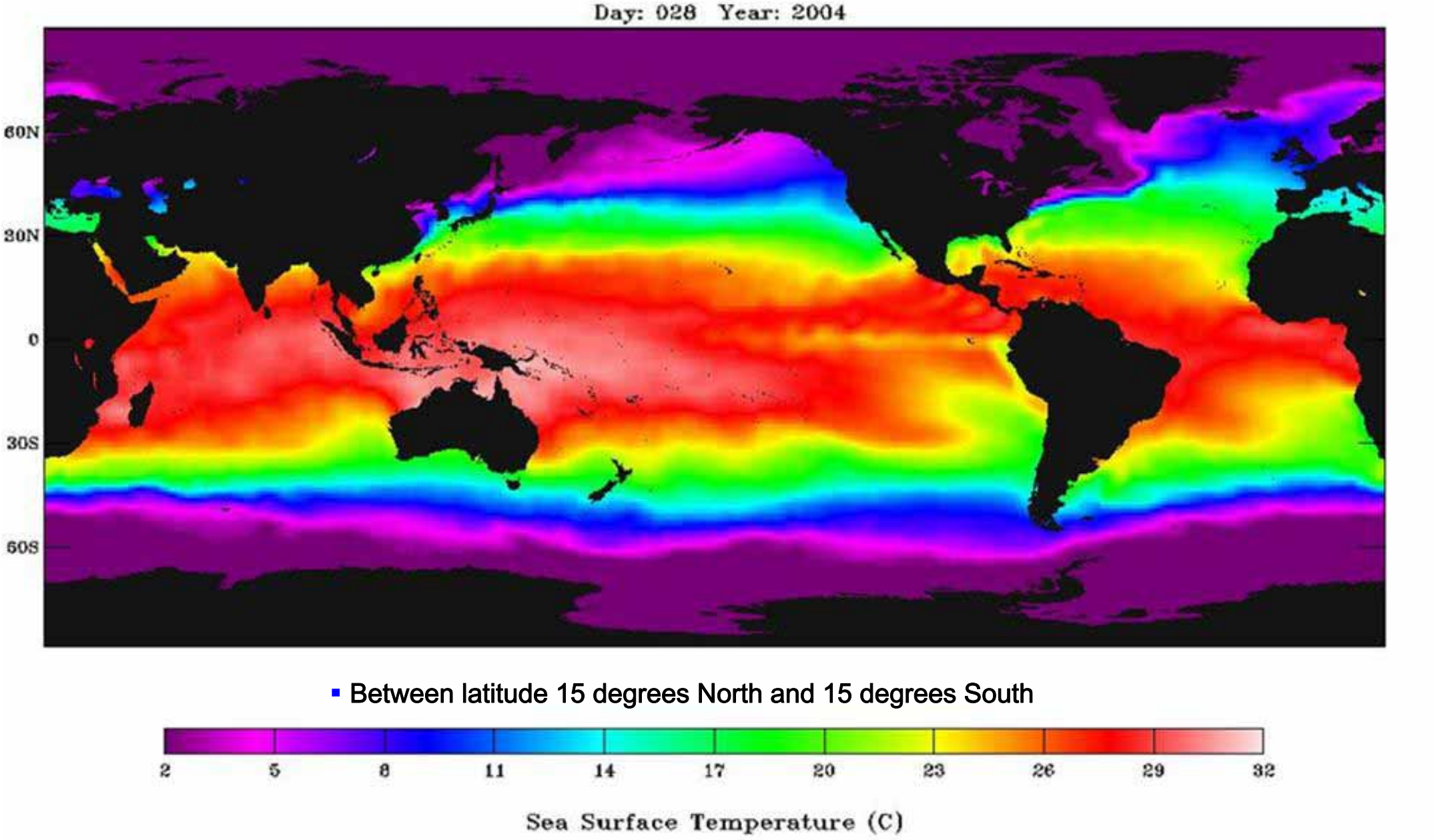
Waters available for Cultivation

- Sea Surface Temperature
  - Source : NASA's Jet Propulsion Institute



- Between latitude 15 degrees North and 15 degrees South

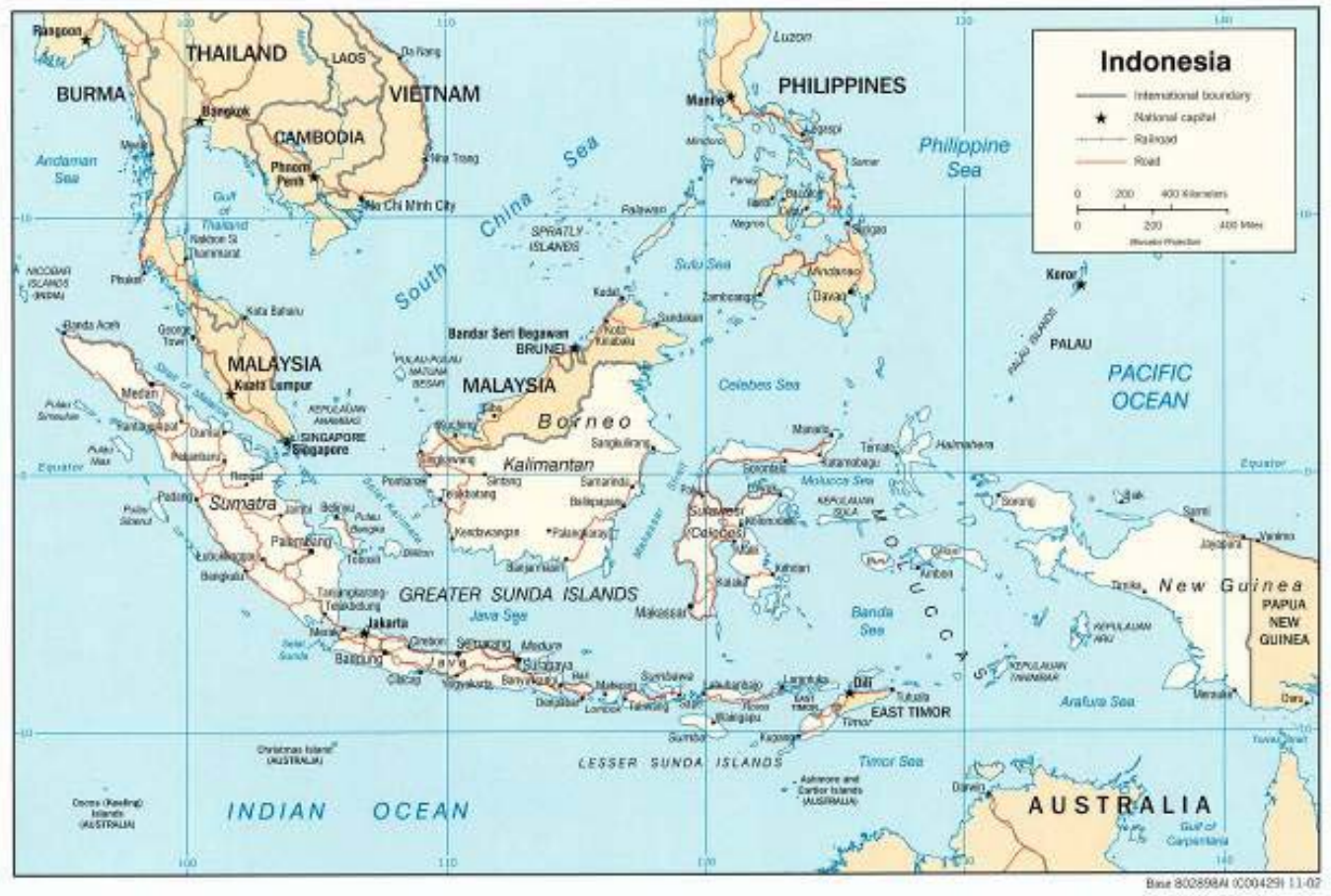
Cost for Cultivation

- Reference on Cultivation Cost
  - Seaweeds currently cultivated on the large scale to meet the industrial demand are :
    Porphyra , Undaria, Laminaria, Gracilaria, Cottonii, etc.
  - There are large differences in the demand and price among nations according to availability of cultivation and application, and the gap between export and local prices is also considerable
  - Labor and material costs are included in the production cost of the cultivation farm, and the materials for cultivation are divided into permanent, semi-permanent and disposal ones
- Production Cost for Seaweeds
  - Top cultivated seaweed genera in the world during 2000 (World Food Plan FAO 2003 Report)

Seaweeds Common names	Scientific names	Production amount ($1 million)	Production weight (ton)	Cost per ton (U.S. $)	Remarks
Green laver	*Porphyra*	1,118	1,011,000	1,105	
Sea mustard	*Undaria*	149	311,105	480	
Laminaria	*Laminaria*	2,811	4,580,000	613	
Gracilaria	*Gracilaria*	11	12,510	879	
Cottonii	*Kappaphycus*	46	628,576	73	Same methods
Total		4,632	5,972,737		

Cultivation in Indonesia

- Bilateral Research Cooperation Contract with organizations in Indonesia since 2006
  - Indonesian National Aquaculture Institute (Sekotong)
  - National Seaweed Center (Gerupuk)



- 12,139,042 ha. (121,390㎢) cultivatable area available (official Indonesian government record)

