value of output/quantity of water used in cubic meters (Ali A. A., 1988).
C. The value of irrigation cost per unit produced from productive activity = Irrigation costs/quantity of physical production (Ali A. A., 1988).
D. The ratio of irrigation costs to variable costs = (Irrigation costs/variable costs of productive activity) *100 (Nasr, 1987).
E. The quantity of water needed to produce the unit of product = Quantity of water used in irrigation / Total physical output of productive activity (Nasr, 1987).

1.1.3.3. Efficiency Criteria by Type of Unit of Measurement

Including two central measurements, such as monetary measurement, and Measurement in kind.

Monetary measurement: In which money is used to express input and output quantities, which is a ratio between the value of outputs and the value of inputs:
Monetary Efficiency = Output Value / Input Value (Shams S. S., 2000)

Measurement in kind (sample): The sample is part of the something taken as a model for the rest of this. It is the ratio between the sum of the homogeneous output quantities and the sum of the homogeneous inputs in an in-kind image, where Productive economic productivity in kind = total quantities of homogeneous output/total quantity of homogeneous inputs. (Shams S. S., 2000)

1.1.4. Technical and Economic Conditions of Efficiency

Heady (1968) shows for efficient use of agricultural economic resources, hence it must be following the conditions:

- The distribution of resources among economic sectors that the marginal productivity of these resources is equal in all cases. It means that the marginal product of the resource at the first farm is equal the marginal product of the resource at the second farm, also the marginal product of the resource at the last farm.

- Distribution of limited economic resources among agricultural production units in the manner in which the marginal production values of the resource on all farmers are equal.
- Distribution of limited economic resources within each farm in such a way that the marginal productivity value is equal to the marginal cost of the resource.
- In the distribution of agricultural economic resources between different productive enterprises, the period taken for each production project shall be taken into account the value of marginal productivity of these projects is equal to the period taken into account.

1.2. Initial Concepts for the Use of Fertiliser in the Production of Vegetables

For many years, the primary goal of applying fertilisers provide nutrients in plants to increase optimal crop productivity. Thus, improving fertiliser use efficiency regarding nutrient uptake and crop productivity is vital to fertiliser producers and users. However, any fertiliser, whether in the natural, inorganic or organic, can harm the environment if misused. Recently, fertiliser use has been labelled by environmentalists as one source of polluting soil. The primary environmental impacts associated with fertiliser use have been linked to nitrate leaching into groundwater, emission of greenhouse gases (nitrous oxides), soils polluted with toxic heavy metals, and surface runoff of N and P nutrients causing aquatic eutrophication.

To ensure that proper use of fertiliser it is beneficial to both crop production and the environment, researchers and fertiliser producers have tried to find ways to achieve the newly defined goal of fertiliser use, that is, improving fertiliser nutrient is used efficiency and minimising environmental impacts.

1.2.1. Fertilisation and the Goals of Fertilisation

The using appropriate types and quantities of dripping (‘balanced fertilisation’) from mineral and organic sources are essential to practice for improving nutrient efficiency (Drechsel, et al., 2015). Fertilisers may be added either in a dissolved form with irrigation water in dropped (especially in sandy soil), or may be added in a dry form in the case of surface irrigation or may follow the spraying fertilisation method.

The fertiliser analysis is used to determine the need for fertilisation. Phosphorous fertiliser is added during the preparation of the land for agriculture. According to the needs of the crop, it is mixed in the surface layer of the soil or added in lines on the neck about 10 cm from the line of agriculture. The appropriate quantities of potassium are added according to the type of crop and the need for it. In addition, secondary fertilisation should be carried out to ensure high production, particularly in the crucial stages of plant life (Finck, 1982). The goal of pond fertilisation can be viewed as merely maximising the causal link between fertiliser inputs and final yields of culture organisms at harvest while minimising economic and environmental costs. This general goal encompasses the four specific objectives in fertilisation theory, namely:

- Improvement of the soil as a nutrient substrate.
- Supplementation of the natural, partly deficient, supply of nutrients.
- Replacement of the nutrients removed by harvesting and other losses (Finck, 1982).

1.2.2. Nutrient

The nutrients are elements essential to plant growth. Plant roots absorb nutrients including water, oxygen, and others from the soil. As the crops grow and are harvested, they gradually remove the existing nutrients from the soil. Over time, most soils will require additional nutrients to maintain or increase crop yield, when nutrients are added more than the plants' ability to utilise them (Stubbs, 2015)**.**

The nutrients are classified into two types, are **Non-mineral nutrients**, and the **mineral nutrients,** three elements, carbon (C), hydrogen (H), and oxygen (O), are non-mineral nutrients because they are derived from air and water, rather than from the soil. Although they represent approximately 95% of plant biomass, they are generally given little attention in plant nutrition because they are always insufficient supply. However, other factors such as soil management and the environment can influence the availability and crop growth response, and the 14 mineral nutrients are classified as either macronutrients or micronutrients based on their plant requirements and relative fertilisation need. There are six macronutrients: nitrogen (N), phosphorus (P), potassium

(K), calcium (Ca), magnesium (Mg), and sulphur (S) (Mallarino, Sawyer, & Pagani, 2013).

The macro-nutrients, N, P, and K, are often classified as 'primary' micronutrients, because deficiencies of N, P, and K are more common than the 'secondary' micronutrients, Ca, Mg, and S. The Micronutrients include boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn) (Mallarino, Sawyer, & Pagani, 2013).

1.2.2.1. The Elements of Nutrient

The nutrient is a substance that leads a particular function in the life of the plant. For the classification of any elements of the necessary plant nutrients must provide the following conditions:

- The absence of the element makes the plant to complete the process of vegetative to fruiting.
- The manifestations of a deficiency of the element cannot be prevented from appearing, and treatment does not extend the plant this element and not another element.
- To be a component of a direct role in plant nutrition and enters the necessary plant or essential compound configured to activate a particular enzyme system (Jafar, 2009).

These conditions have been identified as 17 elements necessary for the growth of higher plants, which are divided into, Micronutrient, and Macronutrients.

Micronutrient**:** The micronutrients are those essential elements required in small quantities for plant growth and reproduction. The quantity needed varies with plant species and the specific element. Seven essential elements are considered micronutrients and include boron (B), copper (Cu), chlorine (Cl), iron (Fe), manganese (Mn), molybdenum (Mo), and zinc (Zn) (Mallarino, Sawyer, & Pagani, 2013). Also, the nickel (Ni) is another Micronutrient (McMahon, 2000)**.** Meaning, elements needed by the plant is estimated at 0.1 grammes per one kg of dry matter in small quantities.

Macronutrients**:** The essential nutrients are six considered macronutrients. They are required by plants in relatively large amounts at levels from 10 to 5,000 times greater than those of many micronutrients. Macronutrients are divided into non-fertilizer nutrient, primary and secondary macronutrients. The non-fertilizer nutrients are Hydrogen (H), oxygen (O), Carbon (C) (McMahon, 2000).

The **primary macronutrients** include nitrogen (N), phosphorus (P), and potassium (K). These are nutrients which are typically limiting to plant growth and are applied to soil as fertiliser. **Secondary macronutrients,** Calcium (Ca), Magnesium (Mg), Sulphur (S), are those that are typically found in soil at relative concentrations to satisfy plant growth. However, these and other nutrients need to be applied to organic substrates (Gill, et al., 2016).

1.2.2.2. Role of Nutrients in Plant

The Carbon (C) nutrient Constituent of carbohydrates; necessary for photosynthesis, and Oxygen (O) nutrient, a constituent of carbohydrates; necessary for respiration. Another nutrient, Hydrogen (H), maintains osmotic balance important in many biochemical reactions constituents of carbohydrates (Mallarino, Sawyer, & Pagani, 2013).

The Nitrogen (N) nutrient constituent of amino acids, proteins, chlorophyll, and nucleic acids. Also, Potassium (K) nutrient involved with photosynthesis, carbohydrate translocation, and protein synthesis. The Phosphorous (P) nutrient, a constituent of proteins, coenzymes, nucleic acids, and metabolic substrates; essential in energy transfer. Also, Magnesium (Mg), Enzyme activator; component of chlorophyll. Sulphur (S), Component of specific amino acids and plant proteins. Chlorine (Cl) nutrient involved in oxygen production and photosynthesis (Mallarino, Sawyer, & Pagani, 2013).

Another nutrient is Iron (Fe), involved with chlorophyll synthesis and in enzyme electron transfer. The Manganese (Mn) controls several oxidation-reduction systems and photosynthesis. Moreover, Boron (B) important in sugar translocation and carbohydrate metabolism. Zinc (Zn) involved in enzymes that regulate various metabolic activities (Sela, 2016). Also, Copper (Cu) catalyst for respiration; component of various enzymes. Also, Molybdenum (Mo), involved in nitrogen fixation and transforming nitrate to ammonium. Nickel (Ni) necessary for the proper functioning of Urease and seed germination (Mallarino, Sawyer, & Pagani, 2013). Moreover, the last nutrient is Calcium (Ca), it is essential for healthy plant growth, and helps in protecting the plant against heat stress (Sela, 2016)

1.2.3. Fertiliser

The organic or inorganic material that is added to soil to provide additional nutrients for plants. Fertilisers are used for soils that are nutrient-deficient naturally, or for soils that have been depleted of nutrients by harvesting and/or grazing (Gellings & Kelly, 2004).

Also, the fertilisers are substances that supply required nutrient elements to the root medium. Use of fertilisers on greenhouse crops dates back to the beginning of greenhouse culture. The first fertilisers were animal manure and bone meal. Today chemical compounds are the most common fertilisers used. Concern for nutrition of plants no longer involves hit-or-miss practices. Plant nutrition has become a precise science in today's high-technology world (McMahon, 2000).

The fertilisers divided into three types of fertiliser, organic fertiliser, chemical fertiliser or (inorganic), and the bio-fertiliser. The organic fertiliser consisting of organic material is such as animal manure, plant (green) manure, compost, fish meal, and bone meal. Organic fertilisers add fewer nutrients to the soil per unit weight than inorganic fertilisers. However, have the advantage that they provide valuable soil conditioners that improve soil properties whereas inorganic fertilisers do not (Gellings & Kelly, 2004).

The inorganic fertilisers are formulated with varying combinations of nutrients. The primary nutrients are nitrogen, phosphorus, and potassium. Also, types of chemical fertilisers are nitrogenous fertilisers (N), phosphate fertilisers, potassic fertilisers. Moreover, the bio-fertilisers are the fertiliser that is associated with biological vaccines and plant extracts or in other words manure that depends on microorganisms, such as rhizobia bacterial and fungal filaments (Mycorrhiza) (Ali N. S., 2007).

However, the FNCA group evaluated the bio-fertiliser is most commonly referred to the use of soil microorganisms to increase the availability and uptake of mineral nutrients for plants (FNCA, 2006).

The types of bio-fertilisers are rhizobium, azotobacterial, AZ spirillum, cyanobacteria, Azolla, phosphate solubilising microorganisms (PSM), AM fungi, Silicate solubilising bacteria (SSB), and Plant Growth Promoting Rhizobacteria (PGPR).

1.2.4. The Objective of Nutrient Use and Fertilisers Use Efficiency

This topic includes the characters, such as Nutrient Use Efficiency, Efficiency in the Use of Fertilizers and how much use.

Nutrient Use Efficiency: A general definition of efficiency according to (De Kok, Hawkesford, & Kopriva, 2014) is the achievement of an intended outcome with a lowest possible input of costs. While the input in the concept of NUE is nutrients, the intended outcome needs to be further specified. This can happen in different ways, which leads to many different versions of what NUE (Nutrient Use Efficiency) means and how it can be improved. Fundamental is the difference between an ecological and agronomical context.

Understanding this difference is crucial to develop strategies for improving a plant in its complex ecophysiological background in the straightforward input-output system of agriculture.

