frontiers | Frontiers in Forests and Global Change

TYPE Perspective
PUBLISHED 03 April 2025
DOI 10.3389/ffgc.2025.1520124

OPEN ACCESS

EDITED BY
Zoran Govedar,
University of Banja Luka,
Bosnia and Herzegovina

REVIEWED BY
Ailiang Xie,
Linyi University, China

*CORRESPONDENCE
Kyoo-Man Ha
✉ ha1999@hotmail.com;
✉ kmanha@ra.ac.ae

RECEIVED 30 October 2024
ACCEPTED 24 March 2025
PUBLISHED 03 April 2025

CITATION
Ha K-M (2025) Facilitating the subject of emergency management in forest research. *Front. For. Glob. Change* 8:1520124. doi: 10.3389/ffgc.2025.1520124

Facilitating the subject of emergency management in forest research

Kyoo-Man Ha*

Rabdan Academy, Abu Dhabi, United Arab Emirates

This brief perspective served as a facilitator to emergency management for the benefit of forest research. While maintaining the relative (or more restrictive) criteria of emergency management domain, a systematic literature review was adopted as a main methodology. While current forest research made headway in adjusting to changing environmental conditions such as fire management, there was still room for improvement. In particular to further make forests resilient and sustainable, future forest research as key findings should incorporate multiple principles of emergency management (including comprehensive emergency management, other emergency management frameworks, prospective research areas, pertinent research questions, communication, etc.). Then, future forest research should apply them to its projects based on potential benefits (including both expanding research opportunities and contributing to the goal of emergency management). This perspective further introduced emergency management, which would help to expand the scope of forest research.

KEYWORDS

comprehensive emergency management, fire management, forest researchers, human loss, research questions

1 Introduction

Emergency management (also known as disaster management, hazard management, or otherwise) systematically deals with various emergencies (e.g., forest fires, earthquakes, zoonosis, etc.) through cooperation, collaboration, coordination, command, and control with key stakeholders such as governments, businesses, voluntary organizations, and local communities (Baratz, 2023). Due to rapidly changing physical and social environments in the 21st century, such as climate change, pandemics, terrorism, psychological stress, unequal treatment, etc., individuals and organizations have come to deal with various threats regardless of national boundaries (Quilez et al., 2020). Without efficiently examining these natural hazards and manmade emergencies, humans would continue to be haunted by related risks.

As dense land, forests have their own characteristics in their nature. However, we assume that each forest comprises its own trees, plants, animals, water, and other elements under its unique ecosystem; their structures or compositions are not identical (Robinson, 2022). Similarly, forest ecosystems vary depending on regional temperatures and rainfall. Forests have been significantly affected by biotic stresses, including human activities, and contribute important abiotic services such as oxygen production and temperature regulation, as well as biotic resources like wood and medicinal materials.

Although the field of forest research has made attempts to analyze or apply the perspective of emergency management to forestry (e.g., forest fire management, disease outbreak, forest as critical infrastructure, forest data integration, etc.), the research level has yet to be extremely satisfactory (Chuvieco et al., 2023; Moore, 2019). To that end, the purpose of this perspective is to examine key areas within current forest research and to identify specific priorities and

directions for future forest research. It will help to apply correct measures that will attempt to diminish the ecological and social impacts of forest emergencies (i.e., until zero risk).

2 Methodology

This brief perspective has relied entirely on a systematic literature review as a fundamental methodology, identifying, excerpting, and synthesizing pertinent texts to include research articles (22), book chapters (1), books (2), government documents (3), and websites (1) (Tedja et al., 2024). In doing so, this perspective has partially depended on relative criteria to investigate the subject of forest research in particular via the restrictive viewpoint of emergency management discipline. Also, a supplementary use of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 flow diagram has been made (See Data availability statement).

