Project Objectives

- Create an alternative livelihood to fishing (dugong hunting, seagrass destruction) through spirulina farming
- Also creates an additional source of nutrition for communities
- Any participants found to be violating the law related to the protection of dugongs (or any other law) will be no longer be allowed to be part of the contract farming program

- **Countries:** Indonesia and Solomon Islands
What is spirulina?

1 tbsp/10g of Skyline Spirulina by EnerGaia contains:

- 5.4g protein
- 8.72mg calcium
- 3.45mg iron
- 4.14mg magnesium
- 21.8mg beta carotene
- 108.3mg potassium

= 22g / 0.78oz of steak
= 5.5oz of milk
= 128g of spinach
= 2/3 large banana
= 1.1kg of carrots
= 17.5 g of tomato
Spirulina smallholder farming program

1. **2-month training program at EnerGaia farm**
   - earn $5 for spirulina produced during training

2. **Graduate from training program**
   - take out loan to purchase tanks
   - payments to the financing program for 3 years
   - down payment for spirulina system

3. **FINANCING PROGRAM**
   - remaining income paid to the farmer

4. **Spirulina**
   - portion for consumption by smallholder farmer
   - harvested
   - processed by EnerGaia
   - earnings from the sales

5. **Start own farm**
   - purchase and deliver spirulina system
   - female entrepreneur
Income creation with guaranteed buyer (EnerGaia)

**SYSTEM**

30 EnerGaia Bioreactors

**PRODUCTIVITY**

3.0 kg Spirulina per year

**CONTRACTED PURCHASE**

$10 per kg

**ANNUAL REVENUE**

$900 per farmer
Teluk Bogam, Central Kalimantan, Indonesia
Bogam is one of four villages in Central Kalimantan well known for dugong sightings & hunters

WWF created a group called Pokmaswas to help protect the dugong

Since 2017, dugong hunting seems to have stopped, but no official declaration from the former hunters

WWF 2018 feasibility study determined an alternative livelihood was needed

Coordination with EnerGaia started in 2018

Bogam was chosen to be the pilot site
What has been achieved
Prepared detailed business plan and financial model

- Indonesian Population: 261 Million
- Estimated local spirulina demand:
  - 1400 tons short term
  - 600,000 tons by 2050
- Growing Season: Year Round
- Operational Costs: Low
- Sell price: USD $20 - $30 kg for fresh spirulina
  USD $40 - $60 for dry spirulina
- Export Markets: USA, Europe, Australia

Understanding local costs and supply availability

<table>
<thead>
<tr>
<th>Supplier Name</th>
<th>Common name</th>
<th>PT Synerg! Tanganj</th>
<th>Central</th>
<th>PT Harapan Kemike</th>
<th>PT Madia Putera Perkasa</th>
</tr>
</thead>
<tbody>
<tr>
<td>(NH₄)₂MoO₄</td>
<td>ammonium molybdate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(NH₄)₂SO₄</td>
<td>Ammonium Sulfate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₆H₈O₇</td>
<td>Citric Acid</td>
<td>$1.08</td>
<td>$1.48</td>
<td>$2.14</td>
<td>$0.94</td>
</tr>
<tr>
<td>Ca(CCl₂)</td>
<td>calcium hypochlorite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CaCl₂</td>
<td>Calcium Chloride</td>
<td>$0.26</td>
<td>$0.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeCl₂</td>
<td>Iron chloride or iron (II) chloride</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FeSO₄</td>
<td>Iron Sulphate</td>
<td>$0.44</td>
<td>$2.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₃PO₄</td>
<td>phosphoric acid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K₂HPO₄</td>
<td>Potassium Phosphate</td>
<td>$2.58</td>
<td>$0.00</td>
<td>$6.41</td>
<td></td>
</tr>
<tr>
<td>K₂SO₄</td>
<td>Potassium Sulphate</td>
<td>$1.19</td>
<td></td>
<td>$3.53</td>
<td></td>
</tr>
<tr>
<td>KCl</td>
<td>potassium chloride</td>
<td></td>
<td></td>
<td></td>
<td>$1.07</td>
</tr>
<tr>
<td>KH₂PO₄</td>
<td>mono potassium phosphate or potassium phosphate dibasic</td>
<td></td>
<td></td>
<td></td>
<td>$2.10</td>
</tr>
<tr>
<td>MgSO₄</td>
<td>Magnesium Sulphate</td>
<td>$0.36</td>
<td>$0.46</td>
<td>$0.51</td>
<td>$0.53</td>
</tr>
<tr>
<td>MnCl₂</td>
<td>Manganese chloride or Manganese (II) chloride</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MnSO₄</td>
<td>Manganese sulfate or Manganese (II) sulfate</td>
<td></td>
<td></td>
<td></td>
<td>$1.53</td>
</tr>
<tr>
<td>MoO₃</td>
<td>Molybdcic acid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na₂EDTA</td>
<td>Di-sodium Ethylenediaminetriacetic acid</td>
<td>$4.30</td>
<td>$13.42</td>
<td></td>
<td>$6.55</td>
</tr>
</tbody>
</table>
Training center and training spirulina farm

