Marine Agronomy

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Advanced Methods in Tropical Phycology

Marine Agronomy Overview

- The science and economics of producing crops in the sea.
- Intensive systems = life cycle, hatcheries, company owned farms that are usually mechanized, usually long grow out – 1 year+. (*Laminaria japonica*)
- Extensive farms = usually vegetative, no inputs, maybe in ponds but usually coastal, short grow out – 4 to 6 weeks. (*Kappaphycus alvarezii*)

Case Study
Kappaphycus alvarezii

Farming

- Site selection
- Farm construction
- Farm operation
  - Planting
  - Maintenance
  - Harvesting
  - Culling -Tying
- Post harvest handling

Site Selection

- Environment (water temp., flow, salinity, herbivory, epiphytes, water depth, distance to village…)
- Logistics
- Socio-economics
- Politics
- Shipping costs
- Demographics

Farm Construction

- Anchor systems
- Preparation of lines
- Construction of drying tables

Farm Construction

Raft

Off
Bottom

Floating
Long line

Farm Operation - Planting

Farm Operation Maintenance

Farm Operation
Harvesting

Farm Operation - Culling/Tying

Post Harvest Handling

Buying station – Warehouse - Export

Achieving Quality, Volume and Price (QVP) goals from cultivated supplies

Quality

- Salt
- Water (moisture)
- Foreign material (extraneous weed, rope, sand, rocks…)
- Gel strength
- Yield

Quality

Bad

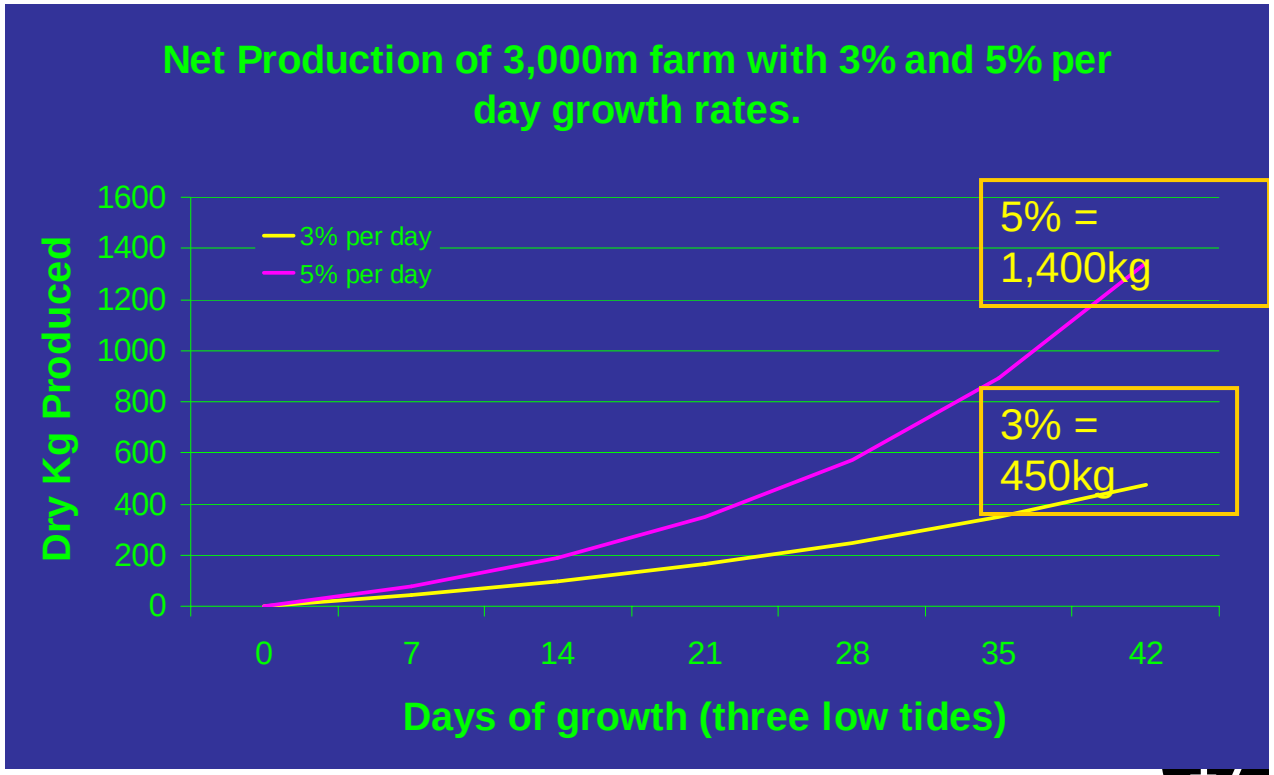
Good

What is the motivation to change?

Volume
Per farmer productivity

Small increase in GR = 3X production!!!
How to increase GR?

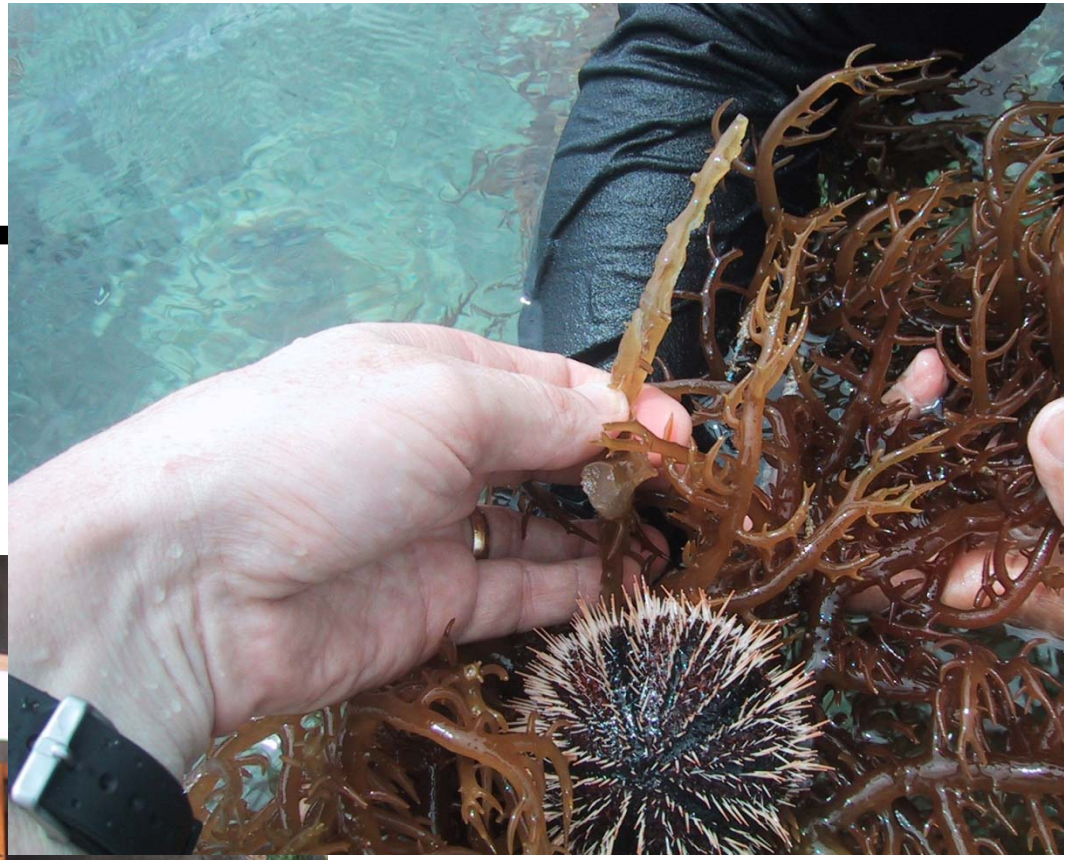
- Open cultivation bottlenecks
- Training in Best Farmer Practices
- Efficient farming technology
- Better strains



Bottlenecks-

Herbivory

Siganidae



Tripnuestes gratilla

Bottlenecks-Herbivory

- The sea urchin *Tripnuestes gratilla* eats the outer, colored layer of the cottonii and spinosum. They can be killed with a sharp stick.
- Asians eat the eggs and in many countries they can be sold for food.

