Local knowledge of Karangwangi People of Cianjur District, West Java, Indonesia on water pollution of the Cikawung River

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Abstract. Primadiani D, Iskandar J, Sunardi. 2018. Local knowledge of Karangwangi People of Cianjur District, West Java, Indonesia on water pollution of the Cikawung River. Asian J Ethnobiol 1: 9-14. In the past, village people of Karangwangi, Cianjur District, West Java Province did not face any problem of water supply, including supply from the Cikawung River. Of late, however, they are experiencing problems with water sources, particularly water supply from the Cikawung River. Since pesticides have been intensively used in the local agroecosystems, such as irrigated rice fields and monoculture vegetable gardens, the Cikawung river water is polluted. In addition, the consequences of increase in conversion of forests and traditional mixed-gardens into agricultural and settlement areas have dramatically affected hydrological balances. On this background, this research was carried out to elucidate the local knowledge of the Karangwangi people on the status of pollution of water of the Cikawung river. This research used a mix of qualitative and quantitative methods with descriptive qualitative analysis. Qualitative data collection technique used was deep interviews with informants chosen purposely with snowball sampling. Quantitative data collection technique was interview with respondents using questionnaires and measurement of physical, chemical and biology parameters of Cikawung River water. Results of this research confirm that village people of Karangwangi have considerable local knowledge on water categorization, pollution and pollution indicators of Cikawung River

Keywords: Local Knowledge, Cikawung River, Karangwangi Village, Pesticides, Water Pollution

INTRODUCTION

In the past, most village people of Java, including those of West Java, were getting appropriate supply of water from various sources, such as wells, springs, showers, and rivers. The water supply was adequate and appropriate because the village environment was properly maintained and population was limited. The village people were using water e based on the local knowledge and cosmos or beliefs (cf. Iskandar 2012). The term local knowledge, in this case, is synonymous with various terms including rural people’s knowledge, indigenous technical knowledge, insider knowledge, indigenous technical knowledge, traditional environmental knowledge, peoples’ science and folk knowledge, and it may relate to any knowledge held more or less collectively by a population, informing understanding of the world, embedded in and conditioned by local tradition (Sillitoe 2002). The village people’s knowledge of water ranges from their ability to categorize water e to maintain water resources based on the traditional conservation practices. Some water resource areas, such as upstream forests and springs, have been considered as sacred places and prohibited from disturbances.

Both local knowledge and cosmos or belief systems have played important roles in utilizing and maintaining the water resources in the village ecosystem. Such local knowledge of village people is inherited from their ancestors and transmitted orally from generations to generation through the mother language. In addition, local knowledge has been obtained by trial and error of the village people during the process of their interaction with the local environment for a long time (Iskandar 2009). Indeed, long process of interaction between the village people and their environment has resulted in the local wisdom of the village about the environment (cf. Aulia and Arya 2010).

However, due to human population increase, intensive penetration of market economy to village areas and rapid development of new technologies, some local knowledge of the village people have eroded. As a result, the environment and natural resources, including water resources, have not been widely exploited. Moreover, some environmental destruction has not been avoided (Iskandar 2014). Unlike in the past, nowadays, the availability of water has been changed due to destruction of watershed area. Therefore, during the dry season in many villages, there has been shortage of water. Conversely, during the wet season, there have been flooding. The water supply is very high in wet season but its quality is very bad because the water is predominantly containing high sediment content. It has been caused due to the destruction of watersheds. For example, the forests and traditional agroforestry systems have been converted to other land uses, such as settlements and other human facilities. Consequently, during the rainy season rainwater rarely penetrates to deep soil, but directly flows into the river and
cause flooding. Conversely, during the dry season, there is lack of water supply due to very limited water stock in the deep soil. In addition, the quality of water in the river has decreased due to many factors, including pollution from pesticides. This is because a lot of pesticides have been intensively used in the wet rice fields and commercial gardens, the leaching of which come into the rivers. As a result, nowadays, the water resources in many villages are not sufficient anymore and water has become an economically high-value commodity (cf. Susilo et al. 2016).

In general, the availability of water supply in village ecosystem is dependent on the condition of watershed environment. Therefore, any change of the watershed environment may change the water supply of the rivers (cf. Wahid 2009; Halim 2014; Sri et al. 2014). The lowland and river bank is known as fertile soil due to sediment that is carried along by river, and this area is predominantly used for agricultural purpose (cf. Rochgiyanti 2011). In many cases, some conflicts between conservation, agriculture, and settlement area have occurred which is caused by socio-economic changes of community. Moreover, they have changed human behavior pertaining to the environment (cf. Hakim et al. 2016).

