

Seaweed Cultivation in the Tropical Waters, Asia



Gracilaria, Kappaphycus, Eucheuma Caulerpa

Production of the cultivated seaweeds of the World

- 1. *Kappaphycus* and *Eucheama* (Tropical seaweeds)**
Phycocoroid (Carrageenan) 83 milion ton (wet)
- 2. *Lminaria* (China, Japan and Korea)**
(Edible seaweed, alginate) 57 milion ton (wet)
- 3. *Gracilaria* (Chile, Asian countries)**
Phycocoroid (Agar) 28 milion ton (wet)
- 4. *Undaria* (China, Japan and Korea)**
(Edible seaweed) 22 milion ton (wet)
- 5. Nori (*Porphyra* (Japan, China, Korea)**
(Edible seaweeds) 18 milion ton (wet)
- 6. Other seaweeds 28 milion ton (wet)**

(FAO data, 2015)

Gracilaria Cultivation

Cultivation country in Asia

Taiwan, China, Indonesia, Vietnam, Thailand



Gracilaria lemaneiformis fronds
growing on the sandy bottom

Production of *Gracilaria* in Asia in 2014

China :	1,116,198 ton (wet)
Indonesia:	1,106,529 ton (wet)
Vietnam:	10,043 ton (wet)
Philippines	536 ton (wet)
Taiwan:	about 1,000 ton (wet)

(FAO,2016)



Powder



Tablet



Flake

Agar products



Japanese cakes
with natural agar

soup



cake



Modern application of agar dish

Method of cultivation

1. Raft (rope) cultivation (**China**)
2. Dispersion cultivation in brackish waters, bay, lagoon and pond
(**China, Indonesia, Vietnam, Taiwan**)
3. Co-cultivation with fish or prawn
(**China, Indonesia, Thailand**)

Taiwan

- 1. Co-cultivation with prawn and *Garacilaria* fronds for 1970s~1990s**
- 2. Stopped the prawn cultivation for disease since 1990s**
- 3. Feed for Abalone culture and edible materials since 1990s~**



**Abalone culture with *Gracilaria* feeds
in Taiwan**



Abalone and *Gracilaria* fronds in the cage



***Gracilaria* cultivation pond (prawn pond)**



***Gracilaria* fronds growing on the bottom
(brackish waters)**



**Cultivated *Gracilaria edulis*
used edible**

Thailand

1. Small scale cultivation by rope method, with co-pig breeding and *Gracilaria* fronds

(There is one agar factory in Bangkok)

2. Feed for abalone in tank culture since 2000s~



Seeding of *Gracilaria* fronds



***Gracilaria* cultivation area
in front of the pigsty**



***Gracilaria* cultivation by support form**

Vietnam

- 1. At present there are at least 10 000ha of *Gracilaria* cultivation area, mainly in northern Vietnam.**
- 2. The total production in the northern region, is based mainly on *G. asiatica* of 4, 000 ~ 5, 000 dry ton /year.**
- 3. In the southern area where the production is based mainly on *G. heteroclada* there is about 200 ~ 250 dried tonnes/year**

(SUMA- Ministry of Fishery, 2001)



Gracilaria cultivation in the lagoon



Harvesting of fronds



Drying of harvested fronds



Stocking of dry products

China

Expanding production with larger long line cultivation since 2000s

Production of 18,000 ton(wet) in 2000

Production of 1,116,108 ton(wet) in 2014

(FAO data)



