International Webinar:
Entrepreneurship Development On
SEAWEED BUSINESS BY COOPERATIVES

(28th January 2021)

Seaweed Cultivation and value chain Development in India

सत्यमेव जयते

Dr Rajeev Ranjan IAS

Secretary

Department of Fisheries

Ministry of Fisheries, Animal Husbandry & Dairying

Government of India

Seaweed Cultivation, Processing & Marketing

- Economic Empowerment of Coastal Women
- Huge Employment
- Risk Mitigation/Diversification
- PMMSY : ~Rs 640 Cr Investment

Uses: Agar, Algin, Carrageenan, Manure, Biofertilizers
Fodder, Bioactive Metabolites

Global Aquaculture Production 2018

Source : FAO SOFIA-2020

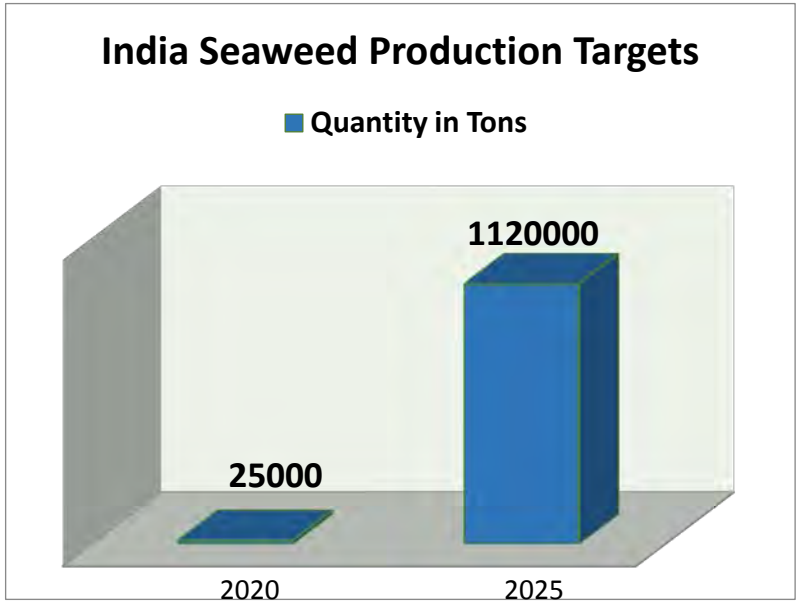
- 1145 Lakh Tons
  - 821 Lakh Tons — Aquatic Animals
  - 324 Lakh Tons — Aquatic plants

Global Market Value : USD 12 Billion (FAO-2019)

Brown Seaweeds
(Phaeophyceae)
Algin yielding
***Sargassum, Turbinaria* etc**
& edible "Kelp" - *Laminaria* spp.

Red Seaweeds
(Rhodophyceae)
Agar & Carrageenan yielding
***Gracilaria, Gelidiella, Hypnea, Kappaphycus* etc.**

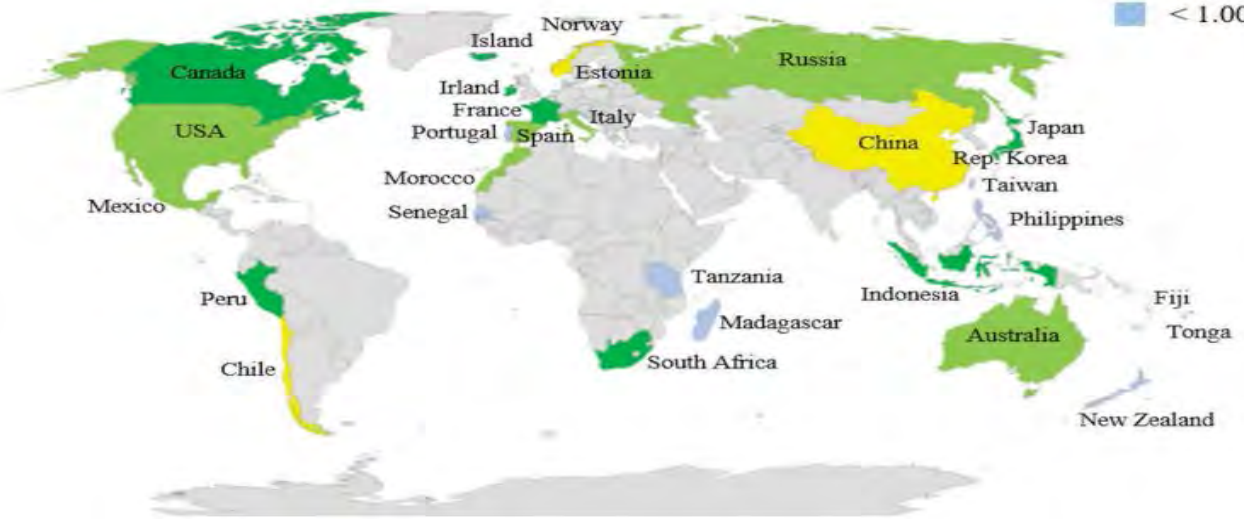
Green Seaweeds
(Chlorophyceae)
Edible
***Caulerpa, Ulva* etc.**



Global Scenario of seaweed production

(a) Seaweed Aquaculture

(b) Wild capture



Country/area	Seaweed aquaculture production (2018) (wet weight) in thousand tones	Share of world total
World	**32386.2**	**100**
Asia	**32226.3**	**99.51**
China	18575.7	57.36
Indonesia	9320.3	28.78
South Korea	1710.5	5.28
Philippines	1478.3	4.56
Democratic People's Republic of Korea	553	1.71
Japan	389.8	1.20
Malaysia	174.1	0.54
Viet Nam	19.3	0.06
India	**5.3**	**0.02**
Africa	**108.5**	**0.34**
Tanzania	103.2	0.32
Madagascar	5.3	0.02
Americas	**20.7**	**0.06**
Chile	20.7	0.06
Oceania	**14.04**	**0.04**
Solomon Islands	5.5	0.02
Papua New Guinea	4.3	0.01
Kiribati	3.65	0.01
Europe	**4.5**	**0.01**
Russian Federation	4.5	0.01
Other producers	**21**	**0.06**

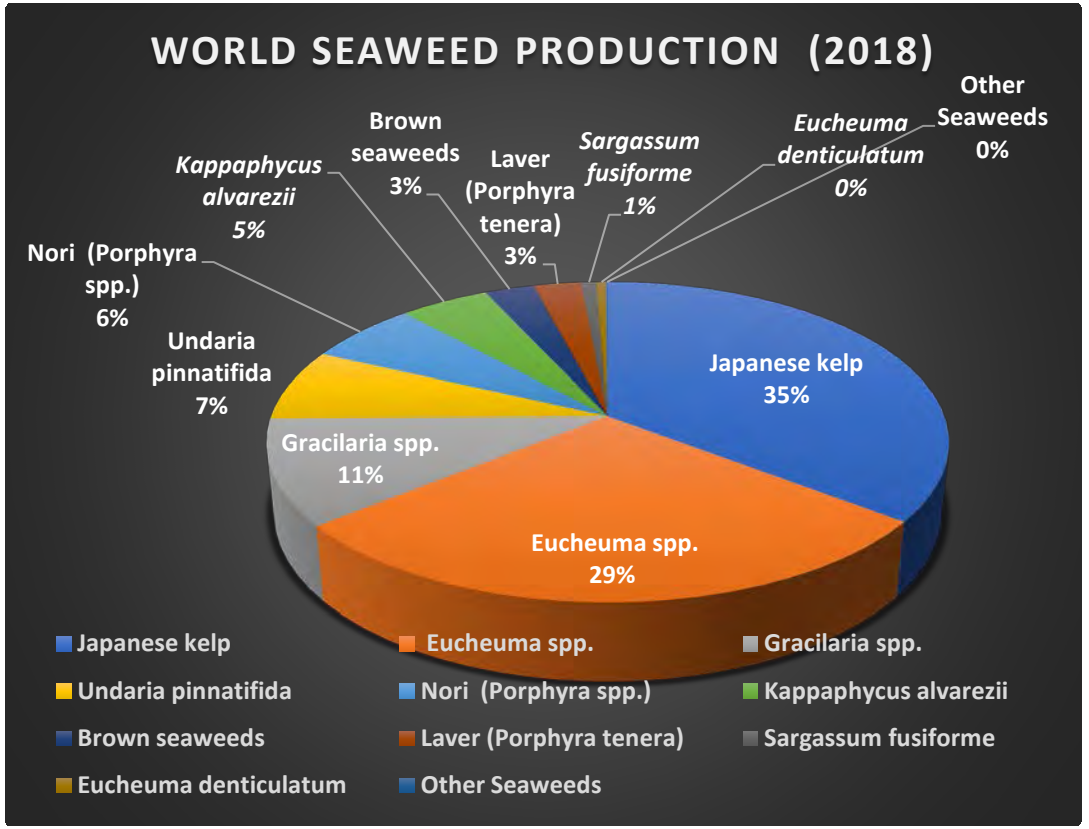
Reported 0.7 percent fall in 2018 from 2016 levels.

(Source: FAO-SOFIA, 2020)

WORLD SEAWEED SCENARIO

The State of World Fisheries and Aquaculture (SOFIA), 2020

- Global production : 32.4 million tonnes (wild-collected and cultivated aquatic algae)
- Farmed seaweeds represents 97.1% by volume
- Seaweed farming is dominated by countries in East and Southeast Asia with China being the largest producer followed by Indonesia, S. Korea, and Philippines.
- Production of seaweed, has more than tripled, up from 10.6 million tonnes in 2000 to 32.4 million tonnes in 2018.
- The rapid growth in the farming of (*Kappaphycus alvarezii* and *Eucheuma* spp.) in Indonesia. Indonesia increased its seaweed farming output from less than 4 million tonnes in 2010 to over 11 million tonnes in 2015 and 2016, and similar production levels in 2017 and 2018
- India produced 5300 tonnes (wet weight) in 2018



INDIA SEAWEED PRODUCTION

- ~5000 tons of cultured seaweed is produced
- ~25000 tons of wild seaweed is collected
- Market value - ~₹300-500 crore

Uses of Seaweeds

Basic utilities

- Food
- Animal feed/supplements
- Biofuel
- Biofertilizer/ growth stimulants

Industrial uses

- Nutraceuticals
- Cosmetics
- Industrial Chemicals

Ecosystem services

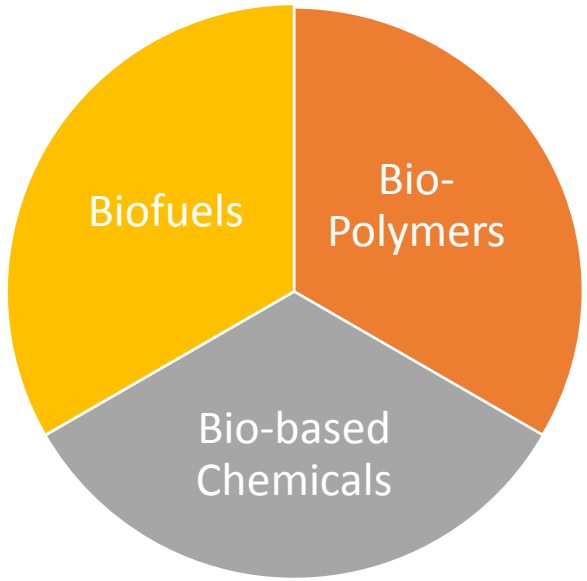
- Nutrient Scrubbers
- CO_2 Scrubber
- Oxygenator
- Nursery ground for fishers

New Avenues – Edible Seaweeds for humans and animals

Food products for human consumption contribute about US$ 5 billion

- Several species in Indian waters
- High in minerals, proteins and polyunsaturated fatty acids
- Non-toxic
- Methods for mass scale cultivation developed by CSIR-CSMCRI – Needs validation

Large Scale Opportunity



Seaweed sap as animal food feed (poultry and cattle)

- Improved body weight of poultry (especially breast) and cattle
- Better Immuno-responsiveness
- Better gut-health (microbial & structural)
- Higher egg production and advancement in egg laying age
- Higher calcium and iron content in milk
- Better calcium retention thereby reducing chances of milk fever
- Reduced methane emission and enhanced feed use efficiency in ruminants
- Toxicologically tested as safe

Important Cultivable species in India

Kappaphycus alvarezii

Gracillaria edulis

Turbinaria sp

Surgassum wightii

Gelidiella acerosa

Gracillaria dura

Raft Culture

Tube net method

Monoline Culture

Methods of seaweed cultivation

Seaweed Value Chain

Raft construction

Tying of Seedling

Floating of seeded raft

Culture of seaweed in rafts (45 days)

