Environmental Management System Toward Sustainable Development Goals Achievement Base on Community Empowerment in Peri-Urban

Sumardjo¹, A Firmansyah²*, L Dharmawan ³, A Kriswatriyono ², Wulandari YP²

¹Communication and Community Development Science Department, Faculty of Human Ecology, IPB University, Bogor, 16680, Indonesia
²Center for Alternative Dispute Resolution and Empowerment (CARE), LPPM IPB University, Bogor 16144, Indonesia
³Vocational School of IPB University, Bogor 16128, Indonesia

E-mail: adifirman@apps.ipb.ac.id

Abstract. Environmental problems in peri-urban communities in the North Coast of Java region are particularly closely related to flooding, waste, and disease prevalence. Regulations in the form of laws, government regulations, ministerial regulation, and local regulation have been issued relating to the handling of residential environmental problems. These regulations show how important this environmental problem is, especially in urban areas. The objectives of this study is to analyze the community-based waste management program with a systems approach. The methods used are participatory rural community appraisal (PRCA) and participatory action research (PAR) in peri-urban communities in Bekasi Regency. Field researchers were placed and lived during research at the study site. The results show that a community-based environmental management system, apart from helping overcome environmental problems, can be an effort to strengthen the achievement of the sustainable development goals (SDGs). An essential factor in the environmental management system is a participatory approach to community empowerment. The community-based environmental management system model produced in the empowerment process has the potential to become an alternative model for environmental management in densely populated cities facing the threat of floods and other environmental problems and the achievement of SDGs.

1. Introduction
The negative impact of the waste problem is increasingly complex, in addition to ineffective handling, flooding is also a factor that exacerbates environmental problems in urban areas. Community participation is needed to be able to manage waste independently and sustainably by utilizing waste into productive businesses that have economic value. On the other hand, the positive value of waste management has great potential to support efforts to achieve sustainable development goals (SDGs). The novelty of this research is the effectiveness of independent and sustainable waste management, in addition to overcoming the problem of the negative impact of waste, it is also a sustainable positive impact for the community.

Regulations on waste management in Indonesia are contained in Law No. 18 of 2008, and Government Regulation no. 81 of 2012 concerning the Management of Household Waste and Similar
Household Waste, as well as the Minister of Public Works No. 03/PRT/M/2013 concerning the Implementation of Waste Infrastructure and Facilities and the Handling of Household Waste and Types of Household Waste. This shows how serious the attention to waste management is. In Bekasi City, there are flood-prone areas whose conditions are exacerbated by the behavior of people who are less concerned about the environment, especially waste. In addition, there are limited waste collection sites and inadequate fleets of waste transporters to landfills. For example, in Kebalen Village, which is the location of this research.

Cases in other locations, related to waste, based on data from two Puskesmas around the Bantar Gebang Final Disposal Site (TPA) location, 9 diseases were found with a total number of 19,261 patients [1]. According to the study, there were 6502 people with Upper Respiratory Tract Infection (ARD), 4081 people with gastritis, 3638 people with caries, 1396 people with diarrhea, 1334 people with skin infections, 905 people with myalgia, and Otitis Media. Perforation (OMP) of 755 people, 450 people with anemia, and 200 people with conjunctivitis. Of almost all of these diseases, can be caused by smoke from burning garbage, poor water conditions, and erratic seasons. Thus, environmental sanitation factors greatly affect the type of disease suffered. Data from the Bantar Gebang District Health Center in 2017, shows that skin diseases are included in the top 5 diseases out of 10 diseases in the puskesmas, which are 2,537 new cases and in February 2018 skin diseases still in the top 5 diseases with 371 cases [2].

Other studies show that there are various complaints of health problems in the community around the landfill, namely skin diseases, diarrhea, respiratory problems, chest pain, sore eyes, dry throat, hot throat, headache, cough, intestinal worms and shortness of breath[3].

Garbage in Bekasi City, according to the Head of the local Health Office, encourages the emergence of a number of diseases, especially those related to the digestive tract. He explained that, besides having an impact on flooding due to the restrained flow of water, it also had an impact on health [1]. In Bekasi City, the accumulated garbage causes the river water to be black, full of larvae, and causes an unpleasant odor. In terms of every six months the waste is dredged by the relevant local agencies.

