The analysis of waste treatment methods and managerial skills towards the effectiveness of CO\textsubscript{2} emissions (an ex post facto study at TPA Bantar Gebang Bekasi)

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Abstract. In the last three years, Java Island produces 29,413,336 m\textsuperscript{3}/year of waste, coming from settlement (house hold) and non-settlement waste. Recently, this waste is managed with conventional technology, composting and recycling. Based on law No. 18 of 2008 on Waste Management, Chapter III Article 5, it is firmly stated that the government and regional governments are responsible for ensuring proper and environmentally sound waste management in accordance with the objectives. The observation of managerial skills is highly needed to investigate the operation of waste management at TPA Bantar Gebang towards the effectiveness of CO\textsubscript{2} emissions. The problems are (1) Whether there is any influence between the method of waste management through Biogas Technology to the effectiveness of CO\textsubscript{2} emissions. (2) Whether there is any influence between managerial skills to effectiveness of CO\textsubscript{2} emission. (3) Whether there is any simultaneous influence between waste management method and managerial skill to CO\textsubscript{2} emission effectiveness and (4) how is the method of waste management. Quantitative and engineering method were used to process the data. Biogas Technology variables and Managerial Skill are simultaneously and significantly influenced to CO\textsubscript{2} Emission Effectiveness, this is based on $F_{h} > F_{t}$ value of 168,453 > 3.072467) and its significance is $0.000 < 0.05$. Then $H_0$ was rejected and $H_a$ was accepted which means that variable of Managerial Skill have influence or very big influence to Effectiveness of CO\textsubscript{2} emission. Correlation coefficient value 94.1% which means there is very strong relation between variable of Biogas Technology, Managerial Skill to Effectiveness of CO\textsubscript{2} emission. Then Technology management through Biogas Technology is anaerobic biology.

1. Introduction

In the last three years, landfill/waste disposal coming from settlement waste (house hold) and non-settlement of waste volume for Java Island reaches 29,413,336 m\textsuperscript{3}/year or 44%. In 2008 the volume of kitchen waste was 22.2 million tons/year (58%) and was increasing in 2009 to 6,594.72 tons/day. It is estimated that it will become 7200 tons/day in 2020 (BSN, 2008). Waste management methods through conventional technology cannot be avoided, so it was caused adverse effects for human health. Conventional technological methods produce very high levels of pollutant gas emissions that are harmful to human health, especially respiratory infections (Respiratory) and skin irritation. One of the problems that arises with the existence of TPA Bantar Gebang Bekasi is the presence of solid waste...
associated with environmental pollution, such as foul odors that can interfere with human health (Daryanto, 2004).

The government's role in waste management at TPA Bantar Gebang cannot be separated from the participation of the community, operational employees and businessmen/stakeholders. Especially, the management of companies involved in waste management in Bantar Gebang was handled by DKI government. The role of government from the aspect of the regulation can be seen from various policies that have been established, based on the policy and mandate of the law mentioned that in carrying out the activities, the entrepreneur was obliged to prevent and overcome the occurrence of interference or pollution to the environment (BSN, 2008). Up to now, it is uncertainly known how much managerial skills of employee in operational waste management at TPA Bantar Gebang relate to the effectiveness of CO\textsubscript{2} emissions.

From the description above, an analysis is needed to investigate the solution of the effectiveness of CO\textsubscript{2} emission with Biogas Technology and managerial skill of operational employees in the company. In the regulatory context, TPA Bantar Gebang Bekasi location was expected to meet health requirements, especially in terms of effectiveness of CO\textsubscript{2} emissions. The formulation of the problems: (1) whether there is any influence between the method of waste management with Biogas Technology to the effectiveness of CO\textsubscript{2} emission in Bantar Gebang Bekasi, (2) whether there is any influence between managerial skill to effectiveness of CO\textsubscript{2} emission in Bantar Gebang Bekasi, (3) whether there is any influence between waste management method with Biogas Technology and managerial skill to the effectiveness of CO\textsubscript{2} emission in Bantar Gebang Bekasi and (4) how is the method of waste management.

The effectiveness of CO\textsubscript{2} emissions by the method of waste management through the use of Biogas Technology is the achievement in the use of waste processing system through the use of Biogas Technology shows the achievement of CH\textsubscript{4} (Methana) and CO\textsubscript{2} value and can influence its environment naturally (Scott JC and Janet M. Thomas 2000: 46).