Harvesting of seaweed after 45 days

Drying of seaweeds for sales

Production of Agar/carrageenan

Agar/carrageenan

Sap production from wet seaweed

Dry seaweed powder

Sap produced

Fertilizer

source- Tamil Nadu Govt

Promotion of sea weed culture in India

Department of Fisheries, Govt. of India

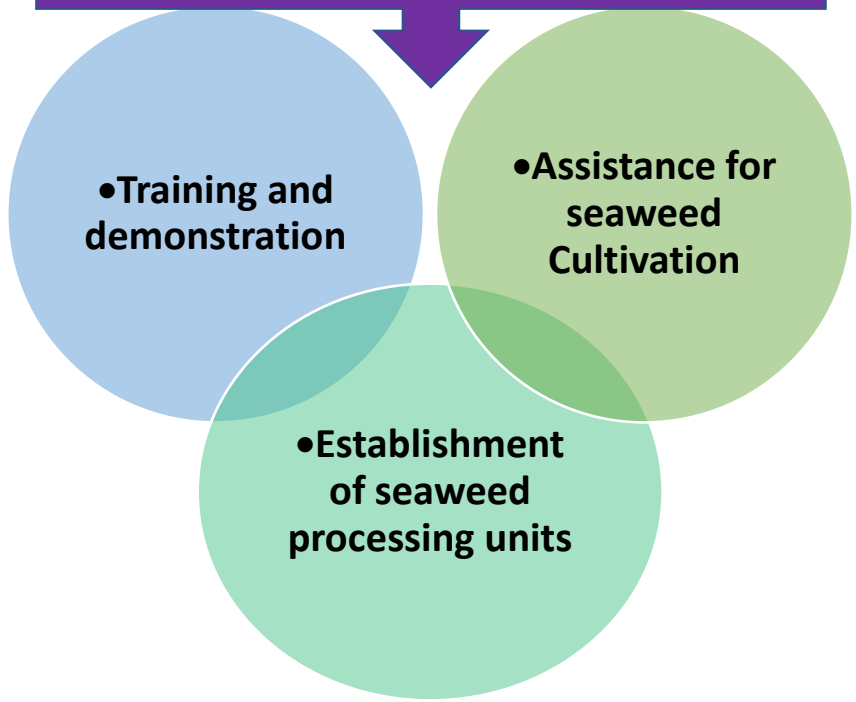
Autonomous body

National Fisheries Development Board (NFDB)

Funding support to

- **Central Salt & Marine Chemicals Research Institute (CSIR-CSMCRI)**
- **Central Marine Fisheries Research Institute (ICAR-CMFRI)**
- **National Institute of Ocean Technology (NIOT)**
- **State Fisheries Departments**

Collaborative efforts in seaweed farming since 2017



Cost of total projects on seaweed farming supported under NFD Funding since 2017:

Rs. 535.5 Lakhs (INR 53.55 million)

Total Seaweed biomass produced (2017-2020):

***Gracilaria spp*: 255.32 tones wet weight**

***Kappaphycus alvarezii*: 201.72 tones wet weight**

Over 1000 beneficiaries

NFDB funded trainings on seaweed farming

During 2007-08 to 2018-19:

NFDB released an amount of **Rs. 551.73 lakh**, for training and demonstration on sea weed culture to fisher communities and women SHGs.

Total Trainings: 18
No of beneficiaries trained: over 1600

DEPARTMENT OF FISHERIES
Government of India

Blue Revolution

Pradhan Mantri Matsya Sampada Yojana (PMMSY)

Providing opportunities to increase the income of SEAWEED FARMERS

Rs. 640 Cr
Investment for 5 years

Seaweed cultivation & Value chain under Pradhan Mantri Matsya Sampada Yojana

Objectives

- To enhance production and productivity in the seaweed aquaculture in the country for harnessing the potential of the coastal waters and reduce reliance on wild harvest.
- To improve the seaweed value chain and industrial product diversification to meet domestic demand and thus reduce dependence on imports
- To promote seaweed cultivation as a viable and sustainable livelihood amongst rural communities, especially for women
- To establish an institutional mechanism in Research and Development in the seaweed farming and value chain and mechanism for effective Transfer of Technology

SWOT Analysis of Seaweed cultivation in India

STRENGTH

1. Long coastline
2. Vast wasteland belts along the coastline
3. Availability of infrastructure and expertise
4. Availability of resources
5. Low cost of technology
6. Low labour cost
7. Domestic markets
8. Seaweed farming is one of the best diversified livelihood options for coastal community

WEAKNESS

1. Lacking automation in seaweed farming and processing
2. Lack of awareness on seaweed farming and its uses
3. Poor industry-R&D institutecollaborations and linkages
4. Non-availability of proven technologies for commercialisation
5. Limited expertise
6. Absence of technology transfer documents with clear investment, cost-benefit and market analysis
7. Absence of policy guidelines
8. Lack of market predictions and technology forecasting

OPPORTUNITY

1. Opportunity for exports
2. Reduced import of sea weeds
3. Multiple value added products from seaweeds
4. Seaweed extracts could revolutionize organic agriculture
5. Destination for overseas investment if proven production and processing technologies developed
6. Fuel blue-economy and inclusive economic growth in the country
7. Promote coastal rural prosperity
8. Scope for rural entrepreneurship

THREATS

1. Climate change and global warming
2. Troubled sea conditions and monsoons
3. Lack of preventive measures for diseases control and grazing
4. Free market.
5. Conflict with traditional fishermen

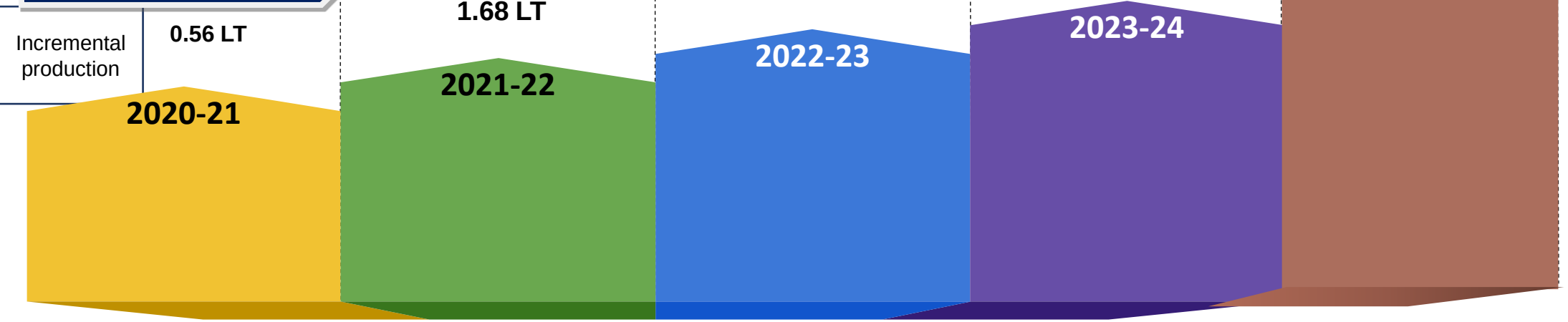
Broad Strategies for Seaweed cultivation & Value chain under PMMSY

Intensive efforts will be made by the implementing agencies **to prioritize formation and promotion of FFPOs , support to cooperatives and women SHG's** in the potential coastal areas in the country.

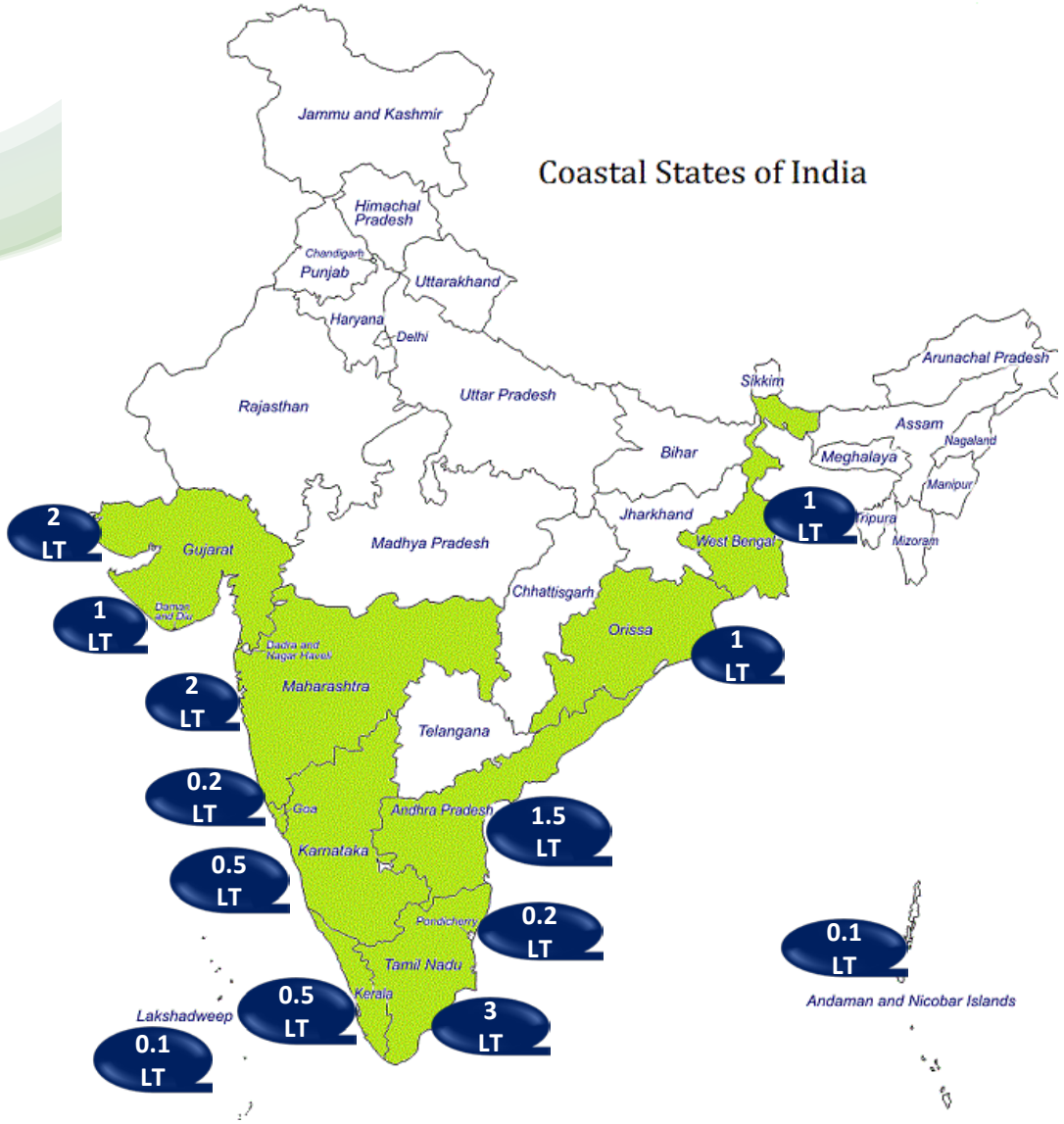
- Area expansion
- Technological upgradation
- Ensuring quality seed supply
- Integrated and cluster based approaches
- Enhancing R&D in seaweed farming and value chain
- Utilization of the existing labour and skill development
- Institutional development for market promotion
- Increasing Capital investment in small scale Seaweed Processing

Year wise Action Plan

- Organize Workshops, seminars, outreach programmes and stake holder interactions
- Enhancing Seaweed Research &Development
- Convergence with schemes and programs of Centre/state governments/UT Administrations
- Mobilization, motivation, training and skill development
- Creation of Indian seaweed brands for seaweed products
- Promoting commercial Hydrocolloid production units and nutraceuticals Industries
- Promoting creation of seaweed FFPOs
- Formation of seaweed clusters and coastal seaweed villages
- Establishing seaweed processing facilities near production centres
- Creating Seaweed seed certification standards
- Import of High Yielding Varieties
- Establishing Seed Banks, tissue culture units and Nurseries
- Mapping of Areas