Tripnuestes gratilla

Bottlenecks-
Herbivory

- Rabbitfish (Siganidae) eat the tips and pigmented layer of cottonii. They usually do not eat spinosum. The solution?

Bottlenecks- Herbivory

- In Tanzania, the best solution is to set a lot of fish traps.
- Net pens are used in Asia to preserve seedstock during heavy rabbitfish months.
- Everywhere it is good to use gillnets

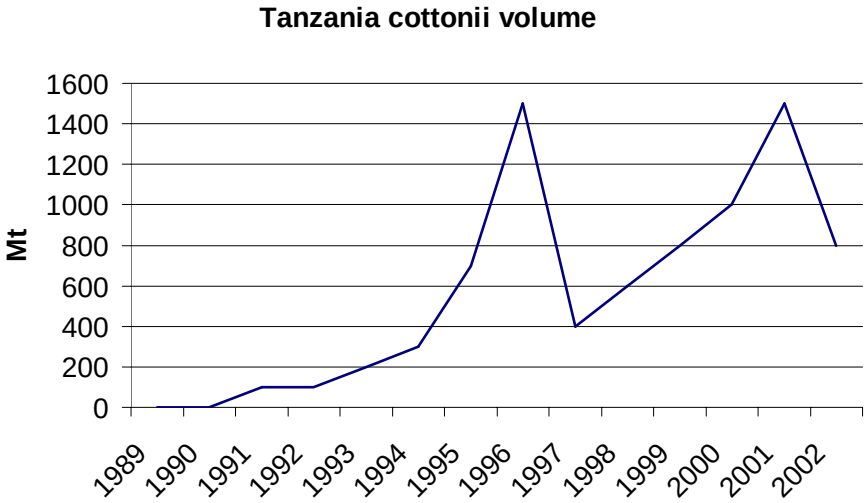
Bottlenecks- EFA

- What it is: epiphytic filamentous algae.
- Seeds of seaweed land on and insert themselves in the cottonii.
- They grow, making a bump on the plant and stunt growth.
- They die, leaving the cottonii stunted, bumpy and poorly branched.
- The solution is to harvest all plants and replant with clean seedlings from other areas. So, need strategic seedbanks.

Bottlenecks- Epiphytic (Endophytic) Filamentous Algae aka EFA

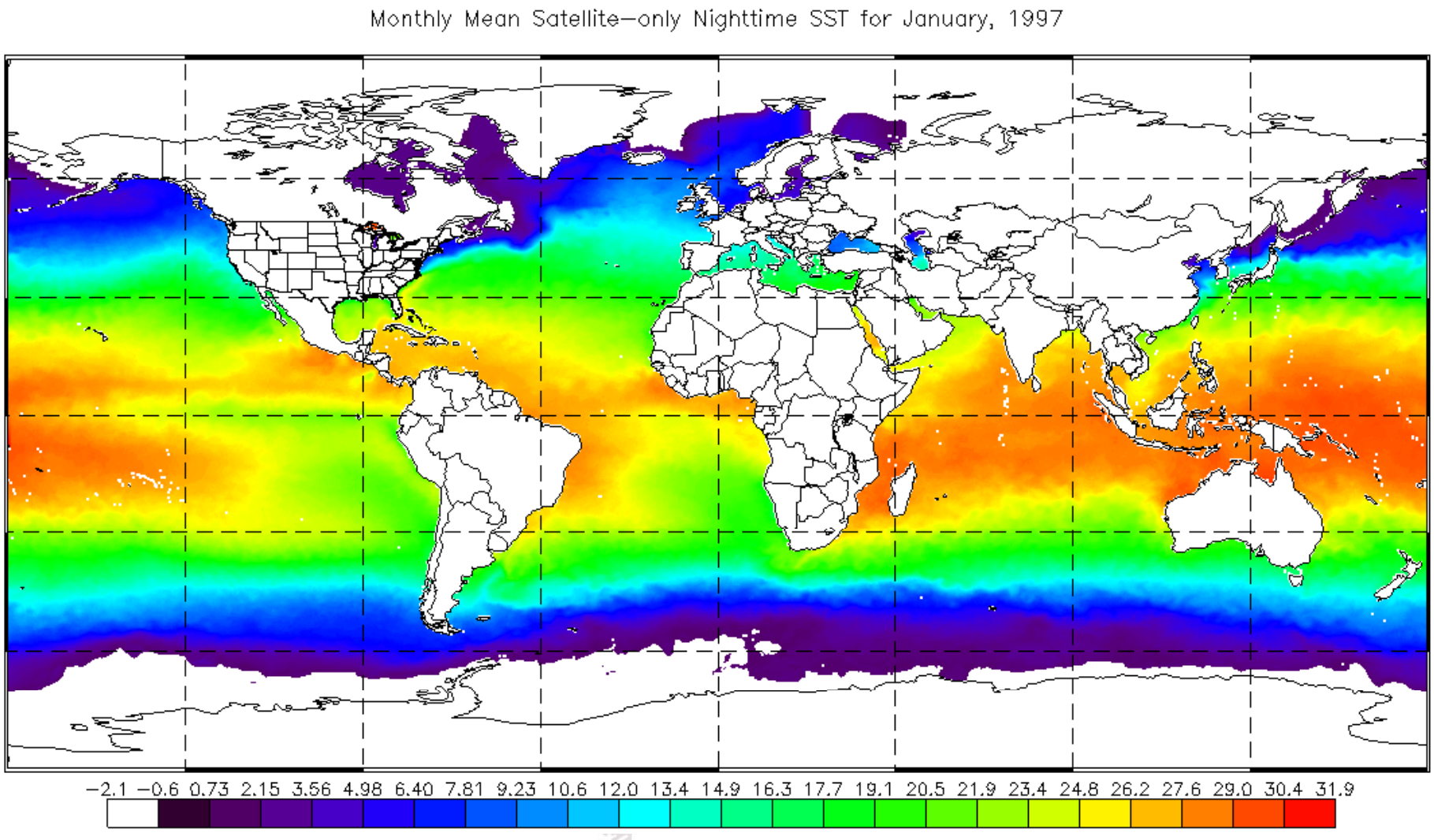
Bottlenecks- Hot water die-off

- *It is important to keep a seedbank in deeper water for faster recovery from die-off.*
- *Also, keep as many types of cottonii on the farm as possible (alvarezii, special, bohol, tambalang and sakol)*

