Disaster, environment and local indigenous knowledge in Indonesia

Moh. Dede[1,2,3], *Siti* Nurbayani Kusumaningsih[1], *Millary* Agung Widiawaty[3,4,5], *Ni* Gusti Ayu Nandhita[6], *Sri* Wahyuni[1], *Aan* Khosihan[1], *Nindita* Fajria Utami[1], *Puspita* Wulandari[1], *Elly* Malihah Setiadi[1], *Arif* Ismail[1,7]

[1]Universitas Pendidikan Indonesia, 40154 Bandung City, Indonesia
[2]Universitas Padjadjaran, 40132 Bandung City, Indonesia
[3]Cakrabuana Institute for Geoinformation, Environment and Social Studies, 45188 Cirebon, Indonesia
[4]University of Birmingham, B15-2TT Birmingham, United Kingdom
[5]Badan Riset dan Inovasi Nasional, 10340 Jakarta Pusat, Indonesia
[6]Insitute for Health Metrics and Evaluation, University of Washington, 98195 Seattle, United States of America
[7]Universitas Gadjah Mada, 55281 Sleman, Indonesia

Abstract. Indonesia is a disaster-prone area due to its complexity in geographical and geological location. For thousands of years, Indonesian society has interacted with various natural disasters. This research aims to summarize and synthesize community adaptation to various disasters by referring to their local indigenous knowledge. Data came from previous studies recorded in two most reputable scientific databases, namely Web of Science and Scopus, 1980 to 2023 . Our review used a qualitative approach with content analysis, resulting in 16 articles that were suitable for meta-analysis. This research shows that local indigenous knowledge in Indonesian society has included environmental adaptations to several disasters, such as floods, landslides, tsunamis, earthquakes, plagues, volcanic eruptions, and other hydrometeorological extreme events. Local indigenous knowledge is mostly spoken orally through various traditions, traditional houses, living equipment, poetry, regional zoning, and traditional institutions that imply disaster events, but there are no written remains. Their experience has not shown any adaptation to disaster-induced environmental changes due to climate change and global warming. Our research can provide input for disaster mitigation that is more appropriate to the local context.

1 Introduction

Indonesia is a country prone to disasters because it is located between the earth's plates, the ring of fires, and a tropical climate with high rainfall [1]. Various hydrometeorological disasters, earthquakes and tsunamis, tropical epidemics and volcanic eruptions are spread throughout the region whose impacts are also exacerbated by climate change [2]. Since the ancestors of modern humans occupied Indonesia 30-50 thousand years ago, they began to study nature and utilize its resources. Facing a surrounding environment that is swamped with disasters, human instincts must try to study the phenomenon process as a form of risk

reduction [3]. The recurrence is immortalized in the form of knowledge that is passed down across generations, thus that their descendants do not become disaster victims, as well as reducing various material and non-material losses [4]. The community formulates this knowledge into local wisdom, they can live in harmony with the surrounding environment [5, 6].

Local wisdom is a set of knowledge, belief, understanding, or insight as well as customs that guide human behavior in ecological communities [7]. This concept can be interpreted as truth that has become a tradition in an area. Local wisdom is community thoughts or ideas, it contains values and goodness that are internalized as heritage [8, 9]. The inheritance of local wisdom can be through traditions, proverbs, songs, folk games, writings, regional stories, and the like. Local wisdom plays an important role in the disaster mitigation process, even when a community is not familiar with disaster management from a formal and modern scientific perspective [10]. Many articles only discussed a local wisdom in the specific place.

Local communities living in disaster-prone areas, generally, have valuable knowledge and experience about disasters that have occurred in their area [11]. Even local wisdom can support sustainable development, this is because disaster mitigation based on local wisdom not only aims to reduce disaster risk but also to preserve nature [12-14]. In Indonesia, there has been a lot of in-depth research on how local wisdom is a form of coexistence with the environment and disasters. The Baduy community in western Java has customary rules *kuranguh*:, coastal communities continue to respect the sea *nadran*, and use sustainable materials from nature, such as example wood, bamboo, palm fiber, palm leaves and cereal fibers [15-17].