There are several elements that make up a system, namely: goals, inputs, processes, outputs, boundaries, control and feedback mechanisms and the environment [4,5]. The concept of integrated waste management based on Reuse, Reduce, dan Recycle or 3R (Law No. 18 of 2008) is expected to fulfill the concept of waste management towards zero waste. The 3R concept with the principle of reducing, reusing, and recycling waste can reduce waste generation, so that the implementation of an integrated 3R-based waste management system is expected to create conditions of cleanliness, beauty, and public health conditions, which ultimately affect the physical development of the planning area.

In the case of Bandaraharjo Urban Village, Semarang City [6], people's behavior is concerned with the cleanliness of the private home environment without thinking about the cleanliness and comfort of the shared environment. The waste produced is not handled properly, causing environmental pollution, disturbing the beauty and endangering public health. The concept of integrated waste management based on 3R in this location is considered appropriate to overcome waste problems in urban areas, especially in addition to implementing regulations, the importance of community participation. In this study explore and develop the concept of strengthening community participation with a participatory rural communication appraisal approach or known as PRCA [7].

Related to this participatory approach, finding the concept of creative social energy as self-social engineering that is effective in developing community independence through empowerment by the role of private extension workers. The role of private extension agents as facilitators of community empowerment. This creative social energy includes the elements of ideals, ideas, and friendships.

The objectives of this study is to analyze the community-based waste management program with a systems approach. Such an approach is considered to be able to improve community behavior to care for the environment in a participatory and effective, community-based and sustainable environmental management. Such an approach has the potential to be sustainable because it provides social, economic and environmental benefits to the community, and is in line with efforts to realize the SDGs.

2. Methods
The research location is Kebalen Village, Babelan District, Bekasi Regency (Figure 1). The research was carried out from January to December 2020. The study uses a qualitatif method by placing the field
researcher who lived in the village during the research period. Data collection applies cybernetic triangulation, in-depth interviews with key figures/informants, consisting of village heads, community leaders, program participants, and focused discussion activities (FGD).

The main methods used in this research are participatory rural community appraisal (PRCA) and participatory action research (PAR) in peri-urban communities in Bekasi Regency [8,7]. This study is supported by quantitative data, that is, 30 people as program participants. The PRCA approach was chosen because it has advantages as a research method because it uses visualization techniques, interviews, and field-based working groups to produce objective, actual, and in-depth information. This approach is a participatory approach that combines ideas and techniques from a logical framework approach, process and goal-oriented project planning [7]. Meanwhile, the PAR approach in this study was used to build trust between researchers and related parties in the community empowerment process, especially the community participation-based waste management system. Thus, the objectivity, depth and up-to-date of data and information are guaranteed.

The PRCA process is carried out by empowering facilitators, who are scholars who live in or live with the community. The task of the empowering facilitator is to assist the community in planning, implementing and monitoring the program. The empowering facilitator also acts as a liaison, both between the community and the company, as well as with the local government. The role of the empowering facilitator in community empowerment is also in synergizing digital communication with conventional communication to build social capital. The community's assessment was very positive about this empowering facilitator because the mentoring method applied by the empowering facilitator was a participatory method. The participatory approach is very appropriate to be used in community empowerment programs because the participatory approach will result in mutual understanding, mutual agreement, and will become collective action for group members in the future [9].

3. Result and Discussion
Participation from various parties is one of the keys to the success of an activity or program that includes decision making, implementation, assessment, and utilization of results [9,10]. Community participation is influenced by public perception of an activity. Perception can be interpreted as the process of sensing and interpreting the stimuli of an object or event that is informed so that a person can view, interpret and interpret the stimuli received according to his circumstances and the environment in which he is located so that he can determine his actions. Strengthening community participation in this study using PRCA.

