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Economic analysis of the risk in the Egyptian crops structure focusing on the water resources

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ABSTRACT

Limited resources of irrigation water represent one of challenges sustainable agricultural development, as they relate to the achievement of the irrigation water which the crops composition needed to grow (different crops) that make water resource management and rational use our critical target must be achieved, and so out the agriculture sector of the most economic sectors used for water resources It consumes about 85% of the total available water resources for Egypt. The problem has been narrowed research in the difficulty of extrapolating effects the risks that might be exposed to crop structure as a result of the instability of irrigation water and its impact on cropping structure imbalance which is based on the population food which need and providing production. Therefore the research aimed to estimate the crops composition which did minimizing risk, and minimizing the consumption of irrigation water, with the development of some of the recommendations relating to the efficient Use and rationalizing irrigation water in Egyptian agriculture. The method was used linear programming written to minimize the risk to the Egyptian crop structure, also relied on data from published and unpublished issued the official authorities governmental organizations such as Ministry of Agriculture and land reclamation and the Central Agency for Public Mobilization and Statistics during the period (2005-2010). The results showed that the actual total profit margin for crops structure in 2010 was about 47.937melliar pounds, while showing that the total proposed profit output of the solution the risk model was about 48.076 milliard pounds, reaching the difference between total actual profit and proposal profit about 149 million pounds, by an increase of 0.31% from the actual Egyptian crop structure in 2010. And the total amount of the actual irrigation water for crops structure in 2010 about 38.051 milliard cubic meters, while showing that the total proposed amount of irrigation water resulting from the risk solution model was about 38.003 milliard cubic meters, with a difference between the total actual amount of irrigation water and proposed around 47.9 million cubic meters, and by decreasing the amount of 0.13% for actual Egyptian crop structure in 2010. finally set some recommendations on the efficient use and rationalization of the Egyptian irrigation water in agriculture is need to reduce the cultivation of crops with water consumption and high gradually replaced crops consuming less water, and installing irrigation systems developed in the old land and new to maximize the use of the irrigation water, rain and floods. And also continue in the policy of re-use of agricultural drainage water for irrigation after mixing it with Nile water under condition the validity of water mixed in terms of salinity and the degree of pollution after treatment processing, and attention to awareness public information for farmers to raise the level of realization on the optimal of water efficient use, and farmers' participation in the work of irrigation development, and the establishment of sewage ringed covered, and management and maintenance irrigation and drainage systems.

Key words: Linear programming, irrigation water, crops composition.

Introduction

Represent the limited resources of irrigation water one challenges of sustainable agricultural development, as they relate to the achievement of the needs of crop composition of irrigation water needed to grow different crops that make water resources management and rational use of target vital must be achieved, and so out of the agricultural sector of the most economic sectors used for water resources It consumes about 85% of the total available water resources for Egypt, and the demand value for water resources used in the agricultural sector increasing as a result of that desire to increase sustainable agricultural development, especially when land reclamation new order to increase the cultivated or planted area and on the other hand compensate erosion of agricultural land by building , so the direct agricultural production through reconsider the crop structure depends largely on the optimal use of agricultural productive resources, and maximizing their economic efficiency.

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Research problem:

The agriculture industry characterized as one of the most activities vulnerable to natural hazards, as well as farmers nether had completely nor lack of knowledge for all future conditions and information, which are difficult appreciation accurately, and due to the limited water resources, so the low level of economic efficiency in used is one of the most important challenges facing the plans and programs of agricultural development in Egypt, Therefore, the research problem confined to the difficulty of induction effects of hazards that may be exposed to the crop structure as a result of instability of water irrigation and the reflection of the imbalance cropping structure which is based on the population food need and providing production inputs.

Research objective:

Under the objectives of agricultural policy strategy towards the optimal use of irrigation water element, the research aims to estimate crops structure or planning composition crops which is help in minimizing the risk and the uncertainty faced by the Egyptian agricultural production. Also minimizing in the consumption of irrigation water, with put some of the recommendations relating to the efficient use and rationalization of irrigation water in the Egyptian agriculture.

Research method and data sources:

Method was used linear mathematical programming to minimize the risk of the Egyptian crop structure, also dependence on data from published and unpublished issued by official governmental authorities such as the Ministry of Agriculture, Land Reclamation and the Central Agency for Public Mobilization and Statistics during the period (2005-2010).

