Green Packaging: Total Integrated Waste Management

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ABSTRACT

Currently, there are green packaging products which are made by the latest innovation of bioplastics, particularly the compostable bioplastics can solve either the global warming problem or natural resource conservation. Two types of bioplastics, compostable bioplastics and non compostable bioplastics are introduced in details. The mentioned products have to be certified under worldwide standard. Recently, the Thai Industrial Standard 17088-2555, specification for compostable plastics has been established.

The waste management of two types of plastic bags, the conventional and compostable bioplastics, shall be described in systematic integration way for six players as the socalled "ALL-WIN Model". Six different sectors do play important role on waste management integrated system i.e. Bioplastics Resin Industry, End Users, Consumers, Municipal, Recycle plants and The Government. As a result with good practice and discipline from every player, this integration work will surely lead to good future for our next generation with good & safety environment and natural resource sustainability.

Key words : Green Packaging, Bioplastics, Compostable, ALL-WIN Model.

INTRODUCTION

Nowadays, the phrase "stop global warming" is oftenly used which refer to the environmental conservation by reducing the emission of Green House Gas (GHG) and "going green" which refers to the world's natural resources conservation through sustainable consumption. In doing so, the international **3R**'s rule must be followed: **R**educe (use raw material as least as possible), **R**euse (use the product again and again) and **R**ecycle (convert used materials into new product).

In logistics and supply chain management, the words "green logistics" and "green packaging" are also used. Big corporations that focus particularly on their images will have such policy to show their environmental and social responsibilities.

From the above reasons, utilizing compostable bioplastics have been taken into account in relation to environmental and social responsibility. The conventional plastic shopping bags used in every hypermarket, supermarket, shop, and convenient store are researched and found that the free-of-charge, give away bags are disposable, used only one time then thrown away. This is resulting of environment pollution as users are not well-managed or good discipline. The normal plastic bag

made by petroleum is more durable and cannot be degraded. So, it will remain unchanged and cause pollution to the environment.

The compostable bioplastics bag can be utilized correctly to solve the environmental problem. It is suitable for packing oilly food or organic waste, and then they all will be compostable into biomass or so called compost and become organic fertilizer later. On the contrary, conventional plastic bags cannot be clean up and be recycled economically. It will be too costly to wash and clean. Then it is usually destroyed by incineration which triggers pollution by emitting carbon dioxide or GHG which is also problem to the global warming and people's health.

Therefore, these bioplastics not only provide carbon credit value but also can provide compost, which is used for planting. Plants use carbon dioxide generated from the compost in the photosynthesis process, which converts carbon dioxide into oxygen and releases it back to the atmosphere.

Consequently, business entrepreneurs and organizations are trying to response to the society. Besides general activities, they have to make an effort on special activities in order to increase their competitiveness. The concern now is, how to protect environment which is much damaged by human. This study will focus only on reducing the global warming and the natural resources sustainability.

BIOPLASTICS DEVELOPMENT [1]

In the past 15 years, many western countries have attempted to produce degradable plastics that are made from petroleum by mixing in corn starch. But there were many problems with such method, so it was suspended. Instead of helping to reduce waste, it created difficulties in managing small plastic debris that cannot be degraded at the same time as the corn starch.

Since then there has been an attempt to find a new method that can break down all components by using additives to expedite the degradation process of the microorganism. The degradation of the plastics that are mixed with an additive relies on the sunlight; however, the degrading process is still not entirely effective because it solely depends on the sunlight. If the waste materials are buried underground, it will not decay. Such method is known as "photodegradation," which is suitable for developing countries that use solid waste disposal by landfill. It's done by leaving the waste on the ground; therefore, plastic waste that is on the outside of the pile will disintegrate. And it may look as if it has degraded completely while it's actually still not being decomposed. If those remainders are consumed by human or animals and there's an excessive amount of toxins left in their bodies, it could be harmful.

Consequently, there has been continuous development to improve the method so that it doesn't rely on the sun. In this method, additives with heavy metal are used to speed up the process under a high temperature and with enough oxygen or "oxodegradation," in which plastics can break down

and eventually completely disintegrated by microorganism; the process is called "biodegradation." However, the method is still far from perfect because there are still traces of toxins that are harmful to living things.

At present, there is an advance method in which heavy metals are not used as an additive to speed up the chemical reactions. Figure 1 shows a comparison of the degradation process for conventional plastics and those mixed with additives.