State Wise Production Targets



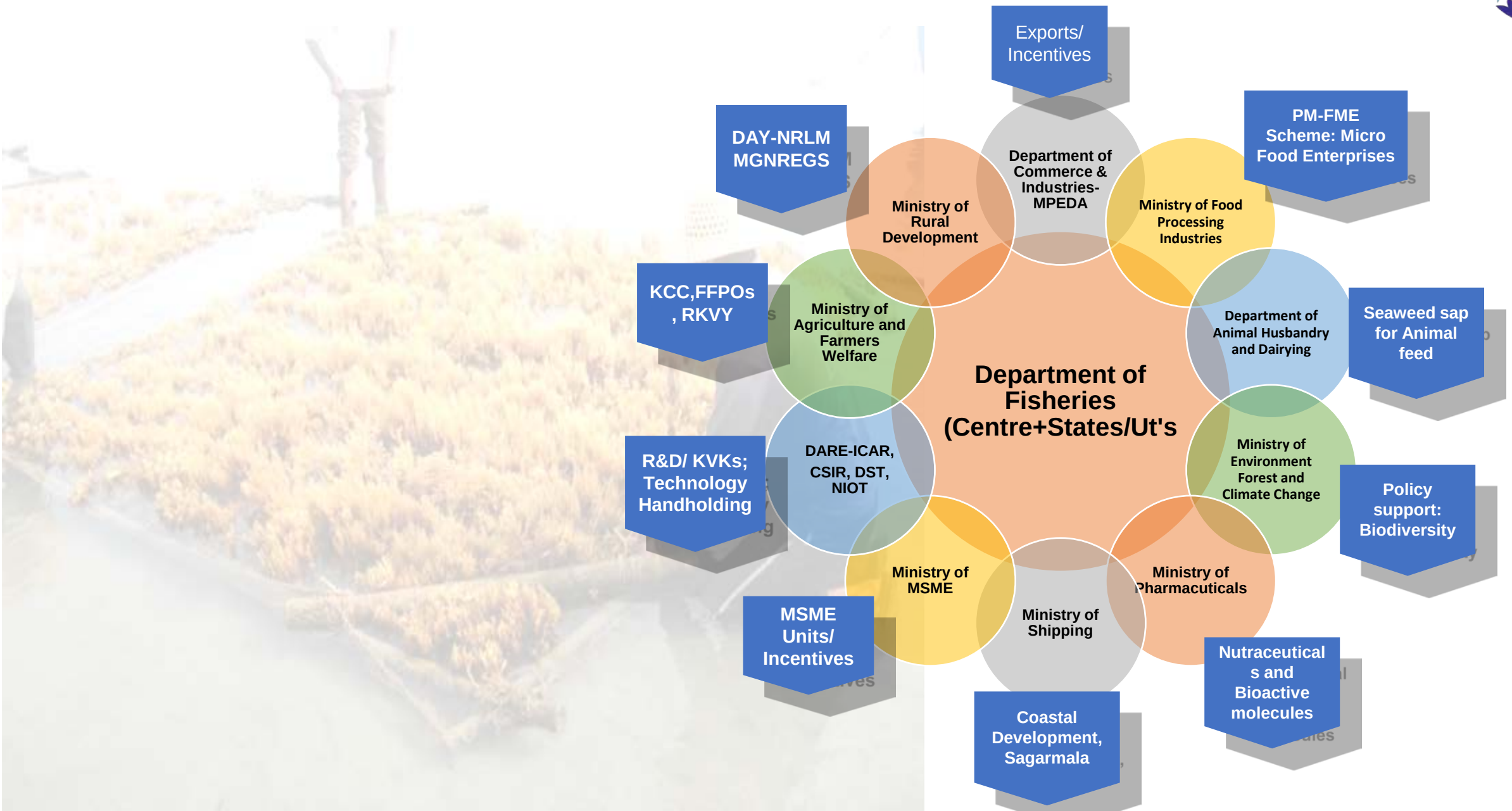
State	Production target (Lakh ton) in wet Weight					
	2020-21 (5%)	2021-22 (10%)	2022-23 (25%)	2023-24 (30%)	2024-25 (30%)	Total (100%)
Gujarat	0.1	0.2	0.5	0.6	0.6	**2**
Maharashtra	0.05	0.1	0.25	0.3	0.3	**1**
Goa	0.01	0.02	0.05	0.06	0.06	**0.2**
Kerala	0.025	0.05	0.125	0.15	0.15	**0.5**
Tamil Nadu	0.15	0.3	0.75	0.9	0.9	**3**
Andhra Pradesh	0.075	0.15	0.375	0.45	0.45	**1.5**
Odisha	0.05	0.1	0.25	0.3	0.3	**1**
West Bengal	0.05	0.1	0.25	0.3	0.3	**1**
Karnataka	0.025	0.05	0.125	0.15	0.15	**0.5**
Puducherry	0.01	0.02	0.05	0.06	0.06	**0.2**
Lakshadweep	0.005	0.01	0.025	0.03	0.03	**0.1**
Andaman & Nicobar Islands	0.005	0.01	0.025	0.03	0.03	**0.1**
Daman &Diu	0.005	0.01	0.025	0.03	0.03	**0.1**
Total	0.56	1.12	2.8	3.36	3.36	**11.2**

State wise funding pattern for seaweed Action plan under PMMSY (Rs. In Cr.)

Coastal State/ Union Territory	Total funds allocated
Gujarat	114.29
Maharashtra	57.14
Goa	11.43
Kerala	28.57
Tamil Nadu	171.43
Andhra Pradesh	85.71
Odisha	57.14
West Bengal	57.14
Karnataka	28.57
Puducherry	11.43
Lakshadweep	5.71
Andaman & Nicobar Islands	5.71
Daman &Diu	5.71
Total	640

For **Seaweed cultivation** as well as additional Investment for interventions like **establishment of seed banks, genetic improvement programs for high yielding cultivars, seaweed parks etc.**

Convergence in Seaweed cultivation and value chain under PMMSY



Status of Seaweed proposals under PMMSY till January 2021

Sanctioned proposals from States/ UTs (Centrally sponsored Scheme CSS)

- Tamil Nadu (Phase I)
- Maharashtra
- Establishment of Seaweed culture rafts and Monoline including inputs
- **Total cost of Rs. 331.48 Lakhs** (INR 3.314 Million)

Proposals under Consideration from States/ UTs

- •Andhra Pradesh
- •Tamil Nadu (Phase II)
- •Karnataka
- •Dadra Nagar Haveli, Daman & Diu
- •Kerala
- •Establishment of Seaweed culture rafts and Monoline including inputs
- •Establishment of Brood banks for seaweed (TN)
- **Total cost of Rs. 4553.54 Lakhs** (INR 455.3 million)

Proposals from Research Institutes/ UTs (Central Sector Scheme-CS)

- CSIR- Central Salt and Marine Chemicals Research Institute
- Andaman & Nicobar Administration
- •Identification of Potential Locations across pan India
- •Seed plant production of *Kappaphycus alvarezii* along Tamil Nadu coast.
- •Pre feasibility studies and pilot scale farming in Andaman Coast
- **Total cost of Rs. 923.58 Lakhs** (INR 9.23 million)

Visit of Hon'ble Minister of FA&D at Seaweed cultivation sites in Rameswaram and Mandapam, Tamil Nadu and launch of seaweed development programmes under PMMSY on 23/01/2021

Visit to Aqua Agri Seaweed processing plant at Rameswaram and Foundation stone laying of SAGARIKA production expansion unit:
22/01/2021

way forward

- The major decision taken after the deliberations during the consultations and meetings on seaweed development are:

Enhancing Seed availability

Multiple number of seaweed banks would be taken up in maritime states/UTs in the coming years for key species.

Promoting Indigenous species

Mapping of potential sites and **cultivation will be promoted** for native species like *Gracilaria dura, G.edulis, Gelidiella acerosa, Sargassum wightii etc.*

Permissions for natural collection

Efforts will be taken to permit collection of native species like *Gracilaria dura, G.edulis, Gelidiella acerosa, Sargassum wightii etc.* **from coastal waters other than restricted areas for industrial usage**.

Support Intensive convergence

States will **tie up with research institutes like CMFRI, CSMCRI, NIOT** etc. to strengthen the efforts towards **quality seed production and advanced culture techniques** to scale up production

Actions towards protecting Kappaphycus farming from the implications of environmental concerns	The **matter concerning the restriction on cultivation of *Kappaphycus* sp. and introduction exotic germ plasm will** be addressed with priority in consultation with MoEFCC and coastal State Governments/Uts.
Enhancing training and capacity building	**Comprehensive training will be provided to the youth especially women** for taking up seaweed cultivation. Empower model of CSMCRI may be proliferated.
Popularising seaweed based products	**Seaweed parks may be established in Tamil Nadu and Gujarat** after working out feasibilities.
Development of seaweed farming in Island territories	Lakshadweep will be developed **as a centre for development of seaweed**. NIOT and ICAR- CMFRI will undertake efforts for development of Seaweed culture in Lakshadweep.
Development of Entrepreneurship in seaweed farming	Each State/UT may identify four (4) Entrepreneurs and support them with technical and financial sources.
Support to Industries	Ministry of **Micro, Small and Medium Enterprises (MSME) may support industry/start-ups/entrepreneurs.**

Thank You

Seaweeds: a key component of Integrated Multi-Trophic Aquaculture (IMTA) providing important ecosystem services, which should be valued

Thierry Chopin

University of New Brunswick

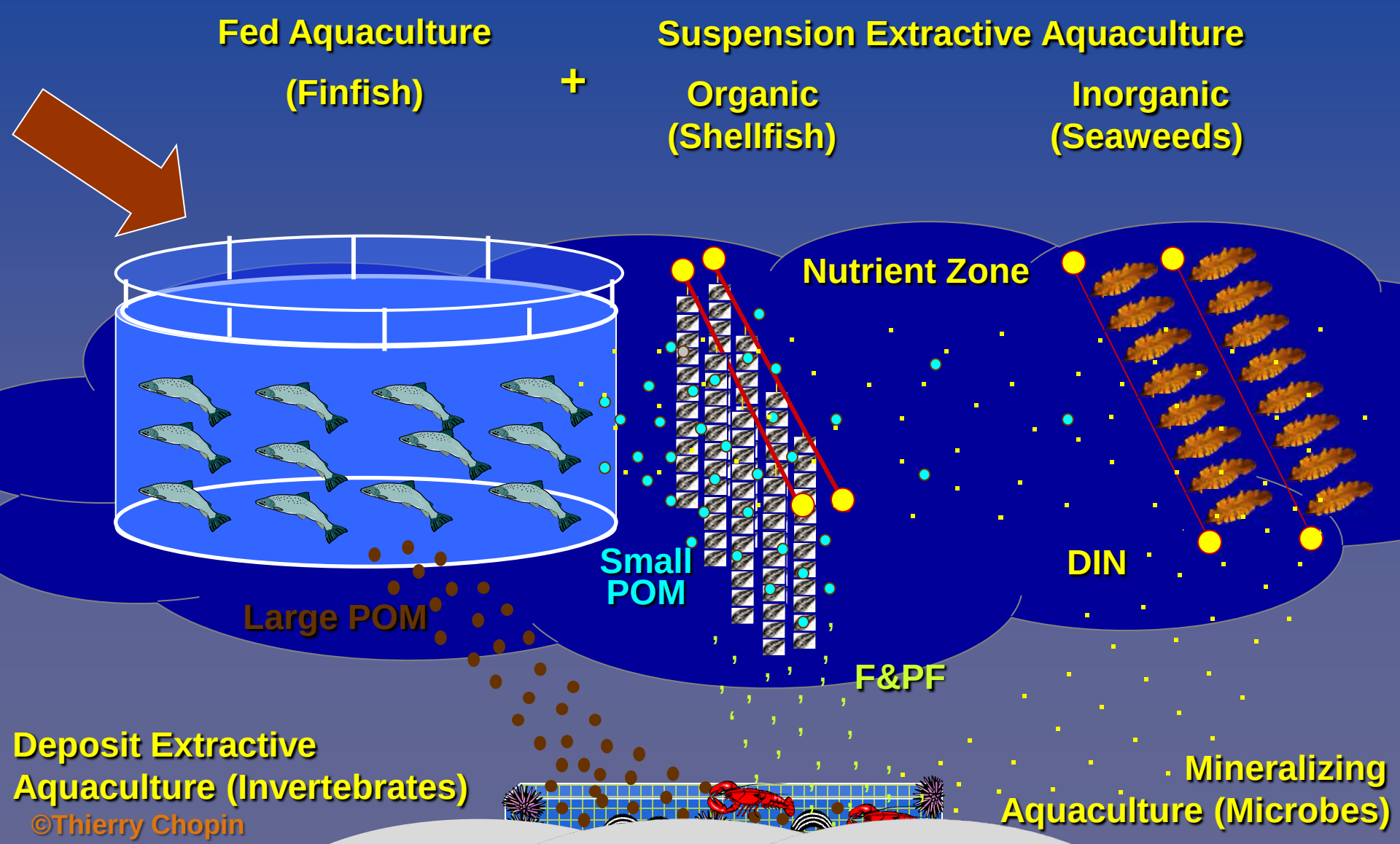
Chopin Coastal Health Solutions Inc.

