Waste System Dynamic Model in the City Kupang

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ABSTRACT

Waste is waste material that is not used to be discarded, in general waste comes from the activities carried out by humans, an increase in the number of waste generation is closely related to population, the higher the population growth garbage diproduksipun higher, so the amount of landfill waste is directly proportional with population growth, this research is the description. Predicted population growth and waste generation using dynamic models powersim 2.5 program, and to know the difference between waste generation and Manulai Sikumana Village II using t-test analysis to determine the relationship of population and waste generation used to test correlations. From the results predicted using known powersim population growth and waste generation for: a) Sikumana Village and b) Manulai Village II is in 2017 the population of: a) 19.584-761.445 kg/year; and b) 3729-112776 kg/year, by 2037 the population of: a) 46.336/1.801.558 kg/year; and b) 8.824/226.826 and in 2062 became a population: a) 135.967/5.286.410 kg/year; and b) 25892-782961 kg/year. T-test results obtained t value = 4.860> 2.2281 or 0.001 ρ <0.05, so that concluded there is a significant difference between the amount of waste in Ex. Sikuamana with in the Village Manulai II, whereas the correlation for both the Village and the Village Manulai II Sikumana get value ρ <0.05. This means there is a strong and positive relationship between the number of residents with a number of waste that is going on in the Village District of Alak Sikumana and also in the District II Sub Manulai Alak Kupang.

Keywords: Waste, population, and model

INTRODUCTION

Development of an area that aims to improve the welfare of the very need to be done along with the components of society is to undertake the construction of physical infrastructure and increasing human resources. Increased public welfare will be coupled with the development of the city, but not all of the development of a city do not carry a definite impact will cause problems both for humans and for the environment itself.

Connection with the development of the city and environmental problems, Alkadri (1999)[1] says that "... the development of the city will be followed by population growth, which will also be followed by social issues and the environment. One environmental issue

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that arises is the problem of waste. Environmental problems that occur will cause environmental degradation."

Development of an area will be an attraction, so that more and more people the more the solid waste that can pollute the environment, this opinion is supported by Abas et al (2010:105)[2], stating the waste production will continuously build mounting piles of garbage and polluting the environment, supported by Hadi (2000)[3] says that "... trash will be a burden of the earth, meaning that there are risks that would cause."

Garbage problems if not properly handled will have an impact on the environment, so it needs to know what it is rubbish, according to Djajanegara (2004:1)[4], said solid waste is the waste (solid waste) which consists of organic and inorganic waste which considered to have no value to the owner first, primarily from household activities (domestic), industrial activities, the activities office, and others.

Linkages with other sources of garbage, Gelbert (1996)[5], stated that "... the sources of waste generation is garbage from residential areas, garbage from public places and trade, trash from the government-owned public service facilities, garbage bins from industry and agriculture."

Avoid the accumulation of rubbish that can have an impact so it will need planning planned so that the waste has economic value and can improve the welfare of the society itself, the Government side of the waste management burden that additional budget Brazilians, but there is also a very simple management that is piling for composting.

Stacking method is cheap and simple, but it poses some risks, among others: the spreading of infectious diseases, causing pollution (especially the smell and dirt) (Kholil, 2006)[6]. Waste management also needs operating costs such as labor wages. This will reduce the operational costs the profit (Prakosa, 2003)[7].

Avoid buildup and impacts and high costs it is necessary to waste management, Nurandani (2006)[8], expressed with better waste management, there will be diversification of waste into more useful goods and also the volume of waste will be minimized which results ::

Linkages with technical aspects of operations, Tchobanoglous, et al. (1997)[9] states that "... the Operational Aspects of Engineering is one of the efforts in controlling the growth of rubbish, but its implementation still have to be adjusted in consideration of health, economics, engineering, conservation, aesthetics and environmental considerations."

At the operational level, the integrated management system is a combination of a solid waste management system by means of recycling, composting, incineration (incinerator) and final disposal system by means of sanitary landfill (land urug). This approach is a manifestation of the 3R system that is now an international consensus that is: Reduce, Reuse, and Recycle. Reducing or minimizing the program started in trash can collection, transportation and disposal systems (Sucipto, 2012:15-17)[10].

Based on the description above, the issues raised in the research model Dynamic System Solid Waste in the city is: 1) how the differences between the Village Sikumana waste generation by Manulai Village II; and 2) how population growth is correlated with an increase in the amount of waste that is going on in the Village Sikumana and Village Manulai II.

