APPLIED OF PRODUCT-SERVICE SYSTEM TO MEASURE SUSTAINABILITY LEVEL OF SME'S TRADITIONAL FISH PROCESSING

by Ratna Purwaningsih

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Ratna Purwaningsih, Anggaina Elfandora Cahyantari , Zulfaida Ariyani, Aries Susanty, Haryo Santoso

Industrial Engineering Department, Engineering Faculty, Diponegoro University
Jl. Prof. Soedarto, SH, Kampus Undip Tembalang, Semarang, Central Java, Indonesia 50275
ratna.tiundip@gmail.com

Abstract

Small Medium Enterprises (SME) of smoked fish traditional processing at Semarang, Central Java, Indonesia still focus on maintains their business to get more profits. Sustainability aspect has not received enough attention yet. This study aims to review the sustainability level of SME smoked fish Semarang using product service system (PSS) method. PSS consists of three dimension (1) Environment, (2) Socio-cultural and (3) Economic. Each dimension consists of 6 criteria's. PSS not only assess the level of sustainability but also formulated the recommendation to increase the sustainability level using the industry system map and SWOT analysis. Formulation of recommendations is guidance by a check list form. Then, the portfolio diagram used to select these recommendations according to its feasibility to be implemented and its importance for the industries. Result of sustainability assessment for smoked fish traditional processing give the average of sustainability level value 0.44, categorized as medium level. The recommendations for the environmental dimension are (1) use of liquid smoke and wastewater treatment with anaerobic ponds Recommendation for socio-cultural dimension is use personal protective tool for workers. And recommendation for economic dimension is to use social media for product marketing, increasing the economic value of fish lung wastes. Recommendations are then illustrated in a diagram in the form of radar sustainability

Keywords: *SME smoked fish , Sustainability assessment, Product-Service System method, formulation of recommendation*

1. Introduction

Sustainable development has been defined in many ways, but the most frequently quoted definition is from *Our Common Future*, also known as the Brundtland Report: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Product-service system (PSS) is a method to measure industry sustainability level. There are three dimensions of sustainability that will be the basis for assessing and formulating recommendations to increase sustainability level. These three dimensions are the environmental, socio-cultural and economic dimensions in which each dimension contains each six criteria (Crul, 2009). Application of PSS in industry was believed to be a source of innovation (Mc Aloone, 2004); improving consumer satisfaction, product life cycle management and information flow in the manufacturing cycle (Haapala, 2008), also increase company productivity levels (Moreau, 2011); and provide benefits for companies, consumers, environment and government (Goddess, 2011).

Assessment of the sustainability level of a region or a business unit has been developed in various fields. Sustainability indicator on mining and mineral sectors was developed by MMSD (Mining, Minerals and Sustainable Development). In the forestry sector, the impact assessment of the forest wood supply chain is measured using ToSIA (A Tool for Sustainability Impact Assessment) [3]. In the chemical sector the characterization factors for human eco-toxicity and toxicity were measured by the Uniform System for the Evaluation of Substance (USES-LCA) [4] method. In industry has been developed a measurement method and indicators of Sustainable Development for Industry (ISDI). Sustainability is assessed through environmental impact, environmental efficiency and voluntary action. ISDI follows the lifecycle approach and consider the complete life cycle of materials and energy utilized [6].

There has been a significant decrease which reaches 48% in production volume of SME smoked fish at Semarang. Although, the raw material for production of smoke fish was increased by 14%, and fish consumption of Semarang community increased at 15% (BPS, 2015). Besides, there are environmental and health problems of workers and the surrounding community due to the smoke from the fish processing. The smoke that arises during the production process contains chemicals that potential to cause decline in lung function and threaten the health of workers. The surrounding community is also disturbed by the pollution. Worker health problems and their impact on surrounding communities are included in the problems of the socio-cultural dimension (Tischner, 2009).
The purpose of this study is to measure the sustainability level, formulate recommendations and assess the feasibility of these recommendations.

Research Method

PSS method is carried out in a series of stages developed by UNEP and DELFT University of Technology. PSS consists of 4 stages (1) Identify system sustainability dimension, (2) Formulate and select recommendation, (3) Conduct assessment of detail of recommendation, and (4) Conduct feasibility test on recommendation to choose the best one.
The first stage is to identify the dimensions of system sustainability. There are 3 activities in this stage,

1. Drawing system maps; A system maps are useful for identifying the current state of the system and the stakeholders involved in the system.
2. Making a SWOT of sustainability; SWOT sustainability is useful for identifying current strengths and weaknesses, as well as opportunities and threats in the future
3. Assessing system sustainability using a checklist. The checklist is used to assess the sustainability level of industry.

