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APPLICATION OF FUZZY GOAL PROGRAMMING TO DETERMINE THE OPTIMAL CULTIVATION CROPS MODEL

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Abstract

Purpose of study: According to the role and importance of farm management units, using mathematical programming models have an essential role in determining the optimal cultivation pattern. This study represents the theory and application of a fuzzy goal programming model to determine an optimal cultivation pattern considering different goals.

Methodology: Analysis of the fuzzy goal programming model and applying it in the decision of optimal cultivation pattern in the Ferdowsi University farm has been shown in this study.

Main Findings: The results indicate that making flexibility in model coefficients - because of deficiency in information- with the fuzzy idea, remove this deficiency extremely, and conditions of cultivation pattern relatively improve, then inputs and sources are applied optimally.

Implications: This study expects to help farmers and agriculture officials to decide better agricultural policies and practices.

Novelty: This study is done at the research farm of agriculture faculty at Ferdowsi University, and the software WinQsb was used.

Keywords: *linear programming, goal programming, optimal cultivation pattern, fuzzy programming, crop model*

INTRODUCTION

Linear programming has been widely used to determine the optimal cultivation pattern since the 1960s. The objective of linear programming is to maximize or minimize the objective function considering some of the constraints (resources) and decision variables (activities) simultaneously. Since linear programming is a single-objective optimization technique, and the nature of many agricultural planning problems are multi-objectives, in such a situation, traditional planning methods cannot meet the demands of decision-makers and policy-makers. New ways have been created in planning by scientific advancements and researchers' efforts in recent decades, which by using them, it is possible to find the best solutions to achieve the goals while being contrasts among the desired goals of managers and the limited resources. In this context, goal programming is one of the highlights tools for analyzing multi-objective decisions in farm management that its features are to achieve several objectives simultaneously based on the prioritization. However, the greatest weakness of goal programming is that all parameters of the problem must be carefully defined in the deciding environment, and all goals and constraints must be definitive. To overcome this problem, the Fuzzy concept, which was first introduced by Zadeh, was proposed for multi-objective optimization problems (Zadeh 1965, Biswas and Pal 2005). In The fuzzy goal programming technique, in addition to achievement to several objectives simultaneously, goals and constraints can be deterministic or fuzzy that makes to be superior to the goal programming and the conventional linear programming (Chalam 1994).

Reasons for using the fuzzy goal programming model for this study are as follows:

1. Existence of Non-aggregated goals in manufacturing sector by farmers and government
2. A change in goals over time and the possibility of considering it in the model
3. Inaccessibility to the goals and restrictions and the possibility of considering their ideal levels in the model
4. The possibility of goals prioritizing and ideals in the model

The main objective of this research is to determine the optimal model for cultivating crops with fuzzy multi-objective approach and to provide quantitative policies based on the following assumptions:

1. The present cropping pattern- in the agricultural sector in the region under the study- is not optimal
2. Resources are not allocated efficiently including water, labor, land and other resources
3. Planning classical models does not have effective performance compared with the flexible model like a fuzzy goal programming model under situations of uncertainty on objectives and available resources

Fuzzy goal programming techniques for the management of agricultural unit under situations of definitive resource constraints where constraints and goals are fuzzy has been recently applied by several researchers such as (Fasakhodi, Nouri, et al. 2010, Zeng, Kang et al. 2010, Regulwar and Gurav 2011, Balezentiene, Streimikiene, et al. 2013, Mirkarimi, Joolaie, et al. 2013, da Silva and Marins 2014, Guo, Chen, et al. 2014, Jana, Sharma, et al. 2016, Sharma 2016).

METHODOLOGY

In FGP, ambition levels for different purposes are always examined in the form of phase (uncertain), while the right constraints amounts can be fuzzy or non-fuzzy that depends on the fuzzy of the decision environment (uncertain) (Biswas, Dharmar, et al. 1978). In this study, the right amount of constraints will examine the crisp (uncertain) to achieve different fuzzy objectives. The general form of the fuzzy multi-objective model is as follows:

Find X(x1, x2, x3 ,…,xn) (1)

To satisfy

$$f_i\ (x) \begin{pmatrix} \tilde{\leq} \\ \cong \\ \tilde{\geq} \end{pmatrix} b_i \qquad (2)$$

Subject to:

$$AX \begin{pmatrix} \tilde{\leq} \\ \cong \\ \tilde{\geq} \end{pmatrix} B,\ X \geq 0 \qquad (3)$$

Where fi (x) is the ith goal of fuzzy (linear or nonlinear), and bi is the aspiration level related to fi (.). These signs ~≤ ,≅, ≥~ reflect the fuzziness of the aspiration level, and AX [~≤ , ≅ , ≥~] B reflects a set of definite limits.

