Weighted product model: a mathematical approach for plant selection

Reshma P. R. and Bindu R Nair

Department of Botany, University of Kerala, Kariavattom
1) reshmaushi@gmail.com 2) bindunair_r@yahoo.co.in

ABSTRACT.

This paper intends to introduce one of the most popular Multi-Criteria Decision Making (MCDM) methods: the ‘Weighted product model’ (WPM), for botanical applications. Adopting this model, plants can be scored and ranked based on preferred characteristics and the plants with higher scores selected for a specific purpose. Initially, decision has to be made on the number and types of plant categories and characters that should be chosen for the particular experiment and given weights accordingly. The final weighted score for a plant is a measure of its utility for the purpose.

KEYWORDS. Weighted product model; Multi-Criteria Decision Making method; weighted category scores; category weights.

*Corresponding author

Reshma P. R.

Department of Botany,
University of Kerala, Kariavattom
Email: reshmaushi@gmail.com,
INTRODUCTION.

Many a times, it becomes necessary to take an appropriate decision in the selection of an article from among many. Such decisions are usually taken considering the different criteria associated with the article, especially, its merits and demerits. Computational and mathematical tools are used for supporting the subjective evaluation of multiple criteria by decision-makers (Mardani, et al. 2015)\(^1\). Multi-Criteria Decision Making (MCDM) is a scientific model that helps in decision making. MCDM is a standard term for all decision making methods that exist for assisting people to make decisions according to their inclinations, in cases where there is more than one conflicting criterion (Ho, 2008)\(^2\). Here, a scoring model is created that finally ranks the article from the others in the group considering its attributes or criteria. Some of the multi-criteria decision making methods are, the Weighted sum model (WSM), the Weighted product model (WPM), the Analytic hierarchy process (AHP), the ELECTRE and the TOPSIS. ‘The weighted product model’ (WPM) proposed by Triantaphyllou (2000)\(^3\) is one of the most popular MCDM methods.

The weighted product model is based on weighted scores (according to order of their preference) assigned to the separate categories (different samples of a test) and their associated criteria (merits and demerits). First, the category score is calculated by summing the weighted scores for each criterion in the category and dividing by the sum of the weights for the criteria in the category. A weighted category score is calculated by multiplying the category score by the category weight. The final score is calculated by summing the weighted category scores and dividing by the sum of the category weights.

The weighted product model can help in situations where it is necessary to evaluate different options. It is likely to assist in presenting the findings with absolute confidence and providing facts to back up the final choice. However, the crucial problem is how to assess a set of alternatives in terms of the number of criteria for a particular experiment.

In this report, a case study is being presented wherein, the weighted product model has been adopted to select a group of plants from among different plant categories (herbs, shrubs and climbers) to set up a herbal garden consisting of medicinal plants with desirable attributes associated with their external appearance and medicinal value.

MATERIALS AND METHODS

For the study, information about a random sample of sixty two locally available plants was collected from literature (Krithikar and Basu, 2000\(^4\); Kumar and Nair, 2006\(^5\); Satyavati et al., 1987\(^6\) and Chopra et al., 1956\(^7\)). Further selection of plants was based on weighted product method proposed by Triantaphyllou, (2000)\(^3\).
Higher plants belong to different categories or groups, such as trees, small trees, shrubs, climbers and herbs. These plant categories were assigned scores on a five point scale (weighted category scores) based on their importance for the specific purpose (related here to the construction of a herbal garden). The scores are as given below:


However, trees and small trees were avoided here due to the space constraint. About twenty two characters (morphological - 16 and medicinal - 6) were considered as the criteria and the character states were coded in their order of preference (client’s choice) for the purpose (weighted criteria scores).

The category score was calculated by summing the weighted scores for each character in each category and dividing it by the sum of the weights for the characters in the category (category weight). The weighted category score was calculated by multiplying the category score by the category weight as shown below.

