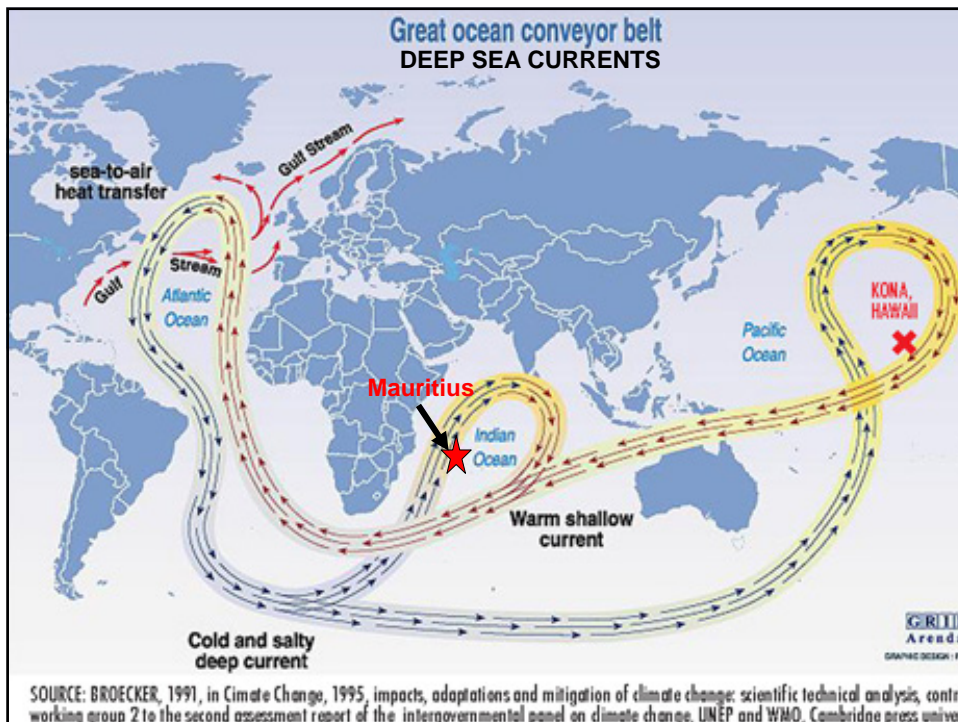


The Blue Evolution

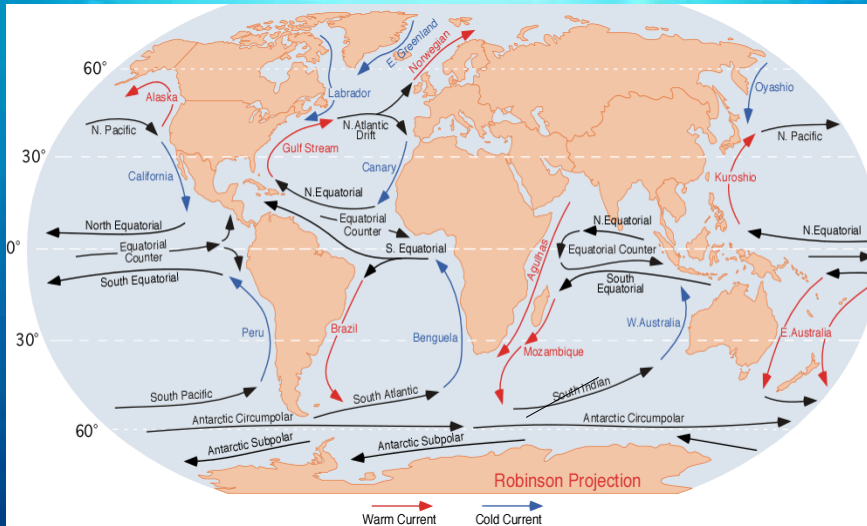
- Exclusive Economic Zone – 2 million sq km
- 1000 x land space of Mauritius
- 4 x size of France
- 3.5 x size of Madagascar
- 30 x size of Ireland
- Mauritius is a big OCEAN STATE

“We’ve barely scratched the surface of that Ocean”





Ocean Currents



Deep Ocean Water, Mauritius

Because of the Deep Ocean Currents present in our EEZ, our Deep (>1000m) Sea Water is:

very cold (5 to 6 C)

