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Designing a Collaboration Form to Overcome Innovation Resistance in Waste Management Practices in Lampung Tapioca Industry

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Abstract—**Waste management is an important innovation in environmental management. It has significant role for minimizing the effect of industrial activities. Unfortunately, this practice has not been fully adopted in Lampung tapioca industries. The purpose of this paper is to analyze innovation resistance among Lampung tapioca and industry in adopting waste management practices. This research offers collaboration form to overcome these barriers. According to Ram and Sheth's theory, five barriers namely usage, value, risk, tradition, and image barriers were used to investigate the impediment. A case study methodology were conducted with eight respondents which represent stakeholders in Lampung tapioca industry (academics, government, and tapioca firm). The data were collected through semi-structured interviews, field observation, and internal documents. The findings show that the awareness about waste management practices have been risen among stakeholders. It indicates with positive attitude toward usage barrier and value barrier. However, risk, tradition and image are the intense barriers to adopt waste management practices. They have found difficulties in technical and management aspect to implement waste management. This research has practical implications to decision maker and innovators in collaboration strategies to overcome resistance to innovations like waste management practices are discussed.**

Keyword: waste management, innovation resistance, tapioca industry, innovation adoption.

I. Introduction

LAMPUNG Province is well-known as the largest tapioca producer in Indonesia with 66 tapioca factories and 8.059.287 tonnes of tapioca starch production [1]. This industry has a significant positive impact on the regional economy; however, the tapioca industry discharges large amounts of waste from its processing that contributes significantly to environmental degradation. Mai [2] identifies the forms of waste that is generated from tapioca starch processing. This includes resource consumption, wastewater, solid waste, and air pollution. Tapioca waste treatment needs a large area for waste processing, and it creates a foul smell that can disturb residents [3].

Some strategies have been developed by key stakeholders (academics/research and development institutions, government, and local firms) to solve these environmental issues. For example, the Indonesian Environmental Compliance Public Disclosure Program (PROPER) was developed by the Government [4] which was informed by research activities from academics and research and development institutions [2,5]. However, the implementation of research innovation and environmental regulation compliance is still low. Based on PROPER assessment results in 2014, there were only 14 of the 66 Lampung Province tapioca processing plants that met the necessary compliances [6].

These failures are the result of a lack of information about environmental regulations and the research results that are available [4]. In Lampung Province, there are several parties that have knowledge and information about waste management practices; however, each stakeholder works independently which leads to overlapping roles and inefficiencies in the innovation adoption process and information sharing.

In order to find the best approach to overcome this situation, the decision maker must understand the impediments that may prevent tapioca industry for adopting waste management practices. The aim of this study is to explore the resistance of innovation in waste management practices in Lampung tapioca industry, while creates a collaboration form among stakeholders. First, the innovation resistance theory is explained. Second, the development of interviews and data collection are transcribed. Thereafter, the presentation of the results. Finally, the conclusion is drawn.

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II. LITERATURE STUDY

A. *Waste Management Practices in Tapioca Industry*

The tapioca processing industry generates a considerable amount of waste and by-products. The environmental impact arises from the processes of cleaning, peeling, and extracting. According to Mol and Dieu [7], $10m^3$ – $20m^3$ of waste water that contains high levels of biodegradable organic materials is released per ton of tapioca starch processed. Moreover, Mol and Dieu [7] analyzed the characteristics of wastewater from tapioca processing with values of 55-200 kilograms of BOD, 130-500 kilograms of COD, 40-140 kilograms of suspended solids, 0.2-0.6 kilograms of phosphorus, and 3-10 kilograms of nitrogen. To produce tapioca starch, roots are peeled, washed, chipped, pressed, grounded or milled, dried, and then sieved. The tapioca starch produced contain around 15 – 19 % moisture content [8]. Fresh cassava roots are then transported to the cassava mills. Several processing stages are involved in the cassava starch extraction process. The tapioca processing stages are shown in Figure 1.