To elaborate, this perspective has employed particular search terms across a number of search engines, including Google.com, ScienceDirect, SCOPUS, Semantic Scholar, and others, to guarantee the reproducibility of this work. Terms like "forest resilience," "emergency management," "forest recovery," "forest research," "human impacts" are a few examples of search expressions that were employed. Whether a text covered subjects linked to both emergency management and forest research has been a primary criterion for selecting which texts to include or exclude. When adequate texts are accessible, this study has come to apply emergency management concepts to forest research, or vice versa. Another eligibility criterion is whether a particular text has just been published or not. Old texts are not included.

3 Discussion

3.1 Current forest research

In response to opportunities (e.g., income increase, ecotourism, carbon sequestration, etc.) and obstacles (e.g., biodiversity loss, bioeconomy emergence, sustainability challenge, climate change, or ineffective forest management.) surrounding forests, a group of forest researchers (e.g., pan-European researchers via Sustainable Forest Management) have developed and managed forest resources (e.g., timber products, non-timber products, recreational values, etc.). Similarly, forest research has been directly or indirectly supported by three dimensions of sustainability: environmental (or planet), economic (or profit), and social (or people) pillars (Rusanen et al., 2024). These three pillars form the basis of the United Nations Sustainable Development Goals. Furthermore, forest researchers have formed numerous alliances with other parties involved in the field (e.g., partnerships with governmental bodies, corporations, academic institutions, businesses, nonprofit groups, or other entities).

Even though forests and their surroundings have undergone rapid changes, some researchers continue to rely on their routine perspectives to include reactive management, focus on individual species, timber-centered views, and many (Lee et al., 2015). The value of a demand-based approach to forest research has increased significantly in recent years. However, a subset of forest researchers has not successfully embraced end-user perspectives as much, including those of locals, forest visitors, indigenous people, etc. Examples include ignoring local farmers' requirements in the planning process, failing to take cultural values into account, and neglecting the needs of the local community in forest management, among others. Despite consistently offering insights and thorough research findings, the field of forest research has not fully adapted to this new trend (at least in certain instances).

Recently, the field has concentrated on managing wildfires at different scales using, among other things, simulations, early fire detection systems, real-time fire behavior monitoring, and atmospheric pollution monitoring systems (Finney et al., 2021; Lahaye et al., 2014; Rodrigues et al., 2022). In addition, the field is still working on mapping fire severity, ecological restoration, reducing the frequency of disasters, and other issues while distinguishing between the situation via active fire suppression and the repercussions at different temporal scales.

However, in terms of relative criteria (i.e., the perspective of emergency management domain), the field of forest research has not sufficiently taken into account other forest-related emergencies (Gooding et al., 2022). It is noteworthy that a variety of actions have been made in the current forest research. Its efforts have not been successfully finished yet, though. When wildfires cause unexpectedly occurring additional severe catastrophes, such as health crises (e.g., respiratory illness in 2020 Australian bushfires), landslides (e.g., debris flows in 2018 Californian wildfires), water contamination (e.g., contaminated water in 2021 Dixie fire, U.S.), floods (e.g., flash floods in 2013 Colorado wildfires), emotional trauma (e.g., posttraumatic stress disorder in 2017 Californian camp fires), social displacement (e.g., permanent evacuation in 2019 Amazon rainforest fires), and safety concerns (e.g., looting in 2021 Oregon wildfires), this phenomenon is referred to as "cascading disasters" (Alexander and Pescaroli, 2019; Crosweller, 2025). Cascade catastrophes are still not sufficiently considered into the path to the ultimate goal of emergency management, when considering the current situation of human loss, economic damages, and psychological impacts.

The field of forest research has generally lacked the application of emergency management within its research domain, comparatively speaking (Lohmander et al., 2022). Emergency management has been extensively applied to business companies (via business continuity) and government organizations (via continuity of operations). Some nations such as Finland, France, Australia, United States, United Kingdom, and others have started looking into risk management in forest research because of significant diebacks or other diseases, especially beyond the purview of emergency management. Despite this, they have been willing to study those fires via traditional disciplines (or independently), including forest sciences, environmental protection, botany, zoology, ecology, genetics, economics, and others.