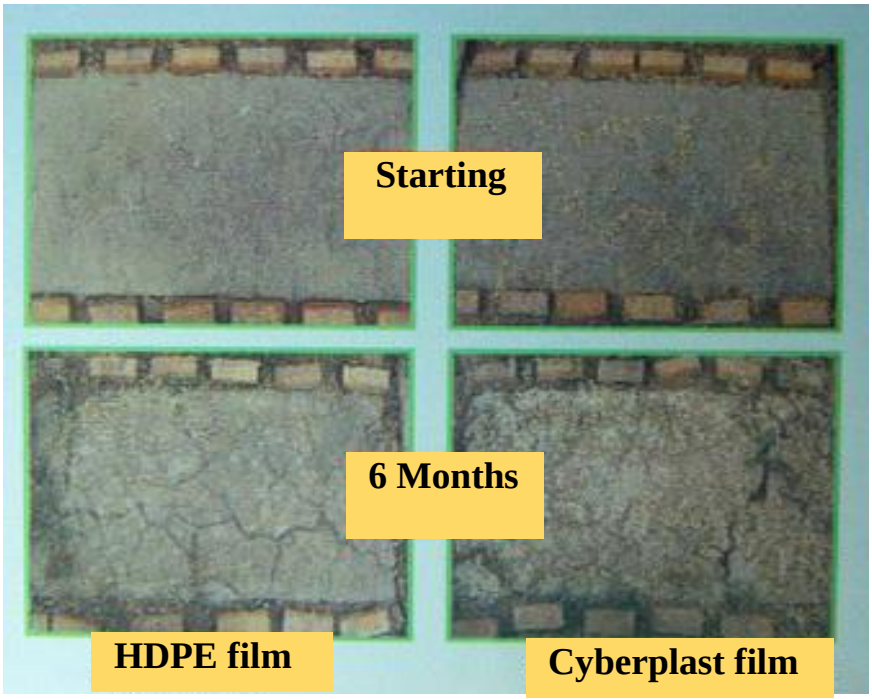

Figure 1 : Degradation of HDPE film and Cyberplast film

However, there is still being a problem. If the remaining components are consumed before they are completely degraded, they can be harmful to living things. Thus, for safety, the method in which waste materials are buried and sealed tightly is introduced to make sure that there's no harmful residue left in the environment. This method is allowed to use and is suitable for large countries with huge size of land such as the United States, Canada, Australia, and China; however, it doesn't help reduce global warming effects because GHG comprised of carbon dioxide (CO_2) and methane (CH_4) etc. are still emitted to the atmosphere.

Currently, there are Green Packaging products which are made by the latest innovation of bioplastics, particularly the compostable bioplastics. They can solve either the global warming problem or natural resource conservation. Moreover, they are also the final product of plants which can replace substantial specific usage of conventional plastics made by petroleum that is going to

be insufficient from national resource. The life cycle of compostable bioplastics so called as "Cradle to Grave" is shown in Figure 2.