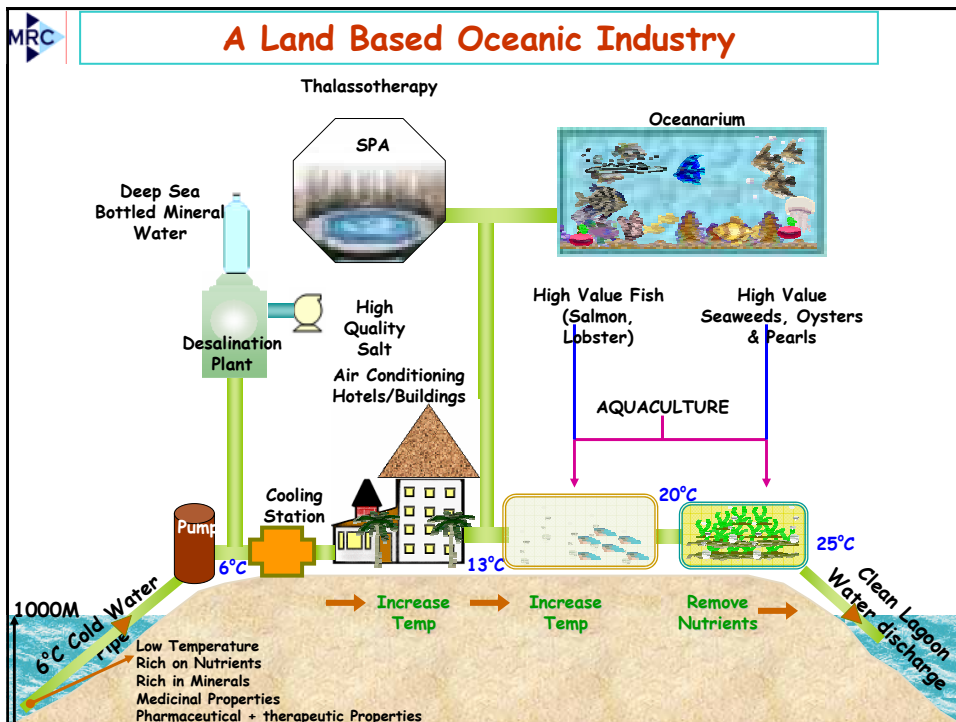
very old

free from pathogens/pollutants

very pure

rich in minerals

rich in nutrients





Technological aspects

Pipe laying

MANOEUVERING PIPES





Toronto – Deep Lake Water Cooling



- Flexible
- Strong Joints
- Long Life in seawater
- Mostly gravity anchors





MAKAI Ocean Engineering (HAWAII) Feasibility & Conceptual Design Study:

Conclusion

- Deep Seawater Intake can be installed in Mauritius by local contractor teamed with international contractor.



Investment in Pipework

Preliminary Estimate:

Rs 200M to 600M



Deep Seawater Industry in Hawaii



Natural Energy Lab of Hawaii

- Originally OTEC research, now diversified DOWA
 - 35 Tenants
 - 9 Commercial - Algae & Flora
 - 15 Commercial - Fish & Shellfish
 - 11 Academic or Pre-commercial
 - SWAC





Pumping Station



The pumping station



Some Business Activities at NELHA

- Low-cost air conditioning
- Energy production
- Cold water agriculture
- Abalone and Oysters
- Black Pearls
- High Value microalgae based products (nutraceuticals, pharmaceuticals, dietary supplements, fluorescent pigments for medical diagnostic market)
- Salt, brine
- Deep seawater-based beverages
- Pathogen-free broodstocks for global aquaculture market
- Commercial production of clams, reef building corals
- Lobsters, crabs, sea cucumbers and sea urchins
- Sea horses and other live marine organisms for world aquarium and oceanarium
- Edible sea weeds
- Cold seawater species





Deep Sea Desalinated Mineral Water



Mysteriously Good Hawaii's Tastiest Secret

Our water began its journey 2,000 years ago off the coast of Greenland, where it flowed via deep sea currents, through the freezing Arctic, and under the vast glaciers, collecting minerals leached from ancient ice fields. The currents ultimately returned this mineral-rich water to the deep sea channels of the Pacific Ocean, arriving at the Zone of the Rejuvenation near Hawaii. Using our state-of-the-art technology, this exceptional water is filtered, purified and bottled for drinking.

Enjoy!



LIQUID GOLD (November 2005)

Mahalo Water Company exports 300 K litres/day at US\$ 4 -6 a bottle to Japan.