The formulation of the problem posed in the research model Dynamic System Solid Waste in the city is: 1) how the differences between the Village Sikumana waste generation by Manulai Village II; and 2) how population growth is correlated with an increase in the amount of waste that is going on in the Village and Village Sikumana Manulai II.

METHODS

This research was conducted in the city of Kupang, by determining the District 2 District of Maulafa, and the District Alak, from each district determined the sampling area of the village, which is on the District Maulafa Sikumana Village and Village Manulai II in the District Alak. This study will use a simulation based on a dynamic system is a way of thinking about the system as a network of interconnected components that affect a number that has been assigned from time to time.

Simulation is a quantitative procedure that describes a process by developing and applying a model of a planned series of tests to predict the behavior of a process over time, so that the analysis can be done for a new system without having to build or change the existing system, and does not need to interfere with the operation of ersebut system. It is generally used for the simulation of dynamic models that involve multiple time periods (Randers, 2000)[11].

Primary data collection using survey techniques, namely the data collected from respondents using garbage collection of data tables for 8 days for each house. The sample in this study is that the number of households of each village is determined by the Indonesian National Standard, so the number of samples in the Village District of Maulafa Sikumana home is 26, and for the District II Sub Manulai Alak is 14 homes. Analysis to determine the difference of waste generated from urban residents Sikumana Maulafa the District of the District II Sub Manulai Alak use T-Test test, and to determine how population growth is correlated with an increase in the amount of waste that is going on in the Village and Village Sikumana Manulai Korelai Test II used Spearman.

RESULTS AND DISCUSSION

A. Causal Model Simpal

The amount of waste generation is directly proportional to the number of residents, therefore the following will be described the causal loop model of Causal Loop Diagram or (CLD) population and waste generation systems, the following causal loop drawings and an explanation of each.

Subsystem has a population of three circles that the circle of people with birth (positive loop) and the circle of people with death (negative loop) and residents with waste generation (negative loop), each element giving feedback (feedback). In the population with birth loops illustrate that caused birth positively by the birth rate leads to an increase in population and an increasingly large number of people causing the greater the number of births, thus the relationship between the population with birth aalah mutually reinforcing.

Lup residents with death illustrates that the death cause a reduction or decrease in number of population (negative relationship or the opposite direction) and the greater the

number of people that will lead to higher mortality rates, thus the relationship of people with death is mutual balance or balancing.

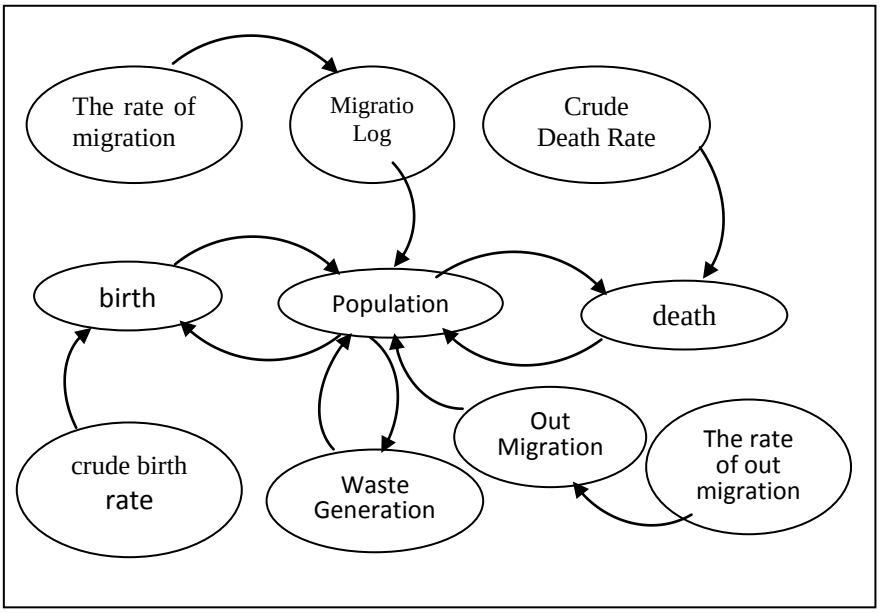

Figure 1. Models causal diagrams and population growt waste generation

Lup residents with waste generation, illustrating that the higher the population growth, the higher its waste generation but a growing number of residents of the surrounding solid waste that is not a good impact on the population that is as undisturbed environment and the population itself is not unhealthy. At the sub-system population, the population other than by birth and death also positively caused by in-migration which resulted in the growth of population in-migration and out-migration which causes negatively namely the out-migration led to a decline in population.

