Recycling Groundwater in Urban Multicultural Society

Herdis Herdiansyah

School of Environmental Science, University of Indonesia, Salemba, Indonesia

*herdis@ui.ac.id

Abstract. The excessive usage of groundwater in Jakarta causing degradation of soil quality and water quality. The Jakarta administration has conducted a policy breakthrough in the management of ground water. It's just that until now has not been a significant change. With the utilization of groundwater in the form of recycling-based 5R, this paper aims to prove that a multicultural society Jakarta actually has a considerable social capital in a prudent use of groundwater because it was built based on an understanding of culture that is synergistic with the environment. The study uses AHP approach to determine the preferred strategy to develop recycling behavior proposal. The result shows that facilitating the program related to develop recycling behavior becomes the priority. The approach is also considered to provide greater social impact to the community.

1. Introduction

Water scarcity is one of the fundamental problems which will be the main focus of modern civilization other than energy and food [1]. The UN World Water Development Report 2009 says that the diminishing availability of water in all areas, especially in arid areas where water scarcity is a result of increasing population, waste and pollution, and the impact of manmade climate change. Reports from the UN World Water Development Year 2009 also predicted that due to the scarcity of water will cause drought and famine, loss of livelihood, the spread of water-born diseases, forced migrations, and even open conflict [2].

Water is the source of life for human use in everyday activities. Because of the scarcity of water not only threaten lives but also a civilization. With the level of water consumption needs of the water conservation efforts become very urgent, especially groundwater.

Due to the use of groundwater that is not balanced with the availability of the degradation of the quality of the soil and water quality. Soil water conservation efforts must take into account both technical and socio-cultural. The technical factors such as the structure of the upper soil (topsoil) and rocks below as the aquifer and the water reservoir [3], [4]. While cultural factors into social engineering that could be applied in the soil water conservation such as how the mindset of the people and the local culture in preserving the environment (groundwater).

The use of groundwater which is not comparable with many conservation efforts going on in the big city, one of Jakarta. Jakarta as the center of government and business center in Indonesia has a thorny problem in the use of groundwater. Based on the data owned by WALHI, in 2007 and limit groundwater needs in Jakarta reached 251.8 m3 per year, far exceeds the threshold of ideal that is
186.2 million m³ per year. Currently 53 percent of consumers of water in Jakarta using groundwater [5].

As a result of excessive use of groundwater in Jakarta is now a decline in soil. The average land subsidence that occurs is between 20-60 cm. Land subsidence is monitored within last 5-8 years. Based on the results of the Jakarta P2B Department between 1982-1999, some locations decreased soil alarming among others in Mangga Dua, West Jakarta, which reached 29.15 cm. In East Jakarta, a decrease of up to 30.27 cm soil occurred on Jalan Pramuka. The last situation in Central Jakarta such as the Road Kalilio, land subsidence is 43.42 cm. Based on research The Jakarta Regional Environmental Management Board (BPLHD), a decline in groundwater level on average as high as 40 meters [6].

At the same time, groundwater in Jakarta also experienced pollution caused by industrial and household waste. Yet again due to the poor sanitation cause are soil contamination by various bacteria E coli. The pollution does not only result in a dangerous groundwater consumption but also increase the burden in an effort to carry out its conservation [7].

The Jakarta administration need to take a lot of breakthrough in groundwater conservation efforts, such as encouraging the absorption holes biopore manufacture as much as possible. But this has not been enough without the understanding and paradigms that exist at the level of the general public, especially for the people of Jakarta. In addition to the conservation of sustainable use of groundwater are also to be conducted with the paradigm of recycling, thus helping more comprehensive conservation efforts.

Associated with the utilization of groundwater, public consumption Jakarta is quite high (53%). This happens because the government is not maximized in serving the water needs of their own community. Based on the report “Jakarta in Figures (2008)” PAM Jakarta which has 11 units installation capable of producing drinking water as much as 509.34 million m³, or a decrease of 4.79% over the previous year. PAM consumers as much as 755 555 Number of customers with its biggest customers is 87.31 percent of consumer households and commercial / small 10.91 percent. Besides in Jakarta there are also consumers who subscribe from PAM hydrant at the end of 2007, there were 2,361 subscribers to the volume of water sold 548.05 thousand m³.