Description the risk model:

Agriculture is as industry biological sensitive to natural factors, and lead to magnitude the risk element and uncertainty in agricultural production, in addition to what characterizes agriculture magnitude fixed capital ratio where the magnitude of the volatility of price and difficulty of controlling the amounts of agricultural production and characterizes those production of magnitude volume and usability of damage. Study of risk and uncertainty and their implications and consequences on the agricultural sector is extreme importance to the farmer and the state, because of their impact very clear on agricultural production and readings related to multiple risks surrounding it, and due to the nature of productivity, which distinguish it from other productive sectors, in light of the current conditions related to risk and uncertainty faced by the Egyptian agricultural production, there for it should be required to find alternative cropping structures depended on the primary determinant factor in it which is the standard income for crop output in those circumstances and variables.

Search model has been used Hzell A mathematical method, which can estimate and measure risk with linear programming style called minimization of total absolute deviations college Minimization of Total Absolute Deviations (MOTAD) and takes the following form:

Minimize $Z = \sum_{h=1}^{S} Y_h^-$

Such that:

$$\sum_{j=1}^{n} (Ch_J - g_j) x_j + Y_h^- \geq O(Forallh, h = 1,...,S)$$

$$\sum_{j=1}^{n} f_i \, x_i = \lambda \qquad (\lambda = 0 \, to \; Unbounded)$$

$$\sum_{j=1}^{n} a_{ij} x_i \leq b_i \qquad \text{(for all I, I = 1, … , m)}$$

$$x_j \, , \, y_h^- \geq 0 \qquad \text{(for all h, j)}$$

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Where:

Z = Objective function

f_i = Total margin expected for the activity.

Y_h^- = Absolute differences between the total margin of crops cultivated during the period (2005-2010).

X_j = Crop.

b_i = Size limitation.

α_i = Technical requirements for the activity.

λ = Constant.

λ = Constant.

$= \sum_{J=1}^{n} (Ch_J - g_J) x_J$ =Total absolute deviation of the total margin for the overall average of the total margin.

Restrictions risk model:

Risk model consists of area constraints, production requirements (inputs), restrictions quantity irrigation water distributed on the months of the year, and agricultural employment restrictions distributed on the months of the year are as follows:

1 - Area constraints:

Table (1) shown the structure of Egyptian cropping under study, and it can be seen with regard to the most important strategic crops important in the winter loop, that the wheat crop area fluctuate from year to year, during the period (2005-2010), reaching the lowest in 2007 at about 2715.5 thousand acres, While a peak in 2009 at about 3147 thousand acres.

For clover tahreesh crop forestation amounted to less space for it in 2010 by about 309 thousand acres, while the maximum space for it in 2005 at about 506.5 thousand acres.

For clover crop, has reached below 2009 about 1518.7 thousand acres, while the maximum in 2007 at 1824.2 thousand acres.

As for the summer crops loop, rice crop area decreased 1093.3 thousand acres, while the maximum area in 2008 rose to 1769.8 thousand acres, it was found that the area of rice has decreased during the two years by about 676.5 thousand acres.

The maize crop summer, the lowest area for it in 2008 at about 1.6474 million acres, while the maximum space in 2009 at about 1977.6 thousand acres, and this shows that the amount of increase in the area maize summer of 2009, amounting to about 330.2 thousand acres resulting from decreased space rice for that year.

For cotton, the lowest recorded area of him in 2009 about 284.4 thousand acres, while the maximum area in 2005 rose to 656.6 thousand acres.

During the years 2009, 2010, respectively, and amounted to 1977.6, 1693.3 thousand acres rice was recorded minimum area for it in 2010 at 1093.3.

The Table (2) resource constraints land distributed on three loops, where a first limitation concerns of the total area of winter crops, which must not exceed 6315.1 thousand acres, and represents second limitation total area of summer crops, which should not exceed about 5285.9 thousand acres, while a third constraint Nile total crop area, which should not exceed 500.7 thousand acres, and finally fourth constraint represents the total crop area of the study, which should not exceed about 12101.7 thousand acres.

Table 1: cultivated area by thousand acres of the most important agricultural crops during the period (2005 - 2010).

