

# Using life cycle inventory to improve the sustainability of traditional market management: a case study in Pandansari Market Balikpapan and Ibuh Market Payakumbuh

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**Abstract.** Indonesia has 13,450 traditional market with 12.6 million traders in 2016. This type of markets has significant role and contribution for the national economic, the traders and the consumers. This research aims to investigate the sustainability of business model in traditional market. Study area are Pasar Pandansari in Balikpapan and Pasar Ibuh, Payakumbuh. Using the LCA methods, this study adopts some phases of International Standard Organization (ISO) 14040 consisting of setting up the goal and scope, and data inventory. Identified inputs include electrical energy, water, and materials/goods to sale. In addition, this study also investigates the economic aspect through the identification of the retribution income to the local government or management and environmental impacts. This study found that Pandansari Market has more extravagant inputs, especially in the consumption of electrical energy 78.5 kW/month (market stall) and 1,217 kW/month (kiosk) and this has an impact on environmental pollution through the exploitation of electrical energy in traditional market environments. The policy of using lights and electronic devices that have low kW and applying the concept of reward and punishment to traders can improve the sustainability of traditional market management.

## 1 Introduction

The existence of traditional markets is very essential for the community both either in the rural area or in the city in order to fulfill their living needs [1]. Traditional markets manifest the trading activities between buyers and sellers as a process of interaction among communities to realize prosperity. Traditional markets are classified as public facilities in every sub-district in rural or city area. At present, there are around 13,450 traditional markets in all parts of Indonesia, of which 12.6 million traders can accommodated and this does not include suppliers and market managers [2].

In terms of regional economic growth, traditional markets contribute a stream of revenue derived from taxes and levies for the central and regional government. Traditional market is one of the sources of Regional Original Revenue (PAD), namely policies on the

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rights of the Regional Government (Pemda) or the City Government (Pemkot) which recognized as an increase in the value of net wealth in a period of government. PAD through intensification and extensification of PAD sources, one of which comes from traditional market service fees [3].

Nonetheless, the traditional market is still portrayed with very negative image for being unclean, uncomfortable, and equipped by very minimal facilities. Currently, traditional market facilities still have not been managed properly. Therefore this condition lead to the improper treatment of solid waste, the zero treatment for wastewater discharged into the river, the lack of green open space, and air pollution due to motorized vehicles. Moreover, traditional markets that accommodate various traders also impacting the environmental quality by producing greenhouse gas emissions, such as shipping the goods, electrical energy, water, and others.

Taking into account all the perspective above, there are several options that Indonesia has to improve the overall quality of traditional market. For example, the existence of professional management in traditional markets could be enhanced to improve society perception about traditional market image and also to improve the competitiveness level of traditional markets. Further, environmental management and social engineering also have a fundamental role for the market manager to improve the quality of traditional market management. Therefore, in regards of answering the problems and challenges in traditional markets and realize sustainability, in this study will be assessed through an environmental management analysis by using the life cycle assessment (LCA) method. LCA is an analytical technique that uses compilation and analysis of input and output data in a production system, evaluating the impact on the environment and interpreting the results of the analysis and impact assessment [4]. LCA evaluates the environmental impacts of a product or process over its entire life cycle. It can provide an environmental profile of a system or process through the evaluation of inputs, outputs, and potential environmental impacts. [5]. LCA essentially includes a detailed analysis of the life cycle of a product or a process in relation to externalities generated [6]. One of the first terms used for such an exercise was Life Cycle Analysis. Recently, two terms viz., Life Cycle Inventory (LCI) and Life Cycle Assessment (LCA), apart from Life Cycle Inventory (LCI) have also been in use as well [7].

Basically, every country in the world should be using the principle of sustainability as a common ground in developing their country. This principle of sustainability emphasizes three aspects, namely the social, economic and environmental aspects. In this case, especially in the traditional market management, these three aspects are very immediate relation to traditional market managers and traders. In essence, sustainability is the natural ability of the earth and humans to survive, develop, and adapt to changes in environmental conditions over a long period of time [8]. In general, sustainability is focused on increasing the quality of life with respect to environmental, social and economic considerations, both in the present and for future generations [9]. Sustainability is the ability of a natural, human or mixed system to withstand or adapt to, over an indefinite time scale, endogenous or exogenous changes perceived as threatening [10].

## **2 Material and methods**

This study adopts phase of LCA by defining the goal and scope and data inventory. These phases are regulated in ISO standards, including ISO: 14040 concerning general principles of LCA and ISO: 14041 concerning inventory and goal and scope [11,12]. The research use Life Cycle Inventory (LCI) that identifies the first stage of LCA. The goal of this study is to investigate business model, economical aspect, and environmental impact of traditional market in big city and small city. The scope of the study covers three (3) main activities in

Market Stall and Kiosk i.e. electrical energy consumption, water consumption, and transportation.