- National Aquaculture Institute

- Research service contract

Location of the Cultivation site

PEGASUS International

- Lombok Island, Next to Bali in Indonesia

Location of the Cultivation site

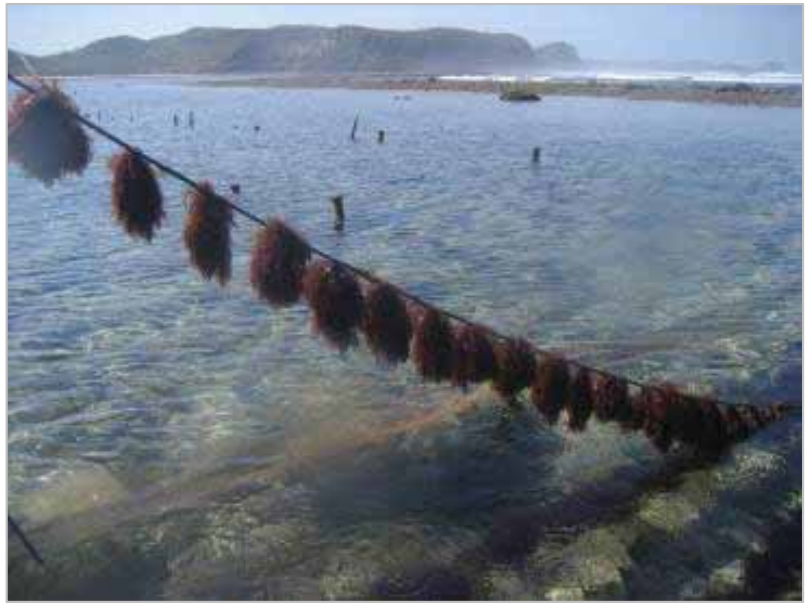
- “Gerupuk,” the south coast of Lombok Island in Indonesia

Location of the Cultivation site

- “Aur-Sombar”, Cultivation Sight on Lombok Island

Pictures of Cultivation Sight #1

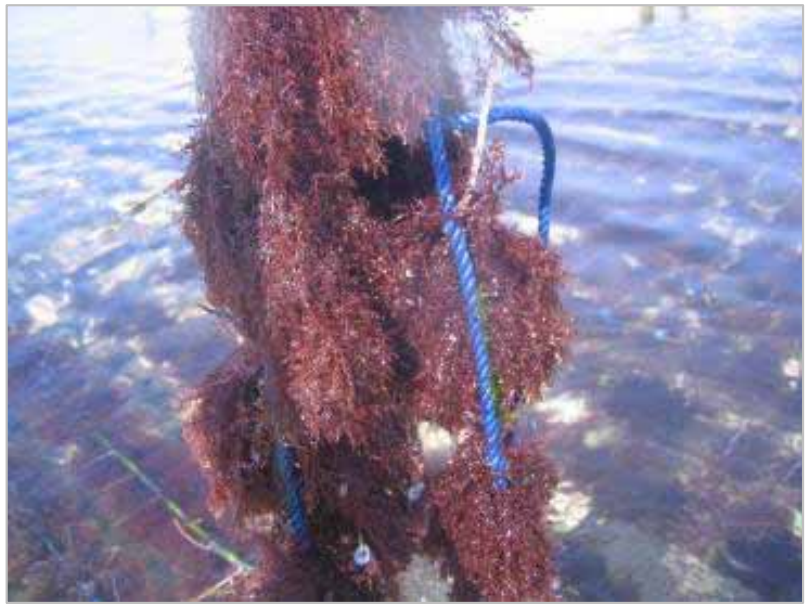
- Actual pictures of *Gelidium* cultivation



Pictures of Cultivation Sight #2

PEGASUS International

- Actual pictures of *Gelidium* cultivation



Preventing the Global Warming

- Contribution to the prevention of the Global Warming by saving forest while producing pulp and paper without cutting down trees
  - Forest, same size as a soccer field, was destroyed every second in 1980s, the peak of deforestation
  - The forest area is still decreasing, and reforestation by humans is not capable of supplying sufficient pulp

Lung of the Earth

- Tropical Rain Forest in Kalimantan(Borneo), Indonesia

32 THURSDAY, JULY 5, 2007 THE WALL STREET JOURNAL.

FROM PAGE ONE

- The Wall Street Journal, 5th July, 2007

Indonesia's drive to combat illegal logging loses ground

Continued from first page

gases behind the U.S. and China, according to a joint British government and World Bank study earlier this year.

Indonesia has long been one of the biggest suppliers of wood to global markets, with some environmental groups estimating an area the size of Belgium being harvested every year, most of it illicitly. Along with Brazil and the Democratic Republic of Congo, Indonesia is one of just a few countries with unexploited rain forests, but it has lost huge swaths of its reserves in the past 30 years.

A U.N. report in February found that all lowland forests on Indonesia's Borneo and Sumatra islands—an important habitat for the endangered orangutan and other animals—could be lost by 2022 at current logging rates of 2.8 million hectares a year.

The World Bank believes the illicit global trade in timber costs governments about $15 billion a year in lost revenue and taxes. Indonesia's government estimates it loses about $4 billion annually.

Realizing the costs, Jakarta in 2001 banned all export of raw logs. After coming to power in 2004, Mr. Yudhoyono tightened the export ban to include all rough-sawn timber. The following year, as part of the crackdown, 1,500 police raiders seized 400,000 cubic meters of timber in Papua, an amount equal to almost 3% of the annual global trade in tropical logs. They also arrested 186 suspected illegal loggers and smugglers.

In 2005, the president vowed to go after the financiers of illegal logging and their protectors in the local government, military and police. Today, only semiprocessed wood can be exported legally.