The Cikawung river of Karangwangi village, Cianjur district, West Java, has an important role for village people. For example, it has been used for irrigation of the wet rice, washing, and taking bath by village people. However, due to intensive use of pesticides in the wet rice field and commercial gardens, this river has been polluted and its water organisms have been killed (cf. Collins 1975) cited by Tilak et al. (2007). In addition, the intensive use of synthetic pesticides has caused erosion of local knowledge about biopesticides (Iskandar 2014). The objective of this paper is to elucidate the local knowledge of the Karangwangi village on water pollution of Cikawung River. In fact, three different aspects are studied in this paper, namely, local knowledge of village people of Karangwangi on river water, water pollution, and indicators of water pollution using macro-zoobenthos diversity.

MATERIALS AND METHODS

Location
This research was conducted from February to May 2017 in Karangwangi Village, Cianjur District, West Java. The Karangwangi Village is located directly adjacent to Indonesian Ocean on South. This village is situated approximately 200-275 m above sea level. Karangwangi Village has a total area of about 2,300 hectares, consisting of 1,115 hectares of rice fields and gardens. Karangwangi Village is also bordered by Jayanti Nature Reserve. Cikawung River is one of the rivers that pass Karangwangi Village.

Figure 1. Research location in Cikawung River, Karangwangi Village, Cianjur Subdistrict, West Java, Indonesia
Data collection

Qualitative and quantitative mixed-method with ethnoecology and ethnobiological approach was applied for data collection (Iskandar 2012; Alburque et al. 2014). Several field research techniques such as observations, deep interviews, semistructured interviews, and biological samplings were undertaken to collect the primary data in the field. Observation was carried out to record general condition of the Cikawung River, agroecosystem types, and settlement environment. The Deep interview was applied to understand the village people’s knowledge on Cikawung river of Karangwangi. It was carried out with informants, such as informal leaders, the village staff, farmers, fishermen, etc. The structured interview was undertaken with randomly selected respondents. The total number of respondents was calculated by Lynch formula (Lynch et al. 1974).

\[
n = \frac{N \cdot Z^2 \cdot p(1 - p)}{N \cdot d^2 + Z^2 \cdot p(1 - p)}
\]

Where:
- \( n \) = sample number (respondents)
- \( N \) = population number
- \( Z \) = normal variable value for level of confidence 95\% (1.96)
- \( P \) = highest proportion (0.5)
- \( D \) = sampling error (0.10) (Lynch 1974).

Based on statistical formula, it has been determined that the total number of household respondents is 92. Each of them was interviewed using the questionnaire. In addition, biological sampling was also carried out by collecting water samples of Cikawung River and some variables, including COD, BOD, PH and macrozoobenthos diversity were analyzed in the laboratory.

Data analysis

The qualitative data was analyzed through several stages (Iskandar 2012). Firstly, data obtained by observation and deep interviews were cross-checked. Secondly, the data were summarized and synthesized. The quantitative data obtained by questionnaire was analyzed by simple statistical methods like calculating the percentage of respondents answering the questionnaires, as shown below:

\[
P = \frac{f}{N} \times 100\%
\]

Where:
- \( P \) = Percentage of the total
- \( f \) = Data Frequency
- \( N \) = Total number of processed samples (Warsito, 1992).

The data of macrozoobenthos diversity was analyzed using Shanon-Wiener Diversity Index (Odum 1981; Yuliana et al. 2012).

\[
H' = - \sum (n_i/N) \ln (n_i/N)
\]

Where:
- \( n_i \) = number of individual genus -i
- \( N \) = total number individual all species
- \( \ln \) = number of species

RESULTS AND DISCUSSION

Water of Cikawung river

In general, all informants of village Karangwangi village opined that the quantity and quality of water in the Cikawung River has changed. The quantity of water in the Cikawung River was more stable, in the past. Even during the dry seasons, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, particularly during the drought periods caused by climatic anomaly, the water level in the river of Cikawung decreases drastically. As a result, many people of Karangwangi village face problems in obtaining sufficient water for their daily needs, such as for washing and taking a bath.

According to some informants, shortage of water has been caused by many factors, both natural and man-made or anthropogenic. The main natural factors long-dry seasons caused by climatic anomaly. In addition, different anthropogenic factors are predominant causes for decrease of water in the Cikawung River as well as in other water sources. On the one hand, the demand for water has increased due to population increase, and water in the various water resources has been intensively exploited; on the other hand water supply has decreased due to destruction of vegetation of the watershed, and the forests and traditional agroforestry systems have been converted to settlements and agricultural areas. The lack of water in the Cikawung River, particularly during the dry season has affected the village people of Karangwangi village. Cikawung River was traditionally used for taking bath and washing. In addition, it was predominantly used for agricultural purposes, such as irrigation of the rice fields and monoculture gardens. On the basis of the monoculture garden, since two years, some farmers of the Karangwangi village have been intensively cultivating chili crops. Since the price of the chili production has been high, some people are interested in planting chili pepper.