Many previous studies that highlight local wisdom in Indonesia are an opportunity for a systematic review to summarize and synthesize the results from previous researchers [18, 19]. Systematic reviews are certainly different from traditional reviews because researchers are bound by predetermined references. Therefore, this research aims to summarize and synthesize community adaptation to various disasters by referring to their local indigenous knowledge. By studying local wisdom, we can find more effective and sustainable disaster mitigation solutions, while also understanding the environmental setting there.

2 Methodology

Our study presented a systematic literature review (SLR), which referred to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) [20]. SLR uses previous studies to provide answers to current research questions, it is different from traditional literature reviews. SLR is more transparent, replicable, and scientific for theory development in a particular field [21, 22]. This research data came from articles published in international journals indexed in two reputable databases, namely Web of Science (https://www.webofscience.com) and Scopus (https://www.scopus.com). These two databases can capture articles published on a global and national scale; they are known to be selective to maintain their quality [23]. We deliberately did not involve articles published in proceedings or chapter books to obtain an in-depth discussion of the study topic. Apart from that, various final assignments (theses), books, and website pages are also excluded to fully obtain scientific works that have been strictly reviewed by external experts [24].

There are several keywords to obtain previous articles for our study such as 'disaster', 'local wisdom', and 'Indonesia'. This research process includes the stages of identification, screening, eligibility, and inclusion (Figure 1). Many articles that have been declared included need to be assessed by the entire research team so that they are not biased [25]. Data from articles were then processed using the content analysis method, this method is useful for obtaining in-depth written information [26-28]. As a qualitative approach, content

analysis also provides the freedom to provide interpretations, build interconnections, identify problems, and understand gaps [29].

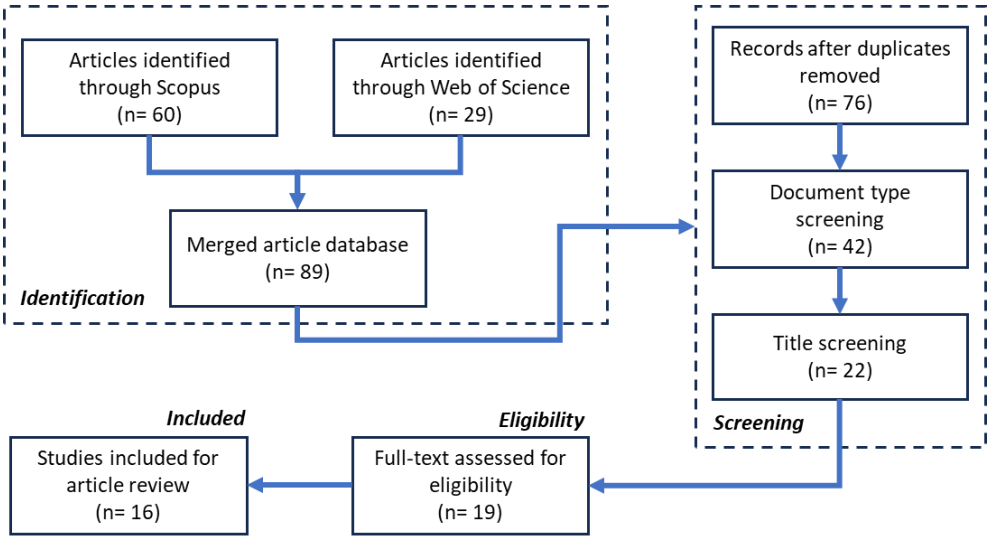

Fig. 1. Selecting articles processes.