If Mauritius exports 100 K litres/day @ USD 3/lit.

Yearly Revenue = **US\$ 108 million**

= **Rs 3.2 billion (Foreign Currency)**

**Investment
Up to \$15 m**



LIQUID GOLD (March 2006)

Mahalo Co. Ltd.

- Exports 1.8 m litres a day to Japan
- Revenue: $1.8m \times 360 \times 4.5 = \3 ***Billion a year***
- 4 other bottled water Companies in Hawaii
- Market Expanding – Korea, USA, Taiwan, China,....
- **Bottled Water – No. 1 export earner of Hawaii**



Market for Mauritius

Middle East Countries

Gulf

Abu Dabi

Dubai

*Desalinated water
is the norm*

Dubai Airport – 20 million visitors a year



Other Spin Offs



High purity deep sea salt





Nasal Spray – Example 1

- [Video](#)

\$15.95 (115mL)
\$17.25 (210mL)

PHYSIOMER® Nasal Sprays

- ✓ No preservatives!
- ✓ No gas propellants!
- ✓ All-natural!

This is all-natural saline with natural sea salt and sea water. It's gentle and safe for your nose.

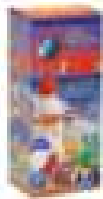
Physiomer helps relieve nasal congestion caused by seasonal allergies and the common cold.

Use for: Physiomer Ocean Breeze (115mL), Physiomer Ocean Breeze (210mL), Physiomer Ocean Breeze (300mL)

PHYSIOMER®



Nasal sprays for children and adults – Example 2



OCEAN NASAL SPRAY FOR KIDS - 37.5 ML

MANUFACTURED: FLEMMING LCO

INDICATIONS: Naturally soothes infants and children with irritates, soothing relief by hydrated nasal passages due to colds and allergies. Gentle enough for infants. Alcohol free, drug free. Contains extra moisturizer. Natural, non-medicated relief for stuffy noses, with no side effects. Safe for frequent daily use.

INGREDIENTS: Active Ingredients: Custom

Chloride OSMs. Inactive Ingredients: Purified Water USP, Glycerin, Sodium Phosphate Monobasic, Sodium Bicarb, Benzalkonium Chloride

DIRECTIONS: For infants, use drop application. For children, squeeze bottle. Squeeze in each nostril as often as needed or as directed by physician. Hold bottle upright for sprays, horizontally for streams, upside down for drops. The use of this dispenser by more than one person may spread infection.



\$4.29
(37.5mL)

Availability: Usually ships the next business day

SKU177 Regular price: \$4.29 Sale price: \$3.99

\$15
(45mL)

Availability: Usually ships in 2-7 business days

Regular price: \$14.00 Sale price: \$11.50



Ear Cleansing Spray



Special Introduction **Care For Your Ears** **Professional & Family Information** **Proven For Life**
Healthcare



Inspired by the AUDICLEAN system, this spray will help you feel safe and secure, knowing that you'll take the best care and efficiency with AUDICLEAN.

AUDICLEAN is the only alternative to other earwax removal products. It gently dissolves the wax for easy removal. AUDICLEAN is safe to use on children (over 3 months of age) and adults who require a more effective product for treatment of wax.



\$11
(60mL)

• [Video](#)

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Marine-based Body Products



- [Animation](#)



Nutritional additives derived from algae

Cytofiltrat®, an intra-cellular liquid of algae and plants, is the basis of a range of nutritional additives.

These natural, preservative-free extracts, are packaged in unbreakable, sterile cytodose®. The liquid form of the product enables its active principles to be assimilated more efficiently.



Thalasso Spa Bora Bora



AN ENCLOSED FAMILY

Extracted at more than 2000 feet below ocean level, with the greatest respect for the Pacific ecosystem, the water whose purity has been preserved for thousands of years. This particularly concentrated water is stored and immediately provides all the necessary substances required by our organisms. This bid affinity between deep water and the human body enhances the penetration of active elements for a unique mineralization.





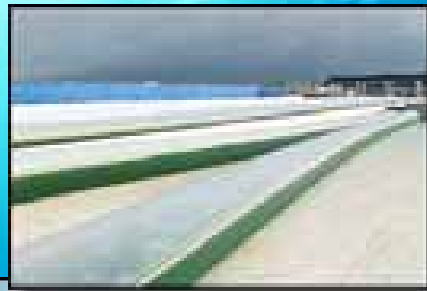
Cyanotech Corp.

