USING MOTAD MODEL TO DETERMINE EFFICIENT PRODUCTION PLANS IN AL-KADHIMIYA AGRICULTURE DIVISION FARMS UNDER RISK AND UNCERTAINTY CONDITIONS 2012-2017

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ABSTRACT
The objective of this research is to determine the current crop structure of Al- Kadhimiya Agriculture Division farms in order to determine the optimal use of the economic resources available for the purpose of achieving optimum crop structure that maximizes profits and total and net agricultural incomes. The study based on the use of (LP) technique to determine the optimum agricultural production plan with the highest net income using the statistical program (QSB), as well as (MOTAD) model was used to determine efficient agricultural plans (Income - Deviation) (E-A) and derive plans that take into account the risk margin of each farm plan using (MOTAD), as a model of alternative (LP) models for quadratic programming models, which used to determine the optimal farm production plans under conditions of risk and uncertainty, and sensitivity analysis was used of this model. The research has reached a number of conclusions, perhaps the most important of which is the matching of the research results to the research hypotheses. It was also found that the efficient plans that take into account the margin of risk have differed from the optimal plans which do not take into account the risk conditions which aim to maximize the expected income represented by the first plan obtained from using LP model. One of the most important recommendations of the research is that farmers should include the risk and uncertainty component within their plans to be more accurate and efficient by using mathematical models to analyze and determine efficient production plans under the risk and uncertainty conditions which represented by MOTAD model.

Keywords: margin of risk , risk management, sensitivity analysis, linear programming, optimal allocation.

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استخدام انموذج الموتاد لتحديد خطط الانتاج الكفوءة في مزارع شعبة زراعة الكاظمية في ظل ظروف المخاطرة واللايقين 2012-2017

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المستخلص
يهدف البحث الى معرفة واقع التركيب المحصولي الراهن لمزارع شعبة زراعة الكاظمية بهدف الوقوف على الاستخدام الأمثل للموارد الاقتصادية المتاحة للتوصل إلى التركيب المحصولي الأمثل الذي يحقق تعظيما للأرباح ولإجمالي وصافي الدخول المز رعية. اعتمدت الدراسة على استخدام أنموذج البرمجة الخطية في تحديد خطة الإنتاج المز رعي المثلى ذات أعلى صافي دخل بالاستعانة بالبرنامج الإحصائي (QSB),كما استخدم أنموذج الموتاد(MOTAD) لتحديد خطط الإنتاج المز رعي الكفوءة ذات(الدخل – الانحراف) المثلى (E-A) واشتقاقها والتي تأخذ بالحسبان هامش المخاطرة المتحقق من كل خطة مزرعية ،كأنموذج من نماذج البرمجة الخطية البديلة عن نماذج البرمجة التربيعية المستخدمة في تحديد خطط الإنتاج المزرعي المثلى في ظل ظروف المخاطرة واللايقين وتحليل الحساسية لهذا الأنموذج. وقد توصل البحث الى مجموعة من الاستنتاجات لعل اهمها مطابقة نتائج البحث لفرضيات البحث كما تبين ان الخطط الكفوءة التي تأخذ بعين الاعتبار هامش المخاطرة قد اختلفت عن الخطط المثلى والتي لاتأخذ بنظر الاعتبار ظروف المخاطرة ,واللايقين والتي تهدف الى التعظيم المطلق للدخل المتوقع والمتمثلة بالخطة الاولى التي تم الحصول عليها من استخدام انموذج البرمجة الخطية ومن اهم توصيات البحث: على المزارع تضمين عنصر المخاطرة واللايقين ضمن خططه لتكون أكثر دقة وكفاءة وذلك عن طريق استخدام النماذج الرياضية في تحليل خطط الإنتاج الكفوءة وتحديدها في ظل ظروف المخاطرة واللايقين والمتمثلة بأنموذج الموتاد .

الكلمات المفتاحية: هامش المخاطرة, ادارة المخاطرة , تحليل الحساسية ,البرمجة الخطية ,التخصيص الامثل.

