ZONATION STUDY AND WASTE MANAGEMENT MODELS IN ORDER TO IMPROVE ENVIRONMENTAL QUALITY, KUPANG CITY

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ABSTRACT.

In 2015, the City of Kupang was able to manage 36% of the waste generated by the residents of Kupang City. Still far from the target set by the Government through Permen PU Number 21 Year 2006, which is 70%. This research aims to arrange the zoning of waste collection and transportation, zoning of the level of waste services based on the physical criteria of the region and evaluating the suitability of the pattern of waste services organized by the Kupang City government with the physical criteria of the region and to compile a waste management model according to zoning. Zoning is obtained by mapping the physical criteria of waste collection patterns which are then overlaid using the Geographic Information System tool. The results showed that the zoning collection and transportation of waste results of the study in the BWK Region II and III of Kupang City can be applied zoning patterns of collecting and transporting individual waste directly, indirectly and indirectly communally. While the service level zoning study results can be divided into three waste management zones. There is a difference / discrepancy between the existing conditions of the collection of waste transportation organized by the City of Kupang with the zoning results of the pattern of collection and transportation of the results of the study based on the physical criteria of the region in accordance with Indonesian National Standard No. 19-2454-2002. The direct communal pattern as the current dominant pattern does not match the study results pattern, namely the indirect and indirect communal patterns. The waste management model based on the results of the zoning assessment can be done based on waste segregation and management based on zoning collection, transportation and service levels.

Keywords: zoning, garbage collection, garbage transportation, garbage services, Kupang city

INTRODUCTION

The rapid growth of cities in Indonesia has not been matched by rural development, which has led to regional development gaps. The impact caused by the development gap between urban and rural areas is the emergence of large migration flows from rural to urban areas. Migration of population to urban areas will result in increased population density in urban areas. Along with growing population without being balanced with the growth of basic infrastructure and facilities that are good settlements will bring great pressure on the environment. Great pressure on the environment will result in a decrease in the quality of the environment itself. The impact of rapid population growth on the environment is the increase in household / domestic waste, industrial and transportation waste, land exploitation and land

quality degradation, depreciation and pollution of water and land resources (Soemarwoto, 1991).

Household / domestic waste is one of the causes of environmental degradation in urban areas. Household waste arises due to the large number of population coupled with the large number of development activities. The production and volume of waste will be directly proportional to the development and increase in population (Tchoblanoglus, 2002).

Various efforts need to be made to overcome the problem of waste in urban areas, one of the efforts that can be done is to involve as much community participation as possible, in addition to increasing the role of government and the private sector in waste management. This needs to be done given the ability of local governments in terms of financing waste management is still very weak, it is hoped that the active participation of the public and private sector in waste management can minimize waste financing (Damanhuri, 2010).

Kupang City is the capital of East Nusa Tenggara Province classified as a medium-sized city with a population of 409,703 people in 2015. The ability of the Kupang City Government to manage waste generated by the residents of Kupang City is still far from the target set by the Central Government through Permen PU No. 21/2006 regarding Policies and Strategies for the Development of Waste Management Systems (KSPSPP) which is 70%. The ability of the Kupang City Government to transport waste to the Final Waste Processing Site in 2010 is 228 m3 per day from the volume of waste as much as 783.24 m3 or 20% equivalent. In 2011 the waste service experienced a decrease of only 174 m3 or 16% of the volume of waste per day as much as 1098 m3.

In 2012 the average transport capacity per day decreased by 174 m3 or only 15.51% of the volume of waste of 1,122 m3 per day (RPJMD Kota Kupang 2013). 2014 was the highest year of waste service, where the volume of garbage transported per day was 400 m3 or only 36.87% of 396,025 m3 (Kupang City RPJMD 2014). In 2015 the volume of garbage

transported per day decreased by 416 m3 or 36% of the volume of waste 1,126 m3 per day (Kupang City RPJMD 2015).

The current waste management carried out by the Kupang City Government is to use a pattern of direct and communal individual and direct individual collection and transportation which takes a long time to operate and requires a large number of transport fleets and operators. So that not all waste removal points can be visited every day for the garbage to be transported. This non-transport of rubbish eventually leads to the phenomenon of rubbish buildup at the point of removal of rubbish, which in turn gives rise to reactions of the community's rejection of the location / point of removal of rubbish due to the unpleasant odor generated by unloaded rubbish.

This large amount of unloaded garbage has certainly become a problem for the residents of Kupang City. It is often encountered the emergence of the phenomenon of accumulation of garbage in temporary landfills (TPS) and on the edge of the Kupang City highway which directly or indirectly affects the beauty and health of the residents of Kupang City itself. The problems caused by the accumulation of waste include increasing the amount of methane (CH4) and carbon dioxide (CO2) so that it will reduce air quality, causing water pollution due to the process of washing garbage by rain water so that the water quality decreases. The physical form of rubbish can also inhibit the flow of water and silt the river, causing flooding. Besides the accumulated rubbish will become a place for disease vector development (Tobing, 2005).

As for the garbage that has been able to be transported by the Kupang City Government, it is also a problem for Alak TPA, which has an area of only 5 hectares. The results of the technical study of the Alak landfill improvement planning covering technical aspects, institutional aspects and financial aspects show that if there is no optimization of the

landfill management, the landfill can only be operated until 2016 (Julianus and Hermana, 2009).

Community-based waste management in Kupang City is still very minimal because there are not many TPS3R-based waste processing sites or garbage banks. The garbage bank itself was only initiated in 2014, facilitated by the Kupang City Government and the private sector.

The regulation on household waste management that needs to be referred to in urban waste management is Permen PU No. 3 of 2013 concerning the Implementation of Waste Infrastructure and Facilities in Handling Household Waste and Trash of Similar Household Waste and Indonesian National Standard No. 19-2454-2002 concerning Procedures for Operational Techniques for Urban Waste Management.