Groundwater conditions in Jakarta deteriorating and limited requires a paradigm shift in conservation efforts. If during the ethics anthropocentrism place people as centrum, where people feel entitled to explore the universe in order of importance, then due to limited natural resources (including groundwater), paradigma anthropocentrism should turn into ecosentrisme. Ecosentrisme principle this will ensure environmental sustainability. Since it was established as the central government at the time of the Dutch East Indies, Jakarta has been set as a multicultural area[8]. This happens because the Dutch government put Jakarta (Batavia) not only the administrative center, but also the center of business and cultural exchange activities. Jakarta society since the first is a set of societies formed from different tribes and different nations.

The multicultural foundation is what makes Jakarta is unique when compared to other cities. The process of acculturation multicultural society in Jakarta also formed due to enter the discharge process of the population at high speed. Old values that brought new value combined with the new place. This combination is sometimes generated conflicts. For example, for migrants, local knowledge already established long been exposed to conditions that force it to compete. Social cohesion forged since living in villages were destroyed and competition and the needs of human life have forced the village to assimilate the relationship patterns of urban society.

The negative effects of assimilation urban fail of the formation of a multicultural society one of which is slowly decreasing environmental concerns. Similarly, the relationship of trust between fellow
increasingly hunted down and filled with the possibility of a conflict between one party with another party [9].

In the conservation of groundwater, Wahyoedi and Moersidik [10] provides an alternative conservation efforts with the concept 5R namely Reduce (reduction-saving water), Reuse (reuse water), Recycle (utilization through recycling process - to obtain water quality desired), Recharge (replenishment of groundwater areas allow to be filled back), recovery (recovery to regain safe groundwater conditions). The biggest problem of all problems concerning environmental policy arises from the passage of the concept in an ideal level. Conceptualization of recycled groundwater by 5R enable successful if the community willing and able to implement it thoroughly. This study aims to see that the soil water conservation efforts to recycling-based 5 R has associated with the condition of the people of Jakarta multicultural culture. This condition can become social capital which in turn could be used in groundwater conservation policy implementation will be done.

2. Methodology

This paper adopts the AHP method to produce groundwater recycling behavior development proposal in an urban area. Determination of preferred proposal analyzed by doing a pairwise comparison for three levels hierarchy. The first level or top level of hierarchy stands for the objective to develop recycling behavior strategy for the urban community with local wisdom approach. The criterion as placed at the second level consist of three aspects: economic factor, sustainability of the environment, and social impact of the behavior. There are three strategies proposed on the bottom level to be considered as the alternatives which are involving the community in the program, facilitating community and developing community awareness about recycling behavior. Then, those elements in both levels are weighed and the final score of each preferred proposal is based on judgment from experts and study from relevant works of literature. The hierarchy model of the groundwater recycling behavior proposal is illustrated in figure 1 below.

**Figure 1. AHP decision model for producing recycling behavior proposal**

Furthermore, the AHP method used 1 to 9 scale to describe the importance level of criteria or alternatives. Table 1 shows the definition of the 1-9 scale using in this decision making.

| Intensity of Importance | Definition |
|-------------------------|------------|
| 1                       | The importance scale of criteria/alternative A and B is equal |
| 3                       | The importance of criteria/alternative A is moderate than B |
| 5                       | The importance of criteria/alternative A is stronger than B |
| 7                       | The importance of criteria/alternative A is very stronger or demonstrated than B |
| 9                       | The criteria/alternative A is extremely important than B |

Reciprocals of above If activity \( i \) has one of the above non-zero numbers assigned to it when compared with activity \( j \), then \( j \) has the reciprocal value when compared with \( i \)

Source : [11]
Since the process deals with the subjective judgment and may engage too much inconsistency, Saaty determined to a parameter of consistency. The result is categorized as consistent if Consistency Ration is less than or equal to 0.10. [12].

3. Result and Discussion
This study attempts to conduct pairwise comparison to weigh the most important criteria for develop recycling behavior in the urban community.