3 Results and discussion

In Sumatra, studies on local wisdom and disasters focus primarily on areas prone to earthquakes and tsunamis. In Aceh, people carry out ancient traditions such as *Smong*, which teaches them to run to higher land when an earthquake occurs and to watch the seawater recede (tsunami) [30]. They also use *kutika* or *keununong* to predict the flood season. Animals' behavior such as snakes, birds, ants, and rats is considered a signal of disaster, and local warning systems such as bamboo sticks, gongs, or alarms to notify possible danger. To protect themselves from floods and natural disasters, they built traditional stilt houses and tall barns. During the COVID-19 pandemic, Acehers adopted local traditions such as relying on *peucicap* salt and bathing in the sea (*manoe rabu abeh* or *manoe safa*) to increase immunity and body cleanliness [31]. The use of betel leaves *pajoh ranup* (*Piper batle L.)* as an antiseptic is also common, as well as *le lam guci* to clean oneself before entering the house as an effort to maintain cleanliness. Burning the *lemang* cake *toet leumang* made from glutinous rice (*Oryza sativa L. var glutinosa*) is a sign of sharing with others, they also use henna *pakek gaca* to reflect compliance with social norms [31].

West Sumatran (Minang) utilizes local concepts in dealing with disasters. They rely on *tambo* and *alam takambang becoming teachers* as guidelines for preparedness, as well as *badoncek* in the local social security system [32]. At Nagari Mandeh, the role of *ninik mamak* (elders) is very important in educating the next generation [33]. The same thing was applied in Meranti Regency, Riau to manage forest fire. They built *tebat* or canalblocking to keep the peatland moist and prevent fires, *tebat* also prevents water from entering directly into the sea or river [34]. In Jambi, people have adopted several practices to deal with floods: They build *ambens* made of wooden or bamboo platforms to store things and sleep during floods [35].

On Java Island, local wisdom practices have long been applied by the people, especially traditional communities. Those who live around Mount Anak Krakatau have in-depth knowledge of the warning signs of earthquake disasters and volcanic eruptions, such as *suara*

burung and *penampakan bulan kuning* due to ash distribution [36]. They also have beliefs in ancestral spirits and guardians, influencing decision making by community groups. Traditional leaders *pembekel* and kiai play an important role in obtaining information about way of life and disasters through spiritual communication. Kampung Naga, Tasikmalaya, they built a house with terraces, with the walls of the house supported by neatly arranged stones. Religious ceremonies are carried out as a self-reflection, also *hajat sasih* is used to connect with *Sa Naga* and group members who live outside the area. Most of their livelihoods are farming, with a collective system of managing *leuit* or rice storage [37].

Table 1. Disaster, environmental setting and local indigenous knowledge in Indonesia.

Disaster	Environmental setting	Local knowledge
Earthquake and tsunami	Coastal area, Aceh, Sumatera (rural)	*Smong*
Drought and flood		*kutika* or *keununong, rumah panggung*
Plague		*Peucicap, manoe rabu abeh* or *manoe safa, toet leumang, pakek gaca*
Earthquake and tsunami	Coastal area, Sumatera Barat, Sumatera (Rural)	*Tambo, alam takambang jadi guru, badoncek, ninik mamak*
Land and forest fires	Small islands and coastal area, Riau, Sumatera (rural)	*Tebat*
Flood	Coastal area, Jambi, Sumatera (rural)	*Amben*
Volcanic eruption	Coastal area, Banten, Java (rural)	*Suara burung, penampakan bulan kuning, pembekel*
	Mountainous area, East Java, Java (rural)	*Jamhur, Jangkar Kelud*
Landslide and drought	Mountainous area, West Java, Java (rural)	*hajat sasih, Sa Naga,* and *leuit*
	Mountainous area, East Java, Java (rural)	*Tumpang sari*
Plague	Coastal area, West Java, Java (rural)	*Adan pitu lan Menjangan Wulung*
	Highland area, Bali, Indonesia (rural)	*Tatwamasi, tri hita karana*
Earthquake, droughts and mass movements	Agricultural area, Lombok, Nusa Tenggara (rural)	*Awik-awik gubung*
	Small islands and mountainous areas, Tidore, Maluku (rural)	*Folajiku*
	Lowland areas, Sulawesi Tengah, Sulawesi (rural)	*Pengataa*
Extreme wave and tide	Near freshwater reservoir, Sulawesi Selatan (rural)	*Cappeang, palawang, bungka, makkaja lalla*

In Cirebon, traditional practices such as *adan pitu* (seven times azan) are still applied even during the COVID-19 pandemic, they believe in *Menjangan Wulung* who is a mythical person described as the disease outbreaks [38]. Taji Village, Malang, the community has adopted the practice of planting terraced plants as an environmental conservation effort. They also cultivate Arabica coffee with *tumpang sari* horticulture [39]. Likewise, around Mount

Kelud, East Java, people rely on cooperation and solidarity for disaster management, facilitated by *Jangkar Kelud*. They have *Jamhur* as a meeting hall where people gather, including evacuation [40].