Data was collected from two markets in two different city areas with several samples of traders as many as 120 traders and market managers in July-September 2018. Administratively, this research is located in Payakumbuh City and Balikpapan City which are presented in figures 1. Primary data is obtained through interview and observation. Secondary data is obtained through literature study and traditional market management documents.

To answer the influence of business processes (some inputs) in traditional markets, this study also analyzed the economic aspect by identifying the retribution income to the local government or management and environmental impacts.



**Fig. 1.** (A) Ibu Market, Payakumbuh City (B) Pandansari Market, Balikpapan City

## 3 Results and discussion

### 3.1.1 Goals and Scope

The goal of the study is for conducting the first two steps of LCA in two traditional markets. Afterward, compare the result of research in striving to improve the sustainability of traditional market management in Big City (Pandansari Market, Balikpapan City) and Medium Cities (Ibuh Market, Payakumbuh City). The scope of the study “using life cycle inventory to improve the sustainability of traditional market management” can be seen in Figure 2.

Traditional market has two (2) main business roles, which are market traders and market managers (management). The business process consists of three processes, i.e. input, process, and output. Consumption of electrical energy, water consumption, and shipping of goods (transportation) is part of input in traditional market service. The market stall traders and kiosk traders are an influence analysis for the sustainability of traditional market management. (Figure 2).

The system boundary of business processes in this context consists of electrical energy consumption, water consumption, and transportation activities. In this case, the data is collected from 60 traders (market stall and kiosk) in each market. Data collection of electrical energy consumption and transportation activities carried out in market stall and kiosk. While water consumption data only applies in particular market stall traders that using the water such as chicken stalls, fish stalls, or meat stalls.

Ibuh Market becomes the main place for conducting economic activities (buying and selling) in Payakumbuh City, in the middle of the city that facilitates the Payakumbuh community and its surroundings. Ibu Market is the central market compare to the other two markets in Payakumbuh City. In the other hand, Pandansari Market is one of the traditional markets in Balikpapan City which located nearby the coastal environment. This

market is the largest market in Balikpapan City with various types of merchandise/goods. However, this market is still struggling for revitalizing the trading facilities which burned in 2016.

3.1.2 Inventory Data

Data inventory of the two traditional market that have been collected consist of primary data and secondary data. Based on investigation activity, traditional market in big city (Pandansari Market) consumes electrical energy accounted 78 kW (Market Stall) and 1.217 kW (Kiosk) with electrical duration 540 hours/month and 2.520 hours/month, whereas the consumption of electrical energy in medium city (Ibuh Market) is 49,5 kW (Market Stall) and 367,2 kW (Kiosk) with electrical duration 1.980 hours/month and 4.470 hours/month. In regard with water consumption, basically water consumption is an input part of business activities in traditional markets. Ibuh Market consumes water around 198,000 litre/month, while Pandansari Market only consumes 5,400 litre/month. Further, weight of merchandise/goods and consumption of gasoline also contribute as an input of transportation activities. The market stall traders in Ibuh Market have a bigger distance estimation (806,9 km) than in Pandansari Market (444,5 km). This is directly proportional to the gasoline consumption of the market stall traders in Ibuh Market which reaches 716,9 litre/month, whereas Pandansari Market only spend 413,2 litre/month. Subsequently, the kiosk traders at Ibuh Market have an estimated amount of distance less than Pandansari Market, which is 705,8 km, Pandansari Market is 1,506 km. However, an estimated of gasoline consumption at Ibuh Market is greater (823,7 litre/month), Pandansari Market only use the gasoline around 556 litre/month. The weight of merchandise/goods for the biggest is in Pandansari Market, which is 11,340 kg/month. Afterward, the biggest weight of the goods in kiosk was found in Ibuh Market which reached 8,100 kg/month. The detailed data inventory for LCA of Pandansari Market and Ibuh Market (Market Stall and Kiosk) is shown in Table 1 and Table 2.

