

Community-based Management of Waste in Settlements-Designated Area, Ujung Pandang District, Makassar

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Abstract Tamangapa Landfill has started to show limitations in accommodating the waste volume from Makassar City. The communities have implemented 3R program. The aim of this study is to analyse the prospects and potential of community-based waste management that has been implemented in Makassar, especially waste from settlements designated area. The study was conducted in settlement area in Pisang Utara Village and Baru Village of Ujung Pandang District. Primary data were collected by questionnaire, in-depth interview and focus group discussion. Secondary data were collected from file and documents from related institution or parties. The prospective analysis is used to prepare for strategic action and see if changes are needed in the future. The results of the assessment resulted in three scenarios. The three scenarios are fairly optimistic (29.50%), the condition remains as it is / Static (22.50%), and optimistic (23.50%). Fairly Optimistic means there is synergy of institution and community participation; Static/Constant means synergy of institution and community participation in current condition, while Optimistic means synergy of institution and community participation is fairly high. The selected scenario based on FGD assessment is the fairly optimistic scenario, which recommended as the highest possibility for the implementation.

Keywords Community-based waste management, Settlement-designated area, Prospective analysis, Strategy scenario

1. Introduction

Indonesia has only about 15-20% of properly disposed waste and the rest is discharged into the river causing flooding problems. It is estimated that 85% of small towns and more than 50% of urban-sized cities officially dispose of their waste into open places [1]. The most common environmental problem in urban areas is poor urban waste management. Wastes of human activities needs to be managed properly thus not cause various problems to human life as well as disruption to the environment, e.g. environmental pollution, decreased the view aesthetics, carriers of disease, etc. Various obstacles are still faced in implementing of waste management in economic, socio-cultural and technological applications [2].

The national policy for the development of waste [3, 4] has one of the targets in waste volume reduction through the 3R (Reduce, Reuse, Recycle) program. Commitment of all stakeholders includes community groups as waste producers in realizing environmentally friendly and sustainable waste management system. In the regulation, it is explained that the handling of garbage starts also involves the awareness

of the community and the government - in this case are the Department of Hygiene and Gardening (DKP), through its directed and integrated program to manage the waste and communicate it to the community to formulate the technical practice. Community involvement in the making of waste management policies in the regions is urgently needed to overcome the waste problems. The most important participation is in the stage of community acceptance, both mentally and emotionally, responsible for the response on the waste handling program [5].

Waste management of 3R has been implemented in the city of Makassar or years, but the volume of waste accumulation is increasing in every year. The volume of garbage in Makassar in 2010 is high; with ratio of 177,557 ha produced up to 800 tons of waste per day, with 80% organic waste [6]. The composition of this waste can be used as a consideration to determine the feasibility options for waste processing, especially recycling and composting and the possible use of landfill gas as an alternative energy [7].

The relevance on the waste problem prompted the municipality of Makassar to consider the application of community-based management, with Bank of Waste. Communities are asked to take responsibility for the waste they generate by asking people to sort organic and organic in their respective and deliver it to the Trash Bank in two different containers. Organic waste is then processed into

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compost, which can be used for greening the environment, whereas non organic waste is stored in the Bank of Waste as the savings of citizens who bring it, and recorded on the savings book. Every month an organic waste is sold to collectors and the money is handed over to the owner of the organic waste. Therefore, the motto of Bank of Waste is "from trash to cash" [8]. The benefits for managing the Bank of Waste are as follows [9]: 1) alternative solution to household waste problem, 2) an effective environmental education media for the community about the importance of sorting and saving garbage, 3) raising awareness of the importance of family waste management, 4) create a healthy, clean and green residential environment, 5) reducing the volume of waste disposed to the landfill, thus saving transport costs, prolonging the life of the landfill and reducing air pollution around the landfill, and 6) an additional source of income for some communities.

Tamangapa Landfill in Makassar City has limitations in accommodating waste volume. Many communities have implemented the 3R program as one of the programs in the waste handling. The program required community participation because the community is the source of waste. The aim of this study is to analyse the prospects and potential of community-based waste management that has been implemented in Makassar. The results of this study are expected to be used as a consideration for all stakeholders in waste management with the ultimate goal sustainable environmental management in Makassar.