B. Dynamic Model

Based on the model of the causal loop diagram of the dynamic flow model of the feedback causal relationship between population growth in waste generation as shown below.

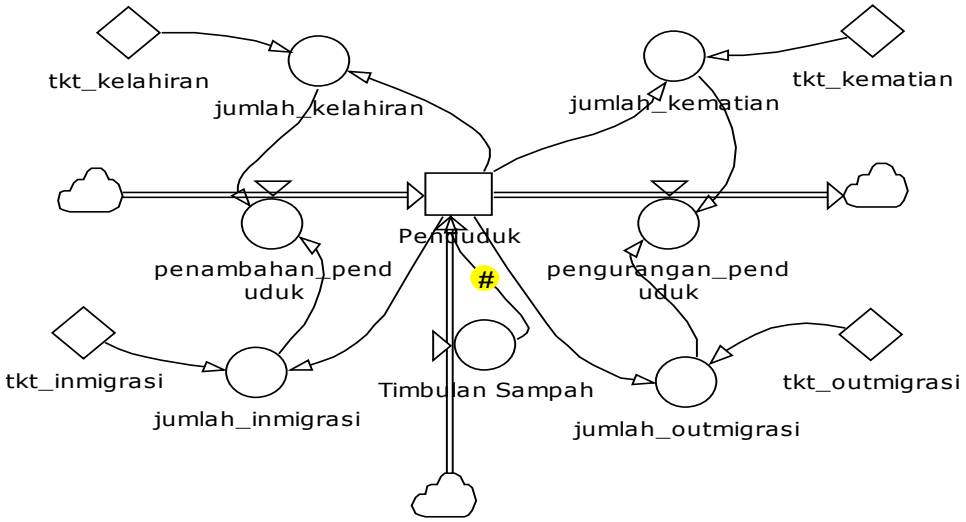

Figure 2. Dynamic Model Of Population And Waste Generation

1. Population Sub Sub System Sikumana district. Maulafa and Village Manulai II district. Alak Kupang

The population is 15,791 inhabitants Sikumana Village, and the population data from the year 2002 to 2012 then with analsisi in Geometric population growth is 4.4% per year, while the District II Sub Manulai Alak, in 2012 the population was 3,007 residents, and growth population of 4.4%, based on data on population and percentage of population growth can be predicted population growth for 50 years using sim powe 2.5 can be seen as follows.

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Table 1. Population Data Sikumana Village and Village Manulai II Subdistrict Maulafa Kupang of the year 2002 – 2012

Number	Year	Population	
		Village Sikumana	Village Manulai II
1	2002	9,787	1,864
2	2003	9,901	1,876
3	2004	10,706	1,976
4	2005	10,767	2,205
5	2006	12,322	2,603
6	2007	12,691	2,649
7	2008	12,672	2,968
8	2009	12,583	2,753
9	2010	14,916	3,160
10	2011	15,486	3,281
11	2012	15,791	3,007

source : BPS Kupang City

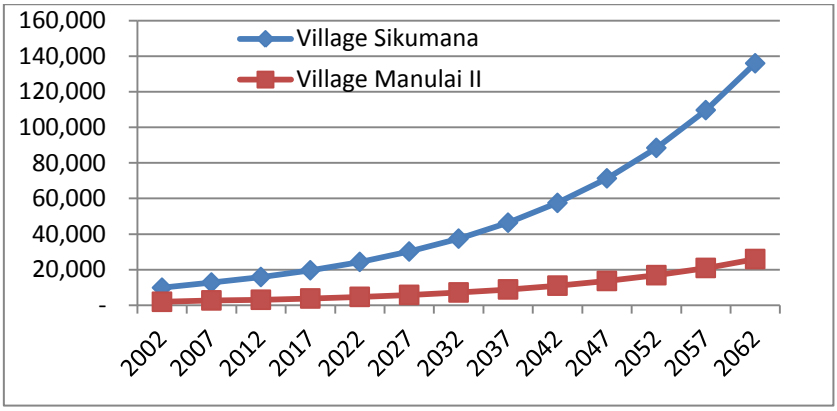

Figure 3. Sikumana Urban Population Growth Model Subdistrict Maulafa Kupang

Based on the assumption that there is no disaster that can lead to a reduced number of population until the year 2062, generating a simulation model of the above chart. The graph above explains that the residents of the Village Sikumana predicted to rise very high, but when the population growth rate using the results of calculations of the Office Agency for

Population and Civil Kupang was 6.41, higher than the researchers refined the analysis calculation of 4.4, then the population growth of the Village Sikumana will be very high.