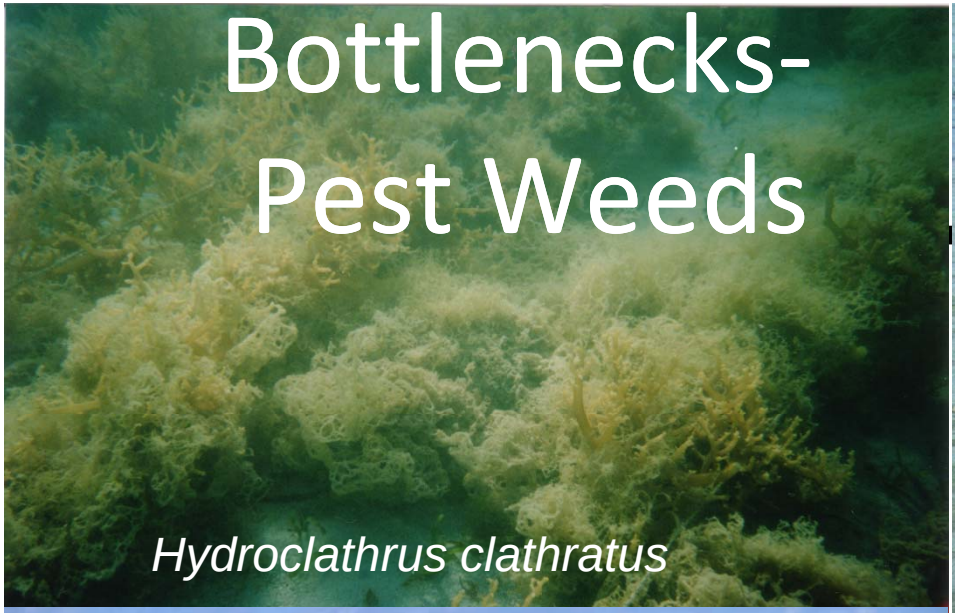


Bottlenecks- Hot Water Die-Off

Water temperature in January, 1997 (El Niño)



Bottlenecks- Pest Weeds



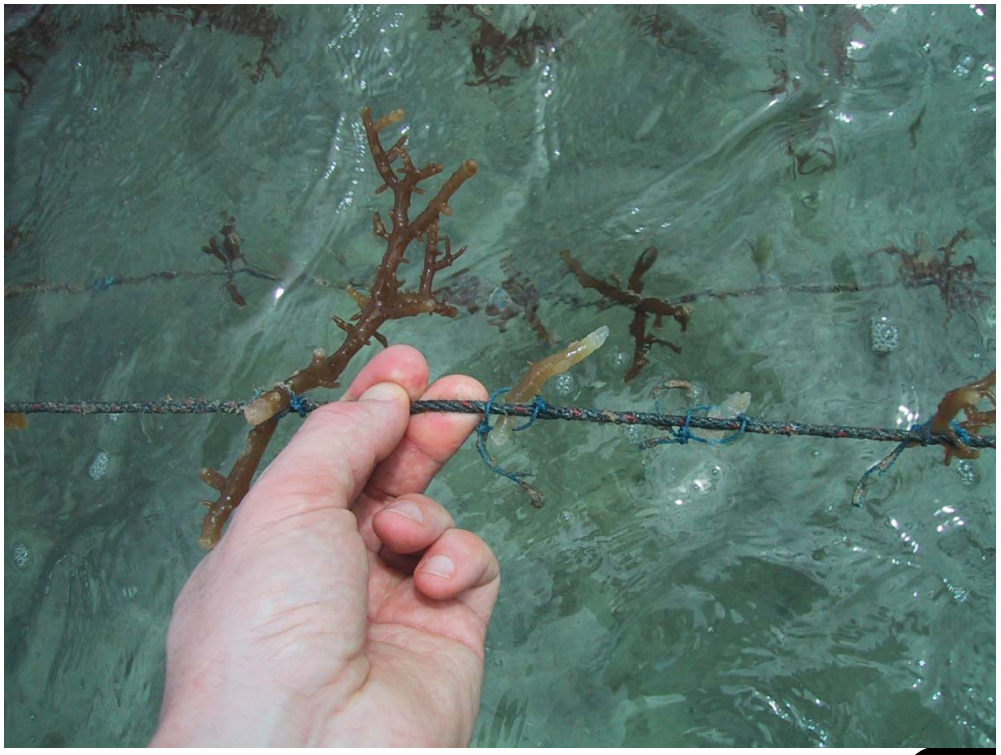
Pest weeds have value in compost.

Bottlenecks- Sediment on plants

- In some areas and some months it is common to get a lot of sediment on the plants.
- In these areas, farmers must shake lines every low tide.

Bottlenecks- Ice-ice

- Ice-ice is due to stress.
- Stress from hot water, low salinity, high salinity, rapid change in water temperature or salinity, getting rained on at low tide, exposure to air and sun during low tide, mishandling during transport after harvest, during seedstock selection and seeding and before planting and other things.
- Ice-ice is death of plant tissue so it becomes white.
- The solution is to prevent stress.
- Stress can be diminished by following proper farm protocol.



Bottlenecks- Ice-ice

Example of diminishing stress:

- Cottonii planted too shallow can have exposed tips that then suffer ice-ice and cannot grow.
- Plant lines in deeper water.

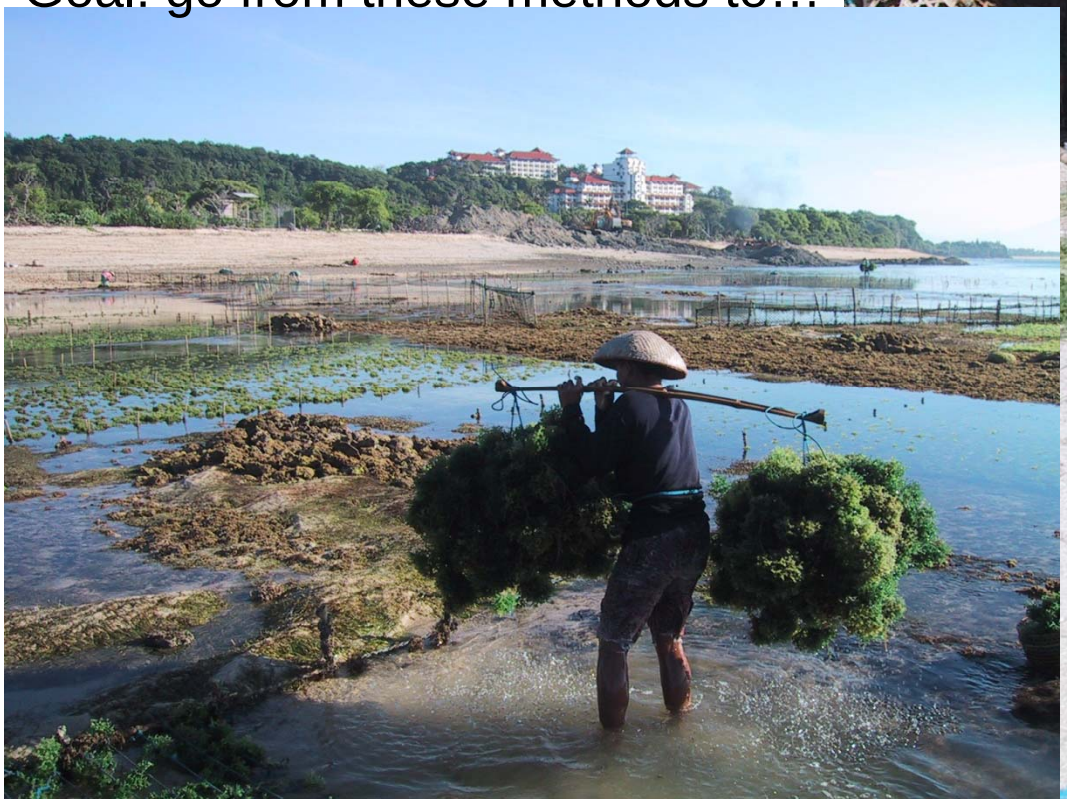
Bottlenecks-

Natural Disasters

Bottlenecks-Transporters

As per farmer productivity increases, the next bottleneck is transporting the harvest to the beach.