About the environmental history, in the past, the Karangwangi people cultivated rice both in the wet-rice field (sawah) and the swidden farming system (huma or ladang) (cf. Iskandar and Budiarwati 2011). They cultivated rice based on the local knowledge and cosmos, and applied LEISA (Low external inputs and Sustainable Agriculture) system (cf. Reijnjties et al. 1992). For example, various inputs such as rice seeds, organic fertilizer, and biopesticides were obtained from the village. Moreover, the Cikawung River was less polluted. Nowadays, however, during the dry season, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, the water of Cikawung never decreased too much. Nowadays, however, during the dry season, the water of Cikawung never decreased too much.
intensified the use of chemical fertilizers and pesticides. As a result, the Cikawung River has been polluted by pesticides. The farmers have adapted the changes in rice and chili pepper cultivation as a response to increase of population density and intensive penetration of market economy to villages. The hydrological system of the Cikawung river has changed due to disturbances in the vegetation of forests and mixed-gardens in the watershed. Therefore, according to some informants, for rehabilitation of the Cikawung watershed, some plant species, including Picung (Pangium edule) and Kiara (Filicium decipiens) have been planted in areas of 100 m from upstream area. This program has not been optimally undertaken due to lack of human resources. According to informants, some species, such as changkring (Erythrina fusca), kiray (Metroxylon sagu), benda or teureup (Artocarpus elastica), and Ficus racemosa have been considered for planting in the river bank area. These plants can be appropriately grown in the lowland area (Ulfah et al. 2015). Two plant species namely Ficus racemosa and Artocarpus elastica of the Moraceae family have predominantly been grown in special areas close to water sources. In general, plants of Moraceae family have the ability of hydrological conductance which is the ability to absorb water in large quantity at night. That is because the plants of Moraceae family have deep root system (Sofiah and Fiqa, 2014).

Water Pollution of Cikawung River

On the basis of the results of deep interview with informants, it can be inferred that quality of water of Cikawung River has also decreased. According to the perception of 92 respondents, the water of the Cikawung River can be divided into two categories, namely dirty water and clean water. The dirty water is polluted by waste and has changed to become turbid and developed bad smell (Table 1).

As mentioned by informants, the water of Cikawung river has become turbid due to cielucang (runoff) containing a lot of mud or sediment. That is why the people of village Karangwangi has traditionally used the water of Cikawung river for bathing and washing only. Water for cooking and drinking has been predominantly obtained from wells and harvesting of rainwater that is collected and stored in gallons. Unlike the dry season, the people of Karangwangi have used water of the Cikawung River, for drinking, cooking, washing, and bathing.

Unlike the Karangwangi people, the water of Cikawung river is categorized by urban people of Jakarta based on sources (the local water company/PAM, private drink, washing, latrine/MCK; river, rainwater), color (colored including chocolate and black and colorless), smell (odorless and smell including smell of soil, rust, stench), motion (flowing profusely/flooding, normal, and not flowing), use (drinking and cooking, bathing and washing, not good for anything), and how to obtain (without cost and labor, and vice versa) (Ahimsa-Putra 1997).

According to informants, the deteriorating quality of water of Cikawung River is also indicated by changes in the diversity of fishes. In the past, a very high diversity of fishes has been recorded in Cikawung river due to support by good quality of water. Today, however, the population of fish species, such as eel or belut (Monopterus albus), catfish (Clarias sp.), lubang (Anguilla marmorata) and beunteur (Puntius binotatus) has decreased. It has been estimated that about 30 % of fish population has decreased compared to that of 40 years ago. The decrease of fish population has been caused mainly by intensive use of synthetic pesticides. The synthetic pesticides are chemical materials that can poison fishes because fishes are good accumulators of several kinds of pesticides, especially lipophilic pesticides (pesticide which easily attaches to fat tissues) (Taufik 2011).

In addition to pesticides of agricultural origin, the river Cikawung has also been polluted by pesticides used by people to catch fishes. In the past, village people of Karangwangi used to catch fishes by fishing nets (heurap) or natural poisons made of plants roots. Presently, some people use chemical pesticides to catch fishes and also to enhance the size of fish catches.