Efficiency in the Use of Fertilizers: One of the most important ways for the grower plants can conserve that fertiliser energy is making efficient use of fertiliser. Economists generally recommend that increasing amounts of fertiliser should only be used when the additional value of productivity realised exceeds the cost of nutrients applied. Efficient use can be defined as maximising yield with a minimum amount of fertiliser. The highest efficiency usually results from the first increment of added fertiliser/nutrients. Additional increases of fertiliser/nutrients usually result in lower efficiency but may be profitable. A grower (farmer) who wants to maximise profits will usually sacrifice some fertiliser efficiency.

1.3. Initial Concepts for the Use of Greenhouses to Produce Vegetables

Agriculture in greenhouses is one of the most famous types of agriculture in the whole world. This type of agriculture is known as the production of vegetables and the different plants within the so-called plastic rooms. They are heated by solar radiation while providing the necessary protection of plants inside of all external weather factors in addition to their protections from some of the agricultural pests that come on plants and eliminate them.

The covered agriculture conditions began to form primitive in Rome between the years 14-37 AD and in the rest of Europe between the fifteenth century and seventeenth century where the crops are grown in the original off-season by the rich only as a kind of luxury (Al Muhammedi, 1990).

Since that historians and specialists, scientists work on the study of greenhouses and the possibility of growing vegetables including, the possibility of replacing the plastic place to glass in agriculture, where the use of first in the hedging purposes low spending to produce seedlings and used the tunnels greenhouses for large agriculture crops.

1.3.1. Definition of Greenhouse

A greenhouse is a place for the production of vegetables and flowers under plastic tunnels or glass fireplace solar radiation. With the need to secure environmental plants and protect them from air currents, and agricultural pests to provide the market with its products outside the normal seasonality times. Another definition by the greenhouse is a glass building in which plants that need protection from cold weather are grown (Oxford Dictionary, 2017).

1.3.2. Features Agriculture in the Greenhouses

The aim of agriculture in greenhouses is to provide people with their needs of various agricultural products outside the season in which these plants grow, and for the cultivation of indoor greenhouses is of great importance and is summarised in the following (Al Dejwy, 1998):

- The productivity may be 10-12 times higher than that of outdoor cultivation.
- Off-season production of vegetable and fruit crops.

- Disease-free and genetically superior transplants can be produced continuously.
- Efficient utilisation of chemicals, pesticides to control pest and diseases.
- Water requirement of crops very limited and easy to control.
- Hardening of cultured tissue plants
- Production of quality product free of blemishes.

1.3.3. Factors Affecting the Production in Greenhouses

To ensure the success crop production in greenhouses in the off-season production or early production, some factors control the production and marketing of these crops, a multiple and interrelated, such as, natural, and industrial factors.

1.3.3.1. Natural Factors

The first should select the location of natural environmental factors such as climate, soil, water, social and environmental factors such as skilled labour that is easily obtained. The site is close to the main road paved as much as possible to facilitate crop transport and handled and marketed in a short time and reduce wastage them to the fullest extent possible to reach the highest yield productive rewarding (Al Dejwy, 1998).

The second should care about the temperature because of greenhouse cultivation systems regardless of geographic location. Depending on their design and complexity, they provide more or less climate control, and condition to a varying degree in plant growth and productivity (Baudoin, Womdim, Lutaladio, & Hodder, 2013).

The third factor is light; the visible light provides the source of energy for plant growth. Considerable intensity and duration are needed to get good plant growth. That is why plants grow better during the summer when the light is stronger and the days are longer (Bartok, 2000).

Also, the fourth factor is its water, the crop water requirement has to be calculated, and irrigation systems have to be designed carefully. The knowledge of the evapotranspiration inside the greenhouse is essential for successful plant growth, calculation of irrigation water consumption, and possible and economic rainwater collection and storage (Von Zabeltitz, 2011).

Finally, the damaging winds especially those caused by drought significant damage as well as set up bumpers with the strengthening of the greenhouse structure. Particularly in the newly reclaimed areas it is built a windbreak of appropriate materials and locally available and more widely used over the long term such as trees that are grown adjacent to some extent the two rows in a row. It must be linked to rising greenhouse rising at a rate of 2.5 meters high (Al Dejwy, 1998).

1.3.3.2. Industrial Factors

The seeds and cultivars, seed characteristics play an important role and a key in the production and quality, where get germplasm and desired genetic traits available for higher productivity. And the seed needs to availability of varieties of Hybrids largess cultivated under membranes plastic characterized by strong growth and the homogeneity, resistance to disease and the abundance of the crop. The homogeneity of the size of the fruit that follows the latest styles to produce seedlings and raise the proportion of its output to the maximum extent possible to capitalize on all the seed of seeds value (Al Dejwy, 1998).

Also, other factors are its fertilisation. The primary objective of fertilisation is to achieve an optimal response of plants to add major mineral elements for economic growth and development of the crop production (Hikmet & Al-Shawk, 2013).

Moreover, the Irrigation Factor Drip irrigation (also known as trickle irrigation or micro-irrigation) an irrigation method that allows precisely the controlled application of water and fertiliser by allowing water to drip slowly near the plant roots through a network of valves, pipes, tubing and emitters. Plasticulture is the combined use of drip irrigation, polyethene mulch and raised beds. Greater productivity may be achieved in vegetable production by combining plasticulture with the use of transplants (Simonne, et al., 2015). Moreover, the pest control, insects, rodents, and birds entering food handling areas can carry microorganisms that cause human disease.

Therefore, the general housekeeping procedures described in the ground and the building prerequisite program serve to control pests by denying them food sources and harbourage sites. A pest control program, whether conducted in-house or contracted for a pest control service should include specific procedures for the placement and monitoring of bait stations, traps, and insect electrocution devices. Access to chemicals should be restricted to authorised individuals who have been trained in their use and who understand the risk that pesticides present in exposed food products (Nirmal, 2011). The plastic materials used in agriculture it is another factor. Plastic materials are mostly synthetic materials with small molecules and are synthesised industrially by polymerisation.

1.3.4. The Major Steps for the Production of Vegetables under Greenhouse

After choosing agriculture location, it should be paid attention, and implementation of the following to get the best results, such as preparation and processing of land for agriculture, sterilize the soil, and it should be chosen the appropriate category, the production of seedlings, the date of production, irrigation, fertilization, directing plants, prevention, disease and insect resistance.

Preparation and processing of land for agriculture: It must be light and loose and well drained and free of rhizomes and herbs soil, if one must soil pry that kind clay soil, and purified from the rhizomes weeds and the remains of the previous crop if used for the first time are softening, and then set up greenhouses on structures (Al Dejwy, 1998)**.**

Sterilise the soil: After the establishment of structures and add prescribed for each house of fertilisers, are being sterilised soil greenhouses, which is the most critical agricultural operation in the elimination of harmful pests in the soil, and the operation is performed in several ways, including sterilization by solar, or sterilisation using certain chemicals (Al-Ameen, 2016).

Choose the appropriate category: Each crop of vegetables grown in greenhouses has own production characteristics which must be observed when cultivating the crop before purchasing the seeds. It is also necessary to identify the local taste and the need of the local market until the appropriate category is selected in shape, size, hardness and exportability (Al-Ameen, 2016).

The production of seedlings: Seedlings with good plant characteristics, the worker must be aware of their production assets because the mistakes made in the production of these seedlings cannot be remedied later and affect the production. It is necessary to have excellent technical expertise in this area, also, to identify the specifications of the category to be cultivated through the following professional technicians. While the purchase of seeds must take into account the quality of the product, the official catalogue of the variety of most of the varieties grown within the greenhouses is hybrid (Al-Ameen, 2016).

The date of production: The purpose of the establishment of greenhouses is to provide production in the rare times of vegetable crops and flowers, so it is worth noting that its maximum production thus determines these times. For example, the cucumbers need to 30-40 at the start of production while tomatoes need about 70-90 days until the fruit begins to harvest. (Al Dejwy, 1998).

Irrigation**:** Agriculture in the Greenhouse requires large amounts of water, using 1 to 2 quarts of water per plant per day during peak growing periods. One of the keys to successful irrigation management is the correct timing of water application. Amounts and frequency of application change through the season (Hochmuth G. J., 2015).

Fertilisation**:** One of the most critical factors to achieve a healthy, well-developed crop with high production, is the proper fertilisation. In particular, hydroponic systems require precision fertilisation with continuous adjustment of electrical conductivity (EC) and PH. Most greenhouse fertilisation programs rely on water-soluble fertilisers to provide most of the nutrients required for plant growth. Irrigation often applies water-soluble fertilisers. This is referred to as a constant liquid fertiliser (CLF) program (Faust & Will, 2000).

Directing plants: The plant guides the process of the greenhouses agriculture is essential and very important to get a bumper production and specifications of excellent fruits because some plants need a string to channels such as tomatoes and cucumbers. Also, others did not need their plants in the guidance to thread it needs a guiding carry flowering in small basins such as cloves. Although this ignorance in both types, it leads to low quality of production. Moreover, it is directed plants that climb on vertical thread after the longitudinal wires above the soil surface, on regular dimensions and offset at the top and an altitude of (2m) other wires connecting the strings between them the recommended crop dimensions (Al Dejwy, 1998).

Prevention, disease and insect resistance: The prevention is better than cure, it must apply on agriculture, especially within the greenhouses because prevention is an essential factor in the success of the covered agriculture because the environmental conditions within greenhouses, industrial, and that protection did not believe the plant's preventive spray against dangerous diseases. It is difficult to eliminate them after their proliferation, so should a prevention program for diseases for each crop and task such as blight disease on tomatoes, such as gray mild disease, wilt soft mode, powdery whiteness diseases, the option to use appropriate and effective drugs to prevent the onset of these diseases and others (Gill, et al., 2016).

The insects will be well placed appropriately for each insect exterminator when they arise, and while spraying must be done in the afternoon, and that doors and windows are closed, and repeat the spray every 5-7 days on a regular basis of the different drugs and appropriate (Gill, et al., 2016).

1.3.5. Types of Greenhouses Used in Agriculture

Greenhouses can be divided into two kinds, glass greenhouses and plastic greenhouses:

Glass Greenhouse: Glass greenhouse in mainly covered by glass, which has high translucency, and suitable for plants demanding for sunlight. Among the cultivation facilities glass greenhouse. Many kinds of heating methods can solve heating problems in winter. However, the cost of the power consumption is high. Also, another problem is the floor space, material utilisation amount and usage of mood which defined by the designing and demands from clients. (Bartok, 2000)

Plastic greenhouse: Spread of agriculture overlying multiple types of greenhouses and tunnels covered, and we shall explain the most important of these houses, though the most common in the present days are tunnel greenhouse, low tunnel, and multi-span greenhouse (Hikmet & Al-Shawk, 2013).

1.3.6 The Greenhouse Management

To cultivate the vegetable crops, should to controlling some things it has the impact of the products, such as:

Heating the Greenhouse: Same all buildings, greenhouses lose heat by conduction, convection, and radiation. Usually, all three are taking place at the same time. Heat travels through a solid material such as glass or metal from a warm area to a more cooling area by conduction. The higher the temperature differences between inside and outside, the more rapid the heat movement. Generally, the heavier or denser material is, the higher the heat flow will be per unit of time. Unless a thermal barrier protects it, a metal frame will lose heat faster than a wood frame. Porous material, such as insulation board, or material that consists of air space between two solid layers, such as thermopane glass, will reduce heat flow (Bartok, 2000).

Moreover, heating greenhouses in cold climates are a significant expense for the greenhouse grower, second only to the cost of labour. Many heating systems are available for heating greenhouses. Choosing the right system for a particular greenhouse depends on some variables: (the climate, the expense of the equipment, the size of the greenhouse, Cost and availability of heating fuels). Moreover, once the heating system is functioning, the greenhouse grower must pay attention to two essential items: (Distributing heat in the greenhouse, and conserving heat (McMahon, 2000).