Goal: go from these methods to…



Bottlenecks-

Transporters

… these methods.

Bottlenecks-Transporters

And now plastic boats!

Volume
Per farmer productivity

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How to increase GR?

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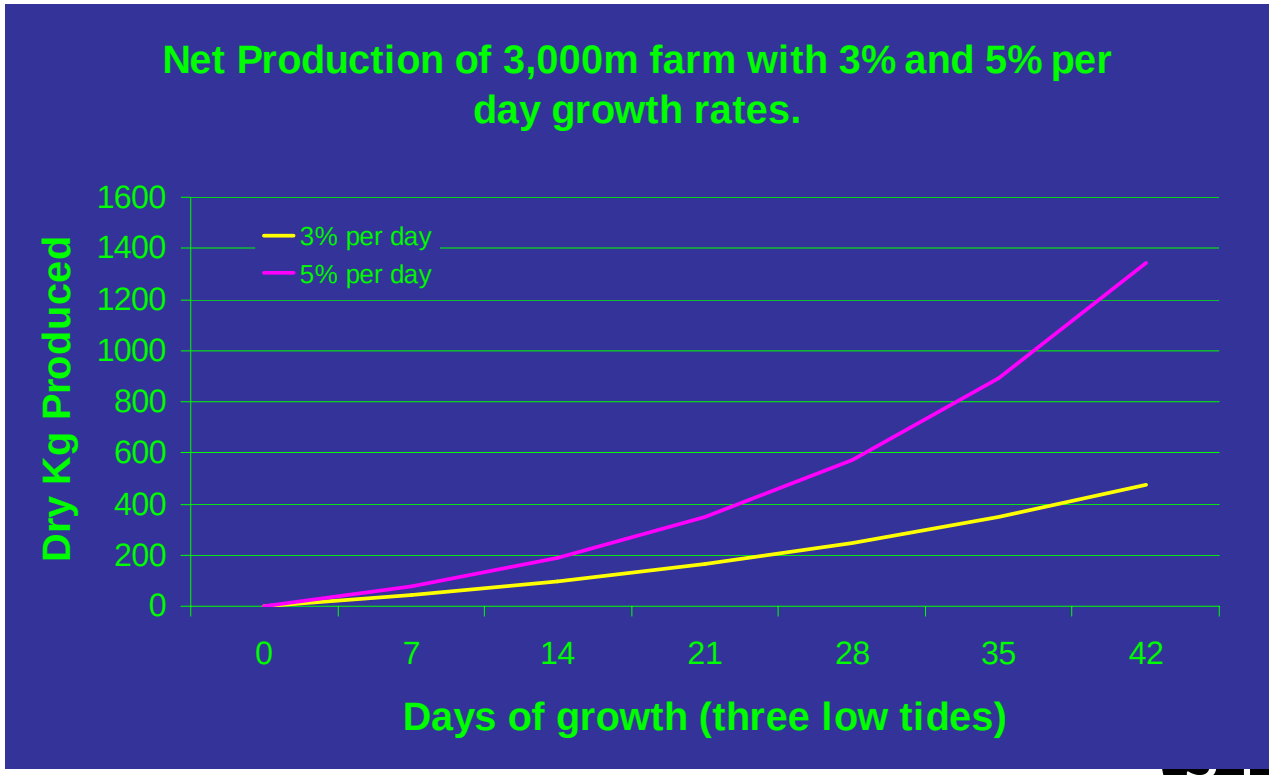


Training Technicians and Farmers

- Ultimate goal = Farmers with knowledge used to increase productivity and improve quality.
- How to achieve?
  - Literature: comic books, posters, brochures, handbooks.
  - Videos.
  - Training: MATs, Fisheries extension agents, Industry field technicians, workshops…

Training

- My opinion: Best means of assuring competent farmers is with qualified technicians working with new farmers for extended periods (months).
- Builds trust and promotes commitment.
- Keeps farmers focused on standardized best practices and high per farmer productivity.

So, how to create qualified technicians?

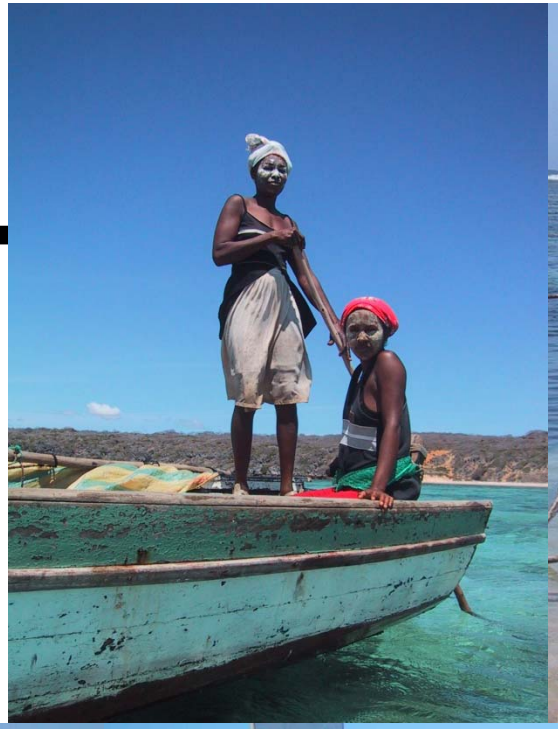
Training

Train technicians in standardized practices using PC based interactive lectures and case studies followed by exams and certificates of completion.

- FMC BioPolymer's program has three levels:
  1. Construction, farming protocol, post-harvest handling
  2. Site selection, water safety, coastal resource management.
  3. Farm business management, proactive farming, farm ecology.
- Semi-annual review, re-certification.
- Constantly updating material.
- Monitor impact on actual farm productivity and quality.

Training

Farmers should get the same message. Very important to promote standardize approach to technical assistance. This course does that.