Based on the predictions of the model or the graph above can be explained that the residents of the Village Sikumana with a population in 2012 of 15 791 inhabitants, in 2017 the position of the population into 19 584 inhabitants, and in 2062 the population of the Village Sikumana be 135 967 inhabitants, up by 1,289%

Not much different from the population's growth manulai Village II, where the population in 2012 was 3,007 residents, predicted in 2017 this number to 3,729 residents, and the graph shows the increase continued until the year 2062 the population of the Village Manulai II to about 25 892 inhabitants.

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2. Sub System of Waste

Trash is a waste or discarded material sources result of human activities and natural processes, it is supported definition of Act - Act No.. 18 of the states waste management garbage as the rest of the daily human activities and natural processes or from solids.

Population growth is directly proportional to the amount of waste generation, this is because the garbage will continue to exist and will not stop produced by the man himself, the following waste generation based population growth in Sub Sikumana Maulafa the District and Sub-District II Sub-district Manulai Alak, the graph model predictions of waste Village to Village Sikumana and Manulai II can be seen below.

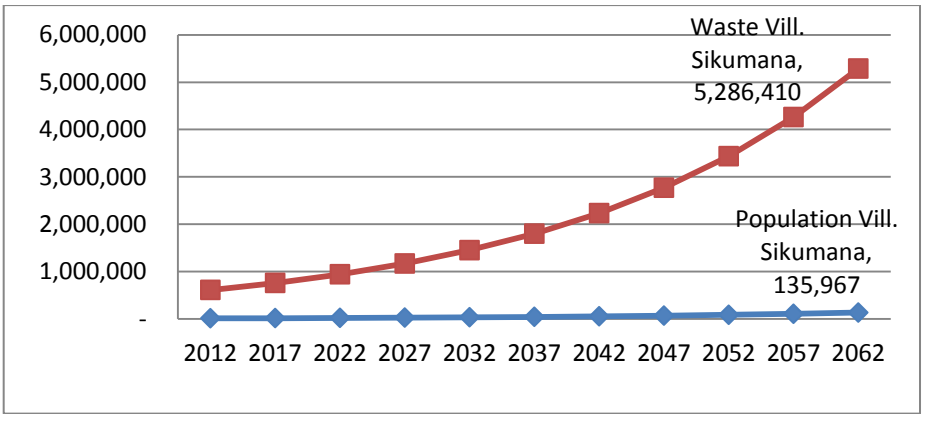

Figure 4. Models Population Growth and Waste Generation Kelurahan Sikumana Kupang City

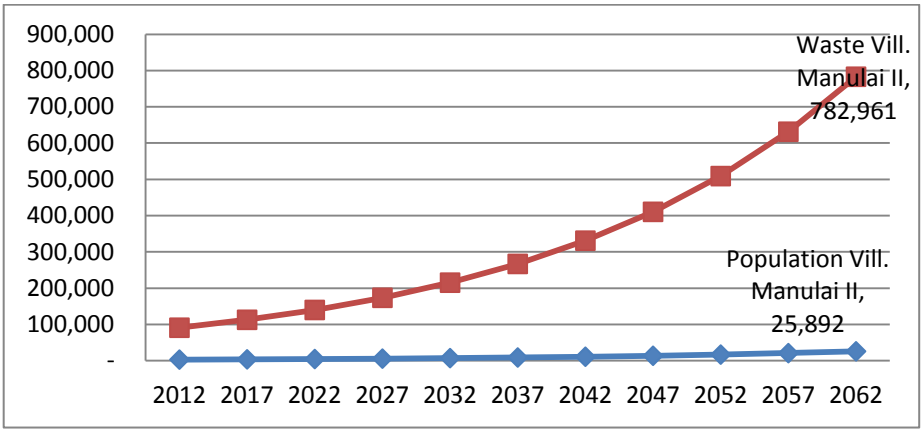

Figure 5. Population Growth Model and Waste Generation Village Manulai II Kupang City

