USING LINEAR PROGRAMMING TECHNIQUE TO DETERME THE OPTIMAL COMODITY COMBINATION IN THE GENERAL COMPANY FOR FOOD PRODUCTS - VEGITABLE OIL FACTORIES (CASE STUDY)

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ABSTRACT

The objectives of the research are to determine the optimal allocation of resources available to the general company for food products using a linear programming(LP) technique to obtain high levels of production and high levels of profits by maximizing the value of the objective function and increasing the profitability of the company, and conducting a sensitivity analysis to see the extent of changes in the optimum commodity composition in terms of quality and quantity with the level of profits in a manner commensurate with the requirements of growth in the company , the study based on the use of (LP)technique to determine the optimum production plan with the highest net income for the products under study for vegetable oil factories as well as using sensitivity analysis by using the statistical program (Win QSB) .The research showed a number of results, perhaps the most important: proof of the hypothesis of achieving high levels of production and profits as well as the optimal allocation of available resources, as the quantity of production increased from 472 tons in the actual production plan to 974 tons in the derived plan , achieving a jump estimated at 106. 4%, and the results of the optimal solution using the (LP)technique showed that the value of net income at current prices has reached 348739500 dinars, an increase of 184.6% over the net income actually achieved at current prices of 122528565 dinars for the year 2018. The research had reached a number of conclusions, perhaps the most important is the matching of the research results to the research hypothesis as well as the optimal solution using the LP technique had showed the difference in the optimum commodity composition and its quantities from the actual commodity composition of the products , the research provides a number of recommendations, the most important of which is the application of a linear programming technique to know the extent of investing available resources in a way efficiency, which helps to increase production in order to achieve economic efficiency and the need to generalize it to production units with similar conditions in order to determine the optimal use of the various production resources.

Key words: economic planning, production economics, linear programming, optimal allocation
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مجلة العلوم الزراعية العراقية -2021: 52 (3):658-674 العقابي والنصر

استخدام اسلوب البرمجة الخطية في تحديد المزيج السلعي الامثل في الشركة العامة للمنتجات الغذائية مصانع الزيوت النباتية (حالة دراسية)

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المستخلص

هدف البحث الى تحديد التخصيص الأمثل للموارد المتاحة للشركة العامة للمنتجات الغذائية باستخدام اسلوب البرمجة الخطية(LP) للحصول على مستويات مرتفعة من الإنتاج ومستويات عالية من الأرباح وذلك بتعظيم قيمة دالة الهدف وزيادة ربحية الشركة وإجراء تحليل الحساسية لمعرفة مدى التغيرات التي تطرأ على التركيبة السلعية المثلى كما ونوعا ومن حيث مستوى الأرباح بطريقة تتناسب مع متطلبات النمو في الشركة ,وقد اعتمدت الدراسة في تحديد خطة الانتاج المثلى ذات اعلى صافي عائد للمنتجات قيد الدراسة لمصانع الزيوت النباتية ,واستخدام تحليل الحساسية بالاستعانة بالبرنامج الاحصائي (QSB) ,أظهر البحث عددًا من النتائج لعل أهمها: إثبات صحة الفرضية بتحقيق مستويات عالية من الإنتاج والأرباح، وكذلك التخصيص الأمثل للموارد المتاحة، حيث ارتفعت كمية الإنتاج من 472 طن في خطة الإنتاج الفعلي الى 974 طن في الخطة المشتقة باستخدام اسلوب (LP) محققة قفزة تقدر بـ106.4 ٪ . كما ان نتائج الحل الأمثل أظهرت أن قيمة صافي الدخل بالأسعار الجارية وصلت إلى 348739500 دينار، بنسبة ارتفاع مقدارها 184.6٪ عن صافي الدخل المتحقق فعلا بالأسعار الجارية والبالغ 122528565 دينار لعام 2018 وقد توصل البحث الى مجموعة من الاستنتاجات منها مطابقة نتائج البحث لفرضيات البحث كما ان الحل الامثل باستخدام اسلوب (LP) يوضح اختلاف التركيب السلعي واختلاف كمياته عن التركيب السلعي الفعلي للمنتجات قيد الدراسة وبناء على ما تقدم فان البحث يقدم عدد من التوصيات اهمها تطبيق اسلوب البرمجة الخطية لمعرفة مدى استثمار الموارد المتاحة بشكل كفوء مما يساعد على زيادة الانتاج بهدف تحقيق الكفاءة الاقتصادية وضرورة تعميمه على الوحدات الانتاجية ذات الظروف المشابهة لتحديد الاستخدام الامثل لمختلف الموارد الانتاجية.

الكلمات المفتاحية: التخطيط الاقتصادي، اقتصاديات الإنتاج، البرمجة الخطية، التخصيص الأمثل .

