

Co-Creating Environmental Solutions through Community-Based Science Education: A Participatory Situation Analysis, Philippines

Mercy O. Manalo¹, Abegail A. Malabuyoc², Dorren R. Arenque³

^{1, 2, 3} Polytechnic University of the Philippines, Philippines

Abstract

The rapid pace of urbanization in Metro Manila poses more environmental issues within densely populated areas, like Tondo, Manila, which suffer from the improper waste disposal, environmental pollution, and insufficient availability of green spaces. The solution of these environmental issues is not only dependent on environmental intervention but on educating people about their surroundings. This paper investigates the use of Participatory Situation Analysis (PSA), within the context of Participatory Action Research (PAR), as an educational tool used for investigating local environmental issues and promoting active community participation. This research included the participation of members of the community, barangay officials, informal waste pickers, and environmental volunteers in selected areas of Tondo, Manila. Data were collected using various means, including interviews, household surveys, observations, analysis of documentation, mapping of the community, and community participatory workshops. Results show persistent environmental issues involving waste management, pollution, and lack of green spaces. However, more significantly, participatory learning processes facilitated community member ability to analyze environmental issues and understand the interrelationship between human actions and environmental condition. Community mapping and dialogue sessions helped improve environmental awareness, fostered collaboration, and emphasized the idea of collective environmental responsibility. This study shows that the Participatory Situation Analysis not only serves as a methodological instrument but also is applicable as an environmental education strategy, promoting community empowerment and environmentally sustainable practices. These results are significant for further development of community-based environmental education since the use of participatory methods helps enhance environmental literacy and promote sustainable practices in local communities.

Keywords: *participatory situation analysis, environmental governance, waste management, community participation, sustainability*

1. Introduction

Environmental problems associated with fast-growing cities have become not just environmental or governance issues but rather educational challenges. Environmental education helps people understand environmental problems, develop an attitude towards them, and participate in environmental decision making. When it comes to urban informal communities where people face various environmental challenges, it is possible to enhance their environmental literacy through educational methods based on practical application of theoretical knowledge.

Tondo, Manila, is considered one of the densest urban areas in the Philippines, suffering from multiple environmental problems like improper waste management, water pollution, pollution, and lack of green areas. This problem negatively impacts environmental conditions and affects people's health as well as sustainability. Despite the existence of governmental programs and environmental policies, sustainable development is dependent on active involvement of local communities and their environmental awareness.

Learning from the environment using the community approach enables the locals to learn through observing, communicating, reflecting, and acting together in relation to the issues. Community-based environmental learning is premised on the theory of learning based on experiences and participatory education which acknowledges the community members as important participants in learning about the environment. Participatory Action Research (PAR) and Participatory Situation Analysis (PSA) are critical to the achievement of the objective in view because they provide opportunities for integrating local experiences and science to address the issues at hand.



Though there are numerous studies focusing on the relationship between environmental management and participation of the community members, few studies have focused on the significance of Participatory Situation Analysis (PSA) to environmental education within urban areas in the Philippines. This study, therefore, aims to fill the identified gap through an analysis of how PSA can contribute to environmental education within Tondo in Manila.

2. Objectives of the Study

2.1 General Objective

To examine how Participatory Situation Analysis can be utilized as a community-based environmental education approach to enhance environmental awareness, environmental literacy, and community participation in addressing environmental issues in Tondo, Manila.

Specific Objectives

1. To identify community knowledge and practices related to waste management and environmental conservation.
2. To examine residents' understanding of environmental pollution and its effects on human health and the environment.
3. To assess community awareness regarding the importance of green spaces and urban environmental sustainability.
4. To determine how participatory learning activities influence environmental awareness and community engagement.
5. To develop community-based environmental education strategies that support sustainable environmental practices and local environmental governance.

3. Methodology

3.1 Research Design

For the current study, the methodology used was Participatory Action Research (PAR). Participatory Situation Analysis was the main methodological framework used for this purpose. The essence of PAR is that it is a research process that involves collaborative inquiry, where community members take part in problem identification and formulation of solutions.

