第 48 卷 第 4 期
2021 年 4 月

湖 南 大 学 学 报（自 然 科学版）
Journal of Hunan University（Natural Sciences）

Vol. 48. No. 4.
Apr. 2021

Open Access Article

Ecological Sustainability of Mitigation Deal with the Surge of the Covid-19 Pandemic and Other Pandemics

M. D. D. Maharani

Environmental Engineering, Sahid University, Jakarta, 12870, Indonesia

Abstract: Pandemic interventions rarely contain clear statements about potentially conflicting interventions of ecological mitigation policy priorities. Ecological mitigation policies are not as popular as economic policies. Ecological Sustainability of Mitigation of handling the COVID-19 pandemic surge and other pandemics can be achieved using various interventions to reduce transmission. Interventions can reduce the impact of an outbreak and buy time until vaccines are developed. This paper aims to formulate an ecological sustainability index of mitigation Deal with the Surge of The Covid-19 Pandemic and Other Pandemics. We use the Driver-Pressure-State-Impact-Response (DPSIR) framework and Multidimensional Scaling (MDS). The DPSIR framework aims to inventory ecological components in mitigation. MDS method to calculate ecological sustainability index and generate leverage attributes. The results found an ecological sustainability index of 74.67%. The attribute of leverage are: (i) Improving Echo-Ethics (introducing complex ethical challenges) for Researchers, Lecturers, Governments introduces complex ecology ethical challenges with an RMS value of 2.98; (ii) The urgent need for COVID-19 research with an RMS value of 2.94; and (iii) One-Health with an RMS value of 2.90. Echo_Ethics and One-Health is an integrated health concept that upholds ecological ethics by paying attention to the sources of interrelated transmission between humans, animals, and plants. The interaction of living things and pathogens with their living environment (bio-ecology) can help explain the priorities of potentially conflicting interventions in society. The disease incidence is the result of interactions between virulent pathogens, living things as vulnerable hosts, and ecological factors.

Keywords: ecology, sustainability, mitigation, COVID-19, pandemic.

緩解新政的生態可持續性與冠状病毒病19流行病和其他大流行的浪湧

摘要：大流行干預措施很少包含有關生態緩解政策優先事項的潛在衝突干預措施的明確聲明。通過使用各種干預措施來減少傳播，可以實現緩解冠状病毒病19大流行和其他流行病的緩解的生態可持續性。本文旨在製定應對冠状病毒病19大流行和其他流行病的浪潮的緩解措施的生態可持續性指數。我們使用驅動程序壓力狀態影響響應框架和多維比例縮放。結果，發現了74.67%的生態可持續性指數。槓桿的屬性是：（i）為研究人員，講師，政府改善迴聲倫理（引入複雜的道德挑戰），引入均方根值為2.98的複雜生態道德挑戰；ii迫切需要研究均方根值值為2.94的冠状病毒病19；（iii）均方根值為2.90的一生。道德與一個健康是一個綜合的健康概念，它通過關注人，動物和植物之間相互關聯的傳播來源來維護生態道德。

关键词：生态，可持续性，缓解措施，新冠肺炎， 大流行病。

1. Introduction

The COVID-19 surge is strongly influenced by climate change conditions, ecological factors, and the evolution of biotic components. According to [1-2], the analysis of phylogenetic models through climate change scenarios and land conversion is estimated by 2070, showing a shift of as many as 3,870 mammalian species. The disruption of various biotic components of

Received: 11 February 2021 / Revised: 13 March 2021 / Accepted: 18 March 2021 / Published: 30 April 2021
About the author: M. D. D. Maharani, Environmental Engineering, Sahid University, Jakarta, Indonesia

the environment, such as animal hyper reservoirs and predators, will affect the onset of viruses.

Viruses cause many health threats, both in humans, animals, and other biotic components, such as: (i) antimicrobial resistance, (ii) environmental health hazards, (iii) food safety risks, and most importantly, (iv) zoonotic diseases such as Nipah, Avian Influenza (AI), Scrub typhus, Congolese fever, COVID-19, and leptospirosis that severely impact the economies of countries around the world including Indonesia. Recent pandemics have exposed policy gaps in public health directives. Pandemics are defined as epidemics that occur in a very large area, cross international borders, and usually affect many people. Therefore, pandemics are identified by their geographical scale rather than the severity of the disease.