Abandoned Fisheries Department Building

Current State of EnerGaia’s Training Center (Lab, Processing)
Hiring and training local EnerGaia support team

Idham (WWF); Paul (Indonesia Country Manager); Rahma (Microbiologist); Thoni (Microbiologist)

Rektarini (Onsite Project Manager)
Preparing first training class

31 community members have signed up for the first EnerGaia training class:
- 9 = Pokmaswas
- 8 = former hunters
- Rest = family members of former hunters

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Gender</th>
<th>Pokmaswas</th>
<th>ex Hunter</th>
<th>ex Assistant Hunter</th>
<th>Family ex/hunter/ Pokmaswas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heirusalem</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mulladi</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sawaludin</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tarmidi</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ardiiansyah</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Arsatad J</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ahmad Ghozali Rahman</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Jailani</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nafriansyah</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Erna</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Heiruni</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Arbavati</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Sahminan</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>A. Saharan</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Umis</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Anang Husni</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Rinto</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Salmieh</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Nexrin</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Afiyani</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Salasiah</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Sarwani Abadi</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>A. Syahhari</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Sampurna</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Suryadi</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Riduansyah</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Alipamoor</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Mursalim</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Rina Wati</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Syahminan</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Anang Godong</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cooking Competition to add Spirulina to Local Dishes

WINNER !!!

[Images of various dishes]
Local Acceptance: Spirulina dishes well received and enjoyed
Solomon Islands
Prepared detailed business plan and financial model

- **Population:** 600,000

- **Estimated local spirulina demand:** very low
  - Business case built around export to Australia

- **Growing Season:** Year Round

- **Operational Costs:** High compared to Thailand
  - Electricity cost 6x
  - Phone and internet much more expensive
  - Labor a bit more expensive for skilled positions
  - Local transport much more expensive

- **Assumed nutrient costs would be similar to Thailand**

<table>
<thead>
<tr>
<th>Items</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Investments (Equipment for Farmers)</td>
<td>$67,700</td>
</tr>
<tr>
<td>Operating Expenses (Tech Support, Processing, Fertilizers)</td>
<td>$288,354</td>
</tr>
<tr>
<td>SG&amp;A (Country team, Office)</td>
<td>$163,296</td>
</tr>
<tr>
<td>Other Expenses (Bad Debts, Misc)</td>
<td>$9,028</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td><strong>$528,378</strong></td>
</tr>
<tr>
<td>Less GEF Funds</td>
<td>-$38,466</td>
</tr>
<tr>
<td>Less Farmer Equipment 10% downpayment</td>
<td>-$6,770</td>
</tr>
<tr>
<td>Less Farmer Equipment Microfinancing (Assumption)</td>
<td>-$60,930</td>
</tr>
<tr>
<td>Less Revenues from Operations</td>
<td>-$236,638</td>
</tr>
<tr>
<td><strong>Funds Needed</strong></td>
<td><strong>$185,574</strong></td>
</tr>
<tr>
<td>Contingency</td>
<td>$14,426</td>
</tr>
<tr>
<td><strong>Funds Sought</strong></td>
<td><strong>$200,000</strong></td>
</tr>
</tbody>
</table>
Understanding local costs vs. business model assumptions

- Electricity costs 6x that of Thailand
- Nutrient costs 10x that of Thailand
  - Breaks the project financial feasibility
  - Trying to find import solution
- Logistics costs also high
- Limited local university support for lab analyses
Identified potential project site locations

Honiara with KPSI

Munda
Key Challenges

- Timing: EnerGaia joined in 2018 (year 4)
- Funding gap to business plan need
- Barriers to entry into a new country
  - Legal Entity Setup
  - Sourcing Nutrients cost effectively
  - Initial support for local data collection
  - Hiring
  - Logistics
  - Micro-finance solutions for smallholders
- Finding a good project site location
Lessons Learned

- Everything takes much longer than hoped to solve or accomplish
- Need to have majority of project funding available ourselves, including micro-financing solution
- Must find a local contractor to help find local component and nutrients supply
- Having a good local partner from the beginning
- Must have enough time to solve issues in a financially sustainable manner for long-term project success
Way forward

- We are preparing Baseline survey for long-term Monitoring & Evaluation
  - Include questions from dugong survey if applicable
- We will be in the community long-term as part of our company business model
  - Ensures sustainability of the project
  - Work with local partner from this project to ensure that some form of conservation activities are continued by the community
WHAT IF WE COULD HELP ADDRESS THE COMING FOOD CRISIS?