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INTRODUCTION

As the conditions of agricultural production are characterized by volatility and instability as a result of a variety of factors such as environmental conditions, general economic policies, market forces, inventions, technology and other factors that interact with each other to be a state of lack of knowledge and uncertainty of economic variables that lead to the emergence of risk conditions which faces the agricultural producer (decision-maker) in the decision-making process, so risk management and methods of dealing with it have attracted the interest of agricultural economic researchers and government institutions and have taken multiple directions to deal with them ,and reduce their negative effects in the decision-making process (1) .As Iraq is under the circumstances passed by and the apparent deterioration in the agricultural sector in all its aspects, this study is trying to identify the reality of the crop structure in an important agricultural area which suffer from multiple problems surrounding the city of Baghdad represented by the Sinaa farm as a large farm contribute to the nutrition and the provision of agricultural crops to surrounding areas in Baghdad province which has been selected as a model farm in the cultivation of summer and winter crops in addition to cultivated covered vegetables . This study is a new qualitative attempt to deal with the risk and management conditions that are often associated with agricultural decision-making which missing by most of the previous agricultural economic research and studies and since the agricultural sector and agricultural production are characterized by the great risk and uncertainties, especially in the recent period, because of the exposure of the Iraqi market to global markets, which increased the elements of risk, the need seems necessary to determine the optimal and efficient agricultural plans in these farms through the use of mathematical models that take into account the circumstances of risk and uncertainty ,The importance of the study is shown by the fact that it is considering a very important subject that concerns the food and national security of Iraq and that it is possible to adopt a scientific method in how to mix the elements of production in a manner that achieves the greatest return at the lowest cost(3) and by defining mathematical models that deal with risk conditions in agricultural decision-making processes in general and linearity in particular , in which optimum and efficient agricultural production plans that take into account risk and uncertain conditions in farm production can be identified, which situation will be more match with the agricultural productive reality(20). Thus saving the extra efforts and costs and the need for special and complex software such as what needed nonlinear and quadratic programming , in particular to obtain optimum and efficient production plans under the conditions of risk, And the possibility of adoption of the mathematical methods in any project or facility, regardless of the quality of its activity because of the simple method and treatments without the complexities in dealing with data and access to information required.The problem of the study is the deterioration in agricultural production in return for the high cost of production due to the cessation of state support as well as the problems of pollution and market exposure and dumping policy and others, which increased the degree of risk that was neglected by the planner or farms in Sinaa farm in determining their production plans which resulted in a negative impact on the efficiency of the use of resources. Consequently, optimal agricultural production plans, assuming the case of certainty, were impractical and unrealistic. This requires determining optimal agricultural production plans that take into account the risk and uncertainty conditions that accompany the decision making process. Since Sinaa Farm as a productive unit suffers from weakness in the planning processes, it is possible to determine the nature of the study problem in how to ensure optimal allocation of agricultural resources to arable areas based on the basis of economic efficiency which means obtaining more production with the same resources available or obtaining the same amount of production but with fewer resources (4, 17). This study is aim to identify and derive efficient production plans with optimal(income-deviation) (E-A) farm production for Sinaa farm using MOTAD model as a linear programming model alternative to quadratic programming models that requires the identification of mathematical models used to determine optimal farm production plans and compare them with the optimal farm production plans obtained using LP Technique, as well as to determine the sensitivity of the model and explain it to some or different dispersion measures as an indicator of the risk margin on the farm mentioned above. The study is based on the following hypotheses: 1- The optimum crop structure according to the linear programming model, which does not take into account the risk and uncertainty conditions in the agricultural production, differs from those of the expected income (E)and the risk expressed by average absolute total deviations (A) within the MOTAD model, which takes into account the risk and uncertainty conditions that have always accompanied the decision-making process. 2-Plans which derived from MOTADmodel are sensitive to the data used in the measurement of average total absolute deviations (A) if the average of the gross net income for the years of study or any other weighted average is used.

MATERIALS AND METHODS

Conceptual Framework:

Risk and Uncertainty Programming Models

Mathematical models for risk analysis and uncertainty in economic activities in general and agricultural production activities in particular are important analytical models. The use of these programs and models enables derive efficient production plans under the conditions of risk and uncertainties that decision makers often face and are expressed in Risk Programming Models These efficient production plans derived from the use of these models are called Efficient Production Plans. It means that these plans give a specific income (return) with the lowest possible risk or higher return from a specific risk margin. Risk is expressed in these models by amount of Variance (V), Standard Deviation (Sd) or Mean Absolute Deviations (A) in each plan. Non-linear programming models (especially quadratic programming models), and MOTAD model is one of the most common of these programs. Table 1 represents the primary table of the MOTD model that can be solved in regular linear programming technique (10). It is worth mentioning that there are other models for dealing with Risk and uncertainty in determining optimal and efficient production plans other than quadrilateral programming models and models, including the Target MOTAD model and simulation model, which represent an analytical technique that includes the formulation of a realistic model and then its choice (13). Because of the difficulty of obtaining programs for other models to deal with risk and the lack of full detailed data needed by these models, MOTAD model was used to derive efficient production plans that achieve the objectives of the study

Minimization of Total Absolute Deviation Model (MOTAD)

MOTAD model represents a developed model of the Parametric Linear Programming model that can be solved mathematically on an electronic computer using conventional linear programming technique where it can be solved by changing the value of (λ) globally which represents the amount of income expected from the plan boundaries that the decision maker wishes to obtain(2). From each plan **($\sum$ CjXi)** we obtain a set of efficient productivity plans with expected farm income (E) and the lowest total absolute deviations (A) (efficient limits E-A) (14). It is worth mentioning that the A statistic obtained from these efficient plans can be converted to the Standard Deviation (Sd), which represents the square root of variance (V). Thus, the efficient(E-A) plans can be converted to efficient(E-V) plans of the quadratic programming with a relative efficiency of 88% and atnatural distribution of agricultural income , the Standard Deviation (Sd) is in terms of (A) as follows: (10):

$$Sd = A \left[\frac{\pi s}{2\,(S-1)} \right]^{1/2}$$

As π represents the fixed ratio and its amount (22/7)

Table 1 . Primary Table of MOTAD Model

Constraints	Decision variables					
	X_1	X_2 ………… X_n	di	d_2 …….	d_n	
Minimize			1	1 ……	1	**Minimizing**
Constraint1	a_{11}	a_{12} ………. a_{1n}	0	0 …...	0	$\leq b_1$
Constraint (2)	a_{21}	a_{22} ………. a_{2n}	0	0…….	0	$\leq b_2$
.	.	. …………….. .	.	. . .		.
.	.	. …………….. .	.	. . .		.
.	.	. …………… .	.	. . .		.
Constraint (m)	a_{m1}	a_{m2} ……………. a_{mn}	0	0 ……	0	$\leq b_m$
Year (1)	d_{11}	d_{12} ……………. d_{1n}	1	0 0	0	≥ 0
Year (2)	d_{21}	d_{22} ……………. d_{2n}	0	1 0	0	≥ 0
.	.	. . .	.	.		
.	.	. . .	.	.		
Year (h)	d_{h1}	d_{h2} ……………. d_{hn}	0	0 0	1	≥ 0
Means total income	C_1	C_2 ……………. C_n	0	0 0	0	$= \lambda$