Table 2. Objective with respect to the criterion

|       | EF                  | SE          | SI                  | Normal | Ranks |
|-------|---------------------|-------------|---------------------|--------|-------|
| EF    | 1                   | Less strong important (0.20) | Less moderate important (0.33) | 0.105  | 3     |
| SE    | Stronger important (5) | 1           | Less moderate important (0.33) | 0.637  | 1     |
| SI    | Moderate important (3) | Moderate important (3)             | 1       | 0.258  | 2     |

Consistency Ratio 0.037

Notes: EF=economic factor; SE=sustainability of environment; SI=social impact

After synthesizing the judgment from expert and literature review, table 2 shows the result of comparison between objective and criteria. Not surprisingly, the calculation emphasizes more on sustainability environment because the proposal to develop recycling behavior is in line with the goal of SDGs. Recycling is playing significant contribution to sustainable development and environmentally friendly activity. The consequence of recycling behavior to social impact is the next consideration to develop a proper proposal.

Table 3. Pairwise comparison matrix between criterion to the alternatives

| Economic Factor | Sustainability of Environment | Social Impact |
|-----------------|-------------------------------|---------------|
| CI              | Normal 0.258 0.14 0.081      | Normal 0.731 1 0.081 |
| PF              | 0.33 1 0.20 0.105            | 0.20 1 0.188 3 5 1 |
| AD              | 3 5 1 0.637                 | 0.20 1 0.188 3 5 1 |

Consistency Ratio 0.037 0.062 0.028

Notes: CI=community involvement; PF= program facilitation; AD=awareness development

From the result of pairwise comparison analysis between criterion to the alternatives in Table 3, it was found that all of the comparisons are consistent as Consistency Ratio is lower than 0.10. For economic factor criteria, the strategy to enhance the community awareness is the priority (0.637), followed by community involvement (0.258) and to implement facilitating program (0.105). In the analysis that based on sustainability of environmental criteria, the priority described respectively are facilitating the program related to recycling behavior (0.731), developing community awareness (0.188) and increasing community involvement (0.081). Meanwhile, awareness development becomes the preferred strategy for social impact criteria by 0.659, community involvement is the second preference (0.185) and facilitating program is the last alternative (0.156).

Table 4. Final results of AHP analysis

| Strategy            | Limiting | Normal | Ranking |
|---------------------|----------|--------|---------|
| Community Involvement| 0.073    | 0.145  | 3       |
| Facilitating Program| 0.252    | 0.503  | 1       |
| Awareness Development| 0.176    | 0.351  | 2       |
Table 4 has provided a final calculation of the AHP approach to propose the recycling behavior proposal. The analysis shows that facilitating program related to recycling behavior is a priority based on the AHP method. The facilitating programs manifested in developing a system which citizen have access to environmental conservation. This approach is in because the possibility of conflicts between community is greater because the community consists of multicultural background.

The result of this research shows that in those communities in which citizens share a strong belief in their ability to recycle, individuals engage in a greater number of recycling behaviors in their communities [13]. Issacs [14] illustrated that even though the ethnicity maintains their wisdom or primordial sentiments, precisely it will create a disharmony when technology and science develop. The consequences are the policy maker should take the issue seriously to fill the gaps. The next approach proposed is developing community awareness about the recycling habituation.

The implementation of environment conservation related to recycling using the concept of the 5 R of groundwater in the multicultural Jakarta community can succeed if there is involvement of all parties. As stakeholders, people in Jakarta have the right to regulate the life and harmonize the life with the environment. The pluralistic community involvement in the use of groundwater resources makes the decision-making mechanism running from below. Although this is quite difficult, as a participatory procedure, the involvement of the multicultural community is required.

Furthermore, the operationalization of the multicultural society in the conservation of soil water conservation can be done by:

a. The institutional process, namely the inclusion of various cultural communities in the socialization of conservation strategies such as recycling-based 5 R. The socialization performance must comply with the rules appreciative and participatory.
b. The approach to cultural figures in a plural society where a culture-bound persona though still considered to have an effect that is still a good grip.

However, previous research shows that recycling behavior involved the participation of several parties, family, friends, colleagues, and so on [15]. The behavior change is usually influenced by social behavior and surrounds influences [16]. Besides, other researchers described that behavioral elements of waste management guidance assisted to change recycling attitude of the community. There was a correlation between recycling attitude with community awareness, political view and spiritual activity [17]. The other challenge is how to enhance the community awareness since the recycling behavior also influenced by socio-economy factors, education level, and gender [18].