- Algae Nutraceuticals
 - *Spirulina*
 - Astaxanthin
- Largest Tenant



Aquasearch, Inc.

- Microalgae
- Astaxanthin



- Large, controlled PhotoBioreactors



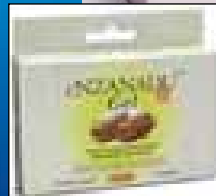
Marine Bioproducts

- Specialty Agar
 - Typically harvested at 40 m
- Canadian firm, Kona harvest is small part.



Enzamin Inc.

- Parent company is Enzanadu - Japanese health products.
- Research on products from deep seawater and *Bacillus natto*





Aquariums

- **Stockly's Aquariums Inc.**
- EcoCosm –
- Sealed glass self-sustaining environment
- **Ocean Rider Inc.**
- Seahorses



\$ 500
Each
(alive)



Hawaiian Black Pearls, Inc.



- Pearl farm in Majuro
- Improving pearl size & quality
- CEROS, ATP grants



MRC

Hawaii Sea Spirits Ltd.
Vodka blended with deep sea water

\$40



Deep Sea Water Business Turn-over

Hawaii : One Bottling Company : USD 3 Billion (2005)

Japan : Products from deep-sea water: USD 6 Billion (2003)
(USD 5.5 billion from beer and distillery industries)

Taiwan: Low temperature flower Industry: USD 69 Million (2006)
Investment of USD 30 Million over 4 years (May 2006)
Projected revenue of USD 3-4 Billion per year

China: Investment in Oceanic Industry

Korea: Products from deep sea water: USD 100m Expanding rapidly



Back to Mauritius

- Do we have the right temperature?
- Is our deep water pure & free from harmful Bacteria?
- Is our deep water rich in minerals & trace metals?
- Is our deep water rich in nutrients?



Mauritius Deep Sea Water Characteristics

- Physical
- Chemical
- Biological / Microbiological
- Toxic/Heavy Metals
- Radioactivity
- AGE



Oceanic Research Vessel (Indian Scientists)

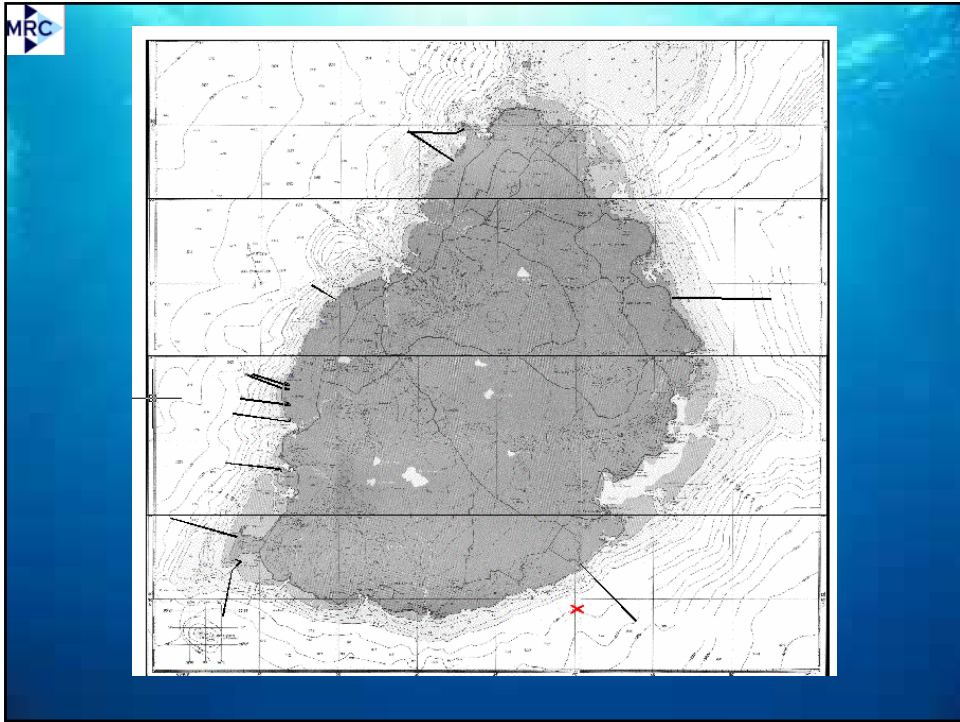


Water Sampling Bottles



Conclusions

- ❑ Mauritius Deep Sea water (West Coast) has all required Physical, Chemical & Biological properties to enable the development of a ***Land Based Oceanic Industry (LBOI)***
- ❑ Mauritius will be the ***first country*** in the **WORLD** to go to 1000m deep