Source:(10)

Net farm income according to the prevailing crop composition

The study of net farm income is important in that it is important to understand planning problems on the one hand. On the other hand, the success of economic planning at the level of individual economic units or at the national level is based on the availability of accurate information on net farm income (19). Net farm income represents the difference between total farm income and total Operating Cost, which is an important economic criterion to measure the productive efficiency of agricultural work(9). To calculate net farm income according to the prevailing crop composition, net income per dunum is calculated by subtracting total agricultural operating costs per dunum of the total agricultural income per dunum for any productive activity and then the output of the subtraction multiplied by the total area of each activity. and as the farms does not organize records for costs and revenues to extract the net farm income, and as these calculations are important and the research is needed for a series of time on the net agricultural income of agricultural activities and its need for technical coefficient of all the production activity required per dunum of products required by LP models ,the data were obtained through the field study and questionnaire (Table 2) shows the development of average net income per dunum of all crops at current prices for the study period. The table shows that the highest average net income was 5974 thousand dinars (TH.D) for the tomato and the lowest average net income was 479.8(TH.D) for wheat crop. It is worth mentioning that the degree of risk has a positive relationship with the value of the heterogeneity coefficient. The crop, which has a high heterogeneity coefficient, includes a higher degree of risk. This will be reflected on crops that will appear or disappear in the results of the optimal solution for the linear programming model of the Sinaa farm as it will show in third section

Table 2. Development of average net income (2012-2017) TH.D **/ dunum**

Year	wheat	barley	Cloves	tomato	Crucum	Water mel
2012	494.7	2709.6	2289.3	5279.4	2536.1	2000.9
2013	560.1	3941.8	1739,8	5033.9	2927	2207
2014	627.6	4979.4	1778	4932	2936.2	1833.2
2015	555.8	5308.5	2455.3	5974	3317.3	2140.4
2016	479,8	4748.3	3937.7	5643.5	3483.8	3084.1
2017	515.5	5675.5	2729.4	5461.1	4182.7	2211.3
Means	**538.9**	**4560.5**	**2487.6**	**5387.3**	**3230.5**	**2246.2**

The Table was organized by the researcher relying on a questionnaire

Identify the optimal and efficient agricultural production plans for the Sinaaa **Farm and analyze the results of models**: In this section, we will address the practical aspect of optimal allocation of resources using LP technique as well as using MOTAD model through the formulation of mathematical models for crops at current prices and then analysis of results. The most important stage of LP model is model formulation stage, which is based on the fact that the farm aims to maximize net farm income through cultivate of several crops subject to specific constraints(1,12). After LP model was formulated, we used QSB (Quantitative System for Business), which maximizes profit by using Simplex Method (5), which is used to solve LP problems in order to achieve the optimal production plan for the agricultural season (2016-2017) which represent last year of study. Producers prefer to adopt the last year, and the changes it has experienced as a benchmark in conceptualizing their future activities.

Methods of analysis

Efficient agricultural production plans according to MOTAD model

To achieve the objectives of the study, we formulated LP model for the Sinaa Farm for the agricultural season (2016-2017) to obtain the optimal allocation of resources, which maximizes the total net farm income per dunam, as the target model is a mathematical model restricted to calculate the best income for the best plan and for the best combination of production maximizes net income, in addition ,drafting the constraints of MOTAD model needs to formulate the constraints of linear programming model because the optimal income obtained from the optimal plan in the linear programming model represents the value of λ (6) in the first plan of the MOTAD model and represents the greatest expected income In this plan which represents the plan realized without taking into consideration the risk (Risk- Free Plan) (15).

Formulating MOTAD Models of the Sinaa Farm (First Scenario):

To identify and derive efficient agricultural production plans which has (income - deviation) (E-A), (Win QSB) Windows Quantitative System for Business, has been used it is ready application with windows operating systems (7). The program was specifically designed to solve administrative problems, decision-making problems, operations research and production systems (8). QSB program was used, which operates on the Simplex Method as well as using MOTAD program in two scenarios as shown below:

First Scenario: Represents efficient production plans using the deviation of net income per dunum of crops for study years of average total net income per dunum for the years of study, as shown in the table 3.

Table 3. Total Deviations from Average Net Gross Income / Crop 011/012-016/017TH.D **/ dunum**

Year	wheat	barley	cloves	tomato	crucum	Water m
2012	-44.2	-1850.9	-198.3	-107.9	-694.4	-245.3
2013	21.2	-618.7	-748.5	-353.4	-303.5	-39.2
2014	88.7	418.9	-709.6	-455.3	-294.3	-413
2015	16.9	748	-323	586.7	86.8	-105.8
2016	-59.1	187.8	1450.1	256.2	253.3	837.9
2017	-23.4	1115	241.8	73.8	952.2	-34.9

The table was organized based on (Table 2)

Second Scenario: represents the efficient production plans using net income deviations per dunam of crops than net average net income of the last year as shown in Table 4 rather than the average net income for the years of study used in the first Scenario. In an attempt to identify the sensitivity of the MOTAD model to the basis for which the deviations are measured (2), the objective function and the determinants of the first Scenario will be used.