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INTRODUCTION

The economic development process requires the advancement of the reality of all economic sectors, through scientific treatments based on the development of this sector through the optimal use of available resources, and in what provides the best ways to exploit these resources optimally in a manner that avoids wastage of those resources and provides an opportunity to achieve technical and economic sufficiency where the industrial sector is considered one of the important sectors that countries seek to develop in order to keep pace with the progress made in various areas of life, to meet the increasing requirements for their products(1). In spite of the interest of many industrial companies in the country in directing the available economic resources towards them to maximize their profits, the use of these resources at the company level is not carried out according to the concepts of production economics, which leads to variations in actual and possible production at the level of the production unit. The scientific planning for productive operations requires constant searching for optimal solutions to the technical, production and organizational problems faced by various companies (12).Production studies have shown that the problem of production planning integrates with the problem of determining the optimal production volume that meets the demand and at the same time achieves optimal exploitation of available resources as those in charge of planning production face several alternatives during preparation of the production plan, and the problem becomes more profound if the company deals with a mix of products, which requires the use of scientific methods that are more capable of expressing the treatment of these problems, and since these methods represent a practical tool that the company can benefit from in planning its production, the formulation of production plans must be in accordance with accurate scientific methods that are subject to change and respond to the developments emergent from the scientific reality to achieve economic efficiency (which means obtaining more production with the same quantity of available resources or obtaining the same quantity of production but with less quantity of resources)(9) to exploit the locally produced and imported resources, requires following planning methods based on scientific foundations as the policy optimizing the available economic resources and redistributing them secures ensure avoiding waste and lose , and this process should represent the forefront of the efforts of the planners as an economic problem that requires to be studied and taken care of. The vegetable oil industry is one of the important industries in the country which is related to providing vegetable oil to individuals, as well It is considered one of the pillars of the national economy as it plays an important role in the process of economic development, which depends on it the development of other sectors because it has many front and back links with the agricultural sector on the one hand and many companies and industrial plants on the other hand where the activity of the vegetable oil industry aims to produce and provide a number of commodities directly related to the needs of different individuals by converting agricultural raw materials from one of their forms to another picture that is more valid and easier to use. The industry sector in Iraq suffers from a significant slowdown in development processes in all aspects because of ineffective in production processes and lack of scientific studies that can contribute effectively to development of this sector , and the General Company for Food Products has not used the LP technique when developing production plans, therefore, the research attempt to use this method in vegetable oil factories came in order to choose a mathematical model to determine the optimal production mix as an attempt to address a specific problem according to a scientific method based on the optimal allocation of resources and then conduct a sensitivity analysis (which is based on LP technique that maximizes profit or reduces costs), to choose the best production plan with a higher net income and to determine the sensitivity of the production plan in relation to changes in objective function and constraints where decision maker become able to choose or decide a wide range of available alternatives and analyse the results of each alternative within certain assumptions and in a short time(2). The research problem is that most of the industrial companies in the country suffer from following the non-scientific method in using their available economic resources which leads to a decrease in their ability to create added value and then decrease their contribution to the formation of GDP, which results in a slowdown in the growth of this sector if we to compared what can be achieved if the decision-maker in this sector uses the appropriate methods to reallocate the available economic resources according to a scientific method in order to achieve their optimal use, and since the current reality of the General Company for Food Products indicates that it does not follow -scientific production plans based on a method scientific in determining the optimal production combination , which led to a decrease in the actual production quantity from the available energies, which led to the emergence of a deficit in the size of the commodity supply and its inability to keep pace with the internal demand for its products and thus resort to import to fill this deficiency, so it has become necessary to study this problem and put effective solutions to serve the central goal of the state, which is to provide the products to the community members due to the importance of these products. The importance of the research comes from the importance of the commodity that the General Food Products Company produces as a necessary commodity that has a relationship with the health of citizens as well as the contribution of research in rationalizing economic activity through allocating and exploit available resources in the optimal way for the company, LP technique is one of the most Mathematical methods that used in making decisions aimed at the optimal use of available resources to achieve the required goals, as the importance of this method comes from the scarcity that characterizes the various resources and helps in taking decisions that lead to the optimal use of resources in a manner that ensures the achievement of the largest return or the lowest possible cost and then achieving the highest efficiency for the economic process. Therefore, the importance of research emerges through dealing with determining the optimal production mix using LP technique and sensitivity analysis as a planning method that aims to maximize levels of production and profit and reduce waste and loose in economic resources available in one of the industrial companies in the national economy because this industry provides food products to individuals , and for the productive role which it play as the value and quantity of production , the research hypothesis based on the ability of the General Company for food Industries to optimum exploit of its available resources and its production energy by applying the proposed plan according to the LP technique instead of the plan implemented by the company, which contributes to achieve an efficiency economic and technical in production process and reducing the waste of its available resources and energies, for optimal planning for productions and optimal allocation of resources which lead to high levels of production and profits. The research aimed to contribute with the proposed plan which its structure based on the LP technique by achieving the following: determining the optimum commodities combination, using LP technique of 2018 to obtain optimal allocation for the available resources to the company, high levels of production, high levels of profitability by maximizing the value of the objective function and increasing the profitability of the company by relying on data from the company and using sensitivity analysis (post-optimization analysis) to know the extent of the changes that occur to the optimal commodity combination and the level of profits in a manner that is appropriate to the requirements of growth in the company. The research consisted of three topics, the first topic dealt with a general definition of the General Company for Food Products, the second topic dealt with the LP technique and the determination of the optimal combination of production, while the third topic dealt with identifying optimal production plans (using LP technique and sensitivity analysis) for vegetable oil factories and analyzing the results of the proposed models, in order to ends the research with a set of proposed conclusions and recommendations.

MATERIALS AND METHODS

This research was accomplished based on the descriptive analytical method, as secondary data were collected through Arabic and foreign books and references and the studies published in the field of research, in order to study the reality of using linear programming technique and demonstrate its importance in improving the quality of administrative decisions. As for the primary data, it was collected through the researcher conducting several personal interviews with those in charge of managing the company in question, which included a set of questions related to the subject of the research. And then the appropriate statistical methods were used depending on the Linear Programming Technique using the statistical program (Win QSB) In analyzing data and testing research hypotheses.

Vegetable oil factories and the reality of production (14): In this research will studied the vegetable oil factories in terms of their establishment and in terms of management, organization and work, as well as the available production resources in it. Also, their requirements, and then the net income will be defined according to the prevailing production structure in the factories. The General Company for the extraction of vegetable oils, which is currently the Al Rasheed factory, was established in 1940, started production in 1945 and its aim was to provide the local market with solid and liquid vegetable oils and other materials, on 6/5/1970 each of the companies listed below was merged into a public company which is the General Company for Vegetable Oils(14).

1.Vegetable Oil Extraction Company 1940
2.Cotton Seed Products Company 1952
3.Al-Rafidain Detergents Company 1957
4.The Industrial Printing Company 1969 .
5 .Abu Al-Hail Soap Factory 1969.