Saint John, N.B., Canada

There is presently a renewed interest in seaweed mariculture, which has been triggered by:

- their cultivation in integrated multi-trophic aquaculture (IMTA) systems,
- the emerging understanding of the ecosystem services they provide, and
- the development of novel uses/applications

Integrated Multi-Trophic Aquaculture (IMTA)



Inorganic component of IMTA: seaweeds

Until now, seaweeds (and the other extractive species) have been valued only for their biomass and food trading values

However, they also need to be valued for the ecosystem services they provide, along with the increase in consumer trust and societal/ political license to operate that they give to the aquaculture industry (circular economy approach)

Ecosystem services provided by seaweeds

- Seaweeds are excellent nutrient scrubbers (especially dissolved nitrogen, phosphorus and carbon)

Ecosystem services provided by seaweeds

- Seaweeds are excellent nutrient scrubbers (especially dissolved nitrogen, phosphorus and carbon)

- With IMTA, seaweeds can be cultivated without fertilizers and agrochemicals

Mentalities will have to change

What were previously considered wastes or by-products, are now co-products from one species, which can be used as recovered fertilizer and feed resources, and energy, by other species, considered additional crops providing economic diversification, while bioremediation of coastal nutrification takes place

Ecosystem services provided by seaweeds

- Seaweeds are excellent nutrient scrubbers (especially dissolved nitrogen, phosphorus and carbon)
- With IMTA, seaweeds can be cultivated without fertilizers and agrochemicals
- Seaweeds do not need to be irrigated
- Seaweed cultivation does not need more arable soil and land transformation (deforestation)
- Seaweeds can be used for habitat restoration

Ecosystem services provided by seaweeds

- Seaweeds is the aquaculture component providing O_2, while the other animal and microbial components consume O_2
- Seaweeds “sequester” carbon dioxide >>> slowing down global warming
- By “sequestering” carbon dioxide, they could also reduce coastal acidification

$$CO_2 + H_2O + \underset{\text{carbonate}}{CO_3^{2-}} \rightarrow 2\ \underset{\text{bicarbonate}}{HCO_3^-}$$

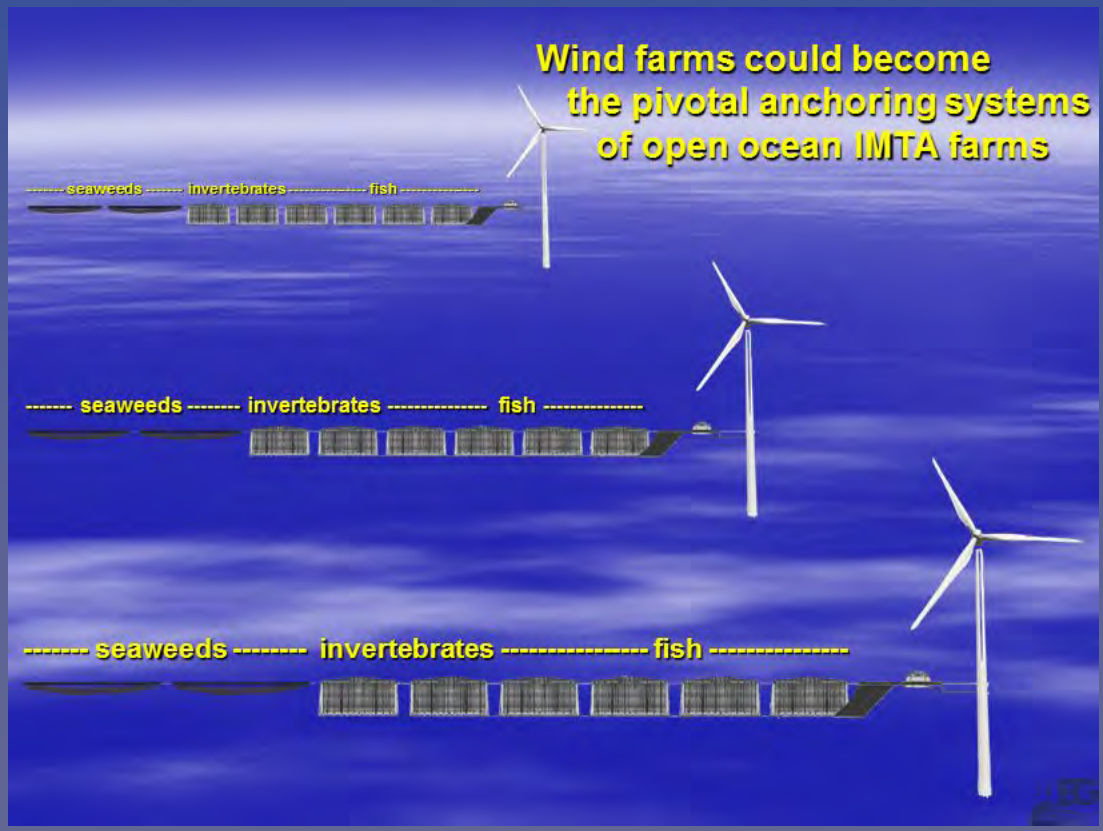
$$CO_2 + H_2O + CO_3^{2-} \leftarrow 2\ HCO_3^-$$

Ecosystem services provided by seaweeds

- The IMTA multi-crop diversification approach (fish, seaweeds and invertebrates) could be an economic risk mitigation and management option to address pending climate change and coastal acidification impacts, hence increasing the resilience of the aquaculture sector

Increase in societal/political license to operate

- Seaweed cultivation (and IMTA systems) could be associated with wind farms, in integrated food and renewable energy parks (IFREP), for a reduced cumulative footprint by combining the two activities



The value of these important services to the environment and, consequently, society are, however, never accounted for in any budget sheet/business plan of seaweed farms and companies, as seaweeds are being valued only for their biomass and food trading value

So, let's calculate the economic value of just the nutrient bioremediation services provided by the world seaweed aquaculture production

The value of the ecosystem services provided by the extractive components of IMTA systems will have to be recognized, accounted for and used as financial and regulatory incentive tools

For example: seaweeds 32.4 million tons US$13.3 billion

Composition	NTC
0.35% N	US$10-30 kg^{-1}
0.04% P	US$4 kg^{-1}
3.00% C	US$25 t^{-1}

>>> Ecosystem services: at least US$1.214 billion to US$3.482 billion

i.e. **as much as 26.2 % of their present commercial value**

>>> Developing a system of nutrient trading credits

There is more money to be made with nutrient trading credits (NTC) than with carbon trading credits (CTC)

Nitrogen trading credits: between US$1.134 and 3.401 billion

Phosphorus trading credits: US$51.82 million

Carbon trading credits: US$29.15 million

The recognition and implementation of NTC would give a fair price to seaweed and extractive aquaculture

They could be used as financial and regulatory incentive tools to encourage single-species aquaculturists to contemplate innovative practices, such as IMTA, as a viable option to their current practices

IMTA is more than

a story of nutrients

Sea-weeds are more

than sea-food

What do we do with all these seaweeds?

We will have to change our attitudes and business models to evolve from the linear approach

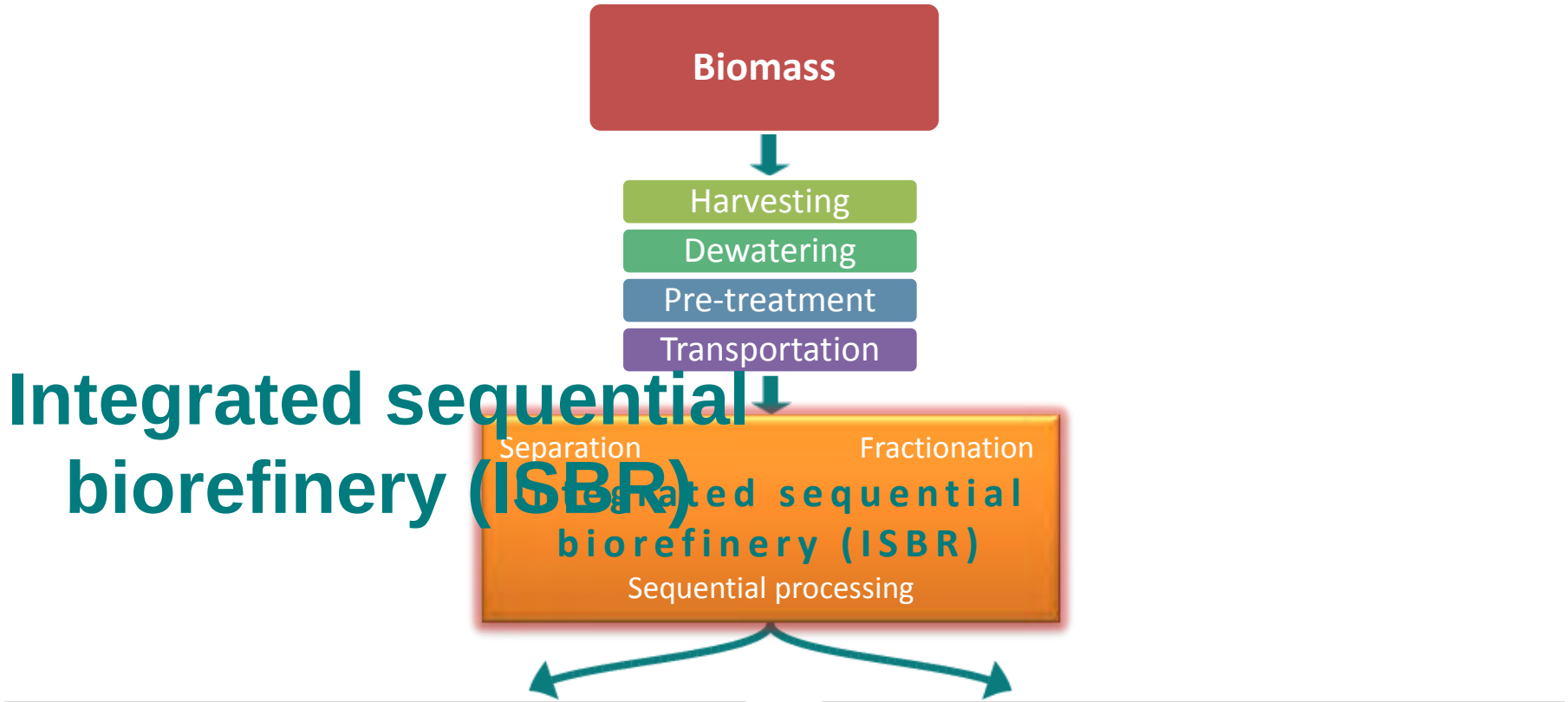
one species – one process – one product

too often used with fishery and aquaculture products, to move towards the Integrated Sequential Biorefinery (ISBR) approach

one species – several processes – several products

No more by-products, but co-products with the circular economy approach

Integrated sequential biorefinery (ISBR)



Bio-based, high-valued molecules

- Food and feed products/ingredients/supplements (from nori, kombu, wakame, etc. to protein substitutions in aquaculture feed)
- Biopolymers (alginates, carrageenans, agars)
- Fine and bulk chemicals
- Agrichemicals, fertilizers, biostimulants
- Pharmaceuticals, cosmetics, cosmeceuticals
- Nutraceuticals, functional foods, antioxidants, biooils (DHA, EPA, etc.)
-Botanicals, pigments, colorants, aromatics

Low-valued commodity energy carrying molecules

- Biofuels
- Biodiesels, gasoline, waxes, olefins
- Biogases (biomethane, biohydrogen)
- Bioalcohols, aldehydes, acids
- Biomaterials, biocomposites, thermoplastics, adhesives
- Heat/steam
- Power/electricity

Markets and added value of seaweed products

At recent conferences, people talk a lot about the

Blue Growth / Blue Economy / Blue Revolution

However, we should also recognize that it needs to become greener

It is, consequently, time we combine the two and we talk about the

Turquoise Growth

Turquoise Economy

Turquoise Revolution

INTEGRATED MULTI-TROPHIC AQUACULTURE

CHOPIN

COASTAL HEALTH SOLUTIONS

Thank you very much

Aapaka bahut bahut dhanyavaad

Seaweed Business Experience – Aquagri Processing Pvt. Ltd. (APPL) - A collaborative effort between APPL – CSIR-CSMCRI - IFFCO

Importance of Seaweed Cultivation

"**Scientific** intervention and technologies hold the key to improving productivity in Indian agriculture... We now need to focus on a Blue Revolution... fisheries... ornamental fishes and seaweeds... We need greater research and promotion of coastal seaweeds... Coastal seaweeds have great potential for human health care and agriculture... We should work on scientific methods of seaweed agriculture. Seaweeds are important raw materials… and can play a significant role in improving crop productivity..."