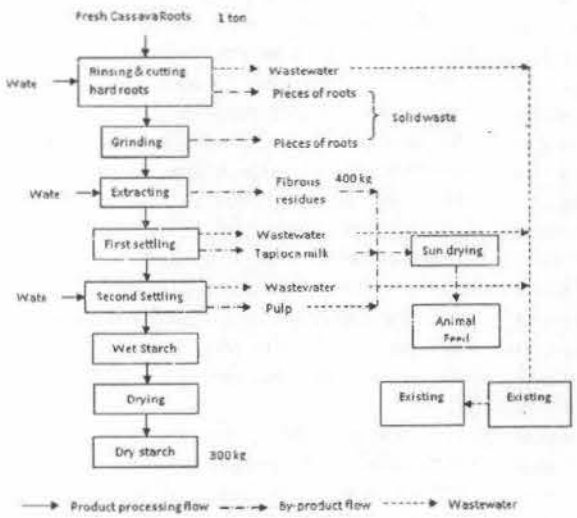

Figure 1 Process in tapioca mills [7].

The study variables include the reuse and recycling of water, use of biogas from wastewater, and technology modification for efficiency in the production process. A systematic methodology was adopted to analyse the implementation of cleaner production. The research methodology consists of four steps:

(1) Analyzing the current situation and collecting information associated with four key factors (water consumption, electricity consumption, fuel oil consumption, and starch loss)
(2) Evaluating and measuring the four key factors by calculating material mass and water mass balances
(3) Selecting an appropriate approach for minimizing the amount of waste generation based on four key factors calculation, and
(4) Designing and implementing potential clean technology options for the tapioca starch plants.

The result of this study show that clean technology implementation in the eight selected tapioca starch processing plants can successfully reduce water consumption and enhance wastewater energy recovery. However, the clean technology approaches that have been offered were only based on material mass and water mass balance calculations. This is more about the technical issues. There were limitations and weakness in this study. For example, the study did not mention the process of clean technology implementation in tapioca starch plants that involves the implementation process and clean technology adoption.

B. *Barriers in Innovation Adoption*

Some studies identify that many organisations experience challenges in adopting innovative products or technologies [9-11]. Users consider innovation as a new way for implementing changes. However, resistance to change is a common response from customers before the adoption of innovation begins [10]. For example, see the study by Laukkanen et al. [10] which investigated innovation resistance among mature consumers in mobile banking. This research followed Ram and Sheth [12] "Innovation Resistance Theory". An internet survey was conducted with 1525 respondents, of which 370 respondents represented mature costumers (over 55 years) and 1155 respondents represented young customers. Based on Ram and Sheth's [12] framework, the Innovation Resistance Theory is divided into five categories:

- Usage barrier
  The usage barrier is associated with the utilization of innovation. These barriers arise when an innovation is not well-matched with customer requirements, in term of habits or practices.
- Value barrier
  The value barrier is related to comparing performance with price. It occurs when an innovation does not show great performance-to-price compared with other products.
- Risk barrier
  Uncertainty is always attached with innovation; therefore, risk cannot be avoided by customers. The risk barrier refers to the consequences that customers may be exposed to should they accept an innovation [10].
- Tradition barrier
  The tradition barrier occurs when innovation gives effect in daily routines. Consumers may be reluctant with an innovation because it changes their daily lives. Therefore, not all consumers have an interest with a new innovation.

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- Image barrier
  The image barrier is linked with stereotyped thinking, it can be brand or certain identity of the product.
  By using this framework, Laukkanen et al. [10] suggests that the value barrier is the most significant barrier to mobile banking adoption for both elderly and younger users. However, the elderly have higher degrees of risk barriers to the use of mobile banking. This is due to more mature people not trying an innovation because it is complicated to use. Hence, banks need to develop promotional campaigns for demonstrating the advantages of mobile banking compared with conventional financial services.

III. RESEARCH METHOD

A. Data Collection

This study adopted a case study methodology with field observations and interviews for the data collection process. Field observation was conducted by visiting the tapioca processing plants to understand the natural process production of tapioca. Then, individual explorative interviews with a representative from the actor groups were arranged for identifying major themes. Semi-structured interviews were arranged with non-participant observation, supported by internal documents where possible. The semi-structured interview began with broad and open questions while exploring each respondent's story to get more insight into the topic. An interview guide was prepared based on the main research questions and keeping the interviews on track. A total of eight (8) interviews were organized, recorded, and transcribed. Each lasted between 45-60 minutes. Three tapioca processing plants represented business, two research institutions and one university represented academics, and two province councils represented government. In the next chapter, individual actors are identified by following codes: Tpp1-Tpp3 for tapioca processing plants, Aca1-Aca3 for academics, and Gov1-Gov2 for a government. Secondary data from institution internal documents was also collected to support the findings.