RESULTS

Information pertaining to certain locally available medicinal plants (sixty two plants: herbs - 29, climbers - 20 and shrubs - 13) was gathered. The plant names, codes and plant families to which they belong have been compiled here for reference.
Table I: Details of plants considered for the study

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Herbs</th>
<th>Climbars</th>
<th>Shrubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aloe vera (A)</td>
<td>A. cochlearis (AA)</td>
<td>Chrysilia squamata (CC)</td>
</tr>
<tr>
<td>2</td>
<td>Arum maculatum(AC)</td>
<td>A. cochlearis (AA)</td>
<td>Chrysilia squamata (CC)</td>
</tr>
<tr>
<td>3</td>
<td>Astilbe chinensis (AS)</td>
<td>A. cochlearis (AA)</td>
<td>Chrysilia squamata (CC)</td>
</tr>
<tr>
<td>4</td>
<td>Begonia semperflorens (BS)</td>
<td>B. semperflorens (BB)</td>
<td>B. semperflorens (BB)</td>
</tr>
<tr>
<td>5</td>
<td>Catharanthus roseus (CR)</td>
<td>C. roseus (CR)</td>
<td>C. roseus (CR)</td>
</tr>
<tr>
<td>6</td>
<td>Chlorophytum comosum (CC)</td>
<td>C. comosum (CC)</td>
<td>C. comosum (CC)</td>
</tr>
<tr>
<td>7</td>
<td>Cnidoscolus aconitifolius (CA)</td>
<td>C. aconitifolius (CA)</td>
<td>C. aconitifolius (CA)</td>
</tr>
<tr>
<td>8</td>
<td>Citrus limon (CL)</td>
<td>Citrus limon (CL)</td>
<td>Citrus limon (CL)</td>
</tr>
<tr>
<td>9</td>
<td>Costus speciosus (CS)</td>
<td>Costus speciosus (CS)</td>
<td>Costus speciosus (CS)</td>
</tr>
<tr>
<td>10</td>
<td>Dalbergia sissoo (DS)</td>
<td>Dalbergia sissoo (DS)</td>
<td>Dalbergia sissoo (DS)</td>
</tr>
<tr>
<td>11</td>
<td>Datura stramonium (DS)</td>
<td>Datura stramonium (DS)</td>
<td>Datura stramonium (DS)</td>
</tr>
<tr>
<td>12</td>
<td>Elaeagnus angustifolius (EA)</td>
<td>E. angustifolius (EA)</td>
<td>E. angustifolius (EA)</td>
</tr>
<tr>
<td>14</td>
<td>Ficus carica (FC)</td>
<td>Ficus carica (FC)</td>
<td>Ficus carica (FC)</td>
</tr>
<tr>
<td>15</td>
<td>Garcinia cambogia (GC)</td>
<td>Garcinia cambogia (GC)</td>
<td>Garcinia cambogia (GC)</td>
</tr>
<tr>
<td>16</td>
<td>Gardenia jasminoides (GJ)</td>
<td>G. jasminoides (GJ)</td>
<td>G. jasminoides (GJ)</td>
</tr>
<tr>
<td>17</td>
<td>Heliocereus undatus (HU)</td>
<td>H. undatus (HU)</td>
<td>H. undatus (HU)</td>
</tr>
<tr>
<td>18</td>
<td>Hypericum perforatum (HP)</td>
<td>H. perforatum (HP)</td>
<td>H. perforatum (HP)</td>
</tr>
<tr>
<td>19</td>
<td>Impatiens noli-tangere (IN)</td>
<td>I. noli-tangere (IN)</td>
<td>I. noli-tangere (IN)</td>
</tr>
<tr>
<td>20</td>
<td>Ilex vomitoria (IV)</td>
<td>Ilex vomitoria (IV)</td>
<td>Ilex vomitoria (IV)</td>
</tr>
<tr>
<td>21</td>
<td>Jatropha curcas (JC)</td>
<td>Jatropha curcas (JC)</td>
<td>Jatropha curcas (JC)</td>
</tr>
<tr>
<td>22</td>
<td>Justicia adhatoda (JA)</td>
<td>Justicia adhatoda (JA)</td>
<td>Justicia adhatoda (JA)</td>
</tr>
<tr>
<td>23</td>
<td>Lagerstroemia speciosa (LS)</td>
<td>L. speciosa (LS)</td>
<td>L. speciosa (LS)</td>
</tr>
<tr>
<td>24</td>