4. Conclusion
Jakarta as a multicultural city has its peculiarities and the structure and dynamics of society. Rapid population growth makes the consumption of water needs to be higher. A water recycling system of groundwater based on 5 R principles can be effectively done if we can understand the characteristics of a multicultural society. The efforts in enhancement facilitation program are required to change urban community's recycling attitudes. Facilitation program is endorsed by the government and involves collaboration between plural society and local people as well. Potential conflict among multicultural community becomes a challenge as well as the sustainability of the program itself. Hence, it is important to develop community awareness about environmental conservation, particularly groundwater conservation.

5. References
[1] W. A. Jury and H. J. Vaux Jr, “The emerging global water crisis: managing scarcity and conflict between water users,” *Advances in agronomy*, vol. 95, pp. 1–76, 2007.
[2] J. Sachs, *The end of poverty: How we can make it happen in our lifetime*. Penguin UK, 2005.
[3] J. E. Schoonover and J. F. Crim, “An introduction to soil concepts and the role of soils in watershed management,” *Journal of Contemporary Water Research & Education*, vol. 154, no. 1, pp. 21–47, 2015.
[4] P. Song et al., “Treatment of rural domestic wastewater using multi-soil-layering systems: Performance evaluation, factorial analysis and numerical modeling.” *Science of The Total Environment*, vol. 644, pp. 536–546, 2018.

[5] D. Suhardjanto, G. Tower, and A. Brown, “Indonesian stakeholders’ perceptions on environmental information,” *Journal of the Asia-Pacific Centre for Environmental Accountability*, vol. 14, no. 4, pp. 2–11, 2008.

[6] I. M. Surbakti, I. C. Idroes, H. Simamarta, and T. Firman, “Jakarta City Report,” presented at the Workshops of Climate Change Vulnerability Assessment and Urban Development Planning for Asian Coastal Cities, Bangkok, 2010, vol. 2010.

[7] C. Quay, “Water Quality Impacts of the Citarum River on Jakarta and Surrounding Bandung Basin,” 2018.

[8] O. Gelderblom, A. De Jong, and J. Jonker, “The formative years of the modern corporation: the Dutch East India Company VOC, 1602–1623,” *The journal of economic history*, vol. 73, no. 4, pp. 1050–1076, 2013.

[9] K. Koentjaraningrat, “Culture, Mentality and Development,” *PT. Gramedia, Jakarta.[Indonesian]*, 1974.

[10] F. R. Wahyudi and S. S. Moersidik, “The Analysis of Ground Water Availability and Utility in DKI Jakarta,” *Procedia-Social and Behavioral Sciences*, vol. 227, pp. 799–807, 2016.

[11] T. L. Saaty and L. G. Vargas, “The Seven Pillars of the Analytic Hierarchy Process,” 2001, pp. 27–46.

[12] T. L. Saaty and G. Hu, “Ranking by Eigenvector versus other methods in the Analytic Hierarchy Process,” *Applied Mathematics Letters*, vol. 11, no. 4, pp. 121–125, Jul. 1998.

[13] C. Taberner, B. Hernández, E. Cuadrado, B. Luque, and C. R. Pereira, “A multilevel perspective to explain recycling behaviour in communities,” *Journal of environmental management*, vol. 159, pp. 192–201, 2015.

[14] H. R. Isaacs, *Idols of the tribe: Group identity and political change*. Harvard University Press, 1989.

[15] N. Jekria and S. Daud, “Environmental concern and recycling behaviour,” *Procedia Economics and Finance*, vol. 35, pp. 667–673, 2016.

[16] P. Tucker and D. Speirs, “Model forecasts of recycling participation rates and material capture rates for possible future recycling scenarios,” *University of Paisley Environmental Technology Group: Paisley, UK*, vol. 44, pp. 1–38, 2002.

[17] M. Martin, I. D. Williams, and M. Clark, “Social, cultural and structural influences on household waste recycling: A case study,” *Resources, conservation and recycling*, vol. 48, no. 4, pp. 357–395, 2006.

[18] D. Fiorillo, “Household waste recycling: national survey evidence from Italy,” *Journal of Environmental Planning and Management*, vol. 56, no. 8, pp. 1125–1151, 2013.