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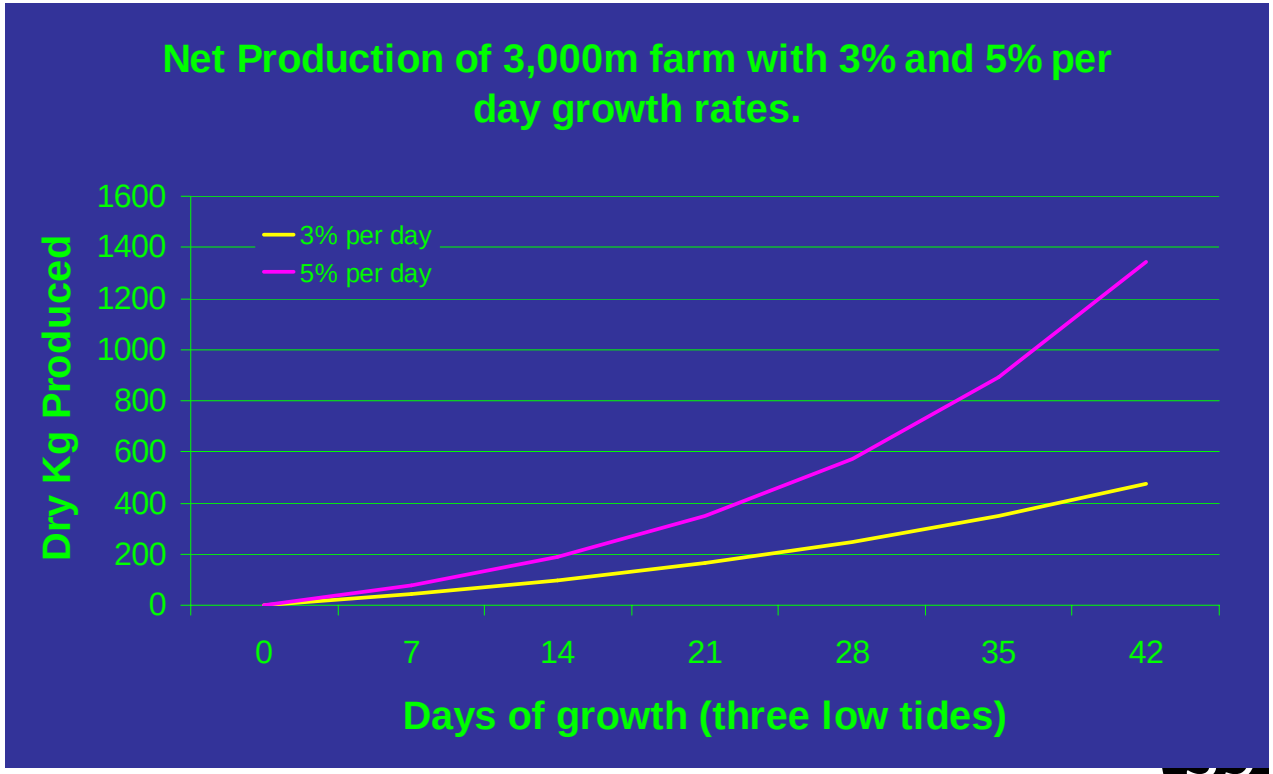
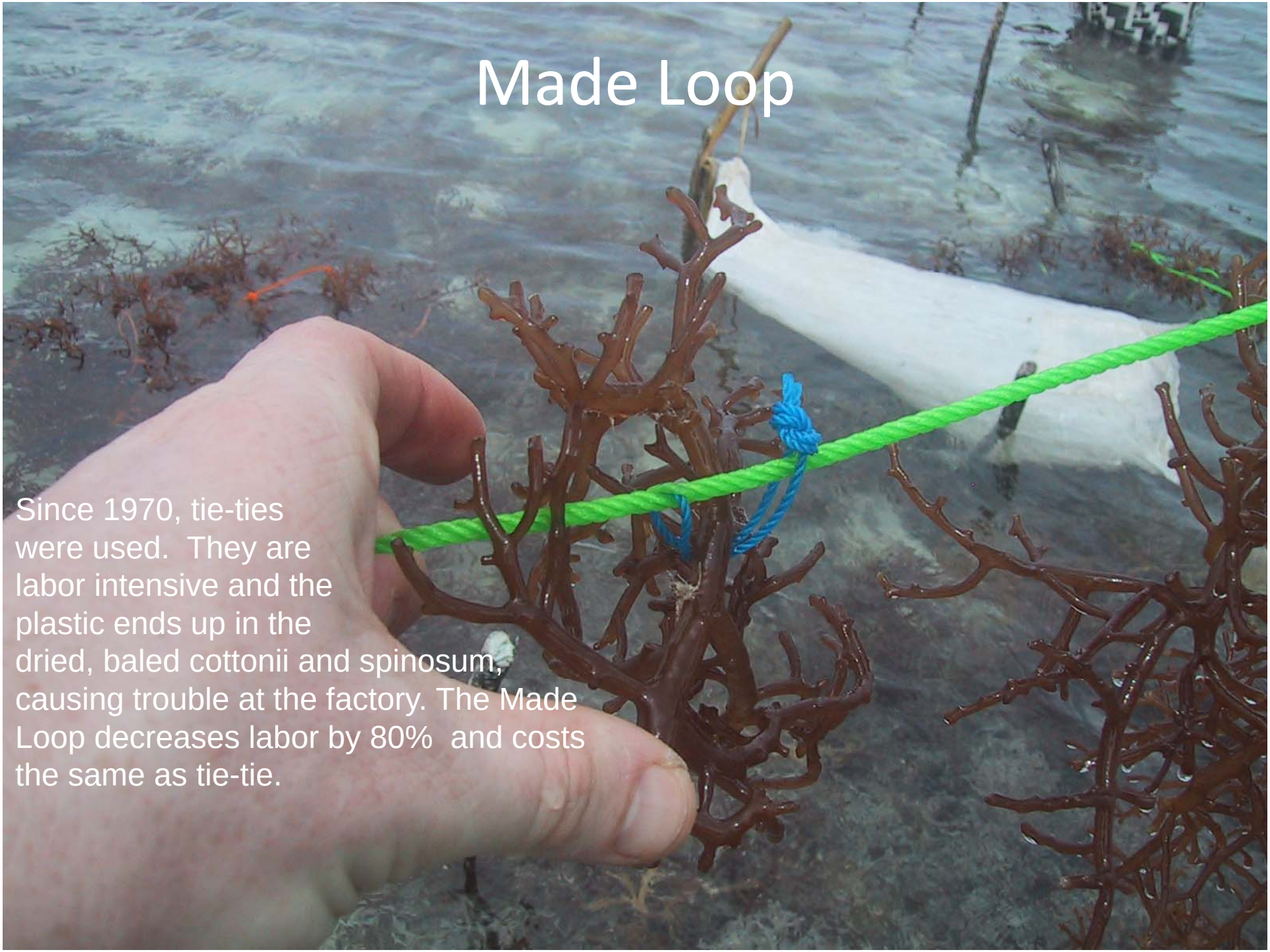