<td>Lantana camara (LC)</td>
<td>Lantana camara (LC)</td>
<td>Lantana camara (LC)</td>
</tr>
<tr>
<td>25</td>
<td>Laurus nobilis (LN)</td>
<td>Laurus nobilis (LN)</td>
<td>Laurus nobilis (LN)</td>
</tr>
<tr>
<td>26</td>
<td>Litchi chinensis (LC)</td>
<td>Litchi chinensis (LC)</td>
<td>Litchi chinensis (LC)</td>
</tr>
<tr>
<td>27</td>
<td>Magnolia officinalis (MO)</td>
<td>M. officinalis (MO)</td>
<td>M. officinalis (MO)</td>
</tr>
<tr>
<td>28</td>
<td>Manihot esculenta (ME)</td>
<td>Manihot esculenta (ME)</td>
<td>Manihot esculenta (ME)</td>
</tr>
<tr>
<td>29</td>
<td>Moringa oleifera (MO)</td>
<td>Moringa oleifera (MO)</td>
<td>Moringa oleifera (MO)</td>
</tr>
<tr>
<td>30</td>
<td>Musa sapientum (MS)</td>
<td>Musa sapientum (MS)</td>
<td>Musa sapientum (MS)</td>
</tr>
<tr>
<td>31</td>
<td>Nerium oleander (NO)</td>
<td>Nerium oleander (NO)</td>
<td>Nerium oleander (NO)</td>
</tr>
<tr>
<td>32</td>
<td>Passiflora incarnata (PI)</td>
<td>P. incarnata (PI)</td>
<td>Passiflora incarnata (PI)</td>
</tr>
<tr>
<td>33</td>
<td>Persea americana (PA)</td>
<td>Persea americana (PA)</td>
<td>Persea americana (PA)</td>
</tr>
<tr>
<td>34</td>
<td>Physalis alkekengi (PA)</td>
<td>P. alkekengi (PA)</td>
<td>P. alkekengi (PA)</td>
</tr>
<tr>
<td>35</td>
<td>Pimenta dioica (PD)</td>
<td>Pimenta dioica (PD)</td>
<td>Pimenta dioica (PD)</td>
</tr>
<tr>
<td>36</td>
<td>Piper nigrum (PN)</td>
<td>Piper nigrum (PN)</td>
<td>Piper nigrum (PN)</td>
</tr>
<tr>
<td>37</td>
<td>Ptelea trifoliata (PT)</td>
<td>Ptelea trifoliata (PT)</td>
<td>Ptelea trifoliata (PT)</td>
</tr>
<tr>
<td>38</td>
<td>Rauwolfia serpentina (RS)</td>
<td>R. serpentina (RS)</td>
<td>R. serpentina (RS)</td>
</tr>
<tr>
<td>39</td>
<td>Rubus idaeus (RI)</td>
<td>Rubus idaeus (RI)</td>
<td>Rubus idaeus (RI)</td>
</tr>
<tr>
<td>40</td>
<td>Rhus vernayi (RV)</td>
<td>Rhus vernayi (RV)</td>
<td>Rhus vernayi (RV)</td>
</tr>
<tr>
<td>41</td>
<td>Sambucus nigra (SN)</td>
<td>Sambucus nigra (SN)</td>
<td>Sambucus nigra (SN)</td>
</tr>
<tr>
<td>42</td>
<td>Solanum lycopersicum (SL)</td>
<td>S. lycopersicum (SL)</td>
<td>S. lycopersicum (SL)</td>
</tr>
<tr>
<td>43</td>
<td>Triticum aestivum (TA)</td>
<td>Triticum aestivum (TA)</td>
<td>Triticum aestivum (TA)</td>
</tr>
<tr>
<td>44</td>
<td>Ustilago maydis (UM)</td>
<td>Ustilago maydis (UM)</td>
<td>Ustilago maydis (UM)</td>
</tr>
<tr>
<td>45</td>
<td>Vitis vinifera (VV)</td>
<td>Vitis vinifera (VV)</td>
<td>Vitis vinifera (VV)</td>
</tr>
</tbody>
</table>

Since the number of plants (62) selected initially for the study was found to be high with respect to the area and layout of the study site (field location of the garden—both outdoor and indoor) considered presently, the number of plants had to be reduced further. Under such a circumstance a judicious decision had to be made regarding the choice of plants (herbs, climbersand shrubs) for the garden. The weighted product method was thus adopted to screen out the more suited plants.

