



## The Identification of Waste Supply Chain Structure for Circular Economy: Case Study in Pangkalan Kerinci

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### Article Info

### Abstrak

#### Kata kunci:

*Pengelolaan limbah padat; Rantai Pasokan; Ekonomi Sirkular; Bank sampah.*

Menjaga bahan pada nilai tertinggi selama mungkin dengan menggunakan kembali dan mendaur ulang sampah, merupakan metode yang paling sesuai untuk mengeliminasi sampah, yang merupakan aplikasi dari konsep ekonomi sirkular di Indonesia. Permasalahan dalam pengelolaan sampah di Pangkalan Kerinci adalah pada saat pengangkutan dan pengolahan menuju TPA, sampah belum dipilah dan dicampur. Penelitian ini menggunakan metode deskriptif dengan pendekatan kualitatif. Hasil penelitian menunjukkan bahwa Dinas Lingkungan Hidup Kota Pangkalan Kerinci telah melayani 72% dari luas wilayah kota, dengan menggunakan 19 kendaraan (truk sampah), 5 rute utaman pengangkutan sampah, 4 kendaraan yang dapat dilipat (truk kontainer), dan sepeda motor untuk lokasi yang sulit dijangkau. Masalah yang ditemukan dalam pengelolaan sampah di Pangkalan Kerinci adalah; kurangnya bank sampah dan tempat sampah, kurangnya personil dalam pengangkutan dan pemilahan, kurangnya ekskavator di TPA, dan kurangnya pasokan truk sampah dan kendaraan pengumpul sampah.

### Abstract

#### Keywords:

*Solid waste management; Supply Chain; Circular Economy; waste bank.*

*Keeping the materials at their highest value for as long as possible through reusing and recycling the waste, was the most applicable method for waste elimination, an application of the circular economy concept in Indonesia. The problem in waste management in Pangkalan Kerinci is, that during the transport and treatment to the landfill area, the waste is not sorted and mixed yet. This study uses a descriptive method with a qualitative approach. The study found that the town of Pangkalan Kerinci Environmental service have serve 72% of the town area, using 19 vehicles (dumping truck), 5 main routes for waste collection, 4 collapsible vehicles (bin container truck), and motorcycles for non-accessible locations. Problems found in waste management in Pangkalan Kerinci are; the*

*lack of waste banks and garbage bins, lack of personnel in transporting and sorting, lack of excavators in the landfill facility, and the short supply of dump trucks and waste collecting vehicles*

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## 1. INTRODUCTION

The concept of circular economy (CE) is one of the most promising approaches for designing sustainable businesses for the future (Hazen et al, 2020). CE refers to regeneration systems that slow down, close, and contract the circulation of matter and energy, thereby minimizing the use and disposal of resources, emissions, and leakage of energy (Geissdoerfer, 2017). According to (Wangsaputr, 2020) the process of recycling municipal waste is a part of the circular economy. A major key to the circular economy is restructuring the capital, including financial, manufacturing, human, social and natural capital.

Waste could be comprehended as a residue or waste product, an effect of a technological or natural process that has no economic value and is no longer beneficial to the environment. The conditions of uncoordinated waste primarily were caused by a lack of proper management, so the issues should be solved. Therefore, proper waste management is necessary to create added value from the waste without damaging the environment (Sampurna, 2021).

The urban area has become one of the areas that produced a lot of waste. According to (Kristiyanto, 2007) population growth has driven the growth and development of the urban area. Population growth will affect community consumption and activities, leading to an increase in the amount of generated waste. Waste generated by activities and consumption of the community, which is classified as household waste, has become an environmental problem that needs to be regulated by governments and managed by communities themselves.

According to (Mulasari, 2016), the waste problem in Indonesia is difficult to be managed; due to the majority of Indonesian lack of environmental awareness. This lack of environmental awareness leads to other problems such as pollution. Improper waste management could lead to negative consequences such as a repulsive environment that could generate various diseases. It is necessary to manage waste appropriately and establish a waste management system that could prevent environmental problems.

One of the areas with waste management problems is the town of Pangkalan Kerinci. Pangkalan Kerinci is a town in Pelalawan regency in Riau Province with approximately 69,444 population. Pangkalan Kerinci is a sub-district that is also the capital of the Pelalawan Regency. The town of Pangkalan Kerinci is central to various activities in the regency such as offices, residences, and markets. According to the Pangkalan Kerinci Environmental Service, the potential of generated waste predicted from 2021 to 2026 ranges from 58,468.3 to 78,243.8 tons per year. Therefore, in reducing unmanaged waste, the efforts in waste reduction and management need to be scaled up. While the problem is, that during the transport and treatment to the landfill area, the waste is still in mixed condition and unsorted.