In Bali, local wisdom practices were implemented during the COVID-19 pandemic with the use of *tatwamasi* and *trihita karana* masks, there were *pecalang* traditional officers during the lockdown period [41]. Meanwhile, in Lombok, the community adopted structural and non-structural mitigation practices in the form of house building and environmental governance led by *pembekel* with *awik-awik gubug* [42]. In Tidore, Maluku, people rely on a building typology that symbolizes the anatomy of the human body *folajiku*. The building's location is adapted to mountainous landscapes to ensure it is safe from earthquakes and extreme weather. Building construction uses traditional techniques and natural materials such as bamboo, river stones, clay and sago leaves. The building's spatial pattern includes the main building, kitchen, and sacred room for supernatural activities [43].

In Central Sulawesi, *pengataa* is a guideline for dealing with earthquakes, tsunamis, liquefaction and landslides. Philosophy principles such as *pehakovia*, *hintuvu*, and *katuvua* shape the worldview and values of the ToKaili people. Naming areas using descriptive toponyms helps identify disaster-prone locations. The ToKaili region was divided into three zones, each with different characteristics, to increase resilience to disasters [44]. Around Lake Tempe, South Sulawesi, people rely on customary law to manage natural resources with *Cappeang*, *palawang*, *bungka*, and *makkaja lalla*. Sacred areas are respected, and ceremonies and offerings are made to prevent disasters originating from waves and tides. Floating settlements are adapted to wind direction, boat paths, poles, floating vegetation, and sacred areas [45].

This adaptive approach reflects local wisdom, which can increase community awareness and participation in disaster mitigation. Local communities who have local wisdom about disaster mitigation will be more aware of and participate in disaster mitigation efforts [46-49]. It appears that disaster adaptation patterns in Indonesia are similar due to similar environmental settings, it appears that local wisdom is most prevalent in coastal communities who live in rural areas (Table 1). Local community knowledge about their environment and potential disasters is reflected in various traditions, traditional houses, living equipment, poetry, regional zoning, and traditional institutions, but there are no written remains. Their experience has not shown any adaptation to disaster-induced environmental changes during climate change and the global warming era.

4 Conclusion

Indonesia's communities employ traditional wisdom extensively to handle numerous disasters, such as earthquakes, tsunamis, floods, landslides, volcanic eruptions, forest fires, droughts, and disease outbreaks. This local knowledge is primarily passed down orally, expressed through various forms like traditional practices, vernacular architecture, customary tools, regional zoning, and traditional institutions. In rural coastal, mountainous, and agricultural communities, many concepts represent instances of local wisdom. These practices embody both an intimate knowledge of the local environment and potential disasters, as well as spiritual beliefs and social structures. Traditional leaders significantly contribute to the preservation and transmission of valuable knowledge. Rooted in local wisdom, adaptive approaches can enhance community awareness and boost participation in disaster mitigation efforts. Notable is the lack of written records regarding this knowledge, and present practices do not evidently reflect adaption to environmental changes prompted by climate change and global warming. Incorporating local wisdom into disaster management plans could enhance their effectiveness. The approach aims to boost community resilience and involvement in disaster mitigation with cultural sensitivity. More study is

required to adapt traditional practices into contemporary environmental challenges and modern disaster management frameworks.

Acknowledgement

This research received support from the Faculty of Social Sciences Education, Universitas Pendidikan Indonesia for 2023-2024. We would like to thank Nana Nur Afriana (Universitas Negeri Semarang) who helped prepare the manuscript well.