2. Material and Method

2.1. Study Site

This study was conducted in Makassar with 175.77 km² area. Data of, Makassar's population in 2013 is about 1,194,000 people with an average growth of 1.79% and a population density of about 6,790 inhabitants per km² [10].

The location of the research was chosen related to the prospect of community-based waste management which is implemented in the residential area. The wastes in Makassar mostly come from household waste of settlements area. The chosen areas are settlement in Pisang Utara Village and Baru Village of Ujung Pandang District. This is considering the spatial aspects of the area of Makassar City that Ujung Pandang District is a designated area for settlements. In addition there is also an area used for economic and educational activities. Therefore, the data collection is concerning aspects of residential areas that have their own specific characteristics.

2.2. Data Collection

Primary and secondary data were collected for this study. Data were collected to analyse the prospective operational of community-based waste management in Makassar City, specifically Ujung Pandang District as a designated area for settlements.

Primary data were collected by questionnaire, in-depth interview and focus group discussion. Questionnaire and in-depth interview's respondents consisted of the group of empowerment community, the group of janitor, the waste pickers/collectors, officer of Cleaning and Landscaping Agency Makassar City, community leaders (RT and RW), academics in Makassar City, District officers, groups of street vendors and business owners, and informal business actors. Otherwise, the Focus Group Discussion was conducted to assess the rules and policies on existed waste management and identify the potential of industrial-based waste management. The FGD involved Cleaning and Landscaping Agency (DKP) of Makassar City, Local Planning and Development Unit (Bappeda) Makassar, community empowerment process of recycling, janitor, business owners in the city area, local government officers, group of academics, and Environmental NGOs. Secondary data were collected from file and documents from related institution or parties, mentioned previously (similar to FGD parties).

2.3. Data Analysis

This prospective analysis is used to prepare for strategic action and see if changes are needed in the future. Stages of prospective analysis using FGD method or workshop are: 1) explain the purpose of study, 2) identify criteria, 3) analysis of influence between factors, 4) create a factor, 5) build and select scenarios, and 6) implications of a scenario. All FGD participants rated the score. The value of relations between factors set as follows: for two factors that there is no mutual influence scored zero value, whereas if there is influence between factors given the value of one to three; the higher value shows the stronger influence. Inter-factor assessment of the prospective analysis is described in the Table 1 below.

Table 1. Influence Values between Factors on Prospective Analysis [11]

Score	Influence
0	No Influence
1	Slight Influence
2	Medium Influence
3	Major Influence

The results of these assessments are then incorporated into prospective analysis software to obtain key factors. The key factors are factors that have high influence and dependency. The next stage is to make the state or state of the key factor. The circumstances must have a tremendous opportunity to happen. Furthermore, from this perspective, scenarios are formulated that may occur and then discussed the implications of the scenario.

3. Result and Discussion

3.1. Existing Condition

One of the excesses of population activity is waste, both

solid waste, liquid and gas derived from household activities, trade, industry and other urban activities. Based on data of 2015 obtained from the Sanitation Department of Makassar City about the source of waste production in Makassar City can be seen in the following Table 2 [12].

Table 2. Waste Characteristics of Urban Communities in Makassar 2015

Source of Waste	Volume of Waste (m ³ /day)	Percentage (%)
Settlements	1,726.50	53
Traditional Market	608.00	17
Shop/Commercial	255.60	8
Public facilities	375.90	12
Road	121.30	4
Industrial area	73.00	2
Waterways	134.80	4
Total	3,748.00	100

The area of service, coverage of waste management services in Makassar City reaches \pm 32,000 ha or 82% of Makassar City area. This means that there are 18% of the areas in Makassar City that have not received solid waste services. In 2015 the amount of waste generation in Makassar reaches 3,748 m³/day. Of the total waste, the waste managed by the existing system is 3,251.74 m³/day or 82% of the total volume of waste generation [12].

The human resources (HR) involved with the handling of garbage in the Sanitation Department of Makassar City consists of PHL Landfill I and II as many as 42 personnel, Freelance Daily Workers for garbage sweeping as many as 258 people. The number of collecting and transporting garbage workers compared to the number of operating facilities is still inadequate. At the service level of 100%, even 600 people required consisting of 120 drivers and truck crews of 480 people [12].

