Community resilience in dealing with Tempe lake disaster

Yusran¹ M S S Ali¹, B Dahliana², D Salman¹, Rahmadanih¹ A Dirpan³, and I M Viantika¹

¹Department of Agro-cultural Socio-Economics, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia
²Department of Agribusiness, College of Agricultural Sciences, YAPI Bone, Indonesia
³Department of Food Technology, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

E-mail: saleh.assofie@agri.unhas.ac.id

Abstract. Tempe Lake is the largest lake in Province of South Sulawesi, located in three regencies, i.e. Wajo, Soppeng and Sidendang Rappang (Sidrap). Every year during the rainy season, the water overflows the lake causing floods, and during the dry season, there is siltation that results in difficulties of catching fish. The condition of the unstable lake often becomes a disaster for people around the lake. This paper aims to analyze the forms of community response or resilience during instability of water of Tempe Lake. The data used are from field studies conducted in June-November 2017. The study sites are focused at Tempe Sub-district, Wajo Regency with the consideration that the area is experiencing the severity of flooding and high silt. The method used is qualitative. The data obtained from direct interviews with some fishermen, farmers, and residents living around the lake and other informants such as Adat Chief, Village Head / Neighborhood Head, Local Government, and Macoa Tappareng (lake guard). The results of the study showed that when the overflowing water causing floods during the rainy season, fishermen and communities around the lake responded through a ritual ceremony of maccera tappareng in the form of a request to the lord of the lake in order not to cause a big disaster. Their houses which are floating houses are tied so well that they are not drifted. But behind the flood, the community also gained blessings in the number of fish catches due to the extensive fishing grounds. In the dry season where the lake becomes silt, the fishermen suffer from the lack of fish caught but obtain a blessing in the form of new agricultural land on the edge of the lake left by the water.

1. Introduction
Resilience is the opposite of vulnerability. Resilience is a concept which includes the capacity and ability to respond for crisis situations. Resilience is the ability to survive and return to its original state in the event of a disaster. Therefore, resilience is a dynamical process that includes positive adaptation during a disaster. [1] in his book The Resilience Factor formulate resilience as the ability to cope and adapt to severe events or problems that occur in life, persisting in a state of distress, and even dealing with adversity or trauma experienced in his life [1].

According to [2] resilience is the ability of a person to assess, overcome, and improve or change herself/himself from the misery in life. Resilience is a form of strengthening system, building up defenses, and implementing back up systems, and reduction of losses [3]. Also, resilience can be
observed as a result of adaptation to difficult circumstances or challenging life experiences, particularly in situations where high-stress levels or traumatic events occur [4,5].

Studies on resilience to natural and social disasters have been conducted in Indonesia. The study can be grouped into (1). The study of social resilience [6] (2). Behavior to cop resilience [7], Factors that increase resilience [8,9], Resilience Strategy [10,11]. In abroad, resilience studies are also conducted on flood resilience [12,13], drought resilience [14,15], earthquakes resilience [16,17, 18]; volcanoes resilience [19,18]; and climate change resilience [20,21].

From various studies, the study of lake resilience still lacks primarily related to the disasters of Tempe Lake which are always flooded during the rainy season and drought during the dry season. Resilience intended as the ability of local communities to adjust the vulnerability that arises from changes in the ups and downs of lake water. The natural conditions mentioned above require local communities to be able to adapt and make specific patterns to sustain their lives.

The floods and droughts that appear on Tempe Lake each year have become a natural rhythm that regularly cause disaster. How the community around the Tempe Lake is resilient to the disaster is the focus of the paper.

2. Methods
This study was conducted in the area of Tempe Lake. The Tempe Sub-district is chosen because the sub-district experienced flooding during rainy season and water shrinking in the dry season. The study was conducted for six months (June - November) in 2017.

Information or data obtained through in-depth interviews of some community members around the lake, mainly fishermen and farmers who often get disasters. Also, interviews with Adat Chairman, Macoa Tappareng, Macoa Tani (farmer group) and local government officials such as Head of Village/ Head of Kampong, Head of Sub-district, and related to SKPD Officials. Data were analyzed qualitatively. Some data are also obtained from other sources such as newspapers and other articles.