CO\textsubscript{2} is a heavy, colorless gas produced by the combustion and decomposition of organic substances and as chemically processed goods. This gas comes from inhaled and exhaled smoke which will not burn and is relatively non-toxic and is not reactive. CO\textsubscript{2} can cause inefficient environments in large concentrations (Christian L. Hackman, 2000). Air pollution or CO\textsubscript{2} emissions can be caused by natural sources or as a result of human activities.

Pollutants are air or components imposed from a combustion activity (a particular process) issued directly from the source. In general, pollution which was caused by natural sources is difficult to know the magnitude (Robert Noyes, 2001).

The effectiveness of CO\textsubscript{2} emissions is synonymous with the term eco-efficiency based on the concept of creating goods and services with the least possible resources and creating little waste (Surna T. Djayadiningrat and Melia Famiola, 2004). In addition, improvements as efficient as possible in energy usages are increased productivity, reducing pollution, and improving company performance. If the allocation of resources does not take into account the environmental impact then the allocation is considered inefficient (Adinul Yakin, 2004).

Waste management is the collection, transportation, processing, recycling or disposal of waste materials (KNLH, 2008). Based on Law No. 18 of 2008 on waste management, in Chapter I in the general provisions of article 1 paragraph 5 the definition of waste management is a systematic, comprehensive, and continuous activity that includes the planning, reduction, and handling of waste. Municipal solid waste management is part of
urban sanitation management. The net notion actually means not only the absence of waste, but also the sense that leads to an aesthetic review (Mr. Pankaj Patel, 2000).

Biogas technology is a modern technology, the decay technology of organic material formed by putrefactive bacteria with stable temperature. Combustion of CH4 and CO2 generally form Biogas and produce slurry in Digestor (Dieter Deublein and Angela S., 2008). Martin Von Lampe and Organization for Economic Co-Operation and Development or OECD Secretariat, defines Biogas as a methane or gas commonly generated from the formation of anaerobic digester biomass. Biogas can be used to fuel transportation on gas fuel in the engine, generate heat, control industrial machinery and warm water heating (Martin Von Lampe and OECD, 2010).

Biogases organic material in this case livestock waste in the form of livestock gonad and urine processed by microorganisms in rare condition oxygen, anaerob and sludge, biogas Consisting of 60% CH4 (methane), 38% CO2, 2% N2 and Hydrogen and other gases. Biogas is having the main elements of methane (35 - 70)% CH4, (30 - 45)% CO2 and added other gases (L.Widarto & FX S.C., 1997).

Biogas technology is collecting methane gas. Methane is a flammable gas which can be used for cooking, lighting gas inside the tool, run the combustion engines and create electricity. This gas is created naturally from the dung, human waste, rice husk, foliage, water plants and rot grass. This gas has many benefits including creating high-quality fertilizers from materials that have been used. The advantage of appropriate technology or technologies of biogas is flammable and can be a substitute fuel alternative energy gas and the rest of the process can be used as organic fertilizer (Widarto and Sudarto, 1997). It is synthesized that Biogas Technology is the technology of sewage treatment or waste from organic materials that generate gases, with the goal of eliminating or reducing air pollution. Some understandings of managerial skills, are shown in table 1.

| No | Source | Definition of Managerial Skills |
|----|--------|---------------------------------|
| 1  | M. Ivanc and James H (1989). | An ability or proficiency in carrying out specific tasks |
| 2  | A. V. and Eugene (1981) | Skill has three expertises i.e. technical, human and Conceptual |
| 3  | Chuck Wiliam (2001) | *Skill has three expertises i.e. technical, human & conceptual *The Manager of the top, middle and first line and group leader. |
| 4  | Freeman S. and Gilbert (2003) | Skill has three expertises i.e. technical, human & conceptual |
| 5  | Richard L. Daft. (1990) | Technical expertise also includes specialized knowledge, the ability of analysis and the use of appropriate technical d to solve problems in a specific field of discipline |

From theories above, it can be synthesized that managerial skill is an ability in carrying out operational duties with regard to the ability to use the tools, procedures and techniques work together, motivating others, and understand the importance of the activities of all the organizations concerned.
2. Research methods

This study employs ex post facto method to examine whether there is influence of the variable bound against free. The measurement at the occurrences of events already in progress but seen in the context of the current time without doing the manipulation of the variables examined (Putrawan, 1990). Occurrences that have been unfolding as measured data in this study are the effectiveness of CO2 emissions from landfill garbage in Bantar Gebang, Bekasi as a bound variable (Y) is a free variable and X1 (composition of NH4) and X2 (Managerial Skills). The value of the effectiveness of the CO2 emission in size with use of Gas Analyzer, then the research results as shown in table 2.