The PRCA tools and techniques used are intended to get to know each other, motivate each other, to understand more deeply about the community, and the communication problems that occur as well as to explore and critically analyze problems among the stakeholders. This approach is basically similar to the participatory rural appraisal (PRA) approach. With this approach, the related parties can reveal well the conditions before and after the implementation of the program. The impact is that community participation in community empowerment is effective, both as a process and as a goal of community empowerment. The facilitator or extension worker is conducive to generating community participation,
both in decision-making or planning, implementation, monitoring, evaluation and utilization of the results of community-based waste management programs.

Based on the community agreement by PRCA, there are six RWs that are interested in developing a waste management program. The education level of the community participants is 55% with tertiary education, 39% with high school education or having received diploma education, in detail can be seen in Figure 2. They are productive aged between 25-55 years, and most of them are housewives.

![Figure 2. Characteristics of Participants by Education and Gender.](image)

From the results of PRCA in the community, participants in the inter-RW program agreed to establish a black box model for a community-based waste management system, as shown in Figure 2. Black box in systems analysis is a box that is not known what happens in it, but only the inputs that enter and the outputs of the dark box are known [11]. In compiling the black box, three pieces of information must be known, namely: input variables, output variables, and parameters that limit the system. The preparation of this black box is based on visualization observations in the field, interviews, and group discussions, so as to produce objective, actual, and in-depth information. The approach used is a participatory approach with PRCA which combines ideas and techniques from a logical framework approach, process-oriented project planning and goals.

The main output desired by the community in managing the environmental system is managed waste so that the impact of flooding is controlled, the environment is healthy, the prevalence of disease is decreased, and the community is independent, and participates in a sustainable manner. However, there are unwanted outputs, such as social jealousy for people who are late in getting the opportunity to participate and they have the potential to depend on assistance [11]. In this case the management in each RW to minimize the occurrence of unwanted outputs. According to the black box theory, to minimize unwanted output, environmental system management is required to be able to manage controlled inputs and consider external factors, namely uncontrolled inputs and environmental inputs. In detail can be seen in Figure 3.

![Figure 3. Black Box Analysis of Community-Based Waste Management System.](image)
3.1. Community-based waste management system analysis system

Several elements of the system analyzed indicate that the community-based waste management system includes objectives, inputs, processes, outputs, limits, control and feedback mechanisms and the environment [12]. The following is an analysis of the elements that make up a community-based waste management system.

3.1.1. Purpose

Every system has a goal. The community agrees that the objectives of waste management in this program are: (1) The development of public awareness in protecting the environment; (2) The creation of a clean, green, healthy and flood-free environment; and (3) The development of community creativity in waste management in accordance with existing potentials and problems. The PRCA approach that prioritizes dialogue and community participation makes this goal a direction and a source of motivation in managing the system.

3.1.2. Input

System inputs in this program are in the form of community interest and participation that developed after PRCA was implemented by empowering facilitators, namely community interest and participation, and agreement on funding activities independently. Community empowerment facilitators are important inputs in the community empowerment system. The roles of community empowerment facilitator are: 1. Defender (advocacy); 2. Facilitator; 3. Enabler; 4. Outreacher; 5. Supervisor; 6. Dynamizers; 7. Motivators; 8. Catalysator; 9. Mediators; 10. Elaborator [13]. The role of the empowering facilitator is in line with the role of the extension worker. Based on Law no. 16 of 2006, the role of the instructor is to carry out a learning process to improve the quality of human resources. Extension is an information service. In addition, counseling also provides consulting services through providing advice if there are problems faced by farmers [14].

In addition, the community also took advantage of the initial support from the company in the form of supporting equipment in the form of a composter, biopori drill, plant seeds that the community wanted to plant, both in their home gardens (urban farming) and on vacant land (public facilities).

3.1.3. Environmental management system development process

The community in managing waste, in a participatory manner, has tried to reduce the behavior of throwing organic and inorganic waste into rivers, as well as improving the skills of housewives so that they can provide economic value products.

In the process of environmental management systems there is a change or transformation from inputs to outputs that are useful and of economic value. In this case, it is in the form of information and products, as well as the utilization of residual household waste. With PRCA, placing the community as a subject in every activity, both in planning, implementing, evaluating (monitoring evaluation) and utilizing the results of the community empowerment process carried out in a participatory manner.

