World seaweed utilisation

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Context

• Zemke-White and Ohno, 1999 - reliable data on seaweed harvesting and farming was difficult to come by - extracted from the “Seaweeds of the World” edited by Alan Critchley and Masao Ohno.

• Food and Agriculture Organisation of the United Nations (FAO) has compiled a dataset of all reported fisheries and aquaculture landings from 1952 to present (the latest data is currently from 2012).

• While it is likely that these data are somewhat under-reporting the landings of various species, it is the most current and accurate dataset available.
Summary

• Worldwide, some 264 species of seaweeds are used by humans, mainly for food and hydrocolloid production (e.g. alginates, agar and carrageenan), but also for medicines, paper, fertiliser and animal feed.
Summary

• Worldwide almost 21 million t of seaweeds were utilised, with less than 800,000 t of this being harvested from the wild and the remaining 94% produced by aquaculture.

• Dominated by just five taxa

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Cultured</th>
<th>Captured</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorophyta</td>
<td>19,685</td>
<td>2,286</td>
<td>21,971</td>
</tr>
<tr>
<td>Phaeophyceae</td>
<td>7,842,533</td>
<td>659,975</td>
<td>8,502,508</td>
</tr>
<tr>
<td>Rhodophyta</td>
<td>12,238,771</td>
<td>130,122</td>
<td>12,368,893</td>
</tr>
<tr>
<td>Grand Total</td>
<td>20,100,989</td>
<td>792,383</td>
<td>20,893,372</td>
</tr>
</tbody>
</table>
Euchuema/Kappaphycus
Porphyra spp.
Gracilaria spp.
Laminaria/Saccharina
Undaria pinnatifida
Trends in production

• An interesting and important trend in terms of the sustainability (both ecological and economic) of the seaweed industry is the growth in seaweed farming as well as a decline in seaweed wild harvest.

• In 1995 around 3.9 million t was harvested, 52% of all seaweeds used. In 2012, only 792,383 t were harvested, comprising only 4% of all seaweed use.

• Much of this change is being driven by the growth in the seaweed farming industries of *Laminaria, Undaria, Gracilaria* and *Porphyra* in China, and *Euchuema/Kappaphycus* in Indonesia.
Growth in main taxa

![Seaweed production over years for different phyla](image)
Trends in production

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Growth in main taxa

The line graph illustrates the growth in seaweed production (in wet weight, tonnes x 10^6) for various genera from 1960 to 2000. The genera are color-coded as follows:

- Eucheuma: Red
- Laminaria: Blue
- Undaria: Green
- Gracilaria: Purple
- Porphyra: Orange

The graph shows a notable increase in production for Eucheuma, starting from a low baseline and rising sharply towards the end of the observed period.
Trends in production

- There has been a massive increase in the amount of seaweed used since 1995
- 7,546,754 t in 1995 increasing by 176% to 20,893,372 in 2012.
- This is largely driven by growth in the seaweed farming activities of Indonesia, China and the Philippines.
  - Indonesia, Euchuma/Kappaphycus farming increased from around 50,000 t to over 5.7 million t
  - China, Undaria was not cultured until the early 2000s and they are now producing 1.75 million t, Laminaria increased by over 1 million tonnes; Gracilaria was barely farmed at all in 1995 and in 2012 China produced 1.9 million tonnes and finally, Porphyra from increased from ~200,000 to over 1.1 million t.
  - Philippines, Euchuema farming increased from around 100,000 t in 1995 to over 1.1 million t in 2012.
Free living gametophytes
## Economics

<table>
<thead>
<tr>
<th>Genus</th>
<th>Price range (US$)</th>
<th>Production (t dry wt)</th>
<th>Lower estimate</th>
<th>Upper estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eucheuma</td>
<td>500-1500</td>
<td>2236896</td>
<td>$1,118,448,338</td>
<td>$3,355,345,013</td>
</tr>
<tr>
<td>Laminaria</td>
<td>5000-7000</td>
<td>1184365</td>
<td>$5,921,828,000</td>
<td>$8,290,559,200</td>
</tr>
<tr>
<td>Undaria</td>
<td>5000-7000</td>
<td>321249</td>
<td>$1,606,245,750</td>
<td>$2,248,744,050</td>
</tr>
<tr>
<td>Grailaria</td>
<td>500-1000</td>
<td>307129</td>
<td>$153,564,750</td>
<td>$307,129,500</td>
</tr>
<tr>
<td>Porphyra</td>
<td>5000-7000</td>
<td>272227</td>
<td>$1,361,135,250</td>
<td>$1,905,589,350</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$10,161,222,088</strong></td>
<td><strong>$16,107,367,113</strong></td>
</tr>
</tbody>
</table>
New Zealand

- Despite the long coastline and clean waters, very little seaweed utilisation
Government regulation of seaweed utilisation

• 1940s - Beachcast red seaweed = agar
• 1985 - moratorium on fishing permits - remains in place
• 1992 - special permits for abalone and mussel farmers
• 2009 - all beach cast in North Island under permit
• 2010 - *Macrocystis pyrifera* under permit
**Undaria pinnatifida** in NZ

- 1980s - invader
- 1990s - what do we do?
- 2000s - "unwanted organism"
- 2010s - harvest from mussel farms