As an example, the procedure adopted to select a small group of climbers from the total has been represented below.

**Selection of climbers:**

The list of 22- [morphological (16) and medicinal (6)] characters that were used for the selection of climbers (11/ 20) from among the total (20 climbers selected initially) has been described. The characters, character states and their scores are provided. The characters, character states and scores were slightly different for the herbs and shrubs but the procedure adopted for selection was similar.
Thus from the sixty two medicinal plants listed (herbs-29, climbers 20, shrubs-13) a total of 30 most suited plants (herbs-14/29, climbers-11/20 and shrubs-5/13) were selected for the study sites.

The selection was based on high scores in the analysis using the weighted product method. Each of the thirty listed plants were scored as shown below using the character weight, character score and weighted score to get the final weighted score.

A model of the scoring table for a particular climber, *Clitoriaternatea* is as shown below. The codes provided for the characters in the Table III can be traced back to the previous table (Table II).

### Table II. Characters and character states with scores for climbers

<table>
<thead>
<tr>
<th>S No</th>
<th>Characters and its codes</th>
<th>Character states / scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Habit</td>
<td>Perennial (PL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Annual (AL)</td>
</tr>
<tr>
<td>2</td>
<td>Availability of material</td>
<td>Very scarce (VS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scarce (S)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prevalent (P)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Most prevalent (MP)</td>
</tr>
<tr>
<td>3</td>
<td>Method of propagation</td>
<td>Sucker (SR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Off shoot (OS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stem cutting (SC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rhizome (RM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seeds (SD)</td>
</tr>
<tr>
<td>4</td>
<td>Ease of propagation</td>
<td>Very difficult (VD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difficult (D)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Easy (E)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very easy (VE)</td>
</tr>
<tr>
<td>5</td>
<td>Presence of thorns/spines</td>
<td>Yes (Y)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (N)</td>
</tr>
<tr>
<td>6</td>
<td>Leaf type</td>
<td>Simple (SM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compound (CD)</td>
</tr>
<tr>
<td>7</td>
<td>Foliage colour at emergence</td>
<td>Dark green (DG)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Green (G)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light green (LG)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variegated red (VR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variegated yellow/white (VYW)</td>
</tr>
<tr>
<td>8</td>
<td>Presence of flower/inflorescence</td>
<td>Flower (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inflorescence (IF)</td>
</tr>
<tr>
<td>9</td>
<td>Colour of flower/inflorescence</td>
<td>Light coloured (LC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bright coloured (BC)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Variegated coloured (YC)</td>
</tr>
<tr>
<td>10</td>
<td>Size of flower or inflorescence</td>
<td>Very small [ρ&lt;5mm] (VS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small [5-10mm] (SM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium [10-20mm] (MD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large [20-50mm] (L)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very large [&gt;50mm] (VL)</td>
</tr>
<tr>
<td>11</td>
<td>Aromatic property</td>
<td>Unpleasant smell (US)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No smell (NS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pleasant smell (PS)</td>
</tr>
<tr>
<td>12</td>
<td>Foliage and floral contrast</td>
<td>No (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes (Y)</td>
</tr>
<tr>
<td>13</td>
<td>Fruit elasticity</td>
<td>No (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes (Y)</td>
</tr>
<tr>
<td>14</td>
<td>Fruit taste</td>
<td>Bad (B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bland (BD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sour (SR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sweet (ST)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very sweet (VST)</td>
</tr>
<tr>
<td>15</td>
<td>Fruit size</td>
<td>Very small [2-5mm] (VS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small [5-10mm] (SM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium [10-15mm] (MD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium large [15-20mm] (ME)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large [20-50mm] (LG)</td>
</tr>
<tr>
<td>16</td>
<td>Fruit shape</td>
<td>Long (LN)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oval (OV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Round (RD)</td>
</tr>
<tr>
<td>17</td>
<td>Medicinal components: grouped</td>
<td>No (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes (Y)</td>
</tr>
<tr>
<td>18</td>
<td>Medicinal parts</td>
<td>Root/Rhizome (R/R)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stem (ST)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flower (FL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seed/fruit (SF)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leaf (LF)</td>
</tr>
<tr>
<td>19</td>
<td>Used in nostrum</td>
<td>No (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes (Y)</td>
</tr>
<tr>
<td>20</td>
<td>Poisonous nature</td>
<td>Yes (Y)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No (N)</td>
</tr>
<tr>
<td>21</td>
<td>Mode of application</td>
<td>Topical (TL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oral (OL)</td>
</tr>
<tr>
<td>22</td>
<td>Air purifying property</td>
<td>No (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes (Y)</td>
</tr>
</tbody>
</table>
Table III: Scoring of *Clitoriaternatea* (climber no. 4) [CW – Character weight; CT- Character type; Scr- Score of each characters; WS- Weighted score]