Ventilation: The high summer temperatures mean that heat must continuously be removed from the greenhouse. A simple and effective way of reducing the difference between inside and outside air temperatures is to improve ventilation. Natural or passive ventilation requires very little external energy. It is based on the pressure difference between the greenhouse and the outside environment, resulting from the outside wind or the greenhouse temperature. If the greenhouse is equipped with ventilation openings (Plate 3), both near the ground and at the roof, hot internal air is replaced by more cooling external air during hot sunny days when there is a slight wind. The external cool air enters the greenhouse through the lower side openings while the hot internal air exits through the roof openings due to the density difference between air masses of different temperature; the result is a lowering of the greenhouse temperature (Baudoin, Womdim, Lutaladio, & Hodder, 2013).

Shading Compounds: Shading compounds are materials that are brushed, rolled, or sprayed onto the glazing. They should be applied during warm, dry weather to get excellent adhesion. Frequently, a light coat is applied in late spring and then one or more additional applications are made during the summer. As fall sets in, the shade compound will start to wear off from the rain, and the first frost loosens most of the remainder. With some compounds, the shading density can be adjusted by varying the amount of water that is mixed with the compound. Other compounds are sensitive to moisture; they let in more light when they are wetter (for example, when it is raining) than when they are dry (Hikmet & Al-Shawk, 2013).

Bartok (2000) shows to remove shading compound and accumulations of dust and dirt, use a glazing cleaner. For a thorough job, use a mop or brush. Most cleaners contain a weak acid that can deteriorate metal parts of the greenhouse, so be sure to rinse off the cleaner with clean water thoroughly. The glazing should be as clean as possible before winter to get maximum sunlight into the greenhouse.

Humidity: There are many problems in a greenhouse can be attributed to the moisture level of the air. Excess moisture can cause leaf spotting from drops, increase the incidence of fungal disease, and result in reduced growth patterns. Arid air can reduce the rooting of cuttings and cause leaves to wilt. Humidity generally means relative humidity. This is the amount of moisture in the air expressed as a percentage of the maximum that the air can hold at a given temperature and pressure. The warmer the air, the more moisture it can hold. Generally, with every 20˚F rise in temperature, the moisture-holding capacity doubles (Bartok, 2000).

Technical Guidance: The agriculture in greenhouses the care of crops is not natural, and they are harder than in conventional farming, although it gets good results which were held in which this agriculture is taken not only by persons with good experience in this field. It is imperative to establish counselling specific centres for this so that agriculture spread to different regions of the country. Its mission is to guide farmers to technical methods in agriculture and prevention from agricultural operations and through education, varieties. (Al-Ameen, 2016)

SECTION TWO

2. THE POSSIBILITIES OF AGRICULTURAL SECTOR AND REALITY OF THE VEGETABLE PRODUCTION CROPS IN THE SLEMANI PROVINCE

Slemani Province is a mountainous province with the difference of temperatures in its various districts. Furthermore, Slemani has many water resources with the many historical and national monuments. Thus, this property makes it a land of agriculture and tourism. Slemani Province locates in the north of Iraq, and it comes in the ninth place regarding area among 18 other provinces. The total area is 17,023km^2, it is an ingredient of %3.9 of the total land of Iraq country (Ministry of Planning, 2004).

The Slemani land is 2.7% mountain with it is 26.6% highland foothills and is the 70.7% a natural amphitheatre land (Ministry of Planning 2014). Similarly, the Slemani Province ranked sixth regarding population among other Iraqi Provinces (Ministry of Planning, population statistics 2015, 2016). The total Slemani Province population estimated is 2,144,865 people in 2015 (Ministry of Planning, population statistics 2016, 2016). Slemani range from 16 Districts (Ministry of Planning, 2016).

Slemani Province is located in the coordinates in 34-36 N latitude with the 45-46E longitude of the earth, and the high above the sea of Slemani is 853m. Hence it comes cooler and much wetter than the rest of Iraq. Most areas in the region fall within the Mediterranean climate zone in parallel with areas to the south-west being semi-arid due to the less extreme summers (Ministry of Planning, 2016).

Slemani has a character for having "mild" summers except for the Kelar and Chemchemal Districts which ranges from 35 – 40°C the average temperatures. Nevertheless, it exceeds 45°C the temperature in certain years. The Slemani climate is dry, winter is average between 9 °C and 11 °C, sometimes under zero in some areas and freezing in others. Also, the annual rainfall intensity is 400-600mm, but in mountain areas is around 1000mm and it sees snowfall occasionally in the winter, and frost is widespread (Ministry of Transport, 2016).

Three rivers are running through the Slemani, which is distinguished by its fertile lands, plentiful water, and picturesque nature, such as, Zeiy Bchuk, Awe Spiy, Sirwan (Ministry of Planning, 2015)

This chapter consists of three main points: The first is a focus on the production of vegetables and an overview of agricultural sector resource and production in Slemani Province. The second is the evolution of the greenhouses and production of vegetable in greenhouses in the Province of Slemani, and the third is the evolution of some of the indicators (area, production, productivity, and cost) of vegetable crops in Slemani Province.

2.1. Overview Possibilities of Agricultural Sector and Vegetable Production Generally with Focus on the Vegetable Production in the Greenhouses from Province of Slemani.

Slemani Province has a high resource and possibility to agriculture, such as land, water, human labour force, and agriculture capital, with the reality of agricultural production, and animal production.

2.1.1. The Reality of Agricultural Economic Resources in Slemani Province

Slemani Province has many agricultural resources such as land suitable for agriculture and water resources including surface and underground water and labour power.

2.1.1.1. Land Resources

Land resource means the ones derived from nature that are using in the production process. Namely, they include the earth's surface and the earth's minerals, water, and other natural resources satisfying human needs. The total agriculture land in the Slemani Province is 7,379,536 Decare. Moreover, the total arable area is 2,431,888 Decare. Therefore the 2,131,404 Decare depends on rainfall for agriculture. Also, the 300,484 Decare is dependent on the groundwater to agriculture (Ministry of Agriculture and Water Resources, 2012).

2.1.1.2. Water Resource

Water resources signify that water can be obtained to be used as a source of drinking water and in matters of benefit to humanity, such as agriculture and industry, as well as domestic utilisation. These usages require fresh water, including rivers, lakes, wells, springs, rain and snowfall.

1.1.1.2.1. Rainfall and Snow

The climate of Slemani Province is affected by the climate of the Mediterranean Sea. The rain and snow are different from dropping year to year. Moreover, the study of snowfall in the area is repeated as necessary, but it is confusing to the measurement of snow falling in a year compared with the amount of rainfall in a year. The annual rainfall between 400-600mm, but the total rainfall in mountain areas is around 1000mm (Ministry of Transport, 2016).

1.1.1.2.2. Surface Water

Surface water is one of the main features of agriculture. It contains a group of collapse, tributaries, and waterways. some artificial lakes are covering the surface of the province. This group feeds on the surface water resources of the river network in varying degrees from three sources: rain, snow and underground water. In the Province of Slemani, there is three main river, such as; Zab Seghir River, Sirwan River and Awe Spiy River. However, in Slemani Province, it has two water projects, one on the Zab Saghir River, its Dukan Dam, and one on the Sirwan River, its Derbendixan dam, to promote the level of agriculture and electricity generation and fisheries also water insurance for industrial and household purposes (Alaaddin, 2012).

1.1.1.2.3. Underground water

The underground water is found in the pores of sedimentary rocks formed through different times that are very old for millions of years ago. The source of this water has often been raining permanent or seasonal rivers or melting ice. The leakage process depends on the type of soil (Assaf & Masri, 2007). Also, the larger of the spaces and the higher porosity, which helps to leak the water better and thus obtain a good groundwater reservoir over time (Bloetscher, 2014). The areas of valleys and plains adjacent to the mountains within Slemani Province are affluent in their groundwater, such as groundwater basins, springs, wells and Karez.

2.1.1.3. Human Resource

In the study of the characteristics of the population in a society in terms of gender, age, social activity, and economic activity in order to provide a detailed picture of the population in different ways, the structure of the population can be represented by the age pyramid, which varies according to the level of progress of the countries.

Population**:** Slemani Province contains 16 districts and the population distribution on the districts, a population defined by the number of people inhabiting in a country, city, or any districts. The total population of Slemani is estimated 2,144,865 person at 2015, the %84.93 of person is living in the urban, because the people left Rural area and coming to urban to working in the public sector instead of agriculture in table 2.3. However, the per cent %15.07 of person is in the rural, and all of them working in the agricultural. Similarly, the labour force between 15-65 age is estimated %61.7 (Ministry of Planning, Statistical Report 2017, 2017).

Participation of Labour Force by an Economic Activity: From economic theory only, human activity accounts for economic activity and any work involving the production and distribution of goods and services at all levels within society. In Slemani Province it has many economic activities such as (Mining, quarrying**,** industry**,** Building and construction**,** Transportation, and Education, etc.). The %14.42 of people working in the agriculture sector, by the number is 299,902 people; there is a high number compared with other economic sectors in Slemani Province. Therefore, the female is more than male working in this sector 238,694 by the rate %0.3, with the male worker is 61,208 by the rate %0.09 (Ministry of Planning, Statistical Report 2017, 2017).

1.1.2. Reality Vegetable Production in the Slemani Province

In Slemani Province it is cultivated many types of vegetables in open field agriculture and the greenhouses too, therefore the open field agriculture depends on the surface water, but it has the low productivity and just one season cultivating such as cucumber, tomato, eggplant, pepper, okra, squash, onion, garlic, etc. also the products used for domestic consumption.

Table 2. 1. Vegetable Production Crops (Open Field and Greenhouses) from Slemani Province in 2006-2015

Years	Cucumber			Tomato			Pepper		
	Area (Decare)	Production (Ton)	Yield (T/D)	Area (Decare)	Production (Ton)	Yield (T/D)	Area (Decare)	Production (Ton)	Yield (T/D)
2007	13,955	57,215	4.10	5,693	13,663	2.40	331	662	2.00
2008	11,065	44,260	4.00	7,423	14,846	2.00	276	552	2.00
2009	9,707	29,121	3.00	8,752	17,504	2.00	577	1,154	2.00
2010	7,481	18,702	2.50	8,025	12,037	1.50	696	1,392	2.00
2011	8,010	48,060	6.00	11,795	35,385	3.00	677	1,286	1.90
2012	7,758	77580	15.00	10,550	63,300	6.00	1,223	2,446	2.00
2013	6,375	86,061	13.50	13,076	71,918	5.50	1,485	3,118	2.10
2014	6,321	81,540	12.90	14,075	84,450	6.00	1,373	2,746	2.00
2015	6,321	85,335	13.50	14,075	91,490	6.50	1,399	2,728	1.95

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Department of Agricultural Planning and Statistics, 2012

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Agriculture and Water Resources of Slemani, Unpublished data, Department of Planning and Monitoring, seasonal reports for several years 2007-2015.

In Table 2.2. We focused on the three types of vegetable crops, and it is related to the central concepts of the study. Data show the highest amount of cucumber production in 2015. It is 85335 T because it spreads the high number of greenhouses in the Slemani Province. However, the lowest amount of cucumber crop production is only 18702 T in 2010. There are two reasons: First one is that the farmers leave the agricultural lands and they come to urban, second one is that the greenhouses number is too much low.

The high amount of tomato was produced 91490 T in 2015 because tomato crop cultivates in both of open agriculture and the greenhouse. The lower amount of production of tomato crop is 12037 T in 2010, the same reason, the farmers, give up the agriculture, and they migrate to work the urban.

The high amount of pepper production was produced in 2013. It this year the farmers cultivated pepper in the greenhouses alone. However, the lower amount of pepper was produced 552 T in 2008 because farmers cultivated pepper in the open agriculture.