Potential Sites for Oceanic Park

1. CANNONIER
2. TROU AUX BICHES
3. ALBION
4. LES SALINES - BAIE DE LA GRANDE RIVIERE NOIRE
5. FLIC EN FLAC - 2A-NORTHERN
6. FLIC EN FLAC - 2C – MIDDLE
7. FLIC EN FLAC - 2B – SOUTHERN
8. TAMARIN
9. BELLE MARE
10. LE BOUCHON
11. LE MORNE – SOUTH
12. LE MORNE - WEST



Important Dates

| Milestones | Indicative timing |
|---|-----------------------|
| Technical Feasibility & Identification of Investors | |
| <i>Pre-feasibility study by national Task Force</i> | <i>December 2005</i> |
| <i>Setting up of the High-Powered Inter-Ministerial Committee</i> | <i>June 2006</i> |
| <i>Award of contract for engineering and marketing studies to Makai</i> | <i>September 2006</i> |
| <i>Preliminary Information Memorandum</i> | <i>December 2006</i> |
| Engineering and marketing reports from Makai | April 2007 |
| Finalisation of site selection | May 2007 |
| Communication with the investor community for formal calls for expression of interest (BOI) | May 2007 |
| Preliminary pipe design specification (MAKAI) | Nov 2007 |
| Implementation Phase | |
| Contractor selected | January 2008 |
| Oceanic Park operational | End 2008 |



CAPACITY BUILDING

- Improve sea water analysis capability
- Acquire new analytical equipments.



Human Resources Requirements



SKILLS & KNOW-HOW for LBOI

- Civil, mechanical, system and electrical engineers,
- Operation and maintenance of desalination and bottling plants
- Scientists and Laboratory Technicians
- Aquaculture specialists and Technicians
- Aquaculture skilled labour
- Project/Cluster managers
- Seaweed cultivating & harvesting & drying techniques
- Pearl culture specialists & technicians
- Oceanarium & aquarium products specialists

Cont...



Skills & know-how for LBOI

- Thalasso therapy & spa experts
- Biochemistry/Biotechnology
- Pharmacology
- Marine science
- Physical oceanography
- Sales & Marketing
- Distribution logistics
- Quality Assurance
- Hospitality Management



Development of a Seaweed Industry in Mauritius



Classification of Seaweeds

- Seaweeds can be classified into three broad groups based on pigmentation: **brown**, **red** and **green**.

Marine Macroalgae - Brown algae (Phaeophyta)

Pacific Giant Kelp



Macrocystis pyrifera
(© Russ Loring)

Bull Kelp



Nereocystis luetkeana
(© Curtis Stuber)

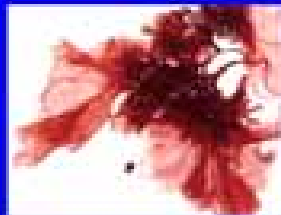
Oar Weed



Laminaria setchellii
(© M.O. Guiry)

Marine Macroalgae - Red algae (Rhodophyta)

Nori



Porphyra (www.usmip.hawaii.edu/)

Dulse



Palmaria palmata (www.globaldulse.com/)

Turkish Towel



Chondracanthus exasperatus

Gracilaria



Gracilaria edulis (© M.O. Guiry)



MRC

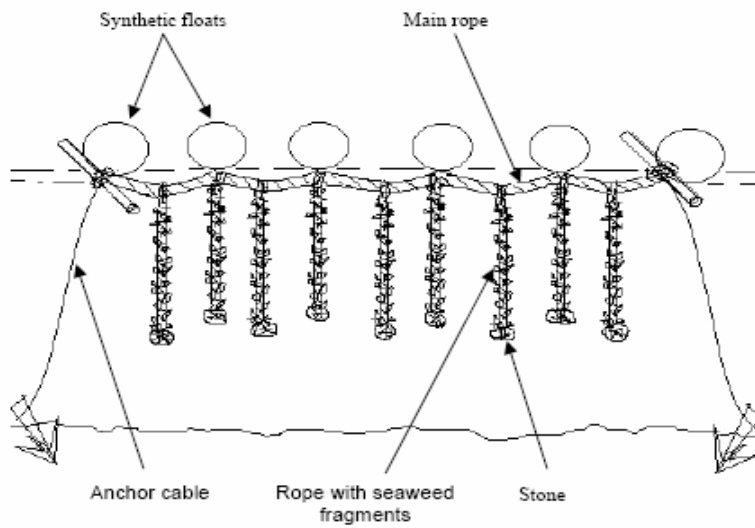
World Seaweed Market (2000)