In a fuzzy decision-making environment, the objectives are defined by membership functions related to them, which are obtained the definition of sustainable changes of up and down, and the type of membership function is dependent on the type of objective. i2 aspiration level of fuzzy goal expresses which the decision-maker will be satisfied with the same amount even for larger values of bi the amount of allowable tolerable changes of less than bi.

The range of allowable tolerable changes to achieve the aspired levels of the fuzzy goals with the difference given the limitations ~≤ , ≅ , ≥~ will be in the form of (bi-ti, bi) and (bi,bi+ti), (bi-ti,bi+ti), respectively, that (bi-ti) and (bi+ti) will be called the range of tolerable changes of up and down, respectively. If ti is representative for tolerable changes for the aspired level of bi, corresponding membership function with the fuzzy goal, µi (x) can be defined as follows:

For the limitation of this type≅, µi (x) will be algebraically as follows:

$$\mu_i(x) = \begin{cases} 1 & if \quad f_i(.) = b_i, \\ \dfrac{(b_i+t_i)-f_i(.)}{t_i} & if \quad b_i < f_i(.) \leq b_i + t_i, \\ \dfrac{f_i(.)-(b_i-t_i)}{t_i} & if \quad b_i - t_i \leq f_i(.) < b_i \\ 0 & if \quad \begin{matrix} f_i(.) < b_i - t_i \\ f_i(.) > b_i + t_i \end{matrix} \end{cases} \qquad (4)$$

For the limitation of this type, ~≤, µi (x) will be algebraically as follows:

$$\mu_i(x) = \begin{cases} 1 & if \quad f_i(.) \leq b_i \\ \dfrac{(b_i+t_i)-f_i(.)}{t_i} & if \quad b_i < f_i(.) \leq b_i + t_i \\ 0 & if \quad f_i(.) > b_i + t_i \end{cases} \qquad (5)$$

Furthermore, for the limitation of this type, ≥~, µi (x) will be algebraically as follows:

$$\mu_i(x) = \begin{cases} 1 & if \quad f_i(.) \geq b_i, \\ \dfrac{f_i(.)-(b_i-t_i)}{t_i} & if \quad b_i - t_i \leq f_i(.) < b_i, \\ 1 & if \quad f_i < b_i - t_i \end{cases} \qquad (6)$$

In a fuzzy decision-making environment, achieving the fuzzy goal to its aspiration level means achieving membership function related to it with the maximum value (one). Membership functions are changed into membership goals by determining the highest value (one) as the optimal level and introducing up and down deviation variables for each of them. Then the negative deviation variables will be minimized based on the importance of achieving the desired quantities in the objective function of the fuzzy goal programming technique. The basic model FGP and its solution method was first proposed by Narasimhan (Narasimhan 1980, Hannan 1981). Yang and colleagues could solve the model with fewer variables and similar responses like Narasimhan and Hanan. While fi (x) represents the ith fuzzy goal with triangular membership function, Young's model is formulated as follows (Yang, Ignizio, et al. 1991):

$$\mu_i(x)=\begin{cases} 0 & if \quad f_i(.)>b_i+t_i, \\ \frac{(b_i+t_i)-f_i(.)}{t_i} & if \quad b_i<f_i(.)\le b_i+t_i, \\ 1 & if \quad f_i()=b_i, \\ \frac{f_i(.)-(b_i-t_i)}{t_i} & if \quad b_i-t_i\le f_i(.)<b_i, \\ 0 \quad if \quad f_i(.)<b_i-t_i \end{cases} \tag{7}$$

Where bi is aspiration level for ith goal and ti represents tolerable changes for aspiration level of bi, and then the linear programming formulation is as follows:

$$\begin{aligned} &\text{Find } X(x_1,x_2,...,x_n) \\ &\text{So as to satisfy} \\ &\text{Maximize } \lambda \\ &\text{Subject to:} \\ &\lambda \le \frac{(b_i+t_i)-f_i(x)}{t_i}, \\ &\lambda \le \frac{f_i(x)-(b_i-t_i)}{t_i}, \\ &AX\begin{pmatrix}\le\\=\\\ge\end{pmatrix}B \\ &\lambda, X\ge 0; \text{ For all I} \end{aligned} \tag{8}$$

The model described above will firstly minimize the degree of membership goals, and then among the minimums, the maximum will be selected. This method is called MaxMin (Yang, Ignizio, et al. 1991).