2.2. The Evolution of the Greenhouses and Production of Vegetable in Greenhouses in the Province of Slemani

The Greenhouses entered to Slemani Province since 2007, in the form of scattered models and a few numbers in different areas, which cost the Ministry of Agriculture of Kurdistan region to buy and distribute among the farmers. The greenhouses are a technological package for the introduction of industrial capital into agricultural production. To control three critical agricultural variables: First, the climate of agricultural production and its season regarding time. Second, the control of the quality of agricultural production. Third, supply control is the competitive agricultural product in the internal or external market (Mohamed, 2010).

Cultivating the vegetables in the greenhouse is the best way to increase the production with productivity. In Slemani Province the greenhouses use to production Vegetables (Cucumber, Tomato, Pepper, Eggplant). Also, they are divided into two types of the greenhouse, (Tunnel with Multi-span), the standard size of Tunnel Greenhouse it's 450 m2. The Multi-Span Greenhouse is a sequential number consisting of a group of greenhouses (according to the farmer's request), one of which is the same as the normal house measuring (standard) 450 m^2 in this study. A single Multi-span is contained eight houses of consecutive greenhouses; it means the Multi-span size is 3,600 m^2.

2.2.1 Structure and Development the Greenhouse in the Slemani Province

The primary objective of the greenhouse project is to increase production of (cucumber, tomato, pepper, etc.) throughout the year. Greenhouses are an economical, strategic project being of particular importance, and they are part of the infrastructure of the regional economy now. Ministry of Agriculture ordered project of greenhouses to increase the domestic agriculture production regarding quality, this project has been implemented in an orderly manner, and day after day, the number of projects increased. Now, the number of greenhouses is about 6316 tunnel greenhouses, with 46 multi-spans, it was started this project in 2007. At the beginning of the project the government bring

57 greenhouses were distributed to 57 farmers, it is a successful project and the farmers interesting to use greenhouses to production vegetables year after year.

Table 2. 2. Development the Greenhouse in the Slemani Province in 2007-2015

Years	Number of Farmer	Number of Greenhouse Tunnel	Number of Greenhouse Multi-span	Area (Decare)
2007	56	56	0	10.08
2008	100	899	0	161.82
2009	0	2,321	0	417.78
2010	0	3,909	0	703.62
2011	542	3,987	0	717.66
2012	665	4,015	172	970.38
2013	696	4,575	70	924.30
2014	656	4,575	32	869.58
2015	830	6,316	46	1,203.12

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

3. Statistics of Greenhouses project in the Slemani Province (Area, planting, and production) Report, Kurdistan Regional Province, Ministry of Planning, Kurdistan Region Statistics Office, Director of Slemani Statistics, Department of Agriculture. 2012

The Table 2.3 shows the number of greenhouses in the Slemani Province, the first in 2007 the government divided 57 greenhouses among 57 farmers. The data show that the numbers of greenhouses increase year after year; however, the multi-span greenhouse structured in 2012, multi-span its same tunnel greenhouse to cultivate crops.

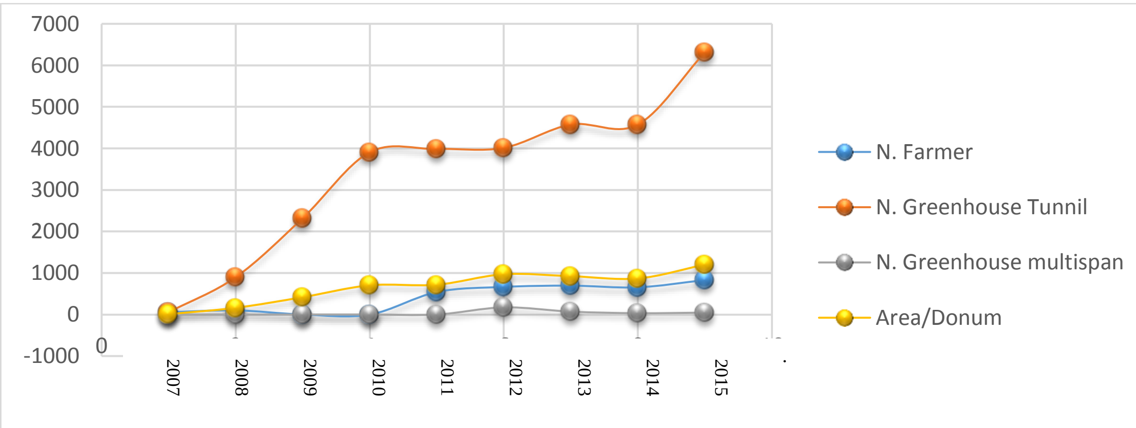

Figure 2.1. Development the Greenhouse in the Slemani Province in 2007-2015

In the figure it shows the development of greenhouses in the Slemani Province, the red line is a tunnel greenhouse. Likewise, it shows increase year after year, the green line it is a multi-span also increasing. It is a reason for farmers to increase demand on the technological way in agriculture as shown in a blue line. The purple line is a custom area of greenhouses.

2.2.2. Development and Distribution the Greenhouses in the Districts of Slemani Province in 2011 to 2015

In this section shows the numbers of greenhouses which are spread in the districts of Slemani Province with the total area of the greenhouses, and some farmers with the number of villages, too. Therefore, compare between the year 2011 and year 2015, because from 2007 to 2010 the government not collect the data about greenhouses project.

Distribution of Greenhouses in 2011: The total of greenhouses in the Slemani Province is 3987, which are spread between districts. With the total number of farmers is 542 in the 255 villages as shown in Table 2.4. Also, it shows the relative importance of districts in greenhouses number with comparisons between other districts.

Table 2. 3. Distribution the Number of Greenhouses in the Districts from Slemani Province in 2011

Zone	Number of Farmer	Number of Villages	Number of Greenhouses	Area (Decare)	Relative importance
Bazian	112	23	1215	218.7	30.47
Dukan	41	22	277	49.86	6.95
Chemchemal	124	85	375	67.5	9.41
Seid Sadiq & Sharezur	21	6	134	24.12	3.36
Helebje	61	18	378	68.04	9.48
Raniye	41	19	194	34.92	4.87
Sharbazhir & Pinjwein	25	11	112	20.16	2.81
District Centre	51	24	477	85.86	11.96
Tanjero	12	9	142	25.56	3.56
Pshder	28	20	57	10.26	1.43
Qeredax&Derebendixan	26	18	98	17.64	2.46
Others "unknown area"	0	0	528	95.04	13.24
Sum	542	255	3987	717.66	100.00

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

3. Statistics of Greenhouses project in the Slemani Province (Area, planting, and production) Report, Kurdistan Regional Province, Ministry of Planning, Kurdistan Region Statistics Office, Director of Slemani Statistics, Department of Agriculture. 2012

In Table 2.4. It shows that the high number of greenhouses located in the Bazian District by the per cent of %30.47 of the total greenhouse from Slemani Province. Because Bazian has several underground glasses of water and it is near with the surface earth, the soil of the Bazian land is beneficial, and as more advantageous entity Bazian is near to the market and main Slemani vegetable store.

In Figure 2.2. It shows the dark Blue is Bazian District it is more significant than other districts. It has high relative importance %31 compare with other districts in the Slemani Province.

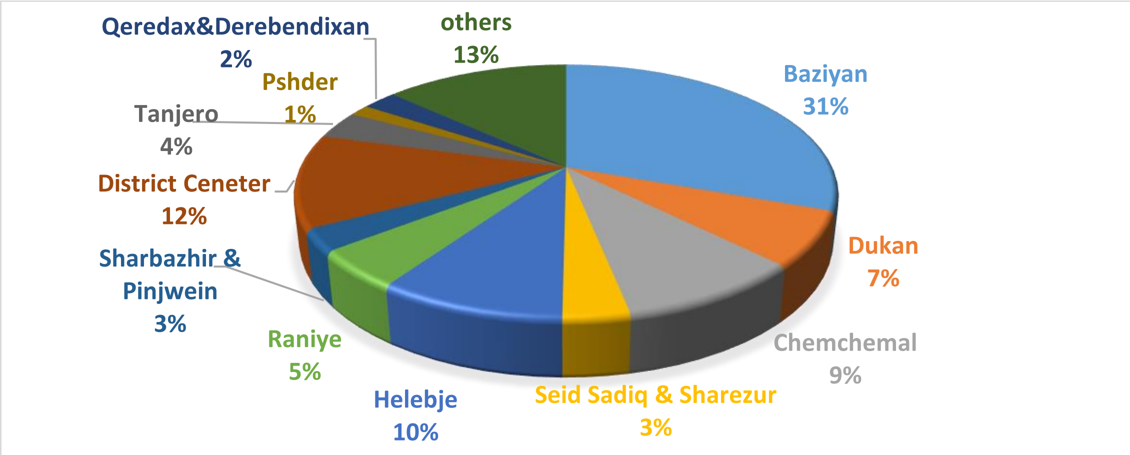

Figure 2. 2. The Relative Importance of Districts of Slemani Province in 2011

Distribution of Greenhouses in 2015: The total of greenhouses in the Slemani Province in 2015 increased to 6316, with 46 Multi-Span greenhouses. Moreover, the total number of farmers also increase to 830 in the 250 villages. Also shows the relative importance of districts in greenhouses number with comparisons between other districts as shown in Table 2.5.

In Table 2.5. It shows the increase the number of greenhouses in the Bazian District and compares with another district and with 2011, the per cent of %47.74 of total Greenhouse from Slemani Province, located in the Bazian, the total greenhouses in the Bazian, are 3055 Tunnel, with 17 multi-spans. We show the reason before.

In Figure 2.3. It shows the dark blue is Bazian District it is more significant than other districts. The relative importance increases to %48 compared with the year 2011 other districts in the Slemani Province.

Table 2. 4. Distribution the Number of Greenhouses in the Districts from Slemani Province in 2015

Zone	Number of Farmer	Number of Villages	Number of Greenhouses	Number of Multi-Span	Area (Decare)	Relative importance
Bazian	267	30	3055	17	574.38	47.74
Dukan and Piremegrun	79	24	731	18	157.5	13.09
Chemchemal	225	70	634	1	115.56	9.61
Seid Sadiq	22	15	158	4	34.2	2.84
Helebje	39	22	343	0	61.74	5.13
Raniye	34	13	286	1	52.92	4.40
Sharbazhir	46	16	190	0	34.2	2.84
District Center	49	16	588	3	110.16	9.16
Tanjero	11	9	142	2	28.44	2.36
Pshder	35	20	93	0	16.74	1.39
Sharezur	15	9	62	0	11.16	0.93
Qeredax	8	6	34	0	6.12	0.51
sum	830	250	6316	46	1203.12	100.00

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

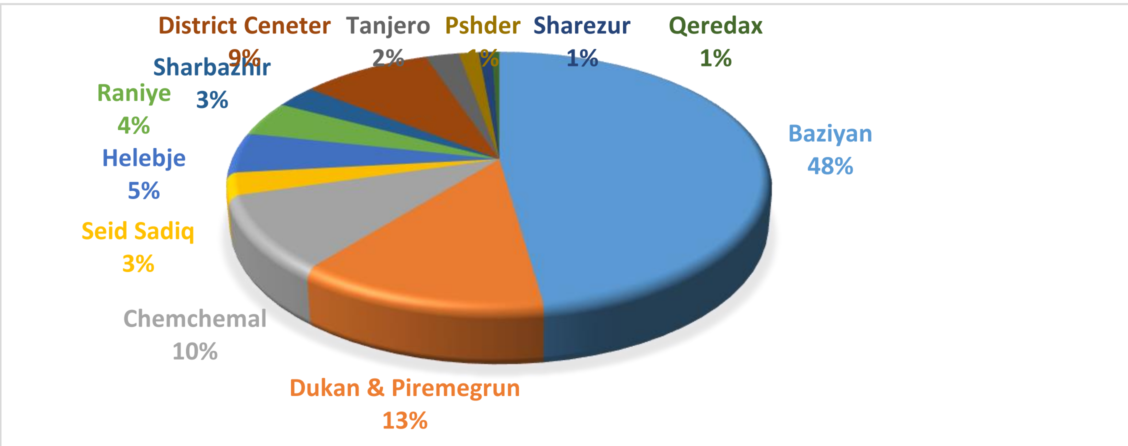

Figure 2. 3. Relative Importance of Districts of Slemani Province in 2015

2.2.3. Development and Distribution of the Greenhouses Vegetable Production in the Districts of Slemani Province in 2011-2015

From the Slemani Province the farmers cultivated some of the vegetable crops, such as cucumber, tomato, pepper, eggplant, squash, okra, but mostly they cultivated the Cucumber, Tomato, and Green Pepper, in the greenhouses.