3.2 Study Area and Participants

The study was done in selected areas of Tondo, Manila, an urbanized municipality distinguished by its congested populace, minimal infrastructure, and environmental problems. Subjects of the study comprised community members, barangay officials, waste pickers, and environmental volunteers. The use of purposive sampling was done to ensure that the respondents belonged to varied community perspectives, especially those who are directly linked with environmental activities.

3.3 Data Collection Methods

Triangulation of data involved several approaches including:

- Semi-structured interviews with community members
- Surveys of households on waste management issues
- Field observations at waste dump sites and community settings
- Barangay records and reports on environmental programs
- Workshops using community maps and environmental visi

3.4 Data Analysis



Analysis of qualitative data involved the use of thematic analysis, which focused on identifying common themes relating to the environment and patterns of community reactions. Descriptive statistics were used to analyze quantitative data collected through surveys.

4. Significance of the Study

The present study is a valuable addition to the body of research in environmental education because it shows the importance of using participatory methods for fostering environmental awareness and community involvement in urban areas. At the individual level, it enables community members to engage in reflection regarding the environmental problems that impact them directly and to get involved in solving them. At the organizational and policy-making levels, on the other hand, the results provide important information to local government units and barangay leaders about the value of supplementing existing environmental programs with efforts aimed at fostering environmental awareness and community participation through environmental education. This study also holds relevance to academic discussions in community-based environmental education and environmental literacy.

5. Conceptual Framework

The research is additionally based on the concepts related to community-based science education, which involve experiential learning, participatory investigation, and environmental understanding within particular settings. In such a case, education involves discussion, observation, reflection, and solving problems in relation to the particular community. Workshops held within PSA involved data collection but were also educational as individuals were encouraged to discuss their environments, share experiences, and establish environmental awareness. Such an approach is aligned with that proposed by Freire and referred to as dialogic education, involving learning through collective reflection and action (Freire, 1970).



6. Results and Discussion

These results indicate that participation in environmental learning activities is crucial for enhancing the practice of waste management. In particular, the community discussions and PSA sessions allowed the residents to think critically about the issue of waste disposal, its negative impact on environmental health, and their role in addressing this problem within the community. Thus, the study shows how community-based science education helps enhance individuals' awareness of environmental issues.

Besides helping to identify environmental conditions, these participatory approaches were effective in promoting environmental learning. Residents were able to consider the causes and effects of environmental problems based on their personal observations and experiences. By reflecting upon these processes, participants gained an enhanced understanding of how human actions affect environmental quality. This type of environmental learning aligns with the basic concepts of environmental education.



6.1 Waste Management Practices

Table 1. Waste Management in the Community

Waste Management Patterns	1	2	3	4	Other Answers
WM1: Waste generation (types, quantities)	There are assigned street sweepers and garbage trucks collecting garbage everyday (4)	Waste segregation is being practiced (3)	There is a lot of garbage due to overpopulation (2)	WM1: Waste generation (types, quantities)	There are assigned street sweepers and garbage trucks collecting garbage everyday (4)
WM2: Waste collection and disposal methods (segregation, recycling, landfill)	They are observing waste management such as collecting the garbage every morning and afternoon (10)	There are declogging, clean up drive and recycling activities initiated by the barangay (5)	—	—	They are observing waste management such as collecting the garbage every morning and afternoon (10); There are declogging, clean up drive and recycling activities initiated by the barangay (5)
WM3: Informal waste management practices (scavenging, dumping)	There are scavengers looking for recyclable waste (4)	Dumping garbage at the back of the building (1)	—	—	—
WM4: Waste treatment facilities and their effectiveness	There are assigned street sweepers and garbage trucks collecting garbage everyday (6)	There are declogging, clean up drive and recycling activities initiated by the barangay (3)	There is a detection device for copper, bronze, and brass burning (Pagsusunod ng tanso) (2)	—	—
WM5: Environmental impacts of waste management (pollution, health risks)	Too hot weather sometimes causes fire on the mountain. It also has extracted that stink (4)	Clean surroundings provide good health (3)	The quality of soil is contaminated. Plants are difficult to grow (1)	—	—
WM6: Public awareness and participation in waste management	There are clean up drives and assigned street sweepers. There are also garbage	There is a MRF project by the barangay (2)	There are designated trash cans every building (1)	—	—