To overcome this problem, the supply chain literature has suggested applying various aspects of the CE concept. Especially in the topics of Green Supply Chain Management (GSCM), sustainable supply Chain Management (SSCM), and Closed Loop Supply Chain Management (CLSCM) (Govindan, 2017; Guide, 2009; Stindt, 2016; Liu, 2018]. A study on the structure of the waste supply chain at Pangkalan Kerinci has not been conducted and needs to be investigated. This study focuses only on types of household waste, street waste (natural waste), and market waste.

## 2. METHODS

This study uses a descriptive method with a qualitative approach. According to (Moleong, 2017), qualitative research is generally descriptive, tends to use inductive analytical approaches that take place in natural settings, and the data collected are generally qualitative.

This research was conducted by the town of Pangkalan Kerinci Environmental Services. Samples were selected through purposive sampling. Primary data were obtained through interviews and observations related to waste management by the town of Pangkalan Kerinci Environmental Service. Secondary data were obtained from documents such as the vision and mission, goals and objectives, main tasks and functions, organizational structure, and waste management activities program of the town of Pangkalan Kerinci Environmental Service.

Data validity was tested by source triangulation. Source triangulation was used to compare sources obtained by the authors from interviews, observations, and literature searches .

Data analysis techniques in conducting this study include:

- a. Supply chain analysis is obtained by tracing from Kemang Integrated Waste Management Facility (Tempat Pembuangan Sampah Terpadu or TPST) and Pasarbaru Integrated Waste Management Facility (TPST) to the Kemang Village Landfill (Tempat Pembuangan Akhir or TPA). Data are provided by the town of Pangkalan Kerinci Environmental Services.
- b. The waste supply chain analysis will be traced from the Pangkalan Kerinci waste disposal site to the landfill (TPA).
- c. Data validation is processed with triangulation.

### 3. RESULT AND DISCUSSION

#### 3.1. The actual condition of solid waste management in Pangkalan Kerinci

According to the results of an interview with the personnel of the town of Pangkalan Kerinci Environmental Service, their service have reached coverage of 72% of the town area and their waste collection service includes:

- a. Waste is transported using 19 vehicles (dumping trucks)
- b. There are 5 main routes for waste collection. The waste collection routes are presented in Fig 1.
- c. Pick up waste with 4 collapsible vehicles (bin container truck)
- d. Motorcycles collect the waste from a non-accessible location.

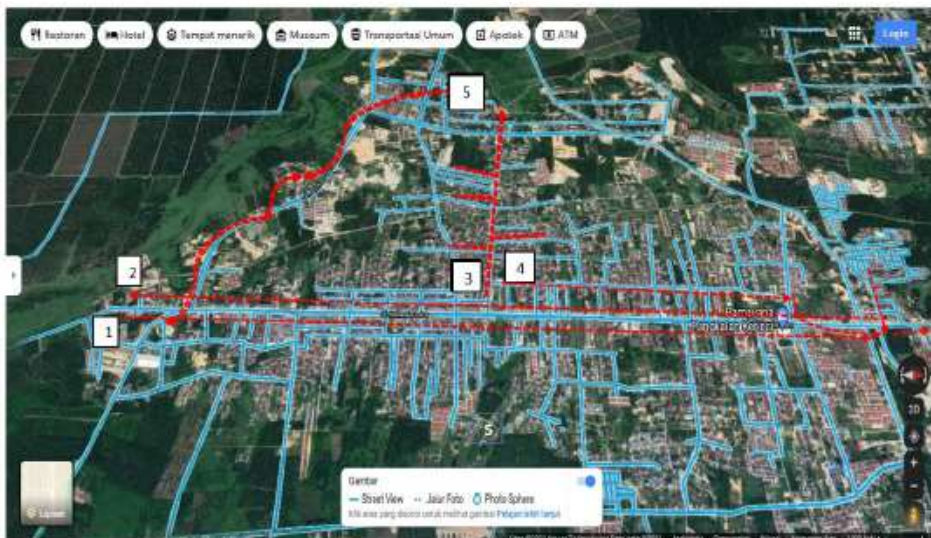


Fig. 1 Routes for Waste Collection in Pangkalan Kerinci

Based on Fig 1, there are 5 main routes for waste collection. These 5 main routes are based on the main roads in the Pangkalan Kerinci area. According to the results of the interview with the personnel in the Environmental Department of Pangkalan Kerinci, there are some problems in solid waste management; lack of waste banks and garbage bins, lack of personnel in transporting and sorting, lack of excavators on the landfill facility, and the short supply of the dump trucks and waste collecting vehicles.