In the process of running the waste handling activities of Makassar City, the Sanitation Service is equipped with insufficient facilities to serve the community as a whole. To transport garbage at 100% service by 2015, it is necessary to have 120 trucks of garbage trucks; which only 71 of it are available [12].

The current waste handling method used for Ujung Pandang District is open dumping. This is the simplest way of managing waste, that is, the waste is only spread on the open landfill site, left without any further process. This method create: (1) disease vectors such as flies, rats and others, (2) air pollution, (3) water pollution caused by leachate fluid, and (4) lower aesthetic value. Garbage that can be transported to landfill from polling stations that spread throughout Makassar City is approximately 37,730 m³ per month or an average of 1,257.6 m³ per day. The garbage transportation capability of the Sanitation Department of Makassar City is also included with the assistance of the private sector. With an average transportation capacity of 1,257.6 m³ per day, the

achievement is only 56%. Achievement 100% when garbage transported per day on average is 6,882 m³.

Table 3. Dominant Factors

No.	Factors	Variable
1	Regulation related to public policy	Institutional
2	Institution of Sanitation Dept.	Institutional
3	Human resources of Sanitation Dept.	Institutional
4	Operational cost	Infrastructure
5	Transport system	Infrastructure
6	Temporary Disposal Site	Infrastructure
7	Landfills	Infrastructure
8	Socialization of 3R (reuse, reduce, recycle)	Policy
9	Government policy	Policy
10	City government participation	Policy
11	Amount of waste	Management Input
12	Amount of sanitation dues	Management Input
13	Level of community revenue	Management Input
14	Role of housewife	Management Input
15	Willingness to pay sanitation dues	Management Input
16	Willingness to pay sanitation retribution	Management Input
17	Willingness to provide personal trash can	Management Input
18	Comprehension to the 3R concept	Policy
19	Waste sorting	Management Input
20	Reuse	Management Input
21	Reduce	Management Input
22	Recycle	Management Input
23	Home composting	Management Output
24	Role of RT/RW (neighborhood head)	Policy
25	Role of Village Office	Policy
26	Role of District Office	Policy
27	Activity of composting business	Management Output
28	Activity of recycle business	Management Output
29	Marketing of compost	Management Output
30	Marketing of recycle products	Management Output
31	Role of NGOs	Policy
32	Role of private company as partner	Policy
33	Socialization of sanitation	Policy
34	Incentive and Disincentive	Policy

3.2. Prospect of Community-Based Waste Management

Prospects analysis for the community-based waste management in Makassar involved all stakeholders. The first step in a prospective analysis is the identification of the factors involved in waste management. Factors obtained were analyzed prospectively by the assessment from the respondents. The respondents are producer groups, management groups, user groups and waste management organizations. Selected respondents then assessed the

relationship between factors. The results of the assessment are then calculated levels of interdependence and influence. Factors with high levels of dependence and influence will be selected as key factors. The results of identification can be seen in the Table 3 above.

The key factors were chosen because it has an important role in community-based urban waste management in residential areas located in Makassar. The key factors are: 1) socialization of 3R, 2) comprehension to 3R, 3) Role of housewife, 4) community based composting activity, 5) marketing of compost, 6) recycling activity in settlement area, 7) marketing of recycling product, and (8) incentive and disincentive. Each key factor is described in its own circumstances. The state of each of these factors is a possible future state of the factor.

FGD results with stakeholders was related to municipal waste management based on community participation in Makassar City resulted in eight key factors with a tiered state between different circumstances. The key factors related to community-based waste management are then

measured qualitatively according to the factual circumstances. The circumstances of the eight key factors identified are described in Table 4.

Possible conditions for each key factor are described as complete as possible, and then the determination of institutional development scenarios for community-based waste management in Makassar is determined. This scenario is determined by a combination of the circumstances of each key factor. The results for the determination of the development scenario consisted of five scenarios, namely strongly optimistic, optimistic, fairly optimistic, static and pessimistic scenario. These scenarios of institutional development for community-based waste management are shown in Table 5. The following scenarios form will be measured quantitatively in FGD with the stakeholders. The results of the assessment of the scenario can be seen in Table 6. The results of the assessment resulted in three scenarios. The three scenarios are fairly optimistic (29.50%), the condition remains as it is / Static (22.50%), and optimistic (23.50%).