- Seaweed aquaculture production was about 10 million tonnes wet weight with an economic value of US\$ 5.6 billion.
- Market growth 10 –20 % annually
- Major producers/consumers of seaweeds (FAO,2002) : USA, China, Japan, Korea, Indonesia, Philippines

The slide has a blue background with a light blue gradient at the top. The text is in white and black. The MRC logo is in the top left corner.

Seaweed Production Techniques

Figure 1: Single Rope Floating Raft culture technique



Open-Water Production Bottom Mounted Racks and Nets

Nori (*Porphyra*)



Rack-Net Systems



Rack-Net Systems



Prefectorial Seeding
Centre (Japan)



Japan and China, FAO
2002 and www.iaffm.org

Open-Water Production - Long Lines

Kombu (*Laminaria japonica*)
(Yam, China)



China, FAO 2002

L. japonica (right) &
Undaria pinnatifida



Open-Water Production - Long Lines

Canadian Kelp Resources (west coast Vancouver Island)

Turkish Towel

(*Cladocanthus exasperatus*)



(Rogan Randall, Ottawa P. Harport)

Sugar Kelp

(*Laminaria saccharosa*)



(R. Emma Lindstrom)

Integrated Open-Water Production - Long Lines

Salmon & Kelp (Bay of Fundy, New Brunswick, Canada)



Thierry Chopin and Wayne Armstrong © holding a long line of cultivated kelp at the integrated aquaculture site in Digby Bay, Bay of Fundy, New Brunswick, Canada.



Land Based Production –Tank Cultivation



Soliv International - Tank Design

Tumble culture of red marine macroalgae using specialized tanks





Seaweeds of Mauritius (1991)

- 127 Species were surveyed (NIO, India)
- 5 Cyanophyta
- 34 Chlorophyta
- 20 Phaeophyta
- 68 Rhodophyta
- 5 Species of sea grasses
- 3 species of mangroves



Economically Important Seaweeds in Mauritius

- Sargassum - 9 species, (500 wet g /m²) at gris-gris
- Gracilaria - 9 species
- Hypnea - 6 species (450 wet g/m²) at Baie du tombeau

Possible production of:

- Agar, carrageenan, alginates & pharmaceutical products, etc



Size of Local Market

- Around 72,000 kilograms of dried seaweeds and other algae and agar-agar was imported during the period January to September 2005 amounting to around 5.5 million rupees for the local market
- These products were mainly imported from China, Japan and Thailand.

Source –Central Statistics Office (Detailed Trade Data by HS/Country Year 2005)



Economics of Seaweed Cultivation



The Economics (Mauritius & Rodrigues)

(Preliminary Figures based on FAO/IFAD Reports)

Assuming 1% of lagoons are cultivated....

Cultivating/Harvesting & Drying

Job Creation 2,700
Revenue Rs 33 M

+ Processing (e.g. agar agar)

Job Creation 5,400
Revenue Rs 248 M

Adding Value



The Economics (Mauritius & Rodrigues)

(Preliminary Figures based on FAO/IFAD Reports)

Assuming 10% of lagoons are cultivated....

Cultivating/Harvesting & Drying

Job Creation 27,000
Revenue Rs 330 M

+ Processing (e.g. agar agar)