**Long line cultivation
in Fujian Province, southern China**



Younger fronds attached on the rope



**New technique of dense
planting of *Gracilaria* seeds**



Agar factory in Fujian



Old pressing system



Agar pressed products



**Modern agar production
at Ina food industry Co., Ltd. in Japan**

***Kappaphycus* and *Euchuema*
cultivation in Asia
Philippines, Indonesia,
Vietnam, Cambodia, Malaysia**



***Kappaphycus alvarezii* growing on the coast in Vietnam**

Photo by Tsutsui



Main *Eucheuma* cultivation grounds in Philippines , Malaysia and Indonesia



Green type



Brown type

Kappaphycus alvarezii



Brown type

Green type

Eucheuma denticulatum

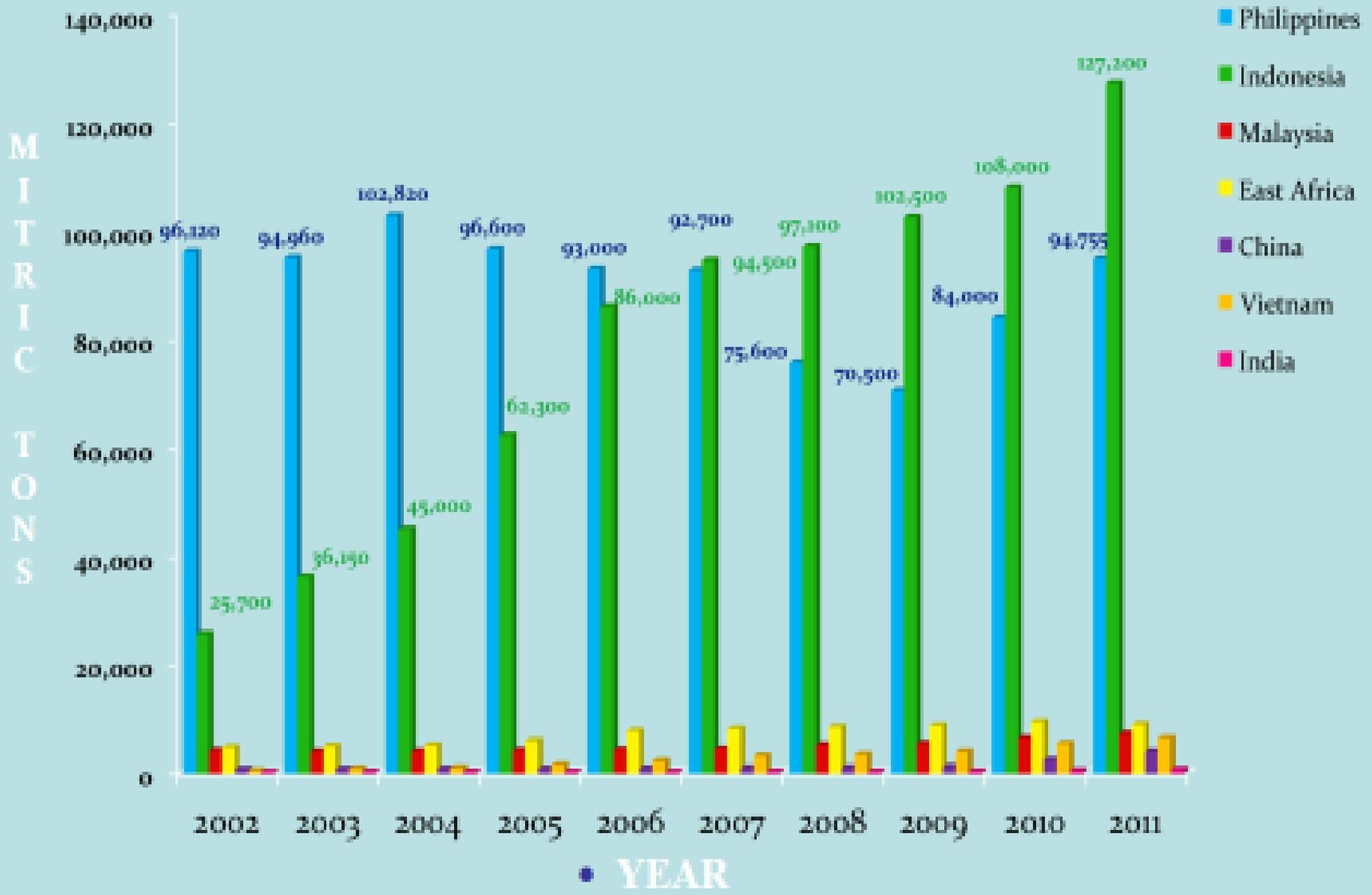
Production of Cultivated *Kappaphycus* and *Eucheuma* of the world in 2010

**Total production about 250,000 ton
(dry weight)**

Indonesia		127,200
Philippines		94,755
Tanzania	about	10,000
Malaysia	about	8,000
Vietnam	about	5,000
China	about	3,000
India	about	2,000

(by data of FAO)

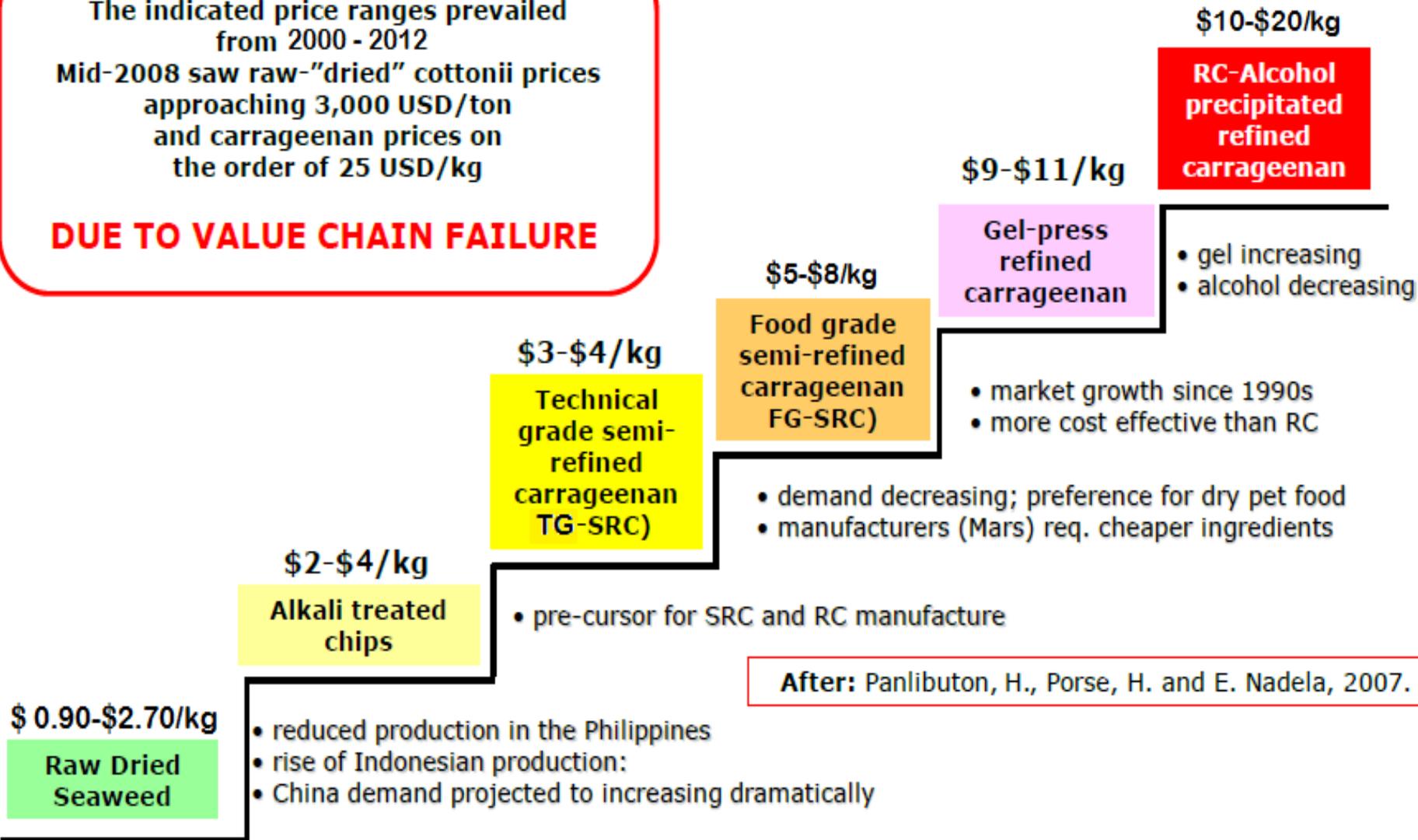
TOP PRODUCERS OF SEAWEED (RDS COTTONII AND SPINOSUM COMBINED)