Table 4. Key Factors in Prospect of Community-based Participation Waste Management in Makassar City

Key Factor	Actual Prospect Condition			
Socialization of 3R	1A None	1B Decrease	1C Constant	1D Increase
Comprehension of 3R	2A not comprehend	2B will comprehend	2C comprehend	2D Will apply 3R (sorting)
Role of housewife	3A None	3B Limited to contain the waste	3C Understand 3R	3D Apply 3R (sorting)
Activity of composting business	4A Decrease, tend to bankrupt because the sell is bad	4B Static, difficult development, marketing obstacles	4C Developed, good price, there is opportunity for capital support	
Marketing of compost	5A Decreased of compost product compared to the compost selling	5B Constant, Producers survive, the compost price is higher than the fertilizer	5C Increase, there is marketing and subsidy support	
Activity of recycle business	6A Decrease, difficulty of raw materials and capital	6B Not developing, product prices are not competitive	6C Developed, there is opportunity for capital support	
Marketing of recycle products	7A Decrease, uncompetitive price	7B Not developed, no legal entity, and limited market	7C Increased, competitive price, legal entity and broad market	
Incentive and disincentive	8A Incentives are implemented in the form of aid facilities and infrastructure of waste management	8B The incentive is in the form of facilitator/waste management assistance	8C Implemented disincentives in the form of increase in waste levies on areas that have not participated waste management	

Table 5. Assessment on the Scenario of Institutional Development of Community-based Waste Management in Makassar

Scenario	Formulation of Key Factors	%
Strongly optimistic , synergy of institution and community participation is very high	1D – 2D – 3D – 4C – 5C – 6C – 7C	12.0
Optimistic , synergy of institution and community participation is fairly high	1D – 2C – 3C – 4C – 5C – 6C – 7C	23.5
Fairly Optimistic , there is synergy of institution and community participation	1C – 2B – 3C – 4C – 5C – 6C – 7C	29.5
Static/Constant , synergy of institution and community participation current condition	1C – 2A – 3B – 4B – 5B – 6B – 7B	22.5
Pessimistic , there is no synergy of institution and community participation	1A – 2A – 3A – 4A – 5A – 6A – 7A	10.5

3.3. The Scenario Implication of Analysis Prospect on Community-based Waste Management in Makassar

3.3.1. Fairly Optimistic Scenario

This scenario is based on 3R (reduce, reuse, recycle), especially in recycle. Socialization is being done with the aim of providing community understanding on 3R. Through this understanding, it is expected to change the perspective on waste, i.e. disposed waste into something to be used. Housewives' role in the management of waste at home should have reached the stage of understanding of 3R so it has started trying to suppress the amount of waste and have started to do waste sorting. This understanding needs to be accompanied by a government policy that leads to support for communities engaged in recycling activities, both on wet and dry waste. Such support may include capital and marketing assistance for entrepreneurs in composting and recycling business.

Recommendations for the achievement of the scenario are two strategies: a) 3R socialization is still done in the same way as has been done so far. The purpose of socialization is to open the community's insight into the benefits of 3R. Attention is more directed to housewives for their understanding of 3R, one step ahead of other family members considering that housewife is very instrumental in waste management at home, b) giving opportunity to people who are interested in composting and production business made from raw waste (recycle). Constraints in terms of capital can be overcome by providing opportunities to obtain capital assistance and subsidies. Network marketing needs to be prepared including the protection of market prices. Composting and recycling efforts can be pursued to incorporate legal entities to help in creating a wider marketing network that provides greater economic opportunities.

