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$$i \quad (\quad) \quad = b_i$$

$$z = \{g_1(n, p), g_2(n, p), \dots, g_k(n, p)\}$$

$$f_i(x) + n_i - P_i = b_i$$

$$x, n_i, P_i \geq 0$$

$$\begin{aligned} K &= z \\ &= x \\ &= n_i, P_i \\ &= g_k(n, P) \end{aligned}$$

$$g_k(n, P) = \Sigma(W_{ik}^-, W_{ik}^+)$$

$$W_{ik}^-, W_{ik}^+, n, p \geq 0 \quad K = 1, 2, \dots, k (K < m)$$

$$(g_k) \quad k$$

$$g_k$$

$$g_1 > g_2 > \dots > g_k$$

$$(g_2)$$

$$(g_1)$$

$$(\quad)$$

$$= W_{ik}^-, W_{ik}^+$$

$$g_k$$

$$n, p$$

$$Z = \min \frac{1}{W_i} (d_i^- + d_i^+)$$

$$W_i$$

$$W_i = \sqrt{\Sigma a_{ij}^2}$$

$$= f_i(x)$$

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۱- داده‌ها مربوط به سال ۱۳۷۳ می‌باشد

D_9^-	D_7^-	D_8^+	$D_1^- + D_1^+$	D_3^-	$D_4^- + D_5^- + D_6^-$	D_2^+	
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(Tw)

D_9^+, D_9^-

D_9^-

$$\text{Min}Z = 0.15D_1^- + 0.15D_1^+ + 0.0000001D_2^+ + 0.00012D_3^- + 0.168D_4^- + 0.6D_5^- + 0.03D_6^- + 0.00006D_7^- + 0.042D_8^+ + 0.096D_9^-$$

Subject to:

$$(1) X_1 + X_2 + X_3 + X_4 + D_1^+ - D_1^- = 19535$$

$$(2) 340728X_1 + 10000X_2 + 20000X_3 + 200X_4 + D_2^+ - D_1^- = 90000000$$

$$(3) 134392X_1 + 19553.8X_2 + 32500X_3 + 200X_4 + D_3^+ - D_3^- = 108000000$$

$$(4) 3.6X_1 + D_4^+ - D_4^- = 8000$$

$$(5) X_2 + D_5^+ + D_5^- = 5000$$

$$(6) 20X_3 + D_6^+ - D_6^- = 10000$$

$$(7) 925X_1 + 802X_2 + 495X_3 + 10000X_4 + D_7^+ - D_7^- = 15000000$$

$$(8) 4.4X_1 + 5.26X_2 + 1.03X_3 + 0.02X_4 + D_8^+ - D_8^- = 21793$$

$$(9) 0.16X_1 + 0.2X_2 + X_3 + 0.1X_4 + D_9^+ - D_9^- = 2500$$

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$$\text{Min}Z = 0.3D_1^+ + 0.3D_1^+ + 0.0000006 D_2^+ + 0.0000007 D_3^- + 0.015D_4^- + 0.3D_5^- + 0.15D_6^- + 0.084D_7^- + 0.00006 D_8^+ + 0.096D_9^-$$

Subject to:

- (1) $X_1 + X_2 + X_3 + X_4 + D_1^+ - D_1^- = 19535$
- (2) $340728 X_1 + 10000 X_2 + 20000 X_3 + 200 X_4 + D_2^+ - D_1^- = 90000000$
- (3) $134392 X_1 + 19553.8 X_2 + 32500 X_3 + 200 X_4 + D_3^+ - D_3^- = 108000000$
- (4) $3.6 X_1 + D_4^+ - D_4^- = 8000$
- (5) $X_2 + D_5^+ + D_5^- = 5000$
- (6) $20 X_3 + D_6^+ - D_6^- = 10000$
- (7) $925 X_1 + 802 X_2 + 495 X_3 + 10000 X_4 + D_7^+ - D_7^- = 15000000$
- (8) $4.4 X_1 + 5.26 X_2 + 1.03 X_3 + 0.02 X_4 + D_8^+ - D_8^- = 21793$
- (9) $0.16 X_1 + 0.2 X_2 + X_3 + 0.1 X_4 + D_9^+ - D_9^- = 2500$

$$\text{Min}Z = 0.15D_1^- + 0.15D_1^+ + 0.00000024D_2^+ + 0.0000002D_3^- + 0.015D_4^- + 0.3D_5^- + 0.016D_6^- + 0.00006D_7^- + 0.084D_8^+ + 0.096D_9^-$$

Subject to:

- (1) $X_1 + X_2 + X_3 + X_4 + D_1^+ - D_1^- = 19535$
- (2) $340728 X_1 + 10000 X_2 + 20000 X_3 + 200 X_4 + D_2^+ - D_1^- = 90000000$
- (3) $134392 X_1 + 19553.8 X_2 + 32500 X_3 + 200 X_4 + D_3^+ - D_3^- = 108000000$
- (4) $3.6 X_1 + D_4^+ - D_4^- = 8000$
- (5) $X_2 + D_5^+ + D_5^- = 5000$
- (6) $20 X_3 + D_6^+ - D_6^- = 10000$
- (7) $925 X_1 + 802 X_2 + 495 X_3 + 10000 X_4 + D_7^+ - D_7^- = 15000000$
- (8) $4.4 X_1 + 5.26 X_2 + 1.03 X_3 + 0.02 X_4 + D_8^+ - D_8^- = 21793$
- (9) $0.16 X_1 + 0.2 X_2 + X_3 + 0.1 X_4 + D_9^+ - D_9^- = 2500$



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Optimum Utilization Pattern of Watershed Resources Using Goal Programming

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Abstract

Nowadays, modeling is a tool in management science, and planning techniques are one of the important management factors in order to allocate scarce resources to obtain maximum benefits. Unlike industry, for planning process in agriculture and natural resources, decision makers need to optimize various objectives simultaneously.

This research was conducted to suggest and compare different alternatives for optimum utilization of resources in Garmabdasht (sub-watershed of Gorgan), using goal programming as well as socio-economic and environmental objectives.

The results showed that the proposed pattern using goal programming has acceptable and flexible outputs when compared to the other linear programming techniques.

Keywords: Watershed management, Natural resources, Utilization pattern, Goal programming.

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