But, with the crackdown faltering, Mr. Yudhoyono's standing with environmentalists is sinking. Many groups are pushing Western consumers to boycott products made from Indonesian timber. They complain that Jakarta isn't doing enough to save forests from illegal logging and from the legal clearing of land for agriculture and palm-oil plantations. Krystof Obidzinski, of the Indonesia-based Center for International Forestry Research, contends that more than 70% of logs going to Indonesia's timber-processing industry have been illegally felled.

Pressure on Papua's forests, in particular, is likely to increase in coming years, with projects on the drawing board to plant enormous plantations for palm oil, which is used to produce biodiesel. Seeking to exploit the rising global demand for alternative energy, China National Offshore Oil Corp. said in January it was ready to invest $5.5 billion to develop plantations and biodiesel factories in Kalimantan and Papua.

Mr. Yudhoyono's attempts to

Stolen forests

Illegal logging costs Indonesia an estimated $4 billion annually in lost revenue and taxes. On the Indonesian island of Sumatra and in the Indonesian parts of Borneo, 98% of rainforests may be gone in 15 years.

Seized: Illegal logging accounts for almost 75% of Indonesian timber.

Deforestation on Borneo — Forest cover

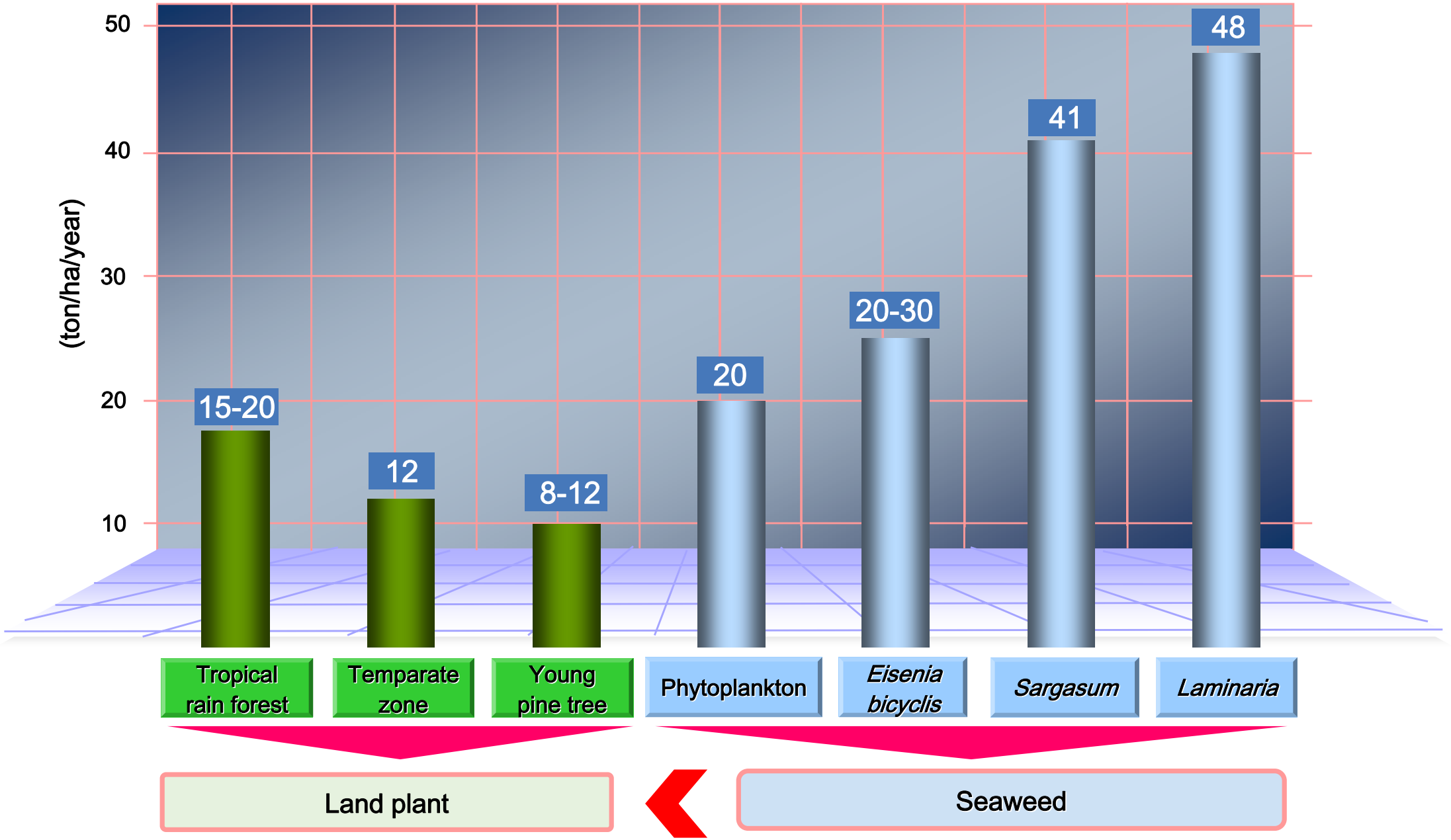
Source: United Nations Environment Program (maps); Tom Wright (photo)

ronmentalists say. Another method is to take the logs to Surabaya, Indonesia's second-largest city, where they are roughly sawed up and hidden in containers for shipping to China and India.