Waste Management Patterns	1	2	3	4	Other Answers
	trucks collecting garbage everyday (6)				

From the study, it is evident that there is a dual waste management system that includes the use of both official municipal waste disposal and unofficial recovery practices. There was evidence of regular garbage collection and street sweepers in some sections of the barangay. On the other hand, there was evidence of the practice of waste scavenging for the purpose of resource recovery and recycling of recyclable materials in most waste dump sites. Waste scavengers form an important aspect of any recycling systems in developing countries. They contribute a lot to resource recovery and the circular economy process (Medina, 2007; Wilson et al., 2006). - The waste collection takes place by truck whereas bulldozers gather the rest of the waste materials. A total of 12 community volunteers handle the waste material from the MRF. The volunteers do not use personal protective equipment (PPEs), putting their lives in danger, along with that of the collectors and scavengers. Such cases have been observed in many parts of Metro Manila where the work of waste scavengers was crucial to resource recovery and recycling processes (Gutberlet et al., 2021).

While formal waste collection services are provided, illegal dumping practices were also noted during the study. Some participants stated that trash was disposed of at the back of buildings or in open areas from time to time, posing problems with foul smells, pests, and even fires during dry weather.

These results are consistent with earlier studies that have found that informal settlements in urban settings function under a mixed economy of waste systems, whereby formal waste management processes exist alongside informal recycling methods (Serrona & Yu, 2009). Although the practice of informal waste picking creates jobs, it is important for policymakers to pay attention to the issue of informal waste management governance as well. As far as involvement in environmental efforts by local communities is concerned, barangay clean-ups and street sweepings were noted as forms of engagement by community members in environmental issues. Yet, some participants were unaware about the barangay MRF, suggesting a lack of integration between current waste management policies and practices in the community.

The difficulties related to illegal dumping and waste management become more pronounced in the case of Tondo. The community encounters serious environmental threats associated with improper waste disposal practices. The lack of law enforcement results in an increase in the number of illegal dumping locations, thus posing various environmental threats. Besides, insufficient public knowledge about the issue in question adds up to existing difficulties related to waste management. It can be stated that governance problems could be successfully dealt with in Tondo.

6.2 Pollution Sources and Environmental Impacts

These activities have also offered chances for environmental learning by the citizens. The discussions enabled them to relate their environmental surroundings such as polluted rivers, toxic soil, and emission of smoke with more extensive environmental impacts on the public. This indicates how community science plays a part in turning environmental surroundings into environmental learning.



Table 2. Pollution Patterns in the Community

Pollution Patterns	1	2	3	4	Other Answers
POL1: Air pollution (sources, types, effects)	Burning of wires for copper, bronze, or brass is already prohibited (7)	Too hot weather sometimes causes fire on the mountain. It also stinks (2)	—	—	—
POL2: Water pollution (sources, types, effects)	The water from the faucet is cleaner than the water coming from the water tank. The water coming from the water tank is not potable (8)	There is a good water supply (3)	Some are buying mineral water (2)	Sometimes, when it is high tide, the water from the river stinks (1)	The plastic bottles floating on the river (1)
POL3: Soil pollution (sources, types, effects)	Due to over population and crowded building, there is no place for planting (3)	Heavy rains cause landslide and soften the soil (2)	The quality of soil is contaminated. Plants are difficult to grow (1)	—	—
POL4: Noise pollution (sources, effects)	Because of over population, there is a noise pollution especially during weekends or if there is occasion (5)	The place is quiet (2)	The vehicles passing through also contribute to noise pollution (1)	—	—
POL5: Regulations and enforcement related to pollution control	Waste segregation, detection mechanism for copper, bronze, and brass burning, and dumping site (5)	Street sweepers assigned by the barangay (2)	—	—	—