Major kappa-carrageenan "ingredient building blocks"

The indicated price ranges prevailed from 2000 - 2012
Mid-2008 saw raw-"dried" cottonii prices approaching 3,000 USD/ton and carrageenan prices on the order of 25 USD/kg

DUE TO VALUE CHAIN FAILURE

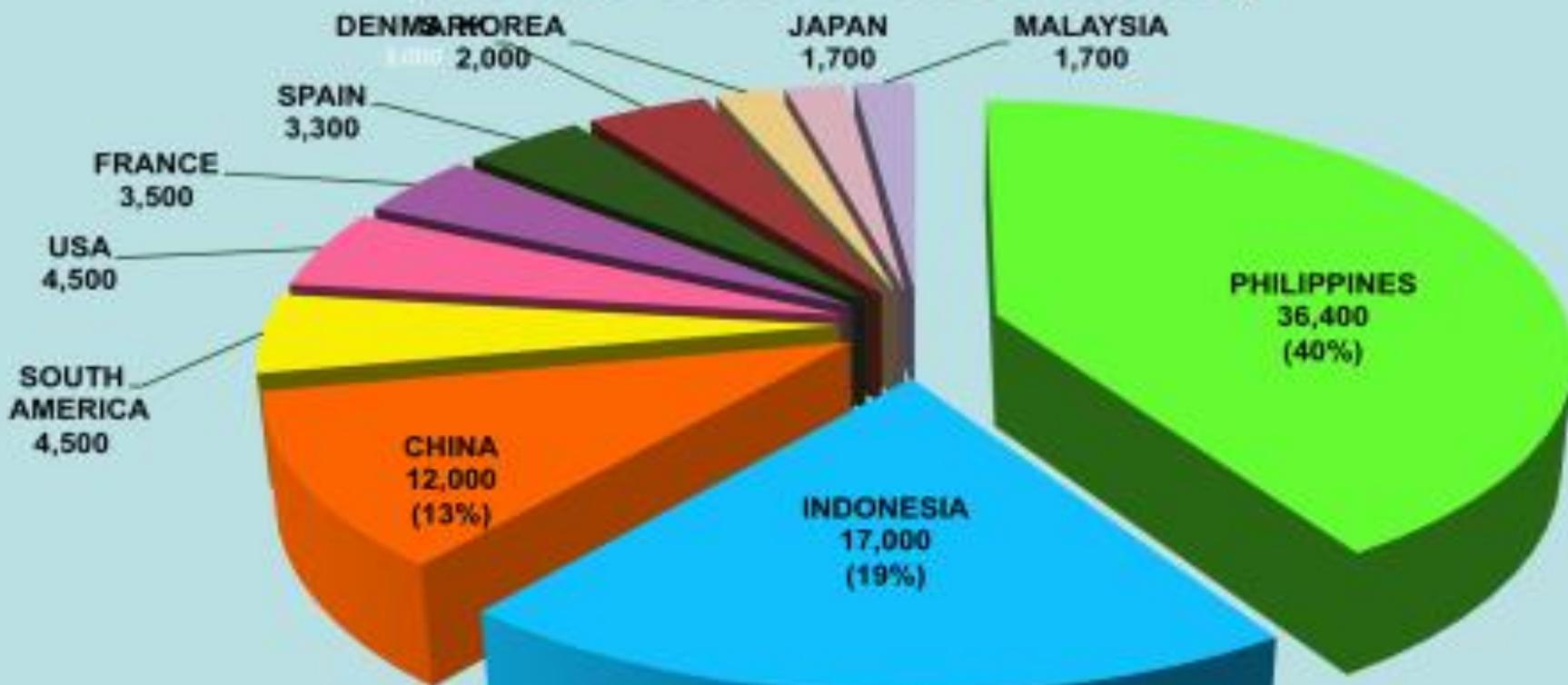


After: Panlibuton, H., Porse, H. and E. Nadela, 2007.