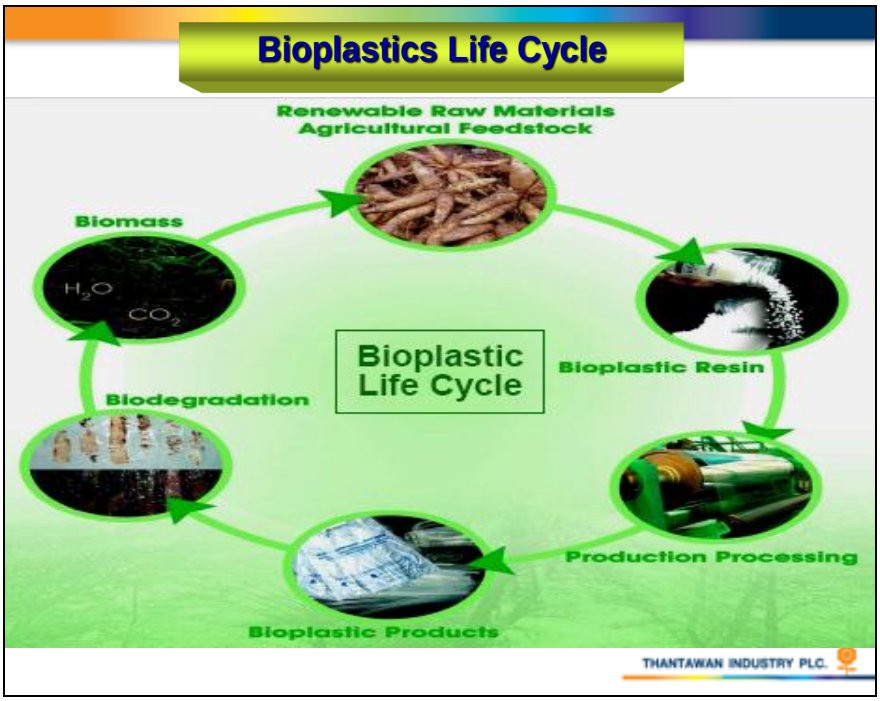

Figure 2 : Bioplastics Life Cycle

There should be a good understanding of different types bioplastic products, including the compostable and the non-compostable ones as shown in Table 1.

Table 1 : Different types of Bioplastics

Bioplastics			
Compostable		**Noncompostable**	
Petro-based	**Bio-based**	**Bio-based**	**Bio-based**
		Compound	**Green plastics**
PBS **PBSA** **PBAT** **PCL** **etc.**	**PLA** **PHA** **PHB** **etc.**	**PHOTO** **OXO** **BIO**	**LDPE** **HDPE** **etc.**

In general there are two types of bioplastics [2] [3], i.e. compostable bioplastics and non compostable bioplastics and will be described as follows :-

Compostable bioplastics are made from plants conceptually or reluctantly from petroleum that can be converted into many packaging products same as regular plastics. But the most important feature is compostable through the process of biodegradability and compostability , in which carbon dioxide (CO_2)and compost are given respectively. For CO_2 will go back to the air for plant using in photosynthesis, and compost will be developed to fertile soil for plant growth processes.

Non compostable bioplastics are only made from plants, which are renewable as substituting resource**.** They have the same polymer structure and durability as the regularly conventional plastics but cannot be compostable into biomass or compost. They are called "Green Plastics" which have a lot of benefits because they help in natural conservation on oil resources, and low carbon dioxide emission in the production process as comparing to that of the conventional plastics. Since the fermentation process for green plastics do not require a lot of energy, therefore, there is an energy consumption difference, so called carbon credit.

The above information does not only offer a good understanding of the classification of bioplastics, but also helps to understand the differences of the biodegradability and the compostability processes more clearly, as summarized in Figure 4.

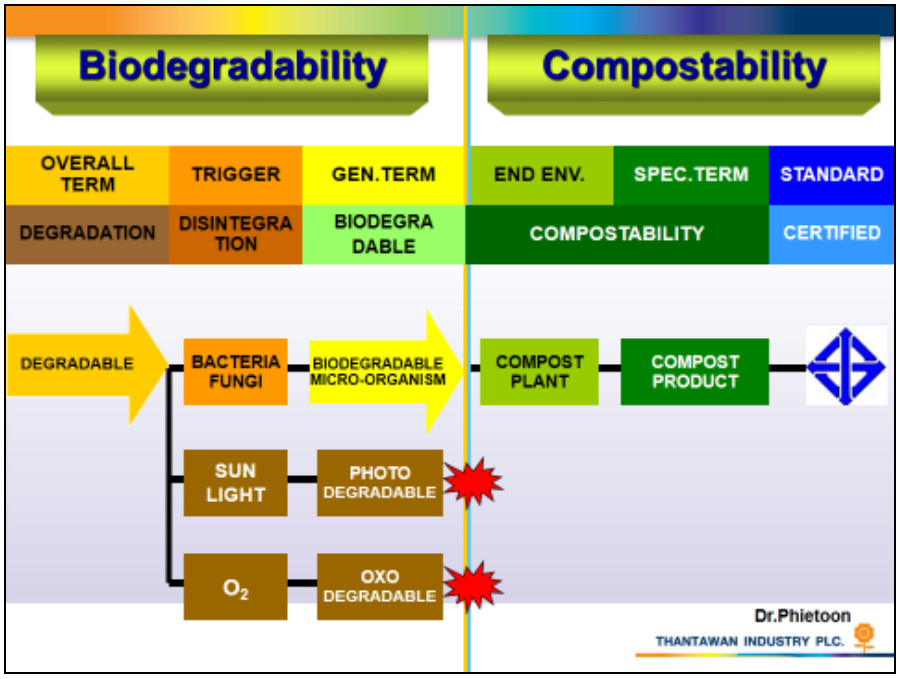

Figure 4 : Comparison of the Biodegradability and Compostability

The data in Figure 4 can be summarized as follows: **"**The compostable plastics undergo the biodegradation process first, then completed at the composting process." Plastics that are made by using additives to speed up the break-down process will end at this point and cannot decompose

further because they are non-composable." In other words, plastics that are biodegradable do not need to be compostable but those that are compostable must be biodegradable.