It is fair to say that current forest research has significantly and thoroughly increased our understanding of regional and global ecological processes, depending on individual criteria. For instance, three research teams offered various approaches to wildfire management. Castellnou et al. (2019) emphasized the value of proactive fire management measures as an alternative to defensive ones. When Gamboa et al. (2023) highlighted the need for resilient landscapes to combat wildfires in the context of climate change, Neidermeier et al. (2023) demonstrated that, among other things, spatial evaluation was crucial to wildfire mitigation.

The field has continued to make significant advances in understanding of vital topics including the carbon cycle, biodiversity preservation, and sustainable management techniques, emphasizing the role that forests play in reducing global warming and maintaining ecosystem services (Chan et al., 2023; Van Hensbergen and Cedergren, 2020). Shortly, these have been a great achievement so far. Forest research has also looked into many roles that forests play in different locations, such as reforestation efforts to prevent soil erosion, rainforest restoration to prevent disruptions to the water cycle, and fire ecology research to prevent health crises caused by smoke. In addition, the field has been at the forefront of implementing cutting-edge research methods and technology, like data modeling, forest genetics, and remote sensing.

3.2 Future forest research

The concept of comprehensive emergency management (CEM), which is essential to the field, encompasses all actions and procedures used to handle emergencies. In particular, hazards represent sources of adverse conditions or potential threats [FEMA (Federal Emergency Management Agency), 2016], while risks are determined by the equation: risks = consequence × likelihood, or, alternatively, risks = (hazard × exposure × vulnerability) ÷ capacity (Scott et al., 2013). This perspective is to propose the use of CEM framework toward future forest research. To elaborate, CEM comprises four sub-factors (Carson, 2024; Jensen and Kirkpatrick, 2022). (1) CEM has maintained the participation of all stakeholders in emergency management. (2) Simultaneously dealing with all kinds of hazards (including not only natural hazards but also manmade emergencies). (3) CEM aims to reduce all risks (consisting of both physical impacts and social impacts of emergencies). Additionally, (4) all phases of the emergency management cycle will be equally managed, such as emergency prevention/mitigation, preparedness, response, and recovery (Figure 1).

With all the above sub-factors in mind, several forest research areas will become more accessible when emergency management