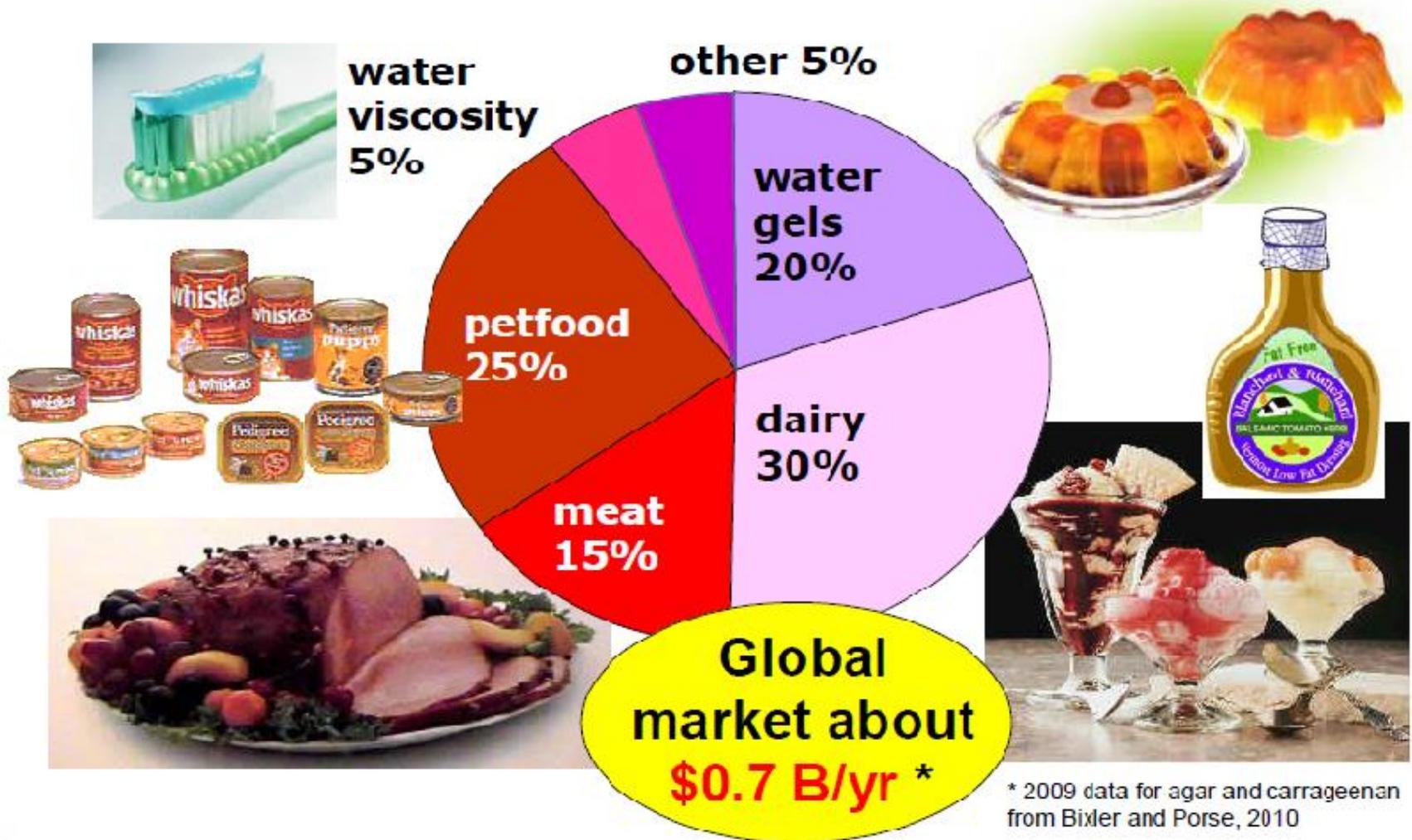
**Alkali treatment powder factory
(small plant: treatment of 1~2 dry ton/ day)
in Malaysia**

CARRAGEENAN PRODUCING COUNTRIES, 2011 (METRIC TONS/YEAR CAPACITY)



TOTAL CAPACITY = 90,000 MT (RDS 335,000 MT)
EST. UTILIZATION (68%) = 61,000 MT
RDS REQUIREMENT = 226,000 MT

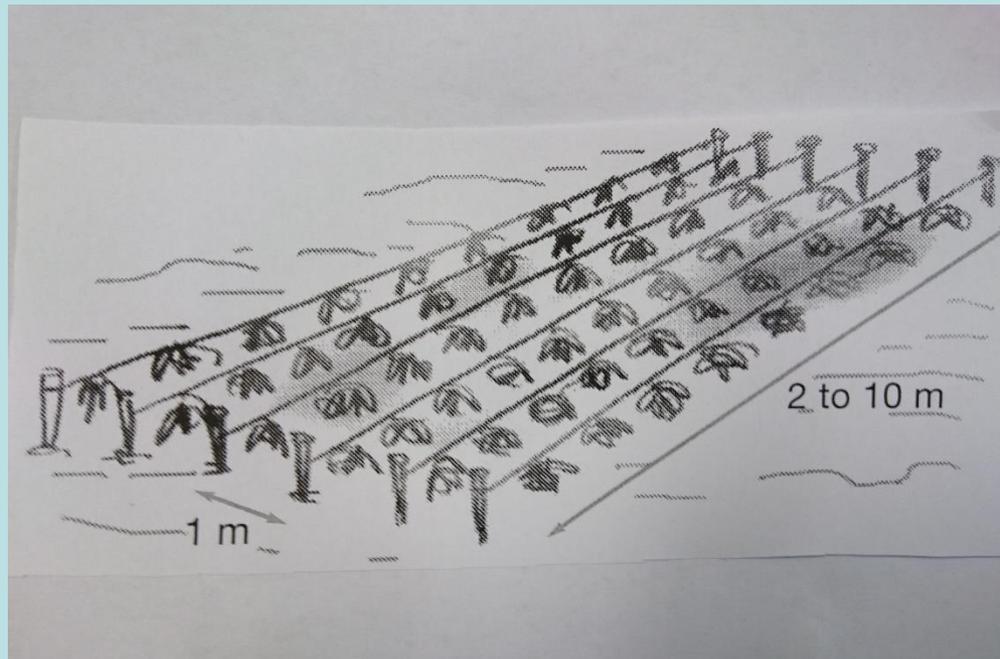
Current markets for carrageenan



Philippines

Characteristics

- Country of origin of *Eucheuma* cultivation since 1970s. Cultivation system by mainly company and co-operative unit
- Mono-line cultivation system



