As a non-governmental organization (NGO) has allocated a budget of RM50,000 for flood relief, you face the challenge of allocating aid to only 15 affected areas out of 40 that have requested help. Each area has a varying degrees of damage severity, different proportions of high-risk residents relative to the total population and different required budgets for the relief efforts. Your goal is to allocate the available budget optimally to maximize the impact of the relief efforts across the chosen 15 areas.

|  |  |  |  |
| --- | --- | --- | --- |
| Area | Damage Severity | Ratio of high-risk resident | Budget estimated (RM) |
| 1 | Low | 1:4 | 4560 |
| 2 | Low | 1:2 | 4360 |
| 3 | Low | 1:2 | 4860 |
| 4 | High | 1:5 | 3770 |
| 5 | Moderate | 1:3 | 2000 |
| 6 | Moderate | 1:4 | 2280 |
| 7 | High | 1:3 | 2600 |
| 8 | High | 1:3 | 3200 |
| 9 | High | 1:6 | 3190 |
| 10 | High | 1:4 | 2030 |
| 11 | Moderate | 1:2 | 2720 |
| 12 | Moderate | 1:5 | 3310 |
| 13 | Moderate | 1:5 | 2980 |
| 14 | Moderate | 1:4 | 1670 |
| 15 | Moderate | 1:5 | 4100 |
| 16 | Moderate | 1:4 | 3780 |
| 17 | High | 1:4 | 3200 |
| 18 | Moderate | 1:3 | 3730 |
| 19 | Low | 1:4 | 3520 |
| 20 | Moderate | 1:4 | 3600 |
| 21 | Moderate | 1:3 | 2840 |
| 22 | Moderate | 1:5 | 2870 |
| 23 | Low | 1:5 | 2310 |
| 24 | Low | 1:5 | 2420 |
| 25 | Low | 1:5 | 3610 |
| 26 | Moderate | 1:6 | 3350 |
| 27 | High | 1:5 | 2780 |
| 28 | High | 1:4 | 3830 |
| 29 | Low | 1:4 | 2590 |
| 30 | Moderate | 1:5 | 2880 |
| 31 | Low | 1:3 | 3130 |
| 32 | Low | 1:3 | 3470 |
| 33 | High | 1:4 | 3050 |
| 34 | Low | 1:5 | 2500 |
| 35 | High | 1:5 | 4140 |
| 36 | Moderate | 1:2 | 3750 |
| 37 | High | 1:3 | 2980 |
| 38 | High | 1:4 | 4480 |
| 39 | Low | 1:3 | 3950 |
| 40 | Moderate | 1:4 | 3610 |
| Total Budget | | | 130000 |

Chromosome representation

Gene - Areas

Allele - Area that will get the budget (1 - 40)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chromosome 1 | 40 | 35 | 15 | 29 | 36 | 28 | 21 | 37 | 14 | 10 | 31 | 34 | 9 | 22 | 13 |
| Chromosome 2 | 32 | 5 | 14 | 38 | 3 | 35 | 24 | 10 | 1 | 4 | 34 | 20 | 31 | 28 | 36 |
| Chromosome 3 | 39 | 30 | 33 | 25 | 26 | 15 | 27 | 2 | 13 | 9 | 8 | 23 | 5 | 22 | 34 |

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\*if the budget value is exceed the allocated budget, the fitness value will be halved

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Chromosome | 40 | 35 | 15 | 29 | 36 | 28 | 21 | 37 | 14 | 10 | 31 | 34 | 9 | 22 | 13 |
| Damage | 2 | 3 | 2 | 1 | 2 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 3 | 2 | 2 |
| High-Risk | 0.25 | 0.2 | 0.2 | 0.25 | 0.5 | 0.25 | 0.333 | 0.333 | 0.25 | 0.25 | 0.333 | 0.2 | 0.167 | 0.2 | 0.2 |
| Budget | 3610 | 4140 | 4100 | 2590 | 3750 | 3830 | 2840 | 2980 | 1670 | 2030 | 3130 | 2500 | 3190 | 2870 | 2980 |

a’ = 32

a = 80

b’ = 3.916667

b = 10.9833

c’ = 46,210

c = 13000

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