Table 4. Positive and negative deviations from net return 2016- 2017 TH.D/ dunum

year	wheat	barley	cloves	tomato	Crucum	Water melon
2012	-20.8	-2959.9	-440.1	-181.7	-1646.7	-210.4
2013	44.6	-1737.7	-990.3	-427.2	-1255.7	-4.3
2014	112.1	-596.1	-951.4	-526.1	-1246.5	-378.1
2015	40.3	-36.7	-274.1	512.9	-865.4	-70.9
2016	-35.7	-927.2	1208.3	182.4	-698.9	872.8
2017	0	0	0	0	0	0

The Table organized based on (Table 2)

It should be noted that MOTAD model in both plans minimizes negative total deviations to obtain efficient farm plans with a defined income and at lowest risk margin expressed by the average total absolute deviations (A), which are called efficient farm production plans or of agricultural production plans with (Income - Efficient) deviation (E-A).Constraints and determinants of the MOTAD model have been formulated in terms of constrains of LP model (Plan I) and its determinants. MOTAD model for application purposes requires a time series of data on Gross Margin for each dunum and for each production activity (Table 2) to determine the negative deviations and income deviations to measure mean absolute deviations (A) as an indicator of the risk margin which accompanies each plan, and this model needs technical coefficients for all the production per dunum of each crop required by LP models (18).

RESULTS AND DISCUSSION

Analyzing the results and deriving the efficient agricultural production plan

It has been noted that the optimal income obtained through the optimal solution of LP model represents the value of λ in the first plan of MOTAD model, and it represents the greatest income expected without taking the risk to take into account to that plan. And the plans which had derived in the first Scenario it is an efficient plans with boundary of (income-deviation) (E-A). In order to analyze the results and derive efficient farm production plans, the data was entered into the computer and analyzed using the QSB program. The results obtained for the first Scenario of the crop model at current prices showed that they corresponded to the results of solving LP model in terms of the crop structure and the crops areas themselves, and a series of efficient production plans were derived for the Sinaa farm in order to define the limits of the risk. In order to obtain misleading results, we have chosen (10) farm production plans from the set of plans that were derived, as follows:

A-First Scenario

Table 5 illustrates the efficient plans (Scenario 1), through which the relevant risk indicators (19) are defined: Mean absolute deviations (A), standard deviation (Sd), variance (V) .The first column represent (Model **1)** shows that the expected optimum income (E) of the first MOTAD plan (the first Scenario) (9.8320) million dinars (M.D), which is the same income obtained from LP model. (A)(2.519)(M.D). (Sd) (3.458) (M.D) and (V) (11.957) (M.D). This plan has included the optimal crop structure achieved within the optimal solution for LP. If the farmer wants to reduce the amount of risk associated with the production plans, he should expect a lower farm income. This is illustrated by subsequent efficient agricultural production plans (2-10), which represents the expected reduction in income at constant rates of (60,000) D. in order to determine the effect of this change on optimal production levels and to estimate (A), (Sd) and variance (V). These indicators reflect the level of risk associated with each level of expected income as indicated by the continuous decrease in the value of these indicators of Plan (2). as follows: The decrease in(A)(0.139)(M.D)by a decrease of (-5.5180%) from the plan (1) which was in plan (10)(2.380)(M.D).For(Sd),the value of plan(10) was(3.268)(M.D) a decrease of (-5.494%) of the plan (1), and for (V), the value of the plan (10) (10.680) (M.D) and a decrease of (-10.679%) of the plan (1).From the observation of the derived plans according to this group, the barley and cloves were not shown in these plans, indicating that their production carries a high margin of risk compared to the other crops that appeared in these plans. The efficient production plans avoid the emergence of crops with a high margin of risk. The plans (1-10) shows that, the low risk margin associated with these plans is significant at higher income levels and lower at lower income levels. The reduction of income by (60000)D led to a decrease in the absolute deviations (A) with less reduction for a fixed rate of income, which means that the rate of diminution of the risk margin in each plan is lower at low income levels than at high income levels. From the previous ten plans, the farmer (decision maker) can choose the plan that maximizes his advantage and agrees with his position on risk.

Model 1: First Scenario

$$\text{Minimize } (Z) = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 + 1X_7 + 1X_8 + 1X_9 + 1X_{10} + 1X_{11} + 1X_{12}$$

Subject to

$$C_1 = 1X_1 + 1X_2 + 1X_3 + 1X_4 + 1X_5 + 1X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12} \leq 200$$

$$C_2 = 70X_1 + 40X_2 + 100X_3 + 25X_4 + 10X_5 + 8X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} \leq 6209$$

$$C_3 = 70X_1 + 50X_2 + 100X_3 + 200X_4 + 66X_5 + 66X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} \leq 22982$$

$$C_4 = 0X_1 + 0X_2 + 0X_3 + 66X_4 + 66X_5 + 50X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} \leq 13186$$

$$C_5 = 5X_1 + 3X_2 + 2X_3 + 6X_4 + 5X_5 + 4X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12} \leq 2000$$

$C_6 = 6X_1+3X_2+14X_3 +18X_4 +13X_5 +8X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 13000$

