Policy issues on covid-19 waste: comparing Indonesia and Taiwan

R A Nugroho1*, A A Rahmawati1, S G Prakoso1,2, I D A Nurhaeni1, A T Kartinawanty3 and H Parwiyanto1

1 Public Administration Department, Faculty of Social and Political Sciences, Universitas Sebelas Maret, Jl Ir Sutami 36 A, Surakarta, Indonesia
2 Institute of Political Science, National Sun Yat Sen University, No. 70 號, Lianhai Road, Gushan District, Kaohsiung City, Taiwan
3 Faculty of Dentistry, Kebangkitan Nasional No.101, Surakarta, Indonesia

Corresponding author: rino.nugroho@staff.uns.ac.id

Abstract. During the covid-19 pandemic, medical waste has been a concern to the sustainability issues. Comparing government awareness is critical to portray the government policy on combating covid-19 and maintaining environmental sustainability at the same time. This paper discussed how the covid-19 waste is managed between two countries: Indonesia and Taiwan. The two countries are chosen because of their contrasting condition where the prior has a high rate of infection while, on the other hand, the latter has a relatively low rate of infection. This study focuses on literature analysis that is available on the research database. Specific keyword search such as “environmental policy and covid-19 and Indonesia and Taiwan” is used in the search engine. The results indicated the significant difference in both countries in managing covid-19 waste. Further results are discussed in the paper.

1. Introduction
Since the appearance of covid-19 instances in many world regions, the World Health Organization (WHO) has declared this a global pandemic disaster in mid-March 2020. According to Worldometers data, China has killed more than 4 million people worldwide since the first instance of covid-19 was discovered in Wuhan. As a result, the covid-19 pandemic has a multifaceted influence at all levels [1], which indirectly impacts the world ecosystem [2,3].

One of the positive impacts that occurred during the pandemic was reducing noise pollution below 60 db. A study estimated the covid-19 pandemic could potentially reduce up to 7% of global emissions if the lockdown was extended until the lockdown was extended the end of the year [3]. In addition, many studies have shown that air quality has improved tremendously during the covid-19 control period [4]. This is because countries that choose to adopt epidemic control measures by limiting travel and movement reduce the use of motorized vehicles, especially gasoline-fueled vehicles, and limit industrial activities based on fossil fuel consumption [5].

In additional, the effects of the pandemic have also caused several negative impacts, such as an increase in environmental pollution due to the widespread use of Personal Protective Equipment (PPE) and related equipment during the Covid-19 pandemic. A significant increase in medical waste in the services of large hospitals and health centers will be an unavoidable result in modern societies around
the world [6]. Medical waste has the potential to produce hazardous and toxic solid waste (B3) where the waste is residual material resulting from activities that are not reused and has the potential to be contaminated by infectious substances or when in contact with patients and/or medical personnel in health care facilities [7].

According to Ocean Conservancy, since this pandemic began, humans have produced 129 billion waste masks and 65 billion single-use gloves every month, most of which are not disposed of properly and end up in the ocean, which has a wide impact on ecosystems and organisms. Although there is no evidence that the covid-19 virus can be transmitted in any way through medical waste (World Health Organization, 2020), the inability to manage medical waste can pose a risk to public health because waste is a vector of the SARS-CoV-2 virus, which Lasts up to 3 days on plastic. The application of standards for handling Covid-19 B3 medical waste needs to use regulatory guidelines in accordance with what has been issued by WHO [8]. To manage Covid-19 B3 medical waste properly and correctly, it is necessary to know the amount of waste generated per bed per day, which differs from one country to another.

In general, high-income countries can generate an average of up to 0.5 kg of hazardous medical waste per hospital bed per day (World Health Organization, 2018). Several studies have been carried out show that the amount of B3 waste generation in several countries has increased during the Covid-19 pandemic. The impact of the Covid-19 pandemic in Taiwan is relatively small compared to other countries, including Indonesia. Based on data obtained from Our World in Data 2021, it can be seen that the increase in confirmed cases and death rates in Taiwan is much lower than Indonesia. This is also one of the variables that affect the increase in the volume of medical waste in the two countries. From February to May 2021, Taiwan produced 1.3 billion face masks. Each mask weighs about 4 grams which can weigh up to 5,500 tons over three months. According to estimates by the environmental group Greenpeace, this number is so large that 1,100 garbage trucks will be required to collect and dispose of it (Wendy Wu, 2021). Meanwhile, the Ministry of Environment and Forestry of the Republic of Indonesia, Siti Nurbaya, recorded that the total medical waste during the covid-19 pandemic until July 27, 2021, reached 18,460 thousand tons [9]. This covid-19 medical waste includes used infusions, masks, vaccine vials, syringes, face shields, bandages, PPE, gloves, PCR equipment, antigens, and cleaning alcohol produced from health facilities, emergency hospitals, self-isolation homes, and self-quarantine locations, as well as vaccination detection test locations.