Vegetable oil factories are one of the largest factories in Iraq specialized in the products of liquid oils, solid fats, detergents and washing powders. The company owns several factories distributed throughout Iraq and among the factories deployed in Baghdad (Al-Rashid, Al-Amin, Al-Mamoun, and Al-Farabi for Industrial Printing). Vegetable oil factories are considered to be one of the first factories to obtain ISO 9001: 2008 quality matching certificate. The factories are constantly working to keep up with modern developments in the field of industries for all of their products. Recently, the production lines have been updated from international sources specialized in this field and possesses high and long-standing technical expertise over more than seventy five years, the company has a large and experienced staff in management and production operations that reaches approximately 2551 employees, but the workers in the factories are about 1166 technicians, administrators and workers. Vegetable oil factories produce many products , but the study had chosen (10) products which represented the high percentage of production, which are (toilet soap, laurel soap, washing Powder, liquid soap, toothpaste, shaving cream, shampoo, stain remover , detergents and calcifications), which have luxury qualities that meet the desires of the consumer and their production depends on raw materials of high quality according to the latest standard specifications and according to the need and desire of the consumer . Factories include 10 major production lines and design energies, as shown in Table 1

Table 1. Products and design energy of Vegetable Oil Product Factories /Year

Products	Designed Energy/ Ton
Toilet Soap	30000
Laurel Soap	11550
Washing Powder	8500
Liquid Soap	7000
Toothpaste	575
Shaving Cream	800
Shampoo	1600
Stain Remover	3000
Liquid Detergent	42600
Calcification Remover	75

Source: General Company for Food Products / Cost account Section

LP technique and determining the optimal mix of production (17)

Mathematical Programming refers to a set of mathematical methods that can be used to find the optimal set of solutions to economic problems that include Objective Function with multiple variables with a set of constraints that are in the form of inequalities (smaller than or greater than or equal to) Mathematical programming includes three mathematical methods are (10): 1- Linear Programming , 2- non-Linear Programming, 3- dynamic programming. The decision-making process includes choosing the optimal decision from a set of alternatives (possible decisions) to accomplish a specific goal for the organization(4), and that many problems in the business field management of the organization can be formed in the form of mathematical programming and on this basis the problem in mathematical programming is to find optimum values for Objective Function is with a set of restrictions, and that all of these relationships can be described mathematically(3) . Nonlinear programming that emerged in 1952 represents a set of mathematical methods that can be used to find the optimal set of solutions to problems that contain nonlinear relationships to the objective function as well as constraints (22). As for the dynamic programming that appeared in 1957, it represents another new technique that includes a set of mathematical methods that can be used in the decision-making process for a set of successive relationships in management field (8).

Linear programming (LP) technique

The first who use linear programming (LP) was Dantzig in 1947 and Marshall (20), as it was used as a means to find the optimal solution to planning problems in the US Air Force, and the use of LP technique quickly spread to very broad areas of business administration, industry and agriculture, where It seemed as an effective and important tool that helps the enterprise manager to make the right decisions during the decision-making process, and included its use from the government sector to the industrial business , and agricultural sectors, and the importance of using LP technique in identifying possible alternatives to achieve (5), LP technique is an effective tool for companies through which can reaching the optimum solutions for many of problems that it faces. Experience and practical application have shown that this technique is economically effective and has a significant impact on the level of companies 'performance and increasing their production. Therefore, this technique has been widely used in addressing many productive and economic problems (23). LP technique is a set of mathematical methods to find optimal solutions to multiple problems, including linear relationships to variables in the Objective Function and in constraints (11). It is a mathematical technique used to solve economic problems with specific characteristics, namely the existence of a Linear Objective Function for maximization or minimization, with many alternatives to achieve an Objective Function with a set of constraints, it is represented by the existence of specific production (components) resources to achieve each alternative (7). Therefore, LP technique represents a method for selecting the optimal alternative from among these alternatives (solutions) and that these determinants are in variations smaller than or greater than or equal to(14) , on this basis LP technique include process of determining the optimum level for a dependent variable includes Objective Function that has linear relationships with some independent variables (X`s) in the presence of a set of linear constraints that includes these independent variables in varying ways: the dependent variable is called Objective Function while the independent variables are called decision variables or Choice variable(13), and the best solution to LP problem is to find the optimal set of solutions for these decision variables and the value corresponding to the Objective Function. **Mathematical form setting for LP (15).** There are three types of information which LP setting needs.

A- Decision Variables, b. Objective Function, c. Constraint as it had been shown previously that the LP model consists of a linear Objective Function consisting of a set of decision variables to be maximized or minimized and that constitute productive alternatives available to the decision-maker and in the presence of a set of constraints or determinants (Constraints) that are in the form of a mathematical contrast that takes the form of Greater than or equal to (≤) or smaller than or equal to (≥). Assuming that there are (n) decision variables from the objective function (Z) and the number (m) of determinants or constraints, the mathematical form of LP model takes the following form

$Max\ , or\ Min. Z = \sum_{j=i}^{n} \text{Cj Xj}$

S.to

$\sum_{j=i}^{n} \text{aij Xj} \ (\geq, =, \leq) bi$

$X_j \geq 0$

i = 1, 2………., m

j = 1, 2……., n

Cj, bi, aij=constants m=number constrains, n=number of variables

Sensitivity analysis or post optimality analysis

The great advantage of mathematical programming in general and LP in particular is that it allows the decision-maker to choose a wide range of adjustments in the available alternatives and analyze the effects of these adjustments on the optimal solution for LP with a short period of time(6), especially after the availability of Parametric LP software, and this is what they express (analysis Sensitivity or post optimality analysis). A decision-maker in order to obtain a full and broad interpretation of the plans obtained through the optimal solution of LP model, wishes to test the stability of this optimal solution and the extent that remains stable and constant from the values of one or some of the factors involved in LP model which are always largely unknown or known, and with certainty, but in most cases these values are determined according to objective or partial expectations or future forecasts. Sensitivity analysis allows the decision maker to deal with many questions, including (19):

1-The extent of stability of activities (decision variables) included in the optimum solution for LP, and what is its relevance range

2-How changes (increase or decrease) in one or some of the determinant values (constraints) can affect the optimal mix of activities as well as the value of the optimal solution, which is profit in (maximization) or costs in (minimization).