The stages of activities in the community-based waste management program with the PRCA approach include: (1) Location Identification and Stakeholder Mapping, (2) Internship, Awareness and Motivation, (3) Skill Development of Group Members, (4) Comparative Study, and (5) Development and strengthening of group institutions. In detail can be seen in Table 1.

3.1.4. Environmental management system output

Based on the community agreement, the system output targets have been set including: (1) Institutional strengthening through group formation; (2) Internship strengthening environmental care behavior; (3) Demonstration of waste processing (compost house, local microorganism/MOL, liquid organic fertilizer/POC); (4) Making Biopori; (5) Waste utilization: handicrafts from waste; (6) The establishment of organic sample gardens; (7) The existence of activity products: processed waste products and agricultural products. Basically, the output of this environmental system management system includes changes in people's behavior to be concerned with waste, utilization of potential
resources, utilization of waste for productive businesses in the form of waste bank management and waste utilization for urban farming; flood reduction through the manufacture of biopori and the functioning of environmental management institutions, particularly waste management. The detailed explanation is presented in Table 2.

Other impacts of this program are changes in perception, increased knowledge, attitudes and skills of the community in waste management, people can sort organic and non-organic waste and have good habits of saving waste. In addition, it also increases self-confidence to teach knowledge possessed to residents or other relatives around the village. Group members are now more confident in expressing their opinions in regular monthly meetings/forums, discussions with relevant agencies, and the local village government.

The waste management internship activity which was carried out in collaboration between PT Bumi Resources, Tbk and CARE IPB raised the concept of three AH (Prevent, Sort and Process waste). Based on the evaluation, people who previously did not know the three AHs, it turned out that after the community empowerment program the majority of the people (66%) recognized and practiced the 3 AH concept. The challenge ahead is to develop community participation, which is 34% to participate in implementing the 3 AH concept.

Perception of Application of Biopore Holes in Environmental Management. The concept of biopore not only functions in water and soil resources but can also be a method of waste management. The biopore theory is well known to the public, it is shown that 43% of families are familiar with and practiced the biopori concept before the training provided by PT Bumi Resources, Tbk and CARE IPB. After training, the application of making biopore holes has increased. This is shown by 93% of families by expressing interest and having participated in making biopore holes in their yards and around their homes.

**Table 1. Plan of activities and outputs of achievement of activities**

| Activity plan | Input | Process | Output | Outcome |
|---------------|-------|---------|--------|---------|
| Location Identification and Stakeholder Mapping | Location Specific, Group Name and organizational structure, | Survey, FGD and depth interview | Found sources of problems and potential that can be developed | Communities / groups are easier to overcome problems and understand the existing potential, Better public awareness, changes in behavior towards understanding environmental problems, able to manage activities and create new potentials that can be done. |
| Internship, Awareness and Motivation. | Training Methods, Participants/Groups, Main Problems, | Training with an adult and participatory approach to education | Better understanding of the community/participants, Awareness of being in a high environment, concerned about the success of the work/Program | |
| Group Member Skill Improvement. | Human resources involved, Facilities and infrastructure | Learn in class and practice or try out activities in the field such as: 3R, waste management, ecobricks, biocyclo farming. | Availability of professionals in managing the environment, waste and Biocyclo Farming. | The group is able to manage existing programs and the group is a producer of agricultural products and partly agricultural inputs, understands the quality requirements for products to be marketed out and has better competence. |
| Comparative study | Visit the location and discuss with the party managing and prepare discussion materials | Participates have a better plan and insight in program management | Carry out better activities or programs or improve existing programs. |
| Development and strengthening of group institutions. | Visiting locations that can provide inspiration for group programs Participants/Local residents | Placing an Associate Degree | Community capacity building | |
| | Run program Learning methods | Study groups regularly | The program runs according to schedule | |
| | | | The group is more solid and growing | |
Perception of Maggot Cultivation in Waste Management. Maggot cultivation is one of the innovations in waste management. Most of the program participants (82%) stated that they did not know about maggot cultivation prior to the training held by PT Bumi Resources, TbK and CARE IPB. The maggot cultivation training which was held with demonstration plots was considered to have a positive impact, as seen from 100% of the empowerment participants who considered this activity useful as a new innovation in waste management. This means that the RW representatives have transmitted the results of the training to other participants in their group.