Table 2. Measurement of Data & Questionnaire Results

| No | NH4 | Resp | CO2 |
|----|-----|------|-----|
| 1  | 47.7| 5    | 31.5|
| 2  | 46.1| 5    | 30.5|
| 3  | 47.4| 5    | 29.1|
| 4  | 48.3| 5    | 29.8|
| 5  | 47.9| 5    | 30.1|
| 6  | 48.5| 5    | 30.2|
| 7  | 49.3| 4    | 29.7|
| 8  | 49.4| 4    | 29.1|
| 9  | 48.7| 5    | 31.2|
| 10 | 49.2| 5    | 31  |
| 11 | 49.8| 5    | 30.3|
| 12 | 47.9| 4    | 30.5|
| 13 | 47.4| 5    | 29.5|
| 14 | 47.5| 5    | 28.9|
| 15 | 48.6| 3    | 30.6|
| 16 | 46.4| 5    | 38.4|
| 17 | 46.9| 5    | 37.8|
| 18 | 47.3| 3    | 38.1|
| 19 | 47.3| 5    | 38.3|
| 20 | 46.3| 3    | 38.7|
| 21 | 49.9| 5    | 45.5|
| 22 | 45.2| 5    | 44.8|
| 23 | 45  | 5    | 44.3|
| 24 | 45.3| 5    | 44  |

Data collection techniques in the study include: (1) collection of data the results of measurements of the methane CH4 (2) measurement of the effectiveness of CO2 emissions (3) data questionnaire consists of 24 questions with answers used Likert scale. Analysis of the data, from the equation: \( Y = b_0 + b_1X_1 + b_2X_2 \). Where: \( b_0 \) = coefficient, \( b_1 \) = coefficient for NH4 composition, \( b_2 \) = coefficient for managerial skills, \( X_1 \) = composition for NH4, \( X_2 \) = for managerial skills and \( Y \) (CO2 emissions effectiveness). Next, to find out the significant regression multiple compare between 0.05 probability values with significant probability values as follows: If the value of the probability of significant probability \( \text{Sig} \leq 0.05 \), Ho and Ha accepted rejected it means not significant.
3. Results and Discussion

The data was calculated by Program SPSS Statistics with SPSS programs 21.0, provides a general overview of the distribution of the normal, regression, linearity and others. The classical linear regression analysis test compounds were obtained, good regression model is the distribution of the data is normal or close to normal, residual values and it indicates that the model has a zero distribution. In the Normal diagram of P-P Standardized regression plot indicates the existence of points around the line, it is concluded that the model is normally distributed.

Autocorrelation was used to test the presence of internal correlations among the variables arranged in the time series. To detect the presence or absence of autocorrelation in a regression model, Durbin-Watson method was used. Regression model can be expressed no symptoms, if probability Durbin-Watson > 0.05 and from the above table Durbin-Watson value is 2.118. So that shows 2.118 > 0.05 concluded regression model did not experience autocorrelation symptoms.

On the equations of the regression may not be occurring multicolinearity meaning there should be no correlation or relationship that is perfect or near-perfect free variables that make up between equations. If on a model equation occurs symptoms of multicolinearity that means fellow free variable occurs or correlation similarity. Multicolinearity test results can be detected from values, VIFs greater than 10, when < from 10 it can be said that there is no multicolinearity. Biogas Technology variable and Management Skill has a value of VIF 3.384 < 10. It has a value of VIF 3.384 < 10.

So it can be concluded that in the regression model, multi collinearity did not occur. Regression model is predicted to have a Heteroscedasticity problem. It means there are some different variants of variable in the model. This symptom can also be interpreted that in the model there is no similarity of variance of residual on observation of regression model. The Heteroscedasticity were tested using Park Gleyser theory.