Supriyono et al. (2015) explained that synthetic pesticides are toxic chemical materials that can disturb ecosystem balance and also disturb aquatic organisms. Catching fish by using synthetic pesticides for certain purpose need selective permission so that its negative impact on ecosystem can be minimized. Kinds of pesticides used by farmers in the study area are starban, aripo, puradan, TSP, Culakron, etc.

Traditionally, the villagers of Karangwangi were having the knowledge of various plants that can be used as natural pesticides to kill pests. For example, fruits of Picung (Pangium edule) has been popularly used as herbal pesticide by rural people. The method of preparation involves dissolving pounded fruits in water which is then sprayed on pests. Picung can be used to kill insect pests, such as wlangang sangu (Leptocorisa acuta). Most village people were also aware that coconut (Cocos nucifera) mixed with cassava (Manihot esculenta) can be used as natural agent for poisoning wild boar (Sus scrofa). Nowadays, however, the natural pesticides are not used any longer by villagers. It is because people assume that synthetic pesticides can kill pests more effectively and faster when compared to natural pesticides. In addition, various synthetic pesticides are easily available in markets whereas the plants used as herbal pesticides are rarely found in the ecosystem. As a result, the natural pesticides are less predominantly used by farmers and later on they

<table>
<thead>
<tr>
<th>Indicator of polluted water</th>
<th>Number of respondents</th>
<th>Percentage of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>82</td>
<td>89.13</td>
</tr>
<tr>
<td>Waste</td>
<td>20</td>
<td>21.73</td>
</tr>
<tr>
<td>Smell</td>
<td>36</td>
<td>39.13</td>
</tr>
<tr>
<td>Taste</td>
<td>8</td>
<td>8.69</td>
</tr>
</tbody>
</table>
will be completely abandoned or forgotten (Kardinan 2011).

Pesticides can cause negative impact not only to environment, but also to the people who directly or indirectly exposed to them. Pesticides that have been sprayed can get into human body through skin absorption (Chaturverdi et al. 2013). Informants of this study also explain that presently several people in Karangwangi have experienced skin diseases, one such person lives in Situwangi. This fact also indicates that the water of Cikawung River has been polluted by pesticides. However, this has not influenced the villagers to stop using the synthetic pesticides.

As presented in Table 1, people of the Karangwangi village categorize the polluted water of Cikawung river not only based on change of color but also by bad smell developing due to contamination. Informants explain that although the water was smelling and containing waste, the people in Karangwangi have still used it as long as the water did not smell of soap or pesticides. If river water didn’t smell, people can still use it for wash and bath.

The results of the semi-structured interview indicated that 35 % respondents mentioned that the Cikawung River at Garedog area has high level of pollution, 24 % respondents mentioned that the Geredog area has moderate level of pollution, and 37 % respondents mentioned that the Situwangi area has the lowest level of pollution. The area is located in the upstream and expected to have high level of pollution due this area is close to the wet rice fields where the use of pesticides is intensive. On the contrary, the Situwangi location is expected to have lowest level of pollution because of the discharge of water is higher when compared to the other areas. In other words, the level of pollution in the Cikawung River is expected to decrease in the downstream area due to water dilution, caused by increasing water volume due to discharge from the creeks originating from the forests of nature reserve of Jayanti.

**Macro-zoo benthos diversity**

Analysis of the macro-zoo benthos diversity in different locations of the river shows that Situwangi which is located downstream has relatively lower diversity than that of the Geredog and Nempel areas which are located in the upper stream (Table 2).

It may be assumed that the lower index of diversity of macro-zoobenthos in the Situwangi area is caused by high water pollution. This biological analysis result is rather different from the respondents perception that the level of pollution in Situwangi is lower than that of Geredog and Nempel due to dilution of water. It must be, however, considered that the diversity of macro-zoo benthos in the different areas of the Cikawung river is influenced not only but water pollution, but also on other factors, including temperature, sediments, organic materials, etc (cf. Putro 2014; Pamudji et al. 2015).

In general, however, the biological and chemical parameters (COD, BOD, and pH based on the government regulation 82, the year 2001) support the perception of village people of Karangwangi that the water of the Cikawung is in relatively good condition.

<table>
<thead>
<tr>
<th>Location</th>
<th>Diversity index of macro-zoo benthos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geredog</td>
<td>1.05</td>
</tr>
<tr>
<td>Nempel</td>
<td>1.04</td>
</tr>
<tr>
<td>Situwangi</td>
<td>0.87</td>
</tr>
</tbody>
</table>

On the basis of this study, it can be concluded that the village people of Karangwangi have special local knowledge on aspects such as water categorization, pollution level, and pollution indicators of Cikawung river. In addition, they are also aware that the quantity and quality of Cikawung river water has changed due to both natural and anthropogenic factors.

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