Table 2. Some achievement indicators from the implementation of the first year program (2019-2020) of the waste management assistance program in Kebalen Village, Bekasi

| No | Indicator | Target | Achievements |
|----|-----------|--------|--------------|
| 1  | Institutional strengthening: Group | Formed 1 unit of waste bank, craft group & yard utilization | There are 5 units of waste bank |
| 2  | Internship strengthening environmental care behavior | Implementing socialization to RW heads and candidates for waste bank management & training for waste bank managers/groups | Implementation of socialization at the village level and 6 RW (RW 04, RW 14, RW 17, RW 19, RW 27, RW 28) |
| 3  | Demonstration of waste processing (compost house, MOL, POC) | 1 unit | 3 locations (RW 14, RW 19 Blok G, RW 28) |
| 4  | Biopore infiltration hole | 500 unit of biopore infiltration hole/LRB | 300 unit of biopore infiltration hole/LRB |
| 5  | Utilization of maggot as a biodigester for organic waste | 1 demonstration plot; 10 participant in one RW | 1 demonstration plot; there are 10 participant, in RW 19 |
| 6  | Utilization of waste: crafts from waste | various bags from waste | There are bag and mask products from plastic waste and cloth waste limbah |
| 7  | The establishment of an organic sample garden | 1 demonstration plot | Utilization of land and empty houses for nursery and hydroponics |
| 8  | The existence of activity products: processed waste and agricultural products | Availability of compost, MOL, POC, availability of fresh vegetables | The community is able to produce MOL and POC, fresh vegetables |

Public Perception of Waste Bank Assistance. The existence of the waste bank which was originally located in three RWs and was less active and has now developed into five waste banks, four of which are active. Garbage Banks have played an important role in non-organic waste management activities, and trained cadres play a role as a driving force for the community. As many as 63% of participants stated that before there were community empowerment activities, there were no mentoring activities. The majority of empowerment participants assessed that the assistance provided by the empowering facilitator provided benefits for the development of the waste bank. The main benefit assessed by 30% of participants is that the mentoring activity has reactivated the existence of a passive waste bank. The benefits of the empowerment program for the development of waste banks can be seen in Figure 4a.

3.1.5. Environmental Management System Boundaries

Boundary analysis of the environmental management system can be seen from the participants of the empowerment program, who participated in joint activities carried out by the community in six RW/blocks. This system boundary is the scope or scope of the system/subsystem itself. In the waste management system, the limits of the system are all aspects of activities ranging from preparation (social mapping), empowerment program planning, implementation of activities, monitoring and evaluation and utilization of results. Despite that, there is dissemination of information related to environmental management, which has the potential to cause social jealousy which is a challenge for system managers in the future.
The environment that affects the management system

Environment outside the system (environment) is everything outside of the system boundaries that affect the operation of a system. The environment of this system has become a concern in the development of a waste management system, including government regulations on waste management, local regulations, and existing supra-village institutions. In addition, those that have a direct effect but are beyond the control of the system manager (uncontrolled input), include the attitude of the community, the commitment of other parties (the Bumi Resources company and the existence of CARE IPB as a community empowerment), support from the village government and the commitment of related figures.

In the context of ecological adaptation, the concept of creative social energy is known, namely the rise of internal strength and independence in community empowerment, which includes ideals, ideas and friendships [9,15], [10]. This creative social energy is known as self-social engineering, where the community as the subject decides the ideal conditions to be realized (ideals), ways and signs in realizing these ideal conditions (ideas), and performs

3.1.6. Control and Feedback Mechanism

The control mechanism is realized by using feedback. This feedback is useful in an effort to control the input and process of the system in producing its output. This is useful for environmental system managers to control so that the system runs according to the expected goals together. One of the program control mechanisms is to conduct participatory discussions on the results of monitoring and evaluation on a regular basis every two months, and measurement of community satisfaction at the end of the year. Based on the measurement of community satisfaction, it is known that 44 percent of the participant program (community) are satisfied with this program (Figure 4b).