Tiwari, Dharmar et al. (1987) provided another way of formulating the problem, which is as follows:

$$\begin{aligned} &\text{Find } X(x_1,x_2,...,x_n) \\ &\text{So as to satisfy} \\ &\text{Minimize } Z=\left[p_1(d^-),p_2(d^-),...,p_k(d^-),...,p_K(d^-)\right] \\ &\text{Subject to:} \\ &\frac{(b_i+t_i)-f_i(x)}{t_i}+d_i^- - d_i^+ =1, \\ &\frac{f_i(x)-(b_i-t_i)}{t_i}+d_i^- - d_i^+ =1, \\ &AX\begin{pmatrix}\le\\=\\\ge\end{pmatrix}B \quad , \quad X\ge 0 \\ &\text{With } d_i^- . d_i^+ =0, \ d_i^-, d_i^+\ge 0 \end{aligned} \tag{9}$$

Where Z is vector K priority access functions and di+, di- are up and down deviation variables in ith goal, respectively. Pk(d-) is a weighted linear function from deviation variables that is in the following form:

$$p_k(d^-)=\sum_{k=1}^{K} w_{ik}d_{ik}^-, \quad w_{ik},d_{ik}^-\ge 0, \quad k=1,2,...,K, \quad i=1,2,...,I, \quad K\le I \tag{10}$$

d-ik is a deviation variable for k^{th} of the priority level, and wik is numerical weight-related with d-ik and representative of the importance of achieving to the desired level of ith goal comparing with other goals which are classified together in kth priority.

It should be noted here that kth priority, Pk is preferred in comparison with the next priority, Pk+1, without any dependency on the priority Pk+1 And the relationship between the priorities are as follows:

$$P_1 >>> P_2 >>> P_k >>>> P_K \tag{11}$$

Namely, the goals with the highest priority, pi, are obtained in their possible range, before a series of goals will be checked in the second level of priority and so (Rao, Sundararaju, et al. 1992).

The objectives are usually in conflict and clash in order to obtain their desired level. Therefore, defining the appropriate priorities is always hard to achieve different goals. For this reason, Euclidian Distance Function, which was introduced by Yu, is used to analyze the decision, to identify the best prioritize structure, and to determine the optimal solutions that lead to the right decisions. Since, the highest membership value of each fuzzy goal is one; an ideal spot will be a vector that all elements are one. Euclidian Distance Function is shown as follows that μij (x) represents the amount of obtained membership ith goal under the jth prioritize structure.

$$D_j = \left[\sum_{i=1}^{I} \left[1 - \mu_i^j(x)\right] \right]^{1/2} \quad (12)$$

Moreover, prioritize structure gives the optimal solutions that they have the lowest amount of D, that is:

$$j = \min(D_j) = D_m \quad 1 \leq m \leq j \quad , \; j = 1,2,\ldots J \quad (13)$$

So, the mth prioritize structure can be considered as an appropriate decision, and it is the structure that has covered the desired objectives more than other prioritize structures (Słowiński 1986, Pal and Basu 1996).

The data used in this study is related to the research farm of agriculture faculty at Ferdowsi University, and the software WinQsb was used.

RESULTS AND DISCUSSION

Desired levels of fuzzy goals and the tolerable swing range of them are given in Table 1, and technical production coefficients are given in Table 2. Farm manager's Different goals are considered in this study as follows, which the priority to achieve these goals is discussed in different scenarios in the following:

- Maximizing program efficiency
- Minimizing current costs of production and maximizing employment
- Minimizing the consumption of nitrogen and phosphate fertilizers and using machines
- Maximizing production goals

Table 1: Desired levels of fuzzy goals and the range of tolerable changes related to them