3. Results and discussion
3.1 A Brief Overview of Tempe Lake
Tempe Lake locates about 192 km from Makassar (the capital city of South Sulawesi) to the north. The lake belongs to Wajo Regency, Sidenreng Rappang (Sidrap) Regency and Soppeng Regency with total size of 47.800 hectares. About 70 percent of the lake area belongs to Wajo Regency. Geographically, the Tempe Lake is located at 4°00’00.0” – 4°15’00.0” SL and 119°52’30.0” – 120°07’30.0” EL (figure 1). The rainfall in the lake was 1.400 – 1.800 mm/year. Water depth in the middle of the lake during wet season was 3 meters, while in dry season was only 1 meter. During the dry season, the area of the lake was only 1000 hectares, while in normal condition the lake area was 15.000-20.000 hectares.

Figure 1. Map of Tempe Lake
There are some rivers run down and become the source of sedimentation of the lake, i.e. (1) Bila River is covered by 3 watersheds from Enrekang, Sidrap and Wajo Regencies. (2) Walnut River covered by watershed from Soppeng, Bone, Maros and Wajo Regencies. and (3) Some small rivers such as Wette’e River, Batu-Batu River, Waronge River, and Tancung River that also contribute to sedimentation of Tempe lake.

A study performed JICA pointed out that every year the sedimentation level is about 15–20 cm and it tends to increase. According to report by BAPEDAL Region III (2000) that when the sedimentation level continuously increased, it was predicted that 100 – 200 years from now, the Tempe Lake will disappear. The climate around the lake was characterized by tropical monsoon with clear distinction between dry season and wet season. Wet season was from March – July, while dry season was from August–February. During dry season when the water level in the lake decreases significantly, the land around the lake has been used by local community to grow rice and other food crop such as corn, bean, etc.

During rainy season when the lake water rises, vegetations that often appear varied, i.e, water hyacinth (Eichhornia crassipes), lotus flowers, water grass floating in the water surface, water weeds, algae. Of the vegetation, water hyacinth is the most dominant growth and often drifting crashing into the settlements. Even several times people have to watch their homes damaged and collapsed hit by this mound of plants. Although it covers three regencies, the most affected area of “water hyacinth” is in Tempe Sub-district, Wajo Regency.

Another vegetation in Tempe Lake is the trees on the shore of the lake and long ago, there are also wooden matches (aju colo). The existence of the vegetation aims to control the speed of water and soil erosion of the river or the lake catchment area. The plants also serve as soil conservation, to reduce the amount of surface flow and the peak flood discharge and decrease sedimentation at the bottom of the lake.

3.2 Tempe Lake Disaster
Every year the Tempe Lake is flooded by overflowing river water into the Lake such as Bila River, Walanae River, Wette’E River, Batu-Batu River, Waronge River and Tancung River. The flood caused many victims including infrastructural damages. In the flood of 2013 in Wajo Regency alone there were 15,587 houses flooded which most of the casualties were from Tempe Sub-district, then Sabbangparu, Belawa and Tanasitolo sub-districts. There are 3,048 hectares of damaged rice fields, particularly in Belawa Sub-district (see Table 1).

| Regency      | Sub-district | House flooded | Agriculture land demaged (Ha) |
|--------------|--------------|---------------|-------------------------------|
| Wajo         | Tempe        | 5.527         | -                             |
|              | Belawa       | 3.794         | 2.825                         |
|              | Tanasitolo   | 2.082         | 223                           |
|              | Sabbangparu  | 4.184         | -                             |
|              | Total        | 15.587        | 3.048                         |
| Soppeng      | Donri-Donri  | -             | 617                           |
|              | Marioriawa   | -             | 625                           |
| Sidenreng Rappang | Pancalautang | 347           | -                             |

Source: Social Services of Wajo, the Welfare Development and Community Protection Agency of Soppeng, Kelurahan WetteE, Pancalautang Sidenreng Rappang Sub-District, 2013