Smugglers often falsely mark the exports as finished wood prod-

wiped out within the next 30 years, environmental group Greenpeace warned in a report in April. The group likened the situation to the demand for high-value mahogany in the 1980s and 1990s, which helped devastate the Amazon basin's rain forests.

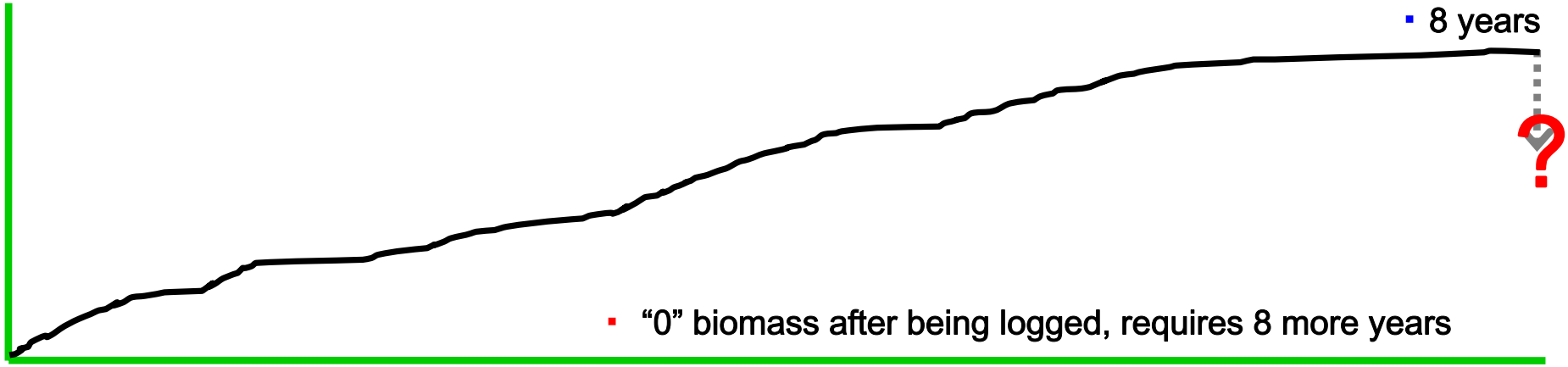
Rate of the CO_2 Absorption



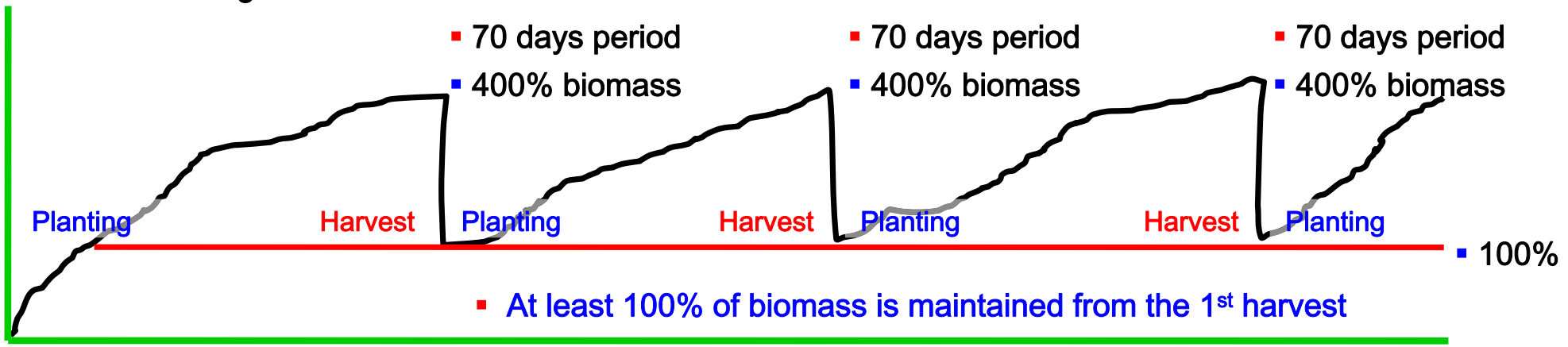
- Source : Dr. Taniguchi (1998), Japan

Concept for the Red Algal CO_2 Sink

- CO_2 sink must be durable & sustainable
  - Reforestation on land Vs. Cultivation of Red Algae on sea
  - A case of Eucalyptus Reforestation