3.3.2. Static/Constant Scenario

This scenario is based on people's understanding of 3R (reduce, reuse, recycling), especially on recycle. The forms of socialization that have been done improved in terms of intensity and distribution on all levels of society with the aim of changing the perspective on waste. Understanding of 3R is expected to have reached the stage of trying to suppress the amount of waste and have started to do waste sorting. This understanding needs to be accompanied by a government policy that leads to support for communities engaged in recycling activities, both on wet and dry waste. Such support may include capital and marketing assistance for composting and recycling entrepreneurs. Optimistic scenario can be implemented when the strategies are implemented. The recommended strategy for achieving optimistic scenarios are: 1) 3R socialization that has been done so far should be intensified and expanded the coverage of socialization area to reach all levels of society. The target of socialization is the formation of people who begin to reduce the amount of garbage and sort the waste into wet and dry garbage. The

form of socialization can be enriched by providing training on sorting waste or composting in household scale, 2) giving opportunity to people who are interested in composting and production business made from raw waste (recycle). Constraints in terms of capital can be overcome by providing opportunities to obtain capital assistance and subsidies. Network marketing needs to be prepared including the protection of market prices. Composting and recycling efforts can be pursued to incorporate legal entities to help create a wider marketing network.

3.3.3. Optimistic Scenario

This scenario is based on people's understanding of 3R (reduce, reuse, recycling), especially on recycle. The forms of socialization that have been done are improved in terms of intensity and spread on all layers of society. The level of community understanding has come to want to apply 3R, especially housewives who have been sorting waste. Through this 3R, the amount of waste can be suppressed and separated into wet and dry waste.

This situation is supportive for composting and recycling business of dry waste. This condition needs to be followed by government policy that leads to support for people doing recycling activities, both on wet and dry waste. Such support may include capital and marketing assistance for composting and recycling entrepreneurs. The chosen third scenario can be achieved by implementing two recommended strategies: The first strategy, 3R socialization that has been done so far intensified and expanded the coverage of socialization area to reach all levels of society. The target of socialization is the formation of people who already know about 3R and want to sort the waste into wet and dry garbage. This situation leads to the opening of opportunities for the utilization of wet and dry waste, both by household and compost production and recycling business.

The second strategy, giving opportunity to people who are interested in composting and production business made from raw waste (recycle). Constraints in terms of capital can be overcome by providing opportunities to obtain capital assistance and subsidies. Network marketing needs to be prepared including the protection of market prices. Composting and recycling efforts can be pursued to incorporate legal entities to help create a wider marketing network.

3.4. Discussion

The selected scenario is Fairly Optimistic which has synergy between waste management institutions and community participation. The results explain the existence of interconnection between five stakeholders in community-based waste management in Makassar, i.e. waste generating society, garbage management community, waste utilization society, environmental observer community, and government. This is reinforced by some previous research which explains that the institutional aspect in waste management is the distribution of functions, responsibilities

and authority between local, regional and central institutions. Organizational structure of institutions responsible for municipal solid waste management including inter sectoral coordination, procedures and methods for planning and management; Capacity of institutions responsible for staff capability; and the private sector involved and the role of the user community [13]. The final process of a prospective analysis on the waste management based on community participation in Makassar is to summarize the results of the analysis, development and implementation of the scenario (Table 6).

Waste-utilizing community receive fresh organic waste as compost raw materials and inorganic waste that is cleaner than if the scavenging is done in the landfill. The economic benefits derived by recycling manufacturers because there is a marketing network that received its products. The government benefit is the smaller amount of waste that must be transported to the landfill. This will directly reduce the cost of transporting waste and land needs for landfill. The shrinking amount of waste that must be handled to make the function of municipal waste management changed from the operator into a regulator. If these benefits can be perceived by each stakeholder, the participation of each stakeholder will continue and will establish a community-based waste management culture in Makassar. 3R incentive regulations and disincentives are aimed at waste generating communities. The regulation is stipulated by the Regional Government of

Makassar City which refers to the Regulation of the Minister of Public Works No. 21/PRT/M/2006 on National Policy and Strategy for the Development of Waste Management System (KSNP-SPP).

Non-Governmental Organization as a community of environmentalists becomes the initiator in drafting academic regulations of incentives and 3R disincentives by involving all stakeholders. The scope of the 3R incentive and disincentive regulatory draft includes form, procedure, implementation and supervision. Incentives can be in the form of waiver of fees and garbage charges, while the form of disincentives can be the imposition of dues and garbage charges that are several times greater. Collection of fees and levies is through the RW community (neighbourhood group) on the grounds that head of RW is the implementer of garbage collection from households. For the purpose of supervision, it was performed by representatives of Sanitation Department at the sub-district level.