3-How to read the price relationships of the productive resources of the total return of the productive activities on the optimal solution. The answer to such questions can also be achieved through the correct analysis of the information provided by the optimal solution form of information in the shadow price that is included in the optimal solution, the shadow prices for real activities (non-essential Xj) that are not included in the final optimal solution, indicate how much the value of the optimal solution decreases if we are forced to enter these variables into the optimal plan, and then the strength of competition between these activities can be determined, likewise, the shadow prices for the Slack Variables) for each production resource appearing in the optimal solution, representing the amount of Marginal Contribution of income from last unit of that resource if it is added , the process of a sensitivity analysis of the optimal solution can take the following forms(18) : -

1-Change in variables values of Objective Function.

A- Non-Basic Variables B- Basic Variables ,

2 -Changes in technical transactions for constraints (aij).

3- Changes in the values of the right side of the constraints RHS.

4- Adding new restrictions.

5-Adding new variables (activities)

It is evident from the above that LP represents an effective mathematical technique to deal with the problems of optimal allocation of resources and thus provides an advantage for decision-making is the ability to choose or define a wide range of alternatives available and analyze the consequences of each alternative within specific assumptions and in a short time.

Determine optimal production plans for Vegetable Oil Factories, analyze data, and discuss model results

In this topic, the practical aspect of the optimal allocation of resources will be covered using a LP technique by formulating a mathematical model for vegetable oil factory products, and then analyzing the results .The most important stage in LP model is formulation of the model that is based on the fact that the company aims to maximize total net income by producing several products subject to specific constraints, and after formulating LP model we applied the Quantitative System for Business (QSB)(21) , that maximizes profit using the Simplex method approved in solving LP problems to arrive the optimal production plan for 2018.

LP setting and defining the optimal commodity mix.

To achieve the goals of the research, we will formulate a LP model for vegetable oil factories for the year 2018 to obtain the optimal allocation of resources that maximizes total net income for products, as the target model is a restricted mathematical model for calculating best income for best plan and best production mix that maximizes net income. LP model setting requires defining the Objective Function and determining the constraints and determinants of technical coefficient that a unit of production per product needs. Depending on the data obtained from the company's records, the Objectives Function can be formulated and the technical parameters and constraints for LP model can be formulated as following:

1-Determination of the data used in the LP Form (20.21)

A- Defining Objective Function: Objective Function in LP model represents maximizing the total expected net income as following:

Max $\sum_{j=1}^{10} C_jX_j = C_1X_1 + C_2X_2 + C_3X_3 \ldots\ldots\ldots\ldots C_{10}X_{10}$

$\sum_{j=1}^{10} C_jX_j$ = represents the total value of the objective function to be maximized (total net income for the factory.

C_j = net income from produce j.

Xj = output level achieved of the product (j), where (j = 1,2, ..., 10)) is the activity level

formulating the model aims to determine the optimal mix of products that achieve the greatest possible net income according to the available capabilities.

B - Determine the technical data of the matrix of technical coefficients of the constraints which represent the needs of products from the various production requirements per unit and which represent left- hand side (LHS).

C- Determining the available quantities of production requirements in the vegetable oil factories, which represent the right-hand side RHS.

RESULTS AND DISCUSSION

Formulating the LP model of Vegetable Oil Factories Productions 2018

The research aims to achieve the optimum utilization of available quantities of resources for production and its factors and to maximize profits in LP from. The products which produced by factories are: toilet soap x1, laurel soap x2, washing powder x3, liquid soap x4, toothpaste x5, shaving paste x6, shampoo x7, Stain remover x8, Liquid detergent x9, Calcification remover x10, and based on data obtained from the General Company for Food Products which represented the needs of products to various production requirements and available quantities as well as costs and net income per unit from various production activities, it is possible to formulate the Objective Function and define technical transactions and constraints for the LP model and the model will formulate as following:

A- Objective Function Data

From Table (2), column 4 which represented net income per unit we can form Objective Function of LP model where aim to maximize the total net income at current prices achieved from various productive activities ,the 10 activities produced during the year 2018, which are shown in Table 2, which shows the selling prices , costs, and net income per unit for each product for the year 2018. The vegetable oil factories produce other products, but our selection of the products which constitutes the largest percentage of total production, which is estimated at about 90% of the total production for the factories where the rest of the products constitute small proportions of the total production, the formulation of Objective Function as following.:

Maximize (Z) = 147214X1 + 132710X2 + 239673X3 + 96502X4 + 1624185X5 + 974156X6 + 163761X7 + 155582X8 + 115449X9 + 201245X10

B- Data for the matrix of technical transactions of the constraints The Objective Function of the model was restricted to 86 constraints, the left-hand side (LHS) represents the needs of each unit and the right-hand side (RHS)represents the available quantities, the constraints are as follows:

1-Determine the technical transaction matrix and available quantities of raw materials used in production; technical transactions represent the production requirements per unit for each product whether from raw materials, working hours, Capital and others.

These constraints are determined based on the technical standards required to produce one unit of the product, the amount of what is needed to produce one unit of these materials for each product has been obtained from company records according to the mixing ratios applied in the Factories ,table 3(which represents the Form 1 matrix) shows what is needed for the production of one unit per product of raw materials and the quantities available of these materials during 2018. These materials were represented by the constraints numbered from c11-c65 in Form 1.

Table 2. Prices, costs, incomes and quantities for each product 2018 at current prices /Ton

Products (1)	(2) Selling Price/D	(3) Total Cost/D	(4) Net Income /D	Ton Quantities/ (5)
Toilet Soap X1	2500000	2352786	147214	10.12
Laurel Soap X2	2500000	2367290	132710	7.20
Washing Powder X3	1875000	1635327	239673	1.80
Liquid Soap X4	1250000	1153498	96502	62.24
Toothpaste X5	13333396	11709211	1624185	30.22
Shaving cream X6	9999966	9025810	974156	8.94
Shampoo X7	2380948	2217187	163761	166.04
Stain RemoverX8	1125000	969418	155582	91.64
Liquid Detergent X9	1764714	1649265	115449	52.61
Calcification Remover X10	2000000	1798755	201245	41.40

Source: General Company for Food Products / Cost account section.

