

## CHAPTER 8

### CONCLUSIONS

Crude palm oil mills generate many by-products and wastewater, which may have a significant impact on the environment if they are not managed properly. Experiences from the five case studies, conclusions can be made to improve the existing environmental management in Thailand. Firstly, Cleaner Production and industrial ecosystem approach for crude palm oil industry, based on reuse, recycling, and utilization of solids and liquid waste and appropriate energy management, can achieve the goal of almost zero discharge of pollutants (against an acceptable costs). Such an approach can transform the palm oil mill in an environmental friendly industry. Secondly, the network analysis has made a clear understanding that there are several barriers and opportunities to implement the proposed a model of an almost zero waste industrial ecosystem of crude palm oil industry in Thailand. It also shows that the principal actor who stimulates firms to improve their environmental performance are the policy networks and societal networks, while the economic networks are play minor role in environmental reform. Finally, to move Thai crude palm oil industry more sustainable, the possibilities improvement options for greening the industry can be introduced:

#### **8.1 Technological Improvement for Environmental performance of Crude Palm Oil Industry**

Currently, resource recycling and recovery is the highest concern of industry. The crude palm oil industry is developing a number of industrial eco-system practices for waste recycling. This case study shows that approaching a zero waste industrial ecosystem needs the combination and integration of various clean technologies and waste exchange. Clean technology and waste exchange prove valuable elements for developing the zero waste industrial ecosystem models for crude palm oil mill both that situated closed to community and sitting in plantation area. The proposed possible solutions for these problems based on recent research are used as foundation for further development of a physical-technological model of an almost zero waste industrial ecosystem for the palm oil industry. The model consists of crude palm oil factory, other types of industries and agricultural sector. Various options are:

- Some by-product such as fibers and shells are already reused/ recycled however the other alternative options that may have potential as a more value added product such as using shell as raw material for activated carbon, fiber for briquette.
- Waste such as decanter sludge can be selling to feed mill after drying by reuse excess steam as a heat source.
- Biogas recovered from palm oil mill effluent can be reuse as fuel in boiler or gas turbines to generate electricity which can be reuse in factory or sold to the grid.
- Empty fruit bunch after reuse as mushroom cultivation media still contains high fertilize value and use as fertilizer in oil palm plantation area.

- Treated wastewater and bottom sediment from anaerobic pond can be reuse for irrigation.

## **8.2 Barriers and opportunity for Clean Technology Implementation and Waste Exchange in Thai CPO Industry**

### **Barriers**

The principle actors of cleaner production are the factories, which operate the production process. Their operations are influenced strongly by politics and policy-makers, their economic actors, and society actors. Result from triad network analysis, it can be identified the barriers for the adoption of cleaner production within Thailand. The most important barriers are policy barriers. The political structure does not support clean technology adoption in the factory. At provincial level, the enforcement mechanism suffers from inadequate staff and weak monitoring on environmental aspect. Local authority is not authorized to monitor and enforce factories to improve their environment performance. The command and control does not give incentive to companies to invest in environmental technologies or to go beyond compliance. There is no government unit to support the research and technological information to develop the palm oil industries, especially the plantation system.

For technical barriers, the internal actors especially the policy maker and employee (human factor) are the important barriers for application of clean technology. These refer to lack of know-how and access to information, lack of willingness to change the technique and lack of knowledgeable personnel.

### **Opportunity**

The ninth National Economic and Social Development Plan (2000-2006) stated on promotion and R&D of renewable energy. The government policy is to develop biodiesel as an alternative fuel for automobiles. Consequently, a Committee of the Agricultural and Energy Ministries implement the government policy on biodiesel development by expanding at least 10 million rai of land to grow oil palm in order to develop biodiesel as an alternative.

## **8.3 Strategy towards Better Environmental Management in the CPO Industry**

To achieved the policy and at the same time move CPO industry more sustainable, Strategy are developed:

### **8.3.1 Economic network**

- The Crude Palm Oil Association should be strengthening and involved in national palm oil policy planning and supported by collecting fee from mills. The association should collect cess from the millers on the basis of every tonne of crude palm oil production. Government should support the association by have representative from DIW, MOAC and Ministry of Energy. This association should been tasked with the long-term growth and

development of the Thai palm oil industry including the planter. There should be center for cooperate between oil palm growers and millers for decreasing raw material price and fertilizer cost. The association is center of information on clean technology and waste exchange and also center of training and seminar on technology development for mills.

- Strengthening the relationship between the industry and research institute/ university in doing research on clean technology and waste exchange.

### 8.3.2 Policy network

- There should be a government establishment (Thai Palm Oil Institute, TPOI) to take care of CPO industry development. This governmental unit should be formed by representatives from the Ministry of Energy, MOInd, MNRE, MOAC, Crude Palm Oil Association, Oil Palm Planter Association and university. TPOI can be sustained by the income from the biodiesel on the basis of every liter of biodiesel selling or emission charge for wastewater discharge from crude palm oil industry. TPOI should undertake comprehensive R&D activity and Focal areas of research are new planting materials for higher crop yields, clean and green technologies to produce better quality and processed palm oil and its products. In line with the need to preserve a clean environment as well as to achieve a vision of an almost zero-waste strategy in the Thai palm oil industry, R&D activities are also focused on the use of oil palm biomass such as EFB, fiber, sludge, front and trunk. R&D in the downstream activities should emphasis on the development of higher value-added palm-based products.
- The Ministry of Agricultural and Cooperation should do more research on waste recycle in plantation area and provide the information on recycle and benefit of such wastes to farmers. Especially the use of compost produced from palm oil sludge, ash and partially treated wastewater instead of chemical compose which will reduce the compose importation. Ministry of Agricultural and Cooperation and TPOI should provide grants of research in waste demonstration project to academic institution for research and publication.
- TPOI cooperate with DIW should provide firms with suggestion in technical and management solution on waste treatment ,reused / recycle of waste and promote waste exchange center as same as from the successful countries in industrial waste minimization. There should be a waste exchange center under DIW control and set up demonstration project for recycler to have know – how and benefit of by product / waste of COP industry. The objectives of the organization are as following:
  - Database on waste generating.
  - Research on waste reuse and recycling.
  - Providing data on waste exchange and industrial ecology including reuse and recycle of waste.
  - Training workshop.

- Research and development machine and equipment in production process including machine for produce value-added product from waste/ by-product.

Local institutions such as university, research institute and private company can play role in training, applying research, academic studies and dissemination of information. Successful utilization of by-product / waste demonstration project will convince producer and waste recycler to know the significant of using more by-product / waste.

- Local authority takes action on monitoring and enforcement of palm oil mill. The enforcement of the regulatory power should be developed. The officers need educational improvement to increase their knowledge of environmental enforcement jobs, clean technology, and industrial ecology application.

### **8.3.3 Policy on Palm Oil Industry**

- Government should encourage miller or planter to investment in downstream and involved in refining, oleochemical production and other value-added products by providing soft-loan and processing/production technology to investors.
- Government should stress at the policy of the cooperation of each planters as oil palm cooperative by local agency such as provincial agricultural agency, a cooperative planter and support high palm gardening to reduce capital cost.
- Application use of market-based instrument. Economic instrument used in Thailand emphasis on tax reduction, low-interest loans for investment in pollution control project. Pollution charge (PPP) should apply on the emission charge on wastewater and air emission should be include in this law. Economic instrument used in Thailand should emphasis on emission charge on wastewater and air emission. Fee from such emission charge should fund for R&D of TPOI and TPOA.