Kompas Daily covered the Tempe Lake flood events of 2016 as follows; "18 villages in five sub-districts in Wajo Regency were submerged by the flooding of the Bila-Walanae River and Tempe Lake. Height of the water reached 50-140 centimeters. A total of 1712 residents house flooded in five sub-districts, i.e. Tempe, Tanasitolo, Sabbangparu, Pammana, and Belawa Sub-districts. Floods also
inundated 760 hectares of rice fields and gardens. The temporary loss is estimated to reach up to Rp 2 billion. In addition, due to deep puddles, some roads are difficult to pass. The provincial road connecting Bone and Wajo, precisely in Belawa Sub-district was submerged up to 80 centimeters. In Tanasitolo Sub-district, a 70-meter road was flooded and in Akkotengeng a 40-meter road was cut off due to landslides that covered half of the road body. “So far no resident has been displaced in refugee camps, most of them whose homes are flooded move to relatives or neighbors’ houses.” The head of Pammana Sub-district, M Yasib, stated that the floods caused most of the people to be unable to move normally. “They should have worked on rice fields or gardens, but because of the flood, they could not do it, not to mention the puddles that hamper transportation. some people have to use boats, so far, no resident has been displaced, they still stay at home”.

The floods of the Tempe Lake were influenced by many factors and resulted in physical vulnerability, social vulnerability, economic vulnerability, environmental vulnerability, and institutional vulnerability in community [22]. Diagrammatically, the factors causing the flood and vulnerability are illustrated in the figure 2.

![Figure 2](https://example.com/figure2.png)

Figure 2. The diagram of flood and vulnerability causes of Tempe Lake.

In addition to flood disaster, fishermen also suffer losses when the water of the lake receded in dry season which only reaches a height of 0.5 meters in the middle of the lake. Ordinary fishermen experience a difficulty in catching fish due to shallow water in the fishing ground. Deep areas have been controlled by fishery entrepreneurs that have got concessions from the Local Government by paying some rent. Because fishermen have a difficulty catching fish in the non-concession fishing ground, they often enter concession areas which often leads to social conflicts between fishermen and holders of concession rights.

A fisherman informant said that “during the dry season and the lakes becomes silt, we only catch fish for our family consumption, there is nothing to sell.” (Field Notes).

3.3 Recilience Strategies
It is a dilemma situation for fishing communities and other communities around Tempe Lake. During the rainy season, they experience flooding due to overflowing, and during the dry season the small
fishermen experience a difficulty in catching fish because the water of the lake shrinks. For fishermen and communities around the lake, the disaster is not something to be resisted, but an unfortunate situation should be turned into a favorable position. In short, behind catastrophe, there is a blessing that must be utilized.

3.3.1 Flood Resilient. The flood of Tempe Lake that comes every year must be faced by fishermen and people living around the lake. Several acts of resilience are performed by the fishermen and the surrounding communities such as creating a floating house, making bridges between dwellings, raising the poles of the house.

a. Building a floating house
Building a floating house as an act of resilience of fishermen against the flood of Tempe Lake has been studied [23] According to them, the floating house consists of 3 main parts, i.e.: the bottom (raft and pole), the center (the body of the house, the floor, the wall), and the top (ceiling and roof) (see Figure 1). Each has its own wisdom in mitigating a disaster over water, so that lives on the water can continue.

The structure system of the raft uses bamboo arranged with 3 (three) alternating layers functioning as the floats of the house. About 20-30 bamboos in each layer are tied into a big, strong bond. Then the bamboo bonds are aligned with the width of the house, with the gap of ± 30-40 cm between the bonds [23].

Another part of the lower structure is the structure of the bottom pole. The structure of the pole is continued from the top of the barge to the ceiling border (rakkeang) in order to support the roof structure. The pole, which is the primary structure of the house, is set just above the second bamboo layer on the raft. The pattern of this house’s pole is rectangular with a maximum span of 3 meters with 15 poles. This distance is made with the small diameter, so that the load of the pole is not too heavy. Poles with a diameter of 10 cm are used meant that the house load is not too heavy to burden the raft, so that it will not be easy to sink. To connect the structure of the poles, the poles are fastened by the lower connecting beam (pattolo riawa) on the underside of the floor horizontally placed sized 3x10 cm across and transversely using a stake connection. In addition, there is also a flat beam (arateng) sized 3 x 10 set with a different direction of 90 degrees with beam pattolo riawa [23].

The middle structure of a floating house consists of floor and wall structure. The floor structure is connected to the lower structure (transverse and longitudinal poles) because the strength of the floor determined by the pole structure and the lower connecting beam (pattolo riawa) and the arateng beam. The function of the middle structure of the floating house is to attach the floor and wall of the house and as the primary support of the existing roof structure. Floor structures in floating houses consist of floorboards on the main house and bamboo floor in the kitchen. Floorboards and bamboo are usually made not too tight, but leaving a small distance (gap) to let air circulate to the house and make the floor material more durable [23].