$C_7 = 2X_1 + 1X_2 + 23X_3 +50X_4 +102X_5 +31X_6 +0X_7 +0X_8 +0X_9 + 0X_{10} + 0X_{11}+ X_{12} \leq 13500$

$C_8 = 0X_1 +1X_2 +0X_3 + 80X_4 + 0X_5+58X_6 + 0X_7 +0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 15024$

$C_9 = 7X_1 + 4X_2 +7X_3+52X_4 +0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 12700$

$C_{10} = 1.5X_1+1.5X_2+1.5X_3+1.5X_4 +1.5X_5 + 1.5X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12}\leq 390$

$C_{11} = 1X_1+1X_2+1X_3 +1X_4+1X_5+ 1X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 390$

$C_{12} = 0.5X_1+0.5X_2 +0.5X_3+0.5X_4+0.5X_5+0.5X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 390$

$C_{13} = 0.5X_1+0.5X_2+1X_3+0X_4+0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 631$

$C_{14} =390X_1+450X_2+370X_3+100X_4+133X_5+100X_6+ 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 129000$

$C_{15} = 275X_1+520X_2+470X_3+1015X_4+955X_5+1215X_6+0X_7+ 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 177500$

$C_{16} = 0X_1+230X_2+150X_3+1683X_4+0X_5+ 1095X_6 +0X_7+0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 122000$

$C_{17} = 300X_1+460X_2+305X_3+0X_4+0X_5+0X_6+ 0X_7+ 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12}\leq 19000$

$C_{18} = 324500X_1+324500X_2 +270600X_3 +538948X_4+ 317350X_5+ 288750X_6+ 0X_7+ 0X_8+ 0X_9+ 0X_{10}+ 0X_{11}+0X_{12}\leq 78500000$

$C_{19}=1X_1+ 0X_2 +0X_3 + 0X_4 + 0X_5 +X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12}\geq 0$

$C_{20} = 0X_1+1X_2+0X_3+0 X_4 + X_5 +0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{21}= 0X_1+0X_2+1X_3+0X_4+0 X_5 +0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{22}=0X_1+0X_2 + 0X_3+1X_4+0X_5+ 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{23} = 0X1+ 0X_2 + 0X_3+ 0X_4 + 1X_5 + 0X_6+ 0X_7 + 0X_8+ 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12}\geq 0$

$C_{24} = 0X1+ 0X_2 + 0X_3+ 0X_4 + 0X_5 + 1X_6+ 0X_7 + 0X_8+ 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12}\geq 0$

$C_{25}= -44.2 X_1 –1850.9X_2 -198.3X_3 - 107.9X_4- 694.4X_5 – 245.3 X_6+1X_7+0X_8+ 0X_9+0X_{10}+0X_{11}+ 0X_{12} \geq 0$

$C_{26}= 21.2X_1- 618.9X_2 -748.5X_3 -353.4X_4-303.5X_5 – 39.2X_6+0X_7+1X_8+0X_9+0X_{10}+ 0X_{11}+ 0X_{12} \geq 0$

$C_{27}=88.7X_1+ 418.9X_2 -709.6X_3- 455.3X_4- 294.3X_5+ 0X_6+0X_7+0X_8 +1X_9+0X_{10}+0X_{11}+ 0X_{12} \geq 0$

$C_{28}=16.9X_1 +748X_2-323X_3+ 586.7X_4 +86.8 X_5 –105.8X_6+0X_7+0X_8+0X_9+1X_{10}+ 0X_{11}+ 0X_{12} \geq 0$

$C_{29}=-59.1X_1 +187.8X_2+1450.1X_3+ 256.2X_4+253.3X_5+837.9X_6+0X_7+0X_8+0X_9+X_{10}+1X_{11} + 0X_{12} \geq 0$

$C_{30} = -23.4X_1+1115X_2+241.8X_3+73.8X_4+952.2X_5 – 34.9X_6+0X_7+0X_8+0X_9+0X_{10}+0X_{11}+ 1X_{12} \geq 0$

$C_{31}=515500X_1+5675500X_2+2729400X_3+5461052X_4+4182650X_5+2211250X_6+0X_7+0X_8+0X_9+0X_{10}+0X_{11}+0X_{12} =9831958$

Table 5. Efficient Plans for Sinaa Farm using MOTAD Model at Current Prices (Scene 1)

Plans number / Crops	1	2	3	4	5	6	7	8	9	10
1-Wheat X1	6.3438	6.3051	6.2663	6.2276	6.1889	6.1509	6.1115	6.0728	6.0341	5.9954
2- Barley X2	0	0	0	0	0	0	0	0	0	0
3- Cloves X3	0	0	0	0	0	0	0	0	0	0
4-Tomato X4	1.1110	1.1042	1.0974	1.0907	1.0839	1.0771	1.0703	1.0633	1.0568	1.0500
5-Cucumber X5	0.0729	0.0725	0.0720	0.0716	0.0711	0.0707	0.0703	0.0698	0.0694	0.0689
6-Water melanX6	0.0857	0.0852	0.0847	0.0841	0.0836	0.0831	0.0826	0.0820	0.0815	0.0810
7- Crops area/Dunum	7.6134	7.5669	7.5205	7.4740	7.4276	7.3811	7.3346	7.2882	7.2417	7.19522
8-Revenue(E) M.D	9.8320	9.7720	9.7120	9.6520	9.5920	9.5320	9.4720	9.4120	9.3520	9.2920
9-Total negative deviation (M.D) Objective Function	7.556	7.510	7.463	7.417	7.371	7.325	7.279	7.234	7.187	7.140
10- (A) Mean absolute deviations	2.519	2.503	2.488	2.472	2.457	2.442	2.426	2.411	2.396	2.380
11- (SD)M.D	3.458	3.437	3.416	3.395	3.374	3.353	3.331	3.310	3.289	3.268
12-(V) M.D	11.957	11.813	11.670	11.526	11.384	11.243	11.096	10.956	10.818	10.680