	Objectives	Desired Amount	The range of tolerable changes Down	Up
	Working Machines (h)	2417.28	-	2442.5
	Labour (n - Labour Day)	4313.1	4166	-
The Fertilizer consumption (kilograms)	Nitrogen fertilizer	23896.3	-	24673
	Phosphate fertilizer	15548.85	-	16044
	Cash costs (Thousand Rials)	240376.9	-	264526
	Efficiency programs (Thousand Rials)	989925.2	965942	-
Levels of production (tons)	Wheat	70	63	-
	Barely	150	135	-
	Alfalfa	400	360	-
	Forage maize	500	450	-
	Potato	60	42	-
	Sugar Beet	150	105	-
	Pea	40	28	-

Table 2: Technical coefficients of production

Product	MH	MD	WC	FEN	FEP	PA	CE	MP
Wheat	22	37	3800	212	159	3.9	1699	1763
Barely	22	26	3400	199	140	3.6	1639	1344
Alfalfa	21	43	7200	255	135	13	1931	1300
Forage maize	25.5	37	6100	235	114	25	6009	750
Potato	22.5	92	7300	245	220	29	4749	900
Sugar Beet	23	73	8000	262	262	33	2614	480
Pea	13.5	31	1900	97	50	2	5062.5	6000

- MH: Average time of work machine required for cultivation in hectares (ha / h)
- MD: Labour (n - Labour Day) required for cultivation in hectares (Ha/person - Labour Day)
- WC: The amount of required water required for cultivation in hectares (Ha / m)
- FR: The amount of fertilizer required for crop cultivation (ha / kg)

- PA: The obtained performance per hectare (ha / t)
- CE: The total annual cost of the product per hectare (ha / Thousand)
- MP: Market prices at harvest (kg / Rails)

Using the data in Tables 1 and 2, membership functions for intended fuzzy objectives are obtained by relationships 4, 5, and 6.

Fuzzy goal to maximize the efficiency of the program is based on the following form:

$$5071.4x1+3199.4x2+14969x3+12741x4+21351x5+13226x6+6937.5x7 \gtrapprox 989925.2 \quad (14)$$

According to the given tolerable changes range for to the efficiency program, membership function for the fuzzy objectives are as follows:

$$\mu_1 = \frac{5071.4x1+3199.4x2+14969x3+12741x4+21351x5+13226x6+6937.5x7-965942}{23983.2} \quad (15)$$

With this method, membership functions can be achieved for other fuzzy objectives. Now, membership objectives will be obtained for defined membership functions as follows:

1) Aimed at maximizing program efficiency

$$\mu_1 : 0.211x_1 + 0.133x_2 + 0.624x_3 + 0.531x_4 + 0.89x_5 + 0.551x_6 + 0.289x_7 - 40.275 + d_1^- - d_1^+ = 1 \quad (16)$$

2) Aimed at maximizing employment

$$\mu_2 : 0.252x_1 + 0.177x_2 + 0.292x_3 + 0.252x_4 + 0.625x_5 + 0.496x_6 + 0.211x_7 - 28.32 + d_2^- - d_2^+ = 1 \quad (17)$$

3) Aimed at minimizing the current costs of production

$$\mu_3 : 10.953 - (0.07x_1 + 0.068x_2 + 0.08x_3 + 0.249x_4 + 0.197x_5 + 0.108x_6 + 0.21x_7) + d_3^- - d_3^+ = 1 \quad (18)$$

4) Aimed at minimizing of using machines

$$\mu_4 : 96.847 - (0.872x_1 + 0.872x_2 + 0.833x_3 + 1.011x_4 + 0.892x_5 + 0.912x_6 + 0.535x_7) + d_4^- - d_4^+ = 1 \quad (19)$$

5) Aimed at minimizing the consumption of nitrogen fertilizer

$$\mu_5 : 31.766 - (0.273x_1 + 0.256x_2 + 0.328x_3 + 0.303x_4 + 0.315x_5 + 0.337x_6 + 0.125x_7) + d_5^- - d_5^+ = 1 \quad (20)$$

6) Aimed at minimizing the consumption of phosphate fertilizer

$$\mu_6 : 32.402 - (0.321x_1 + 0.283x_2 + 0.273x_3 + 0.23x_4 + 0.444x_5 + 0.529x_6 + 0.101x_7) + d_6^- - d_6^+ = 1 \quad (21)$$