The structure system of the roof of the floating house uses a wooden-framed roof by following the saddle roof (figure 3). But a small fraction of floating house also uses bamboo as the primary structure of the roof. The roof structure, according to the local wisdom, has to adapt to nature and disaster mitigation by using lightweight but durable materials, so as not to overload the house structure. This is to make the house easily rotated around the mooring pole and achieve the durability of the structure. The roof cover uses materials from zinc or rumbia leaf [23].

Another part of the roof structure is rakkeang (space under the roof) or attic. Rakkeang is usually given a base of board or bamboo that serves as a ceiling and as a place to put fishing equipment. The rakkeang does not cover all the house, but only on the sides of the edge. The use of bamboo on rakkeang is more on security considerations settled from the strong wind disaster that often struck the water of Tempe Lake, so that the burden of the house is not too heavy, which will make it easy to follow the direction of the wind [23].
Figure 3. Floating house in Tempe Lake

b. Building an inter-house bridge

Resilience by residents who live on the edge of the lake when flooding is making a wooden bridge that connects houses and public facilities. The wooden bridge was constructed high enough so that flood cannot reach the bridge. This small bridge is made from bamboo or wood and can only be passed by people (figure 4).

Figure 4. Inter-house bridge

c. Raising the level of the house

Almost all the existing houses on the edge of Tempe Lake is a stage house made from wood. Their house model is a Bugis house consisting of a pole that is a house rigid, then the middle of the house and the upper part consisting of roof and rakkeang. This stage house model is very adaptive with the flood. Some stone houses have been elevated as well so that the flood cannot reach them. In the study area, some public facilities, such as mosques, are constructed with a Bugis model house in which the bottom of the pole supports the body of the mosque, while the middle is used as the place of worship.

d. Renting the floating house to tourists

Observing the charm of a floating house in the middle of the lake provides a unique atmosphere. Many fishermen take advantage of their floating house by renting them out to foreign tourists.
e. **Ritual ceremony of “maccera tappareng”**

Every year before entering the rainy season, people around the lake do a *maccera tappareng* ritual led by *macoa tappareng* (the lake guard). This ritual activity is intended to ask the protection of Allah (God) so that the people who live and have livelihoods from the Lake Tempe avoided the danger of flooding, and more fish populations can be caught. In this event, a buffalo is slaughtered by *macoa tappareng*, and its head docked into the lake [24]. Because the event *maccera tappareng* is very crowded, it becomes an immeasurable moment to visit by local tourist and international tourist.

3.3.2. **Resilience when water lake shrinks.** Tempe Lake has now undergone intensive silting, and many areas of the lake have been converted into agricultural land. The results of mapping and multi-time satellite imagery review (1981, 1989, 2000, and 2015) taken during the rainy season of the year and the results of a field survey in 2015 shows that the effective extent of Tempe Lake continues to shrink over time. The decline in its size over the past twenty years has reached more than 15,000 hectares and is expected to continue shrinking in the future if no lake conservation effort is taken [25]. Based on a study conducted [26], the decline rate in the lake area reached 1.48 km per year. It is predicted that in the dry season in 2093, Tempe Lake will disappear.

As a result of this serious situation, in the dry season, many areas of the lake were only about 0.5 m deep, so that the fishing area for fishers are limited. In such situations, fishermen and communities around the lake responded in the form of utilizing the lakeside land that arose from the water left to be used as agricultural land, looking for specific fishing areas in certain areas, limiting fishing time, and migrating to the city.

a. **Utilizing the arising land**

The area of the Tempe Lake is about 48,000 hectares, but during the dry season, the lake area is only about 3,000 hectares. So there are about 45,000 hectares of the area that can be used to plant seasonal crops such as rice, corn, palawija, melon and so on. At the study site, the embossed land was called Koti soil. The land was given the name of Koti land because it used to be the way of sharing the area with melottre or lottery by means of "Koti" (taking in a lottery from a container). From then on it is called Koti land. The Koti land is divided into three categories, the Koti land *langga satu* (first grade), *langga dua* (second grade), and *langga tiga* (third grade). The division of this land has existed since the first of hereditary inherited it to her family. There is a difference in the land of each langga (grade), in addition to the soil being far from the lake water area (*langga satu*), it is more fertile than the land of *langga dua* and *langga tiga*. This land’s allotment is managed by people around the lake aiming at keeping the prosperity of the people.