Referring to the above discussion, it is necessary to do research on zoning and the model of waste management in Kupang City based on regulations namely Indonesian National Standard No. 19-2454-2002 in the BWK II and BWK III areas of Kupang City. The selection of the BWK II and BWK III areas is because in this area all physical aspects needed in the preparation of zoning can be found and in this region the Spatial Detail Plan has been completed by the Kupang City Government so that the basic map of the planning results can be used as a reference.

The creation of a waste management model through the regional spatial approach with the concept of waste zoning is expected to help the government program in waste management. This is in line with the mandate of Law Number 18 Year 2008 where the approach to waste management approaching upstream or the source of waste generation will be more effective, in this case the City Government of Kupang will be easier and more focused in providing the type of service according to the specified service zone. .

RESEARCH METHOD

The research location was carried out in the Kupang City area, namely in the Region II City Region (BWK II) and City Region III Region (BWK III). The population in this study is the population in the BWK II and BWK III areas of Kupang City. The determination of the sample using simple random sampling technique which is a form of probability sampling technique that each sample is selected based on selection procedures and has the same opportunity to be selected as a sample (Kuncoro, 2003).

Sampling was preceded by calculating the determination of the number of respondents who are residents of the kelurahan in the BWK II and BWK III areas of Kupang City, determining the number of samples using the Slovin formula, namely:

$$n = \frac{N}{1 + N(e)^2}$$

Information :

n = number of sample members needed
N = population member
e = margin error (estimated error of 10%)

The initial step in determining the number of samples is done by calculating the population in the BWK II region in 2015, namely N = 66,857 inhabitants (BPS, 2015), so that by using an estimation error of 10%, the minimum number of samples (n) taken are:

$$n = \frac{66.857}{1 + 66.857(10\%)^2} = 99{,}850 \approx 100$$

The population in the BWK III region in 2015 was N = 92,513 inhabitants (BPS, 2015), so by using a 10% estimation error the minimum number of samples (n) taken were:

$$n = \frac{92.513}{1 + 92.513(10\%)^2} = 99{,}892 \approx 100$$

After knowing the number of members of the sample then the sampling using the accidental sampling method is that the sampling is imposed on individuals who incidentally are found or can be found under study (Sugiyono, 2008).

To obtain data sources in this study, sample survey and observation methods were used. The sample survey was conducted by administering questionnaires to residents found in the BWK II and BWK III areas of Kupang City to get primary data on community participation in waste management. While direct observations in the field related to the implementation of municipal waste management operations and interviews with management agency officials according to the type of data needed to support research whose basic purpose is to optimize existing waste management. Secondary data was collected from the Kupang City BPS, demographics of the population to look for data on population, population density and area of Kupang City's BWK II and BWK III and the City of Kupang Sanitation and Landscaping Office to find data on the location of waste removal / Temporary Waste Disposal Sites (TPS), documentation in the form of articles and scientific journals on urban waste management and geographical analysis.

The data used in this study were analyzed using two approaches, namely (1) the development of an assessment model and the database of Geographic Information Systems, (2) spatial data analysis using Geographic Information Systems and continued with descriptive analysis.

The assessment model to determine service level zoning, waste collection and transportation patterns is based on service level requirements and each waste collection pattern will automatically be followed by the waste transportation patterns required by SNI 19-2454-2002.

The development of an assessment model to determine service level zoning and collection patterns followed by the pattern of solid waste transportation is carried out as follows:

1. Conduct a literature review so that assessment criteria will be obtained which are theoretically key factors in the development of a zoning determination assessment model.
2. Determine physical criteria as a basis for spatial analysis (overlay) to get zoning.
3. Development of service level assessment model design, waste collection and transportation patterns.

Assessment models in determining service level zoning, waste collection and transportation patterns based on criteria issued by the Balitbang of the Ministry of Public Works (1990) and SNI 19-2454-2002. Criteria for waste collection patterns issued by the Balitbang Department of Public Works and SNI 19-2454-2002 are divided into two categories, physical and non-physical. Physical criteria are criteria that can be mapped and non-physical criteria are criteria that cannot be mapped.

Physical criteria consist of slope of land, road network, distribution of settlements, business centers, waste generation, population density and availability of relocation sites. Whereas the non-physical criteria consist of the community's participation in waste management and the role of the village apparatus in facilitating waste management in their area.

Based on the above criteria and to make it easier to conduct spatial analysis by overlaying the map of physical criteria for determining the level of service zoning, patterns of collection and transportation of waste, it is necessary to arrange classifications for each physical criteria as follows:

1) Slope of land consists of two slope classes, i.e. if <5% and> 5% are known

2) The road network is divided into two classes based on the width of the road, i.e. <3 m for environmental roads and> 3 m for collector and arterial roads.
3) Distribution of settlements consists of regular and irregular settlements.
4) Distribution of public services consists of the central business district (CBD): areas of trade and public services in the "City Area (BWK)", traditional markets (large), tourist destinations, bus terminals, ports / airports, hotels
5) Waste generation is based on the built up area with garbage pile> 0.3 m3 / day and the unbuilt area with waste pile <0.3 m3 / day.
6) Availability of the location of waste removal in accordance with existing in the scope of the waste management area.
7) Population density is based on population / ha consisting of population density> 100 inhabitants / ha, 25 <population density <100 inhabitants / ha, population density <25 inhabitants / ha

While the assessment code of the physical criteria can be seen in the Table below:

Table 1. Zoning Determination Assessment Model

Physical Kriteria	**Valuation model code**	
Slope of land	< 5 % > 5 %	K1 K2
Road Network	< 3 m > 3 m	R1 R2
Distribution of settlements	Regular Irregular	S1 S2
Waste generation	< 0,3 m^3/Hari > 0,3 m^3/Hari	T1 T2
Distribution of public service	Trade area market tourist destination bus terminal port airport hotel corridor	P1 P2 P3 P4 P5 P6 P7
Population density	density > 100 p/ha 25 < density <100 p/ha density < 25 p/Ha	D1 D2 D3

source: SNI 19-2454-2002andresults of analysis (2017)

