Seaweed industry in asia environmental sciences essay

Between 1984 and 19941995, there were a significant rise, overall 119%, in seaweed production worldwide (Zemke-White and Ohno, 1999) Nowadays, the trend is still booming in both cultivation and commerce. Seaweeds production saw a quite long history in Asian countries, such as China, Japan, and it grows continuously. China produces more than 10 million t (Mt) annually, and is considered as the largest producing place in the world. Its expansion in both cultured area and production volume are ascending steadily. According to Food and Agriculture Organisation, in 2007 its overall mariculture production was responsible for two thirds in the world (Tang et al., 2011) And definitely, seaweed accounted for an important portion. There are quite many enterprises of seaweed industry in China, and several hundred thousand people are working in this field. The main products varies from phycocolloids, chemicals, drugs, food, feed to fertilizer. There are mostly 6 seaweed industries: First of all, there is a so-called ‘ summer sporeling method’ for Laminaria japonica cultivation in large scale, and this industry has become the largest one in seaweed cultivation. Second, the ‘ rock cleaning method’, has given rise to the industry of Porphyra cultivation, which is the second largest in seaweed cultivation with the dry output is 40, 000 t annually. Third, the Undaria cultivation has the entire production reaching 50, 000 t wet weight annually. Fourth, the carrageenan-producing industry is based on Eucheuma denticulatum, Betaphycus gelatinum, Kappaphycus alvarezii. Fifth, there is Gracilaria industry, and the main products are marine feed and agar. The sixth industry is about microalga, and it includes two species: Spirulina and Dunaliella salina (Tseng, 2001)As for the products from seaweed industry, in fact, algin, carrageenan and agar dominate this field. Algin extracted from L. japonica started as an industry in

1960s in China and currently it has become one of the largest industry in the world, with annual output is 13, 000 t. Carrageenan in China is mainly produced from raw materials of KappaphycusandEucheuma, and 60% of the carrageenan, 2500 t, is exported. The raw material of agar Gelidium amansii is mainly obtained from Qingdao. Furthermore, seaweeds are desirable resources for iodine and anthelminthics. The latter are recommended for children infected with intestinal worms. Lastly, seaweeds also present in food industry, e. g. Spirulina processed in the form of tablet is accepted as healthy food (Tseng, 2001). On top of all, seaweed may bring a wave in fashion, since it beats cotton in some properties and probably is adopted in clothing industry (News, 2013). According to the various seaweed industries in China, we can conclude it would keep flourishing in the following decades. A former director of the Department of Fisheries, Malakai Tuiloa, and is a partner of Wee Kong Marine Products and Exporters Company Limited said: " China knows about seaweed cultivation and currently the demand is 5000 tonnes per month and Fiji is only able to supply 20 tonnes per month, with Ono-i- Lau being the largest supplier, producing 10 tonnes per month'' (TAWAKE, 2013). In Korea, there is a promising market for Sargassum fulvellum that has a wide distribution on the southeast coast of Korea. The retail price of edible S. fulvellum in local market is $ 2. 3–3. 8 kg per fresh wt. The demand for this type of seaweed is expected to increase in the future (Hwang et al., 2007). In Japan, seaweed products have experienced a long history, some of which are kept today. For instance, hoshi-nori made from Porphyra becomes prevalent across Japan. Currently there are more than 200 seaweed products that are marketable. Apart from hoshi-nori , there are appealing profitable markets of nori goods. They are roasted laver, seasoned

laver and laver boiled down in soy sauce, which are exported mainly to USA, Canada, Australia, Taiwan, and the exported amount made huge profit, with the business turnover gaining amount to 30 x 109 yen in 1984. Furthermore, laver jam, cheese nori, soup and wine made from Porphyra already cam in market (Nisizawa et al., 1987). Besides, seaweed industry in India, Malaysia is booming as well. In summary, the economic potential of seaweed in Asia is expected to be promising and attractive.

4. 4. The biofuel consumption and potential market in Norway

The biofuel consumption market in Norway included bioethanol and biodiesel that are usually sold through retail service stations and wholesalers. All currency conversions used in the creation have been calculated using constant 2011 average annual exchange rates. The total annual income from biofuel consumption market was $339. 5 million in 2011, corresponding with a compound annual growth rate (CAGR) of 61. 5% from 2007 to 2011. There was a significant increasing in a CAGR of 50. 9% from 2007 to 2011 in market consumption sizes, climbing from 0. 68 to 2. 6 thousand barrels per day (Table 4. 4. 1). It is estimated that the performance of the market can slow down, with a forecast of CAGR of 14. 3% for the five-year period 2011 - 2016, corresponding to a value of $662. 3 million by the end of 2016 (https://www. marketresearch. com/, 2013, March 20). From the data that was given on https://www. marketresearch. com/ (2013, March 20), it means that the potential market for biofuel in Norway is very promising and well-developed in the near future.