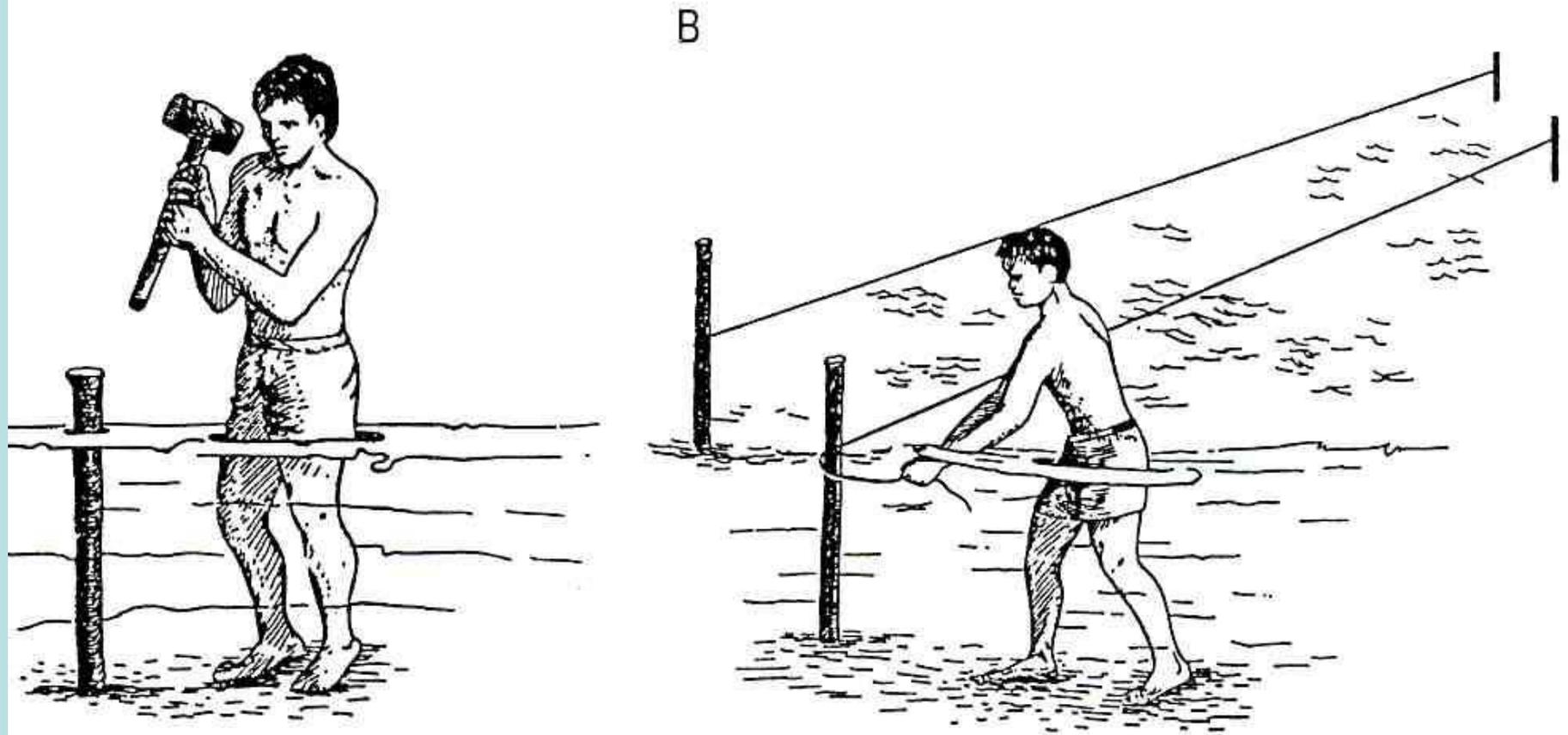


Figure 8. A. Construction of the support system starts with knocking holes in the substratum using a pointed iron bar. B. Monofilament line for attaching *Eucheuma* seedlings is attached and stretched tightly between two wooden stakes.



Mono line system of the cultivation



Setting of the seeds of *Kappaphycus* fronds

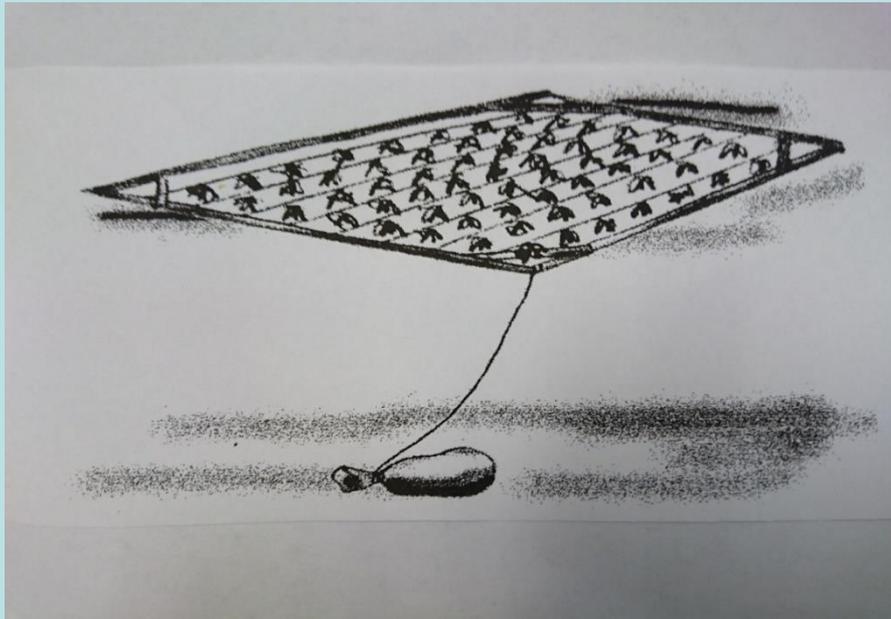


Working station at the coral area

Indonesia

Characteristics

- 1. Cultivation form of family unit**
- 2. Cultivation ground in the bay and inlet**
- 3. Floating(raft) cultivation system**