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Characters</th>
<th>CW</th>
<th>CT</th>
<th>Scr</th>
<th>WS</th>
<th>Sl No</th>
<th>Characters</th>
<th>CW</th>
<th>CT</th>
<th>Scr</th>
<th>WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Habit (H)</td>
<td>2</td>
<td>AL</td>
<td>2</td>
<td>4</td>
<td>13</td>
<td>Fruit edibility (FEY)</td>
<td>1</td>
<td>N</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Availability of material (AOM)</td>
<td>5</td>
<td>MP</td>
<td>5</td>
<td>25</td>
<td>14</td>
<td>Fruit taste (FTE)</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Method of propagation (MOP)</td>
<td>4</td>
<td>SD</td>
<td>5</td>
<td>20</td>
<td>15</td>
<td>Fruit size (FSZ)</td>
<td>1</td>
<td>MD</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Ease of propagation (EOP)</td>
<td>4</td>
<td>VE</td>
<td>5</td>
<td>20</td>
<td>16</td>
<td>Fruit shape (FSP)</td>
<td>1</td>
<td>LN</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Presence of thorns/spines (PT/S)</td>
<td>5</td>
<td>N</td>
<td>2</td>
<td>10</td>
<td>17</td>
<td>Medicinal components reported (MCR)</td>
<td>1</td>
<td>Y</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Leaf type (LT)</td>
<td>1</td>
<td>SM</td>
<td>1</td>
<td>1</td>
<td>18</td>
<td>Medicinal parts (MPT)</td>
<td>1</td>
<td>Whole</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Foliage colour at emergence (PCE)</td>
<td>1</td>
<td>LG</td>
<td>2</td>
<td>2</td>
<td>19</td>
<td>Used as nostrum (UAN)</td>
<td>3</td>
<td>Y</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Presence of flower / inflorescence (PF/I)</td>
<td>3</td>
<td>F</td>
<td>1</td>
<td>3</td>
<td>20</td>
<td>Poisonous nature (PNR)</td>
<td>5</td>
<td>N</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>Colour of flower or inflorescence (CF/I)</td>
<td>2</td>
<td>BC</td>
<td>2</td>
<td>4</td>
<td>21</td>
<td>Mode of application (MOA)</td>
<td>3</td>
<td>OL</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Size of flower or inflorescence (SF/I)</td>
<td>2</td>
<td>MD</td>
<td>3</td>
<td>6</td>
<td>22</td>
<td>Air purifying property (APP)</td>
<td>4</td>
<td>N</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Aromatic property (APT)</td>
<td>5</td>
<td>NS</td>
<td>2</td>
<td>10</td>
<td>TOTAL</td>
<td>60</td>
<td>52</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Foliage and floral contrast (FFC)</td>
<td>5</td>
<td>Y</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weighted score = CW × Scr

Category score = Total WS ÷ Total CW = 150 ÷ 60 = 2.5

Final weighted score = Category score × Category weight = 2.5 × 4 = 10

A summary sheet of the scores and ranks assigned to the thirty selected plants based on the scoring model is provided below. The score of the selected climber is highlighted.
Table IV. List of selected plants for the construction of healing gardens