BIOPLASTIC STANDARD

At this point, the difference between the terms bioplastics, compostable bioplastics, and biodegradable plastics should be understandable clearly.

These bioplastics have an impact on nature and the environmental balance. In order to manage and eliminate plastic waste efficiently and resourcefully, it is important to have a good understand of the meaning and the standard of practice.

Therefore, a standard for compostable plastics has been established [4] [5], on a global level, because it is a flawless innovation and the answer to environmental conservation as well as it will not emit GHG excess to the atmosphere. It is called "Standard Specification for Compostable Plastics," which is adopted by organizations in Europe, the United States, Japan, Australia, etc. and is being developed to become a global standard or ISO 17088 in the future. In Thailand, an ISO-based standard is adopted and will soon be implemented to show the country's ability in meeting the world standard as the total value of the country's exporting goods is higher than 65 percent of the GDP.

Consequently, these mentioned products are certified under worldwide standard as shown in Figure 5, while the conventional plastics are not certified due to uncompliance with the above specific qualifications. Recently, the Thai Industrial Standard 17088-2555, specification for compostable plastics has been published and will be extended to each individual product standard in the near future. [6]

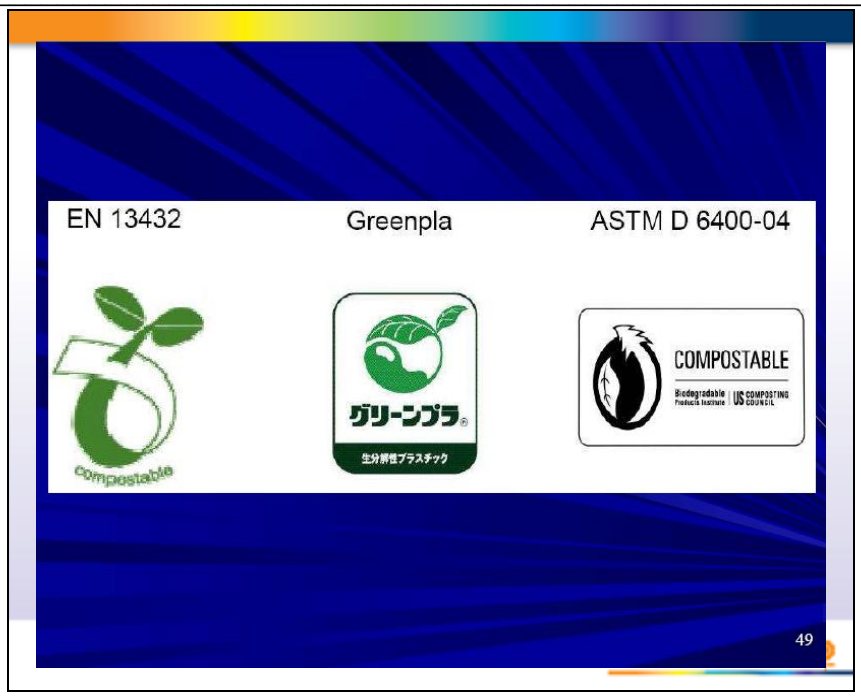

Figure 5 International Compostable Certified Logo

BIOPLASTICS MARKETING

Limitations and obstacles in marketing of compostable plastic can be listed as follows :

1. It is an innovative product that has not yet been used widely.

2. Its price is three times as high as a regular plastic, but if there is more demand price should be lower.
3. There is still a small supply in the market because it is an emerging market, and consumers do not have enough knowledge or good understanding about it.

The marketing trend today should not only focus on quality and design but also corporate social and environment responsibility (CSER); compostable bioplastic products will serve such purpose perfectly. Developed countries that give high importance to compostable bioresins include the European Union nations and Japan. For the United States and Australia, biodegradable plastics are still being used because they are large countries and can still use solid waste disposal by sealed landfill. Therefore, additives for oxobiodegradation are still allowed as long as there are no heavy metal and the bury site is securely closed.

Thailand is a biomass resource country that produces a lot of agricultural products. More than 50% of the garbage in landfill is wet garbage; therefore, it is suitable for waste separation method discussed earlier by using compostable bioplastic bags, especially for food packaging.