Utilization of koti land is distributed to fishermen and farmers around the lake evenly through a draw made by the village head or regency head. Each person is given a land of about 10x10 meters depending on the number of people who will get koti land and the amount of land available. The duration for cultivating in koti land is 2 years, and after that period, it will be drawn again.

b. **Fishing on certain areas**

When the lake water recede in dry season, the lake becomes shallow. However, in certain areas of the lake, there are areas with deep water in free access areas or outside the fishing grounds that are controlled by fisheries entreprenures. These are narrow and used by fishermen to catch fish by using simple fishing tools such as bubu and sero.

c. **Fishing time regulation**

To maintain the preservation of fish population in the Lake, the local community led by Macoa Tappareng made a fishing ban on Friday. It is also prohibited to catch fish 3 days after Idul Fitri / Idul Adha and 3 days-3 nights after Macera Tappareng event. Furthermore, it is prohibited to use explosive and toxic materials, as well as the use of battery/accu to catch fish.
d. Migrating or looking for another job
Many fishermen, during the dry season, migrate to city to find a work, particularly as construction workers, pedicab drivers and so on. Some are also looking for jobs as farm laborers or looking for land, particularly if they do not get koti land.

4. Conclusion
Tempe Lake is the largest lake in South Sulawesi that brings disaster and blessings at the same time. Every year there is a flood in the rainy season and water shortage during the dry season. All of these occur because of the high sedimentation process that causes siltation in the area of the lake. The community with various resilience efforts responds to the disasters that are infested by the lake both in the rainy season and in the dry season. In the rainy season, their resilience efforts are in the form of floating houses, building bridges between houses, elevating homes, and renting a floating house to tourists. While in the dry season, they respond by exploiting the arising land abandoned by the lake water called Koti soil. They also respond by searching for catching areas on some areas of the lake, limiting fishing time, and migrating or finding other jobs outside the fishing job.

References
[1] Reivich, K., and Shatte, A., 2002. The Resilience Factor: 7 Essential Skills for Overcoming Life’s (Inevitable Obstacles. Broadway Books ) pp 342.
[2] Grothberg, E. H., 1999. Tapping Your Inner Strength: How to Find the Resilience to Deal with Anything. Oakland (CA: New Harbinger Publications) pp 67-69
[3] Adger, W. N., 2000. Social and Ecological Resilience: Are They Relaxed? Progress in Human Geography. 24 347-364.
[4] O’Leary, V. E., & Ickovics, J. R., 1995. Resilience and thriving in response to challenge: An opportunity for a paradigm shift in women’s health. Women’s Health, 1 121-142.
[5] Rutter, M., 1987. Psychosocial Resilience and Protective Mechanisms. American Journal of Orthopsychiatry, 57 316-331
[6] Ciptaningrum, M. U., Pamungkas, A., Penilaian Resiliensi Dimensi Sosial Berdasarkan Konsep Climate and Disaster Resilience Initiative (CDRI). Jurnal Teknik ITS, 6 2337-3520
[7] Nurul Hartini, N., 2017. Resiliensi warga di wilayah rawan banjir di Bojonegoro Residents’ resilience in flood prone area in Bojonegoro. Masyarakat, Kebudayaan dan Politik 30 114-120)
[8] Rahmawaty, A. A., 2013. The Study Of Coastal Area Resilience Towards Flood Disaster Labuhan Jambu Village, Sumbawa Regency West Nusa Tenggara pp 67-68
[9] Ariviyantri, N., Pradoto, W., 2014. Faktor-Faktor Yang Meningkatkan Resiliensi Masyarakat Dalam Menghadapi Bencana Rob Di Kelurahan Tanjung Emas Semarang. Jurnal Teknik PWK, 3 90-98
[10] Susanto, A., 2017. Strategi Peningkatan Resilieni Masyarakat Pesisir Terhadap Tekanan Sosio-Ekologis (Studi Kasus Pesisir Kota Semarang). Jurnal Matematika, Saint, dan Teknologi, 18, 11-27
[11] Widya, Y., Suharto, T., Budiyono, 2018. Resiliensi Masyarakat Dalam Menghadapi Banjir Rob di Kelurahan Bandarharjo Kota Semarang (Studi Kasus Aspek Lingkungan Dan Kesehatan) Jurnal Kesehatan Masyarakat (e-Journal) 6 2356-3346)
[12] Bryant-Tokalau, J., 2016. Community Responses to Floods in Fiji: Lessons Learned . http://www.mei.edu/content/map/community-responses-floods-fiji-lessons-learned. Diakses tanggal 8 Oktober 2018
[13] Aerts, Jeroen C. J. H., Botzen, W. J. W., Emanuel, K., Lin, N., de Moel, H., Michel-Kerjan., E.O., 2014. Evaluating Flood Resilience Strategies for Coastal Megacities Science, Vol. 344, 2 May 2014
[14] Busby, J. and Smith, T. 2014. Assessing resilience to drought: defining drought and reviewing trends in the Horn of Africa. Report prepared by the Technical Consortium, a project of the CGIAR. Technical Report Series No 1: Measuring Resilience in the Horn of Africa. Nairobi, Kenya: International Livestock Research Institute (ILRI).