<table>
<thead>
<tr>
<th>Sl no</th>
<th>List of selected plants</th>
<th>Garden</th>
<th>Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HERBS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Aloe vera</td>
<td>Both</td>
<td>14.0</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Catharanthus roseus</td>
<td>Outdoor</td>
<td>13.1</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Chlorophyllum capense</td>
<td>Both</td>
<td>12.2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Chrysanthemum moriflorum</td>
<td>Outdoor</td>
<td>14.1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Costus speciosa</td>
<td>Outdoor</td>
<td>12.1</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Curcuma longa</td>
<td>Outdoor</td>
<td>14.0</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Dendrobium species</td>
<td>Both</td>
<td>12.0</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Impatiens balsamina</td>
<td>Both</td>
<td>12.0</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Impatiens walleriana</td>
<td>Both</td>
<td>12.0</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Kaempferiagalanga</td>
<td>Outdoor</td>
<td>12.0</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>Ocimum basilicum</td>
<td>Both</td>
<td>14.5</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Ocimum sanctum</td>
<td>Both</td>
<td>14.0</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>Pleuranthusamboineus</td>
<td>Both</td>
<td>12.5</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>Sanverseiariiflata</td>
<td>Both</td>
<td>12.5</td>
<td>5</td>
</tr>
<tr>
<td><strong>CLIMBERS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Asparagus recemosus</td>
<td>Outdoor</td>
<td>9.2</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Centellaasiatica</td>
<td>Outdoor</td>
<td>9.5</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>Clitoriernata</td>
<td>Outdoor</td>
<td>10.0</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Epipremnummaureum</td>
<td>Both</td>
<td>8.0</td>
<td>6</td>
</tr>
<tr>
<td>19</td>
<td>Hemigraphisalternata</td>
<td>Outdoor</td>
<td>8.0</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>Ipomoea quamoclit</td>
<td>Outdoor</td>
<td>9.2</td>
<td>4</td>
</tr>
<tr>
<td>21</td>
<td>Jasminumofficinale</td>
<td>Outdoor</td>
<td>9.7</td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>Jasminumsambac</td>
<td>Outdoor</td>
<td>9.7</td>
<td>2</td>
</tr>
<tr>
<td>23</td>
<td>Piperlongum</td>
<td>Outdoor</td>
<td>10.0</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>Protolacagraulifolia</td>
<td>Both</td>
<td>8.0</td>
<td>6</td>
</tr>
<tr>
<td>25</td>
<td>Thunbergiafragrans</td>
<td>Outdoor</td>
<td>8.4</td>
<td>5</td>
</tr>
<tr>
<td><strong>SHRUBS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Hamelia patens</td>
<td>Outdoor</td>
<td>7.9</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td>Hibiscus rosasinensis</td>
<td>Outdoor</td>
<td>7.6</td>
<td>2</td>
</tr>
<tr>
<td>28</td>
<td>Lawsoniainemis</td>
<td>Outdoor</td>
<td>7.3</td>
<td>3</td>
</tr>
<tr>
<td>29</td>
<td>Murrayaokonigii</td>
<td>Outdoor</td>
<td>7.2</td>
<td>4</td>
</tr>
<tr>
<td>30</td>
<td>Tabernaemontana divaricata</td>
<td>Outdoor</td>
<td>7.2</td>
<td>4</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION

The present study was intended to help the botanists to make use of a mathematical method as a selection criterion. The same procedure can be extended for any similar application. However, it should be kept in mind that the parameters identified for a particular experiment and weights to be provided for specific parameters can be changed according to the situation and are likely to affect the final scores. However, the utility of the weighted product method in making appropriate decisions is evident.

ACKNOWLEDGEMENT

Authors are thankful to Suhara Beevy, Head of the department of Botany, Kerala University Kariavattom for providing the necessary facilities for the conduct of this research work.
REFERENCES


6. Satyavati GV, Raina MK, Sharma M. Medicinal plants of India. Indian Council of Medical Research; 1987