2.2.3.1. Cucumber Production

Table 2. 5. Cucumber Production in the Greenhouse from the Districts of the Slemani Province in 2011

Zone	Number of Greenhouses	Number of greenhouses planted	Total Area (Decare)	Production (TON)	Yield (T/D)
Bazian	**1215**	**1,172**	**210.96**	**5395.3**	**25.57**
Dukan	**277**	**134**	**24.12**	**672.00**	**27.86**
Chemchemal	375	216	38.88	995.77	25.61
Seid Sadiq & Sharezur	134	11	1.98	47.91	24.20
Helebje	378	170	30.60	765.00	25.00
Raniye	194	194	34.92	873.00	25.00
Sharbazhir & Pinjwein	112	83	14.94	371.08	24.84
District Centre	477	477	85.86	1716.7	19.99
Tanjero	142	142	25.56	617.39	24.15
Pshder	57	41	7.38	180.65	24.48
Qeredax&Derebendixan	98	90	16.20	417.70	25.78
Others	528	0	0.00	0.00	0.00
Sum	3,987	2,730	491	12052.5	24.53
Relative importance		42.93	42.93	44.76	

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2012

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2012

The farmers of Slemani Province usually cultivate cucumber because it is easy in growing and obtaining the high amount of production when compared with the other vegetables. Correspondingly, they cultivate cucumber two times a year. The first season starts on 21 March continues until 1 August, and the second season begins on 15 August until 15 November. The cucumber needs to 35-40 days of growth in the first season, but in the second season need to 30 days to grow. In this study, we selected and compared between the two years 2011 and 2015, to show the development of the greenhouse production in Slemani Province.

Cucumber Production in 2011: The total cucumber production in 2011 from Slemani Province is 12052 ton, by the productivity 24.53 ton/decare. Therefore the per cent of %68.5 of greenhouses dedicates to cucumber production. Look Table 2.6.

The Table 2.6. shows the production and productivity of cucumber vegetable, the whole a year of 2011[1] with the total area, in the districts of Slemani Province with the compare each district with others. The high amount of cucumber production located in the Bazian is 5395 T by the range %44.76 when the total production of cucumber in Slemani Province is 12052 T. Also; we note %42.93 of total greenhouses organised the cucumber in the Slemani Province located in Bazian.

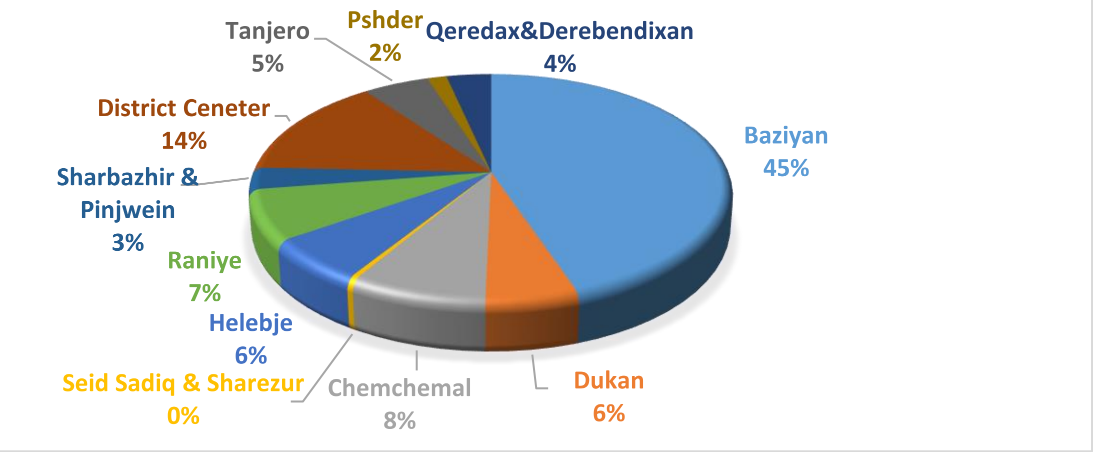

Figure 2. 4. The Relative Importance of Cucumber Production in the Districts of Slemani Province in 2011

In Figure 2.4. it shows the dark Blue zone, its Bazian District; it has the highest relative importance in cucumber production when compared with other districts, it was almost %45 of all cucumber production in the Slemani Province in 2011.

Cucumber Production in 2015: The total cucumber production in the first season in 2015 from Slemani Province is 34967 ton, by the productivity 40.79 ton/decare. The per cent of %75 of tunnel greenhouses, with the %56.5 of multi-span greenhouses,

[1]. The government collection the data of whole a year without spare the season.

dedicate to cucumber production. However, in the second season the cucumber production is17396, by the productivity 26.79 ton/decare. Therefore the %54.4 of tunnel greenhouses, with the %48 of multi-span greenhouses dedicate to cucumber production. Look Table 2.7.

Table 2. 6. the Cucumber Production in the Greenhouse from the Districts of the Slemani Province in 2015

			Cucumber first season					Cucumber Second season				
zone	Number of Greenhouses	Number of Multi-span	Number of greenhouses planted	Number of Multi-span planted	Total Area (Decare)	Production (Ton)	Yield (T/D)	Number of greenhouses planted	Number of Multi-span planted	Total Area (Decare)	Production (Ton)	Yield (T/D)
Baziyan	2946	17	2346	12	440	20415	46.44	2392	12	448	13407	29.94
Dukan & Piremegrun	657	18	618	8	123	3558	28.98	555	8	111	1944	17.45
District Ceneter	569	3	420	1	77	2972	38.58	273	1	51	1384	27.36
Chemchemal	633	1	437	1	80	2622	32.73	199	1	37	609	16.34
Raniye	285	1	183	0	33	1281	38.89	0	0	0	0	0.00
Helebje	343	0	213	0	38	1272	33.18	13	0	2	52	22.22
Sharbazhir	190	0	114	0	21	912	44.44	0	0	0	0	0.00
Tanjero	126	2	73	2	16	704	43.95	0	0	0	0	0.00
Seid Sadiq	142	4	65	2	15	655	44.92	0	0	0	0	0.00
Pshder	93	0	54	0	10	324	33.33	0	0	0	0	0.00
Qeredax	34	0	27	0	5	224	46.09	0	0	0	0	0.00
Sharezur	62	0	4	0	1	28	38.89	0	0	0	0	0.00
sum	6080	46	4554	26	857	34967	40.79	3432	22	649	17396	26.79
Relative importance			51.52	46.15	51.28	58.38		69.70	54.55	68.96	77.07	

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

Also, in 2015 Bazian District has the proper relative importance when compared with other districts in Slemani Province, the per cent of %51.52 of tunnel greenhouse, with %46.15 of multi-span greenhouses, dedicated to cucumber production in Slemani Province located in Bazian. Its higher amount compares with 2011. Therefore %51.28 of total cucumber production in Slemani Province produces in Bazian during the first season. In the second season, it increased %69.7 of greenhouse tunnels with %54.55 of multi-span greenhouses organised to Cucumber in Slemani Province located in Bazian, and %77.07 of the whole cucumber produced in Bazian.

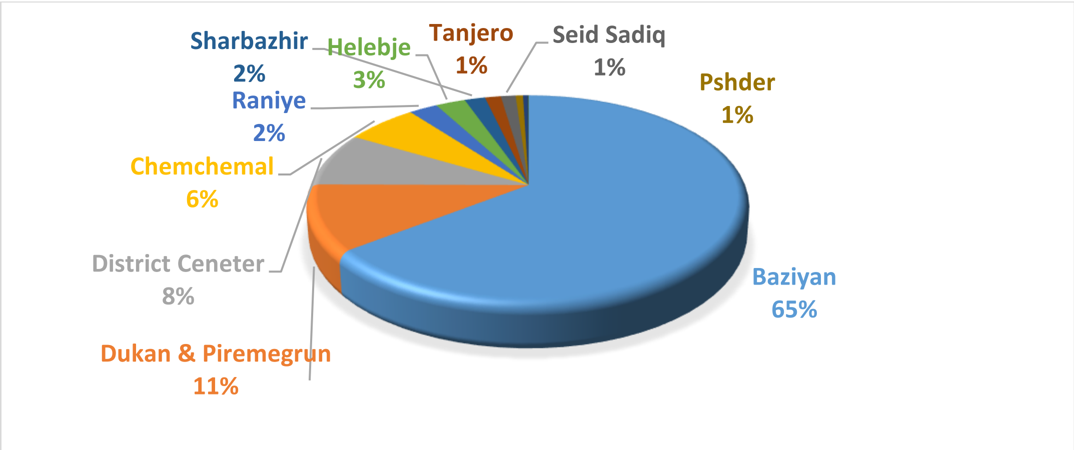

Figure 2. 5. The Relative Importance of Cucumber Production between Districts of Slemani Province in 2015

In Figure 2.5. it shows the dark blue zone is Bazian District whole a year; it has the highest relative importance in cucumber production when compared with other districts, it is almost %65 of all cucumber production in both seasons in Slemani Province in 2015.

2.2.3.2. Tomato Production

In Slemani the farmers are cultivating the Tomato vegetable one-time in a whole year because tomato needs a long time to grow. Tomato has the lowest production when compared with cucumber and its reason for farmers destined a little of greenhouses to cultivate of the tomato. The season of tomato starts on 1 April continues until half of 15 November. Also, the Tomato needs to grow up 90-100 days.

Tomato Production in 2011: The total tomato production in 2011 from Slemani Province is 3093 ton, by the productivity 30.69 ton/decare. Therefore the per cent of %21 of greenhouses divides into tomato production. Look Table 2.8.

Table 2. 7. Tomato Production in the Greenhouse from the Districts of the Slemani Province in 2011

Zone	Number of Greenhouses	Number of greenhouses planted	Total Area (Decare)	Production (TON)	Yield (T/D)
Bazian	1215	26	4.68	1445	30.92
Dukan	277	124	22.32	702	31.48
Chemchemal	375	140	25.20	777	30.87
Seid Sadiq & Sharezur	134	16	2.88	87	30.25
Helebje	378	208	37.44	1123	30.00
Sharbazhir & Pinjwein	112	29	5.22	168	32.18
Pshder	57	10	1.80	54	30.09
Qeredax&Derebendixan	98	7	1.26	36	28.57
Sum	2646	560	101	3093	30.69
Relative importance	46	5	5	5	

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2012

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2012

The table shows in 2011 the Helebje District has a high relative importance of tomato production when compared with the other districts in the Slemani Province. By the %37.14 of tunnel greenhouses organised to the tomato production. Moreover, the %36.31 of total tomato production in Slemani Province located in the Helebje District.