References

1. M. Dede, S.B. Wibowo, Y. Prasetyo, I.W. Nurani, P.B. Setyowati, S. Sunardi, Water resources carrying capacity before and after volcanic eruption, Glob. J. Environ. Sci. Manag. **8**, 4, 473-484 (2022)
2. M.A. Widiawaty, K.C. Lam, M. Dede, N.H. Asnawi, Spatial differentiation and determinants of COVID-19 in Indonesia, BMC Public Health **22**, 1, 1030 (2022)
3. G.D.Li.B. Van den Bergh, A. Brumm, R. Grün, D. Yurnaldi, M.W. Moore, I. Kurniawan, R. Setiawan, F. Aziz, R.G. Roberts, Suyono, Earliest hominin occupation of Sulawesi, Indonesia, Nature **529**, 7585, 208-211 (2016)
4. T. Okubo, Traditional wisdom for disaster mitigation in history of Japanese Architectures and historic cities, J. Cult. Herit. **20**, 715-724 (2016)
5. O.S. Abdullah, Ekologi manusia dan pembangunan berkelanjutan (Gramedia Pustaka Utama, Jakarta, 2017)
6. J. Iskandar, Ekologi manusia dan pembangunan berkelanjutan (PSMIL Universitas Padjadjaran, Kota Bandung, 2019)
7. R. Febriani, A. Dani, Environmental Crisis and Local Wisdom; Learning from the Cosmology of the Minang and Javanese Communities, Digit. Press Soc. Sci. Humanit. **9**, 00014 (2023)
8. A.J. Pesurnay, *Local wisdom in a new paradigm: Applying system theory to the study of local culture in Indonesia*, in IOP Conference Series: Earth and Environmental Science, IOP Publ, Vol. 175, No. 1, p. 012037, Bristol, United Kingdom (2018)
9. A.L. Diab, M. Pabbajah, R. Nurina Widyanti, L.M. Muthalib, W. Fajar Widyatmoko, Accommodation of local wisdom in conflict resolution of Indonesia's urban society, Cogent Soc. Sci. **8**, 1, 2153413 (2022)
10. A. Mulyadi, M. Dede, M.A. Widiawaty, The role of tradisional belief and local wisdom in forest conservation, J. Geogr. Gea **22**, 1, 55-66 (2022)
11. P.F. Wialdi, R.E. Putera, K. Kusdarini, R. Ariany, T.R. Valentina, R. Dermawan, *Local wisdom of coastal communities in mitigating earthquake disaster risk reduction*, in E3S Web of Conferences, EDP Sci. Vol. 331, p. 04001, Les Ulis, France (2021)
12. D.P. Keliat, A. Amirudin, Y. Luqman, *Chances and challenges of Local Wisdom as a management model toward sustainable fisheries*, in E3S Web of Conferences, EDP Sci. Vol. 317, p. 01055, Les Ulis, France (2021)
13. K. Anwar, *Disaster mitigation local wisdom in the tradition of the minangkabau community*, in E3S Web of Conferences, EDP Sci. Vol. 331, p. 04013, Les Ulis, France (2021)
14. A. Mulyadi, N.N. Afriana, M.A. Widiawaty, M. Dede, Water resources carrying capacity in the Bali Island: A history and local wisdom for environmental conservation, Hist.: J. Pendidik dan Peneliti Sej. **6**, 1, 89-96 (2023)