One of the interventions in handling pandemic diseases is the international concept of One Health (OH). The concept of OH is a validated, integrated, and holistic approach advocated by the World Health Organization, Food And Agriculture Organization, and the World Organization for Animal Health or the Office International des Epizooties (OIE). The goal of OH is to combat health threats to humans and animals through the human-animal-plant environment interface [3].

The concept of OH is basically that all biotic components have value. To appreciate them lies in three interfaces, namely, humans, animals, and the environment, to protect the overall health of our planet. The lack of interdisciplinary collaboration has resulted in many zoonotic diseases potentially transmitted to humans or vice versa, i.e., diseases in humans can be transmitted to animals and cause endemicity. Furthermore, as challenges have increased in recent years, the OH approach is not only to address pandemics but also to control and manage disease-oriented collaborative approaches [4-5].

Based on these issues, a review of the Ecological Sustainability Directive Strategy is needed to mitigate the COVID-19 pandemic surge and other pandemics. It is hoped that this Directive Strategy can contribute to health services for humans, animals, and the environment because it is built based on interdisciplinary collaboration and communication in all aspects, thus helping to protect and save millions of lives of current and future generations.

The objectives of this study are: (i) Analyzing important and necessary components in ecological sustainability mitigation; (ii) 2. Formulating and recommending an ecological sustainability index of mitigation to deal with the surge of COVID-19 and other pandemics into key Performance Indicators of the National Medium-Term Development Plan (NMTDP) 2020-2024 and the National Long-Term Development Plan (NLTDP) 2005-2025 Indonesia

The potential for pandemics caused by pathogens varies greatly in the resources, capacities, and strategies of directives required for mitigation. However, there are also general requirements for effective preparedness and response. When a pandemic occurs, a coordinated response is needed with a focus on maintaining situational awareness, public health messages, reducing transmission, treatment of diseases. The Mitigation of Ecological Sustainability and attributes leverage as key performance Indicators on NMTDP 2020-2024 and NLTDP 2005-2025 deserves to be implemented quickly and strictly for the greatest benefit, as it requires long-term community preparation, education, and compliance during the COVID-19 pandemic and other possible pandemics.

2. Methods

Preliminary research was conducted at the end of 2019 and continued in 2020 until February 2021. The design of this research is carried out through 2 stages, as follows:

2.1. Inventory of Ecological Mitigation Components

The method used is the Driver-Pressure-State-Impact-Response (DPSIR) framework model.

2.2. The Driver-Pressure-State-Impact-Response (DPSIR) Framework Model

The Driver-Pressure-State-Impact-Response (DPSIR) Framework model has been used for integrated environmental reporting and assessment, developed by the European Environment Agency (EEA) in 1999 [6]. DPSIR can also be used as an analysis of environmental problems ranging from the global system, as well as local, evaluation of sustainable development, success or failure of projects, and other troubling results of development efforts. At the same time, the data is obtained from library studies, expert consultations, planning documents, and government evaluations. The output is the ecological components of mitigation.

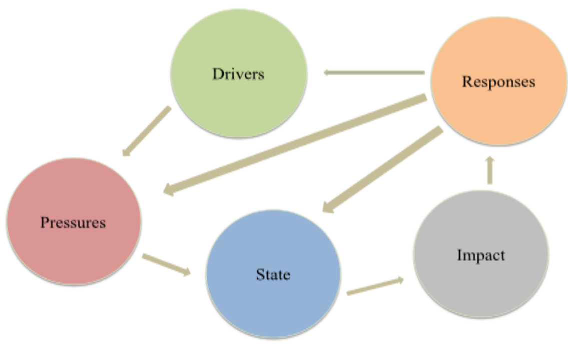

Fig. 1 Driver-pressure-state-impact-response (DPSIR) analysis

3. Analyzing Ecological Sustainability of Mitigation

The analysis methods used are Multidimensional Scaling (MDS) through Rap-Ecological-Mitigation software, leverage, and Monte Carlo analysis.