Floating cultivation in the bay, Indonesia



Raft system made with bamboo



Seeding with family



**Growing of *Kappaphycus* fronds now
bigger strain attached on the rope**



**Transplanting of wild strain
Kappaphycus strain in Indonesia**



**Wild strain *Kappaphycus* sp.
collected in Indonesia**

China

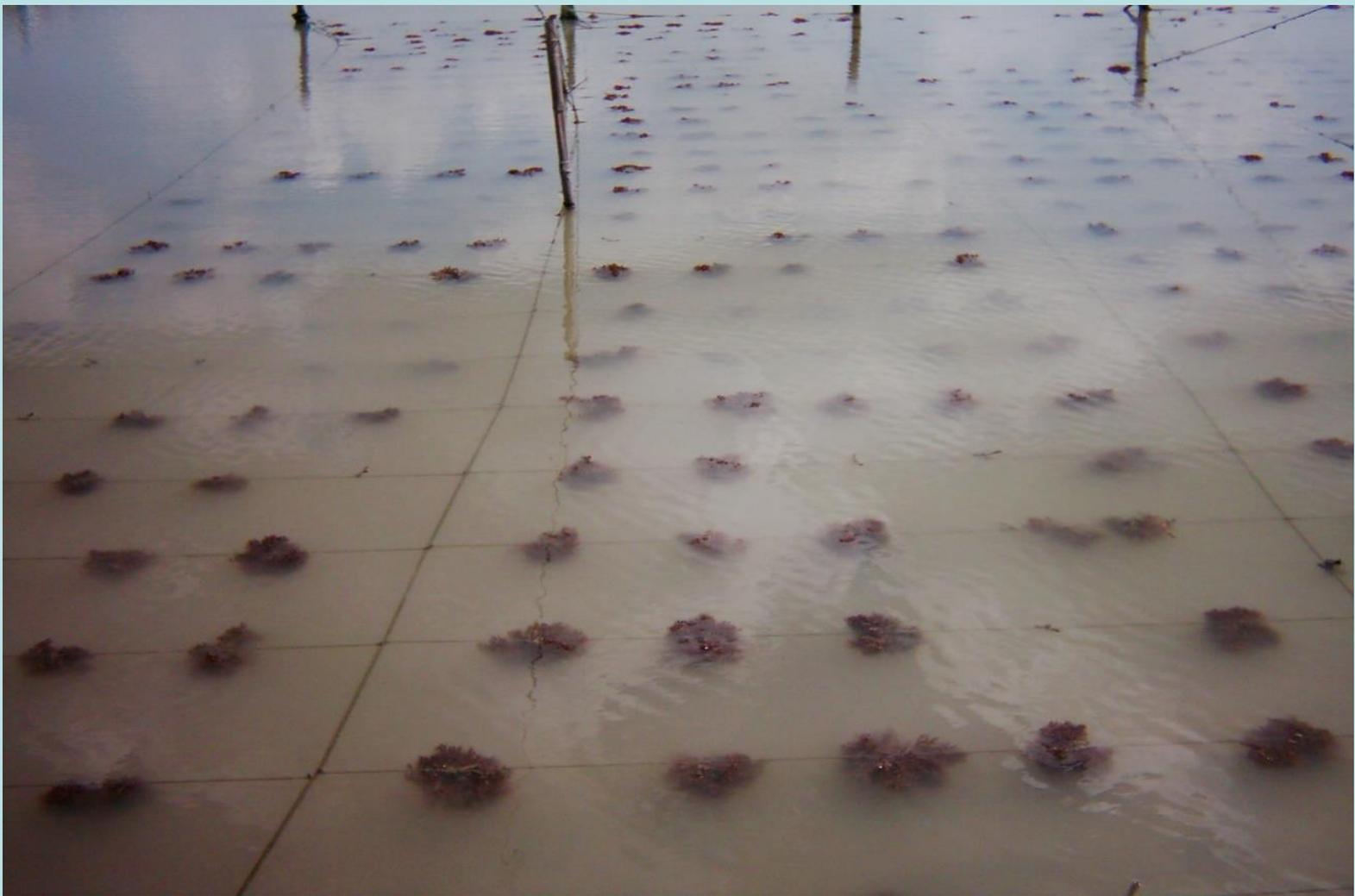
Characteristic

1. Mono- line method of *Kappaphycus* spp.
2. Cultivation in the shallow waters





**The cultivation area
in the shallow waters**



The cultivation is done in the shallow waters



Lifted fronds is not longer



The frond of *Kappaphycus* spp.



***Kappaphycus* spp.**

Vietnam

Kappaphycus fronds after one month
from transplanting (from Japan), in
February , 1993



