Teymourifar, A.; Trindade, M.A.M. A Framework to Design and Evaluate Green Contract   
Mechanisms for Forestry Supply Chains. Sustainability 2023.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1 | 2.5 | 150 | 125 | 0.025 | 0.1 | 0.08 | 0.1 | 0.09 | 0.1 | 0.1 | 0.08 | 0.1 | 0.08 | 0.1 |
| 2 | 7.5 | 175 | 100 | 0.075 | 0.1 | 0.09 | 0.1 | 0.08 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 3 | 12.5 | 200 | 75 | 0.125 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.08 | 0.09 | 0.1 | 0.1 | 0.09 |
| 4 | 17.5 | 225 | 50 | 0.175 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 5 | 22.5 | 250 | 25 | 0.225 | 0.09 | 0.1 | 0.07 | 0.1 | 0.1 | 0.1 | 0.1 | 0.08 | 0.1 | 0.1 |

*Pairwise comparison*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 1 | 0.33 | 0.2 | 1 |
|  | 3 | 1 | 0.6 | 3 |
|  | 5 | 1.67 | 1 | 5 |
|  | 1 | 0.33 | 0.2 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 0.1 | 0.1 | 0.1 | 0.1 |
|  | 0.3 | 0.3 | 0.3 | 0.3 |
|  | 0.5 | 0.5 | 0.5 | 0.5 |
|  | 0.1 | 0.1 | 0.1 | 0.1 |

|  |  |
| --- | --- |
|  | 0.10 |
|  | -0.30 |
|  | 0.50 |
|  | 0.10 |

*Entropy*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 1.48 | 1.55 | 1.53 | 1.57 |
|  | -0.48 | -0.55 | -0.53 | -0.57 |
|  | 0.23 | 0.26 | 0.25 | 0.27 |