3.1. The Multidimensional Scaling (MDS) Model

Multidimensional Scaling (MDS) method has been implemented for several studies [7-10]. MDS method is the mapping of perception relying on Euclidian Distance, with the formula:

$$d_{1,2} = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2 + (Z_1 - Z_2)^2 + ...}$$

where:
$d_{1,2}$ = Euclidian distance
X, Y, Z = Attributes
$_{1,2}$ = Observation

Two-dimensional Euclidian distance regression formula ($\dot{D}_{1,2}$):

$D_{1,2} = a + b\ D_{1,2} + c$

where:
a = intercept
b = slope
c = error

Data is sourced from library studies, ecological mitigation attributes resulting from Stage 1. Output in the form of an index and ecological sustainability status of mitigation and leveraged attributes. The same two points or objects are mapped in one point adjacent to each other using the ALSCAL FORTRAN algorithm techniques available in statistical devices. Rap-Ecological-Mitigation software (modified Rap-Fish), in principle, makes iteration. The regression process is such that it gets the smallest stress value and tries to force the intercept on the equation equals 0. For attributes as much as m, then stress is formulated in the equation:

$$stress = \sqrt{\frac{1}{m}\sum_{k=1}^{m}\left(\frac{\sum_i\sum_j \left(D_{ijk}^2 - d_{ijk}^2\right)^2}{\sum_i\sum_j d_{ijk}^2}\right)}$$

The magnitude of the stress value is shown in Table 1.

Table 1 Stress values [11]

Number	Stress value	Conformity
1	➢ 20.00%	Bad
2	(10.00-20.00)%	Enough
3	(5.00-10.00)%	Good
4	(2.500-5.00)%	Excellent

Through the rotation method, the position of the sustainability point can be described through the horizontal and vertical axes with the sustainability index values rated 0 percent (bad) and 100 percent (good). If the system studied has a sustainability index value of > or = 50 percent, then the system is sustainable and unsustainable if the index value < 50 percent.

4. Results and Discussion

The DPSIR framework assumes a chain of causal relationships starting with 'Driving force' through 'Pressure' to 'State, provinces, districts/cities' and 'Impacts' on ecosystems, ultimately leading to a political 'Response'. Setting the DPSIR framework for complex mitigation settings requires causal effect relationships to be carefully explained. Mitigations that consider environmental changes can rarely be attributed to a single cause. The results of identification and inventory of important and necessary components in ecological sustainability mitigation in the face of the covid-19 surge and other pandemics can be seen in Table 2.

Table 2 Results of identification and inventory of ecological attributes to mitigate

Number	Attributes	Component Category DPSIR
1	Deforestation	Driver
2	Poaching wild animal for consumption	Driver
3	Land and forest fires	Driver
4	Land conversion	Driver
5	The disruption of various biotic components of the environment (such as animal hyper reservoirs and predators) will affect the onset of viruses.	Pressure
6	Natural evolution of biotic components (such as pathogens)	Pressure
7	Genetic adaptation of pathogens and models of transmission	Pressure
8	Air, water, and land pollution	Pressure
9	Ecological handling of at-risk populations	State
10	Tele-environmental and Tele-health	State
11	One-Health	State
12	Natural resources and environmental security arrangements	State
13	Improved Safety, Environmental occupational health	State
14	Improved Supervision of animal health.	State
15	Restrictions on consuming potential wildlife as an intermediary host	State
16	Shift of as many as 3,870 mammalian species.	Impact
17	Investing and innovating in health technology, food, green energy	Response
18	Environmental diplomacy efforts	Response
19	The importance of the ratio of energy returned to nature with invested energy	Response
20	Environmental Legal improvements, International Environmental Regulations on Bio and Big Technology	Response
21	Improved Supervision of animal traffic between regions	Response
22	Proportional improvement in environmental health at site severity	Response
23	More integrated transportation and land use	Response
24	Improving the basic ecological components on the pandemic plans	Response
25	Restrictions on freedom of movement of wildlife to stop the spread of the disease	Response
26	Government-controlled investments towards a sustainable energy transition	Response

27	The urgent need for COVID-19 research	Response
28	Improved Echo-Ethics (introducing complex ethical challenges) for Researchers, Lecturers, Governments	Response
29	Building infrastructure related to hygiene and sanitation	Response