Shri Narendra Modi, Honourable Prime Minister of India, July 29, 2014 at the 86th Foundation Day of the Indian Council of Agricultural Research (ICAR), New Delhi.

"**Seaweed** cultivation neither requires land nor irrigation water nor any fertilizer; instead it yields fertilizers, which will be used in land-based crops."

Dr. APJ Abdul Kalam, Former President of India

Seaweed Cultivation – A potential New Livelihood Vertical

Key Features of Seaweed Industry

Seaweed Business viable for all stakeholders. Sustainable livelihood opportunity for the coastal community without having to relocate. Provides additional income to Fishermen Families.

Seaweed cultivation is a resource neutral technology, not requiring land, fresh water, fertilizers or pesticides. It sequesters CO_2 which results in mitigation of ill effects of climate change.

Seaweed is a sunrise industry catering to commercial requirements of Food, Feed, Pharma & Chemicals, Cosmetics, Biofuels, Biofertilisers, Biostimulants etc.;

Seaweed extract based bio-stimulants provide relief against abiotic stress and boost crop production.

The next big opportunity area is in animal and human nutrition products to boost immunity and productivity

Visual Overview of Seaweed Farming Operations

Livelihood creation – 1000+

Natural Carbon Sink

Reverses Ocean Acidification

Protects the coral reefs

Seaweed is pesticide and fertilizer free – 100% Organic

Potential Products from Seaweeds

Food Additives
Hydrocolloids

Organic Agri- Inputs
Bio- stimulant (Sagarika)

Animal Nutrition

Organic Chemicals

Nutraceuticals

Edible Packaging

Aquagri Journey…

Organic Bio-Stimulant Product Range – IFFCO India

AQUAGRI

SEAWEED BASED FORMULATIONS FOR IMPROVING PRODUCTIVITY AND HEALTH OF DAIRY AND POULTRY ANIMALS





FOR GROWING CALVES

Reduced methane emisions from animals

Higher Average Daily Gain (ADG)

FOR LACTATING COWS

Better persistency of lactation

High Calcium content in milk

FOR LAYERS

Age of sexual maturity reduced

Higher egg production

FOR BROILERS

Lower Feed Conversion Ratio

Enhanced immunity

EXCLUSIVELY LICENSED TO AQUAGRI FOR 5 YEARS BY CSIR – IN NOVEMBER 2020

Seaweeds are rich source of choline, glycine, betaine, nutrients along with biologically active compounds such as fucoidan, betaine and glucans which are known to enhance animal's immunity. Polyphenols in the seaweed exhibit antioxidant and Reactive Oxygen Species (ROS) scavenging activity. Seaweed formulations were developed to harness the active ingredients for improving productivity, improved rumen function, boost immunity and all round health of animals (cattle and poultry).

AQUAGRI

FOOD INDUSTRY PRODUCTS **CARRAGEENAN**

MEAT

DAIRY

BEVERAGE

ICE CREAM

JELLY AND GUMMIES

AIR FRESHENER

Carrageenan Application in Various Industries

Our range of carrageenan blends assist in improving gelling, thickening and stabilizing properties of various food products. Aquagri specializes in blending Carrageenan with other ingredients to create customized solutions that meet the demands of our clients.

National & International Benchmarks

Globally aquatic algae is the fastest-growing of all aquaculture sectors, with an annual growth rate of 10 % and a turnover value of US **$ 13.3 billion** (**FAO**).

The goal set by the Department of Fisheries for FY 2020-25 is 11.2 Lakh MT of Fresh Seaweed Production in India which is envisaged to be achieved under Pradhan Mantri Matsya Sampada Yojana **(PMMSY**) during next 5 years.

Seaweed based bio stimulants account for 25 % of Indian bio stimulant market (~Rs 2,200 crores projected to reach **8,500 crores** by 2030 @ 15 % CAGR). 75 % of the seaweed based bio stimulants sold in India are imported from North America and Europe and based on cold water marine algae species.

Seaweed Cultivation – Road Map to Success

- Ensuring continuous availability of high quality planting material for the cultivators by establishing a PPP company under Section 25 involving the Private Sector, Fisheries Department and Research Institutions of ICAR & CSIR for producing tissue cultured Kappaphycus Seedlings.

- Opening of gulf areas for seaweed cultivation where globally seaweed cultivation is practiced. Pilots between CSMCRI/CMFRI/NCSCM expected to start shortly, clearing the pathway for cultivation.

- Only 3/7 globally cultivated species can be grown in tropical waters of India, we have Kappaphycus/Euchema cottonii and Gracilaria, need permission to import Euchema Spinosium/spp. acclimatise, study and release to farmers.

- Improving the vigor of the planting material to achieve higher & robust growth and be less susceptible to climate change by advanced tissue culture techniques and polyploidy needs to be undertaken with the best institutes on a continuous basis.

Seaweed Cultivation – Road Map to Success

- R&D to be started with select research institutes on land based cultivation models like tubular photo bio-reactors and pond culture. Human Nutrition another area which needs investment in research.

- Seaweed site mapping and pilot study, before training and infrastructure distribution to cultivators.

- Identification of natural seaweed sites with collection norms for sustainable seaweed harvest leveraging the knowledge of international practice.

- Deep sea seaweed cultivation infrastructure creation by the Fisheries Department to encourage farmers to move beyond shallow waters to behind the reef area where growth is higher due to the higher water motion and better nutrient exchange.

- Leverage the cooperative network and model for propelling the growth of seaweed cultivation

Seaweed Cultivation – Road Map to Success

- Encourage and support adoption of seaweed based nutrient in dairy, poultry and fish diets to improve immunity, reduce mortality and increase productivity.

- Seaweed based hydrocolloid application is on western food, focused attention required for developing India specific dairy and confectionary product application.

- Food technology research institutes to work on developing food products fortified with seaweed acceptable to Indian pallet.

SNAP NATURAL AND ALGINATE PRODUCTS PVT. LTD.

Established in 1979 in Ranipet, Tamil Nadu, India, we are the largest processor of Natural Seaweed based products in India.

ISO 9001,ISO 14001
BUREAU VERITAS
Certification

India Organic

मानक: पथप्रदर्शक:

fssai

Established in 1979, largest processor of Natural Seaweed based products in India

Sargassum wightii (Brown Algae), collected from natural beds at Ramanathapuram. Collect **15,000 MT** of wet weeds per year

Eucheuma Cottonii (Red Algae), cultivated in sea.
Have **500 rafts**

7 Acre site in Tirupallani (near sea shore) for post processing of Seaweed

12 Acre manufacturing site in Ranipet, Tamil Nadu

We manufacture Natural Seaweed based products

- **Alginates** manufactured from Sargassum Wightii (Brown Algae)
  - Food, Pharmaceutical & Industrial grade

- **Carageenan** manufactured from Eucheuma Cottonii (Red Algae)
  - Food grade

- **Specialized Blends** for Icecream and Dairy Industry

- **Agriculture & Aquaculture Inputs** manufactured from pure seaweed extract

Alginates manufactured from Sargassum

- Started with textile grade Alginate, main competitor was Chinese material.
- Unable to match viscosity since Chinese use Lameneria weeds.
- Sargassum weeds however give excellent Gel strength making it ideal for food and pharmaceutical industry.

Alginate usage in Pharmaceutical Industry

Type of Drug	Property of Alginate	Prominent Clients
Antacids	• Forms a raft layer (gel) in the stomach so the acids will not reflux • Alginate also has wound healing properties and is known to heal stomach ulcers	Dr. Reddy's, Reckitt Benckiser, Aristo Pharmaceuticals Pvt. Ltd.
Crocin Advance	• Enables quick action – faster reduction in temperature (fever) • Soothes the stomach	gsk
Heart medication	• Sustained release drug	Abbott
Other	• Wound healing • Dental impression material • Cosmetics – Face Packs	

Alginate usage in Food Industry

Type of Food	Property of Alginate	Prominent Clients
Ketchups / Sauces	• Gelling agent - Prevents separation or settling down of any particles (pulp, sugar etc..)	Nestlé
Fruit drinks / Flavoured Milks	• Gelling agent - Prevents separation or settling down of any particles (pulp, sugar etc..)	Dabur
Ice cream	• Prevents ice crystal formation	Various clients

Alginate usage in other industries

	Property of Alginate	Prominent Clients
Welding Electrode	• High purity alginate used in high end welding electrodes • Enables binding of the flux	ESAB SUPERON
Rubber Latex	• Creaming of rubber	Rubber belt – Kerala

Carageenan manufactured from Eucheuma Cottonii (Red Algae)

- Eucheuma Cottonii (Red Algae), is cultivated in sea
- Primarily used in Food products

Carageenan usage in Food Industry

Primarily sold as **Specialized blends** for the dairy Industry.

Currently make blends for:

- Khoya
- Icecream
- Milkshakes
- Unripened Cheese
- Other – Jellys, Processed Meats, Puddings etc…

Primary property of Carageenan is to:

- Reduce protein denature of milk while heating
- Improve texture and taste (eg. Icecream - more creamy)
- Impart uniform colour and flavour release
- Improve yield (better water binding & solids recovery)

Internationally food industry is the biggest consumer of Alginate & Carageenan. In India we have traditionally used lower quality ingredients and a change in mindset is needed to increase consumption.

Impact of Seaweed Farming on Socio-Economic Development of Coastal Communities

Socio-economic profile of seaweed farmers:

- Low literate

- Fisherfolk, who take up this occupation to diversify livelihood

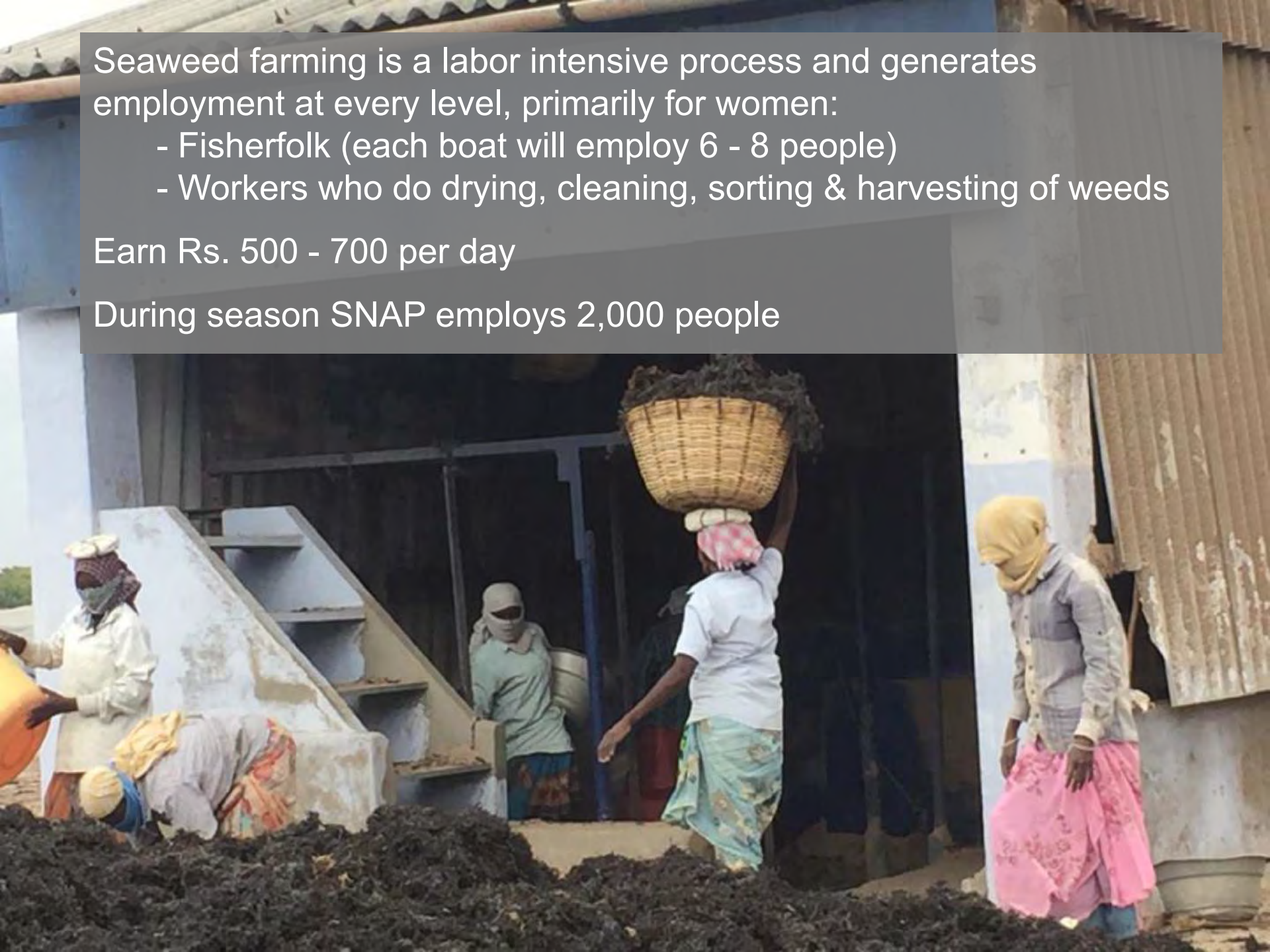
- Several women take up seaweed farming

- Far more profitable than fishing

Seaweed farming refers to both:

Harvesting from natural beds based on calendar (Sarghassum, Turbeneria) and,

Cultivation in the sea (Kappaphycus)



Seaweed farming is a labor intensive process and generates employment at every level, primarily for women:

- Fisherfolk (each boat will employ 6 - 8 people)
- Workers who do drying, cleaning, sorting & harvesting of weeds

Earn Rs. 500 - 700 per day

During season SNAP employs 2,000 people

SNAP NATURAL AND ALGINATE PRODUCTS PVT. LTD.

www.snapalginate.com

sales@snapalginate.com

ISO 9001,ISO 14001 BUREAU VERITAS Certification

India Organic

मानकः पथप्रदर्शकः

fssai

Seaweed Farming for Industrial Applications- *A Value Chain Approach*

International Webinar on Entrepreneurship Development on Seaweed Business by Cooperatives

28 January 2021

Yugraj Singh Yadava

Director, Bay of Bengal Programme Inter-Governmental Organisation

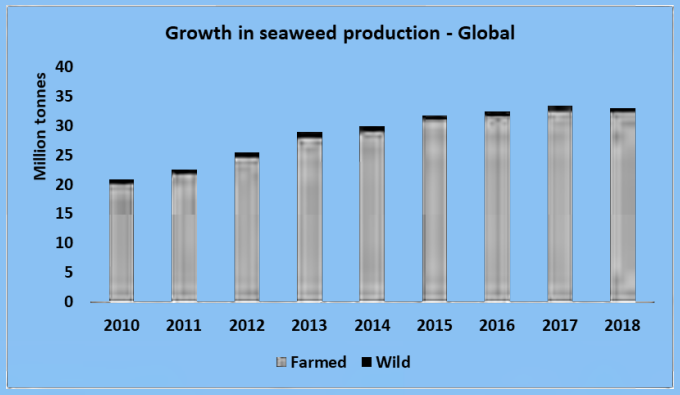
yugraj.yadava@bobopigo.org

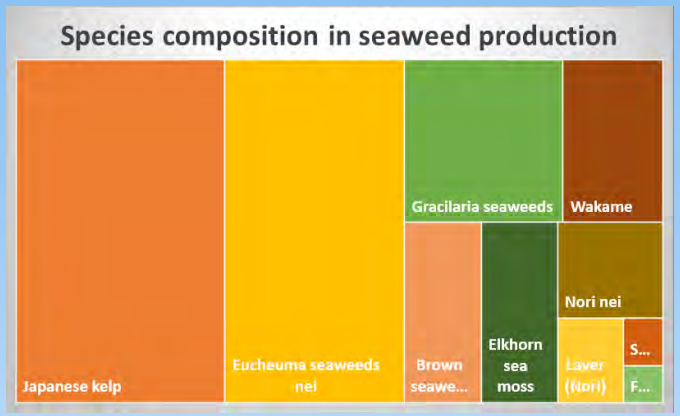
Structure of the presentation

1. Seaweed production- Global picture
2. Seaweed production- India
3. Industrial applications of seaweed
4. Demand for seaweed products in India- *Case of agar agar*
5. Growth in downstream sectors
6. The seaweed value chain
7. Scope for cooperatives in seaweed entrepreneurship
8. Lessons from Indonesia & Malaysia- Case studies
9. The road map

Seaweed production- Global picture

- The global seaweed production during 2010-18 reached 33 million tonnes in 2018, from about 21 million tonnes in 2010. On an average, 97% percent of the production is farmed.
- The average annual growth of production is about 4%.
- Japanese kelp, Eucheuma and Gracilaria are the top species. Together, they constitute about 70% of the production.
- Major producers: China, Indonesia and the Republic of Korea. Their contribution amounts to about 87 percent of the global production.
- Use of seaweed is booming.
- In 2017, globally, 0.48 million tonnes of seaweed valued at USD 880 million was exported. Indonesia led the global export with 21 percent market share, followed by Chile (9%) and Ireland (7%).
- Most traded commodities are lever, agar agar, red seaweeds and *Undaria pinnafitida* (brown algae).

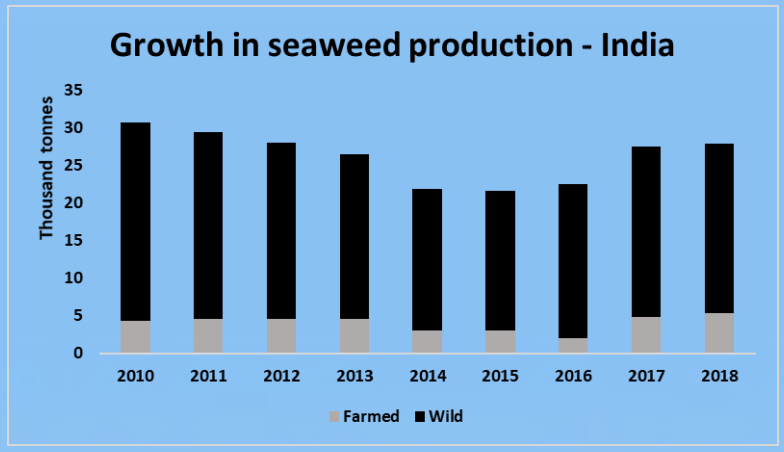


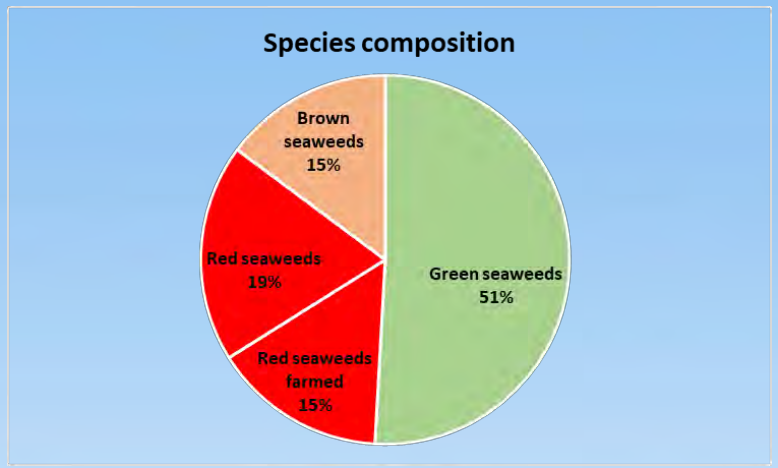


Source: FAO

Seaweed production- India

- Seaweed production hovered around 26 000 tonnes during 2010-18.
- In contrast to the global trend, only 15% of seaweed is farmed.
- Green seaweed makes 51 percent of the production. Red seaweed is the major farmed species.
- The production remains more or less concentrated on the coasts of Tamil Nadu and Gujarat.
- The Pradhan Mantri Matsya Sampada Yojana (PMMSY) has provisions to promote seaweed business.





Source: FAO

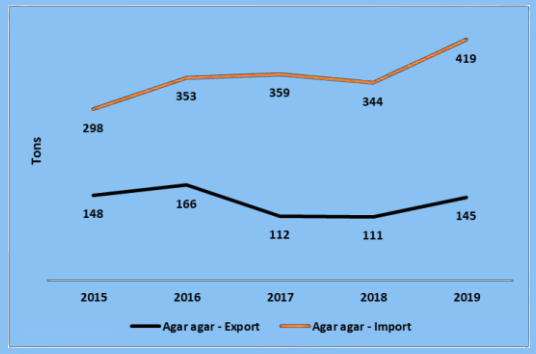
Industrial Applications of Seaweed

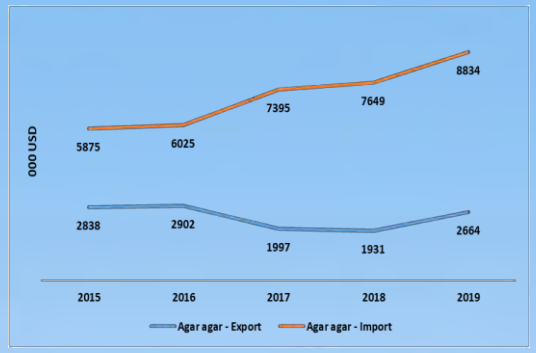
Hydrocolloid	Description
Agar	The two key grades of agar are produced from either gelidium or gracilaria seaweeds. Consumption of gelidium agar is focused in the pharma bacteriological plates although there is some use in food. Gracilaria agar is mainly used in food and often sold as a single ingredient for home use in Asia.
Alginate	Sodium alginate and propylene glycol alginate (PGA) are widely used in food and industrial applications. The calcium gelling reaction is used in many food applications, the classic of which is the red pimento strip in green olives. Sodium alginate is also used as thickener in sauces, syrups and toppings for ice cream.
Carrageenan	Extracted from red edible seaweeds. Widely used in the food industry, for their gelling, thickening, and stabilizing properties. Their main application is in dairy and meat products, due to their strong binding to food proteins.

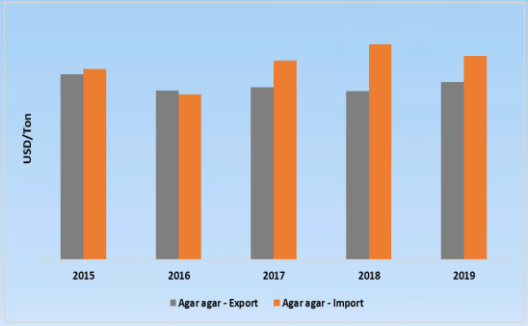
https://www.hydrocolloid.com/summary_extracts.php

Demand for seaweed products in India – *Case of agar agar*

- The chart shows *agar agar* export and import from/to India in quantity (tons), value (000 USD) and unit value realization (USD/ton).
- Data indicates there is a growing demand for seaweed products, both for trade and domestic consumption.
- India is a net importer of seaweed products.
- The unit value of seaweed products imported is usually higher than exported products.
- To sum up, there is a scope in the domestic market both for increasing production and value addition.