The Regression coefficient of the test results indicates that the characteristics of probability (significance), if the value is 0.05 < 0.000 it means there is no symptoms of heteroscedasticity. It turns out that the variable of Biogas Technology is 0.000 while the managerial skills is 0.000. Thus, we can conclude that there is no heteroscedasticity symptoms in the regression model. Hypothesis testing in this study was conducted by using statistical analysis tools in the form of the correlation coefficient, coefficient of determinants, F-test and t-test significance level. Where the level of significance or probability (α) is 0.05 or 5%. The correlation coefficient measures the strong relations. The strong relations is stated by a quantity value of the correlation (r) whose value is in the range -1 to 1. If the value obtained is increasingly close to the numbers -1, this means the relationship is getting stronger and the direction of the relationship is reverse. It figures out that there is a weak relationship between managerial skills and Biogas Technology towards the effectiveness of CO2 emissions, from table 6. The value of the correlation coefficient of 0.97.

The determinant coefficient was used to determine the number or presentation of the contribution of independent variables in the regression model simultaneously or synchronously giving effect to the dependent variable. Table 6 shows that the value indicates that the value of the Adjusted R Square r² was 0.941, it means E simultaneously influenced Biogas Technology and Managerial Skills 94.1%, while the rest of 5.9% influenced by other factors were not examined in this study.

The coefficient results of a determinant shows, for testing the equations simultaneously using between countdown with a comparison between the calculated F > F table, or by using
the value of significance. The basis of decision-making was Ho will reject or accept Ha. Considering the value of the significance is less than 0.05 and the value of F is F count (168.453 > 3.072467) value of significance was 0.05 < 0.000. It inferred that Ho is denied and Ha is accepted. Thus, the Managerial skills and Biogas Technology simultaneously affect the effectiveness of the company’s significant CO2 emissions.

T-test was conducted to find out whether in partially or individually affects the dependent variable. The t-test can be done by comparing the t with a t > count table (15.586 > 2.079614), or by using the value of significance. The basic decision-making is Ho will be rejected or Ha will be accepted if the significance value t 0.000 < 0.05. Table 8 shows that: (1) Variable X1 towards Y: the significance value of TB variable towards the effectiveness of CO2 emissions was 0.000 < 0.05. It concludes that Ho was rejected and Ha is accepted. Thus, Biogas Technology variable affects the effectiveness of CO2 emissions (15.586 > 2.079614). (2) X2 variable towards Y (-7.811 < 2.079614), the significance value of managerial skills variable towards the effectiveness of CO2 emissions is 0.000 < 0.05 significant. It concludes that managerial skills variable have no (or small) effect to the effectiveness of CO2 emissions.

In multiple linear regression analysis (see table 8), the correlation coefficients showed that the values of the constants b1 = -232.961; b1 = 6.202 b2 = -6.157. Linear regression of equations, so is Y = -232.961 + 6.202 X1- 6.157X2. For multiple regression equations above can be deduce through statements as follows: If the Biogas Technology variable rise one unit the scale ratio, then the effectiveness of CO2 decreases and if the Managerial Skills variable rise one unit the scale ratio, then the effectiveness of CO2 decreases.

Management technologies through Biogas Technologies in Anaerobic Biological, according to (Ketut Sumada, 2012): In anaerobic biological treatment process occurred four (4) stages of the processes involved include: 1. hydrolysis Process, 2 Acidogenysis Process, 3. Acetigenysis Process4. Methanogenysis Process. Based on the model of the growth of microorganisms, waste water treatment in anaerobic biological is divided into 2 (two) model: (1) Suspended Microorganisms growth Model and (2) of the microorganism growth Model is attached. On waste water treatment in anaerobic biological material organic (COD) converted to gas produced 90% of CH4 and CO2, and 10% of his mud. The resulting gases can be purified by a process of absorption of CO2 gas, so the resulting pure CH4 gas that can be used as fuel.

4. Conclusions

- Biogas Technology variable significantly influence the effectiveness of CO2 emissions in TPA Bantar Gebang Bekasi.
- Managerial skills variable significantly influence the effectiveness of CO2 emissions in TPA Bantar Gebang Bekasi.
- Biogas Technology and managerial skills variables simultaneously and significantly influence CO2 Emissions in TPA Bantar Gebang Bekasi.
- Management technology through biogas technology is done by anaerobic biology (hydrolysis, acidogenesis, acetogenesis and methanogenesis process).

