Vetiver grass is a very versatile plant that has been used worldwide to address a myriad of environmental and engineering rehabilitation issues. Due to its unique ability, except for nutrients N P K, vetiver retains all of its absorbed contaminants, especially heavy metals in its roots, so its shoot biomass is safe for animal feed in both fresh and dry forms.

Its shoot biomass harvested from various applications such as soil and water conservation in agricultural land, mining waste rehabilitation and phytoremediation of wastewater, is a valuable resource for forage, biofuel, handicraft, thatching and mulch.

This presentation will concentrate only on its most valuable contribution – FORAGE PRODUCTION.
Major Attributes of Vetiver as a Forage Plant

• High yield comparing with common tropical and subtropical pasture grasses
• Nutritional values comparable with common tropical and subtropical pasture grasses
• Tolerance to extremely adverse climatic variations: drought, flood, inundation, fire
• Tolerance to extremely adverse edaphic variations: heavy clay to sandy soil and hardpan
• Tolerance to extremely adverse growing conditions: extreme pH, alkalinity, salinity, sodicity
• Tolerance to most pests and diseases
• Tolerance to most agrochemicals: herbicides and insecticides
Vetiver Growth and Biomass

As a result of the unique photosynthetic (C4 plant) ability, Vetiver can produce massive biomass, 100t/ha under field conditions and 130t/ha under experimental conditions.

Potential dry matter yield of three grasses over time
Vigorous growth and massive biomass under favorable conditions
<table>
<thead>
<tr>
<th>Analytes</th>
<th>Units</th>
<th>Vetiver grass</th>
<th></th>
<th>Rhodes</th>
<th></th>
<th>Kikuyu</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Young</td>
<td>Mature</td>
<td>Old</td>
<td>Mature</td>
<td>Mature</td>
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<tr>
<td>Energy (Ruminant)</td>
<td>kCal/kg</td>
<td>522</td>
<td>706</td>
<td>969</td>
<td>563</td>
<td>391</td>
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<tr>
<td>Digestibility</td>
<td>%</td>
<td>51</td>
<td>50</td>
<td>-</td>
<td>44</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>%</td>
<td>13.1</td>
<td>7.93</td>
<td>6.66</td>
<td>9.89</td>
<td>17.9</td>
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<tr>
<td>Fat</td>
<td>%</td>
<td>3.05</td>
<td>1.30</td>
<td>1.40</td>
<td>1.11</td>
<td>2.56</td>
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<tr>
<td>Calcium</td>
<td>%</td>
<td>0.33</td>
<td>0.24</td>
<td>0.31</td>
<td>0.35</td>
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<tr>
<td>Magnesium</td>
<td>%</td>
<td>0.19</td>
<td>0.13</td>
<td>0.16</td>
<td>0.13</td>
<td>0.19</td>
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<tr>
<td>Sodium</td>
<td>%</td>
<td>0.12</td>
<td>0.16</td>
<td>0.14</td>
<td>0.16</td>
<td>0.11</td>
<td></td>
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<tr>
<td>Potassium</td>
<td>%</td>
<td>1.51</td>
<td>1.36</td>
<td>1.48</td>
<td>1.61</td>
<td>2.84</td>
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<tr>
<td>Phosphorus</td>
<td>%</td>
<td>0.12</td>
<td>0.06</td>
<td>0.10</td>
<td>0.11</td>
<td>0.43</td>
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<tr>
<td>Iron</td>
<td>mg/kg</td>
<td>186</td>
<td>99</td>
<td>81.40</td>
<td>110</td>
<td>109</td>
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<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>16.5</td>
<td>4.0</td>
<td>10.90</td>
<td>7.23</td>
<td>4.51</td>
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<tr>
<td>Manganese</td>
<td>mg/kg</td>
<td>637</td>
<td>532</td>
<td>348</td>
<td>326</td>
<td>52.4</td>
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<tr>
<td>Zinc</td>
<td>mg/kg</td>
<td>26.5</td>
<td>17.5</td>
<td>27.80</td>
<td>40.3</td>
<td>34.1</td>
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</tbody>
</table>
Vetiver Grows Under Extremely Adverse Conditions

- Arid tropical savannah
- On beach sands
- In water
- On heavy black cotton soil
Vetiver Grows Under Extremely Acidic Conditions

Vetiver thrives at soil pH=3.8 and Aluminium Saturation Percentage (ASP) of 68% and 87% under field conditions.
Highly erodible acid sulfate soil (pH 3.0) in coastal Australia

One year after planting on acid sulfate soil (pH 3.0) in coastal Australia
Vetiver is Highly Tolerant to Saline Conditions

Vetiver can survive at soil salinity level of Ecse = 47.5 dSm$^{-1}$ under dryland salinity conditions.
Vetiver can tolerate almost twice as much salt as salt water couch.

ECse = 18.3 for Vetiver

ECse = 9.7 for Salt water couch

Vetiver can tolerate almost twice as much salt as salt water couch.
Vetiver growing between mangrove seedlings in brackish water
Vetiver Grows Under Extremely Cold Conditions

Vetiver grass can survive temperatures as low as minus -12°C (10°F) if following daytime temperatures rise well above freezing and the ground is not frozen.

Summer heat is often at 43+°C (110+°F) or higher

Vetiver was covered by 35cm of snow for 4 days and fully recovered in spring in Jordan

In California’s Mojave Desert
Vetiver Is Fire Proof

Soil is a very good insulator, as Vetiver buds are underground, they are not affected by fire.
Some Common Sources of Vetiver Biomass

ETHIOPIA

Vetiver grass contour hedges for soil and water conservation, and habitat rehabilitation on Ethiopian highlands. Biomass harvested for fresh and dry animal feed.
AUSTRALIA

Free range grazing on gold mine tailings rehabilitation site
AUSTRALIA - Hay from Sewage Effluent Treatment Plant
Some Examples of Vetiver As a Forage Crop

Free range grazing by cattle in Australia
Free range grazing by buffalo in China

Right: Free range grazing by cows in India
Left: Fresh fodder for cattle in New Zealand

Right: Fresh fodder for milking cows in Vietnam
Fresh fodder for goats and pig in Vietnam. Also vetiver straw is very good for bedding – soaks up urine.
Info from South Africa indicates that vetiver reduces worms in horses
Feed for Wildlife

Kangaroo in Australia

Giraffe and Rhino at Animal Kingdom, Florida, USA