15. O. Shalih, H. Setiadi, T. Nurlambang, W. Sumadio, *Toward a community resilience framework for disaster risk management. a case study: Landslide Cisolok in Sukabumi 2018 and Sunda Strait Tsunami in Pandeglang 2018*. in E3S Web of Conferences, EDP Sci. Vol. 156, p. 01011, Les Ulis, France (2020)
16. N. Danapriatna, I. Ismarani, R. Luthifadi, M. Dede, Effect of straw compost (Oryza sativa L.) on crop production, Pertanika J. Trop. Agric. Sci. **46**, 3, 1047-1062 (2023)
17. M. Dede, S. Nurbayani, I. Ridwan, M.A. Widiawaty, B.I. Anshari, *Green development based on local wisdom: A study of Kuta's indigenous house, Ciamis*, in IOP Conference Series: Earth and Environmental Science, IOP Publ, Vol. 683, No. 1, p. 012134, Bristol, United Kingdom (2021)
18. S. Nurbayani, L. Utami, *Local wisdom education to develop geo-diversity understanding*, in IOP Conference Series: Earth and Environmental Science, IOP Publ, Vol. 145, No. 1, p. 012037, Bristol, United Kingdom (2018)
19. I. Meliono, Understanding the Nusantara thought and local wisdom as an aspect of the Indonesian education, Tawarikh **2**, 2, (2011)
20. S. Nurbayani, M. Dede, M.A. Widiawaty, Utilizing library repository for sexual harassment study in Indonesia: A systematic literature review, Heliyon **8**, 8, e10194 (2022)
21. M.A. Franco, S.N. Groesser, A systematic literature review of the solar photovoltaic value chain for a circular economy, Sustainability **13**, 17, 9615 (2021)
22. S. Setiadi, A. Sumaryana, H. Bekti, D. Sukarno, Public policy communication for flood management, J. Soc. Media **7**, 2, 300–312 (2023)
23. D.E. Irawan, J. Abraham, R.A. Zein, I.A. Ridlo, E.K. Aribowo, Open access in Indonesia, Dev. Change **52**, 3, 651-660 (2021)
24. M. Dede, S. Sunardi, K.C. Lam, S. Withaningsih, Relationship between landscape and river ecosystem services, Glob. J. Environ. Sci. Manag. **9**, 3, 637-652 (2023)
25. D. Priharsari, Systematic literature review di bidang sistem informasi dan ilmu komputer, Jurnal Teknologi Informasi dan Ilmu Komputer **9**, 2, 263-268 (2022)
26. J. Lee, K.A. Hayden, H. Ganshorn, H. Pethrick, A content analysis of systematic review online library guides, Evid. Based Libr. Inf. Pract. **16**, 1, 60-77 (2021)
27. S. Nurbayani, M. Dede, E. Malihah, Fear of crime and post-traumatic stress disorder treatment: investigating Indonesian's pedophilia cases, J. Ilm. Peuradeun **10**, 1, 183-204 (2022)
28. S. Nurbavani, E. Malihah, M. Dede, M.A. Widiawaty, A family-based model to prevent sexual violence on children, Int. J. Body Mind Cult. **9**, 3, 159-166 (2022)
29. L. Khirfan, M. Peck, N. Mohtat, Systematic content analysis: A combined method to analyze the literature on the daylighting (de-culverting) of urban streams, MethodsX **7**, 100984 (2020)
30. H. Syahputra, Indigenous knowledge representation in mitigation process: A study of communities' understandings of natural disasters in Aceh Province, Indonesia, Collect. Curation **38**, 4, 94-102 (2019)
31. H.J. EL-Matury, F. Lestari, S. Ginting, S. Batubara, B.M. Sembiring, Agile in the fight against the COVID-19 Pandemic: Lesson learned from Aceh's readiness and acehnese's local wisdom dealing with the COVID-19 Pandemic, J. Nat. Resour. Environ. Manag.)/J. Pengelolaan Sumberd. Alam dan Lingkung. **12**, 4 (2022)
32. S. Rozi, A.R. Ritonga, J. Januar, 'Local community-based disaster management'The transformation of religious and local wisdom values in preparation to deal with natural hazards in West Sumatra, Indonesia, Jàmbá: J. Disaster Risk Stud. **13**, 1, 1-7 (2021)