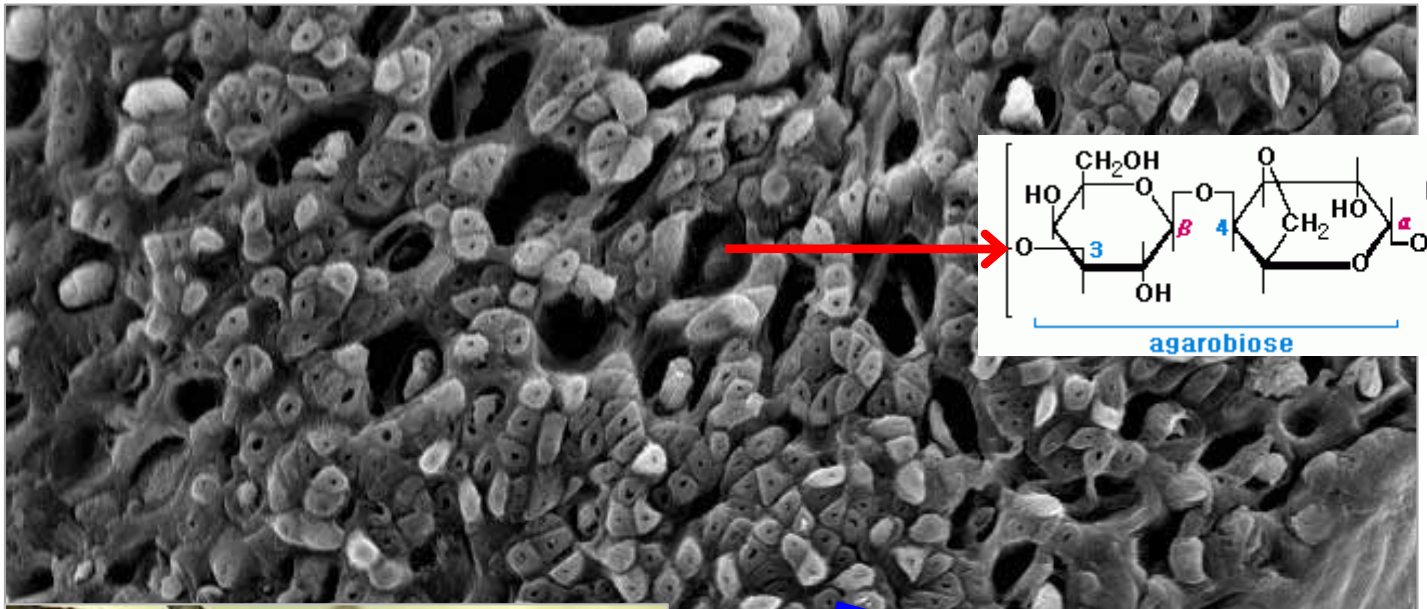
  - A case of Red Algae cultivation

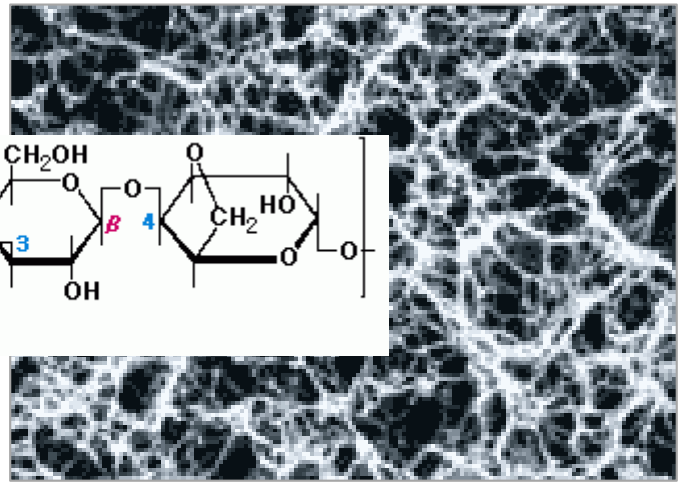


  - A fixed amount of biomass could be maintained in a certain farm size; therefore, the farm was suitable as a CO_2 sink for CDM business

Why Red Algae?

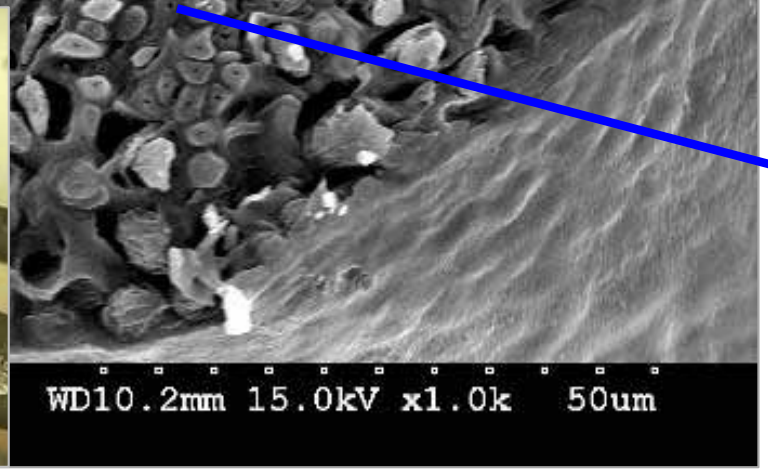
- Red Algae can make Polysaccharide (Galactan), which is similar to “Starch”