Crop	2005	2006	2007	2008	2009	2010
Wheat	2958.3	3064	2715.5	2920.4	3147	3066
Barley	247.7	214.5	245.1	182.0	95.4	279
Fenug reek	15.2	15	14.0	7.9	9.3	13.8
Broad bean	221.3	198.4	235.4	190.5	206	202
Lentils	2.5	1.5	1.9	1.5	1.9	3.3
Lupine	3.5	3.4	3.7	3.1	3.5	3.6
Chieck peas	15	15.2	10.9	8.8	6.3	9.3
Flax	16.3	15.6	20.8	20.1	12.8	7.9
Sugar beet	167.3	186.4	248.3	257.7	264.6	385.7
Clover Tahreesh	506.5	470.2	497.8	419.5	335	309
Clover	1603	1657	1824.2	1619.8	1518.7	1612
Winter onions	108.7	65.5	86.6	109.4	115.3	134.6
winter Garlic	17	17.3	24.9	28.1	17.5	23
Winter tomatoes	214.6	209.1	200.3	217.9	265.2	204.4
Winter squash	20.3	21.8	24.7	27.9	30.1	29.1
Winter green peas	56	52.2	54.0	51.9	60.1	53.0
Winter cabbage	27	28.2	33.3	34.6	37.8	36.5
Winter Potato	141.9	102.4	109.2	149.0	1537	156
Winter Pepper	22.9	25.3	25.4	25.6	34.9	29.4
Rice summer	1459	1593	1672.7	1769.8	1369.2	1093.3
Maize Summer	1943.4	1711	1785.6	1647.4	1977.6	1693.3
Sorghum summer	351.3	367.5	347.2	363.7	332.2	328.9
Soybeans	20.1	17.8	18.5	20.7	17.1	36.2
Sesame	67	73.4	74.9	66.4	98.8	87.9
Pea nuts	148	132.1	155.3	146.2	151.8	158.9
Sunflower	31.5	35.7	27.2	19.2	39.6	35.3
Sugar cane	321.4	326.9	335.1	323.6	316.7	320.3
Cotton	656.6	536.4	574.6	312.7	284.4	369.1
Tomatoes Summer	215.5	241.3	267.0	285.0	270.3	262.5
Potato Summer	113.3	79.1	85.9	122.1	120.7	133.9
Cucumber	49.1	60.5	47.2	42.2	39	17.5
Squash Summer	67.7	59.6	61.1	51.6	43.6	47.2
Eggplant summer	65.6	58.4	56.1	59.0	53.2	53.2
Pepper Summer	45	59.6	54.0	58.3	56.9	52.5
Watermelon Summer	156.2	157.2	148.9	115.7	113.8	74.4
Maize Nili	317.2	282.5	288.1	309.2	363.1	274.3
Green beans Nili	5.4	7.7	6.9	27.3	9.8	5.8
Tomato Nili	65.4	74	70.0	69.0	64.1	48.7
Potatoes Nili	45.5	39	62.0	56.4	55.3	44.7
Cabbage Nili	7.1	10.3	9.1	9.3	8.4	8.8
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin "various issues"						

Table 2: Restrictions risk model crop for installation in Egypt in 2010.

Statement	Enrollment	Maximum	Month	agricultural workers Million working days	Irrigation water in million cubic meters
Crop area (thousand acres)	≥	12101.7	January	56.2	1837.4
Winter loop area (thousand acres)	≥	6315.1	February	29.5	2170.8
Summer loop area (thousand acres)	≥	5285.9	March	45.6	3000.3
Nile loop area (thousand acres)	≥	500.7	April	43.5	3187.5
Wage workers (million pounds)	≥	8222.48	May	112.9	2677.8
Wages animals (million pounds)	≥	109.17	June	83.4	5 247.0
Wages machines (million pounds)	≥	4818.52	July	98.3	6479.9
Seed value (million pounds)	≥	3499.33	August	70.7	6503.5
fertilizer value (million pounds)	≥	902.16	September	64.8	2692.7
The value of chemical fertilizer (million pounds)	≥	4931.83	October	111.9	1070.2
Pesticides value (million pounds)	≥	933.03	November	55.8	1277.5
Incidental expenses (million pounds)	≥	2263.71	December	41.6	1906.4
Total production requirements		25680.2	Total	814.3	38051.0
Source: - The Ministry of Agriculture and Land Reclamation, Economic Affairs Sector Agricultural Statistics Bulletin various issues. - The Ministry of Agriculture and Land Reclamation, Economic Affairs Sector "ESS records" unpublished data. - Central Agency for Public Mobilization and Statistics, "Bulletin of Irrigation and Water Resources" various issues.					

2 - Restrictions production requirements:

Table (2) that the total production requirements crop structure under study amounted to 25.68 milliard pounds, spread over: the wages of workers Machines, wages animals, seed value, the value of fertilizers, the value of chemical fertilizers, pesticides value and other charges for each crop.

3 - Restrictions Irrigation water:

Table (2) The total amount of irrigation water cropping structure under study, has reached about 38.05 milliard cubic meters, with the assumption that the amount of irrigation water for crops model does not over than the total amount of irrigation water available per month, and has been use of 12 restrictions under for the amount of irrigation water represent inter monthly irrigation water requirements of the crop activities within the model.