The second stage is to formulate and select recommendations. At this stage the questionnaire was distributed using the PSS worksheet. The results of the questionnaire are then used to make detailed recommendations. The recommendation categorize on 4 class; H = high, M = Medium, L = Low and N = No, or have no relation. The recommendation will be detailed are the H categorize.
The third stage is to choose the recommendations to be applied. At this stage, the recommendations selected in stage 2 are then detailed. We assess the recommendation by giving the 'mark' ++ for much better, + for better, = for nothing change and – mean worse than existing condition. This mark then became the-y axis value of sustainability improvement possibility in portfolio diagram at stage 4.
The fourth stage is to test the feasibility of recommendations by making portfolio diagrams and PSS radar. Radar serves to compare the future conditions if the recommendation applied to the current system. Then, we need to create a portfolio diagram use a feasibility recommendation questionnaire.
In the questionnaire, respondents were asked to assess detailed recommendations with judgment based considerations, (a) Duration of recommendations (long term or short term), and (b) Easy-ness of implementation / implementation (difficult to implement, or easy to implement). This feasibility value became the value of the-x axis on portfolio diagram.
The steps to create a portfolio diagram as a feasibility evaluation chart are:

a. Discuss with fish processing managers about the feasibility to implement the recommendation.
b. This portfolio diagram has the - y axis for sustainability improvement possibility and the-x axis for feasibility / implementation. Put all recommendations in the matrix according to its value on these two dimensions.
c. All recommendations are compared against each other and consider the priorities analysis done before.
d. Position in the diagram based on the highest from the aspect of sustainability and feasibility of implementation. The recommendations locate on the top right of diagram are the best ones to be implemented.

3. Result and discussion

The sustainability assessment was given to 21 traditional smoked fish processing at Bandarhardjo Semarang. The system map and sustainability SWOT were done by interviewing the owner of traditional fish processing industries and related agencies. Result of system map given on figure 1 and sustainability SWOT in detail given on table 1. This SWOT analysis will be useful in identifying recommendation for sustainability improvement.

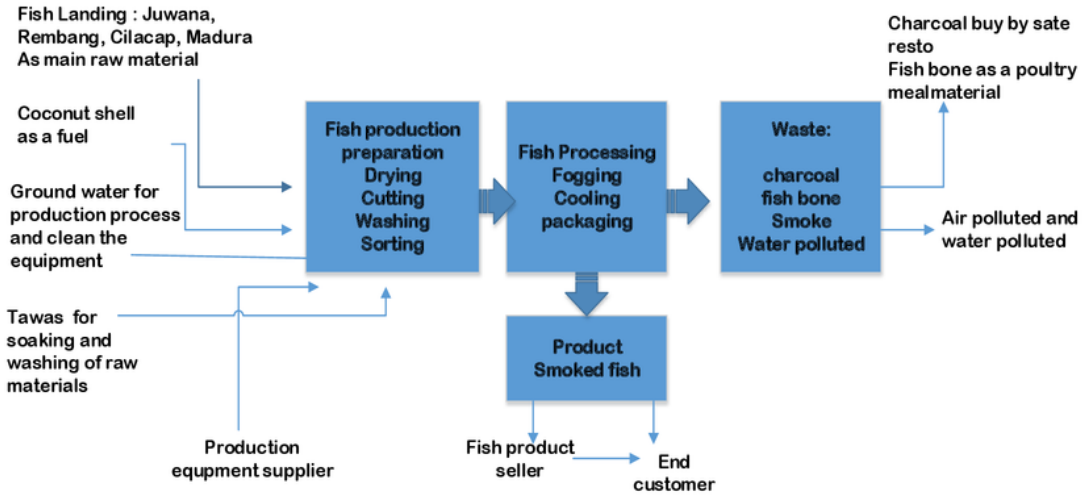

Figure1. System Map of traditional Smoked fish processing industries

Figure 1 show the parties involved in smoked fish production. Related parties include fresh fish suppliers, coconut shell suppliers, processed fish traders, waste collectors, and consumers. System begins when the industry owner purchase of fish as raw materials in the fish market. The amount or the availability of raw material was following the natural conditions. The fuel (the coconut shell) purchased from coconut shell collectors who came to the traditional fish processing center. The raw materials obtained on one day, then processed entirely on the same day. Smoked fish are immediately distributed on the same day to traders in the market, or to consumers who come directly to the industries location. The wastes are partially sold, and some are still poorly managed.

Table1. Result of SWOT Sustainability analysis

SWOT	State the existing condition		Forecast of Future condition	
	Strength	**Weakness**	**Opportunity**	**Threat**
Environment	Several types of waste have been utilized There is waste that has a high selling value	The production process is still traditional and resulting polluted waste. Poor water quality Extremely poor environment conditions	Liquid curing techniques can reduce pollution and carcinogenic in the product. waste can be processed further.	Long-term environmental degradation.