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3.2. Relation of the Impact of Environmental System Management on the SDGs

The evaluation results show that environmental system management activities contribute to at least six of the 17 SDGs targets. In detail, it can be seen in Table 3. This contribution is inseparable from the real role of community leaders and changes in community behavior in waste management as well as the role of participants who develop in line with the PRCA approach consistently in community empowerment.

3.3. Lesson learn from the results of the study

The environmental management system approach, particularly with regard to waste management in peri-urban (suburbs) areas, has effectively contributed to efforts to achieve some of the SDGs. This happened through the system development approach, which was carried out with a consistent PRCA approach, namely placing trained and professional empowering facilitators as private extension workers who lived with the community during program development.

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synergistic collaboration with related parties (friendships). Basically this is realized with the PRCA approach where the main paradigm of the participatory approach is dialogical communication. This dialogical communication is characterized by a non-dominant, humanist, equity and fair relationship.

Approaches as above: analysis of environmental management systems, PRCA approach, participatory action research (PAR) are approaches to explore and develop community-based solutions to environmental problems in a participatory, independent and sustainable way.

Table 3. Achievement of SDGS through Community-Based Waste Management Program

| Before | Forms of Mentoring Activities | Alteration | SDGS Number |
|--------|--------------------------------|------------|-------------|
| Yard land has not been used optimally | Training and assistance for urban farming and waste processing in the yard | - The development of the use of the yard through urban farming - There are already people who sell vegetable products even in limited circles | 2 |
| No waste management | - Dissemination, awareness and training on waste management to community, the number of participants is approximately 300 people (0.4% of the population of Kebalen) - Comparative Study of Waste Bank Management to Bogor | Increased waste management activities in the community in the Kebalen area, starting from waste transportation by DLH and waste management in 5 RW | 13 |
| The majority of waste is disposed of to unofficial temporary garbage collection (TPSS) | Dissemination of waste management technology (composting, maggot cultivation, MOL and POC manufacture, biopori and waste craft) | Implementation of the waste management model: - Maggot cultivation (RW 19 & 28) - Making MOL & POC (RW 14 & RW 28) - Composting (RW 14 & RW 19) - Trash Craft (RW 14, 19, 28) - Biopori (RW 4, 14, 17, 19, 27, 28) - Arranged areas along the Bekasi River and Kebalen Irrigation River. - The arrangement of several residential areas, especially those participating in the competition. - Increasing the amount of forage around Kebalen Village. | 11 |
| A small part of the community knows about waste management | Reforestation on the banks of rivers, settlements and schools Organizing a cleanliness competition (Kebalen Bumi Hijau) in Kebalen Village | - Support from the Kebalen Village Government in waste management and environmental management - Involvement of the Environment Agency in waste management in Kebalen and participation in cleaning competitions | 15 |
| Riverbank and settlement arrangements | | - Circular on reducing plastic waste by the Kebalen Village Head - Support for making 1,000 biopore holes in Kebalen Village through regular community service activities every month | |
| The government’s attention to waste management in the Kebalen area is lacking | Assistance in waste bank management | A total of 5 waste banks are actively collecting and managing waste in 4 RW | 16 |
| There are 3 garbage banks in Kebalen Village but they are not active | | | |

4. Conclusion
The main output of this program is managed waste so that the impact of flooding is controlled, the environment is healthy, the prevalence of disease is decreased, and the community is independent, and participates in a sustainable manner. There are unwanted outputs, such as social jealousy for people who are late in getting the opportunity to participate and they have the potential to depend on assistance. In this case the management in each RW to minimize the occurrence of unwanted outputs. According to the black box theory, to minimize unwanted output, environmental system management is required to be able to manage controlled inputs.
and consider external factors, namely uncontrolled inputs and environmental inputs. An essential factor in the environmental management system is a participatory approach to community empowerment. The community-based environmental management system model produced in the empowerment process has the potential to become an alternative model for environmental management in densely populated cities facing the threat of floods and other environmental problems and the achievement of SDGs.

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