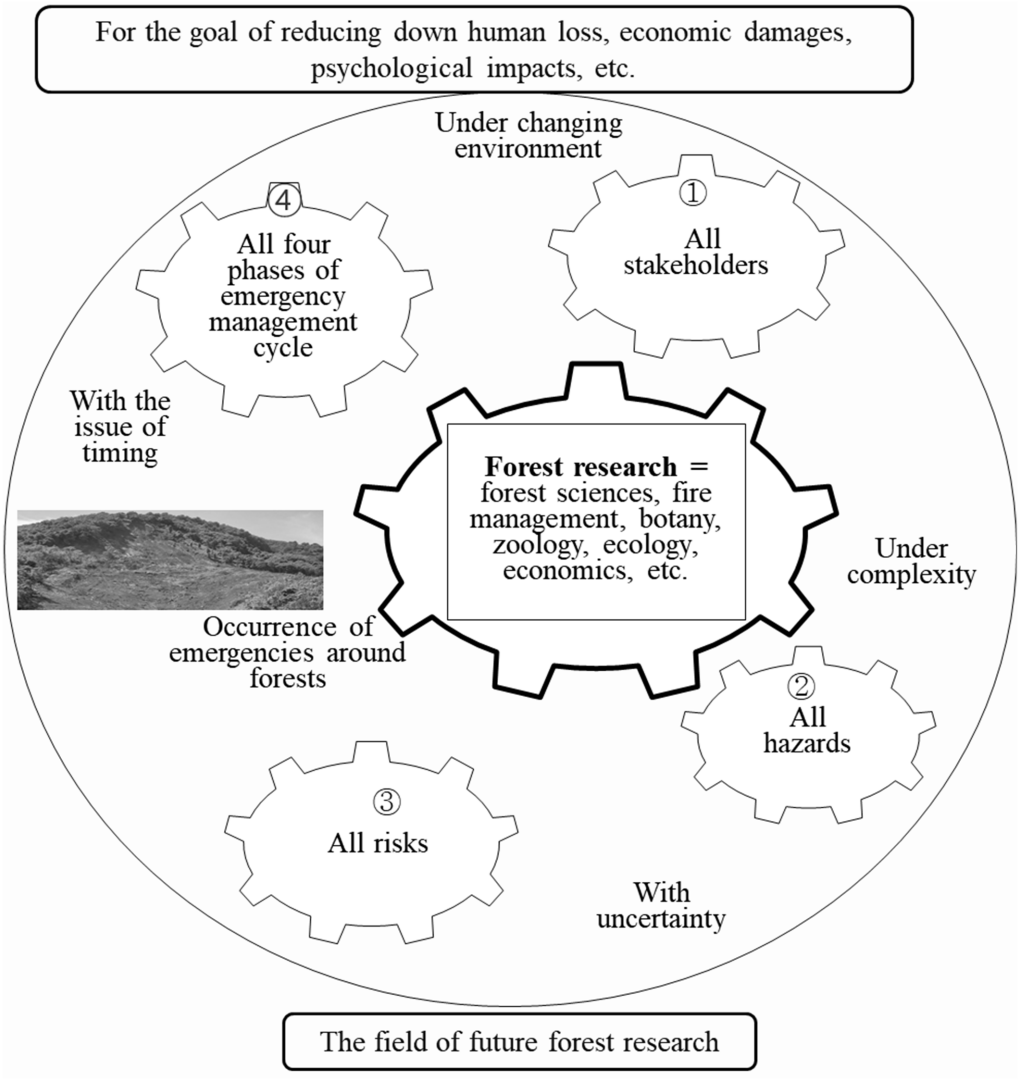

FIGURE 1
Image on locating CEM components around future forest research.

is the focus. Specific examples include the whole community approach to treating forest insect diseases, emergency recovery through forest bathing (also known as Japnaese shinrin yoku, ecotherapy, or else), the further use of technology in forest emergency management (e.g., remote sensing, real-time decision support system, predictive models, etc.), and the importance of local culture during forest emergency management (Santiago-Gomez and Rodriguez-Rodriguez, 2023). Future studies will undoubtedly examine how CEM addresses cascading disasters through collaboration (e.g., cross-sectoral alliance, public-private partnership, etc.) land-use planning, multi-hazard risk reduction, etc. Acknowledging that emergency management constitutes a classic case of transdisciplinary study, forest researchers will work even more closely with other researchers on their upcoming projects such as disaster risk reduction, education, cross-sectoral integration, etc. Furthermore, forest researchers will refer to other frameworks beyond CEM such as Sendai Framework for Disaster Risk Reduction (2015–2030), business continuity management from International Organization for Standardization, World Health Organization's emergency response framework, etc.

In the same vein, several research questions will arise. "How will all stakeholders treat Asian long-horned beetles for the sake of a whole community approach?" is one example. "How will forest bathing be used by local communities to promote mental health recovery?" "How can technologies for forest emergencies be developed or implemented effectively?" "How will indigenous knowledge in Amazon contribute positively to managing forest emergencies?" and many more. Each forest researcher's study environment and criteria will determine how these research questions are refined (Wulandari et al., 2023).