Source: The table was organized by the researcher as follows data grades (1-6, 8 and 9) based on the results of the above plans, the data of the other rows were calculated by the researcher**.** The first scenario shows that efficient farm production plans that take into consideration the margin of risk have differed from optimal farm production plans that do not take into account the risk conditions and which aim to maximize the expected income represented by the first plan obtained from using the model Linear programming. It is also different from the actual farm plan, and the difference is to allocate fewer resources to crops with higher risk margins than we have observed in the direction of their areas of decline compared with low levels of income, as opposed to crops with a lower margin of risk.

B- Second Scenario

By analyzing the data based on MOTAD model and deriving the efficient risk limits (E-A) by deriving a set of efficient farm risk plans, 10 farm plans were selected so that the decision maker (farmer) could choose between these plans on the basis of expected return (E) and less average total absolute deviations (A) Which reflects the risk associated with each production plan, (MOTAD plan(1) Model (2))included an income equal to (9.831) (M.D) , which is the income obtained from the LP plan. The average total absolute deviation (A) of 1.590(M.D) with less (Sd) of (2.184) (M.D) and (v) of (4.7699) the crop composition of this plan was the following crops: wheat with 16.225 and 0.6637 dunum, respectively. Table 6 shows that if the farmer wants to reduce the risk margin associated with the production plans, he should expect less income, Efficiency 2-10, which represents the expected reduction in income at fixed rates of 100,000D per plan. Table 6 shows that the crop structure of the plan is not changed (1-10). However, we note the continuous decrease in the area of the crops. Wheat area continues to decrease to 14.7405 dunum in plan 10 and a decrease of (-9.15%) of plan 1 which had (16.225) Dunum, and water Melan area continues to decrease until the plan (10) reaches an area of (0.6029) dunum and a decrease of (-9.16%). In the ten plans we note a continuous decrease in the value of the risk indicators. The average of absolute deviations (A) decreased by (-9.12%) from Plan (1) with a value of plan (10) of (1.445) (M.D), as for the (Sd), the percentage decreased by (-9.34%). The value of the plan (10) (1.98) (M.D), and there were also continuous decreases in the variance (V) of (3.92) (M.D) of the plan (10). A decrease of (-17.82%) of Plan (1). The first and second plans show the positive relationship between the risk margin of each plan and the expected income. The higher income plan includes a greater margin of risk. The values of the statistical indicators are higher than those for the plans that include a lower margin of risk. The defined income (E) of each plan and the associated risk margin expressed in the absolute deviation value (A) Standard deviation (Sd) or variance (V) The plan with the higher defined income includes a higher margin of risk

Model 2: Second Scenario

Minimize $(Z) = 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 + 1X_7 + 1X_8 + 1X_9 + 1X_{10} + 1X_{11} + 1X_{12}$

Subject to

$C_1 = 1X_1 + 1X_2 + 1X_3 + 1X_4 + 1X_5 + 1X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12} \leq 200$

$C_2 = 70X_1+ 40X_2 + 100X_3 +25X_4+10X_5+8X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 6209$

$C_3 = 70X_1+50X_2 +100X_3 + 200X_4 +66X_5+66X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 22982$

$C_4 = 0X_1+0X_2 +0X_3 +66X_4 + 66X_5 + 50X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 13186$

$C_5 = 5X_1+3X_2+2X_3 +6X_4 +5X_5 +4X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10}+ 0X_{11}+ 0X_{12} \leq 2000$

$C_6 = 6X_1+3X_2+14X_3 +18X_4 +13X_5 +8X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 13000$

$C_7 = 2X_1 + 1X_2 + 23X_3 +50X_4 +102X_5 +31X_6 +0X_7 +0X_8 +0X_9 + 0X_{10} + 0X_{11}+ X_{12} \leq 13500$

$C_8 = 0X_1 +1X_2 +0X_3 + 80X_4 + 0X_5+58X_6 + 0X_7 +0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 15024$

$C_9 = 7X_1 + 4X_2 +7X_3+52X_4 +0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 12700$

$C_{10} = 1.5X_1+1.5X_2+1.5X_3+1.5X_4 +1.5X_5 + 1.5X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12}\leq 390$

$C_{11} = 1X_1+1X_2+1X_3 +1X_4+1X_5+ 1X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 390$

$C_{12} = 0.5X_1+0.5X_2 +0.5X_3+0.5X_4+0.5X_5+0.5X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 390$

$C_{13} = 0.5X_1+0.5X_2+1X_3+0X_4+0X_5 + 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 631$

$C_{14} =390X_1+450X_2+370X_3+100X_4+133X_5+100X_6+ 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 129000$

$C_{15} = 275X_1+520X_2+470X_3+1015X_4+955X_5+1215X_6+0X_7+ 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 0X_{12}\leq 177500$

$C_{16} = 0X_1+230X_2+150X_3+1683X_4+0X_5+ 1095X_6 +0X_7+0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 0X_{12} \leq 122000$