Furthermore, the Forum Group Discussion (FGD) agreed on 20 of the 29 attributes analyzed with MDS (Rap-Ecological-Mitigation software). FGD is followed by government, academia, the private sector, Religious Leaders (Kyai and Jehovah's Witness Leaders). The agreed attributes are the "State" and "Response" components

4.1. Components DPSIR

4.1.1. Driver Component

Human activity in the socio-economic dimension that poses a rich risk will potentially drive the spread of the COVID-19 pandemic and other possible pandemics. Deforested land has also been linked to outbreaks of disease (Ebola and Lyme), as humans come into contact with previously untouched wildlife. Deforestation, poaching for consumption, land and forest fires, land conversion are the drivers of ecosystem destruction that coincide with a sharp increase in the disease.

While the origin of the COVID-19 virus has not been determined, 60% of infectious diseases are from animals, and 70% of infectious diseases appear from wildlife. That is because wildlife habitats are disrupted by human activity. The distance between humans and wildlife is getting closer. AIDS is derived from chimpanzees, and SARS is thought to be transmitted from animals that are still unknown to this day. As a result of wildlife poaching there has been a loss of 60% of wildlife in the last 50 years. Meanwhile, the number of new infectious diseases has quadrupled in the last 60 years [11].

2.1.2. Pressure Component

Deforestation, poaching for consumption, land and forest fires, land conversion increased the emergence of animal-to-human diseases and stressed that human behavior is the underlying cause. Pressure on the carrying capacity and capacity of the environment will change nature has implications that humans are destroying.

As a result, it occurs: (i) The disruption of various biotic components of the environment (such as animal hyper reservoirs and predators) will affect the onset of viruses; (ii) Natural evolution of biotic components (such as pathogens); (iii) Genetic adaptation of pathogens and models of transmission, and (iv) Water, water and land pollution.

4.1.3. State Component

Some of the State components that can be done to cope with driver components and pressure are: (i) Ecological handling of at-risk populations; (ii) Tele-environmental and Tele-health; (iii) One-Health; (iv) Natural resources and environmental security arrangements; (v) Improved Safety, Environmental occupational health; (vi) Improved Supervision of animal health, and (vii) Restrictions on consuming potential wildlife as an intermediary host.

4.1.4. Impact Component

As a driver of viral spillage, some viruses of mammal species have been shared with humans. That is as an impact of the shift of 3,870 species of mammals [1, 12].

4.1.5. Response Component

There are 13 components of Response in the face of the Covid-19 pandemic and other possible pandemics within the DPSIR framework (Table 2).

4.2. Sustainability Analysis

The ecological dimension is one of the important parameters in the status of sustainability. Therefore, it should be considered for the long term when designing mitigation in the face of the surge of the COVID-19 pandemic and other pandemics. Based on the analysis, the ecological dimension index value is 74,66 percent (fairly sustainable) (Table 3)

Table 3 Index categories and sustainability status

Number	Index value	Category
1	(0.00-24.99)%	Bad (unsustainable)
2	(24.99-49.99)%	Less (less sustainable)
3	(49.99-74.99)%	Enough (fairly sustainable)
4	(75.00-100.00)	Good (very sustainable)

The results of ecological sustainability analysis of mitigation facing the surge of the COVID-19 pandemic and other possible pandemics can be seen in Fig. 2.

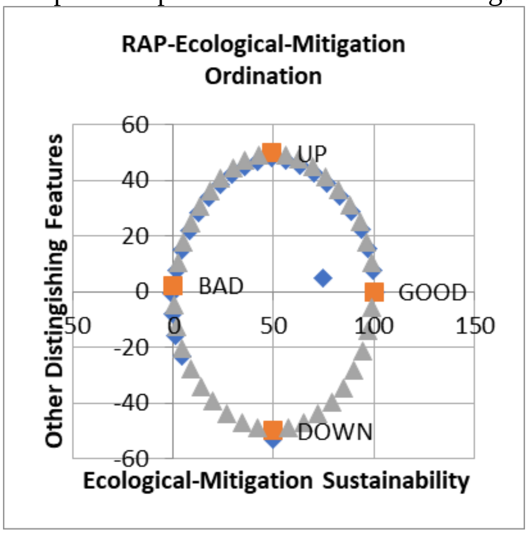

Fig. 2 Sustainability level of ecological mitigation of the handling of the COVID-19 pandemic surge and other pandemics

There are 20 attributes that are thought to influence the ecological dimension of mitigation (Fig. 2).