Table 2. Combinations of model valuation codes and physical criteria for determining zoning for collection and transportation

Garbage collection patterns	**Combination of valuation models**	**Transport patterns**
Direct individual pattern	K2R2S1T2 K2R2S2T2	Direct transportation
indirect individual pattern	K1R2S1T2 K1R2S2T2 K1R1S1T2 K1R1S2T2	Transportation through a transfer system to a temporary disposal site or transfer station (*Transfer Depo*)
Dirrect komunal pattern	K2R1S2T2	Container transportation
Indirect communal pattern	K1R2 K2R2	

source: SNI 19-2454-2002 and result of analysis(2017)

Table 3. Combination of assessment model codes and physical criteria for determining zoning of waste service levels

Service level	**The requirements**	**Combination of valuation models**
Zone I	a. density > 100 p/ha b. Trade area c. market d. tourist destination e. bus terminal f. port g. airport h. hotel corridor	D1P1P2P3P4P5P6P7
Zone II	a. density > 25 p/ha < 100 b. is there any or not market c. is there any or not tourist destination d. is there any or not bus terminal	D2P2P3P4 D2P2P3 D2P2P4 D2P3P4
Zona III	a. density < 25 p/ha b. is there any or not market c. is there any or not bus terminal	D3P2P4 D3P2 D3P4

Source: SNI 19-2454-2002 and Modul F45.PZ02.003.01

RESULTS AND DISCUSSION

Part of City Region (BWK) II and III according to Kupang City Regulation No. 11 of 2011 concerning Spatial Planning for the City of Kupang in 2011 - 2031, covering 4 sub-districts and 12 sub-districts, namely part of Kota Lama sub-district, Kelapa Lima sub-district, part of Oebobo sub-district and part of Maulafa sub-district. The population in the BWK II and BWK III areas is 145,343 inhabitants with a total family of 37,183 (BPS 2016). More detailed population per kelurahan as in Table 4.

Table 4. Population numbers by sex and number of HHs in BWK Region II and BWK III

Village office	**Total Population**	**Soul density (Jiwa/Ha)**	**BWK**
Pasir Panjang	7678	123.8	II
Nefonaek	4184	123.1	
Fatululi	18402	76.0	
Kayu Putih	12235	72.4	
TDM	10331	97.5	
Liliba	14027	13.4	III
Kelapa Lima	16248	63.2	
Oesapa	27822	63.7	
Oesapa Barat	11077	68.4	
Oesapa Selatan	4307	36.2	
Lasiana	13889	26.6	
Penfui	5143	38.4	
TOTAL	**37183**		

source : BPS 2016 and result of analysis (2017)

1. Slope of the Land

Physical criteria of land slope are very influential in determining the pattern of waste collection and transportation. In accordance with SNI-19-2454-2002, the slope of the land to determine the pattern of collection and transportation is divided into two classes, namely slope <5% and slope of 5%>.

After analyzing the slope of the land in the BWK II and BWK III areas of Kupang, the results obtained for slope <5% covering an area of 2,200.48 Ha or 67.25% and for a slope of> 5% covering an area of 1,071.53 or 32.75%.

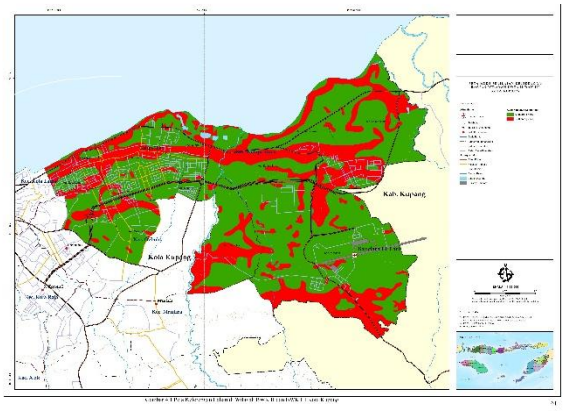

Figure 1.

2. Road Network

The road network in BWK II and III consists of several types of roads, namely arterial roads, collector roads and neighborhood roads. As a differentiator of the three types of roads is the function and width of the road.

The results of the road analysis show that road buffers <3 m wide in the BWK II and BWK III areas of Kupang City cover 107.57 hectares or 16.3% of the roads in the BWK II and BWK III areas of Kupang City.

While road buffers with a width of> 3 m in the BWK II and BWK III areas of Kupang City the results of the analysis show an area of 553.63 Ha or 83.7% of the roads in the BWK II and BWK III areas of Kupang City

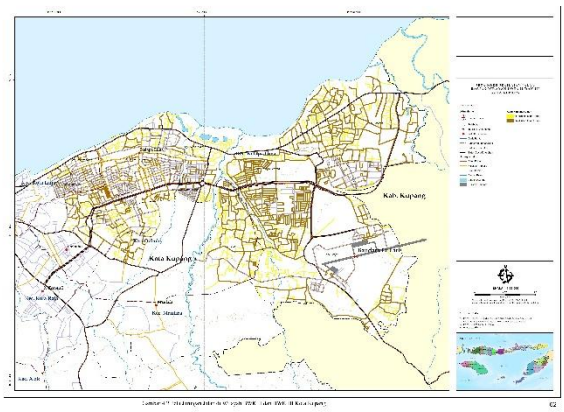

Figure 2.

3. Distribution of settlements

The pattern of settlements in the areas of BWK II and BWK III according to the results of the analysis showed 1,268.33 Ha or 98.09% are regular settlements with typical adequate plot size so that the distance between houses is quite well marked by the presence of a yard, adequate road facilities, direction towards the house orderly.

While irregular settlements are found in a small part of the Oesapa and West Oesapa districts, which are 24.66 Ha or 1.91%, where there are a number of dense houses facing irregularly facing, houses are restricted by narrow roads / alleys, supporting sanitation facilities are limited limited, located in coastal areas and near markets.