2. Methods

This study employs a systematic review data-gathering technique, in which the author gathers data from a number of prior publications that have been indexed in Scopus using keywords such as "environment policy," "government," and "covid-19 waste." The data analysis technique used included conducting a
systematic literature review to identify studies and journals that described environmental issues that emerged during the covid-19 pandemic. In addition, data display using VOSViewers [10] was also used to visualize the dataset for easy understanding.

3. Result and discussion
The research database search was conducted through Scopus database with unique keywords combination. No less than 41 studies were collected using the keywords Environment, covid-19, Taiwan, and Indonesia.

| Keyword                          | Result | References |
|----------------------------------|--------|------------|
| Environment and Covid-19 and Taiwan | 11     | [13–23]    |
| Environment and Covid-19 and Indonesia | 19     | [24–42]    |
| Pollution and Covid-19 and Taiwan  | 5      | [21,43–46] |
| Pollution and Covid-19 and Indonesia | 6      | [40,47–51] |
| Total                            | 41     |            |

The result is then inserted into the VOSViewers [10] for data visualization, and the result is presented in Figure 3.

![Figure 3. Data Visualization based on VOSViewers Analysis [10]](image)

With VOSViewer [10], the author mapped the keyword with co-occurrence type of analysis and used keywords as a unit analysis. It can provide an overview of the main research areas that have been investigated. The minimum number of publications in this study is 2, so the total keyword that meets the threshold is 89 out of 443. The most counted occurrence is Covid-19, with 22 occurrences. On the other hand, the most total link strength is human, with total 244 links. Further analysis was taken based on the findings that have been depicted in Figure 2.

Some keywords linked with Taiwan as a node in Figure 2. Those are health care facility, severe acute respiratory syndrome, hygiene, public health, government, coronavirus, epidemic, death, development country, influential criteria, competitiveness, business, post-pandemic, conceptual frameworks, prediction, knowledge management, hospitality industry, management practice, covid-19, covid-19 pandemic, education, internet, pandemic, coronavirus disease 2019, human, humans, pandemics, coronavirus infection, coronavirus infections, adult. This result indicates that researchers who focus on
Taiwan with keywords mentioned in Table 1 have a more diversified discussion than researchers who focus on Indonesia. Key terms such as government appeared in the result. But apparently, it was not discussing environmental issues during the pandemic. 

On the other hand, the keywords linked to Indonesia as node are anxiety prevalence, male and female, mental health, anxiety disorder, working time, tuberculosis, health behaviour, hospitalization, sanitization, body mass, education SARs-Cov-2, epidemiology. It is safe to say that research focusing on Indonesia has more attention to the influence of Covid-19 on health more frequently, focusing on mental health and some discussion of physical fitness. The result indicates that researchers in Indonesia are mostly focused on the Covid=19 from a health perspective. This contrasting result indicates that the focus of research in both countries is different. One thing in common is in both countries, very few concerns of the researchers in discuss the policy of Covid-19 waste.

4. Conclusion
Different countries may have a different actions towards covid-19 handling. This study identifies that the two countries had a contrasting difference on the covid-19 waste issues. Based on the data collected from Scopus Database, Taiwan has more complex issues ranging from health issues regarding the covid-19 symptoms to covid-19 waste and government policy. While on the other hand, Indonesia had more limited issues on health concerns from the public and government. Further studies need to be conducted to get more insight into the differences between the two countries regarding covid-19 pandemic management and policy.

Acknowledgment
Authors acknowledges Taiwan Fellowship Program 2020 and PNBP UNS 2021 research grant for funding this research and publication.