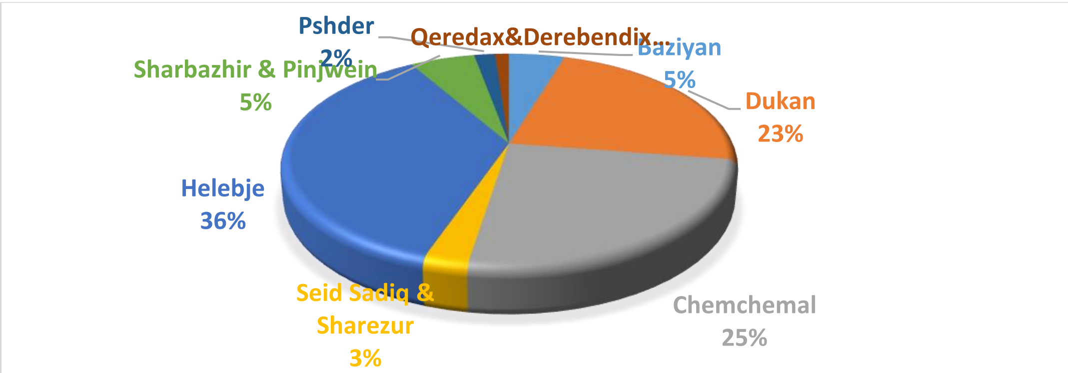

Figure 2. 6. The Relative Importance of Tomato Production between Districts of Slemani Province in 2011

In Figure 2.6. it shows that the sky-blue zone is Helebje District and has the highest relative importance in tomato production when compared with other districts, it was almost %36 of all tomato production in the Slemani Province in 2011.

Tomato Production in 2015: The total tomato production in 2015 from Slemani Province decrease to 802 ton, by the productivity 22.97 ton/decare. Therefore the per cent of %0.028 of tunnel greenhouses, with the %0.065 of multi-span greenhouses dedicate to tomato production. Look Table 2.9.

Table 2. 8. Tomato Production in the Greenhouse from the Districts of the Slemani Province in 2015

Zone	Number of Greenhouses	Number of Multi-span	Number of greenhouse planted	Number of Multi-span planted	Total Area (Decare)	Production (Ton)	Yield (T/D)
Bazian	2,946	17	126		22.68	600	26.46
Dukan & Piremegrun	657	18	3	3	4.86	32	6.58
Pshder	93		2		0.36	9	25.00
Chemchemal	633	1	30		5.40	141	26.11
Seid Sadiq	142	4	5		0.90	18	20.00
District Centre	569	3	4		0.72	2	2.78
Sum	6080	43	170	46	35	802	22.97
Relative importance			74.12		64.95	74.81	

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

In 2015 the relative importance of the tomato production in districts of Slemani, conversely with 2011, Bazian district has the best relative importance when compared with the other district of Slemani Province. By %74.12 of tunnel greenhouses organised to tomato production, its highest number is %74.81 of total tomato production produced in Bazian.

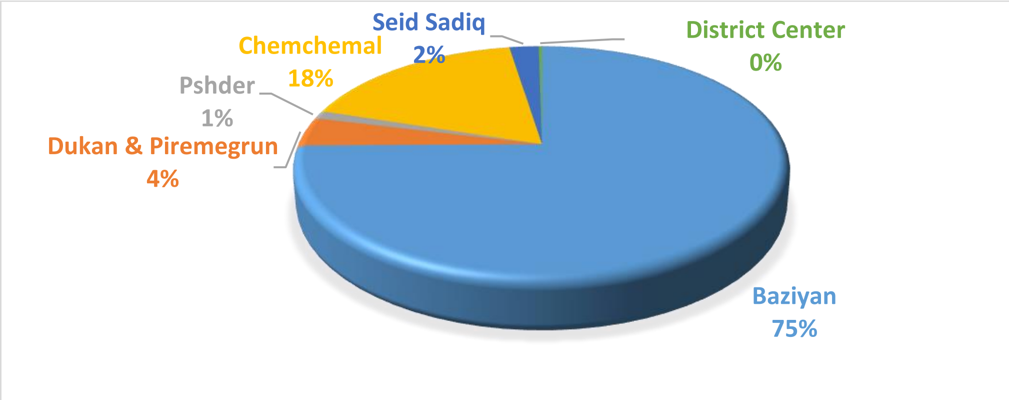

Figure 2.7. The Relative Importance of Tomato Production between Districts of Slemani Province in 2015

Figure 2.7 it shows Bazian District on the blue zone; it has the highest relative importance in tomato production when compared with other districts. It was almost %75 of all tomato production in Slemani Province in 2015.

2.2.3.3. Green Pepper production

The farmers from the Slemani Province cultivate the green pepper in the greenhouses, but the green pepper is cultivated within the common areas with cucumber in the greenhouse, this means farmers do not prepare the greenhouse for green pepper alone. Green pepper cultivating two times during a year starts on 21 March and continues until 1 August the first season and the second season it begins on 10 August to 15 November. Occasionally farmers cultivate on March 21 during the year until 15 November.

The green pepper needs to 35-40 days to grow in the first season, and in the second season need to 30 days to grow in. In this study, the first among the farmers in 2011 didn’t cultivate the green pepper because they did not know how to cultivate the green pepper. However, it shows in Slemani Province two seasons cultivated green pepper in 2015 in the Table 2.10.

It might be observed in the first season the Table 2.10. that it has high relative importance in the production of green pepper in Helebje District among the districts of Slemani Province. By %78.38 of tunnel greenhouses are structured green pepper Slemani Province located in the Helebje with %85.15 of whole green pepper produced in the

Helebje. In the second season, conversely with the first season, just Bazian district cultivated the green pepper, it means the per cent %100 of green pepper production located in the Bazian District.

Table 2. 9. The Pepper Production in the Greenhouse from the Districts of the Slemani Province in 2015

			First Season					Second Season				
Zone	Number of Greenhouses	Number of Multispan	Number of greenhouses planted	Number of Multispan planted	Total Area (Decare)	Production (Ton)	Yield (T/D)	Number of greenhouses planted	Number of Multispan planted	Total Area (Decare)	Production (Ton)	Yield (T/D)
Dukan & Piremegrun	657	18	1	0	0.18	3	13.89	0	0	0.00	0	0.00
Helebje	343	0	58	0	10.44	261	25.00	0	0	0.00	0	0.00
District Center	569	3	1	1	1.62	11	6.79	0	0	0.00	0	0.00
Baziyan	2946	17	14	0	2.52	32	12.70	13	0	2.34	30	12.82
Sum	4515	38	74	1	15	307	20.77	13	0	2	30	12.82
Relative importance			78.38	0.00	70.73	85.15	0.00	100.00	0.00	100.00	100.00	0.00

Source: 1. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, Directorate of Horticulture and Forestry Slemani, Vegetable Section, unpublished data, 2016

2. Kurdistan Regional Province, Ministry of Agriculture and Water Resources, General Directorate of Horticulture and Forestry, Vegetable Section, 2016

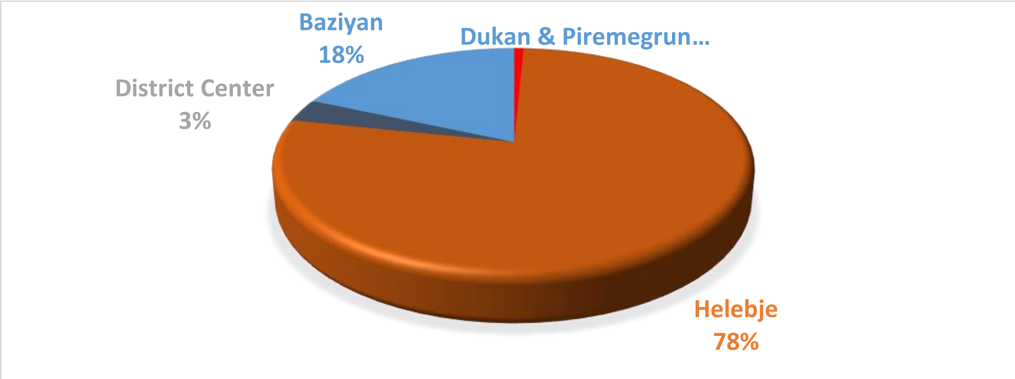

Figure 2. 8. The Relative Importance of Green Pepper Production between Districts of Slemani Province in 2015

It shows in Figure 2.8. that the brown zone is Helebje District whole a year and it has the highest relative importance in green pepper production when compared with other districts, it is almost %78 of all green pepper production during the year 2015 in the Slemani Province produced in Helebje.

SECTION THREE

3. AN ECONOMIC ANALYSIS OF THE PRODUCTION FUNCTIONS AND COSTS OF VEGETABLE PRODUCED IN GREENHOUSES IN BAZIAN DISTRICT

Agricultural production is influenced by some important factors that affect the quantity and quality of production and accordingly it affects its output prices. The agricultural production requires to provide all the requirements of agricultural production and agricultural operations. The requirements include all that is added to the agricultural soil such as seeds and fertilisers (organic and chemical), pesticides and other elements of production. Agricultural operations include the preparation of agricultural land spraying of agricultural fertiliser and other agricultural operations.

In this study, among factors that have effects on the greenhouses vegetable production, we focus on fertilisers because we noticed that the farmers in Bazian district spent a high amount of money to buy fertilisers because they believe using more fertiliser is to achieve more production. Therefore, for analysing and exhibiting the effects of fertiliser on the production, the questionnaire was prepared for the most critical questions to be answered by farmers to obtain the most critical information requiring the research plan. The questionnaire was filled out by the personal meeting of the farmer and questionnaire form, which contains the amount of production, and the real amount of fertiliser which uses by farmers, with the fertiliser cost to per decare. Almost the number of available farmers in the Bazian Area that produce vegetables in the greenhouses is about 267 farmers, and the research samples are taken about 200 farmers observation, who represent 75% of the total growing vegetables in greenhouses. They are ranged from 80 farmers producing cucumber, and 70 farmers producing tomato, and 50 farmers producing green pepper.

The theme of the efficiency of production has great importance because the national economy of any country is based mainly on the degree of efficiency in the use of economic resources. Using the data of the field study of the sample of vegetable crops in greenhouses in Bazian District is during the agricultural season 2016, and it achieves the objectives of the research. This chapter aims to estimate the production functions of the main vegetable crops (cucumbers, tomatoes, green peppers) produced in greenhouses in Bazian.

3.1. The Standard Estimation of the Production Functions of the Main Vegetable Crops Produced in the Greenhouses in Bazian District

This section deals with the measurement of the inputs and outputs of the main vegetable crops. The Cobb-Douglas function (Neoclassical Production Function) is used as an exponential function. This study aims to estimate the function of production through the elasticities of the production and the most critical production factors that affecting the production of vegetable crops. Among different types of fertilisers, there is three main of fertiliser, and it is nitrogen, potassium, and phosphorus that have a high effect on the vegetable production in the greenhouses. Which measures the relationship between the physical vegetable production and the production elements, in the exponential formula in the following form:

$$Y= \beta_0 X_1^{b1}\, X_2^{b2} \ldots \ldots\, X_n^{bn} \tag{3.1}$$

Where:

Y = The quantity of physical output ton/decare

X_1 = Manure Fertilizer ton/decare

X_2 = Nitrogen Fertilizer kg/decare

X_3 = Phosphorous Fertilizer kg/decare

X_4 = Potassium Fertilizer kg /decare

X_5 = Other elements of fertilizers

β_0 = Represents the equation constant

(b_1, b_2, …, b_n) = regression coefficients that represent the productive elasticities. Log transformation is applied to (3.1).

3.1.1. The Standard Estimation of the Production Function of the Cucumber Crop in the Bazian District

The research samples are taken from almost all 200 farmers for three main crops, who represent 75% of the total growing vegetables in greenhouses. Therefore, there are ranged from 80 farmers are producing cucumber.

Table 3. 1. Production Function of Cucumber in Greenhouse in the Bazian District

Variable	Unit	Coefficient	(t) test	Marginal production	Average production	Marginal production value	unit price of Resources	coefficient element efficiency	Average resource quantity
Organic fertilizer	Ton	0.032	1.911 *	2	0.064	0.692	22.2	0.031	13
Nitrogen	Kg	0.009	3.05 **	0.5	0.004	0.173	0.32	0.509	51
Phosphorus	Kg	0.092	2.935 **	0.38	0.025	0.131	2.25	0.053	92
Potassium	Kg	0.017	1.983 *	0.29	0.005	0.090	2.1	0.043	88
Micro elements	Kg	0.039	1.811 *	0.23	0.009	0.027	2.9	0.027	113
	constant	0.481	2.321 *						
*** confidence at level (5%)** **** confidence at level (1%)**									

$R^2 = 0.807$ F=177.4

Average productivity dunums of cucumber = 32 ton/dunum

The average selling price a ton of cucumber = $ 346 per ton

Average Resource Quantity = Total Fertilizer Use in 2016 / Total Farmers Acquired in 2016.
Coefficient Element Efficiency = Marginal Production Value / Unit Price of Resource.