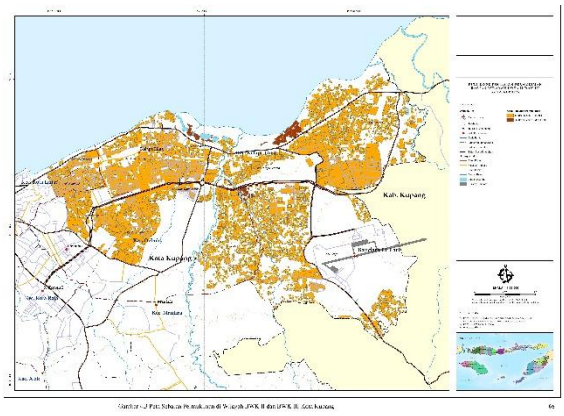

Figure 3.

4. Waste generation

Analysis of solid waste generation in the City BWK II and BWK III areas shows 1,751.10 Ha or 53.47% of the undeveloped area that produces waste <0.3 m3 / day. These undeveloped areas are mostly terrain, tidal areas and green belt. Whereas areas with rubbish generation> 0.3 m3 / day are areas built with an area of 1,524.02 Ha or 46.53% of the area of BWK II and BWK III of Kupang City. Most of the developed areas are residential areas and public facilities such as offices, schools, shops, markets, hotels, terminals etc.

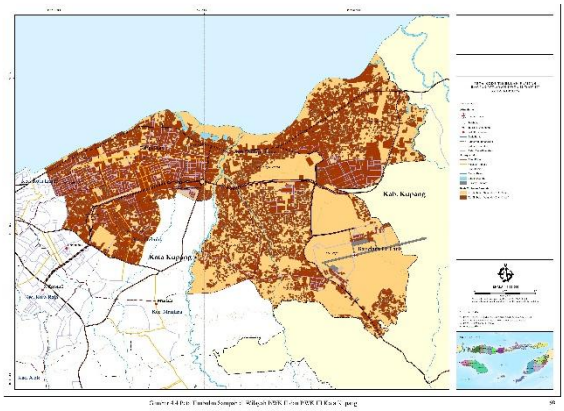

Figure 4.

5. Waste Removal Points

The garbage removal points in the BWK II and BWK III areas which are targeted for the operation of the Kupang City Sanitation Department's garbage fleet are 167 points.

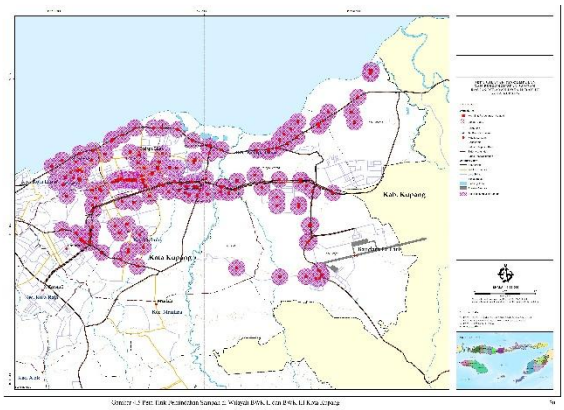

Figure 5.

6. Distribution of Public Services

The results of observations in the BWK II and BWK III areas for the trade area were found in the Fatululi Urban Village area with the presence of the Oebobo shop complex and the Lippo shopping center / mall. Public services in the form of markets are found in Fatululi Urban Village, namely Oebobo Market, Oesapa Urban Market, Oesapa Market, and Penfui Urban Market, Penfui Market. The public service of a tourist destination is found in the Lasiana district, namely the Lasiana tourist beach. The bus terminal is found in the Fatululi sub-district, the Oebobo bus terminal. Seaports as public services are not found in the BWK II and BWK III areas of Kupang City. While the airport is found in the Penfui Urban Village, El

Tari Airport. Hotel corridors are found along the Timor Raya road in the districts of Pasir Panjang, Kelapa Lima, West Oesapa and Oesapa.

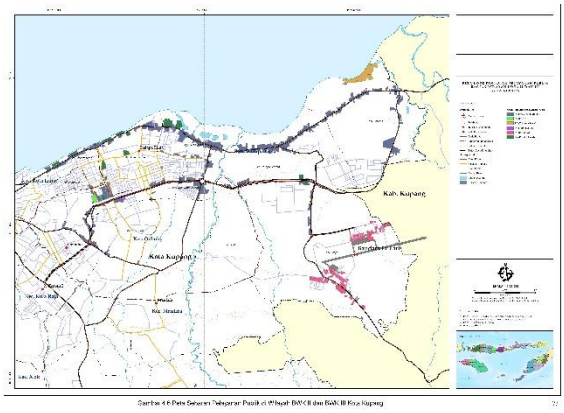

Figure 6.

7. Population Density

Results of the analysis of population density in the BWK II and BWK III areas of Kupang City are areas with a density of> 100 inhabitants / ha totaling 216.33 Ha or 6.61%. While areas with a population density of <25 people / ha are 290.97 Ha or 8.89% of the total area of BWK II and BWK III Kupang City. While the area with a population density of 25 <P <100 inhabitants / ha covers an area of 2,764.71 Ha or 84.50% of the total area of BWK II and BWK III Kupang City

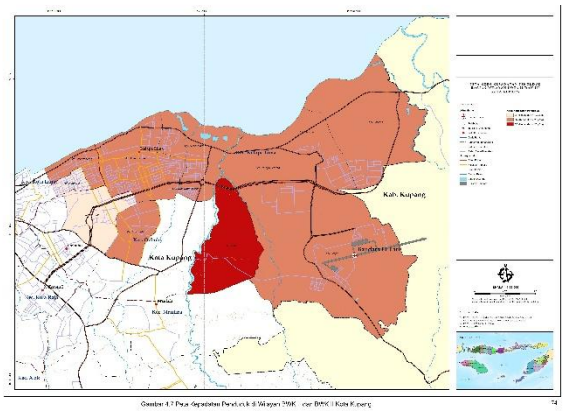

Figure 7.