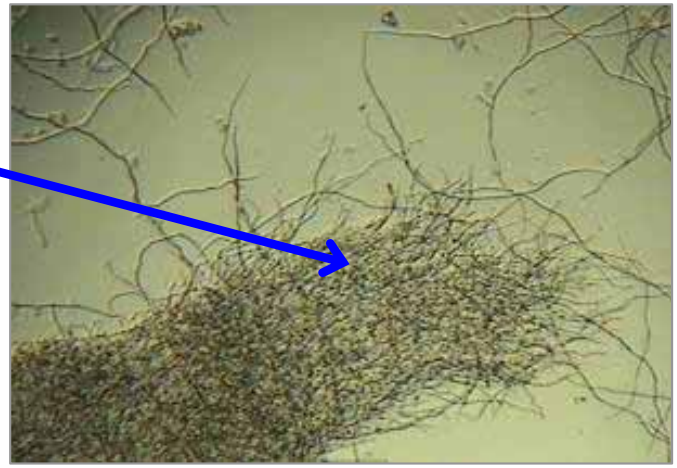


- Agar-agar

- Branch of *Gelidium*



- SEM micrograph of endofiber region



- Endofiber (300X)

Bio-ethanol from Red Algae

PEGASUS International

- Agar is By-product of Pulping process, “Free of Charge” for Red Algae Pulp Maker

Red Algae → Agar Extraction → 1st Bleaching → 2nd Bleaching → Papermaking





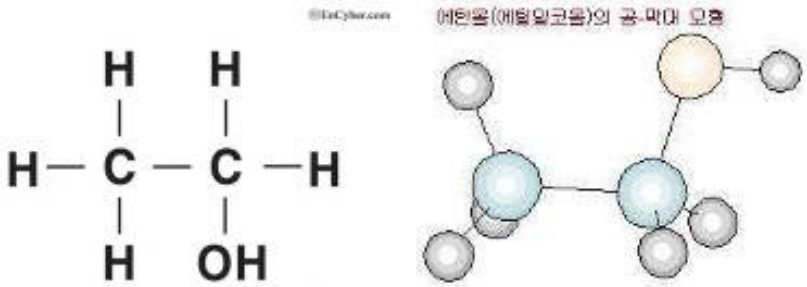
Extracted Agar → Fermentation → Distillation → Bio-ethanol

Saccharification




Bio-ethanol from Red Algae

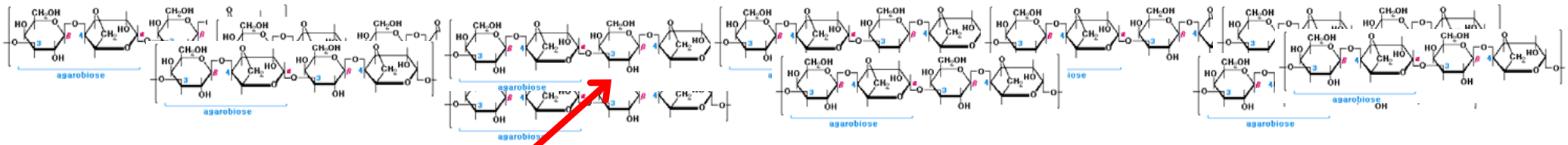
- By-products from Pulp processing can be used to produce Bio-ethanol
  - Ethyl alcohol can be produced by fermenting agar, a by-product delivered in large quantity from Red Algae through hydrostatic pressure processing
- Components of Agar
  - Ferments galactose
  - Is cheaper than corns when mass-cultivated
  - Chromatogram and Analysis from Carbohydrate Research Center, Seh-Jong University

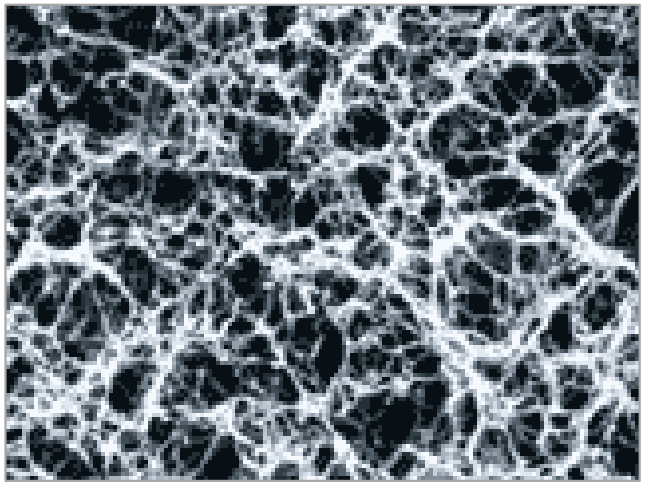


Components	Red Algae Pulp	Extracted Agar	Treatment with Ozone
D-Glucose	28.9 %	3.9 %	4.0 %
D/L-Galactose	65.7 %	93.5 %	67.6 %
D/L-Fucose	5.4 %	1.5 %	24.2 %
D-Xylose	- %	1.2 %	4.3 %