B. Data Analysis

The collected data was transcribed and organized based on research questions and themes. Standard techniques for a case study were followed Yin [13]. First, the interviews were transcribed with the Indonesian language, to get more understanding and minimize misperceptions. Second, data was clustered to produce more general codes and to identify themes. A coding method was used to organize interview data into a limited number of issues around the questions. Data from the field observations are also compared with the data from the interview. Third, data are divided into specific themes, in a term to capture different perspectives and interpretations. Therefore, it can answer the research questions. Fourth, the data analysis involved translated the interviews into English.

C. Validity

To support the validity of the findings, multiple sources of data were used based on Yin's [13] suggestions. Interviews, non-participant observations, and secondary data were used as data. These data resources were triangulated, and from an analytical standpoint, only those results are presented which are supported by multiple streams of evidence.

IV. RESULTS AND DISCUSSION

A. Current Waste Management Practices

From the data analysis, the main topic that occurs is the nature of waste management practices in the tapioca industry. According to the interviews with the key tapioca industry actors, simple waste management practices have been implemented in a tapioca processing plant, especially with reuse and recycling activities for solid waste. According to Sriroth et al. [14], the cassava slurry contains a high starch content (about 68% based on dry weight) and fiber (about 27% based on dry weight). Because of this high starch concentration, an animal feeder industry uses cassava slurry as a raw material. Another development in solid waste treatment is the utilization of cassava peel as biofertilizer. Cassava peel consists of two elements, an outer covering brown layer and an inner covering of parenchymatous. Both are lignocellulolytic components [15]. By using a particular fermentation process, the tapioca industry can produce biofertilizer from cassava peel. These following statements support the reuse and recycling practices in solid waste management:

In the words of Gov1: "It is true that the tapioca industry produces some waste from the process production. But, they can sell their solid waste to the market. Usually, cassava peels are used as raw materials for animal feed or compost, and the acid citrate industry needs cassava slurry as their primary material". Tpp1 adds: "20% of our cassava slurry production has been used as feed for waste water treatment, and we have sold the rest to the market. Another factory need cassava slurry as a material for traditional sauce, and cassava peel as a material for animal feed".

While solid waste treatment provides a positive trend, a different situation emerges in waste water treatment in the tapioca industry. The Majority of actors in the Lampung Province tapioca industry persist with conventional lagoon treatments, rather than using applied biogas reactors for further benefits. According to Gov1, only 10-20 tapioca processing plants from 66 factories are going further with new technology by converting methane from wastewater into biogas (a renewable energy resource). In the words of Aca1: "Most of them (tapioca processing plants) are using conventional lagoons like a big pond

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with long time detention, at least 3-5 months for processing treatment". However, some of the tapioca processing plants have implemented or modified their waste water treatments to get more benefit from waste water. Tpp1 says: "Nowadays, lagoon treatment is used in our factory. But, we have modified this treatment with a mixing tank reactor. Tpp2 adds: "Before 2012, we were using lagoon treatment for our waste water. But since 2012, a biogas plant is now effectively used in our factory".

B. Innovation Resistance in Waste Management Practices

Rogers [16] assumes that all innovations are accepted and adopted by users. However, innovation means change for users, and this could result in resistance as a response to change before the adoption process begins. The tapioca industry actors may have their reasons for resisting innovation for their products. Based on innovation resistance theory [12], some factors are identified as potential impediments to Lampung Province innovation adoption of waste management:

- Usage barriers
  The usage barrier commonly relates to service utilization and consumer requirements. From the interviewee feedback, it seems that usage barriers are not the main obstacle to adopting good waste management practices. All the stakeholders have an interest in implementing new technology. Tpp1 says: "Now, we use conventional lagoons for our wastewater treatment, but since we have heard of the success stories from another factory, we decided to install a biogas converter". On the other hand, the respondents may have found difficulty in the first implementation of new waste management practices. As mentioned by Tpp3: "when the first time we tried the biogas reactor, there were so many trial and error experiences. We are a little bit afraid of using this technology".
- Value barriers
  The value barrier relates to a comparison of performance-to-price to substitutes. Some respondents feel that the relative advantage of waste management practices is high from their point of view, since they get added value from waste. Ramsey, Ibbotson and Mccole [11] states that firms are profit driven, therefore firms compare benefits and costs of technology use before making a decision in adopting a technology. The new trend shows that waste does not become a burden for cost production but can give benefits, such as additional income from selling cassava peel and cassava slurry, and energy from wastewater. Nevertheless, some interviewees revealed that a financial burden is a barrier for implementing the innovation production. In the words of Aca2: "Basically, they (the tapioca processing plants) understand the advantages of good waste management practices, but we cannot deny that the investment for new technology in waste management is expensive". This research suggests that some respondents felt that high investment in waste management implementation is the main issue against innovation adoption.
- Risk barriers
  The risk barrier refers to the risk that users are exposed to when using innovative technologies. Laukkanen et al. [10] stated that inventors should notice that risk is a user perception rather than a product characteristic. Some tapioca processing plants fear that they might make mistakes when applying new technology for the first time, especially for SMEs. Sometimes SMEs do not have the financial or technical resources to adopt innovation [9]. For an SME tapioca processing plant, human resources are a key problem in the innovation adoption process. These firms have high dependencies with the owners for adopting new innovations. In the words of Tpp3: "as an owner, I have to know everything about this factory. This includes knowledge about how to manage our waste. I come to a workshop or sometimes the Government invites me so I can learn new things, then I can share it with my workers. Most of my workers only graduate from high school; they do not have any idea about how to manage waste". These practices increase the risks even though the owners have supervised the innovation adoption transfer from their thoughts to their workers. However, these risks can be minimized by employing a consultant or having a discussion with experts. In the big tapioca processing plants, innovation adoption runs more smoothly and there is less risk because the larger firms have better infrastructures and human resources.
- Tradition barriers
  The tradition barrier implies the change caused by innovation in daily routines. Johnson [9] explains that the adoption of technology is a gradual process and it is time consuming. Adopting new waste management practices mean changing daily routines. For example, by implementing a biogas reactor, Tpp2 and Tpp3 have to change their production lines and train their workers to get used to the technology. Based on the situation in Tpp2, this requires training for workers not only for introducing the technology but also for changing their attitudes toward technological innovation. Studies have reported that technology adoption will succeed if there is support from top management [11]. As several interviewees affirm, "management policies become important issues".
- Image barriers
  The image barrier refers to stereotyped thinking that can hamper innovation adoption. The image barrier in waste management practices emerges from waste management behaviours. On the one

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hand, the tapioca processing plant operators perceive the implementation of waste management to be too complicated to apply because they have to change their organizational habits. Tpp1 reports: "Before we have our kick start in new waste management next year, we have to change our installation system, habits, and perspectives. It is not an easy job, big homework for the company". On the other side, the adoption of waste management practices will lead to good reputations for the company since the awareness of environmental issues has risen recently.

Other than five barriers based on innovation resistance theory, this research has found other obstacles to the adoption of waste management practices. From the interviews, the researcher noticed that there was an emerging problem related to joint research activities among stakeholders. As regards funding issues, the R&D institutions point out disagreement about the ownership of intellectual property. Aca1 says: "There may be disagreements occurring over the ownership of an innovation product that has been produced from research activities. They want to own that product for free and do not want to pay for the intellectual property for our researcher". This situation may appear because of unclear contractual agreements between the two sides.

C. *Collaboration Form of Innovation Adoption*

One aspect that researchers believe encourages the innovation adoption process in waste management practices is the collaboration of stakeholders. They feel that stakeholder interactions will improve if the role of stakeholders and form of collaboration are clearly defined. In Lampung Province, collaboration involves several parties such as the tapioca processing plants, government, and academics or R&D institutions. Each stakeholder has its role description that is listed in the regulations or legislation, especially for Government, academics,or R&D institutions. However, problems can emerge during the information sharing process.

According to Regulation of Lampung Governor No. 33/ 2010, the Environmental Monitoring Agency has a role in coordinating, facilitating, mentoring, and reviewing environmental management in Lampung Province. These roles include providing technical assistance and consultancy about environmental issues for the industry and society. However, it is found that a coordinating role has not worked in the field. Another organization that has involvement in the innovation adoption process is the Regional R&D institution. The Regional R&D institution has a role in developing technical policies for research and development; and providing advice to the local government based on scientific studies. Nevertheless, the presence of this institution is not perceived well by another stakeholder. Aca2 says: 'There is a poor role from the Regional R&D institution to coordinate and manage the innovation in this province. They do not even have a database for innovation'. For this reason, the tapioca firms had difficulties getting information about innovation.