33. Z. Alhadi, S. Sasmita, A. Yulfa, S. Fatimah, D. Syafrini, K.D. Maani, O. Riandini, The Coping Strategies Patterns Based on Local Wisdom and Resilience Capital in Facing Natural Disaster Risk in Nagari Mandeh, Indonesia, Int. J. Sustain. Dev. Plan. **18**, 1 (2023)
34. W. Utami, M.N. Salim, Local Wisdom as a peatland management strategy of land fire mitigation in Meranti regency, Indonesia, Ecol. Environ., Conserv. **27**, 1, 127-137 (2021)
35. A. Subandi, S. Alim, F. Haryanti, Y.S. Prabandari, Training on modified model of programme for enhancement of emergency response flood preparedness based on the local wisdom of Jambi community, Jàmbá: J. Disaster Risk Stud. **11**, 1, 1-9 (2019)
36. A. Firdaus, F. Lestari, S.A. Afiff, H. Herdiansyah, Integration of knowledge and local wisdom for disaster resilience in Anak Krakatau volcano, Jàmbá: J. Disaster Risk Stud. **15**, 1, 1457 (2023)
37. E. Maryani, A. Yani, Local Wisdom of Kampung Naga in Mitigating Disaster and Its Potencies for Education Tourism Destination, ASEAN J. Hosp. Tour. **14**, 2, 72-85 (2015)
38. H. Qodim, W. Hernawan, Azan Pitu: The Pacification of Plagues rituals during the COVID-19 pandemic, HTS Teol. Stud./Theol. Stud. **79**, 2, 8432 (2023)
39. H. Masruroh, F. Rosyida, Lesson Learn From the Indigineous Community to Manage Environment and Developing the Tourism Object in the Taji Villages Malang Regency, Indonesia, Geo J. Tour. Geosites **42**, 775-781 (2022)
40. S. Andreastuti, E. Paripurno, H. Gunawan, A. Budianto, D. Syahbana, J. Pallister, Character of community response to volcanic crises at Sinabung and Kelud volcanoes, J. Volcanol. Geotherm. Res. **382**, 298-310 (2019)
41. F. Fatmah, Role of leadership and local culture in COVID-19 control in Bali Province, Indonesia, J. Pengelolaan Sumberd. Alam Dan Lingkung. (J. Nat. Resour. Environ. Manag.) **11**, 3, 342-349 (2021)
42. N. Wahyuningtyas, A. Tanjung, I. Idris, K. Dewi, Disaster mitigation on cultural tourism in lombok, Indonesia, Geo J. Tour. Geosites **27**, 4, 1227-1235 (2019)
43. M. Rahim, M. Arham, D. Darmawijaya, *The Identity of Gurabunga Traditional Architecture and its Response to Sustainability*, in E3S Web of Conferences, EDP Sci, Vol. 328, p. 10023, Les Ulis, France (2021)
44. Z. Sirajuddin, P. Fitriaty, Z. Shen, Pengataa, ToKaili customary spatial planning: A record of tropical settlements in Central Sulawesi, Indonesia, For. Soc. **6**, 2, 547-569 (2022)
45. N. Naing, Model of Settlement float management based on local wisdom for disaster mitigation in Tempe Lake–Indonesia, Int. J. Appl. Eng. Res. **10**, 21, 42329-42335 (2015)
46. H. Kurnio, A. Fekete, F. Naz, C. Norf, R. Jüpner, Resilience learning and indigenous knowledge of earthquake risk in Indonesia. Int. J. Disaster Risk Reduct. **62**, 102423 (2021)
47. J. Hos, S. Roslan, R. Supiyah, Disaster mitigation based on local wisdom in shifting cultivators communities, WSEAS Trans. Environ. Dev. **17**, 237-243 (2021)
48. M. Dede, G. Anggasta, E. Sukriah, G.N. Rahman, M.A. Widiawaty, A. Pratama, R. Rosita, S. Marhanah, K. Muhammad, C. Mukaromah, Melihat potensi pariwisata pedesaan di Desa Sukamandi (Mega Press, 2024)

49. D. Oktavia, S.D. Pratiwi, N.N., Kamaludin, M.A. Widiawaty, M. Dede, Dynamics of land use and land cover in the Belitung Island, Indonesia, Heliyon **10**, e33291 (2024)
50. S. Sunardi, M. Dede, S.B. Wibowo, Y. Prasetyo, A.J. Astari, L. Lukman, F. Lavigne, C. Gomez, I.W. Nurani, Y. Sakai, M.K.A Kamarudin, Preliminary assessment of river ecosystem services in the volcanic area of Mount Merapi, Indonesia, Aquat. Ecol., **58**, 1-14.