8. Community participation

In general, community awareness at the location of the study carried out independent waste management is still low, this can be seen in the answers of respondents 86.5% did not carry out the process of sorting waste, only 13.3% of the people who have been sorting waste according to the type of waste.

However, if the independent waste management movement is facilitated by the government, the community's desire to conduct waste management independently is very good, this is indicated by the answers 84% of respondents said they were willing to do the sorting of waste, while 16% of the public stated not willing to do.

Community compliance with regulations is also still low, this is shown from the results of observations on people who access the new TPS 27.5% of people who know and obey when allowed to dispose of waste, 40.5% of people are not aware of the rules on the time allowed to dispose rubbish. Community compliance with regulations is important to support the control system for collecting and transporting waste. This control system becomes one of the requirements for the pattern of collecting and transporting individual waste directly, indirectly, and indirectly communal, where the active participation of the community is shown by storing their respective waste up to the time allowed to take out the waste to be transported by officers or to dispose of waste in communal containers that have been determined to be transported by officers.

9. Participation of Village Officers

The participation of government officials, in this case the village officials, is in order to increase the active participation of the community is still limited to mobilizing the community to do community service every week. The active role of the Kelurahan officials that stood out according to the results of observations was only found in the Kelurahan Nefonaek. Nefonaek Village is the only village that has initiated the establishment of a

community of waste management communities. In addition to initiating waste management communities, the Nefonaek Village apparatus also provided the community with knowledge of waste management.

The interest of the kelurahan apparatus in waste management decreased along with the elimination of the KGC competition at the kelurahan level. So, that the budget allocation for the Kelurahan is no longer focused on efforts to improve the hygiene and environmental health of the kelurahan.

10. Zoning for Collection and Transportation of Waste from Assessment Results

Based on the analysis of physical criteria overlay in the form of slopes of land, road networks, distribution of settlements, waste generation and removal locations, obtained the following matters:

1. Slope of land in BWK II and BWK III Kupang City which is divided into two slope classes (<5% and> 5%) supports the implementation of all existing garbage collection and transportation patterns.
2. The road network in BWK II and BWK III Kupang City consists of arterial roads, collector roads and neighborhood roads of varying widths. The three types of roads are divided into two broad categories namely <3 m for environmental roads and 3 m for arterial and collector roads. The condition of the existing road network supports the application of all waste collection and transportation patterns.
3. Distribution of settlements in BWK II and BWK III Kupang City are classified in two classes, namely regular settlements and irregular settlements supporting the implementation of all patterns of garbage collection and transportation.
4. Waste generation in BWK II and BWK III Kupang City is divided into two sources of generation in the built area with garbage generation> 0.3 m3 / day and the area not built with waste generation <0.3 m3 / day. Based on these conditions, waste generation in

BWK II and BWK III in Kupang City is suitable to support the implementation of all waste collection and transportation patterns.

5. The availability of existing relocation sites in waste management in BWK II and BWK III Kupang City only supports the collection of indirect individual patterns, direct communal patterns and indirect communal patterns, whereas in direct individual collection patterns it does not require the support of the availability of displacement locations

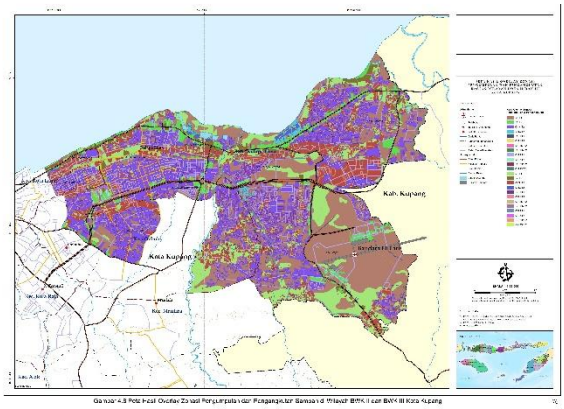

Figure 8.

Based on the zoning of the collection and transportation patterns of the results of the assessment as shown above, three ideal collection patterns are obtained to be applied to the BWK II and BWK III of Kupang City, namely the pattern of direct individual collection, indirect individual collection patterns and indirect communal patterns in accordance with SNI criteria 19-2454-2002. Based on the collection pattern, the waste transportation pattern will follow the following pattern:

1. Collection of rubbish with individual direct patterns, transportation of waste using direct transport patterns.
2. Garbage collection with an indirect individual pattern, with the existing transfer point being TPS.

3. Garbage collection with an indirect communal pattern, with the existing transfer point is in the form of garbage containers, TPS and containers.

11. Waste Level Zoning Service Assessment Results

Based on the analysis of physical criteria overlay in the form of the distribution of public services and population density obtained the following matters:

1. The distribution of public services in the BWK II and BWK III areas supports the implementation of 3 waste service level zones, because there are hotel corridors along the Raya Raya protocol road, Central Businnes Distric (CBD) area in Fatululi Sub-district, markets in Fatululi Sub-district, Oesapa and Penfui, a bus terminal in the Fatululi sub-district, airports in the Penfui sub-district, tourist destinations found in the Lasiana sub-district.