|  |  |
| --- | --- |
|  | 0.23 |
|  | -0.26 |
|  | 0.25 |
|  | 0.27 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 117 | 1203 | 700 | 774 | 427 | 692 | 555 | 512 | 455 | 464 |
|  | 2 | 519 | 371 | 295 | 117 | 101 | 70 | 38 | 87 | 7 | 113 |
|  | 3 | 846 | 44 | 27 | 37 | 29 | 13 | 3 | 14 | 12 | 8 |
|  | 4 | 867 | 33 | 12 | 18 | 16 | 1 | 0 | 2 | 2 | 0 |
|  | 5 | 870 | 40 | 9 | 27 | 12 | 11 | 8 | 1 | 0 | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 932 | 388 | 91 | 723 | 230 | 848 | 552 | 643 | 556 | 471 |
|  | 2 | 259 | 631 | 358 | 194 | 173 | 54 | 38 | 90 | 83 | 53 |
|  | 3 | 676 | 214 | 69 | 152 | 127 | 17 | 13 | 6 | 6 | 7 |
|  | 4 | 843 | 57 | 45 | 22 | 0 | 29 | 10 | 14 | 3 | 8 |
|  | 5 | 858 | 52 | 10 | 38 | 28 | 4 | 1 | 5 | 5 | 0 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 392 | 928 | 423 | 828 | 319 | 843 | 569 | 622 | 383 | 627 |
|  | 2 | 8 | 882 | 183 | 623 | 181 | 400 | 303 | 101 | 24 | 119 |
|  | 3 | 328 | 562 | 256 | 264 | 99 | 179 | 112 | 72 | 16 | 52 |
|  | 4 | 479 | 421 | 230 | 163 | 64 | 87 | 11 | 76 | 49 | 18 |
|  | 5 | 780 | 130 | 24 | 126 | 101 | 16 | 9 | 12 | 7 | 10 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 897 | 423 | 416 | 426 | 107 | 733 | 681 | 420 | 387 | 457 |
|  | 2 | 440 | 450 | 346 | 61 | 56 | 35 | 24 | 77 | 48 | 55 |
|  | 3 | 795 | 95 | 94 | 18 | 16 | 4 | 1 | 5 | 0 | 11 |
|  | 4 | 856 | 44 | 39 | 5 | 2 | 3 | 1 | 1 | 1 | 0 |
|  | 5 | 718 | 192 | 143 | 20 | 3 | 13 | 8 | 2 | 2 | 0 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 189 | 1131 | 382 | 1034 | 39 | 1288 | 1062 | 494 | 225 | 680 |
|  | 2 | 783 | 107 | 3 | 186 | 40 | 212 | 171 | 127 | 41 | 110 |
|  | 3 | 834 | 56 | 52 | 1 | 0 | 19 | 18 | 18 | 14 | 13 |
|  | 4 | 858 | 42 | 27 | 12 | 7 | 2 | 0 | 3 | 1 | 3 |
|  | 5 | 868 | 42 | 24 | 15 | 4 | 9 | 7 | 0 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 152 | 1168 | 110 | 1336 | 189 | 1379 | 159 | 1471 | 316 | 1390 |
|  | 2 | 834 | 56 | 8 | 143 | 45 | 203 | 62 | 238 | 229 | 108 |
|  | 3 | 272 | 618 | 119 | 379 | 300 | 25 | 6 | 34 | 12 | 39 |
|  | 4 | 561 | 339 | 229 | 104 | 57 | 56 | 29 | 18 | 10 | 7 |
|  | 5 | 731 | 179 | 175 | 7 | 1 | 15 | 7 | 10 | 10 | 0 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 738 | 582 | 500 | 471 | 134 | 742 | 453 | 655 | 495 | 542 |
|  | 2 | 803 | 87 | 50 | 73 | 23 | 82 | 58 | 81 | 56 | 74 |
|  | 3 | 766 | 124 | 67 | 39 | 12 | 27 | 11 | 19 | 1 | 22 |
|  | 4 | 835 | 65 | 10 | 54 | 20 | 26 | 16 | 7 | 1 | 6 |
|  | 5 | 890 | 20 | 11 | 12 | 12 | 3 | 1 | 4 | 1 | 2 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 530 | 790 | 559 | 580 | 436 | 528 | 344 | 588 | 497 | 485 |
|  | 2 | 796 | 94 | 7 | 141 | 138 | 32 | 6 | 72 | 35 | 81 |
|  | 3 | 735 | 155 | 117 | 14 | 12 | 13 | 7 | 6 | 1 | 11 |
|  | 4 | 886 | 14 | 13 | 13 | 2 | 9 | 4 | 4 | 2 | 1 |
|  | 5 | 883 | 27 | 7 | 16 | 11 | 3 | 1 | 2 | 1 | 1 |
|  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1 | 87 | 1233 | 414 | 1084 | 1026 | 341 | 182 | 597 | 488 | 501 |
|  | 2 | 725 | 165 | 160 | 86 | 9 | 168 | 146 | 22 | 10 | 67 |
|  | 3 | 839 | 51 | 14 | 40 | 21 | 20 | 19 | 14 | 9 | 4 |
|  | 4 | 888 | 12 | 7 | 7 | 3 | 5 | 5 | 1 | 0 | 2 |
|  | 5 | 767 | 143 | 107 | 12 | 4 | 6 | 0 | 5 | 2 | 2 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 280686.64 | 1386.93 | 189.92 | 293186.64 |
|  | 201163.02 | 1235.83 | 248.00 | 362813.02 |
|  | 223598.40 | 978.45 | 190.10 | 485410.76 |
|  | 278488.86 | 955.41 | 189.30 | 290988.86 |
|  | 206063.79 | 1775.04 | 210.40 | 359788.79 |
|  | 74804.38 | 2515.04 | 500.75 | 441429.38 |
|  | 279695.16 | 1122.37 | 170.33 | 292195.16 |
|  | 203669.87 | 1131.64 | 148.85 | 366919.87 |
|  | 11809.00 | 1440.49 | 190.65 | 538734.00 |

WS

|  |  |  |
| --- | --- | --- |
|  | Score | Rank |
|  | 57898.37 | 2 |
|  | 56892.35 | 7 |
|  | 71289.5 | 1 |
|  | 57329.04 | 5 |
|  | 57222.97 | 6 |
|  | 52628.26 | 9 |
|  | 57610.9 | 3 |
|  | 57472.89 | 4 |
|  | 55581.77 | 8 |