4 - Restrictions agricultural employment:

Table (2) The total number of working days for the installation of crop under study, has amounted to about 814.3 million working days, it has been assumed that the number of working days for crop model does not exceed the total working days available per month, and I have been using 12 under for the number of working days, representing total monthly requirement of human labor required for installation crop under study.

The results of model solution to minimize the risk:

I had been working five scenarios to minimize the risk model (MOTAD) As follows:

1 - the first scenario: the targets here maximizing the total profit margin for the crop composition with not taking the risk at mind and therefore has been put the value of the expected profit, amounting to about 48.086 milliard pounds, which is a result when I estimate the linear programming model in the case of maximizing Gross profit margin.

2 - The second scenario: the targets here minimize the risk, while kipping the same total profit margin for the composition crop, which amounted to about 47.927 milliard pounds, which is the Total value of the profit margin for the composition the current crop for the average period which is (2005-2010).

3 - The third scenario: targeting the minimization of risk, with a lower expected profit margin overall composition crop is by about 5%, which amounted to be about 43.277 milliard pounds.

4 - The fourth scenario: targeting the minimization of risk, with expected a lower profit margin overall crops composition is about 10% to be about 40.873 milliard pounds.

5 - Scenario V: targeting the minimization of risk, with a lower profit margin overall crop composition is expected to be less by about 15% to be 38.469 milliard pounds.

Table (3) the solution results of scenarios minimize the risk model, and it can be seen that the best of those alternatives is the third scenario, which shall take into account the access on the expected profit for the installation of the crop is estimated at 48.076 million pounds.

Gross profit margin for the crop composition:

The total profit margin actual installation crop in 2010 about 47.937 million pounds, while showing that the total profit proposed output of the risk model solution was about 48.076 milliard pounds, reaching the difference between the total actual profit and proposal profit about 149 million pounds, therefore the proposal profit increase of 0.31 % up than the profit of the actual crop structure in 2010.

The total quantity of irrigation water for crop structure:

The total actual quantity of irrigation water of the crop structure in 2010 about 38.051 milliard cubic meters therefore showing that the total amount of proposed irrigation water resulting from risk model solution was about 38.003 milliard cubic meters, with a difference between the total actual amount of irrigation water and proposed about 47.9 million cubic meters, in decreased 0.13% for actual crop structure in 2010.

Finally Table (4) the actual amount of irrigation water during the months of the year compared to their counterparts proposed resulting from risk model solution, it was found that the crop structure proposed contributes to the provision of 47.9 million cubic meters of water, and notes from the table mentioned there is no change in the amount of irrigation water used during the months of June, July and October, while showing that the months of March and April and May from the top of the months that contribute to the provision of irrigation water and approximately 28.6 million cubic meters.

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Table 3: minimize the risk model scenarios (MOTAD) Egyptian crop for installation.