2-Determine the production energy of the factories for each product: The data for this constraint is related to production lines, the production energy of factories for each product represented according to the available and actual production energy .Table 4(column4,5), shows actual and available energy of vegetable oil factories for each type of products for year 2018, which is represented by restrictions from c67 -c76 in Form1.

3- Determining the working time required for production: Table 4 (column 2,3) shows the time (needed and available) to produce one unit of each product. Time dimension of the production process is determined (or restricted) by the available hours of work during year 2018, in addition to the standard and technical specifications required for the production of one unit for each product, the working hours available annually was estimated according to the following formula:

- number of employees × number of actual working hours during the day × number of working days per year 2018,**.**The standard of working hours has been adopted in calculating the cost of time required to produce one unit due to the nature of the productive art applied in the company, and the actual number of working days during the year has been limited to 250 days, after subtracting Fridays, official holidays and employee licenses. Which is represented by the limitations of c1-c10 in Model 1

Table (3) (Form 1 Matrix) Quantities Required from The Primary Materials for The Production of a Single Unit and The Quantities Available from Them 2018

	Quantities Required	Toilet Soap X1	Laurel Soap X2	Washing Powder X3	Liquid Soap X4	Tooth Paste X5	Shaving Cream X6	Shampoo X7	Stain Remover X8	Liquid Detergent X9	Calcification Remover X10	Quantities Available
1	Stearic acid			0.00025			0.00032					0.51
2	Coconut oil acid						0.00011					0.025
3	Potassium hydroxide						0.000135					0.79
4	Soduim hydroxide						0.000013					0.8
5	Glycerin						0.00006					0.8
6	Sorbitol						0.09					185
7	Alcohol style						0.005					1
8	Arkansan					0.003	0.005					3
9	Boric acid						0.006					1
10	Alumina Alfa hydrox					0.5						25.6
11	Sodium Laurel SLS					0.2						10.5
12	CMC7M Sodium Carboxy					0.005						0.5
13	Soduim Fluoride					0.006						0.5
14	Soduim Mono Phosphite					0.002						0.3
15	Screen					0.003						1
16	Titanium Dioxide	0.001				0.005						1
17	Empekole 100 %				0.07			0.1				18.1
18	Kembertlan				0.02			0.02				4.2
19	Amphoteric Cleaner							0.025				6
20	Polly Cole							0.02				2.75
21	Formalin				0.002			0.01				2
22	Pearly							0.01				1.4
23	Table Sait		0.1					0.025				7
24	Perfume Zahi							0.004				0.6
25	Pink Tint		0.0002					0.0004				0.06
26	Khawa Clay							0.03				3.8

Source: General Company for Products-Cost Account Section

Supplement of Table (3)

	Quantities Required	Toilet Soap X1	Laurel Soap X2	Washing Powder X3	Liquid Soap X4	Tooth Paste X5	Shaving Cream X6	Shampoo X7	Stain Remover X8	Liquid Detergent X9	Calcification Remover X10	Quantities Available
27	Olive Oil							0.008				1.2
28	Yellow Pigment		0.0002					0.0004				0.06
29	Nutty Tincture			0.0002				0.00003				0.05
30	Ink Blue Dye		0.0002									0.001
31	Concentrated Hydraulic Acid										0.105	12
32	Refresh Blue Perfume				0.004							0.4
33	Apple Perfume				0.004							0.6
34	Nacl				0.022							2
35	Sulfonic									0.25		44
36	Polyphosphate									0.17		30
37	Sodium Carbonate									0.15		4
38	Base Sodium Silicate									0.075		2
39	SS Sodium Sulfate									0.3		7
40	Scmc7M									0.01		120
41	Barbite									0.2		4.5
42	Perfume									0.003		51
43	Flashy Substance									0.0002		0.8
44	Stearin Oil		0.21	0.41								17.3
45	Sunflower Oil		0.082	0.328								511
46	Nervnide Substance		0.0002	0.0002								6
47	Soap Oxidizer		0.0005	0.0005								9
48	Kostek Soda Crust Concentrate	0.13	0.13									41.7
49	Industrial Olive Oil		0.082	0.082								4
50	Laurel Oil		0.1									0.3
51	Palm Kernel Oil		0.08									8
52	Tincture of Chlorophyil		0.2	0.2								8.5
53	Laurel Perfume		0.003									1
54	Soraya Perfume			0.004								0.2
55	Hypo								0.65			155

Table 4. (Required& available) time, (actual& available) energy to produce each product

Products (1)	Time required/ H (2)	Time Available /H (3)	Actual Energy/T (4)	Available Energy/T (5)
Toilet Soap	0.417	42000	10.12	15800
Laurel Soap	1.176	28000	7.2	3000
Washing Powder	1	24500	1.8	4000
Liquid Soap	10	117250	62.24	4000
Toothpaste	6.667	80500	30.22	75
Shaving Cream	8	31500	8.94	150
Shampoo	5.882	183750	166.04	300
Stain Remover	0.769	159250	91.64	2400
Liquid Detergent	0.294	112000	52.61	2300
Calcification Remover	25	108500	41.4	60

Source: General Company for Food Products / Cost account Section

4-Determining capital required to produce one unit of each product This constraint represents the need from capital to produce one unit of product, as it represents the total production costs for one unit for each product and is shown in Table 2, which includes the costs of raw materials, work, industrial expenses and other expenses, and that the total costs of the products that appear in The plan must not exceed the capital available for the vegetable oil plant for the year 2018, which is 3236414000 D at current prices, and it is noted that this value is greater than the sum of the total costs of products for the year 2018, thus the cost constraint can be written as in the following form, which is represented by C66 in Form

$$\mathbf{C66 = 2352786X1 + 2367290X2 + 1635327X3 + 1153498X4 + 11709211X5 + 9025810X6 + 2217187X7 + 969418X8 + 1649265X9 + 1798755X10 \leq 3236414000}$$

5-Non-Negativity Constraints It means that all the variables in the model must be positive, that is, they are greater or equal to zero, which were represented by constraints from c77-c86 in Model 1 .After defining the most important basic constraints and non-negativity constraints, We moved to the stage of determining the actual formulation of LP model for vegetable oil product factories which Maximize net return for the company for 2018 as shown in the following form 1.