The residents reported several types of pollution in their area, ranging from air, water, soil, and noise pollution. The main sources of air pollution involved the burning of metal wires and other waste products. It should be emphasized that such activities are banned, although residents report instances when burning of such materials occurs; consequently, toxic substances in the form of fumes are released into the atmosphere. This problem can be regarded as an example of difficulties that arise in the enforcement of environmental policies in informal urban settlements. Water pollution was another critical issue. According to respondents, although tap water can be regarded as clean, water in storage tanks was believed to be unsuitable for consumption purposes. Besides, during high tide, river water smelled bad and contained various plastic wastes. Such facts can be compared with results of earlier studies reporting issues associated with water quality in informal settlements adjacent to water bodies in Metro Manila (Casiw, 2020). Moreover, inadequate waste management led to the pollution of soil, making it impossible to plant any vegetation.

The study also found that heavy rainfall led to poor soil stability and soil contamination. In addition, noise pollution proved to be another environmental problem brought about by high population densities and higher incidences of human activities. Noise pollution was found to be higher when there were meetings or traffic congestion. From the results obtained, it can be seen that environmental problems in Tondo are inter-related.



6.3 Green Spaces and Urban Environmental Quality

Further small-scale planting programs showed how participatory environmental actions could be educational. The people were not only involved in the planting process itself but also in conversations about the heat in urban areas, ecology, and wellbeing within the community. These examples show that environmental education can result from community actions, rather than being confined to classroom education only.

Table 3. Green Spaces in the Community

Green Spaces Patterns	1	2	3	4	Other Answers
GS1: Types of green spaces (parks, gardens, forests)	There is an ongoing barangay project for planting (3)	Upper part of the mountain used for planting vegetables, Barangay project for vegetation (1)	—	—	—
GS2: Accessibility and availability of green spaces	No area because the area is crowded with buildings (1)	Very few because the soil is contaminated. (1)	—	—	—
GS3: Quality and maintenance of green spaces	The barangay is clean every morning and afternoon because of the street sweepers (1)	—	—	—	—
GS4: Ecological functions of green spaces (biodiversity, climate regulation)	Solar system and generator charge problem (1)	—	—	—	—
GS5: Public use and enjoyment of green spaces	It is in order (1)	—	—	—	—
GS6: Urban planning and green infrastructure development	Barangay project for development of the community such as planting and recycling (3)	There is a mountain where they plant (2)	—	—	—

In general, it can be seen that there is a significant absence of green spaces in the community. Some of the respondents have identified that there are some planting efforts initiated by the barangay, specifically in the mountain areas. These places are used sometimes for gardening. However, there are also many areas that do not have any green space at all due to high population density and the presence of residences that occupy the area. In addition, there does not seem to be any effort in the maintenance of green spaces in the community other than those done by street cleaners. This suggests that the ecological benefits are less present in the barangay. The scarcity of green spaces in urban informal communities has been extensively studied in urban planning literature. The importance of green infrastructure in urban areas is crucial for enhancing environmental quality, cooling urban areas, and ensuring the well-being of residents (Newman & Jennings, 2008; UN-Habitat, 2020).



Nevertheless, there were indications that the community was showing interest in greening activities. The barangay's tree planting program and the planting of vegetable gardens are clear indicators that the community is willing to participate in efforts to improve the environment. These observations indicate that green community-based interventions like container gardening, roof-top planting, and vertical gardening could be viable solutions for urban environmental improvement in space-strapped communities

7. Conclusion

This study illustrates how Participatory Situation Analysis is not just a way of analyzing the environmental status of the community but also an effective environmental education tool. By means of community mapping, discussions, observations, and reflections, the residents were able to enhance their knowledge about the environmental problems and develop their sense of responsibility for environmental protection. Some of the results obtained from the study indicate the existence of persistent problems regarding waste disposal, pollution, and lack of green areas in Tondo, Manila. On the other hand, the participants of the process acquired environmental literacy and knowledge through collective learning and community engagement. Environmental education should be integrated in community-based environmental programs in order to promote responsible community involvement in environmental activities.