4.2.1. Leverage Analysis

Leverage analysis to determine the effect of stability if one of the attributes is omitted during ordination. Leverage analysis results show the percent change in the root means square of each attribute. The attributes that have the highest percentage are the most sustainability-sensitive attributes [13]. From the leverage analysis, the RMS value of each attribute can be seen in the Table 4.

Table 4 Root mean square value from leverage analysis results

Number	Attribute	Root Mean Square
1	Ecological handling of at-risk populations	2.6283
2	Building infrastructure related to hygiene and sanitation	2.8906
3	Improved Echo-Ethics (introducing complex ethical challenges) for Researchers, Lecturers, Governments	2.9815
4	The urgent need for COVID-19 research	2.9443
5	Government-controlled investments towards a sustainable energy transition	2.6850
6	Natural resources and environmental security arrangements	2.4509
7	Restrictions on freedom of movement of wildlife to stop the spread of the disease	2.2079
8	Improving the basic ecological components of pandemic plans	2.1695
9	Improved Safety, Environmental occupational health	1.9453
10	Restrictions on consuming potential wildlife as an intermediary host	1.9051
11	More integrated transportation and land use	1.8860
12	Tele-environmental and Tele-health	1.9413
13	Proportional improvement in environmental health at site severity	2.0326
14	Improved Supervision of animal traffic between regions	2.1719
15	Improved Supervision of animal health.	2.3577
16	Environmental Legal improvements, International Environmental Regulations on Bio and Big Technology	2.5585
17	The importance of the ratio of energy returned to nature with invested energy	2.7406
18	Environmental diplomacy efforts	2.8649
19	One-Health	2.9002
20	Investing and innovating in health technology, food, green energy	2.8248

Improved Echo-Ethics (introduces complex ethical challenges) greatly influences the ecological dimension sustainability index with an RMS value of 2.98. Currently, the activity of editing genes of biotic components that cause genetic changes is highly possible. By upholding ethics, such activities will not cause scientists to create bad findings. The spread of COVID-19 is a great ethical dilemma for resource-constrained nations with less developed health and research systems [14]. In the current crisis, scientific knowledge and technology have an important role in playing an effective response. Emergency preparedness is a shared responsibility of all countries with a moral obligation to support each other. The second and third leverage attributes are the urgent need for COVID-19 research with an RMS value of 2.94, and One-Health leverage attributes are also urgent to be implemented with an RMS value of 2.90.

4.2.2. Monte Carlo Analysis

From the leverage analysis, the RMS value of each attribute can be seen in the Table 4. Validation of Rap-Ecological-Mitigation simulation results shows that the Squared Correlation (RSQ) value is quite high at 0.96. That means that 20 attributes have a considerable role in explaining the ecological diversity of mitigations being built. The magnitude of the S stress value is 0.21 (< 0.25), meaning the accuracy of the configuration of the points (goodness of fit) of the model built can represent a good model [15]. After the analysis of leverage aspects then conducted Monte Carlo analysis.

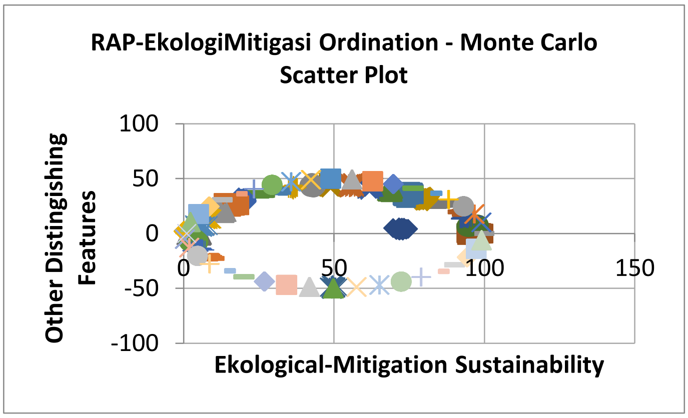

Fig. 3 Monte Carlo analysis of ecological sustainability mitigation levels

The difference between the MDS calculation result and the relatively small Monte Carlo analysis is 0.58 (< 1) (Fig. 3). That suggests that MDS counting results can reflect high levels of precision Patricia Kavanagh and Tony J. Pitcher [13]. Validation of Rap-Ecological Mitigation simulation results for ecological dimensions can be seen in Table 5.