Social Cultural	The industry in Bandarharjo is the first in Semarang and has been established for almost half a century	High health and safety risks Air pollution disturb the community Many studies have criticized the not hygienist process of smoked fish. Low level education of owners.	Its status as a pioneer in Semarang has become an opportunity to attract consumers. Future generations who are educated can change to better production process	The health of workers is threatened. Poor quality of the production environment may trigger social institutions to take action
Economic	economic support from the government	Raw material comes from out of town. The low quality of products (potentially containing bacteria and carcinogenic substances) Existence began rivaled from Jepara and Demak	The potential of culinary tourism Increased fish consumption in Semarang City. Further waste treatment will increase revenue	Competition that is not addressed properly will threat the existence of industries

Next step is categorization of sustainability criteria. This step is conducted to find out what sustainability criteria need to be developed by give the categorization as No, Low, Medium or High categories. Categorization of criteria conducted after the spreading of questionnaires (worksheet 2 PSS) to 21 fish processing industries. Then, the average calculation of all criteria was scores (Purwaningsih, 2016). From the results of the calculation found that the level of sustainability of smoked fish industries of Semarang City is 0.44. It indicates that the sustainability of the industries center is in the medium class. Recapitulation of the results can be seen in table 2.

Table 2. Result of sustainability assessment

Dimentions	Criteria's	Scor	Categorize
Environment	System Age Optimization	0.36	*Medium*
	Reduction of Transportation / Distribution	0.09	*Low*
	Reduction of Resources	0.11	*Low*
	Minimization / Waste Management	1	*High*
	Conservation	0	*No*
Socio Cultural	Toxicity	0.5	*Medium*
	Social Responsibility	0	*No*
	Occupational Health and Safety	1	*High*
	Product quality	0.28	*Low*
	Employment	0.38	*Medium*
	Stakeholders relationship	0.5	*Medium*
Economic	Market position and competitiveness	0.9	*High*
	Profitability	1	*High*
	Value added for consumers	0.33	*Low*
	Long Term Risk	0.7	*High*
	Partnership / Cooperation	0.4	*Medium*
	Macroeconomic Effect	0	*No*
Mean		**0.44**	***Medium***

The third step is the formulation the recommendations. It is obtained from the results of the questionnaires referring to the Recommendation Development Guide. Then, recommendations are further

detailed due to the Detailed Recommendation Guide. Questionnaires were distributed to 23 academicians, 2 industries practitioners, and 3 industry and trade ministry officer of Semarang district. 14 alternative recommendations were obtained from that process. The environmental dimension got two recommendations (1) using liquid smoke and (2) treating liquid waste with the concept of anaerobic ponds. The socio-cultural dimension got two recommendations (1) using personal protective equipment (PPE) while working and (2) using a smoking cabinet. The economic dimension got 10 recommendations (1) using vacuum packaging, (2) expanding the marketing area, (3) clean water supply by filtration, (4) promoting through social media, 5) improving the economic value of the fish waste, (6) the promotion of culinary tourism, (7) cooperating with the culinary party to participate in popularizing smoked fish food recipes, (8) maintaining sanitation and hygiene of the production process, Rewarding by the government, and (10) industrialization of fish fogging in Bandarharjo. Then, the valued process result of the recommendation given on table 3 (only for recommendation on ++ and +).

Table3. Recommendation assessment

Dimension	Criteria	Value
Environment	Waste Minimization	++
Socio cultural	Occupational Health and Safety	+
Economic	Market Position and Competitiveness	++
	Profitability	+
	Long-term risk	++

Alternative recommendations that have been compared with the condition of fish harvesting center of Semarang City at this time, then conducted feasibility testing to find out how difficult alternative recommendations to be applied The results of the appraisal and feasibility test of the recommendations are then visualized into the recommendation diagram of the recommendation, which can be seen in Figure 3. In Figure 3 it can be seen that the recommendation alternative is formulated at the top right which means that the alternative recommendation is an alternative recommendation The best that can improve the sustainability of the Semarang City fish filling centers and make it possible to apply.

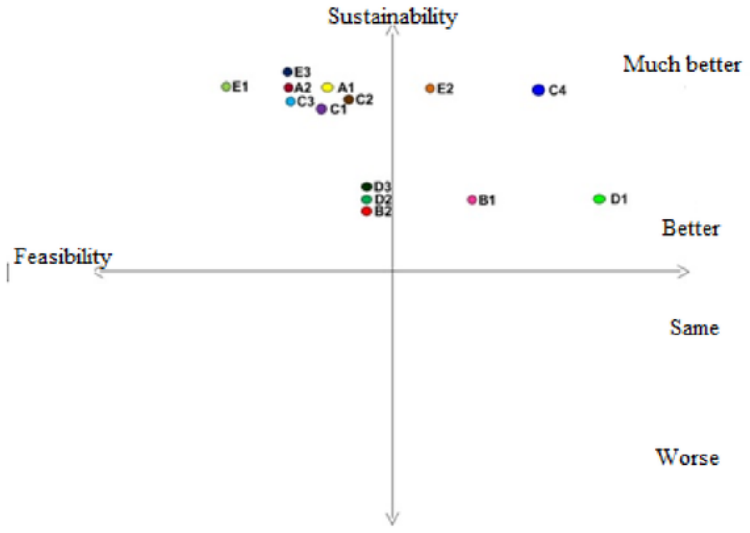

Figure 2. Portfolio Diagram to map the recommendation

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