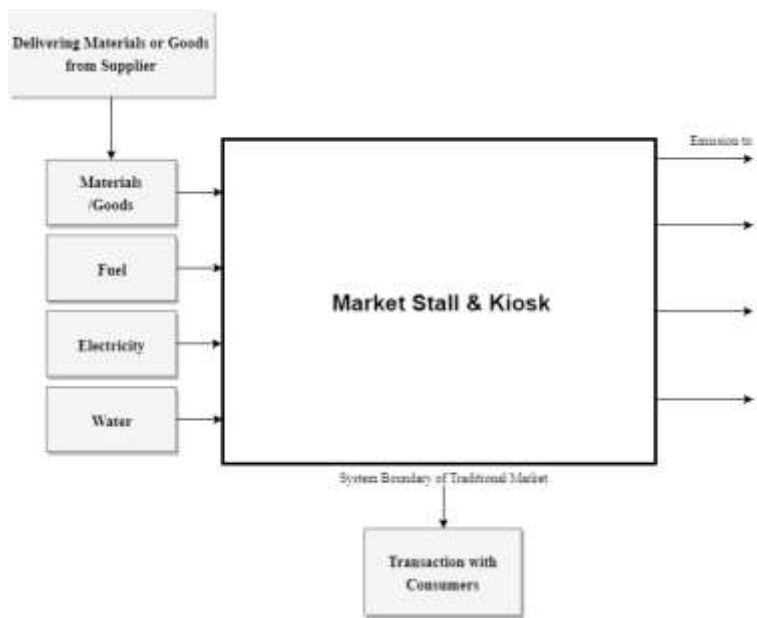


Fig. 2. System boundary of traditional market.

**Table 1.** Data Inventory for LCA of Pandansari Market and Ibh Market (Market Stall)

	Ibh Market (Medium City)	Pandansari Market (Big City)	Source of Data
Electrical Energy (kW/month)	49,5	78,5	Primary Data
Electrical Duration (hours/month)	1.980	540	Primary Data
Water (litre/month)	198.000	5.400	Primary Data
Fuel (litre/month)	716,9	413,2	Secondary Data
Distance Estimation (Km)	705,8	1.506	Secondary Data
Goods/Material to be Sale (kg/month)	390	11.340	Primary Data

**Table 2.** Data Inventory for LCA of Pandansari Market and Ibh Market (Kiosk)

	Ibh Market (Medium City)	Pandansari Market (Big City)	Source of Data
Electrical Energy (kW/month)	367,2	1.217	Primary Data
Electrical Duration (Hours/Month)	4.470	2.520	Primary Data
Fuel (litre/month)	823,7	556	Secondary Data
Distance Estimation (Km)	705,8	1.506	Secondary Data
Goods/Material to be Sale (kg/month)	8.100	5.400	Primary Data

The management of Ibh Market secure a total retribution from the market stall traders every month amounting to Rp.4.930.000, while the Pandansari Market management secure amounting to Rp.11.882.000. The total income of retribution from kiosk traders every month at Ibh Market is greater than Pandansari Market, which gain Rp.9.480.000, meanwhile the management of Pandansari Market only gain Rp.6.865.000. Overall, Pandansari Market management earn retribution from both the market stall and kiosk traders bigger than the Ibh Market. Pandasari Market management earns Rp.18.747.000, meanwhile, the Ibh Market management only earns Rp.14.410.000. The detailed data

inventory of Economical Aspect in Pandansari Market and Ibh Market (Market Stall and Kiosk) is shown in Table 3 and Table 4.

**Table 3.** Data Inventory of Economical Aspect of Pandansari Market and Ibh Market (Market Stall)

	Ibh Market (Medium City)	Pandansari Market (Big City)	Source of Data
Lease Fees (Rp./Month)	1.930.000	6.122.000	Primary Data
Daily Retribution (Rp./Month)	3.000.000	5.760.000	Primary Data
Total	4.930.000	11.882.000	Primary Data

**Table 4.** Data Inventory of Economical Aspect of Pandansari Market and Ibh Market (Kiosk)

	Ibh Market (Medium City)	Pandansari Market (Big City)	Source of Data
Lease Fees (Rp./Month)	7.855.000	4.785.000	Primary Data
Daily Retribution (Rp./Month)	1.625.000	2.080.000	Primary Data
Total	9.480.000	6.865.000	Primary Data

Based on the data above, it shows that the two subject markets in this research have variations in the consumption of electrical energy, water consumption, and the delivery of merchandise/goods (transportation). Furthermore, this study also discovers several findings in relation with the characteristics of traders who provide merchandise/goods from inside or outside the city, and techniques or ways of storing water.