There are several points of waste piles in the area of Pangkalan Kerinci town. The waste was transported using a vehicle that is provided by the local government. The daily schedule for garbage collection service for office areas, medical facilities, and schools starts from 7 am to 4 pm (WIB) and the schedule for garbage stacking in the designated site is start from 7 pm to 6 am (WIB). The waste pile condition can be seen in Fig 2.



Fig 2. (a) waste-piles on Jl. Lingkar; (b) Waste piles at the previously known BTN intersection; (c) waste pile in Pasar Baru.

### 3.2. Identification of the Structure of the Waste Supply Chain

The structure of the waste supply chain in Pangkalan Kerinci starts with waste transportation from 5 main routes to TPS Kualo and TPS Pasar Baru. The TPS Kualo and TPS Pasar Baru have separated the collected waste into organic and inorganic waste. The organic waste will be processed to be composted, while the non-organic waste will be sold to waste handlers in Pekanbaru. Waste that cannot be processed at Pasar Baru and Kuala TPS will be forwarded to Kemang TPA. The next waste supply chain is the Landfill or TPA located in the Kemang area. The structure of the transportation route for waste disposal in Pangkalan Kerinci Town can be seen in Fig 3 and the structure of the waste supply chain in the Pangkalan Kerinci can be seen in Fig 4. .

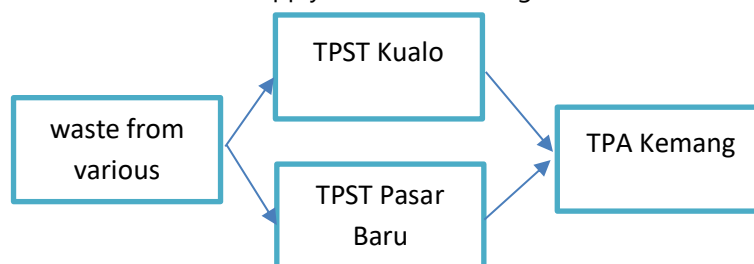


Fig 3. The structure of the vehicle route for transporting waste in Pangkalan Kerinci

Waste in Pangkalan Kerinci consists of both organic and non-organic waste. All collected waste is transported immediately to TPS, and from TPS to TPA without any sorting or treatment process. Usually, many people assumed that plastic waste is no longer valuable and must be disposed of immediately in landfills. People who dispose of the waste thought that they have just done enough. They never think about the consequences, paying the fee for transporting waste from their location to the Temporary Shelter (TPS) is considered the end.