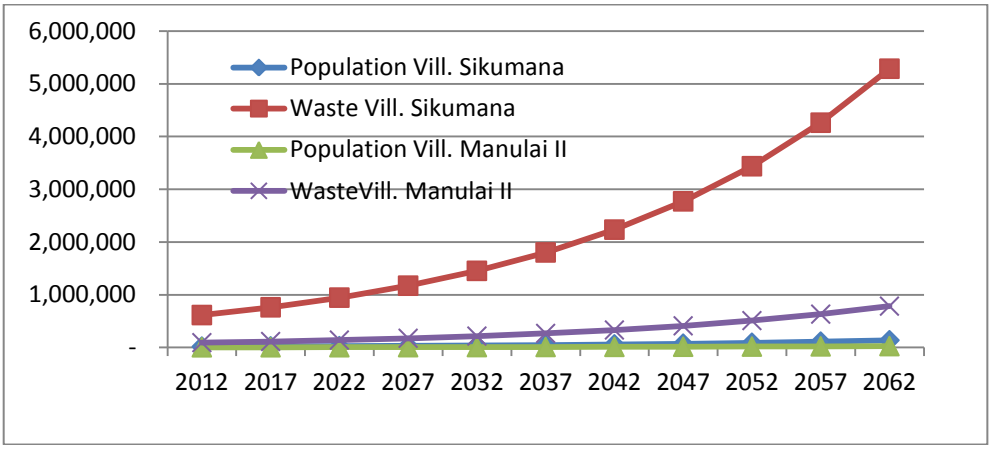

Figure 6. Population Growth Model and Generation Garbage Village Sikumana and Village Manulai II Kupang

The results of model predictions based waste generation by population growth, the Village Sikumana with population growth of 4.4%, can be explained in the year 2012 with a population of 15 791 produce as much garbage 613.954 kg / day, 10 years later in 2027 the population of 30.124 generate garbage as many as 1,171,233 kg / day, and in 2062 became the Village Sikumana population 135 967 so that the waste generated is also very high, be 5.286.410 million kg / day.

Based on the prediction of waste generation graphics based on population growth, can be explained by 2012 the population of the Village Manulai II is yielding 3,007 waste generation as much as 90 932 kg / day, in 2022 the population of the Village Manulai II as much as 4,625 residents generate solid waste as much as 139 869, and in the year 2062 with a population of 25 892 782 961 generates waste generation kg / day.

Differences population of an area would generate different waste generation, and therefore to know the difference of garbage that occurred in the Village District of Maulafa Sikumana with the District II Sub Manulai Alak used t-test analysis, while the t-test analysis results can be seen below.

Table 2. Test-t Sikumana Urban Waste Generation Differences With Manulai Village II Kupang City

Paired samples test									
		Mean	Std. Dev	Std.Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Vil.Sikumana Vil.Manulai II	1.91569E6	1.30725E6	3.94152E5	1.03747E6	2.79392E6	4.860	10	0.001

Source: results of the analysis

Based on the table above statistical test obtained-T Test showed that the larger the value of t 4.860 0.001 2.2281 or ρ <0.05, so it can be concluded concluded that there are significant differences between the amount of waste that is contained in the District Maulafa Sikumana village with the amount of waste in the Village District of Alak Manulai II Kupang.

As for knowing the relationship between population growth Sikumana Urban District of Maulafa with the resulting waste generation and population growth also Manulai II Urban District of waste generation digunkan Alak with Spearman's correlation analysis, while the results of the analysis can be seen below.

Table 3. Test Correlation Relationship With The Population Growth In Waste Generation In The Village Sikumana And Village Manulai II Kupang City

Correlation				
			Population	Waste
Spearman's rho	Population	Correlation Coefficient	1.000	1.000**
		Sig. (2-tailed)		,000
		N	51	51
	Waste	Correlation Coefficient	1.000**	1.000
		Sig. (2-tailed)	,000	
		N	51	51

Source: results of the analysis

Based on the table above statistical test obtained with the correlation coefficient is 1 Significant values (ρ) is 0.000, which indicates that the value of ρ <0.05. This means there is a strong and positive relationship between the number of residents with a number of waste

generation that occurred in the Village Sikumana Maulafa District and Village Manulai II Alak Distric of Kupang City.

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