: **Form1. The Final Form of the LP Model - Vegetable Oil Factories for the year 2018 at current prices**

$$\text{Maximize } (Z) = 147214X1 + 132710X2 + 239673X3 + 96502X4 + 1624185X5 + 974156X6 + 163761X7 + 155582X8 + 115449X9 + 201245X10$$

$$C1 = 0.417X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 42000$$

$$C2 = 0X1 + 1.176X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 28000$$

$$C3 = 0X1 + 0X2 + 1X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 24500$$

$$C4 = 0X1 + 0X2 + 0X3 + 10X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 117250$$

$$C5 = 0X1 + 0X2 + 0X3 + 0X4 + 6.667X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 80500$$

$$C6 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 8X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 31500$$

$$C7 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 5.882X7 + 0X8 + 0X9 + 0X10 \leq 183750$$

$$C8 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0.769X8 + 0X9 + 0X10 \leq 159250$$

$$C9 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.294X9 + 0X10 \leq 112000$$

$$C10 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 25X10 \leq 108500$$

$$C11 = 0X1 + 0X2 + 0.00025X3 + 0X4 + 0X5 + 0.00032X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.51$$

$$C12 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.00011X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.25$$

$$C13 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.000135X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.79$$

$$C14 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.00013X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.8$$

$$C15 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.00006X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.8$$

$C16 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.09X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 185$
$C17 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.005X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 1$
$C18 = 0X1 + 0X2 + 0X3 + 0X4 + 0.003X5 + 0.005X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 3$
$C19 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0.006X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 1$
$C20 = 0X1 + 0X2 + 0X3 + 0X4 + 0.5X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 25.6$
$C21 = 0X1 + 0X2 + 0X3 + 0X4 + 0.2X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 10.5$
$C22 = 0X1 + 0X2 + 0X3 + 0X4 + 0.005X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.5$
$C23 = 0X1 + 0X2 + 0X3 + 0X4 + 0.006X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.5$
$C24 = 0X1 + 0X2 + 0X3 + 0X4 + 0.002X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.3$
$C25 = 0X1 + 0X2 + 0X3 + 0X4 + 0.003X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 1$
$C26 = 0.001X1 + 0X2 + 0X3 + 0X4 + 0.005X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 1$
$C27 = 0X1 + 0X2 + 0X3 + 0.07X4 + 0X5 + 0X6 + 0.1X7 + 0X8 + 0X9 + 0X10 \leq 18.1$
$C28 = 0X1 + 0X2 + 0X3 + 0.02X4 + 0X5 + 0X6 + 0.02X7 + 0X8 + 0X9 + 0X10 \leq 4.2$
$C29 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.025X7 + 0X8 + 0X9 + 0X10 \leq 6$
$C30 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.02X7 + 0X8 + 0X9 + 0X10 \leq 2.75$
$C31 = 0X1 + 0X2 + 0X3 + 0.002X4 + 0X5 + 0X6 + 0.01X7 + 0X8 + 0X9 + 0X10 \leq 2$
$C32 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.01X7 + 0X8 + 0X9 + 0X10 \leq 1.4$
$C33 = 0X1 + 0.1X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.025X7 + 0X8 + 0X9 + 0X10 \leq 7$
$C34 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.004X7 + 0X8 + 0X9 + 0X10 \leq 0.6$
$C35 = 0X1 + 0.0002X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.0004X7 + 0X8 + 0X9 + 0X10 \leq 0.06$
$C36 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.03X7 + 0X8 + 0X9 + 0X10 \leq 3.8$
$C37 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.008X7 + 0X8 + 0X9 + 0X10 \leq 1.2$
$C38 = 0X1 + 0.0002X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0.0004X7 + 0X8 + 0X9 + 0X10 \leq 0.06$
$C39 = 0X1 + 0X2 + 0.0002X3 + 0X4 + 0X5 + 0X6 + 0.00003X7 + 0X8 + 0X9 + 0X10 \leq 0.05$
$C40 = 0X1 + 0.0002X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.001$
$C41 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0.105X10 \leq 12$
$C42 = 0X1 + 0X2 + 0X3 + 0.004X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.4$
$C43= 0X1 + 0X2 + 0X3 + 0.004X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.6$
$C44= 0X1 + 0X2 + 0X3 + 0.022X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 2$
$C45 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.25X9 + 0X10 \leq 44$
$C46 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.17X9 + 0X10 \leq 30$
$C47 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.15X9 + 0X10 \leq 4$
$C48 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.075X9 + 0X10 \leq 2$
$C49 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.3X9 + 0X10 \leq 7$
$C50 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.01X9 + 0X10 \leq 120$
$C51 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.2X9 + 0X10 \leq 4.5$
$C52 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.003X9 + 0X10 \leq 51$
$C53= 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0.0002X9 + 0X10 \leq 0.8$
$C54 = 0X1 + 0.21X2 + 0.41X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 17.3$
$C55 = 0X1 + 0.082X2 + 0.328X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 511$
$C56 = 0X1 + 0.0002X2 + 0.0002X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 6$
$C57 = 0X1 + 0.0005X2 + 0.0005X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 9$
$C58 = 0.13X1 + 0.13X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 41.7$
$C59 = 0X1 + 0.082X2 + 0.082X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 4$
$C60 = 0X1 + 0.1X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.3$
$C61 = 0X1 + 0.08X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 8$
$C62 = 0X1 + 0.2X2 + 0.2X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 8.5$
$C63 = 0X1 + 0.003X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 1$
$C64 = 0X1 + 0X2 + 0.004X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 \leq 0.2$
$C65 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0.65X8 + 0X9 + 0X10 \leq 155$
$C66 = 2352786X1 + 2367290X2 + 1635327X3 + 1153498X4 + 11709211X5 + 9025810X6 + 2217187X7 + 969418X8 + 1649265X9 + 1798755X10 \leq 3236414000$