Encouraging more bioplastic productions from cassava will benefit farmers economically. When being a surplus, also the price will not be affected. It seems freezing potatoes by converting them

into polymers for exporting. In the future, it is predicted that there will be more demand of cassava because there is still a big market for them. The overall production of bioplastics in global market is only 1: 1,000 of regular plastics. [7]

GREEN REVERSE LOGISTICS [8]

The Reverse Logistics can be direct and indirect in reclaiming the after used products which is either responsible to take back by the product makers or the third parties, the municipal respectively. Consequently, the latter type will be discussed on the basis that is how to protect the environment namely, "Green Reverse Logistics".

Both the bioplastics and conventional plastics, when being used and well-managed with discipline, can reduce the global warming and reduce the importation of chemical fertilizer; and the trade balance of the country which could be done by, for instance, influencing the reuse of plastic bags which are made by either bioplastics or conventional plastics, instead of the non-reusable or give away bags which can contaminate the environment.

After the bags have been used for many times, especially the compostable bioplastic ones, they can be reused to pack organic or food waste. Whereas the normal plastic bags, they can be reused for packing dry waste, then they will be transferred to recycle plant, In this way, it will provide add value to the recycle waste as it will be cleaner and no need to be burned which will lead to pollute the air by GHG and result the illness and global warming. [9]

Meanwhile, the normal plastics bag must not be allowed in packing food containing fat or organic waste. Because as we burn the oilly bags, the GHG shall be released. On the other hand, the normal plastics bag must be used to pack dry waste then it can also be recycled cleanly. Base on the above information, the waste management of two types of plastic bags, the conventional and compostable plastics, shall be fully described in systematic integration way as the socalled "ALL-WIN Model".

TOTAL INTEGRATION MANAGEMENT OF PLASTICS WASTE [10]

The linkage of six different sectors which play important role on waste management integration system is shown in Figure 7, the ALL-WIN Model.

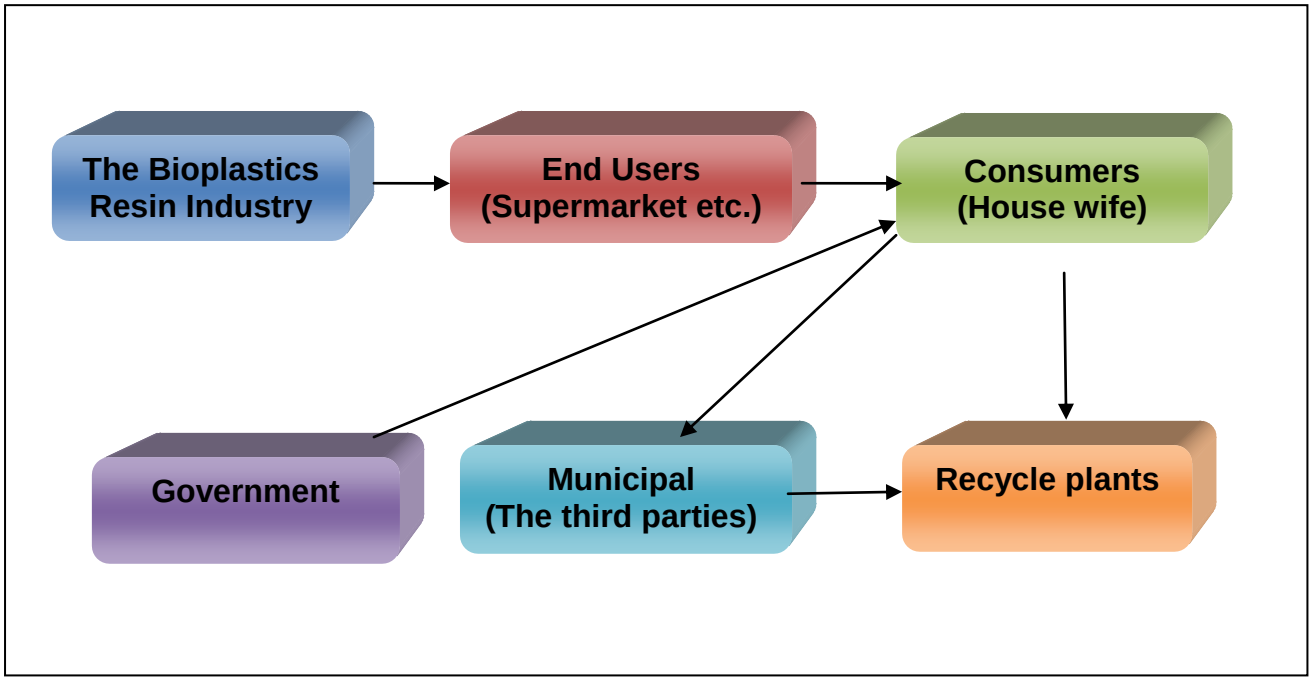

Figure 7 ALL- WIN Model

There will be describe by outline of each sector which can be proved that every sector gain benefit substantially. Especially the government sector has to conduct the linkage by campaigning through all medias e.g. TV, radio & newspaper. The followings are the brief important out line function in sector by sector.