Population density in the BWK II and BWK III areas supports the implementation of 3 zones of waste service level, because there are 3 different classes of population density. Population densities of> 100 people / Ha are found in Nefonaek and Fatululi Sub-Districts. Population density 25> P <100 inhabitants / ha found in the village of Pasir Panjang, Kayu Putih, TDM, Kelapa Lima, Oesapa, West Oesapa, South Oesapa, Lasiana, Penfui. Population density <25 inhabitants / Ha found in Liliba Urban Village

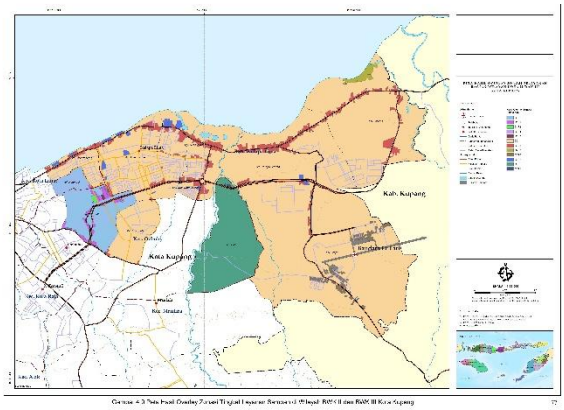

Figure 9.

According to the results of the analysis of physical criteria overlay in the form of the distribution of public services and population density obtained the following matters:

1. The distribution of public services at BWK II and BWK III Kupang City divided into six classes supports the implementation of all existing patterns of waste service levels.
2. Population density at BWK II and BWK III Kupang City consists of three classes namely> 100 inhabitants / ha, 25> P <100 inhabitants / ha and density <25 inhabitants / ha, supporting the implementation of all existing patterns of waste service levels.

Based on the level of waste service according to zone, the scope of service and transportation of waste follows the following pattern:

1. Zone I: service coverage up to 100%, street sweeping, waste collection patterns using direct individual patterns, indirect individual collection and indirect communal patterns. The territories included in Zone I are Nefonaek and Fatululi.
2. Zone II: service coverage up to min. 70%, RT-based waste segregation, with the pattern of collecting and transporting individual waste directly to indirect individual collection and patterns of indirect communal collection and transportation. The territories included in Zone II are Pasir Panjang, Kelapa Lima, West Oesapa, South Oesapa, Oesapa, Lasiana, Tuak Daun Merah, Kayu Putih and Penfui.
3. Zone III: community-based waste management, sorting and RT-based waste management, local waste transportation. The kelurahan that is included in zone III is Liliba kelurahan.

12. Analysis of Conformity of Existing Collection and Transportation Patterns with Zoning Collection and Transportation of Assessment Results

The patterns of collection and transportation of existing waste in the BWK I and BWK II areas of Kupang City are found in three patterns, namely the pattern of collecting and transporting individuals directly, indirectly individuals and direct communal. Individual

patterns are directly found along the protocol roads in the BWK II and III areas of Kupang City, namely in the areas of Pasir Panjang, Kelapa Lima, West Oesapa, Oesapa and Lasiana. Individual patterns are not directly found in the BWK II region, namely in the Nefonaek village. The direct communal pattern is the most common pattern found in the BWK II and III areas of Kupang City, almost the entire existing pattern is the direct communal collection and transportation pattern.

The pattern of garbage collection and transportation results of the study show that in the BWK I and BWK II areas of Kupang City three types of garbage collection and transportation can be applied, namely the pattern of collecting and transporting individual directly, the pattern of collecting and transporting indirect individuals and the pattern of collecting and transporting indirect communal.

There is a compatibility between the existing conditions of collection and transportation of indirect communal pattern waste with the results of the study, namely waste management in the CBD area of the Oebobo market, Ruko, Lippo Mall and Siloam Hospital Fatululi Village. The suitability of the results of the study with the existing conditions of collecting and transporting individual waste patterns is not directly found in the Nefonaek kelurahan location, where there is a garbage motor that collects waste from house to house and then is moved to the TPS removal location.

There is a difference / discrepancy between the existing conditions of collection of waste transportation with the pattern of collection and transportation of the results of the study. The existing conditions of direct individual collection and transportation patterns that are not in accordance with the results of the study are along the Perintis Kemerdekaan road, Kelapa Lima Urban Village, while the results of the study at that location are suitable to be applied indirectly. Likewise, the pattern of direct communal collection and transportation which is the most common pattern found in the BWK II and BWK III areas, but the results of

the study did not find an appropriate area to apply this pattern. Indirect communal collection and transport patterns are not found in the existing patterns but according to the study results this pattern can be applied to most of the BWK II and BWK III areas of Kupang City.

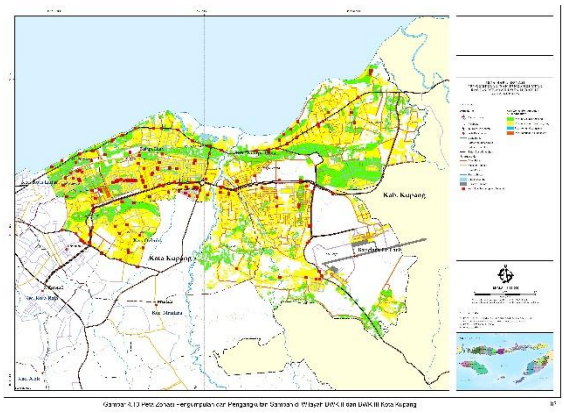

Figure 10.

13. Conformity Analysis of Existing Waste Services with Zoning Level of Waste Services Assessment Results

    1. Zone I: Fatululi and Nefonaek kelurahans with a zoning direction of 100% service level with daily transportation from the source of waste generation to the landfill and sweeping the road, Patterns of collecting individual direct or indirect transportation. The current service level is calculated from the number of polling stations with a 150m service radius, for Nefonaek Kelurahan the level of TPS services has reached 187%, while for Fatululi Kelurahan it is only 49.6% and can still be increased by 50.4%.

Table 5. Zone I Conformity Analysis

Village office	**An area (Ha)**	**Number of Eksisting TPS**	**Eksisting services (Ha)**	**TPS need**
Nefonaek	34	9	63,6	14
Fatululi	242	17	120,1	51

Source : result of analysis (2017)

The analysis shows that even though the Nefonaek Kelurahan area has exceeded 100% of waste services, it is found that there are areas that have not been

covered by service, this is due to the placement of waste collection points that are too close and even coincide with the service area. If the garbage collection point is corrected by shifting its collection location, then the entire Nefonaek Village area will be served 100%.