In regards with electrical energy consumption comparison between Ibh Market and Pandansari Market. In one side, Ibh Market does not set lamp life hours, therefore the duration of electrical energy from the lights will consume around 1.980 hours/month (market stall) and 2.520 hours/month (kiosk). On the other side, in Pandansari Market, the market manager limit the lamp life hours. However, it does not restrict the use of electronic devices by market stall traders and kiosk traders. As a consequence, the total amount of electrical energy consumption in Pandansari Market growing intensively, to the amount of 78,5 kW/month (market stall) and 1.217 kW/month (kiosk). Under the circumstances, the Ibh Market consume less electrical energy compare to the Pandansari Market even though Ibh Market does not set an intervention policy in relation with lamp life time. The electrical energy consumption in Pandansari Market is very large and this situation is aligned with the total daily retribution income, i.e. Rp.18,747,000. In conclusion, the efficiency of electrical energy consumption in Pandansari Market does not work effectively and tends to increase the impact of environmental pollution.

Most of Ibh market stall traders in the process of sending commodity or trips to market locations are located in the sub-city of Payakumbuh City, thus requiring a longer distance.

Likewise, providers or suppliers of goods are located in the border area of Payakumbuh City. Therefore, this factor has a huge impact on gasoline consumption level. A different situation was found in the kiosk traders of Ibh Market who provided commodity close to the Ibh Market, resulting in less gasoline consumption. Meanwhile, most of the markets stall traders in Pandansari Market provide goods from the inside of Balikpapan City, which means that the goods already near the market. Consequently, Pandansari Market has lower gasoline consumption. However, some kiosk traders also still providing goods or commodity originating from outside the city of Balikpapan. Around two to five traders bring merchandise from Surabaya City or Makassar City. In general, market stall traders of Ibh Market and market stall traders of Pandansari Market have implemented sustainable business processes by providing merchandise inside the city which requires less gasoline.

Based on the observation, the traders of Pandansari Market (wet stall) have a good habit in water consumption, each trader is limited to use or consume water with a bucket of 20 litre per day and consume around 5,400 litre/month. In this matter, Ibh Market traders spend water more than Pandansari Market. In Ibh Market, normally one block (wet stall) consumes 1 big bucket with a size of 220 litre per day and consume around 198.000 litre/month. by virtue of limitation on water quality, the traders of Pandansari Market (wet stall) potentially could reduce the water consumption level. Conclusively, this is a habit that will support the preservation or the conservation of water in the Pandansari Market environment.

This research introduces the use of the LCI method for assessing traditional market management processes in improving the sustainability of traditional markets. This research still requires review and evaluation in preparing data inventory. The reliability of the results of these assessment (LCI) methods depend largely on the quality of the inventory data. As a measured data in general, LCI data are also subject to various kinds of errors. The need for addressing uncertainty in LCA has been identified over the years by many researchers, and several papers have discussed their characteristics and sources. Such uncertainty is due to process variability and failures such as instrument malfunction, poor sampling, or miss-transcription of data. In general, these errors may be divided into two categories, which are random and gross errors [13]. Limitations of this research are on transportation data which does not mention about the type of the vehicle and water consumption data that could not be obtained from each market stall.

One of the essential factor affecting the contribution of emission or environmental pollution generated from traditional markets is the factor of location where the traders coming from, mostly coming from Java island. However, this trend seems to shifting considering there is a turn of the traders. According to Kaminski and Boatman research, the economic growth and temporal behavior of innovation may change according to particular circumstances, this situation depending on economic and cultural factors in various periods [14]. In reducing environmental pollution in traditional markets, we have to prepare the comprehensive planning and continuous monitoring plan. In this regards, the best plan for professional management of traditional market in the future is the plan of applying the appropriate landscape policies [15]. Meanwhile, the affective bond between people and the environment in the traditional market community could further enhance social relationships, community experiences, and resident's well-being [15]. On the other hand, the improvement of traditional market management shall be focused on strengthening the capacity and networks of local government, on following the national regulations or programs as necessary, and on sharpening the power of local government to reconfigure the policies at the local scale or traditional market [16]. In this degree, the reduction of environmental pollution in traditional markets will be more perceived by the traditional market community.



## 4 Conclusion

This study found that Pandansari Market has more extravagant inputs, especially in the consumption of electrical energy 78.5 kW/month (market stall) and 1,217 kW/month (kiosk) and this has an impact on environmental pollution through the exploitation of electrical energy in traditional market environments. On the other hand, Pandansari Market offers the implementation of sustainable business processes in the supply of water and the provision of local merchandise/goods. In comparison, Ibul Market has fewer inputs (efficient) because of the market management have policy in the efficiency of electrical energy, but the consumption of water is still excessive.

In this paper, we suggest to the market manager to create initiative such as implementing policy of using low kW for lights and electronic devices and also applying the concept of reward and punishment to traders. These efforts potentially will improve the sustainability of traditional market management. Water-saving campaigns and facilities that support water conservation may be applied in wet stalls which require water every day.

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