Forest researchers will communicate with diverse peers (e.g., data scientists, urban planners, etc.) and other professionals (e.g., emergency managers, policy makers, etc.) to gain a deeper understanding of the need for emergency management in the context of forest research, facilitating prospective research areas and pertinent research questions (Fouqueray and Frascaria-Lacoste, 2020). Additionally, the field of forest research must increase its capacity for studying the novel problem of emergency management while training future researchers, providing sufficient funding for their work (e.g., government grants, private sector funding, crowdfunding for forest research, etc.), creating leadership and strategies, and other tasks. Governments and businesses will help greatly accelerate these efforts.

Several potential benefits will arise when the field of forest research further or innovatively applies the topic of emergency management to its research processes (Skydan et al., 2022). Forest researchers will have more research opportunities when they incorporate emergency management principles, potential research areas, and favorite research questions into their future studies. These researchers may develop new principles of emergency management based on various studies. At the same time, the scope of forest research will be significantly broadened, particularly by decreasing the boundary between forests and emergency management.

Efforts to merge the topic of emergency management with forest research will ultimately contribute to reducing human loss, monetary damages, and psychological stress around forests (Brunette et al., 2017). By studying not only natural hazards (e.g., forest fires, landslides, plant diseases, etc.) but also manmade emergencies (e.g., arson, improvement of human health, etc.) around forests, human casualties may certainly decrease. When effectively coping with forest fires or other emergencies, economic harm will also be reduced. By further managing major mental emergencies via forest bathing, people's psychological stress will accordingly decrease.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

K-MH: Conceptualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Acknowledgments

The author thanks reviewers for their valuable comments.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author declares that no Gen AI was used in the creation of this manuscript.

Publisher's note

References

Alexander, D., and Pescaroli, G. (2019). What are cascading disasters? *UCL Open Environ.* 1:e003. doi: 10.14324/111.444/ucloe.000003

Baratz, A. (2023). Emergency management today: quantum computing is a 21st century solution for 21st century problems. Available online at: https://federalnewsnetwork.com/commentary/2023/07/emergency-management-today-quantum-computing-is-a-21st-century-solution-for-21st-century-problems/ (accessed July 31, 2024).

Brunette, M., Couture, S., and Pannequin, F. (2017). Is forest insurance a relevant vector to induce adaptation efforts to climate change? *Ann. For. Sci.* 74:41. doi: 10.1007/s13595-017-0639-9

Carson, J. (2024). Finalizing emergency management professionalization in 2024. *J Emerg. Manage.* 22, 225–234. doi: 10.5055/jem.0866

Castellnou, M., Prat-Guitart, N., Arilla, E., Larranaga, A., Nebot, E., Castellarnau, X., et al. (2019). Empowering strategic decision-making for wildfire management: avoiding the fear trap and creating a resilient landscape. *Fire Ecol.* 15:31. doi: 10.1186/s42408-019-0048-6

Chan, K. K., Golub, A., and Lubowski, R. (2023). Performance insurance for jurisdictional REDD+: unlocking finance and increasing ambition in large-scale carbon crediting systems. *Front. For. Glob. Change* 6:1062551. doi: 10.3389/ffgc.2023.1062551

Chuvieco, E., Yebra, M., Martino, S., Thonicke, K., Gomez-Gimenez, M., San-Miguel, J., et al. (2023). Towards an integrated approach to wildfire risk assessment: when, where, what and how may the landscapes burn. *Fire* 6:215. doi: 10.3390/fire6050215

Crosweller, M. (2025). Compassion in disaster management: The essential ethic of relational leadership. New York, New York: Routledge.

FEMA (Federal Emergency Management Agency) (2016). Hazard mitigation flood Insurance in Disaster Operations. Emmitsburg, Maryland: Emergency Management Institute (EMI).

Finney, M. A., McAllister, S. S., Grumstrup, T. P., and Forthofer, J. M. (2021). Wildland fire behaviour: Dynamics, principles and processes. Victoria, Australia: CSIRO Publishing.