7) Achieving goals to the desired production

$$\mu_7 : 0.557x_1 - 9 + d_7^- + d_7^+ = 1$$
$$\mu_8 : 0.24x_2 - 9 + d_8^- + d_8^+ = 1$$
$$\mu_9 : 0.325x_3 - 9 + d_9^- + d_9^+ = 1$$
$$\mu_{10} : 0.5x_4 - 9 + d_{10}^- + d_{10}^+ = 1$$
$$\mu_{11} : 1.611x_5 - 2.33 + d_{11}^- + d_{11}^+ = 1$$
$$\mu_{12} : 0.733x_6 - 2.33 + d_{12}^- + d_{12}^+ = 1$$
$$\mu_{13} : 0.166x_7 - 2.33 + d_{13}^- + d_{13}^+ = 1 \quad (22)$$

Certain restrictions that are included in the model are as follows:

$$x_1+x_2+x_3+x_4+x_5+x_6+x_7=111$$
$$3800x_1+3400x_2+7200x_3+6100x_4+7300x_5+8000x_6+1900x_7\le 559700$$
$$15.4\le x_1\le 28.6$$
$$26.6\le x_2\le 49.4$$
$$21\le x_3\le 39$$
$$8.4\le x_4\le 15.6$$
$$2.1\le x_5\le 3.9$$
$$2.8\le x_6\le 5.2$$
$$1.4\le x_7\le 2.6 \quad (23)$$

The first limitation is related to the ground. In this case, the total available land will be cultivated. The first limitation is related to the water: the total consumable water should not exceed its current amount, and the last limitation is related to the maximum change in the current cropping pattern that can be changed by a maximum of 30%.

In the solution process, four priority factors Pi (i =1, 2, 3, 4) have been investigated to obtain the desired levels of fuzzy goals, and they have been prioritized under four different scenarios in which the obtained results are given in Table 3. The obtained production of crops and the membership values related to them for various programs of land allocation under different prioritized scenarios are presented in Table 4.

Table 3: Land allocation scenarios and Euclid values related to them

	X1	X2	X3	X4	X5	X6	X7	$\sum_i^7 Xi$	Di
Current Situation	22	38	30	12	3	4	2	111	-
$P_1: d_1^-$ $P_2: .4d_2^- + .6d_3^-$ $P_3: .25d_4^- + .35d_5^- + .4d_6^-$ $P_4: .1d_7^- + .2d_8^- + .2d_9^- + .2d_{10}^- + .1d_{11}^- + .1d_{12}^- + .1d_{13}^-$	28.6	29.99	27.51	15.6	3.9	2.8	2.6	111	3.0449
$P_1: .4d_2^- + .6d_3^-$ $P_2: d_1^-$ $P_3: .1d_7^- + .2d_8^- + .2d_9^- + .2d_{10}^- + .1d_{11}^- + .1d_{12}^- + .1d_{13}^-$ $P_4: .25d_4^- + .35d_5^- + .4d_6^-$	28.6	34.25	29.25	8.4	3.9	5.2	1.4	111	2.6065
$P_1: .25d_4^- + .35d_5^- + .4d_6^-$ $P_2: .1d_7^- + .2d_8^- + .2d_9^- + .2d_{10}^- + .1d_{11}^- + .1d_{12}^- + .1d_{13}^-$ $P_3: d_1^-$ $P_4: .4d_2^- + .6d_3^-$	15.4	49.4	30.3	8.4	2.1	2.8	2.6	111	2.554
$P_1: .1d_7^- + .2d_8^- + .2d_9^- + .2d_{10}^- + .1d_{11}^- + .1d_{12}^- + .1d_{13}^-$ $P_2: d_1^-$ $P_3: .4d_2^- + .6d_3^-$ $P_4: .25d_4^- + .35d_5^- + .4d_6^-$	17.95	41.51	27.9	15.6	2.1	4.54	1.4	111	2.7859

Based on Table 3 it is observed the third scenario of prioritized goals has the lowest amount of Euclidean (d = 2.554) which implies the scenario, namely, the first priority is minimum using of chemical fertilizers and minimum using of machinery, the second priority is production goals, the third priority is maximization efficiency program, and the fourth priority is minimizing current costs of production and maximizing of employment, the best scenario of prioritization of different goals which based on it, fuzzy goals are provided more than the other scenarios.

