1. Introduction

Objective
➢ To design a cost-effective harvester for cilantro and methi that doesn’t cut the roots while requiring minimal labor.

Design Elements
➢ Harvesting Head
➢ Plant transportation system

2. Project Background

➢ Currently these herbs are harvested by hand and require 12-14 hour work days to harvest one acre. They are pulled out of the soil manually.
➢ Farmbrero wants to keep roots intact since this increases shelf live and boosts the product's aesthetic.

Criteria
➢ Harvest 1 acre in 8-hour day
➢ Keep plant roots intact
➢ Minimize labor
➢ Ease of manufacturing

Constraints
➢ ~$72,000
➢ Simple to operate and maintain
➢ ~1 meter wide header

3. Factors

Social Factors
➢ Increases cilantro and methi production
➢ Makes both plants more accessible

Economic Factors
➢ Allows Farmbrero to reduce labor costs

Environmental Factors
➢ Harvester runs of gasoline, producing CO2 emissions

4. Harvester Design

Harvesting Head
➢ Loosely based on sod-cutter blade
➢ Hydraulic cylinder adjusts cutting depth
➢ Paddle reel assists plant movement

Plant Conveyance System
➢ Uses chain-link wire mesh belt
➢ Powered by Hydraulic Motor

Complete Assembly
➢ Designed to sit on self-propelled platform
➢ Forward motion pushes plants from cutter blade to conveyor belt

5. Alternative Solutions

<table>
<thead>
<tr>
<th>Design Matrices</th>
<th>Harvesting Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td>Removal</td>
</tr>
<tr>
<td>Scorers</td>
<td>0.3</td>
</tr>
<tr>
<td>Sod Cutter</td>
<td>9 / 2.7</td>
</tr>
<tr>
<td>Indiv. Heads</td>
<td>7 / 2.1</td>
</tr>
<tr>
<td>Radish Type</td>
<td>8 / 2.4</td>
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</tbody>
</table>

Cost Estimate
➢ "Total Parts" refers to number of pieces required prior to fabrication

The cost analysis does not include an estimate for the platform the plant transportation system will sit on as it was not within the project scope. Given the small cost in respect to the $72,000 estimate from similar harvesting machines, it can be assumed this solution is economically feasible for Farmbrero. It can also be concluded that the platform may take up a large portion of the budget.

6. Deliverables

➢ Design of a harvesting head and plant conveyance system for cilantro and methi crops
➢ 3-D Model: Solidworks
➢ Make cilantro and methi more accessible in the United States
➢ Cost Estimate

7. Validation Process

finite Element Analysis
➢ Cutter blade
➢ Utilizing ASAE D497.4 Standard, the draft (in Newtons) can be calculated with the following equation:

\[ D = F \left( A + B(S) + C(S)^2 \right) \]

8. Economic Analysis

Cost Estimate
➢ "Total Parts" refers to number of pieces required prior to fabrication

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Material/Item | Total Parts | Cost   |
-------------|-------------|--------|
Motors + Accessories | 6 | $1,366.10 |
A36 Steel | 11 | $667.96 |
Carbon Steel | 1 | $78.26 |
Plastics | 2 | $203.20 |
Miscellaneous | 54 | $335.47 |
Chain Belt | 1 | $1,125.00 |
Fabrication | N/A | $1,135.80 |
Total | $4,911.79 |

9. Conclusion

The group concluded that the project scope of designing a harvesting head and plant transportation system that has the ability to harvest cilantro and methi has been successfully fulfilled. The harvesting head is properly designed to allow the plants to move from the cutter blade to the conveyance belt, and then up to workers who can bundle the plants.

For future projects, a group could work on designing a moving platform that the harvesting mechanism can rest on. In addition, the machine could be built and testing could be performed to validate the machine's design.