$C_{17} = 300X_1+460X_2+305X_3+0X_4+0X_5+0X_6+ 0X_7+ 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12}\leq 19000$

$C_{18} = 324500X_1+324500X_2 +270600X_3 +538948X_4+ 317350X_5+ 288750X_6+ 0X_7+ 0X_8+ 0X_9+ 0X_{10}+ 0X_{11}+ 0X_{12}\leq 78500000$

$C_{19}=1X_1+ 0X_2 +0X_3 + 0X_4 + 0X_5 +X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11} + 1X_{12}\geq 0$

$C_{20} = 0X_1+1X_2+0X_3+0 X_4 + X_5 +0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{21}= 0X_1+0X_2+1X_3+0X_4+0 X_5 +0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{22}=0X_1+0X_2 + 0X_3+1X_4+0X_5+ 0X_6 + 0X_7 + 0X_8 + 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12} \geq 0$

$C_{23} = 0X1+ 0X_2 + 0X_3+ 0X_4 + 1X_5 + 0X_6+ 0X_7 + 0X_8+ 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12}\geq 0$

$C_{24} = 0X1+ 0X_2 + 0X_3+ 0X_4 + 0X_5 + 1X_6+ 0X_7 + 0X_8+ 0X_9 + 0X_{10} + 0X_{11}+ 1X_{12}\geq 0$

$C_{25}= -20.8X_1 – 2959.9X_2 -440.1X_3 – 181.7X_4- 1646.7X_5 – 210.4X_6+1X_7+0X_8+ 0X_9+0X_{10}+0X_{11}+ 0X_{12} \geq 0$

$C_{26}= 44.6X_1- 1737.7X_2 -990.3X_3 -427.2X_4-1255.7X_5 – 4.3X_6+0X_7+1X_8+0X_9+0X_{10}+ 0X_{11}+ 0X_{12} \geq 0$

$C_{27}=112.1X_1 – 596.1X_2 -951.4X_3- 529.1X_4- 1246.5X_5- 378.1 X_6+0X_7+0X_8 +1X_9+0X_{10}+0X_{11}+ 0X_{12} \geq 0$

$C_{28}=40.3X_1 -36.7X_2 -274.1X_3+ 512.9X_4 -865.4X_5 –70.9X_6+0X_7+0X_8+0X_9+1X_{10}+ 0X_{11}+ 0X_{12} \geq 0$

$C_{29}=-35.7X_1 -927.2X_2+1208.3X_3+ 182.4X_4 -698.9X_5+872.8X_6+0X_7+0X_8+0X_9+X_{10}+1X_{11} + 0X_{12} \geq 0$

$C_{30} = 0X_1+0X_2+0X_3+0X_4+0X_5 +0X_6+0X_7+0X_8+0X_9+0X_{10}+0X_{11}+ 1X_{12} \geq 0$

$C_{31}=515500X_1+5675500X_2+2729400X_3+5461052X_4+4182650X_5+2211250X_6+0X_7+0X_8+0X_9+0X_{10}+0X_{11}+ 0X_{12} =9831958$

In the analysis and comparison of the series of efficient crop production plans shown in Table 6 and derived from the second scenario and compared with the similar set of efficient plans derived from the first Scenario shows in Table (5), we note that the plans of the two groups differ from each other in terms of crop composition each plan and its space, as well as the amount of risk margin associated with each plan expressed in values A or Sd, where the group of production plans of the first group (the first scenario) measured on the basis of total negative deviations from the average of net income for the study years Showed greater values than m (Second Scenario), which is measured on the basis of negative total deviations from the average net income of the last year, at each specific level and corresponding to the expected income of each plan, the average absolute deviations (A) and standard deviation (Sd) (Scenario 1) is larger than in the corresponding plans in the second set (Scenario 2), so the decision maker has several efficient plans (Scenario 2) to compare these plans based on the amount of expected income (E) and the amount of risk margin accompanying it. From the foregoing, it is clear that the plans derived from the MOTAD model are sensitive to the data used in the measurement of total absolute deviations (A) if the general average net income for the years of study or any other weighted average is used. This is included in the second assumption of the hypotheses.

Table 6 . Efficient plans for Sinaa farm using MOTAD at current prices(Scenario 2)

Plans number Crops	1	2	3	4	5	6	7	8	9	10
1-Wheat X11	16.225	16.0608	15.8957	15.7307	15.5657	15.4006	15.2356	15.0706	14.9055	14.7405
2- Barley X2	0	0	0	0	0	0	0	0	0	0
3- Cloves X3	0	0	0	0	0	0	0	0	0	0
4-Tomato X4	0	0	0	0	0	0	0	0	0	0
5-Cucumber X5	0	0	0	0	0	0	0	0	0	0
6-Water melanX6	0.6637	0.6569	0.6502	0.6434	0.6367	0.6299	0.6232	0.6164	0.6097	0.6029
7- Crops area/Dunum	16.8895	16.7177	16.5459	16.3741	16.2023	16.0306	15.8588	15.6870	15.5152	15.3434
8-Revenue(E) M.D	9.831	9.731	9.631	9.531	9.431	9.331	9.231	9.131	9.031	8.931
9-Total negative deviation (M.D) Objective Function	4.771	4.723	4.674	4.626	4.577	4.529	4.480	4.432	4.383	4.335
10- Mean absolute deviations (A)	1.590	1.574	1.558	1.542	1.525	1.509	1.943	1.477	1.461	1.445
11- (SD)M.D	2.184	2.162	2.139	2.117	2.093	2.073	2.668	2.028	2.006	1.98
12-(V) M.D	4.7699	4.6742	4.5753	4.4817	4.3807	4.3733	4.1182	4.1128	4.0240	3.920

Source: The table was organized by the researcher as follows data grades (1-6, 8 and 9) based on the results of the above plans, the data of the other rows were calculated by the researcher.