Table 3.1 shows the function of producing cucumber in greenhouses in Bazian estimate productivity according to sample F explanatory variables included in the production elements for cucumber production in greenhouses has significant confidence since the value of F is estimated 177.4. As indicated by the coefficient of determination (R^2) amounted to 0.807 the independent variables in the function explain about 80.7% of the variables in the production of cucumber crop. In the sense of fertilizer effects on the cucumber production about 80.7% among other elements of production of cucumber crop.

About *t*-test that all of the variables included in the estimate function have significant confidence in the better level of confidence %1 and %5. If the confidence level 1% it means that this fertiliser has a statistically significant effect on the production. While the manure fertiliser, phosphorus and other elements at the confidence level 5% also have a positive impact. Moreover, the equation constant (β_0) significant at a confidence level of 5%.

Also, Table 3.1 shows that the production coefficient of the cucumber production components is all positive and this means that the quantity of cucumber production responds directly to the quantities of ingredients used in production. Where the maximum amount of fertiliser its phosphorus by the range %0.092, indicating that the increase of this component by 1% leads to an increase in the production by 0.092%. Also, for other production inputs the increase 1% leads to an increase in the quantity of production less than 1%, such as organic manure %0.032, nitrogen %0.009, potassium %0.017 and other elements %0.039.

The marginal production value is the resource's marginal product multiplied by the product price. In estimating the efficiency using of the production elements of the cucumber. The coefficient efficiency of the elements calculates from the data in Table 3.1 shows an increase in the value of production elements but after the efficiency use of the variables approaching of the one, such as organic fertiliser 0.031, potassium 0.043 and micro elements 0.027. By the time the value of this coefficient arrived 0.509 - 0.053 for two fertilisers nitrogen, and phosphorus, which indicates the high efficiency of these two elements, which could be increasing efficient other elements by increase the quantities of utilised.

For each data like data for cucumber we worked to find residual then we test residual of the data to test normal and heteroskedasticity. It is noticed in Table 3.2 that the skewness statistics is 0.478 and the kurtosis statistics is 0.228. Thus, there were statistically significant of the range skewness and kurtosis. This means that the assumption of normal distribution was achieved (Field, 2009; Gravetter & Wallnau, 2013). Moreover, the value of both statistics method Kolmogorov-Smirnov and Shapiro-Wilk are 0.072 and 0.977 respectively, and the *p*-value for both was (0.200, 0.153) respectively. There is no evidence of any significant deviation from normality for the residuals. Moreover, the white's general test is used to test the assumption of heteroskedasticity. The value of chi-square equals 31.24, and the *p*-value equals 0.2154 which were more than 0.05. As a result, there is no a problem of heteroskedasticity. Finally, the data for cucumber shows normality and no heteroskedasticity problem.

Table 3. 2. Test of Normality for Cucumber

Standardized Residual for Cucumber	Statistics	P-value
Kolmogorov-Smirnov	0.072	0.200
Shapiro-Wilk	0.977	0.153
Skewness	0.478	
Kurtosis	0.228	
Observation (N.)	80	
Heteroskedasticity Test (White)		
	Test	P-value
Chi- square	31.24	0.2154

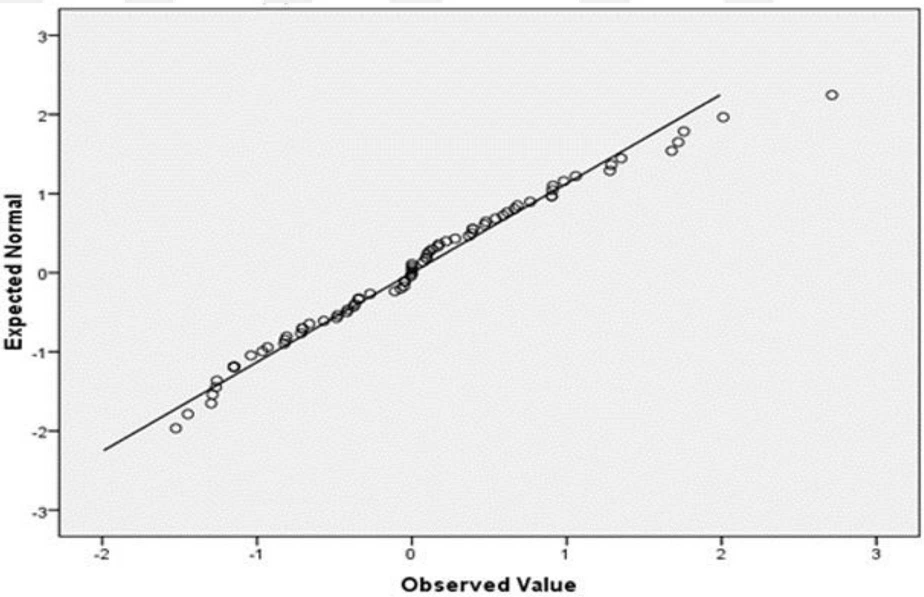

Figure 3. 1. Normal Q-Q Plot of Standardized Residual for Cucumber

3.1.2. The Standard Estimation of the Function of Tomato Production in the Bazian District

The research samples give almost all 200 farmers observation for three main crops, who represent 75% of the total growing vegetables in greenhouses. Therefore, there are 70 farmers are producing a tomato.

Table 3. 3. The Function of Producing Tomato in Greenhouse in the District of Bazian

Variable	Unit	Coefficient	(t) test	Marginal production	Average production	Marginal production value	Unit price of Resources	Coefficient element efficiency	Average resource quantity
Organic fertilizer	Ton	0.059	1.917 *	1.03	0.06	0.515	22	0.023	6.2
Nitrogen	Kg	0.016	2.09 *	0.09	0.001	0.005	0.32	0.141	70
Phosphorus	Kg	0.071	3.901 **	0.41	0.009	0.205	2.25	0.091	45
Potassium	Kg	0.218	4.211 **	0.60	0.013	0.300	2.3	0.130	90
Micro elements	Kg	0.163	1.79 *	0.098	0.016	0.049	2.8	0.018	65
	constant	0.835	2.497 *						
*** Confidence at level (5%)** **** Confidence at level (1%)**									

$R^2 = 0.834$ F=232.4

Average productivity decare of tomato = 26 tons/decare

The average selling price a ton of tomato = $ 500 per ton

Average Resource Quantity = Total Fertilizer Use in 2016 / Total Farmers Acquired in 2016.
Coefficient Element Efficiency = Marginal Production Value / Unit Price of Resource.

Table 3.3 shows the function of producing tomato in greenhouses in the Bazian District estimated productivity according to sample F explanatory variables included in the production elements for tomato production in greenhouses has significant confidence since the value of F is estimated 232.4. As indicated by the coefficient of determination (R^2) amounted to 0.834. The independent variables in the function explain about 83.4% of the variables in the production of tomato. In the sense of fertilizer effects on the tomato production about 83.4% among other elements of production.

The *t*-test that all the variables included in the estimate function are statistically significant in the better level of confidence %1 and %5. If the confidence level 1% it means the fertiliser has a statistically significant effect on the production, the nitrogen and phosphorus fertiliser are effective in the tomato production. While the manure fertiliser, potassium and other elements at the confidence level 5% also have a positive effect. Moreover, the equation constant (β_0) significant at a confidence level of 5%.

The Table 3.3 shows that the production coefficient of the tomato production components is all positive and this means that the quantity of the tomato production responds directly to the quantities of elements used in production. The maximum amount of fertiliser is the effect on the tomato is potassium by the per cent 0.218%, indicating that the increase of this component by 1% leads to an increase in the production by 0.218%. Also, other production inputs if the increase 1% leads to an increase in the quantity of production less than 1%, such as organic manure 0.059%, nitrogen 0.016%, phosphorus 0.071% and other elements 0.163%.

The marginal production value is the resource's marginal product multiplied by the product price, from the data in Table 3.3 that the estimation of the practical uses of the production elements calculate for tomato is all positive. However, the most efficient use of elements is nitrogen and potassium where it reached 0.141 and 0.130 respectively, while the value of the coefficient efficiency of the organic fertilizer is about 0.023 for phosphours 0.091, and micro elements is 0.018.

For each data like data for tomato we worked to find residual then we test residual of the data to test normality and heteroskedasticity test too**.** As shown in Table 3.4 the skewness statistics is -0.407 and the kurtosis statistics is 1.297. Thus, they are statistically significant of the range skewness and kurtosis. This means that the assumption of normal distribution was achieved (Field, 2009; Gravetter & Wallnau, 2013). Moreover, the value of both statistics method Kolmogorov-Smirnov and Shapiro-Wilk are 0.083 and 0.966 respectively, and the *p*-value for both was (0.201, 0.053) respectively. There is no evidence of any significant deviation from normality for the residuals. Moreover, the white's general test is used to test the assumption of heteroskedasticity. The value of chi-square equals 20.8456, and the *p*-value equals 0.3952 which were more than 0.05. As a result, there is no a problem of heteroskedasticity. Finally, the data for tomato shows normality and no heteroskedasticity problem.

Table 3. 4. Test of Normality for Tomato

Standardized Residual for Tomato	Statistics	P-value
Kolmogorov-Smirnov	0.083	0.201
Shapiro-Wilk	0.966	0.053
Skewness	-0.407	
Kurtosis	1.297	
Observation (N.)	70	
Heteroskedasticity Test (White)		
	Test	P-value
Chi- Square	20.8456	0.3952

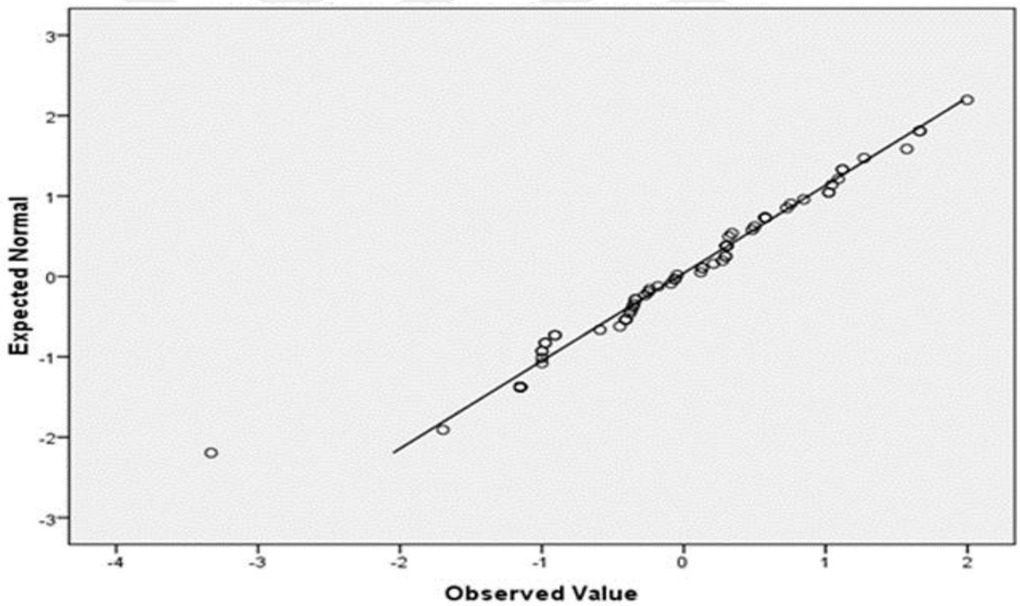

Figure 3. 2. Normal Q-Q Plot of Standardized Residual for Tomato

3.1.3. Standard Estimation of the Function of Producing Green Peppers in the Bazian District

The research samples are taken from almost all 200 farmers observation for three main crops, who represent 75% of the total growing vegetables in greenhouses. Therefore, 50 farmers are producing green pepper.