Table 4. 4. 1: Biofuel Consumption in Norway (thousand barrels per day) from (http://community. junar. com, 2013, March 20)

2007

2008

2009

2010

2011

Norway

0. 681. 882. 22. 72. 6

4. 5. The biofuel consumption and potential market in United States, Europe and China

Generally, the biofuel consumption market, included bioethanol and biodiesel, in the U. S, Europe and China have been increasing from 2007 to 2011. All currency conversions used in the creation have been calculated using constant 2011 average annual exchange rates. In fact, total revenue of biofuel consumption market in USA, Europe and China was $62, 221. 6 million, $29, 578. 4 million and $2, 542. 8 million in 2011 respectively, corresponding to compound annual growth rate (CAGR) of 15. 4%, 21. 9% and 27. 2%, respectively between 2007 and 2011. There was a remarkable growth in market consumption volume in USA, Europe and China from 2007 to 2011, rising by about 426. 3, 129. 5, 14. 3 thousand barrels per day (Table 4. 5. 1) (https://www. marketresearch. com/, 2013, March 20). According to the statistic and analysis from Administration (2013, March 20), the anticipated value for the market in USA, Europe and China is about $3, 602.

8 million, $56, 374. 7 million and $3, 602. 8 million by the end of 2016. Clearly, the potential market for biofuel consumption in USA, Europe and China is very prospective and stable in the near future.

Table 4. 5. 1: Biofuel Consumption in USA, Europe and China (thousand barrels per day) from (Administration, 2013, March 20)

20072008200920102011

United States

472. 5271650. 4776741. 1669855. 9252898. 8904

Europe

173. 386238. 18292. 545331. 215343. 843

China

30. 739. 4434345

4. 6. Short conclusion of the plan

Aquaculture fish farming is the third biggest export in Norway and if the nutrient waste (nitrogen and phosphorous) from the aquaculture fish farming release into the environment, it will probably not only cause some negative effects on the marine habitat but also result in a disaster of pollution or contamination of the fish cage farming industry in Norway. It can strongly affect to the sustainable development of the fish farming industry. However, if the integrated multi trophic aquaculture system (IMTA) has been used to exploit fish waste as a food resource for extractive and filter feeding species (e. g. shellfish and seaweed) at lower trophic levels, it will not only solve the

environmental problem but also adding an extra value to the fish cage aquaculture industry. It will lead to the sustainable development of fish farming industry in Norway. Moreover, the consumption market of the biofuel in Norway particularly and in the world generally is very developing and promising, so it can be ensured that there will be a huge profitable potential market for bioethanol produced from seaweed. Moreover, according to the calculation mentioned above, it can be concluded that the project can be feasible in both short term and long term consideration due to the net profit (nearly 68 million NOK per year) and ROI% (25. 23%). It can also be concluded that although the net profit achieved from bioethanol produced from seaweed can be small, the " real" profit of the cultivation seaweed together with fish farm is probably very enormous and long-lasting. In short, cultivation of seaweed integrated with fish farming cage will lead to the three main benefits namely the extra profit from bioethanol production from seaweed, outstanding environmental effect of seaweed supplying to fish farm, and the sustainable development of the fish farm industry.

V. Conclusion

5. 1. Advantages and Bright Future

With urgent issues arising from fossil fuels such as greenhouse effect, extreme weathers, acid rain and from first and second generation biofuels such as competition for arable land and fresh water, usage of fertilizer and herbicide, effects on commodity price, humans are keen on find new-generation biofuels. However, in comparison, seaweed has many advantages: capable of CO2 sequestration, abundant in fatty acid, has biofiltration in eutrophication and contaminated water, grows fast without

pesticide, herbicide, fertilizer, not compete for arable land and fresh water, the residual biomass can be used as feed, contains easily hydrolysable sugars and polysaccharides composed of glucose, lacks lignin and has low cellulose content, which makes it easier to be biodegraded than land plant,. etc.. Besides, we can control the chemical composition of seaweed by altering the growth environment, making it rich in chemical components of interest. Therefore, seaweeds are recognised as the third-generation biofuel. In terms of methodology, the production process already exists, which includes harvesting, pretreatment, saccharification & fermentation, purification. Moreover, scientists have engineered E. coli. to convert seaweed sugar into ethanol more efficiently and effectively, which is expected to be applied in commerce scale in the coming five years. Currently, mass production of seaweeds can be seen in many countries, such as France, Norway, Ireland, China, Japan, Korea, India, US, etc. Subsequently, there is a huge potential market for seaweeds industry. Most importantly, given the fact that the ocean area accounts for 70% of the earth, exploitation of seaweeds is, undeniably, a promising strategy to solve the problem of increasing demand of energy and simultaneously preserve our environment.

5. 2. Social relevance

The social benefits from seaweed industry is profound. Initially, it creates a large market that could promote the economy growth regionally or internationally and provide a multitude of employment opportunities, which can benefit developing countries most. Moreover, it can help solve the problem of human dependency on fossil fuels, since seaweed has an increadible profile of biofuel production that is eco-friendly. In addition,

seaweed has a function of preserving environment, which can be illustrated by carbon dioxide assimilation, biofiltration, maintaining biodiversity, etc. This means that seaweed is desirable for human being’s sustainable development.