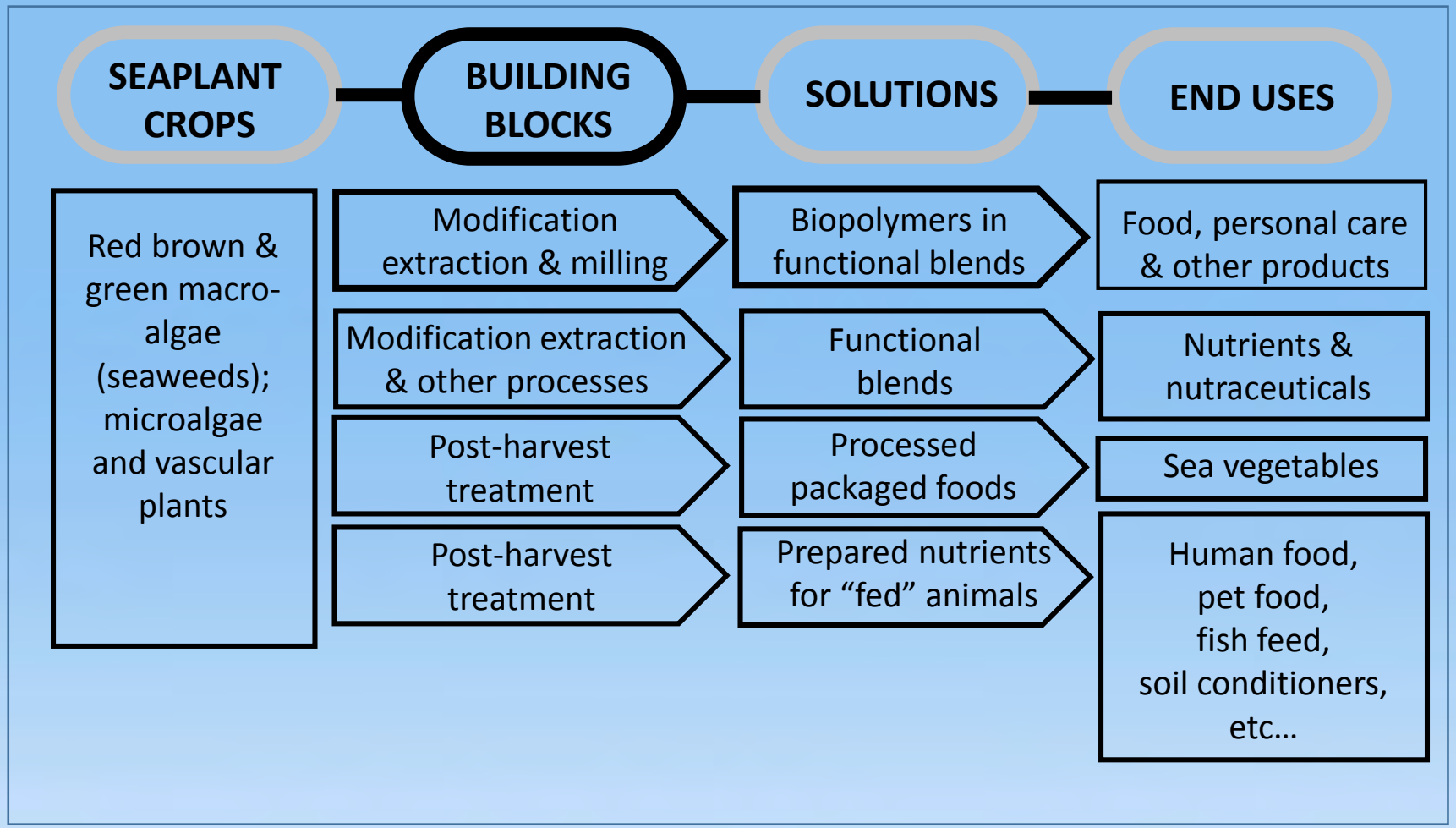
Source: ITC Trademap

Growth in downstream sectors

Sector	Projection
Pharmaceuticals	Indian pharmaceutical sector supplies over 50% of the global demand for various vaccines. Pharma Vision 2020' by the Department of Pharmaceuticals, Government of India aims to make India a major hub for end-to-end drug discovery. India also plans to set up a nearly Rs. 1 lakh crore (US$ 1.3 billion) fund to provide boost to companies to manufacture pharmaceutical ingredients domestically by 2023.
Food processing	The Indian food processing industry accounts for 32% of the country's total food market, one of the largest industries in India and is ranked fifth in terms of production, consumption, export and expected growth. The Ministry of Food Processing Industries (MoFPI) is making all efforts to encourage investments in the business.
Cosmeceutical	Indian Cosmetics Products Market is projected to grow at a CAGR of 4.23% during the forecast period 2020 - 2025. The cruelty-free (no animal testing), vegetarian, and vegan (no animal ingredients at all) beauty market has exploded in recent years globally and has been finding its space in the Indian market too.

Sources: https://www.ibef.org/; www.mordorintelligence.com

The seaweed value chain



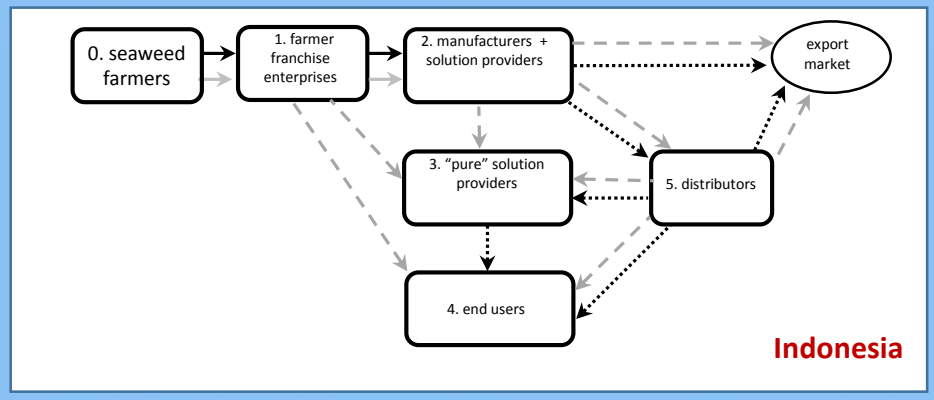
Ref: Neish C (2007) Assessment of the seaweed value chain. USAID

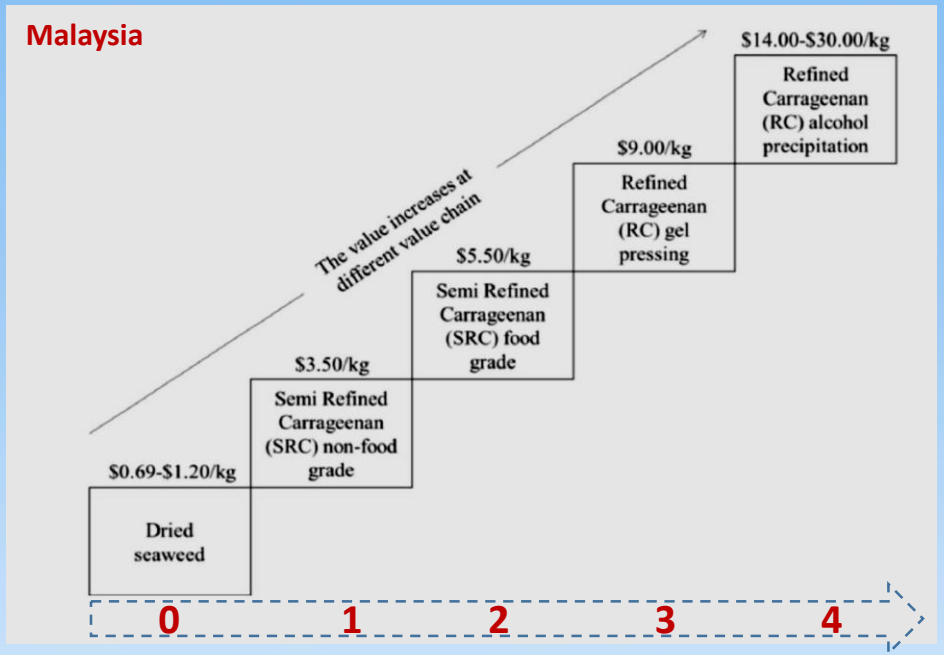
Scope for cooperatives in seaweed entrepreneurship

- At farming and harvesting level, seaweed is more of a labour-intensive activity.
- Labour intensity decreases but still remains substantial at washing, grading and drying stages.
- Low level of technology is required for initial processing of seaweeds.
- Through community entrepreneurship the above three stages can be brought under the production sphere of the cooperative.

Lessons from Indonesia & Malaysia- Case studies

- Currently, farmers/ harvesters sell the product at level 0.
- However, substantial value addition takes place between levels 0 to 1 (192%).
- For a profitable and sustainable cooperative there is a need to capture levels 0 to 2.





Ref: Neish C (2007) Assessment of the seaweed value chain. USAID
Nor, A.M., Gray, T.S., Caldwell, G.S. et al. A value chain analysis of Malaysia's seaweed industry. J Appl Phycol 32, 2161–2171 (2020).

The road map

- Seaweed farming is receiving global attention.
- With projected growth in the upstream industries, the domestic demand is likely to increase.
- There is a scope of rural entrepreneurship in seaweed farming through cooperatives.
- However, a cooperative focussing only on production and drying is unlikely to make enough money to grow.
- The entrepreneurship will be on internalizing as much of the value chain as possible.
- At the same time, a clear Government policy will be required that *inter alia* covers identification of suitable areas, forward and backward linkages, market intelligence, knowledge and capacity building of stakeholders at different levels and finally access to finance.

Thank You!

Seaweed Business Prospects – Maharashtra

- Dr. Atul Patne, IAS
Commissioner of Fisheries
Govt. of Maharashtra

Aims & Objectives

- Creation of livelihood opportunities for coastal populations
- Provide alternate source of income for fishers, especially during the fishing ban period
- Meet the industrial demand for manufacturing of Agar, Agarose, Carrageenan and Alginates from Seaweeds
- Mass production of seed material for commercialization of the seaweed culture and conserving natural resources
- Fisherwomen, who are majorly marketing of fresh fish (exploitation of natural resources), can also explore Seaweed as a lucrative business prospect
- At present Maharashtra state fisher folks have not yet started seaweed culture due to Unavailability of Seeds & Unidentified Potential Sites

Area of execution - MH

- India compromises of 9 Coastal States and 4 Coastal UT
- Maharashtra state has a **720 Km Coastline comprising of 7 coastal districts**.
- 12 Taluka's from 4 coastal districts are Primarily Selected for Seaweed Cultivation in coordination with UNDP:

District	Implementing Area
Palghar	Dahanu, Palghar
Raigad	Uran, Shriwardhan, Alibaug
Ratnagiri	Dapoli, Guhagar, Rajapur, Ratnagiri
Sindhudurg	Devgad, Malvan, Vengurla

- Department will be conducting awareness programs for alternative source of income for livelihood & sustainable development.
- Survey for the selection of Suitable Sites to cultivate seaweed need to be carried out by Central Fisheries Org. /Institutes immediately on Priority

Plan of Action

Through PMMSY scheme 10-20 % fisher women of selected coastal villages need to be involved in seaweed culture resulting in fixed income source

NFDB has approved 2000 Rafts & 800 Monoline for Seaweed Cultivation for current year 2020-21.

Planning awareness & training programmes regarding seaweed training

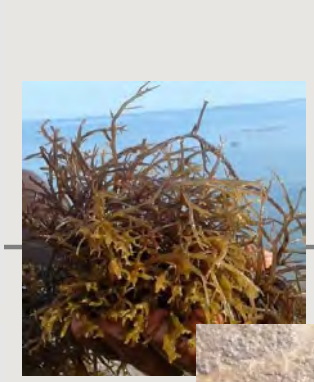
Department will arrange for seed availability through research centers like CSMCRI, (Central Salt and Marine Chemical Research Institute), Bhavnagar

Department will arrange Pre & Post Harvest / Processing, channelize through Buyer- Producer Meet

Economically important seaweeds in India

Agar/ Agarose

- Gel-forming agent
- Used to make clear noodles in Japan
- Binder for medical tablets and capsules
- Molecular and Microbiological application



Gracilaria edulis, *G. dura*, *G. debilis*

Carrageenan

- Creaminess to dessert
- Thickening agent in dairy products
- Salad dressings
- Emulsifier in the pharmaceuticals
- Pet food

Kappaphycus alvarezii

Alginates

- Animal food
- Textile printing
- Dental impressions
- Emulsifier in the pharmaceuticals


Sargassum spp., *Turbinaria* spp.

Major Suggestions - MH

- Survey for the selection of Suitable Sites to cultivate seaweed needs to be carried out by Central Fisheries Organisation /Institutes immediately on Priority Basis
- To fulfil Seed requirements, Seed bank and Facilitation Centres should be run by the expert institutes like CSMCRI(Central Salt and Marine Chemical Research Institute), Bhavnagar & CMFRI
- FFPOs to encourage and promote for seaweed culture
- Central Govt. need to channelize the buy-back intervention policy to encourage seaweed culture

THANK YOU

राष्ट्रीय सहकारी विकास निगम
NCDC
Assisting Cooperatives, Always!

Department of Fisheries
Ministry of Fisheries, Animal Husbandry & Dairying
Government of India

NEDAC

INTERNATIONAL WEBINAR ON
ENTREPRENEURSHIP DEVELOPMENT IN SEAWEED BUSINESS BY COOPERATIVES

Presentation on

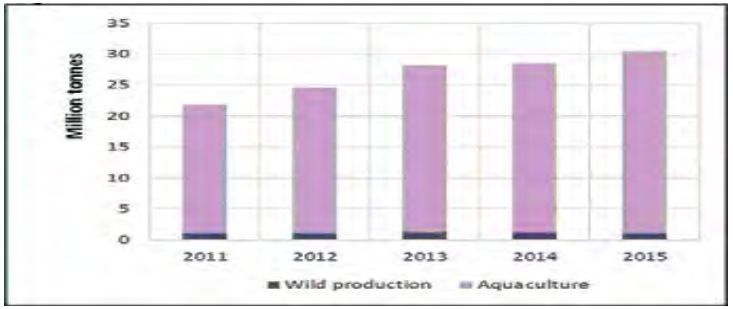
SEAWEED SCENARIO in INDIA

by
Dr. R.N. Gopal &
Mr. Nilesh Patil,
NCDC, India.