Scenario	Actual area in 2010	First	second	Third	fourth	fifth
Gross profit (million pounds)		48085.8	48085.8	48076.2	48075.7	48072.6
Wheat	3066	3147.0	3147.0	3147.0	3146.6	3146.8
Barley	279	95.4	95.4	95.4	95.4	95.4
Fenug reek	13.8	7.9	7.9	7.9	7.9	7.9
Broad bean	202	207.3	207.3	207.1	207.4	207.2
Lentils	3.3	1.5	1.5	1.5	1.5	1.5
Lupine	3.6	3.1	3.1	3.1	3.1	3.1
Chieck peas	9.3	6.3	6.3	6.3	6.3	6.3
Flax	7.9	18.9	18.9	20.1	20.5	20.8
Sugar beet	385.7	264.6	264.6	264.6	264.6	264.6
Clover Tahreesh	309	345.1	345.1	346.2	346.4	346.8
Clover	1612	1518.7	1518.7	1518.2	1518.7	1518.7
Winter onions	134.6	112.5	112.5	100.8	100.4	100.4
winter Garlic	23	17.0	17.0	28.1	28.1	28.1
Winter tomatoes	204.4	265.2	265.2	265.2	265.2	265.2
Winter squash	29.1	30.1	30.1	30.1	30.1	30.1
Winter green peas	53.0	60.1	60.1	60.1	60.1	60.1
Winter cabbage	36.0	37.8	37.8	37.8	37.8	37.8
Winter Potato	156	141.7	141.7	140.2	140.1	139.5
Winter Pepper	29.4	34.9	34.9	34.9	34.9	34.9
Rice summer	1093.3	1369.2	1369.2	1369.2	1369.2	1369.2
Maize Summer	1693.3	1977.6	1977.6	1977.6	1977.6	1977.6
Sorghum summer	328.9	342.9	342.9	367.5	367.5	367.5
Soybeans	36.2	17.4	17.4	17.2	17.1	17.1
Sesame	87.9	98.8	98.8	88.9	88.8	88.6
Pea nuts	158.9	149.3	149.3	134.4	134.4	134.2
Sunflower	35.3	29.3	29.3	32.2	32.0	32.7
Sugar cane	320.3	316.7	316.7	316.7	316.7	316.7
Cotton	369.1	284.9	284.9	284.9	285.2	285.1
Tomatoes Summer	262.5	283.2	283.2	280.7	280.7	280.6
Potato Summer	133.9	122.1	122.1	122.1	122.1	122.1
Cucumber summer	17.5	39.0	43.6	39.0	39.0	39.0
Squash Summer	47.2	43.6	53.2	43.6	43.6	43.6
Eggplant summer	53.2	53.2	45.0	53.2	53.2	53.2
Pepper Summer	52.5	45.0	113.8	45.0	45.0	45.0
Watermelon Summer	74.4	113.8	361.0	113.8	113.8	113.8
Maize Nili	274.3	361.0	16.4	353.6	353.6	353.5
Green beans Nili	5.8	16.4	74.0	23.8	23.8	27.1
Tomato Nili	48.7	74.0	39.0	74.0	74.0	74.0
Potatoes Nili	44.7	39.0	10.3	39.0	39.0	39.0
Cabbage Nili	8.8	10.3	10.3	10.3	10.3	7.1
Source: Results of the analysis model (MOTAD)						

Table 4: surplus and deficit in the irrigation water quantity of the proposed crop composition by million cubic meters.

Statement	Actual	Suggestion	difference	%
January	1837.4	1831.2	6.2	0.34
February	2170.8	2166.7	4.1	0.19
March	3000.3	2990.4	9.9	0.33
April	3187.5	3179.6	7.9	0.25
May	2677.8	267.0	10.8	0.40
June	5247.0	5247.0	0.0	0.00
July	6479.9	6479.9	0.0	0.00
August	6503.5	6502.9	0.6	0.01
September	2692.7	2692.3	0.3	0.01
October	1070.2	1070.2	0.0	0.00
November	1277.5	1274.0	3.4	0.27
December	1906.4	1901.8	4.6	0.24
Total	38051.0	38003.1	47.9	0.13
Source: Results of the analysis model (MOTAD)				

The proposed policy for the agricultural irrigation water development under the risk:

Consider that reduce waste in the agricultural water irrigation and water conservation of the most important policies of water resources development in Egypt, and by reducing waste evaporation of Nile water, clearing waterways channels of water plants that increase evaporation rates, and work to reduce waste colds resulting from the leakage of water from canals, causing low efficiency water moving. On the other hand, the policies of water resources development takes into consideration the development methods for agricultural irrigation expansion in irrigation systems sprinkler and drip especially when ground water irrigation water wells and agriculture land in the high permeability such as sand land and new land, to reduce dependence on the Nile water and reduce the loss flood irrigation and agricultural soil settlement to prevent the accumulation of water in low-lying areas to avoid soil degradation and improve the efficiency of field irrigation and water delivery efficiency waterways, contributing to an increase in irrigation efficiency.

It can expand the use of groundwater as well as the exploiter of them now, where is the source of supplemental irrigation some lands Upper and Delta, the presence of groundwater reservoirs renewable Valley and Delta, which arise from the leak Nile water and irrigation network and agricultural land, as well as re-use of treated wastewater in agriculture irrigation greenery and plant some non-food crops to be care used for mixing with some caution solids, chemical and soluble salts and bacteria.

Recommendations:

1- The need to reduce the cultivation of crops with high water consumption and gradually replaced crops consuming less water with the use of genetic engineering to produce crops with low water requirements, and modified cropping all appropriate period of time in line with our water resources.

2 - Installation of sophisticated irrigation networks in the old and new land to achieve maximum utilization of irrigation water and rain and floods.

3 - Continuation of the policy of re-use of agricultural drainage water for irrigation after mixing it with Nile water provided power blended in terms of salinity and the degree of contamination after processing.

4 - Media attention to awareness of the farmers to raise the level of awareness on the optimal use of water, and the participation of farmers in irrigation development work, and the establishment of banks covered field, and the management and maintenance of irrigation and drainage networks.

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