The same thing was also found in Fatululi Urban Village, the results of the analysis showed that 49.6% of the urban area had been served, but because the placement of garbage collection points that were close together even coincidental caused many Fatululi Urban Village areas that had not yet been served. If corrections are made to the garbage collection point and the addition of new garbage collection points, the Fatululi Kelurahan area can still be improved by 50.4% of the waste service. The need to add new waste collection points is 17 points.

2. Zone II: Pasir Panjang, Kelapa Lima, West Oesapa, South Oesapa, Oesapa, Lasiana, TDM, Kayu Putih, Penfui areas. The zoning direction is a minimum service level of 70% accompanied by household-based waste segregation activities. The pattern of collecting waste transportation can use individual patterns directly or indirectly. The current service level is 3 Kelurahan that are already above 70%, namely Pasir Panjang 91.6%, TDM Kelurahan 146.6% and Kelapa Lima Kelurahan 112.7%, while 6 Kelurahan are still below 70% namely West Oesapa Kelurahan 52.3 %, Oesapa 24.3%, South Oesapa 47.5%, Lasiana only reached 8.1% while for Penfui Kelurahan it reached 52.7%. In zone II, waste services can still be improved in urban areas which have not reached the service level of 70%, namely for West Oesapa sub-districts can be improved by 17.7% by adding 4 new TPS points, Oesapa 45.7% by adding 28 new TPS points, South Oesapa 22.5% with the addition of 4 new TPS points, Lasiana 61.9% with the addition of 46 new TPS points, Kayu Putih 28.2% with the addition of 7 new TPS points and Penfui kelurahan 17.3% with the addition of 3 new TPS points.

Table 6. Zone II Conformity Analysis

Village office	**An area (Ha)**	**Number of Eksisting TPS**	**Eksisting services (Ha)**	**TPS need**
Pasir Panjang	62	8	56,5	8
Kelapa Lima	257	41	289,7	41
TDM	106	22	155,4	22
Oesapa Barat	162	12	84,7	16
Oesapa	437	15	106	43
Oesapa Selatan	119	8	56,5	12
Lasiana	523	6	42,4	52
Kayu Putih	169	10	70,7	17
Penfui	134	10	70,7	13

Source : result of analysis (2017)

3. Zone III: Liliba Urban Area with individual community-based waste management patterns accompanied by an RT-based sorting system. The pattern of garbage collection and transportation is local. Existing conditions and zoning assessment results in Zone III are in accordance

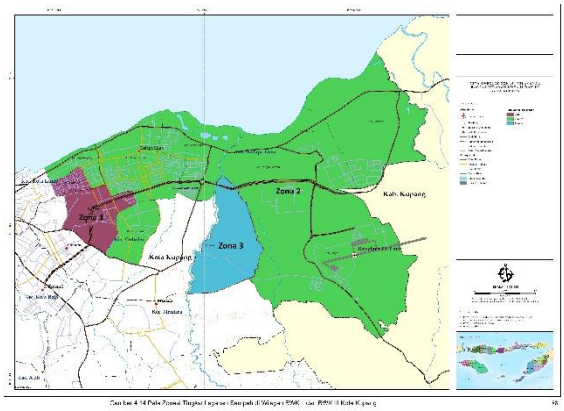

Figure 11.

14. Waste Management Model Based on Zoning Collection, Transportation and Level of Waste Services

The waste management model based on the results of the zoning assessment based on collection, transportation and service level will follow the pattern of waste handling at the source, by looking at the following criteria:

a. Waste sorting at source

b. Post-collection waste sorting

c. Zone I with full service

d. Zone II with 70% service

e. Zone III with the necessary services

f. Street sweeping

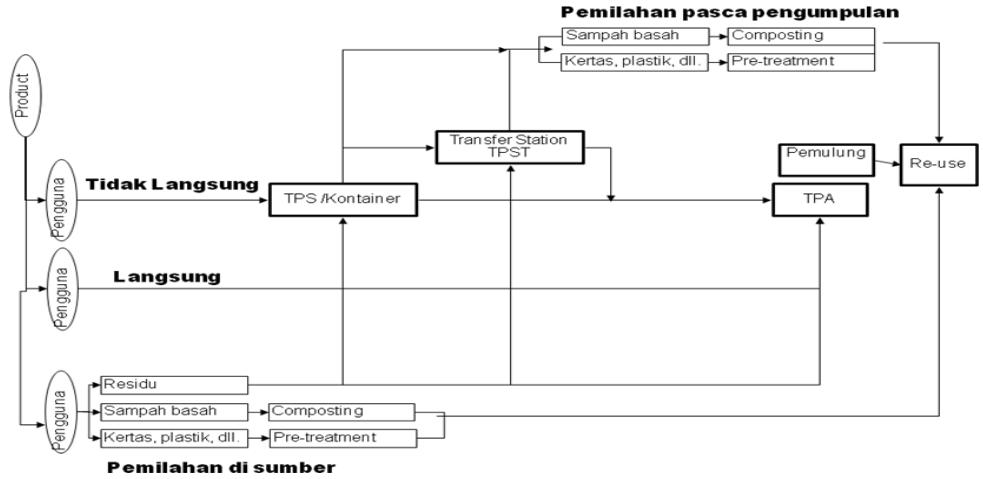

Figure 12. Waste Management Model Based on Waste Sorting

a. Waste collected by the user when using the indirect transportation pattern, the waste will be moved to the TPS / Container, then it will be moved to the Transfer Station (if any), the garbage will then be sorted by the garbage officer according to the type of wet / organic and inorganic waste which will then be the waste is processed by composting the organic waste and certain treatments for inorganic waste or later it will be used by scavengers, the residual waste will then be transported for disposal to the landfill.

b. Waste that is collected by the user when using a direct transportation pattern, the waste will be transported directly by the garbage officer and immediately thrown to the landfill.

c. The waste is sorted directly by the user according to the type of wet / organic and inorganic waste which will then be processed by the composting process for organic waste and certain treatments for inorganic waste or later it will be used by scavengers, waste residues can be disposed of to landfill following a direct collection pattern or indirectly like the letters a and b above.