10bn
POPULATION
by 2050

4.5bn
MIDDLE CLASS*
by 2050

70%
FOOD DEMAND
by 2050

*Protein consumption increases 3x as person moves from low to middle income
While using less water than other protein foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Liters to produce 1kg of protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGGs</td>
<td>29,000</td>
</tr>
<tr>
<td>MILK</td>
<td>31,000</td>
</tr>
<tr>
<td>CHICKEN</td>
<td>34,000</td>
</tr>
<tr>
<td>PORK</td>
<td>57,000</td>
</tr>
<tr>
<td>BEEF</td>
<td>112,000</td>
</tr>
<tr>
<td>NUTS</td>
<td>139,000</td>
</tr>
</tbody>
</table>

Source: Mekonnen and Hoekstra (2010)

*Based on EnerGaia Spirulina and using the same tank of water for 6 months
And producing more oxygen

0.7 trees produce the same amount of O2 as 1 EnerGaia tank
While utilizing unused or infertile space

Downtown rooftop in Bangkok, Thailand

Rural village in Madurai, India
Our Disruption: A proprietary close-circuit production system

- No airborne contamination
- Reduced water consumption
- Better productivity

- Easy to set-up and scale
- Optimizes non-useable land
- High quality and taste neutral spirulina produced
Our Traction

6-year commercial track record

Winners of:
✓ 2016 Blue Economy Challenge (DFAT)
✓ 2017 Tech4Farmers Challenge (USAID)
✓ 2017 Fish 2.0 Southeast Asia Track

Global press coverage from: Al Jazeera, The Guardian, UK Channel 4 and many others

9 Farms Operating
## Types of Farms

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INTERNAL</strong></td>
<td>EnerGaia owned and operated farm</td>
</tr>
<tr>
<td><strong>PRODUCTION</strong></td>
<td>Privately owned, operated with EnerGaia’s technology and spirulina</td>
</tr>
<tr>
<td></td>
<td>produced is sold directly to EnerGaia</td>
</tr>
<tr>
<td><strong>LICENSE ONLY</strong></td>
<td>Privately owned, operated with EnerGaia’s technology and sold to</td>
</tr>
<tr>
<td></td>
<td>private buyers, paying a licensing fee to EnerGaia for all product sold</td>
</tr>
<tr>
<td><strong>SMALLHOLDER</strong></td>
<td>Small scale farms operated in low income communities in collaboration</td>
</tr>
<tr>
<td></td>
<td>with a local organization and an EnerGaia internal farm</td>
</tr>
</tbody>
</table>
4 Internal Farms in Thailand

- Rooftop farm at the Novotel
- EnerGaia HQ and R&D
- Farm at AIT University
- Farm in Phuket (in partnership with GFood)
Internal Experience

- Having our own farms helps better equip us to support farmers that purchase our technology. EnerGaia has experience assisting with the development of new spirulina projects in: Thailand, Bangladesh, France, Singapore, India, Indonesia and Peru.
- We have developed a due diligence process to access whether a self-sustaining spirulina project should be developed in a new region.
Ensuring Quality
Smallholder Partners
Hub and Spoke Model

- Each smallholder farming program is paired with an EnerGaia owned and operated farm.
- By having our own farm on the ground we can best offer technical support as we grow in the same conditions, require the same nutrients, have inoculum close by in case of a disaster and can use our farm for training new farmers.
- Each program also partners with a local organization that is already established in the region to help identify participants, assist with a smooth integration and aid in locally sourcing supplies.
What it takes to Run a Spirulina Farm

Spirulina Farming skills required:

- Cleaning tanks
- Monitoring the tanks located at the home and adding the appropriate amount of nutrients as needed
- Harvesting and bringing the harvest to the collection center in town
- Approximately 9 hours of work per week
- Additional year round source of income

In the regions we work in, the women tend to have the skills that parallel with these best:

- House cleaning
- Spend time at the home looking after children and cooking (which often requires following a recipe)
- Make the weekly trip to the market (can bring the spirulina along)
- Hardworking
- Usually have many ways to make money (season dependent)
Spirulina Smallholder Selection Process

1. Verification Steps
   - Local organization partner helps identify candidates
   - Candidate evaluation conducted

2. 2-month Training Program
   - 30 Candidates - each candidate:
     - Runs a system of tanks at the EnerGaia farm
     - Earns money per kg of spirulina produced
     - Learns the skills required
     - Learns the benefits of consuming spirulina

3. Graduation from Training Program

4. 10% Downpayment for System and Loan Initiated

5. Tank installment and EnerGaia staff available for technical support

6. Weekly harvests are cleaned and tested at the processing center
   - If quality does not meet standards EnerGaia staff will visit the farm site to offer assistance
Spirulina local dish creations in Teluk Bogam

- Spirulina Rice Noodles
- Galangal
- Ginger
- Red onion
- Garlic
- Turmeric

- Kaffir leaves
- Bay leaf
- Purée candlenut
- Salt
- Pepper
- Palm oil
- Chicken

MEE GORENG AYAM

- Spirulina rice noodles
- Garlic and shallots - mixed together with palm oil and sautéed
- Sweet Indonesian soy sauce
- Tomato sauce
- Chicken bullion - one cube