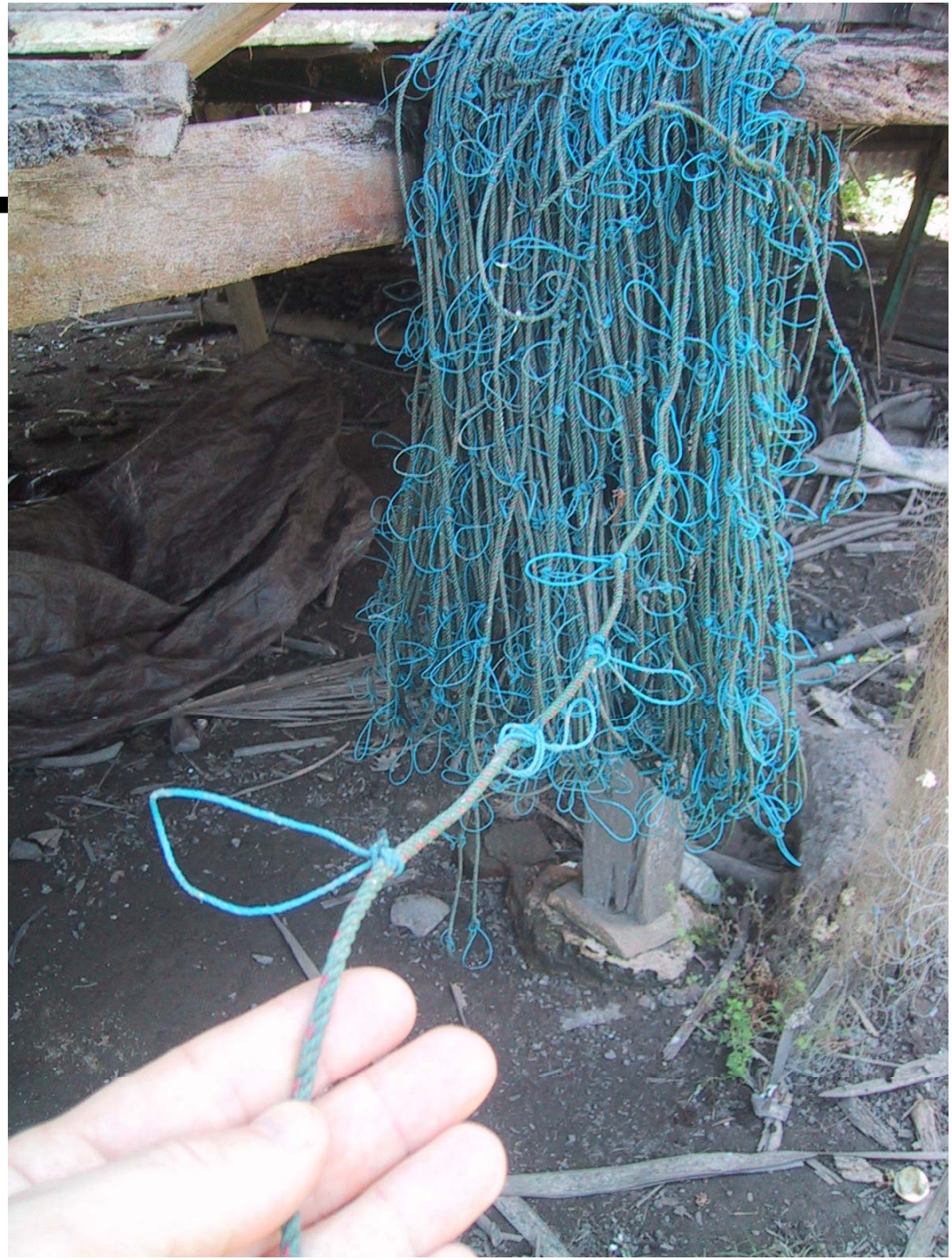
Made Loop



Since 1970, tie-ties were used. They are labor intensive and the plastic ends up in the dried, baled cottonii and spinosum, causing trouble at the factory. The Made Loop decreases labor by 80% and costs the same as tie-tie.

Made Loop

- 2 year life span.



Double Made Loop

for floating systems

Line Strippers

- Also fantastically fast and efficient, easily made with local materials. Old idea but perfect for Made Loop.

Broadcast Spinosum Farming

Use old fishing nets to create pens.

Boats with few divers harvest tons in short time.

Broadcast Spinosum Farming

20 minutes of work with no maintenance, planting, culling, tying, farm material cost…

Broadcast Spinosum Farming

And product is clean and healthy.

No tie-tie, sand or rocks!

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Per farmer productivity

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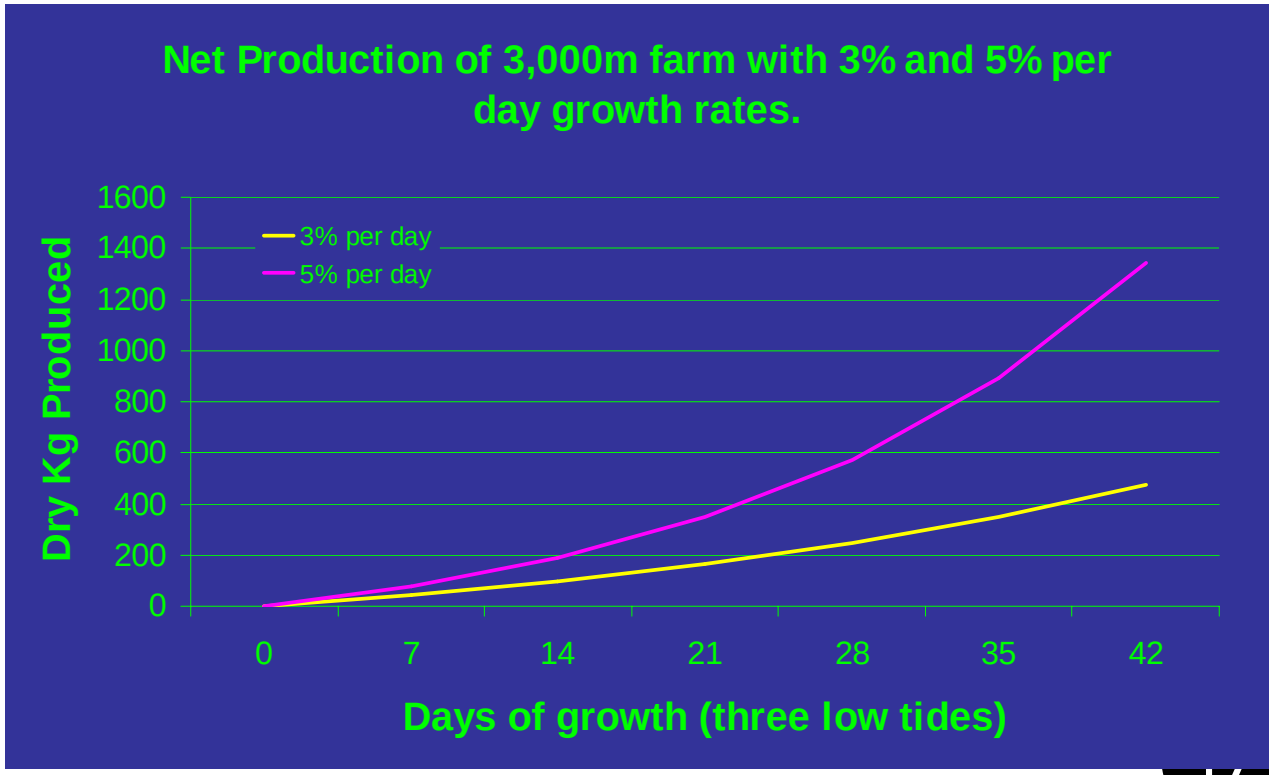
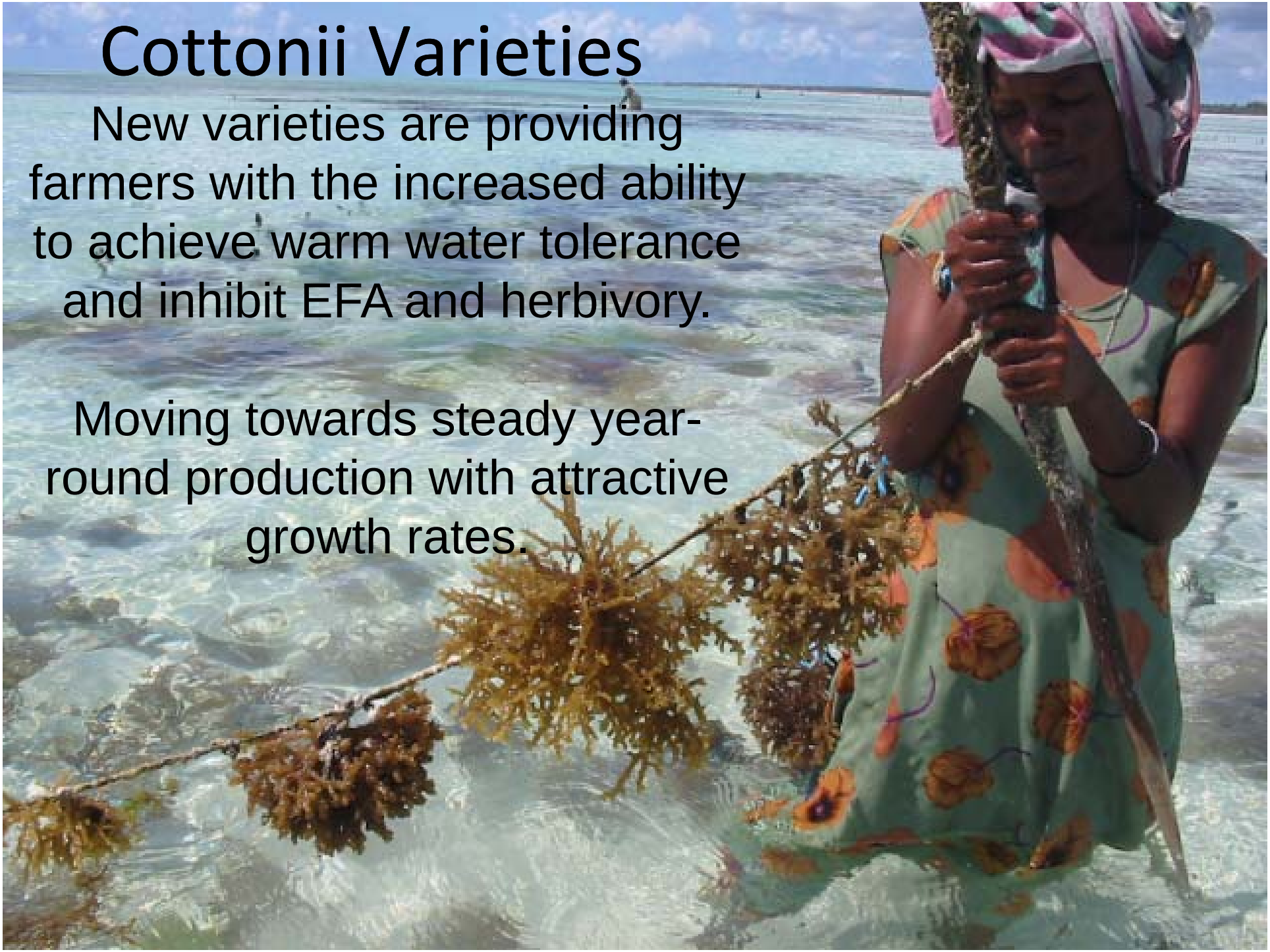