Academics and R&D institutions have roles as a center of knowledge. In Indonesia, academics have three main roles that are called "Tri Dharma". Tri Dharma defines the three main roles of universities: Education, research and development, and community service. The R&D institution also has a role for conducting research and development activities. These situations raise a problem in the overlap of innovation products. It is often found that R&D institutions and academics organize almost similar research, especially for the most demanding topics such as alternative energy sources from tapioca waste water. Aca2 mentions: 'It happened with us. A few years ago we arranged research about biogas in Pesawaran district, then we got information that the R&D institution from the Ministry of Energy and Mineral Resources did the same research in another tapioca plant'. It indicates lack of information sharing among stakeholders.

Another issue in cross-actors information sharing is business competition among the tapioca plants themselves. It prevents them from sharing information about new waste treatments. Nowadays, many international organizations give funds or grants for carbon markets. Each tapioca plant makes a proposal to get funding by creating waste management strategies. Therefore, they keep information from competitors.

Based on the description of the role of stakeholders, the collaboration form among stakeholders can be arranged as seen in Figure 2.

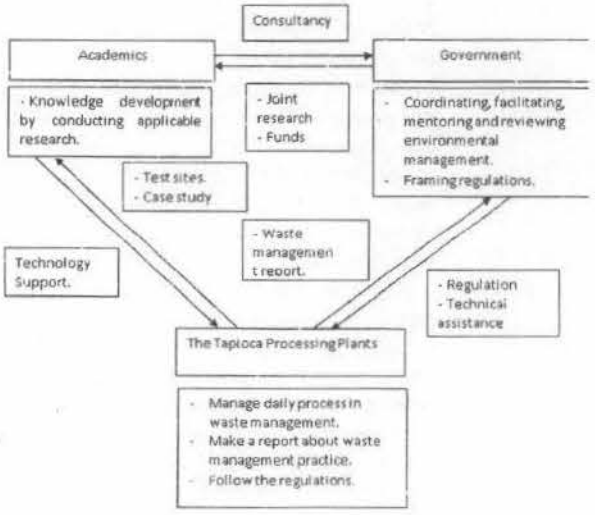

Figure 2. The Collaboration Form of Innovation Adoption in Waste Management

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V. CONCLUSION AND RECOMENDATION

When majority of research have discussed about the success of innovations and factors driving to adopt, the innovation resistance theory explains the reasons that impede adoption of innovation. Waste management represents one of the recent innovations in the environmental issues. Today, companies realize by adopting waste management, they reduce not only pollution but also gain benefits from waste [17]. However, the adoption rates of waste management in Lampung tapioca industry are significantly low. Environmental Compliance Public Disclosure Program (PROPER) result in 2014 has reported that there were only 14 tapioca processing plants out of 66 tapioca processing plants that met regulation compliances.

The initial findings found that stakeholders have concerns about waste management practices. The results showed that the usage barrier and value barrier are not the reason for tapioca industry for not adopting waste management. They are understand about this issues and have interest to adopt waste management practices into their daily process. Tapioca processing plants in Lampung Province aware about the benefits and value that they will get from the tapioca waste. For example, waste water for biogas, and tapioca slurry as raw material for biofilm. Though, risk, tradition and image barriers are significant barrier to waste management adoption among Lampung tapioca industry. This means that innovation users consider that the innovation is uncertainty process of trial and error, and time consumed. In this respect, stakeholders could develop collaborative action among stakeholders by sharing the role in innovation adoption process, based on the fact that innovation is an inter-disciplinary proccess. Government plays role as mediator and innovation broker by framing regulations, and controlling and monitoring waste management practices. Academics as an innovation producer can provide their experts through coaching or mentoring to help tapioca processing plant in adopting new innovation. While the tapioca processing plant itself become innovation user or funds provider. They have role to manage daily operation of waste management and to share the experience on the field.

The scope of this study was limited which leads to typical findings due to it is difficult to be generalized to other cases. However, the result would be important to provide the foundation for future research in the development of innovation adoption strategies. As a suggestion for further improvement, the study needs to use more respondent. For primary data collection, a quantitative method such as survey or questionnaire can be used to get more representative respondents. More detailed in process production will be needed in the background to get more understanding about the nature of tapioca industry. Another actor should be involved as a respondent to get their perspective.

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