Table 5 RSQ calculation data, stress value, MDS, and Monte Carlo analysis

Dimension	RSQ	Stress value	MDS	Monte Carlo	Difference between MDS-Monte Carlo
Ecology	0.96	0.21	74.66	74.08	0.58

Validation of Rap-Ecological Mitigation simulation results of ecological dimensions indicated by the value of the coefficient of determination (RSQ) is quite high (0.96), the value of S stress = 0.21, and the difference in the value of MDS-Monte Carlo = 0.58 can represent a model of ecological sustainability of mitigation of handling the COVID-19 pandemic and others pandemic that is considered good.

5. Conclusion

Mitigation of the ecological dimension of handling the COVID-19 pandemic surge and other possible pandemics is included in the classification is 74.66 percent (quite sustainable). To improve the ecological sustainability index of mitigation, the medium and long-term priority intervention improves Echo-Ethics (introducing complex ethical challenges) for Researchers, Lecturers, Governments.

In addition, an urgent need for research into COVID-19 and other pandemics is to implement One-Health. One-Health Priority Intervention is urgent to be formulated into a key Performance Indicator of the National Medium-Term Development Plan (NMTDP) 2020-2024 and the National Long-Term Development Plan (NLTDP) 2005-2025 Indonesia.

The novelty of this research is: (i) Ecological Sustainability Model Mitigation facing the Surge of the Covid-19 pandemic and other Pandemics, (ii) Leverage attributes (Improved Echo-Ethics) to improve the index of ecological sustainability mitigation.

Acknowledgments

The author would like to thank:

1. Prof. Dr. Ir. Giyatmi Irianto, M Si as Chairman of research and community service institute of Sahid University Jakarta, Indonesia, has provided funding in internal grant research batch X.

2. Prof. Jerome Amir Singh, BA, LLB, LLM, MHSc, PhD as Head of Ethics and Law at the Center for AIDS Research Programs in South Africa (CAPRISA), Nelson R. Mandela School of Medicine, University of KwaZulu-Natal (UKZN),

He is an Adjunct Professor of Clinical Public Health, Dalla Lana School of Public Health, University of Toronto, Canada.

He also as Director of the Ethical, Legal, and Social Issues (ELSI) Advisory Services on Global Health Research and Development, through which he has served as an ad hoc Consultant to several UN entities, including the WHO, UNAIDS, UNICEF, the Special Programme for Research and Training in Tropical Diseases (WHO-TDR), and the United Nations Interregional Crime and Justice Research Institute (UNICRI).

He is the Principal Investigator and Director of the Scientific Advisory Group on Emergencies (SAGE),

He also currently serves on several oversight bodies, including the International Ethics Review Board of Médecins Sans Frontières (MSF) and the World Health Organisation's Ad Hoc Research Ethics Review Committee for COVID-19.

Dr. Singh serves as a member of the WHO Access to COVID-19 Tools (ACT) Accelerator Ethics and Governance Working Group, which supports the WHO and partners in responding to ethical and governance issues as they arise in the Accelerator (including the COVAX facility) and in facilitating the ethical implementation of ACT activities in countries, globally.

He also serves as a member of the WHO Technical Advisory Group for Emergency Use Listing of COVID-19 vaccines.

He shared with the author the Global Consultation's conclusions on The Decision Framework for Assessing the Impact of the SARS-CoV-2 Variant Community, held on 29 March 2021, 13:00-16:30 CEST.