Table 3. 5. The Function of Production Green Pepper in Greenhouse in the District of Bazian

Variable	Unit	coefficient	(t) test	Marginal production	Average production	Marginal Production Value	Unit price of Resources	Coefficient element efficiency	Average resource quantity
Organic fertilizer	Ton	0.036	2.109 *	4	0.144	1.540	22	0.070	8
Nitrogen	Kg	0.013	3.06 **	0.2	0.003	0.077	0.32	0.241	160
Phosphorus	Kg	0.046	2.631 *	0.4	0.018	0.154	2.25	0.068	80
Potassium	Kg	0.061	4.61 **	0.42	0.026	0.162	2.3	0.070	75
Micro elements	Kg	0.029	1.935 *	0.33	0.009	0.127	2.8	0.045	95
	constant	0.703	2.361 *						-

*** Confidence at level (5%)**
**** Confidence at level (1%)**

$R^2 = 0.921$ F=211.7

Average productivity decare of green pepper = 6.4 ton /decare

The average selling price a ton of green pepper = $ 385 per ton

Average Resource Quantity = Total Fertilizer Use in 2016 / Total Farmers Acquired in 2016.
Coefficient Element Efficiency = Marginal Production Value / Unit Price of Resource.

Table 3.5 shows the function of producing green pepper in greenhouses in the Bazian District estimated productivity according to sample F explanatory variables included in the production elements for tomato production in greenhouses has significant confidence since the value of F is estimated 211.7. As indicated by the coefficient of determination (R^2) amounted to 0.921. The independent variables in the function explain about 92.1% of the variables in the production of green peppers. In the sense of fertilizer effects on the green peppers production about 92.1% among other elements of production.

The *t*-test shows that all the variables included in the estimate function have significant confidence in the better level of confidence %1 and %5. If the confidence level is 1% this means that the fertiliser has a statistically significant effect on the production, the potassium and phosphorus fertiliser have a high impact on the green pepper production. While the manure fertiliser, nitrogen and other elements at the confidence level 5% also have a positive impact but less than potassium and phosphorus. Moreover, the equation constant (β_0) significant at a confidence level 5%.

Also, the Table 3.5 shows that the productivity coefficient of the green pepper productivity components is all positive and this means that the quantity of the green pepper production responds directly to the quantities of ingredients used in production. Where the maximum amount of fertiliser its potassium by the range %0.061, indicating that the increase of this component by 1% leads to an increase in the amount of production by 0.061%. However, rest of the production inputs (organic manure, nitrogen fertiliser, phosphorus and other elements) if the increase 1% leads to an increase in the quantity of production less than 1%, about any 0.036%, 0.046%, 0.029%, respectively.

The marginal production value is the resource's marginal product multiplied by the product price. Estimating the practical use of the production elements of the green pepper in Bazian is calculated by the coefficient of element efficiency. In Table 3.4 shows the high coefficient of efficiency for all the production elements. For organic fertiliser is 0.070, nitrogen 0.241, phosphorus 0.068, potassium 0.070, and micro elements 0.045. Meaning all value is positive which is equal to the value of the marginal product with the unit price of the element. A better level of efficiency can be achieved by increasing the quantities of those inputs produced in the framework of production elasticities.

It is evident in Table 3.6 that the skewness statistics is 0.079 and the kurtosis statistics is 0.199. Thus, there were statistically significant of the range skewness and kurtosis. This means that the assumption of normal distribution was achieved (Field, 2009; Gravetter & Wallnau, 2013). Moreover, the value of both statistics Kolmogorov-Smirnov and Shapiro-Wilk are 0.115 and 0.98 respectively, and the *p*-value for both are 0.130, 0.831 respectively. There is no evidence of any significant deviation from normality for the residuals. Moreover, the white's general test is used to test the assumption of heteroskedasticity. The value of chi-square equals 22.0321, and the *p*-value equals 0.4123 which were more than 0.05. As a result, there is no a problem of heteroskedasticity. Finally, the data for green pepper shows normality and no heteroskedasticity problem.

Table 3. 6. Test of Normality for Green Pepper

Standardized Residual for Cucumber	Statistics	P-value
Kolmogorov-Smirnov	0.115	0.130
Shapiro-Wilk	0.98	0.831
Skewness	0.079	
Kurtosis	0.199	
Observation (N.)	50	
	Heteroskedasticity Test (White)	
	Test	P-value
Chi- Square	22.0321	0.4123

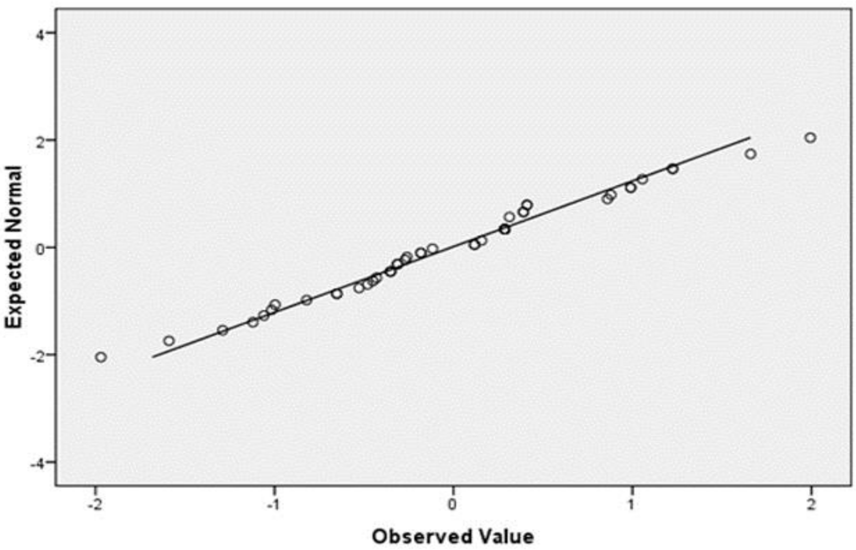

Figure 3. 3. Normal Q-Q Plot of Standardized Residual for Green Pepper

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Research reached the following main findings, such as, in 2015 the per cent of %47.74 of greenhouses located in the Bazian District. However, the %65 of Cucumber that produces in greenhouses in Slemani Province produced in Bazian. Moreover, the 75% of Tomato with 78% of Green pepper is produced in the Bazian District (Section 2).

The practical use of chemical fertilisers in the production of vegetable crops in Greenhouses is low. The results of the analysis show the function of production is located in the first area of the production function (Increasing return of scale), thus should be used more of fertiliser (Section 3).

The coefficient of determination (R^2) shows the relation between production and production elements, in this study shows the fertilizers effects on the vegetable production among the other elements of vegetable production. The coefficient of determination (R^2) for **cucumber** amounted to 0.807. And to **tomato** the coefficient of determination (R^2) is 0.834. Also, the coefficient of determination (R^2) for **green pepper** amounted to 0.921 (Section 3).

By the coefficient *t*-test shows which fertiliser is statistically significant in the vegetable crops among five types of fertilisers. That all the variables include in the estimate function have significant confidence in the better level of confidence %1 and %5. Nitrogen and phosphorus elements influence the **cucumber**. Also, the **tomato** is influenced by potassium and phosphorus fertiliser. However, the **green pepper** is influenced by nitrogen and potassium fertiliser (Section 3).

The practical use of chemical fertilisers in the production of vegetable crops in Greenhouses is low. The reason is the farmers not depend on scientific methods to use fertilisers in the production of vegetables well. Also, the government's guidance is weak, especially in recent years, and this is because of the financial crisis in the region.

Recommendations

The research concluded some recommendations to believe that it may contribute to the identification of indicators that work to develop and improve productivity and economic efficiency by using fertilisers in the production of some vegetable crops produce in greenhouses in Slemani Province, mainly in Bazian District.

The most important of these recommendations as follows: From the result of the study, recommends increasing the use of chemical fertiliser for cucumber, tomato and green peppers. According to the research, the economic analysis of the functions of the use of fertilisers and their impact on the increase in production.

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Questionnaire

An Economic Analysis of the Efficiency of Using Fertilisers in the Production of Vegetables in Greenhouses in the Slemani Province
Area / Baziyan

1. Farmer Private Information:

Name:			Years	Experience in agriculture		The structure of greenhouses	
Mob. Number							
Social status		Single	Married	Family members		Male	
						Female	
Educational Status							
Other Profession							
N. of Tunnel Greenhouses				N. of Multi-Span Greenhouse			
Type of possession Greenhouse	N. of Greenhouse	Possession /Decare		Rent /Decare		Participation /Decare	
Type of possession Land		Possession		Rent		Participation	

2. Current and previous crop structure

Item	The current year 2016						The previous year 2015					
	First Season			Second Season			First Season			Second Season		
	Production / ton	Area /Decare	N. Of Greenhouses	Production / ton	Area /Decare	N. Of Greenhouses	Production / ton	Area /Decare	N. Of Greenhouses	Production / ton	Area /Decare	N. Of Greenhouses
Cucumber												
Tomato												
Green Pepper												

- Unit: ton
- The green pepper crop is cultivated within the common areas of the cucumber crop where the plastic house facades are left for the cultivation of the green pepper crop.

3. What are the method of planting and the method you follow in planting for each crop?

Seasons	Product	Irrigation style	Area /Decare	Total Production	Productivity Decare/Ton	Self consumption and gifts	Farmer Price $	Total Revenue
First Season	Cucumber							
	Tomato							
	Green Pepper							
Second Season	Cucumber							
	Tomato							
	Green Pepper							
							Total Revenue In year $	

• Price and revenue in dollars $.

4. Fixed costs:

Detail	Number	Price per capita $	Total $
Greenhouse Structure			
Processing of land			
Well			
Water pump			
Pump for water distribution			
Water basin/masquerade			
Electric generator			
Fence			
A column and electrification			
Road			
Holder			
Tractor + Cassen + Rotiver			
Store			
Car			
House			
		Total	

• Unit: Dollar $

5. Quantities and prices of production elements (variable costs): The working period is 7 months

Detail	First Season				Second Season			
	Quantity	Unit Price	Total	Not.	Quantity	Unit Price	Total	Not.
Seed								
plant Cork								
Moss Peat								
action Human								
work Automated								
Owners action								
bag/Packing								
Box / Packing								
Engineer Agricultural								
Government Electricity								
Maintenance								
Line Drip								
rope								
of Transfer production								
gasoline								
Diesel								
Store Vegetable								
others								
Total								

• The farmer pays the commission to Vegetable and Fruit Store For sale the products, 0.6% of every $ 100.

6. **Quantity, type of fertilisers, pesticides and fungi:**

	First Season				Second Season				Total season 1+2
Type Fertilizer	Quantity	Unit Price $	Total	Not	Quantity	Unit Price $	Total	Not	
Organic fertilisers									
Potassium									
Phosphor									
Nitrogen									
Magnesium									
Calcium									
NPK balanced									
Humax									
Dab									
Pesticides									
Fungi									
Total									

7. **Are you satisfied with the quality of the fertiliser you buy?**

Question	No	Sometimes	Often	Yes
Government sector				
Private sector				

8. **Does the Ministry of Agriculture (Government) provide the required fertiliser amounts in a timely manner?**

Not Sure Sure not

9. **Does the private sector provide fertiliser at the right times?**

Not Sure Sure not

10. **Is there a delay in adding fertiliser to the crops because they are not available?**
    Yes Not

11. Do you weigh the packages using the balance or according to the personal assessment to see if there is a deficit?

Yes, I Use the balance Not, by the weight of packages

12. Are the packets you get?

Good Very Good Not Good (Poor)

13. What are the transportation costs incurred by the transfer of fertiliser from the trader to the field (farm)?

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