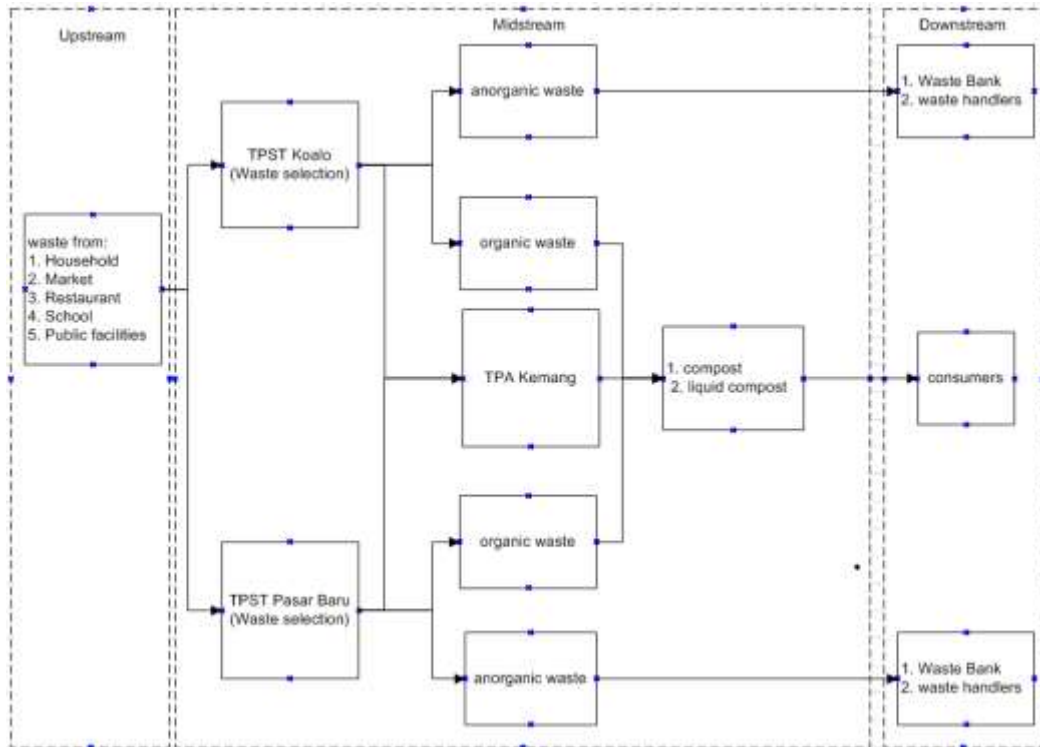


Fig 4. The structure of the waste supply chain in Pangkalan Kerinci

Based on Fig 4, the details are as follows:

a. Upstream

In this study, the commodities produced in the supply chain are in the form of waste, and the waste came from:

a) Household

Household waste is waste that is no longer useful or result of exploited material as used by the communities. Waste comes from Jl. Akasia, Jl. Pemuda, Jl. Lintas Timur Kelurahan Pangkalan Kerinci Timur, Jl. Keluarga, JIDtk Engku Raja Lela, Jl. Arbes, Jl. Ambisi, Jl Sakura, Jl. Kamboja, Perum BTN Lago Permai, BTN Lama and its surroundings neighborhood.

b) Market

The waste collected from the market is a mixed waste of organic and non-organic waste. Market waste is located in the Pasar Baru district, which is the largest waste supplier in Pangkalan Kerinci and the volume is daily increased.

c) Restaurant

Restaurant waste is waste from restaurants in different areas and restaurants in the capital of Pangkalan Kerinci. Among them are the restaurant in the Jl Lintas Timur, Jl Acacia and Jl Pemuda.

d) school

Garbage is collected from human consumption at the school around. As well as in the East Highway region, the Evergreen School, PGRI School-East, the Sub-District Head Office - Perum Bumi Asri II - SDIT At-Taqwa.

e) Public facilities

The garbage generated by plants around expressways and garbage generated by existing public facilities. Garbage originated from New Canal Area, Regent's Office, Cuaron, Bhakti Praja, Jalan Langgam 7 km.

b. Midstream

The midstream supply chain focus on production management, manufacturing, and inventory control. Sometimes referred to as information flows involved in the midstream or the Pangkalan Kerinci waste supply chain, are treatment processes that include:

a) The temporary housing is divided into two locations, the Kualo area, and the Pasar Baru area. This waste collection point will be the collection point before the waste is disposed of at the TPA. Waste is selected and processed into compost. Plastic waste is not processed into compost but sold in waste collectors.

- b) The Kemang district landfill is the final destination for all waste. Discarded waste can no longer be recycled. Before disposing of the waste, the wastes were weighted to determine the total weight of the waste capacity.
  - c) The product of processed waste is compost. the Fertilizer is produced daily and traded with the consumer, or any company that needs it. In addition, people also become the primary consumer of purchasing compost fertilizer.
- c. Downstream
- The downstream supply chain includes all activities related to delivering products to end customers. In the downstream supply chain, the focus is on logistics, warehousing, transportation, and after-sales service. This includes downstream consumers who buy organic waste products that have been processed into compost, including:
- a) Public Works Department
  - b) Company, and
  - c) Public.

#### 4. CONCLUSION

Based on the identification of the existing supply chain structure, it can be used as a reference to examine the structure of the waste supply chain of Pangkalan Kerinci. So that stakeholders can establish policies to overcome the existing waste problem in Pangkalan Kerinci. In addition, there is also no application of the circular economy in waste management problems involving residents.

Temporary Shelters (TPS) are divided into two points, namely in the area of Kualo and Pasar Baru. Garbage arrived at TPS and was collected from many sources and places. To the decreased amount of waste transported and carried to TPS, community empowerment can be employed in sorting the waste from each existing settlement. One of the empowerment is by establishing Waste Banks in residential areas, so that waste can be processed to increase its value. Additional provision of the garbage bin should be added to prevent scattered or messy waste. Based on the identified waste supply chain structure, analysis can be done to improve the next supply chain structure design and overcome the waste problem existing in Pangkalan Kerinci. In addition, it is possible to calculate an effective and efficient transport route by installing a garbage transport shelter.

#### 5. ACKNOWLEDGMENTS

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