Job Creation 54,000
Revenue Rs 2.5 Billion

Adding Value

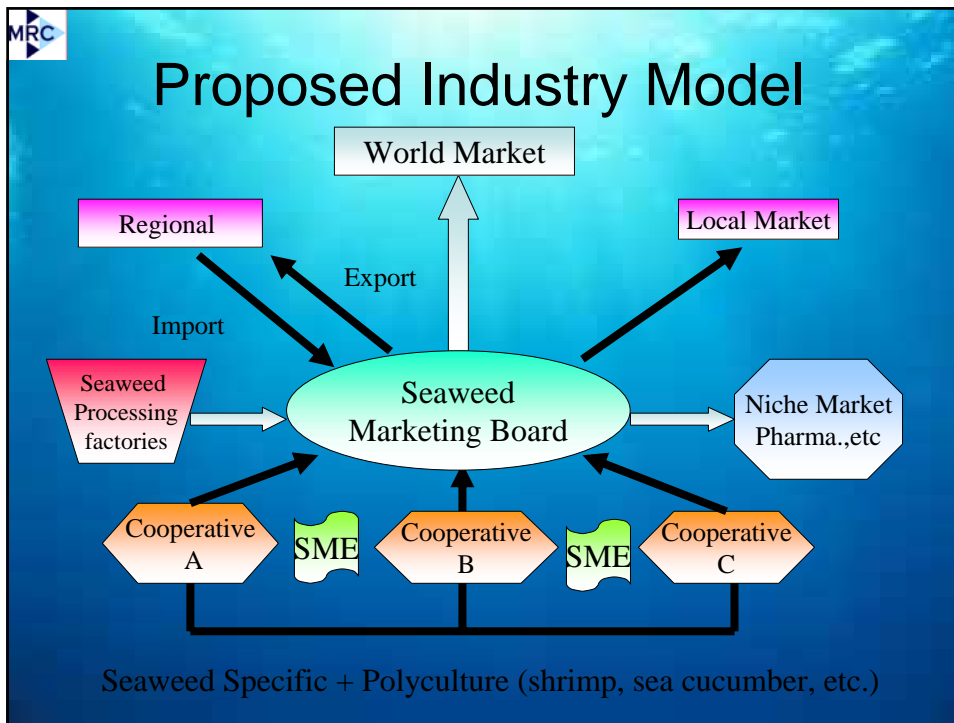


Economics of Seaweed VS Sugar Cane

- Seaweeds Production – Per hectare Per annum
 - Average production 5 tons dry seaweed (or 30 tons of wet seaweeds)
 - Net Income – Rs 72,000
- Sugar Cane Production – Per hectare Per annum
 - Average production 65 tons
 - Average Net Income - Rs 25,000



Road Map for Seaweed Industry



- Functions of Seaweed Board**
- Promote the Industry
 - Establish regional & overseas markets
 - Attract (through incentives) foreign seaweed processing plants
 - Supply training, grants, soft loans, seeds, expertise, etc
 - OFFER a Guaranteed price to local planters
 - Indulge in R&D



Potential for Growth

- World market growth 10-20%
- Aspire to be a Regional Seaweed Technological Hub
- Exploitation of outer islands lagoon
- Other spin offs:
 - Edible (high end market) for local tourist & regional markets
 - Polyculture: Abalone, Sea cucumber, etc
 - Thalassotherapy
 - Pharmaceutical-Biomedical
 - Cosmetics
 - Fertiliser
 - Major CO² absorber – Carbon Credit
 - Bio-Fuel

Could become a MULTI Billion Industry



Scarcity of skills & Training Requirements for Seafood Industry



SCARCITY AREAS

- Marine Engineers
- Marine Technicians
- Assistant Engineers
- Helpers
- Welders and drivers
- Electricians
- Maintenance
- Mechanics

Cont...



SCARCITY AREAS

- Accounting/ Auditing
- Captains/skippers
- Assistant Captain
- Managers
- Factory workers
- Machine operators
- Foremen
- Marine Mechanics



TRAINING NEEDS

The processing companies falling under the Seafood sector are mostly looking for training programmes in the following fields:

- Food Technology
- Principles of canning
- Thermal processing and deviations
- Retort operations
- Double seaming
- Microbiology for non- microbiologists

Cont...



TRAINING NEEDS

- Seafood HACCP
- Quality Assurance & Total Quality Management
- Heat Processing and Fish Technology
- Product development
- Functional food ingredients- tools for improving health
- Incident Management & crisis prevention
- Food safety
- Food chemistry for non food chemists
- Hygienic engineering



Conclusions

- Industry to be driven by safety & high quality norms
- Requires High Mauritian Branding
- Innovative Marketing
- High degree of professionalism
- Establishment of a National Seafood Training Institute, NSTI (New Zealand/Australian model/Networking)



New Zealand Seafood Training Institute





New Zealand Seafood Training Institute



THANK YOU

Mr. Mohammad Vayid
Dr. Ashock Aubeeluck
Mr. S. Hanoomajee
Dr. M. Bhikajee
Mr. D. Gangapersad
Dr. K. Sukon
Mr. V. Seegoolam
Mrs V. Kokil (Secretary)
Workshop Participants

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