C67 = 1X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 15800
C68 = 0X1 + 1X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 3000
C69 = 0X1 + 0X2 + 1X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 4000
C70 = 0X1 + 0X2 + 0X3 + 1X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 4000
C71 = 0X1 + 0X2 + 0X3 + 0X4 + 1X5 + 0X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 75
C72 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 1X6 + 0X7 + 0X8 + 0X9 + 0X10 ≤ 150
C73 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 1X7 + 0X8 + 0X9 + 0X10 ≤ 300
C74 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 1X8 + 0X9 + 0X10 ≤ 2400
C75 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 1X9 + 0X10 ≤ 27300
C76 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 + 0X8 + 0X9 + 1X10 ≤ 60
C77 = 1X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 +0X8+ 0X9+0X10 ≥ 0
C78 = 0X1 + 1X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 +0X8+0X9+ 0X10 ≥ 0
C79 = 0X1 + 0X2 + 1X3 + 0X4 + 0X5 + 0X6 + 0X7 +0X8+0X9+ 0X10 ≥ 0
C80 = 0X1 + 0X2 + 0X3 + 1X4 + 0X5 + 0X6 + 0X7 +0X8+0X9+ 0X10 ≥ 0
C81 = 0X1 + 0X2 + 0X3 + 0X4 + 1X5 + 0X6 + 0X7 +0X8+0X9+ 0X10 ≥ 0
C82 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 1X6 + 0X7 +0X8+0X9+ 0X10 ≥ 0
C83 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 1X7 +0X8+0X9+ 0X10 ≥ 0
C84 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 +1X8+0X9+ 0X10 ≥ 0
C85 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 +0X8+1X9+ 0X10 ≥ 0
C86 = 0X1 + 0X2 + 0X3 + 0X4 + 0X5 + 0X6 + 0X7 +0X8+1X9+ 1X10 ≥ 0.

After the completion of formulation of the model, we moved to the stage of determining the optimal solution and analysis the results and sensitivity analysis.

Determining the optimal commodity mix in Vegetable Oil Products Factories, analyzing data and discussing the results

After completing the mathematical formulation of the Objective Function and the constraints of the LP model, we applied the QSB (special program for solving LP problems) based on the data model for factory products in the purpose of analysis , the optimal solution results shows ,that the value of net income at current prices has reached 348739500 D, an increase of 184.6% over the net income actually achieved at current prices of 122528565 D for the year 2018, as it was calculated by the researcher by multiplying (the value of net income at current prices for each product by the quantities of production) as has shown in the table 2 ,then collect the result of the multiplication , the optimal solution using LP method has shown that the resources that had used , which represents the left hand side of the model (LHS), is less than the available resources, which represents the right hand side (RHS) of the model, which means that the optimal plans have used less resources and gave greater net income , and the productive structure will not change if the income of (X1, X3, X4, X5, X6 ,X7,X8 ,X9 andX10) will change from(X1. a min of 107036.7 D/ Unit(U) and a max of 164695.7 D) (X3, Amin of 102322.50 D/U and a max of M.D),(X4, a min of 89696.47 D/U and a max of M.D), (X5 a min of 732646.3D/ U and a max of M .D).(X6 a min of 564745.6 D/U and a max of M.D), (X7, a min of 138729.6 D/ U and max of 173483.2 D),(X8, a min of 60656.6 D/unit and a max of M.D), (X9, a min of 103194.6D/U and a max of M.D) and (X10 , a min of 112548.2 D/ U and Max of M.D) respectively as had shown in table (5)

Table 5. Results of optimal solution

Products	Allowable Min. c(j)	Allowable Max. c(j)
Toilet Soap X1	107036.7	164695.7
Washing Powder X3	102322.5	M
Liquid Soap X4	89696.47	M
Toothpaste X5	732646.3	M
Shaving cream X6	564745.6	M
Shampoo X7	138729.6	M
Stain RemoverX8	60656.55	M
Liquid Detergent X9	103149.6	M
Calcification Remover X10	112548.2	M

Source; The table is organized by the researcher depending on the results of the optimum solution.

Table 6.showes the fully exploited productive resources that represent limited resources which had represented by alumina C20, alpha hydroxide ampicol 100% C27, sodium chloride C44 ,, and bisulfite C51, and citrines oil C54, hypo, C65 and capital, available C66 pure paste Shaving, C72 is the energy available from the calculator, C76, adding one unit of the C20 will add to the target function value 1783078 dinars and up to 26.25 units maximum, while one unit of C27 adds an amount of 250314.4 dinars to a maximum of 18.27 units, and C44 adds an amount of 309342.5 dinars, up to a maximum of 2.13 units, while one unit of the C51 adds an amount of 61271.81 dinars to a maximum of 4.67 units, and one unit of C54 adds an amount of 33,500.15 dinars to a maximum of 17.42 units It also adds one unit from C65 for an amount of 0.06 dinars up to M and adds one unit of C72 for a amount of 409410.4 dinars to a maximum of 166.67 units as well as adding one unit from C76 for an amount of 88696.77 dinars to 144.29, a maximum unit and this is reflected in the Shadow Prices for these resources. In view of the importance of the current productive structure and the availability of surplus resources needed for production, we have conducted a number of alternatives on the costs of production requirements and product prices by the sensitivity analyzing to demonstrate their impact on the proposed model to reach optimal plans that can be adopted by factories management and choose what suits them in light of the capabilities available in the company

Table 6. The fully exploited productive resources

Constraints	Shadow Price	Allow-able Min RHS	Allow-Able Max RHS
C20	1783078	13.56	26.25
C27	250314.4	6.36	18.27
C44	309342.5	1.71	2.13
C51	61271.81	0	4.67
C54	33500.15	0	17.42
C65	146039.1	0	471.98
C66	0.06	-M	M
C72	409410.4	118.76	166
C76	88696.77	0	144.29

Source; The table is organized by the researcher depending on the results of the optimum solution.