WSN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 0.159 | 0.111 | 0.093 | 0.085 |
|  | 0.114 | 0.099 | 0.122 | 0.106 |
|  | 0.127 | 0.078 | 0.093 | 0.141 |
|  | 0.158 | 0.076 | 0.093 | 0.085 |
|  | 0.117 | 0.142 | 0.103 | 0.105 |
|  | 0.043 | 0.201 | 0.246 | 0.129 |
|  | 0.159 | 0.089 | 0.084 | 0.085 |
|  | 0.116 | 0.090 | 0.073 | 0.107 |
|  | 0.007 | 0.115 | 0.094 | 0.157 |

|  |  |  |
| --- | --- | --- |
|  | Score | Rank |
|  | 0.038 | 6 |
|  | 0.053 | 2 |
|  | 0.050 | 3 |
|  | 0.048 | 4 |
|  | 0.031 | 8 |
|  | 0.080 | 1 |
|  | 0.039 | 5 |
|  | 0.032 | 7 |
|  | 0.029 | 9 |

TOPSIS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  | 0.016 | -0.033 | 0.047 | 0.009 |
|  | 0.011 | -0.030 | 0.061 | 0.011 |
|  | 0.013 | -0.023 | 0.047 | 0.014 |
|  | 0.016 | -0.023 | 0.046 | 0.008 |
|  | 0.012 | -0.042 | 0.052 | 0.010 |
|  | 0.004 | -0.060 | 0.123 | 0.013 |
|  | 0.016 | -0.027 | 0.042 | 0.009 |
|  | 0.012 | -0.027 | 0.037 | 0.011 |
|  | 0.001 | -0.034 | 0.047 | 0.016 |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 0.016 | -0.023 | 0.123 | 0.016 |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 0.001 | -0.060 | 0.037 | 0.008 |

|  |  |
| --- | --- |
|  | 0.077 |
|  | 0.063 |
|  | 0.076 |
|  | 0.077 |
|  | 0.074 |
|  | 0.039 |
|  | 0.081 |
|  | 0.087 |
|  | 0.078 |

|  |  |
| --- | --- |
|  | 0.033 |
|  | 0.041 |
|  | 0.040 |
|  | 0.041 |
|  | 0.026 |
|  | 0.087 |
|  | 0.037 |
|  | 0.035 |
|  | 0.029 |

|  |  |
| --- | --- |
|  | 0.297 |
|  | 0.393 |
|  | 0.346 |
|  | 0.351 |
|  | 0.258 |
|  | 0.688 |
|  | 0.312 |
|  | 0.287 |
|  | 0.267 |

|  |  |
| --- | --- |
|  | Rank |
|  | 6 |
|  | 2 |
|  | 4 |
|  | 3 |
|  | 9 |
|  | 1 |
|  | 5 |
|  | 7 |
|  | 8 |

VIKOR

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 0.159 | 0.201 | 0.246 | 0.157 |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| 0.007 | 0.076 | 0.073 | 0.085 |

|  |  |
| --- | --- |
|  | 0.324 |
|  | 0.214 |
|  | 0.189 |
|  | 0.243 |
|  | 0.370 |
|  | 0.116 |
|  | 0.301 |
|  | 0.332 |
|  | 0.334 |

|  |  |
| --- | --- |
|  | 0.442 |
|  | 0.359 |
|  | 0.441 |
|  | 0.443 |
|  | 0.413 |
|  | 0.077 |
|  | 0.469 |
|  | 0.500 |
|  | 0.441 |

|  |  |
| --- | --- |
|  | 0.840 |
|  | 0.526 |
|  | 0.574 |
|  | 0.683 |
|  | 0.897 |
|  | 0.000 |
|  | 0.829 |
|  | 0.925 |
|  | 0.859 |

|  |  |
| --- | --- |
|  | Rank |
|  | 6 |
|  | 2 |
|  | 3 |
|  | 4 |
|  | 8 |
|  | 1 |
|  | 5 |
|  | 9 |
|  | 7 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | WS | WSN | TOPSIS | VIKOR | Average  score | Rank |
|  | 2 | 6 | 6 | 6 | 5.0 | 6 |
|  | 7 | 2 | 2 | 2 | 3.3 | 3 |
|  | 1 | 3 | 4 | 3 | 2.8 | 1 |
|  | 5 | 4 | 3 | 4 | 4.0 | 4 |
|  | 6 | 8 | 9 | 8 | 7.8 | 8 |
|  | 9 | 1 | 1 | 1 | 3.0 | 2 |
|  | 3 | 5 | 5 | 5 | 4.5 | 5 |
|  | 4 | 7 | 7 | 9 | 6.8 | 7 |
|  | 8 | 9 | 8 | 7 | 8.0 | 9 |