C



Mono line system in Vietnam

Photo by Nang

A



Growing of *K. alvarezii* by mono line system

Photo by Nang



Long line cultivation in Vietnam

Photo by Nang



Growing fronds of long line system

Photo by Nang



Shrimp pond cultivation of *Kappaphycus*

Photo by Nang



Growing fronds of mono line cultivation

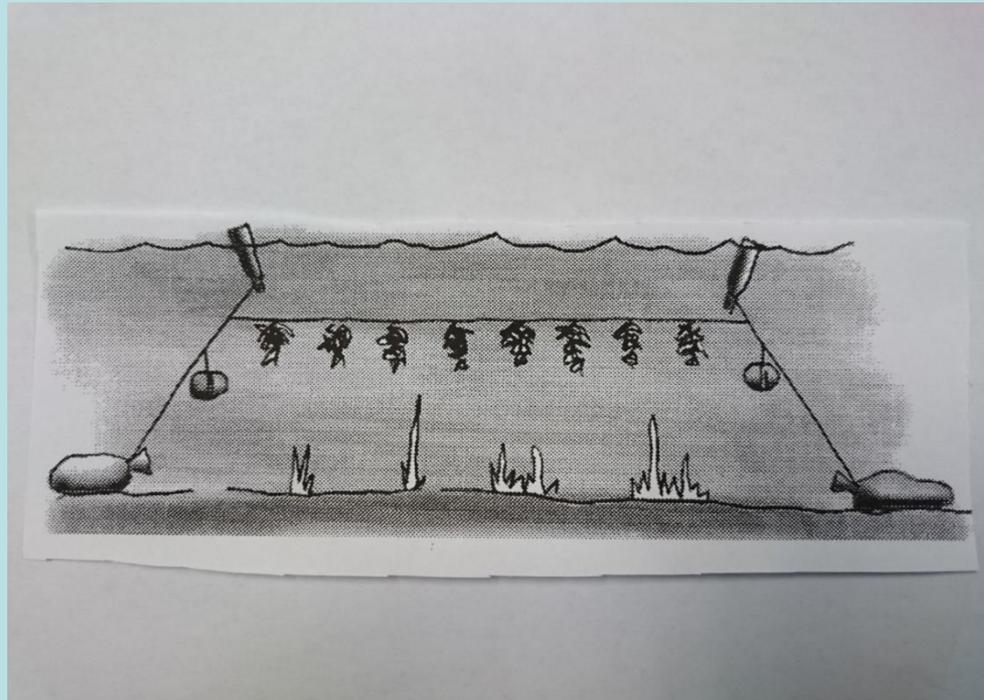
Photo by Nang

Malaysia

K.alvarezii cultivation is done on the coast
of Sabah region

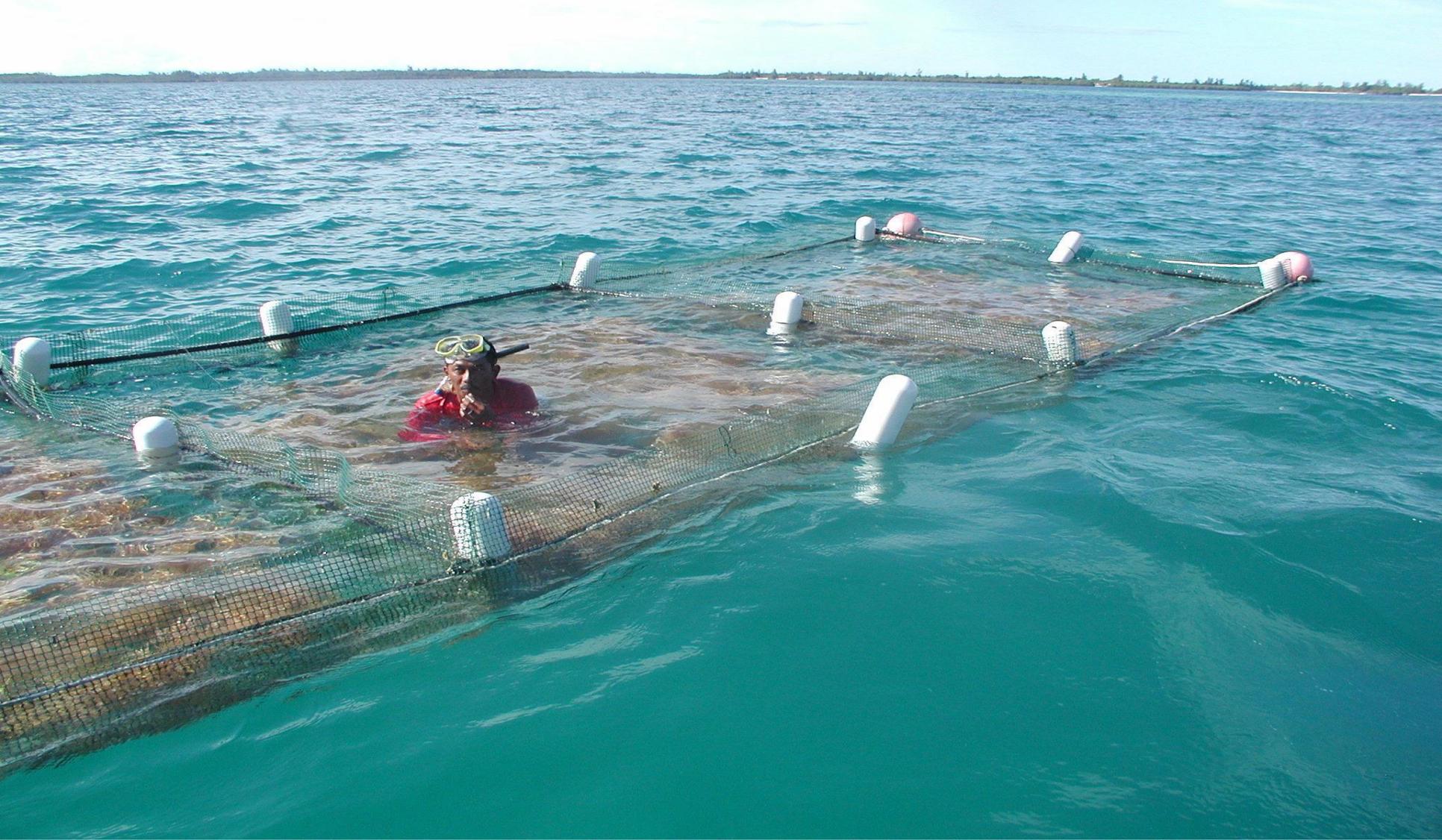
Characteristics

Only larger long line cultivation





Long line system in Malaysia



**Cage system cultivation of *E.denticulatum*
in Malaysia (researching)**



**Long line cultivation in Saba, Malaysia
length of 100 m**



**Cultivation area and houses
of marine life**



**Working station with Fishermen
family(marine life)**



Packing of dry products in the plant



**White fronds covered with Epyphate
(desease)**

Herbivores

There are four types of herbivore damage which are listed in table 3.1 and discussed in detail below.