References

[1] COLIN J. C, GREGORY F. A, CORY M, CHRISTOPHER H. T., CASEY M. Z., EVAN A. E., KEVIN J. O., NOAM R., and SHWETA B. Climate change will drive novel cross-species viral transmission. 2020. http://bansallab.com/publications/Carlson2020.pdf

[2] XIAOXU W., YONGMEI L., SEN Z., LIFAN C., and BING X. Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. *Environment International*, 2016, 86: 14–23. https://www.sciencedirect.com/science/article/pii/S0160412015300489?via%3Dihub

[3] BHATIA, R. Implementation framework for one health approach. *Indian J. Med. Res*, 2019, 149(3): 329-331. https://www.ijmr.org.in/article.asp?issn=0971-5916;year=2019;volume=149;issue=3;spage=329;epage=331;aulast=Bhatia

[4] RADHAKRISHNAN K.S. *Importance of One Health Approach in the Time of COVID-19 Outbreak*. 2020. https://www.english.manoramaonline.com/news/columns/straight-talk/2020/04/08/opinion-importance-ofone-health-approach-coronavirus-outbreak.html

[5] PREJIT N. India to envision One Health movement for confronting emerging health threats: From concept to approach toward institutionalization. *International Journal of One Health*, 2020, 6(2): 165-176. https://www.onehealthjournal.org/Vol.6/No.2/12.pdf

[6] WENYAN P., MUHAMMAD A. G., and WASEEM H. Synthetic Evaluation of China's Regional Low-Carbon Economy Challenges by Driver-Pressure-State-Impact-Response Model. In*ternational Journal Environmental Research and Public Health*, 2020, 17(15): 54-63. https://doi.org/10.3390/ijerph17155463

[7] MAYA D. D. M., SUMARDJO S., ERIYATNO S., and EKOSUGENG P. Structural Model for Sustainable Management of Ruminant Cattle Slaughterhouse (RC-S): The Establishment and Renovation of RC-S. *Global Veterinaria*, 2015, 14(5): 707-719. https://www.idosi.org/gv/gv14(5)15/12.pdf

[8] MAYA D. D. M., SUMARDJO S., ERIYATNO S., and EKOSUGENG P. Management strategy for sustainable

ruminant-cattle slaughterhouse (RC-S) services. *Jurnal Veteriner*, 2017, 18(1): 94-106. https://www.idosi.org/gv/gv14(5)15/12.pdf
[9] MAYA D. D. M., & ISMANIAH I. The Sustainability of the Regional Government Directive Policy and Key Performance Indicator in Addressing Radicalism and Extremism in Indonesia. *JSIS*, 2020, 5(6): 1-6. https://www.articlegateway.com/index.php/JSIS/article/view/3600
[10] MAYA D. D. M, & JUNE M. Index of sustainability of Nuclear energy center development regulation in Indonesia, *Jurnal Pengembangan Energi Nuklir*, 2019, 21(1): 19-24.
[11] WORLD ECONOMIC FORUM. *COVID-19 and nature are linked. So should be the recovery*. 2020. https://www.weforum.org/agenda/2020/04/covid-19-nature-deforestation-recovery/
[12] CHRISTINE K. J., PETA L. H., PRANAV S. P., JULIE R., TIERRA S. E., CRISTIN C. W. Y., and MEGAN M. D. *Global shifts in mammalian population trends reveal key predictors of virus spillover risk*. 2020. https://doi.org/10.1098/rspb.2019.2736
[13] PATRICIA K., & TONY J. P. Implementing Microsoft Excel Software For Rapfish: A technique For The Rapid Appraisal Of Fisheries Status. *Fisheries Centre Research Reports*, 2004, 12(2): 1-75. http://fisheries.sites.olt.ubc.ca/files/2016/08/12-2.pdf
[14] FAOUZIA T., ALI T. K., MUHAMMAD A., and ZABTA K. S. Ethics, pandemic and environment; looking at the future of low middle income countries. *International Journal for Equity in Health*, 2020, 19: 182. https://equityhealthj.biomedcentral.com/track/pdf/10.1186/s12939-020-01296-z.pdf
[15] JACKIE A., SYLVIE G., JORDAN B., WILLIAM C., and VILLY C. Ecosystem-based Global Fishing Policy Scenarios. *Fisheries Centre Research Reports*, 2007, 15(7): 1-41. https://open.library.ubc.ca/cIRcle/collections/facultyresearchandpublications/52383/items/1.0074764

参考文:

[1] COLIN J. C, GREGORY F. A, CORY M, CHRISTOPHER H. T., CASEY M. Z., EVAN A. E., KEVIN J. O., NOAM R., 和 SHWETA B. 气候变化将推动新型跨物种病毒传播. 2020. http://bansallab.com/publications/Carlson2020.pdf
[2] XIAOXU W., YONGMEI L., SEN Z., LIFAN C., 和 BING X. 气候变化对人类传染病的影响：经验证据和人类适应.国际环境, 2016, 86: 14–23. https://www.sciencedirect.com/science/article/pii/S0160412015300489?via%3Dihub
[3] BHATIA R. 一种卫生方法的实施框架.印度医学杂志, 2019, 149(3): 329-331. https://www.ijmr.org.in/article.asp?issn=0971-5916;year=2019;volume=149;issue=3;spage=329;epage=331;aulast=Bhatia
[4] RADHAKRISHNAN K.S. 新冠肺炎爆发时一种健康方法的重要性. 2020. https://www.english.manoramaonline.com/news/columns/straight-talk/2020/04/08/opinion-importance-ofone-health-approach-coronavirus-outbreak.html
[5] PREJIT N. 印度将设想一场健康运动，以应对不断出现的健康威胁：从概念到制度化的方法。国际一生杂志, 2020, 6(2): 165-176. https://www.onehealthjournal.org/Vol.6/No.2/12.pdf
[6] WENYAN P., MUHAMMAD A. G., 和 WASEEM H. 通过驾驶员-压力-状态-影响-响应模型对中国区域低碳经济挑战进行综合评估。国际环境与公共卫生杂志, 2020, 17(15): 54-63. https://doi.org/10.3390/ijerph17155463
[7] MAYA D. D. M., SUMARDJO S., ERIYATNO S., 和 EKOSUGENG P. 反刍类牛屠宰场可持续管理的结构模型：反刍类牛屠宰场的建立与改造. 全球兽医, 2015, 14(5): 707-719. https://www.idosi.org/gv/gv14(5)15/12.pdf
[8] MAYA D. D. M., SUMARDJO S., ERIYATNO S., 和 EKOSUGENG P. 可持续的反刍动物牛屠宰场服务的管理战略。兽医杂志, 2017, 18(1): 94-106. https://www.idosi.org/gv/gv14(5)15/12.pdf
[9] MAYA D. D. M., 和 ISMANIAH I. 印度尼西亚应对激进主义和极端主义的区域政府指令政策和关键绩效指标的可持续性. 战略信息系统杂志, 2020, 5(6): 1-6. https://www.articlegateway.com/index.php/JSIS/article/view/3600
[10] MAYA D. D. M, 和 JUNE M. 印尼核能中心发展条例的可持续性指数，彭彭邦日报核能, 2019, 21(1): 19-24.
[11] 世界经济论坛. 新冠肺炎与自然联系在一起。所以应该恢复. 2020. https://www.weforum.org/agenda/2020/04/covid-19-nature-deforestation-recovery/
[12] CHRISTINE K. J., PETA L. H., PRANAV S. P., JULIE R., TIERRA S. E., CRISTIN C. W. Y., 和 MEGAN M. D. 哺乳动物种群趋势的全球变化揭示了病毒外溢风险的关键预测因子. 2020. https://doi.org/10.1098/rspb.2019.2736
[13] PATRICIA K., & TONY J. P. 为豚鼠实施微软精益求精软件：一种用于快速评估渔业状况的技术。渔业中心研究报告, 2004, 12(2): 1-75. http://fisheries.sites.olt.ubc.ca/files/2016/08/12-2.pdf
[14] FAOUZIA T., ALI T. K., MUHAMMAD A., 和 ZABTA K. S. 伦理，大流行和环境；展望中低收入国家的未来。国际卫生公平杂志, 2020, 19: 182. https://equityhealthj.biomedcentral.com/track/pdf/10.1186/s12939-020-01296-z.pdf
[15] JACKIE A., SYLVIE G., JORDAN B., WILLIAM C., 和 VILLY C. 基于生态系统的全球捕鱼政策方案。渔业中心研究报告, 2007, 15(7): 1-41. https://open.library.ubc.ca/cIRcle/collections/facultyresearchandpublications/52383/items/1.0074764