References
[1] Cheval S, Adamescu C M, Georgiadis T, Herrnegger M, Piticar A and Legates D R 2020 Int. J. Environ. Res. Public Health 17 1–25
[2] Anser M K, Yousaf Z, Khan M A, Voo X H, Nassani A A, Alotaibi S M, Abro M M Q and Zaman K 2020 Air Qual. Atmos. Heal. 13 1083–92
[3] Bar H 2021 COVID-19 Environ. Dev. Sustain. 23 8161–78
[4] Chen Q X, Huang C L, Yuan Y and Tan H P 2020 Aerosol Air Qual. Res. 20 1541–51
[5] Kang A, Ren L, Hua C, Song H, Dong M, Fang Z and Zhu M 2021 Sci. Total Environ. 769 145158
[6] Fan Y Van, Jiang P, Hemzal M and Klemeš J J 2021 Sci. Total Environ. 754
[7] Kemenepri RI 2020 Kementeri. Kesehat. RI 1–14
[8] Capoor M R and Parida A 2021 Indian J. Med. Microbiol. 39 171–8
[9] Asmara C G Sampah Masker Hingga APD Bekas Covid-19 Tembus 18.460 Ton! cnbcindonesia.com
[10] van Eck N J and Waltman L 2010 VOSViewer: Visualizing Scientific Landscapes
[11] Mavragani A, Ochoa G and Tsagarakis K P 2018 J. Med. Internet Res. 20 270
[12] Sato K, Mano T, Iwata A and Toda T 2021 medRxiv 2012–20
[13] Hsu W-C J, Lo H-W and Yang C-C 2021 Sustain. 13 1–19
[14] Sun Y, Wang T-H and Wang L-F 2021 Sustain. 13
[15] Hsieh H-C, Nguyen X-H, Wang T-C and Lee J-Y 2020 Sustain. 12 1–27
[16] Geng Y, Huang P-S and Huang Y-M 2021 C Sustain. 13
[17] Lan F-Y, Wei C-F, Hsu Y-T, Christiani D C and Kales S N 2020 PLoS One 15
[18] O’Connor H, Hopkins W J, Johnston D, Bacha O I, Hsieh H-C, Nguyen X-H, Wang T-C and Lee J-Y 2021 J. R. Soc. New Zeal. 51 S214–31
[19] Wu S-Y 2021 Front. Educ. 6
[20] Chien L-C, Beý C K and Koenig K L 2020 Prehosp. Disaster Med. 35 434–7
[21] Wang Q, Dong W, Yang K, Ren Z, Huang D, Zhang P and Wang J 2021 *Int. J. Infect. Dis.* **105** 675–85

[22] Yeoh E K, Chong K C, Chiew C J, Lee V J, Ng C W, Hashimoto H, Kwon S, Wang W, Chau N N S, Yam C H K, Chow T Y and Hung C T 2021 *One Heal.* **12**

[23] Bacha O I, Hsieh H-C, Nguyen X-H, Wang T-C and Lee J-Y 2021 *Duzce Med. J.* **23** 24–6

[24] Rachmawati R, Choirunnisa U, Pambagyo Z A, Syarafina Y A and Ghiffari R A 2021 *Sustain.* **13**

[25] Ihsan I Z and Rahmayanti H 2020 *Eur. J. Educ. Res.* **9** 1257–65

[26] Yeoh E K, Chong K C, Nguyen X-H, Wang T-C and Lee J-Y 2021 *Duzce Med. J.* **23** 24–6

[27] Bacha O I, Hsieh H-C, Nguyen X-H, Wang T-C and Lee J-Y 2021 *Sustain.* **13**

[28] Suter F and Lüthi C 2021 *Environ. Urban.* **33** 99–116

[29] Rohman N and Andriani R 2021 *J. Educ. Eval. Res.* **18**

[30] Fihartini Y, Helmi A, Hassan M and Oesman Y M 2021 *Innov. Mark.* **17** 17–29

[31] Ayuningtyas D, Haq H U, Utami R R M and Susilja S 2021 *Front. Public Heal.* **9**

[32] Purnamasidhi C A W, Sukmawati N M D D, Gayatri A A A Y, Utama I M S, Somia I K A and Merati K T P 2020 *Open Access Maced. J. Med. Sci.* **8** 366–70

[33] Fihartini Y, Helmi A, Hassan M and Oesman Y M 2021 *Innov. Mark.* **17** 17–29

[34] Warsono W, Antonio Y, Yuwono S B, Kurniasari D, Suroso E, Yushananta P, Usman M and Hadi S 2021 *Decis. Sci. Lett.* **10** 393–400

[35] Ewers K D, Mclernon D J and Myint P K 2021 *BMJ Open* **11**

[36] Purnama S G and Susanna D 2020 *Kesmas* **15** 6–13

[37] Harrison M E, Wijedasa L S, Cole L E S, Cheyne S M, Choiruzzad S A B, Chua L, Dargie G C, Ewango C E N, Honorio Coronado E N, Ifo S A, Imron M A, Kopansky D, Lestarisa T, O’Reilly P J, van Offelen J, Refisch J, Roucoux K, Sugardjito J, Thornton S A, Upton C and Page S 2020 *Peer J.* **8**

[38] Purnama S G and Susanna D 2020 *Kesmas* **15** 6–13

[39] Harrison M E, Wijedasa L S, Cole L E S, Cheyne S M, Choiruzzad S A B, Chua L, Dargie G C, Ewango C E N, Honorio Coronado E N, Ifo S A, Imron M A, Kopansky D, Lestarisa T, O’Reilly P J, van Offelen J, Refisch J, Roucoux K, Sugardjito J, Thornton S A, Upton C and Page S 2020 *Peer J.* **8**