The research concluded a number of results, most notably the matching of the results obtained for the first Scenario of MOTAD model of crop for the results of solving LP model in terms of crop structure and the same agricultural areas, and the plans of the first and second groups shows that efficient agricultural production plans that consider the risk margin is different from the optimal farm production plans, which do not take into consideration the risk conditions, which aim to maximizing the expected income represented by the first plan obtained from LP model, (as included in the first assumption of the study hypotheses), The difference is that fewer resources are allocated to crops that involve a greater margin of risk, which is what we have observed in the direction of their areas of decline than low income levels, as opposed to crops with a lower risk margin. Production plans that do not take into account the risk margin of the plan .The actual planning of the Sinaa Farm and LP plan differed from the efficient production plans that take into account the risk conditions represented by efficient plans that represented the highest possible income with the lowest possible risk of Sd and A, as they varied in terms of crop structure, areas, income and risk margin values. The appearance of wheat, tomatoes , cucumbers and Water melon in the first set of plans of the first Scenario, the emergence of wheat crop, and Water melon in the set of plans of the second scenario shows that these crops include a lower margin of risk than the crops that did not appear in them, and their appearance confirms to us that one of the means and procedures that the decision maker can reduce the risk or control is the diversification of products or projects, and the absence of barley and cloves crops in the first scenario of plans, barley, cloves, tomato and cucumber in the second scenario of plans shows that their production carries a high margin of risk compared to other crops that appeared in these plans, as efficient production plans to avoid the appearance of crop production margin of carrying a high risk, low risk and that facilities for the production plans efficient margin of derivative (1-10) is significant at high income levels, and falling by lower at levels low incomes. Through the derived plans according to MOTAD model (first scenario) we note the continuous decline in the value of these indicators starting from Plan (2) as follows: The decrease in(A)(0.139)(M.D)by a decrease of (-

5.5180%) from the plan (1) which was in plan (10)of(2.380)(M.D).And for(Sd),the value of plan(10) was(3.268)(M.D) a decrease of (-5.494%) of the plan (1), and for (V), the value of the plan (10) (10.680) (M.D) and a decrease of (-10.679%) of the plan (1) in (Scenario 2) we can see a continuous decrease in the value of the risk indicators . Plan (1) shows the average total absolute deviation (A) of 1.590(M.D) with (Sd) of (2.184) (M.D) and (v) of (4.7699) ,the crop composition of this plan was the following : wheat with 16.225 and 0.6637 dunum, respectively. The average of absolute deviations (A) decreased by (-9.12%) from plan (1) with a value of plan (10) of (1.445)(M.D), as for the (Sd), the percentage decreased by (-9.34%). The value of the plan (10) (1.98)(M.D) and there were also continuous decreases in the variance (V) of (3.92)(M.D) of the plan (10) A decrease of (-17.82%) of plan (1).We also note through the two sets of plans that there is a type of trade-off or barter between the expected income (E) for each plan and the amount of risk margin. The high-income plans are highly risky and the values of the statistical indicators are larger than for the plans that include a lower risk margin. There is a positive relationship between the margin for each plan and the expected income from it, and there is a difference between efficient production plans with a fixed income and less (V) or less (A) and measured on the basis of total deviations from the value of the average of farm net income for the entire period of time expressed in the first plan of those efficient farm plans and measured on the basis of total negative deviations from the average net farm income for the last year of the period expressed in the second scenario Which is included in the second assumption of the hypotheses of the study).Which reflects the sensitivity of MOTAD model to the scale of total deviations used. These agricultural plans differed in terms of the crop structure and the areas exploited for each crop as well as the margin of risk associated with each plan. From the previous conclusions, we can make a number of recommendations, the most important of which is the use of the linear programming method to determine the extent to which the available resources are invested efficiently, which helps to increase production, and the need to generalize this method and apply it in farms with similar conditions to determine the optimal use of the available productive resources. Crop yield as indicated by linear programming results with the aim of achieving economic efficiency for farmers and excluding agricultural crops that are not economically important, while establishing agricultural training and extension courses for farmers to use the best productive methods. Modern sponsor. In addition, the farmer must include the risk and uncertainties within their plans to be more accurate and efficient by using mathematical models in the analysis of the efficient production plans and identifying them under the risk and uncertainty conditions of the model of death or other mathematical models as the target model of the target as the decision maker has several efficient plans To choose from them what maximizes their benefit or preference and agrees with their position on risk. As well as increasing resources whose shadow prices are positive, including land and capital for the purpose of benefiting from other surplus resources whose prices are zero, such as compost, urea, manure, pesticides, manual labor, mechanical work and irrigation water to increase production, Crops in order to reduce the impact of risk and uncertainties such as crop cultivation included in the plan after reducing the impact of risk. If the management of the association wants to increase the degree of risk, it should limit its cultivation to less crops as in the first or second plan of the mopeds in order to obtain a higher net income.

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