Cottonii Varieties

New varieties are providing farmers with the increased ability to achieve warm water tolerance and inhibit EFA and herbivory.

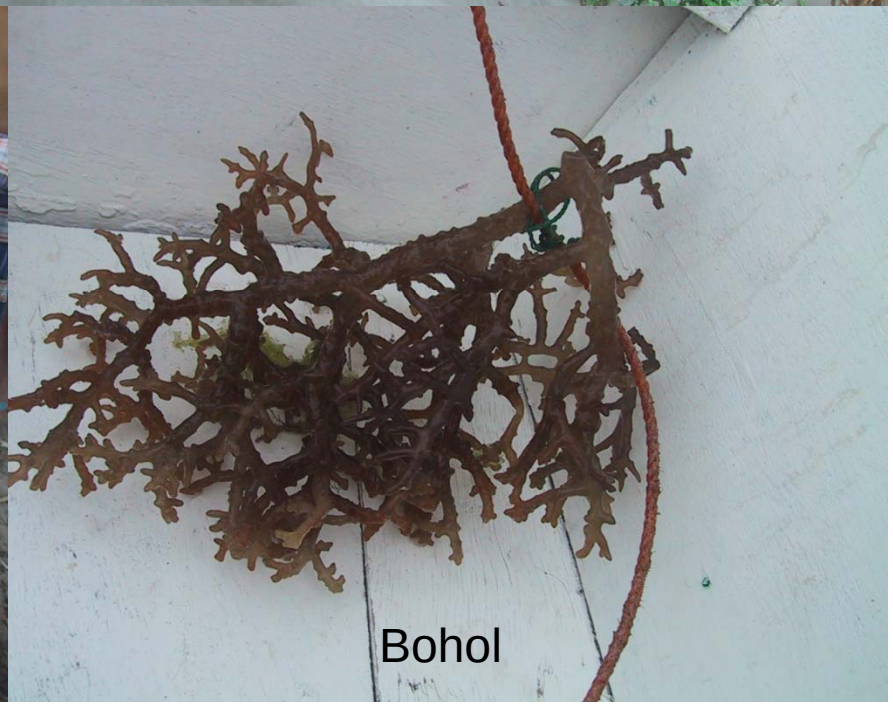
Moving towards steady year-round production with attractive growth rates.