The Bioplastic Resin Industry

- Fully promoted by the government with taxation benefit.
- Gain "Adder" with certain amount per metric ton of bioresin produced, duplicating the same concept as giving to renewable energy plants as both are serving eco friendly issues.
- Bioplastics resin price can be reduced comparable to conventional plastics and will be marketable.

End Users (Supermarket etc.)

- Allow to reduce tax by deducting the factor of 2-3 from the buying expenses for compostable bioplastics products as CSR project for society.
- Able to save cost from the give away bag expenses substantially as housewife will bring their own reusable bag.
- Give special discount for ones who bring their own reusable bag for shopping.

Consumers (House wife)

- Have to join domestic waste separation program strickly.
- As a token, will be given free garbage and reusable shopping bags as following types and quantities each month.
    - 3 big garbage bags

eg. one yellow bag for plastics waste
one blue bag for paper waste
one hazy bag for bottle / can waste
(municipal will come to pickup every 3-4 weeks.)

- 6 green compostable bioplastics bag for organic / food waste
  (municipal will come to pickup every week)
- 2 shopping bags ie. compostable bioplastics and conventional. (After reusing both shopping bag till they are worn out then can be used as a garbage bag for specific organic and dry waste respectively)

- As a token, housewife will get discount when they bring along their own reusable bag for shopping.

Municipal (The third parties)

- Gain more clean conventional plastics waste and get higher value from recycle plant.
- Gain better organic waste in compostable bioplastics bag then all together can be compostable into good fertile soil or organic fertilizer with higher value.
- After gaining certain record their may give open bidding for concession to recycle plants that they can collect the recycle wastes direct from each house by themself.
- After giving concession, then just only organic waste will be collected and administration & logistics cost can be saved substantially.
- Reducing substantial solid waste from incineratior that can provide good environment to the atmosphere and reduce cost of public health substantially as well.

Recycle Plants

- Gain good quality and clean recycle wastes to reach more productivity and convenience.
- May get the concession of direct collecting the recycle wastes ie. conventional plastics, paper, glass bottles and cans from every house in a certain concessive territory.

Government

- Strongly campaign for domestic waste separation seriously.
- Give new regulation for TV and radio to provide at least one or half minute in every hour on air of broadcasting with video clip or radio spot for CSR programs.
- CSR program will cover good information & knowledge for the public in nation wide basis with following content e.g.
  - Education on social responsibility.
  - Domestic waste separation program.
  - Convention plastic with safety & maximization usage.
  - Bioplasts both compostable & noncompostable with safety & maximization usage.
  - Going green : 3R & renewable.
  - Global warming & climate change.
  - Natural resource sustainability.
  - Democracy with proper & safety application.
  - Election with higher ethic, duty & responsibility.

- Long term saving.
- Insurance in proper usage.
- Etc…..

CONCLUSION

The economical, social and environment impact from compostable bioplastic can be provided in several benefits for many sectors as follows:

- 1. Enables efficient domestic waste management and recycle products of good value.
- 2. If waste separation is practised, the environment will be better because the bad smell from the landfill / open dump will be eliminated.
- 3. Helps reduce global warming effects by not producing excessive GHG to the atmostphere.
- 4. Helps cassava farmers economically with more stable price.
- 5. Increases exporting value because there is still demand in the world market to increase trade balance.
- 6. Thailand is abundant with biomass resources; therefore, it should position as a bioplastic production hub for Asia and attract investors to increase economic value
- 7. In the future, the value of carbon credit produced from bioplastics will increase, and Thailand will greatly benefit from it.
- 8. Save substantially budget on Health Welfair due to better environment & less ecology problem.

By the well understanding with good practice from every player, this integration work will surely lead to good future for our next generation. It is not only provide with prosperous economy and social security but also with good & safety environment and sufficient natural resource inherit to our offspring endlessly.

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