Bio-ethanol from Red Algae

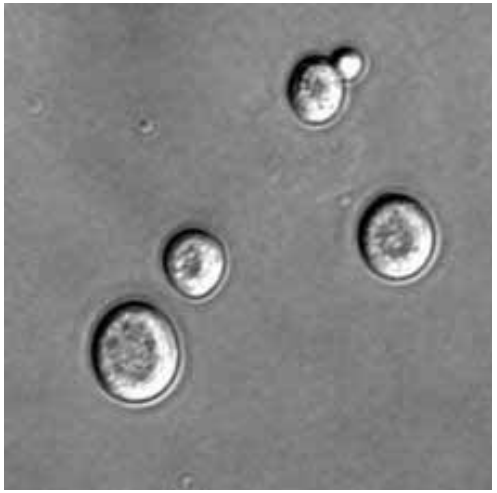
- Agar has strong Chain Structure, so it can make a “Jelly”
  - Chain structure (= Solid agar, Gel)



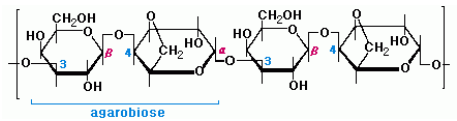


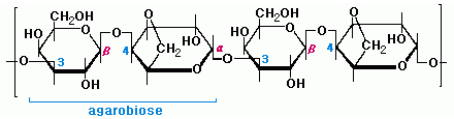
Saccharification

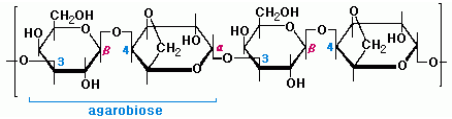
- For fermentation, depolymerization to make reducing sugar is required

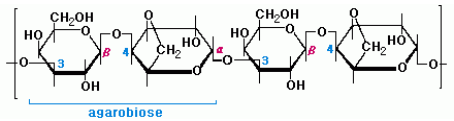


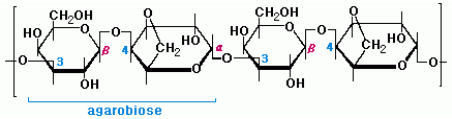
- Yeast
  - Cut chain (= Liquid agar, Sol)











Bio-ethanol from Red Algae

- Energy from Seaweeds, does not use food sources like Corn, Sugarcane


청정 바이오연료?
되레 지구 망칠라
곡물 재배 위해 숲 파괴… 가공 때 화석연료 써 온실가스 더 배출

- U.S.A. Year 2007
- Bio-ethanol for E10 = 24,000,000,000 liter
- Made from Corns = 19,000,000,000 liter
- Imports from Brazil = 5,000,000,000 liter
- Corns for Material = 80,000,000 ton

- The Dong-Ah Daily News, 18th Jan, 2008

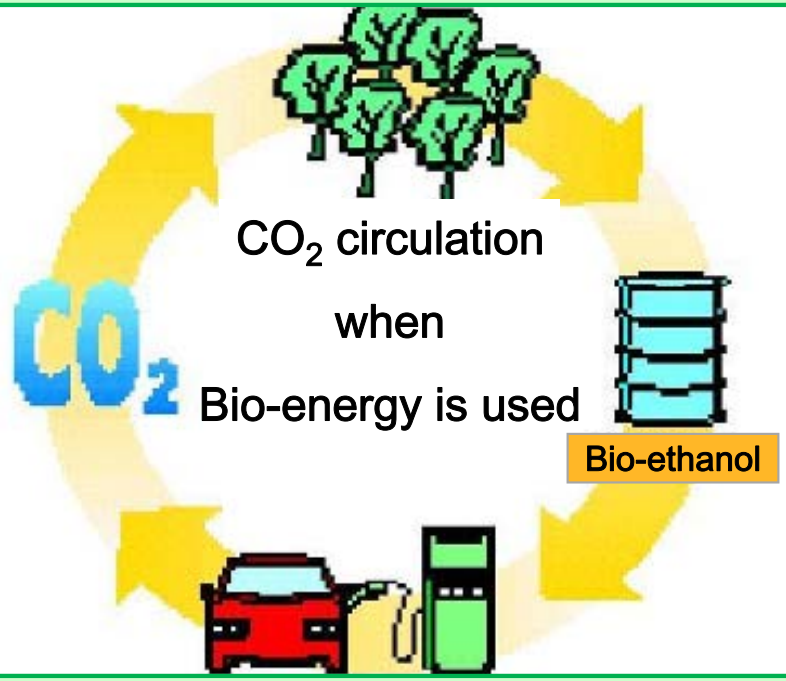
Coping with Weather Change

- Reducing CO_2 by replacing petroleum and coal with bio-energy from by-products

- Fossil fuel such as petroleum and coal
- The absolute quantity of CO_2 increases when burning energy from deposits

- Decrease of CO_2 sink
- Acceleration of the Global Warming
- At the point of no return

- CO_2 is absorbed by plants and stored in their biomass
- An existing CO_2 circulation on Earth



- Protecting forest by replacing wood pulp
- Preventing increase of CO_2 by bio-fuel
- Direct absorption of CO_2 by cultivation of algae