A. **Nipped Tips:** It has been observed that adult rabbitfish (Siganidae), filefish (Monacanthidae) and cowfish (Ostracidae) are the primary perpetrators. Triggerfish (Balistidae), surgeonfish (Acanthuridae), parrotfish (Scaridae), porcupinefish (Diodontidae) and pufferfish (Tetradontidae) have been observed eating tips but only on rare occasions. Examples of these fish families are depicted in figures 3.6 to 3.12).



Figure 3.6 Type of rabbitfish (family Siganidae)



Figure 3.7 Type of filefish (family Monacanthidae)

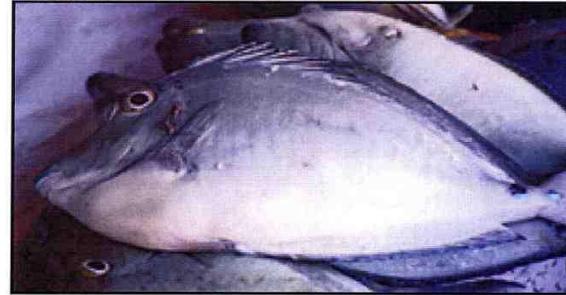


Figure 3.8 Type of surgeon fish (Family Acanthuridae)



Figure 3.9 Type of triggerfish (family Balistidae)



Figure 3.10 Type of parrotfish (family Scaridae)



Figure 3.11 Type of porcupinefish (Diodontidae)

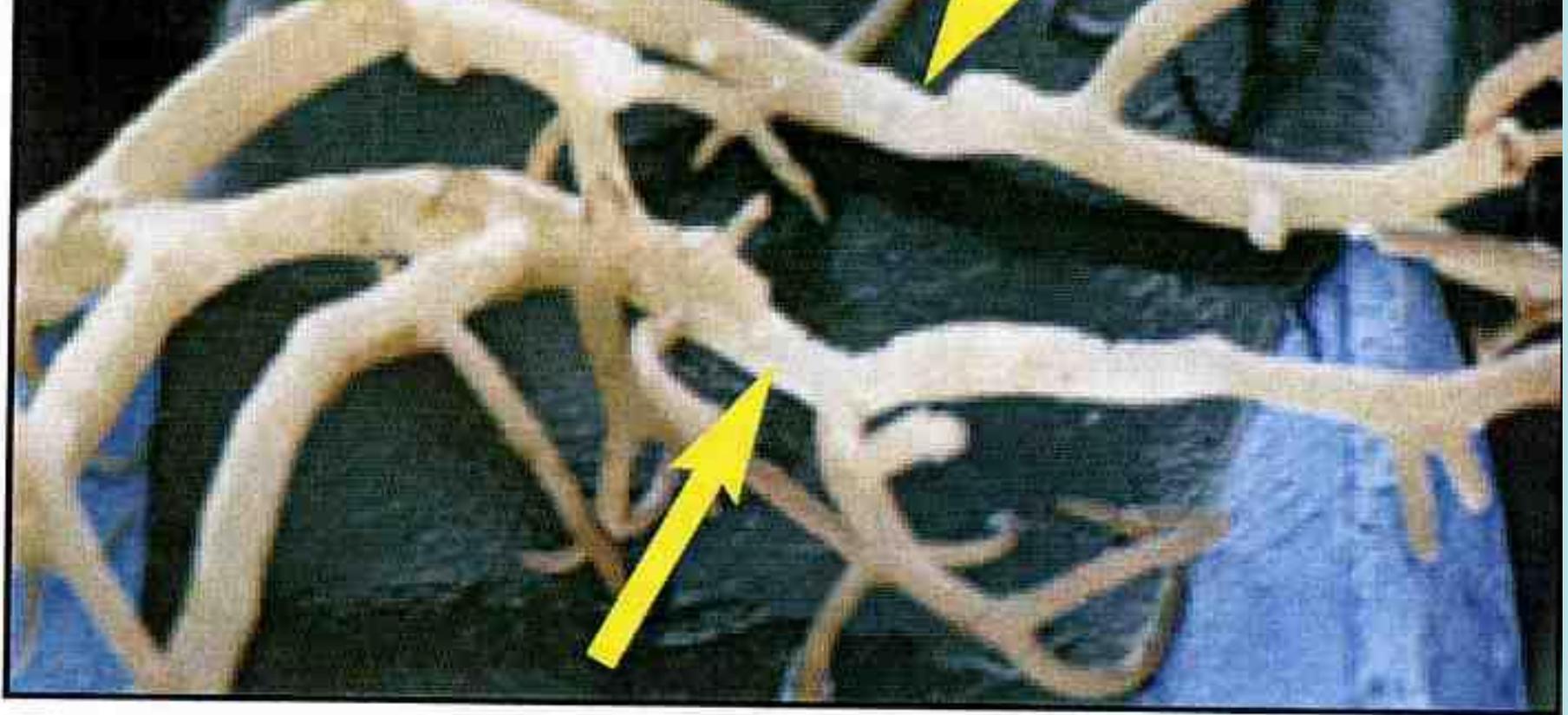


Figure 3.18 Tripneustes gratilla has “planed” the branches of this cottonii plant (yellow arrows). Not only is the pigment gone, but the branches are heavily gouged.

Ice-Ice

View and subject of Kappaphycus and *Euchuema* cultivation

View:

- 1. Demand of the carrageenan in China sphere grows.**
- 2. Expands of the product used carrageenan in Asian sphere**

Subject:

- 1. Promotion of stable production**
- 2. Promotion of reseach of grazing by fish and sea ulchin**
- 3. Promotion of reseach of ice-ice , epiphyte and disease**

Caulerpa cultivation

**Edible seaweeds for local family at the
coral reef sea area of Japan**

Philippines and South Pacific Islands





***Caulerpa* cultivation ponds in Cebu,
Philippines**



Harvesting of *Caulerpa* fronds



Harvested fronds of *Caulerpa lentillifera*



Packing of *Caulerpa* product

**Thank you
for kind attention**