References

[1]. C. Hackman, L. (2000). Hazardous Waste Operations & Emergency. New York: Mc Graw-Hill.
[2]. Chuck William (2001). Management. New Jersey: PrenticeHall
[3]. CCME. (2006). National Guidelines for Hazardous Waste Landfills
[4]. Daryanto. (2004). Problem of Pollution. Bandung: Transito
[5]. Daft, Richard L. (19900. Management, 6th Edition Philadelpia: Dryden Press
[6]. Deublein, Dieter and Angela S. (2000). Biogas from Waste and Renewable Resources. Singapore: Wiley VCH Verlagin GmbH & Co.
[7]. Djayadiningrat, Surna T. and Melia Famiola. (2004) Environmentally Friendly Industrial Area. Bandung: Engineering Science.
[8]. Ivancevich, John M. and James H. Donnelly. (1989). Management Principle and Function. New York: McGraw-Hill
[9]. Journal homepage. (2008), www.elsevier.com/locate/wasman, Waste Management. China.
[10]. KNLH. RI Law, No.18 of 2008, on Waste Management. Jakarta.
[11]. Kostova, Irina. (2006). Leachate from Sanitary Landfills – Origin Characteristics, Treatment, Borovetz.
[12]. Ministry of Environment (1995). Deputy Activity Report of Control Field Pollution. Jakarta: Deputy II KNLH.
[13]. MNLH Decision No. 295 Year 2007. The team's decision on waste management, Jakarta
[14]. Lampe, Martin Von. (2010). Organization for Economic Co-Operation, and Development or OECD Bioheat, Biopower and Biogas, Development and Implications for Agriculture. Netherland G.
[15]. Madibrata, Roni and Ade Moetangad Kramadibrata. (2007). Waste Reactor Management System Integrated. Jakarta: Silar satu.
[16]. Mc Dougall, Forbes R., Peter R. White., (2003). Marina Franke, and Peter Hindle. Integrated Solid Waste Management a Life Cycle Inventory, Published by Blackwell Science.
[17]. Michael, H. (2007). Waste Processing Technology. Jakarta: PT. Gramedia.
[18]. Noyes, Robert. (2001). Hand Book of Pollution Control Processe ., New Delhi: Jaico Publishing House.
[19]. Patel, Mr. Pankaj, et al. (2000). Municipal Solid Waste Management. New York: WAVE.
[20]. Minister of Home Affairs Regulation No.33 of 2010. (2010). About the Management Manual Trash Consisting of 45 Articles. Jakarta
[21]. Robbin, Stephen P. and Mary Coulter. (2002). Management, 7th Edition. New Jersey: Prentice Hall.
[22]. Scott, J. C. and Janet M. Thomas. (2000). Environmental Economics and Management, Theory, Policy and Application.Harcourt: College Publisher, Printed in the United States of America, 46.
[23]. Sink, RK and Misra. (2005). Biofels fromt Biomass, Department of Chemical Engineering National Institute of Technology. Roukela.
[24]. Soemarwoto, Otto. (2004). New Paradigm of Environmental Management. Yogyakarta: Gadjah Mada University Press.
[25]. Stoner, James A. F. (2003). Jersey Management.New: Prentice Hall.
[26]. Supardi, U.S., et al. (2012). Statistics In Research Applications, Most Statistics Books Comprehensive, First Print. Jakarta: Ufuk Press.
[27]. Stohr, Uli Werner Ulrich and Nicolai Hees., (1989). Biogas Plant in Animal Husbandry, Humanity Developomenty Library Document Text. Vierg.
[28]. Stoner, James A. F. and Charles Wankel. (2003). Management, 2nd Edition. Jakarta: Rineka Cipta.
[29]. Tammega, Hans. (1999). The Waste Crisis, Landfill, Incinerators, and the Search for a Sustainable Future. New York: Oxford University Press.
[30]. TPST. (2008). Company Organization. Jakarta: PT GTJ and PT NOEI
[31]. Widarto, L. and FX. Sudarto C. Ph (1997 dan 2010) Appropriate Technology to Make Biogas, Jakarta.
[32]. Wignyosubroto, Sritomo. (2003). Introduction to Industrial Management Techniques. Surabaya
[33]. Wiliam, Chuck. (2001). Management. New Jersey: PrenticeHall.
[34]. Winardi, J. (2006). Organizational Theory and Organizer. Jakarta: Raja Grafindo Persada