[15] Rey, Dolores & Holman, Ian & W. Knox, Jerry. (2017). Developing drought resilience in irrigated agriculture in the face of increasing water scarcity. Regional Environmental Change. 17. 10.1007/s10113-017-1116-6

[16] Ainuddin, S., Routray, J.K., 2012. Community resilience framework for an earthquake prone area in Baluchistan. International Journal of Disaster Risk Reduction, Volume 2, December 2012, Pages 25-36

[17] Becker, Julia & Johnston, David & Paton, Douglas & Ronan, Kevin. (2018). Community Resilience to Earthquakes: Understanding How Individuals Make Meaning of Hazard information, and How This Relates to Preparing For. https://www.researchgate.net/.../251844101_Community_Resilience_to_Earthquakes

[18] Cui, K., Han, Z., and Wang, D., 2018. Resilience of an Earthquake-Stricken Rural Community in Southwest China: Correlation with Disaster Risk Reduction Efforts. Int. J. Environ. Res. Public Health, 15, 407; doi:10.3390/ijerph15030407

[19] Cho, S.E., Won, S., and Kim, S., 2016. Living in Harmony with Disaster: Exploring Volcanic Hazard Vulnerability in Indonesia. Sustainability, 8, 848; doi:10.3390/su8090848

[20] Leichenko, R., 2011. Climate change and urban resilience. Current Opinion in EnvironmentalSustainability. Volume 3, Issue 3, May 2011, Pages 164-168

[21] Singh, B. and Cohen, M.J., 2014. Climate Change Resilience:The Case of Haiti. Oxfam Research Reports. https://www.oxfam.org/.../rr-climate-change-resilience-haiti-

[22] Nurjanah, Sugiharto, R., Kuswanda, D., 2012. Manajemen Bencana Bandung: Alfabella.

[23] Naing, N. and Halim, H., 2013. Sistem Struktur Rumah Mengapung Di Danau Tempe Sulawesi Selatan (Structure System Of Floating House At Tempe Lake In South Sulawesi). Jurnal Permukiman, Vol. 8 No. 3 November 2013 : 145-152

[24] Dahliana, A.B., Ali, M.S.S., Salman, D., Demmallino, E.B., Halimah, A.S., 2018. Farmers’ Household Livelihood Resilience in the Lake Tempe Area. Advances in Environmental Biology, 12(3), March, p.1-4. doi: 10.22587/aeb.2018.12.3.1

[25] Marjuki, B., 2016. Pendangkalan Danau Tempe Sulawesi Selatan (1981 – 2015) Dan Upaya Konservasi Sumber Daya Air. https://Setjen_Pu.Go.Id/Pusdat_in/Uploads/Artikel/27%20desember%20202016%20-%20Obramantyo%20marjuki.Pdf.

[26] Pance, R., Saraffah, A., Manurung, H., Harahap, T. N., Retnowati, I., Nasution, S. R., & Rustadi, W. C. 2014. Gerakan Penyelamatan Danau (GERMADAN) Tempe. Jakarta: Kementerian Lingkungan Hidup