Sensitivity Analyses

To clarify the sensitivity analysis cases on the basis of which the extent of possible changes in the components of the model will be identified, the researcher analyzed the sensitivity of the optimal production plan as follows: The sensitivity analysis included the following forms (16):

A- Sensitivity analysis of the optimal solution (Basic Solution) to the changes in the parameters of Objective Function (17)

Sensitivity analysis in this case includes a 10% decrease in the probability of a decrease in the prices per unit of products by 10% over the prices of the first plan products, and it has achieved Objective Function of 313865600 dinars, a decrease of 34873900 dinars from the first plan Objective Function and the same productive structure and quantities achieved.

B- Sensitivity analysis of optimal solution to changes in constraints coefficients.

This analysis includes the following possibilities:

1 - The probability of an increase in the total costs of per unit of production by 10%. This plan has achieved an Objective Function of 330330100 D and a decrease of 18409400 D from the first 0bjective Function has achieved. There is also a decrease in the production quantity of x1 and the same production structure for the optimal solution.

2-The probability of a decrease in the prices per unit of products by 10% over the prices of the first plan and an increase in the total costs of per unit of production by 10% of the first model. This plan has achieved an Objective Function of 297297200 D and a decrease of 51442300 D from the first Objective Function has achieved. This plane has achieved the same production structure for the optimal solution and the same products quantities of plan 3.

3- Reducing the available capital by 10% from what is in the first plan, and this plan has achieved Objective Function of 328,489,200 D, a decrease of 20,250,300 D from the first plan and the same production structure in the optimal solution, with a decrease in the production quantities of the product x1 than it achieved in the optimal solution for the first plan and the second probability plan In sensitivity analysis of changes in the coefficients of constraints.

The study showed a number of results, perhaps the most important of which are:

1-Proof of the hypothesis of achieving high levels of production and profits as well as the optimal allocation of available resources, as the quantities of production increased from 472 units in the actual production plan to 974 units in the derived plan using the LP method, achieving a jump of 106.4%

2-The plan derived from the LP model differs from the actual production plan for the year 2018 in terms of the value of net income, where the results of this plan showed the optimal use of all available resources, and that the value of net income at current prices has reached 348739500 D, an increase of 184.6% from the net Income actually achieved at current prices of 122528565 D for the year 2018.

3- The optimal solution using LP technique shows us that the exploit of resources which represents the LHS of the model, is less than the available resources RHS, which means that the optimal plans have used less resources and gave more net income. The optimum solution for the structure of the production of the first plan also showed the following: A-Productive structure represented by, toilet soap X1, washing powder X3, liquid soap X4, toothpaste X5, shaving paste X6,shampoo X7 , stain remover X8, liquid detergent X9, Calcification removerX10 , includes that the productive resources that have been fully exploited and that represent limited resources that represented by Alumina C20, Alpha Hydroxide Ampicol 100% C27, table salt (NaCl) C44 ,, and Berberite C51, and Citarin C54, Hypo, C65 and Capital, C66 fluorine available for shaving cream, C72 Energy available from Calcification remover C76 added of one unit of (C20, C27, C44, C51, C54, C65, C66, C72, C76), will add to the Objective Function value of (C20 ,1783078 D, up to a max of C5126.25 U), (C27, 250,314.4 D to a max of 18.27 U), (C44, 309342.5 D to a max of 2.13 U), (C51 ,61271.81 D, to a max 4.67 U), (C54, 33500.15 D to a max of 17.42 U), (C65, 0.06 D to M U), (C72, 409410.4 D to a maxi 166.67 U) and (C76m 88696.77 D to 144.29 U). respectively, this is what Shadow Prices reflects for these resources.

B-The results of the LP technique showed efficiency in the optimal allocation of resources and the ability of decision-makers to make decisions by increasing profits in line with available capabilities.

4- The results of the sensitivity analysis in the LP technique for the Objective Function parameters, the constraints used and the technical parameters showed the following: **A-** The results of the sensitivity analysis of Objective Function parameters indicated that the upper and lower limits of the change in the gross margin of net gross income for each product ensure that these products remain within the optimal production volume, and it was found that there is possibility for the decision-maker to change the prices of products in line with competitive market conditions and approved price policies.

B - The results of the sensitivity analysis of the alternative plans showed a decrease in the value of Objective Function and the production structure itself and the quantities exploited from the resources available for the initial plan, but there are differences in the quantities allocated to the production structure between increase and decrease. From the previous conclusions, we can provide a number of recommendations, perhaps the most important of them: using LP technique to know the extent to invest the available resources efficiently, which helps to increase production. Also, the need to generalize this method and apply it in the rest of the factories with similar conditions to determine the optimal use of the various productive resources available. To increase the resources whose prices are positive (Shadow Prices) which include alumina, alpha hydroxyamino 100%; table salt, barbet, citrine oil, hypo, capital, energy available for shaving cream, energy available for stain remover for the purpose of taking advantage of other surplus resources whose shadow prices are zero in order to increase production. The company must take a scientific approach to address the lost in available resources . improving the organization's quantitative performance in general and production in particular. The necessity to rely on mathematical and quantitative methods for diagnosing and solving various economic problems. The necessity of an advanced production system that depends on quantitative methods and advanced programs through which the institution can determine the optimal production mix that guarantees maximum profit for the lowest costs. Not following the traditional methods in regards to controlling production and stock and relying on modern methods. The necessity of employees understanding the quantitative methods and their application, especially those supervising planning, production and the various processes related to it.

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