28th January, 2020

Global Scenario in Seaweed Business

- More than 1000 species of seaweeds are available through world.
- Production has grown from 14.70 million tons in 2005 to 30.40 million tons in 2015.



- The global Seaweed industry is worth more than US$ 6 billion/annum.
- Rising in commercial market demand of seaweed extract is mainly driven by it's application as dietary supplements, food and beverage, pharmaceutical , medical & healthcare related other industries.
- Key players are Producers, FMCG companies, Research Organizations, medicinal and cosmetics manufacturers, fertilizers, etc.

Ref. :FAO Reports (2016,2018,2019)

… continued…

Global Scenario

- Due to growing consumer awareness on the benefits of seaweed extracts is not only used supplements to nutrient food (as staple diet), flavour enhancers, beauty enhancement, diabetes control and fertilizers etc. but also for their weight loss property the consumption of seaweed has increased by 125% in the UK alone.
- Global seaweed-extracts market is growing maximum in Europe.
- More than 80% Seaweed production comes from China and Indonesia.
- Leading Exporters - Indonesia, Chile, Republic of Korea and Philippines.
- Leading Importers - Japan and the USA.

Reference – FAO Reports (2016,2018,2019)

Seaweed Production & Areas in India

- About 200 species are being commercially cultivated along coasts of Tamil Nadu, Gujarat and around Lakshadweep and Andaman & Nicobar islands.
- In 2020, seaweed production was approx. 25,000 tonnes.
- Main varieties: *G. acerosa, G. edulis, G. dura, G. debilis, Ulva Spp*, etc.
- Enhancing the incomes of fisherfolk with large employment generation potential.

Opportunity for Seaweed Business in India

Supports global food supply including bio-fertilizers.

Long coastline of around 8118 km, with traditional marine fisher-folk.

Will enhance livelihood of fisher-folk communities

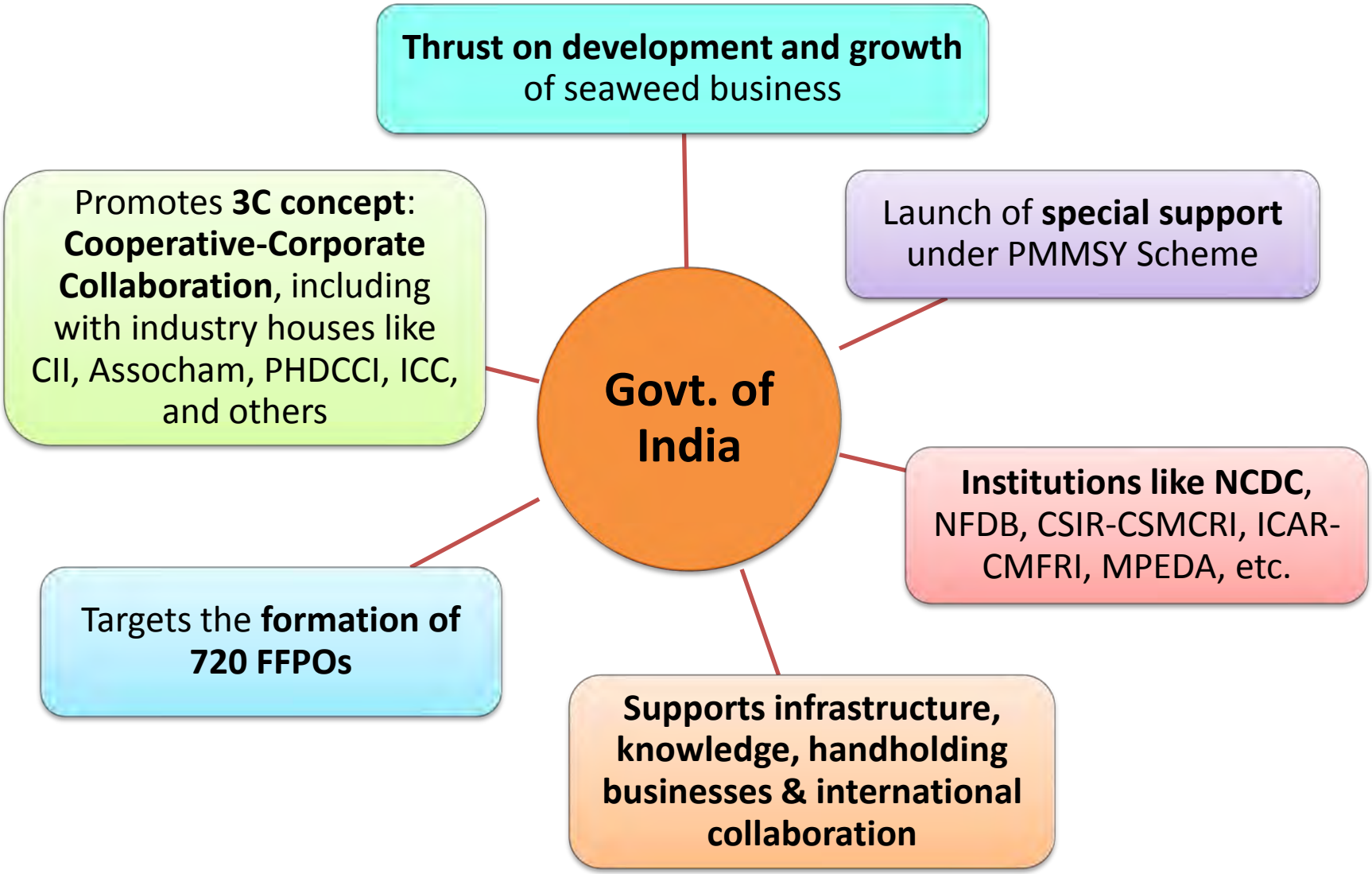
Strengthen supply for seaweed based products & applications

Major tool to help treat pollution and mitigate CO2 emissions

Special focus by GoI to promote Seaweed Business

Steady growth seen in consumer demand, across sectors, domestic & international

GoI as Catalyst for Seaweed Business



Seaweed sector as part of Blue Revolution Initiative by GoI (2020)

Pradhan Mantri Matsya Sampada Yojna (PMMSY)- Rs.20,500 cr.

- Rs 640.00 crore Investment by Government in seaweed sector
- 8 lakh Employment Direct and Indirect in seaweed sector
- Socio-economic Empowerment of Coastal Fishers, especially fisherwomen
- Supports infrastructure and activities to mitigate business Risks

Financial support by Govt. by way of:

Central Sector Component (100% Subsidy) –

i. Genetic Improvement Programme and Nucleus Breeding Centre
ii. Innovative project on Seaweed Business under Central Sector Component

Centrally Sponsored Component (40% Subsidy for General Category and 60% for SC/ST/Women) –

i. Establishment of Seaweed culture Rafts, including inputs
ii. Establishment of Seaweed culture with Monoline/Tubenet method, including inputs
iii. Establishment of Seed Bank for Seaweeds

Seaweed Business Challenges & Opportunities

Challenges

- Inefficient production
- Business awareness lacking among farmer-producers
- Marketing constraints
- Limited extension services
- Lean period in monsoon due to Coastal turbulence
- Ineffective collaboration with research and industry
- Limited credit & financial support

Being addressed under Blue Revolution Initiatives

Business Demand

Medicine/Cosmetics

- Antioxidant, anticancer, anti diabetic etc
- Beauty enhancer

Food/Fertilizers

- Growing demand for seaweed vegetables and processed seaweed.
- Animal feed & fertilizers

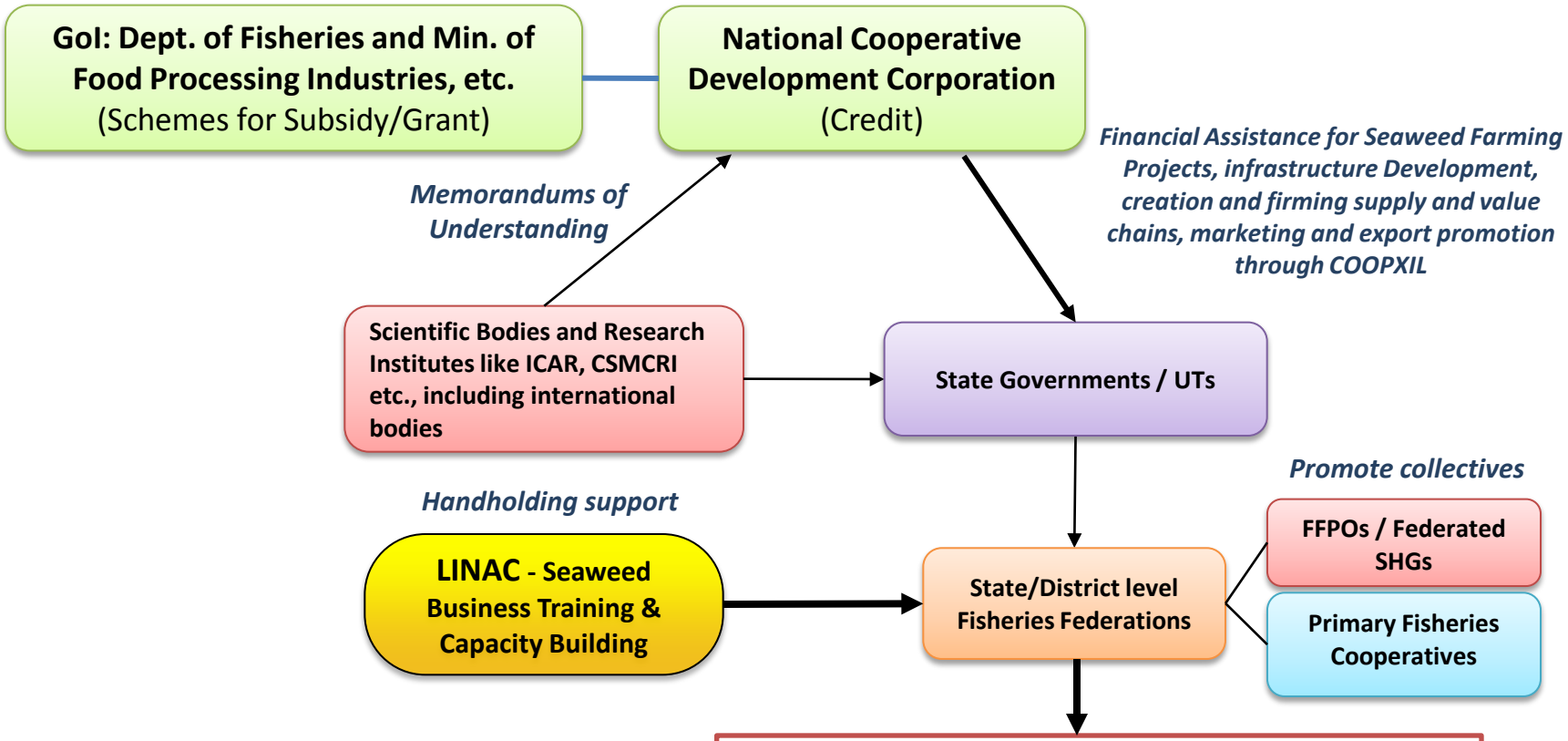
Industrial uses

- Seaweed extract in Industrial applications such as Alginate, Agar, and Carrageenan.
- Textile

Export markets

- Rising export demand to Asia-Pacific markets like China, Japan, Indonesia and Korea

Seaweed Business Entrepreneurship Development Model



Expanding the business eco-system of fisher cooperatives with larger supply chain, processors and users.

Bringing holistic and long-term focus on scaling-up of seaweed based businesses.

Outcome of proposed model :

- Economically Sustainable Development
- Long-term Income Growth
- Product Diversification
- Sustainability benefits
- Partnerships with user-industry
- Collaboration with scientific research

राष्ट्रीय सहकारी विकास निगम
NCDC
Assisting Cooperatives. Always!

THANK YOU

Presented by

National Cooperative Development Corporation

A Statutory Corporation
under Ministry of Agriculture & Farmers Welfare, Government of India
(ISO 9001:2015 Certified Organization)
4- Siri Institutional Area, Hauz Khas, New Delhi - 110016, India
Tel: +91-11-26960796, Fax: +91-11-26962370, 26516032,
Email: mail@ncdc.in, www.ncdc.in