The institutional development scenario aims to reduce the amount of waste that must be disposed to the final disposal site (TPA). The achievement of reduction targets is done with two strategies namely 3R socialization and open up business opportunities for composting and recycling. Waste reduction efforts have been done in many countries through recycling of waste. Some countries already have a 3R portfolio that contains waste reduction targets that must be disposed to the TPA [14].

Table 6. Development and Implementation of Community-based Waste Management Institutional Development Scenarios

Group of actor	Analysis Results	Development	Implementation
Waste Producing Community	<ol style="list-style-type: none"> 1. Household is the largest waste producer in Makassar City 2. Volume of garbage per house per day is 25 liters 3. Waste management and handling of household waste mostly done by housewives 4. The people of Makassar do not understand and do not apply the 3R concept 5. The composition of household waste in Makassar has an average composition of 75% wet waste and 25% dry waste 6. The basis of city garbage collection is household 	<ol style="list-style-type: none"> 1. Housewives in all areas of Makassar City must understand the concept of 3R 2. The concept of 3R will cause the waste accumulation of the city decreased, because it has been done reduction process at the base of household or home scale. 3. Residential areas are required to sort the wet and dry waste before being sent to the landfill 4. Conducting recycling and composting management processes at the RT (neighborhood)/communal area base 	<ol style="list-style-type: none"> 1. Expansion and socialization of 3R concept to all community not only to housewives 2. Establishment of waste bank as a model of management based on family economic potential 3. Establishment of waste management organization from production, marketing and selling the compost
Waste Management Community	<ol style="list-style-type: none"> 1. RT is the most important waste management organization that acts as a garbage collector 2. RW is an organization that one level higher than the RT that serves to decide the amount of garbage collection, garbage collector, and garbage collection site 3. There is a missing link process between the RW as an institution directly related to municipal waste with those who are categorized as waste beneficiaries 	<ol style="list-style-type: none"> 1. The RT and RW institutions are the spearhead of community waste management at the lower level 2. The RT institutional function facilitates the process of collecting, selecting and delivering RT-based waste for the beneficiaries to process waste 3. Institutional RW serves as coordinator of 3R implementation and incentive and disincentive providers 	<ol style="list-style-type: none"> 1. Institutional RTs in addition to managing waste also distribute the waste to waste banks and people who recycle garbage 2. The RW institutional coordinated with the Sanitation Office and NGOs to socialize the 3R concept 3. The RW institute formulates the form of incentives and disincentives for RTs who have sorted out the garbage and provided its place

Notes: RT/RW= neighbourhood group, manage by a head of RT/RW

Based on the National Policy and Strategy of Waste Management System in the 2004-2009 National Medium-Term Development Plan, it is mentioned that the reduction of waste in Indonesia dumped to TPA is targeted at 20% by 2015 [15]. The city of Makassar has already established a regulation in which it regulates the 3R issue, but has not been provided with provisions on incentives and disincentives for people who have and have not done 3R. Nevertheless, waste of Makassar has a composition that allows for 3R to be done by the community. The composition is 63.56% in the form of organic waste and 36.44% of inorganic waste; which 66% comes from households and 34% of non-households. Based on these conditions it can be assumed that the 20% waste reduction target will be achieved within 20 years, i.e. 2025 to 2024. The target is achieved with the following assumptions: (1) Sorting only by household, (2) Compostable organic waste is 50%, (3) Recyclable inorganic waste of 30%, and (4) Residual waste of 20% disposed to Tamangapa landfill.

4. Conclusions

The prospect of waste management based on community participation in Makassar City resulted in three scenarios. The three scenarios are fairly optimistic (29.50%), which is mean that there is synergy between institutions and community participation, the static/constant condition (22.50%): the current synergy between institutions and community participation, and optimistic scenario (23.50%), where the synergy between Institutions and community participation is rather high. The selected scenario is Fairly Optimistic, as the highest percentage on the FGD assessment.

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