It can be seen in Table 4 that, based on the fourth scenario, fuzzy goals of the desired products have been got the highest value (one), and almost all are nearby it except forage corn and pea. It can be seen that the desired levels of production goals have been provided and are tolerable within the changes range tolerable. As noted above, when a fuzzy goal is achieved within the range of a sustainable change, its membership amount is zero and one. If the desired value is exactly obtained or is obtained greater than it, the membership amount will be one, and if it were otherwise, the membership amount would be zero, and the definitions are obtained from describing the membership functions for fuzzy goals.

Table 4: The production values and membership goals of various products in different scenarios

Scenario	Wheat	Barely	Alfalfa	Forage maize	Potato	Sugar Beet	Pea
1	(1, 111.5)	(0, 108)	(0, 357.6)	(0, 390)	(1, 113.1)	(0, 92.4)	(0, 5.2)
2	(1, 111.5)	(0, 123.3)	(0.506, 380.3)	(0, 210)	(1, 113.1)	(1, 171.6)	(0, 2.8)
3	(0, 60.1)	(1, 177.8)	(0.847, 393.9)	(0, 210)	(1, 60.9)	(0, 92.4)	(0, 5.2)
4	(0.998, 70)	(0.962, 149.4)	(0.067, 362.7)	(0, 390)	(1, 60.9)	(0.997, 149.8)	(0, 2.8)

Table 5: Different objectives and their percentage changes in different scenarios

	Current Situation	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Efficiency program	965942	989888	961245.7	896642.4	954829.1
Percent changes	-	2.47	-0.49	-7.18	-1.16
Employment	4166	4241.87	4299.05	3946.1	4088.33
Percent changes	-	1.82	3.19	-5.28	-1.87
Cash costs	264526	283610	250885.9	246570.7	27505.2
Percent changes	-	7.21	-5.16	-6.79	3.98
Phosphate fertilizer	16044	15959.85	16539.15	15738.3	15931.83
Percent changes	-	-0.53	3.08	-1.91	-0.7
Nitrogen fertilizer	24673	24653.56	24765.4	24296.2	24686.17
Percent changes	-	-0.08	0.37	-1.53	0.05
Using machines	2442.5	2451.74	2437.4	2422.85	2462.39
Percent changes	-	0.37	-0.21	0.81	0.81

Table 5 shows different goals and the percentage changes in various scenarios. In the first scenario, it is observed that the efficiency program and employment are increased by 2.47%, and 1.82%, respectively, and consumable fertilizer and machinery remain almost unchanged. In the second scenario which minimizing current costs of production and maximizing of employment have higher priority than other goals it is observed that the current costs and employment are decreased and increased 5.16% and 3.19%, respectively, and efficiency program and the use of machinery and consumable nitrogen fertilizer have been remained almost unchanged, and consumable phosphate fertilizer increases 3.08%. In the third scenario, which has known as the best scenario in terms of achieving different goals, efficiency program and employment have been decreased by 7.18% and 5.28%, respectively. The current costs of production and phosphate fertilizer and consumable nitrogen have been decreased 6.79%, 1.91% and 1.53%, respectively and the use of machines has been remained almost been unchanged, and in the last scenario, efficiency program and employment have decreased 1.16% and 1.87%, respectively. The current costs of production have been increased 3.985, And the use of chemical fertilizers and the use of machines have been remained almost unchanged.

CONCLUSIONS AND RECOMMENDATIONS

The fuzzy goal programming technique described in this study for planning cropping pattern provides a new approach to analyze the different agricultural activities in a fuzzy decision environment (imprecise). Farmers' aims are usually to maximize the efficiency of the program. However, besides of considering this matter, agricultural officials and managers are looking for the other objectives such as increasing the rate of employment, reducing the use of fertilizers and chemical pesticides and environmental protection, sustainable development of agriculture, self-sufficiency and food security. By taking a series of economic, social, and environmental objectives in the designed model, it has tried to optimize the cropping pattern in the farm using a fuzzy goal programming model.

This model can consider a series of mutual or conflicting goals within it and maximize the rate of access to the goals by prioritizing the goals. The fuzzy approach provides the ability to the model that information (inaccurate) can best be exploited. Under the changing nature of the priority to achieve different goals, the fuzzy goal programming technique is based on it, priority structure for the decision about the right combination of products is easily changed based on needs and decision-makers' wishes. Also, by creating flexibility in the coefficients of the model, which is resulted from inaccuracy in the information, and with attitude and fuzzy thinking, this inaccuracy is much relieved, and conditions of cropping pattern is relatively improved. The resources and inputs are used more effectively.

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