Cottonii Varieties

Alvarezii

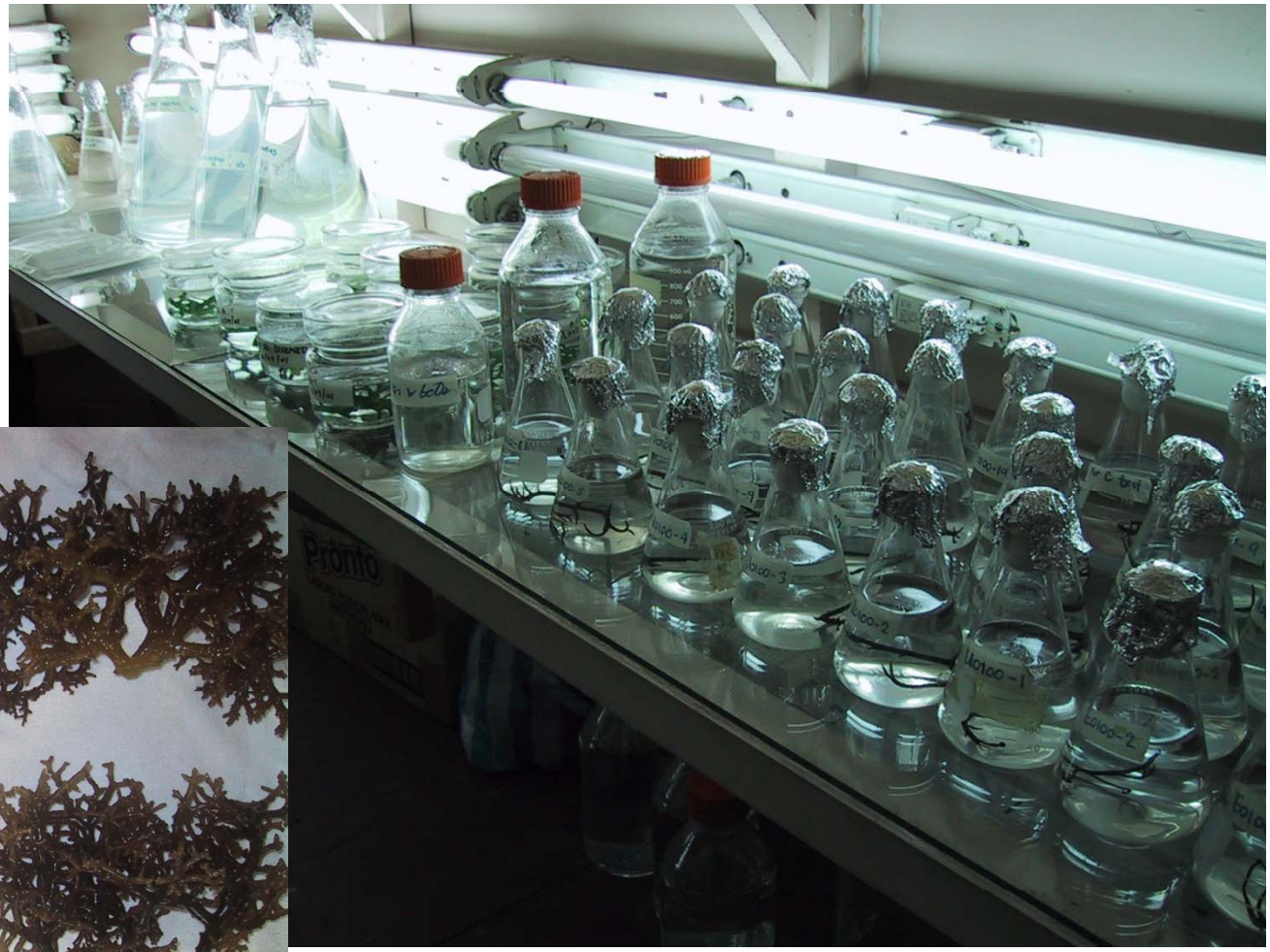
Sakol & Alvarezii

Special


Bohol

Cottonii Varieties

Developed from strain selection in wild beds (farmer, Fisheries and academe driven) and breeding programs.



Volume

- Increase per farmer productivity
- Increase number of farmers
- Increase geography of farming

Price

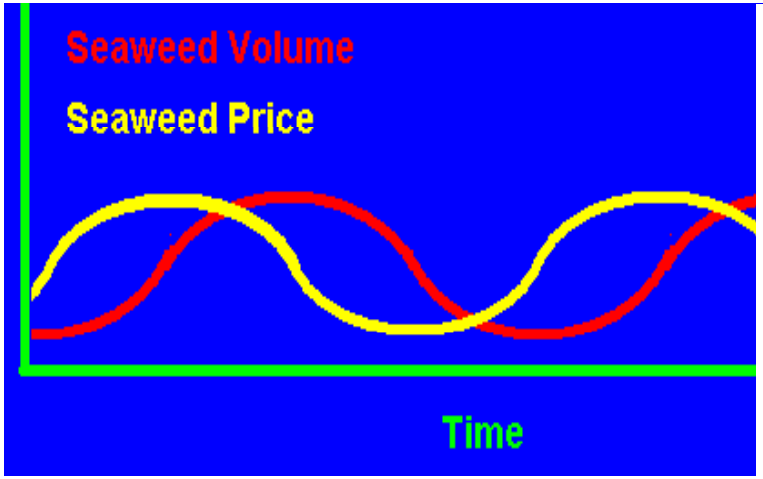
- Increase Volume to meet demand
- Contract farming
- Warehouse in water
- Shipping costs

Warehouse in Water-

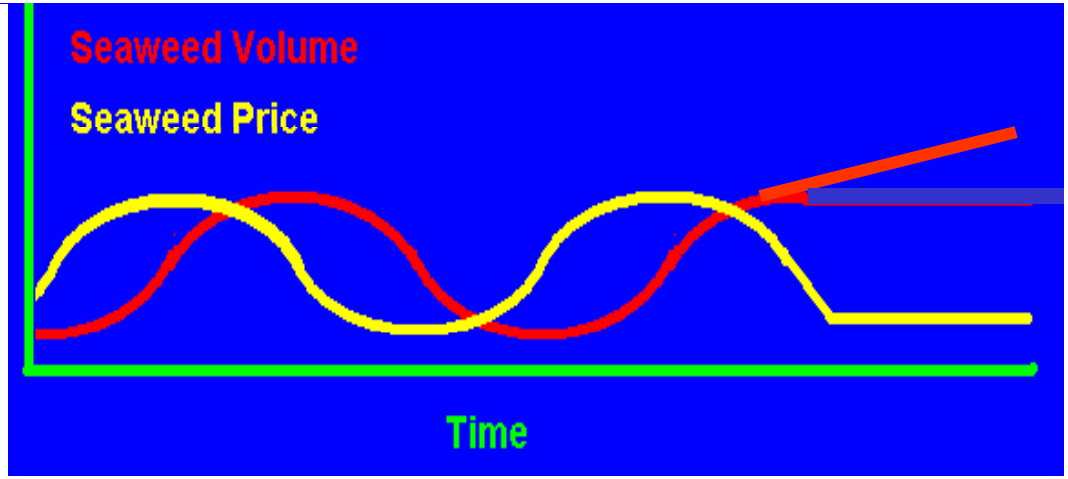
Broadcast Spinosum Farming

Broadcast farm always in production. Need spinosum? Dive, scoop and dry – three days later it is yours.

Warehouse in Water = stability in price and volume



Cottonii



Spinosum

- Warning: this is simplistic!
- Supply and demand drive fluctuating volume and prices. Demand = inventory and demand for carrageenan. Supply = farms in production, productivity of farms, including environmental conditions and impacts.
- Typically:
  - Increased buying = rising prices = rising volume (more farms) = full warehouse = Decreased purchasing = declining prices = decreasing volume (less farms)
  - Lag time between demand and supply (getting farms into production)
  - Broadcast Spinosum puts warehouse in the water.

That’s it, but a final note.

FMC BioPolymer supports thousands of jobs in villages and sustainable seaweed harvesting and cultivation provides numerous environmental, social and economic benefits.

When people buy products with carrageenan, they are doing a good thing, supporting village economies and numerous benefits.

Sustainability

- Developing world = growing populations and increasing impact on natural resources.
- For example…

And…

- Dynamite fishing
- Over fishing

Cottonii and Spinosum farming is an alternative sustainable livelihood

Environmental Benefits

- *Nutrient Sink*
- *Primary Production*
- *Habitat*
- *Alternative Sustainable Livelihood*
- *Promotes a Stewardship Mentality*

Socio-economic Benefits

- *Sustainable job*
- *Cash Crop*
- *85% of farmers in Tanzania are women. Cash goes to food, housing, education and clothing for family.*
- *Family owned businesses / cottage industry = easier to balance other demands on time.*

FMC Supports Farmers

- FMC Raw Material works hard to create sustainable seaweed cultivation industries, promotes research to increase farmers' productivity and income and approaches Q, V, P problems in creative ways.
- We partner with donors, NGO's, academics and governments in these pursuits.
- Similarly, for harvested raw materials, we work hard with all parties to assure a sustainable harvest.

Thanks to my colleagues!

Jostein Vea