It can be observed that environmental governance in informal urban settlements is closely intertwined with community learning and environmental education. In this regard, Participatory Situation Analysis can be considered not just a methodological approach for conducting research but also an instrument for community-based science education, whereby residents analyzed the local environment, shared their experiential knowledge, and thought collectively about what they could do environmentally. Thus, the research indicates that participatory approaches contribute to fostering environmental awareness and promoting environmental stewardship on a local level.

In this study, Participatory Situation Analysis has been demonstrated to be not just a research methodology but also a tool for community-based science education among urban poor communities in the Philippines. Through participatory workshops and other educational methods, residents were able to engage in learning about the environment based on scientific insights.

Environmental problems related to waste management, pollution, and lack of green growth infrastructure have been identified in Tondo, Manila. The research indicates that participatory education can help foster environmental awareness and promote participation in environmental governance processes.

Though there are other studies done on participatory environmental education around the world, what is provided here is unique data gathered within the Philippine urban setting. Thus, this research adds to existing studies on community-based environmental education in its illustration of how participation in learning can contribute to environmental initiatives in underdeveloped urban communities.

For the government, it is recommended that the promotion of environmental literacy, inclusion of informal waste workers in community-based education, and implementation of participatory green infrastructure be considered for policy development.

REFERENCES

- [1] Ballesteros, M. M. (2010). Linking poverty and the environment: Evidence from slums in Philippine cities. Philippine Institute for Development Studies.
- [2] Casiw, G. M. (2020). Revisiting the ecological solid waste management program in the slum areas of Manila. *International Journal of Advanced Research*.
- [3] Gutberlet, J., Uddin, M., Kalita, P., & Hosseini, M. (2021). Waste pickers and environmental stewardship. *Sustainability*.
- [4] Regmi, R. K. (2018). Urbanization and environmental issues in Metro Manila. *Journal of Advanced College of Engineering and Management*.
- [5] Serrona, K. R. S., & Yu, J. S. (2009). Waste-to-energy development and livelihood support in Payatas, Metro Manila. *Journal of Environmental Sciences*.
- [6] World Bank. (2019). *Overcoming the challenges of water, waste and climate change in Asian cities*.



- [7] Ahorro, J. R., Boholano, H., & Roldan, A. (2023). *Community-based environmental education and sustainability practices in urban communities in the Philippines*. *Journal of Environmental Education and Sustainability*, 15(2), 45–59.
- [8] Arnstein, S. R. (1969). *A ladder of citizen participation*. *Journal of the American Institute of Planners*, 35(4), 216–224.
- [9] Chambers, R. (2017). *Participatory rural appraisal: Principles, methods and application*. *World Development*, 94, 1–9.
- [10] Gutberlet, J. (2015). *Co-operative urban mining in Brazil: Collective practices in selective household waste collection and recycling*. *Waste Management*, 45, 22–31.
- [11] United Nations Environment Programme (UNEP). (2021). *Waste management outlook for Asia and the Pacific*. United Nations Environment Programme.
- [12] United Nations Human Settlements Programme (UN-Habitat). (2020). *World Cities Report 2020: The value of sustainable urbanization*. UN-Habitat.
- [13] Medina, M. (2007). *The world's scavengers: Salvaging for sustainable consumption and production*. AltaMira Press.
- [14] Wilson, D. C., Velis, C., & Cheeseman, C. (2006). *Role of informal sector recycling in waste management in developing countries*. *Habitat International*, 30(4), 797–808.
- [15] Choguill, C. L. (1996). *A ladder of community participation for underdeveloped countries*. *Habitat International*, 20(3), 431–444.
- [16] Newman, P., & Jennings, I. (2008). *Cities as sustainable ecosystems: Principles and practices*. Island Press.
- [17] Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge University Press.
- [18] FAO. (2018). *Participatory approaches for sustainable natural resource management*. Food and Agriculture Organization of the United Nations.
- [19] Freire, P. (1970). *Pedagogy of the Oppressed*. Continuum.
- [20] Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, 25(6), 791–812.
- [21] Brossard, D., Lewenstein, B., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, 27(9), 1099–1121.
- [22] Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation. *Biological Conservation*, 241, 108224.