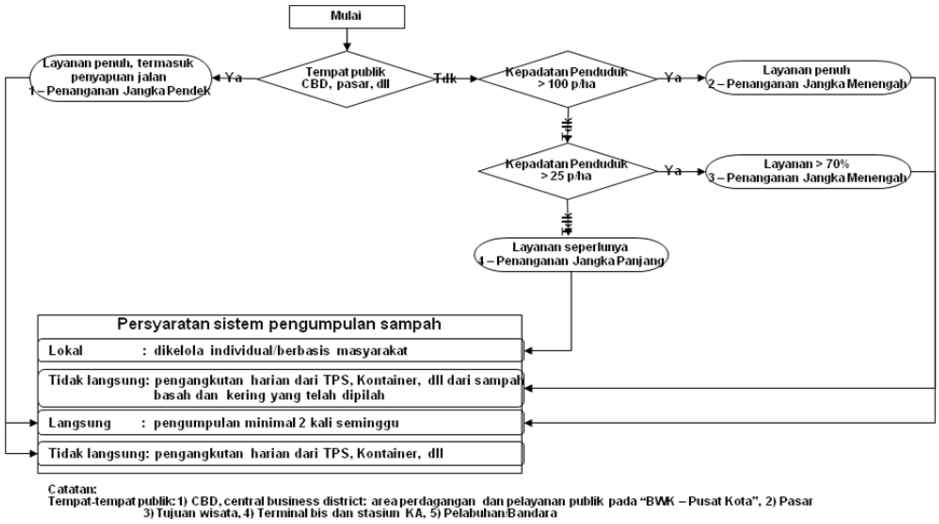

Figure 13. Waste Management Model Based on Zoning

a. Priority of short-term handling: if waste originates from the District Business District area or public service and road sweeping areas, when using direct transportation patterns, then a minimum is collected and transported twice a week, whereas if using indirect transportation patterns daily transportation is carried out daily from the TPS / Container.
b. Medium-term priority management: if the waste does not come from the CBD / public service place but comes from zone I, a full service system for the whole area is carried out in the form of direct and indirect transportation. For direct transportation, a minimum of 2 times is collected and transported. Whereas when using the indirect transportation pattern, daily transportation is carried out daily from the TPS / Container and sorting wet / organic and inorganic waste is done.
c. Medium-term priority management: if waste does not originate from CBD / public service locations but originates from zone II, a service system is implemented in 70% of the area in the form of direct and indirect transportation. For direct transportation, a minimum of 2 times is collected and transported. Whereas when using the indirect transportation pattern, daily transportation is carried out daily from the TPS / Container and sorting wet / organic and inorganic waste is done.

d. Waste management does not originate from CBD / public service locations but originates from zone III by a local service system, where the waste is managed by the community itself.

CONCLUSION

Based on the results of the analysis and discussion, the conclusions of the results of this study are:

1. Zoning collection and transportation of waste results of studies in the BWK Region II and III of Kupang City can be applied zoning patterns of collecting and transporting individual waste directly, indirectly and indirectly communally. Whereas the service level zoning of the study results can be applied to the division of Zone I, Zone II and Zone III.
2. There is a difference / discrepancy between the existing conditions of the collection of waste transportation organized by the City of Kupang with the zoning results of the pattern of collection and transportation of the results of the study based on the Indonesian National Standard No. 19-2454-2002. The direct communal pattern as the current dominant pattern does not match the study results pattern, namely the indirect and indirect communal patterns.
3. The waste management model based on the results of the zoning assessment can be done based on waste segregation and management based on zoning collection, transportation and service levels.
4. The waste management model based on sorting is waste collected by users with indirect and communal individual patterns that will be sorted according to the type of wet / organic and inorganic waste then processed with the concept of reuse and recycling, the residual waste that will be disposed of to landfill.

5. Management based on zoning of collection, transportation and service level is done by looking at the source of origin of the District Business Center (CBD) waste or public service areas, Zone I, Zone II and Zone III. Waste originating from CBD or public services, Zone I and Zone II, if using a direct transportation pattern, then a minimum is collected and transported twice a week, whereas if using an indirect transportation pattern, daily transportation is carried out daily from the TPS / Container. While those coming from zone III have a local service system, where waste is managed by the community itself.

SUGGESTION

1. Kupang City Government

(1). One of the findings in this study is that the delivery of solid waste services by the Kupang City Government does not pay attention to the physical characteristics of the area. In connection with the limited personnel and funding experienced by the Technical Office, the Kupang City Government should consider adjusting the implementation of waste services in accordance with the physical characteristics of the area, so that waste services can be carried out effectively and efficiently and can meet the SDGs target;

(2). The City Government of Kupang needs to add a point of transfer of rubbish in the form of communal containers, as well as repairing communal containers that are in severe damage conditions;

(3). The City Government of Kupang needs to educate the public intensively through socialization so that it can change the perception of the people who are currently still passive in managing waste in their environment to be more active;

(4). The City Government of Kupang needs to revive the Kupang Green and Clean (KGC) program as a motivation for Kelurahan officials and the community to remain active in maintaining environmental cleanliness through community-based waste management activities.

(5). The City Government of Kupang needs to encourage and facilitate the formation of independent waste management groups at the village level so that they are in accordance with the physical characteristics of waste management, namely indirect and indirect communal waste management.

2. Academics

The zoning result of collection, transportation and service level is a description of the management approach by region that can be applied to improve waste services, but has not clearly calculated the ability of the Kupang City Government to provide management human resources and supporting equipment, the number of waste collection points that need to be added or shifted to its location in order to be able to reach wider waste services, this can be a new research topic for academics who want to research about municipal waste management.

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