Fouqueray, T., and Frascaria-Lacoste, N. (2020). Social sciences have so much more to bring to climate studies in forest research: a French case study. *Ann. For. Sci.* 77:81. doi: 10.1007/s13595-020-00989-3

Gamboa, G., Otero, I., Bueno, C., Arilla, E., Ballart, H., Camprubi, L., et al. (2023). Participatory multi-criteria evaluation of landscape values to inform wildfire management. *J. Environ. Manag.* 327:116762. doi: 10.1016/j.jenvman.2022.116762

Gooding, K., Bertone, M. P., Loffreda, G., and Witter, S. (2022). How can we strengthen partnership and coordination for health system emergency preparedness and response? Findings from a synthesis of experience across countries facing shocks. *BMC Health Serv. Res.* 22:1441. doi: 10.1186/s12913-022-08859-6

Jensen, J., and Kirkpatrick, S. (2022). Local emergency management and comprehensive emergency management (CEM): a discussion prompted by interviews with chief resilience officers. *Int. J. Disaster Risk Reduct.* 79:103136. doi: 10.1016/j.ijdrr.2022.103136

Lahaye, S., Curt, T., Paradis, L., and Hely, C. (2014). "Chapter 3 - fire management: classification of large wildfires in south-eastern France to adapt suppression strategies" in Advances in Forest fire research. ed. D. X. Viegas (Coimbra, Portugal: University of Coimbra Press), 696–708.

Lee, D. K., Salleh, M. N., Ho, W. M., and Combalicer, M. S. (2015). "Changing trends of forestry research demand" in Tropical forestry handbook. eds. M. Kohl and L. Pancel (Berlin, Germany: Springer), 1–9.

Lohmander, P., Mohammadi, Z., Kaspar, J., Tahri, M., Bercak, R., Holusa, J., et al. (2022). Future forest fires as functions of climate change and attack time for central bohemian region, Czech Republic. *Ann. For. Res.* 65, 17–30. doi: 10.15287/afr.2022.2183

Moore, P. F. (2019). Global wildland fire management research needs. *Curr. Forestry Rep.* 5, 210–225. doi: 10.1007/s40725-019-00099-y

Neidermeier, A. N., Zagaria, C., Pampanoni, V., West, T. A. P., and Verburg, P. H. (2023). Mapping opportunities for the use of land management strategies to address fire risk in Europe. *J. Environ. Manag.* 346:118941. doi: 10.1016/j.jenvman.2023.118941

Quilez, R., Valbuena, L., Vendrell, K., Uytewaal, K., and Ramirez, J. (2020). Establishing propagation nodes as a basis for preventing large wildfires: the proposed methodology. *Front. For. Glob. Change* 3:548799. doi: 10.3389/ffgc.2020.548799

Robinson, C. (2022). Four elements of a healthy forest. Available online at:https://www.fws.gov/story/2022-10/four-elements-healthy-forest (accessed August 12, 2024).

Rodrigues, M., Zuniga-Anton, M., Alcasena, F., Gelabert, P., and Vega-Garcia, C. (2022). Integrating geospatial wildfire models to delineate landscape management zones and inform decision-making in Mediterranean areas. *Saf. Sci.* 147:105616. doi: 10.1016/j.ssci.2021.105616

Rusanen, K., Hujala, T., and Pykalainen, J. (2024). Research approaches to sustainable forest-based value creation: a literature review. *Forest Policy Econ.* 163:103222. doi: 10.1016/j.forpol.2024.103222

Santiago-Gomez, E., and Rodriguez-Rodriguez, C. (2023). Building forest fires resilience, the incorporation of local knowledge into disaster mitigation strategies. *Soc. Sci.* 12:420. doi: 10.3390/socsci12070420

Scott, J. H., Thompson, M. P., and Calkin, D. E. (2013). A wildfire risk assessment framework for land and resource management (no. RMRS-GTR-315). Ft. Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Skydan, O. V., Fedoniuk, T. P., Mozharovskii, O. S., Zhukov, O. V., Zymaroieva, A. A., Pazych, V. M., et al. (2022). Monitoring tree mortality in Ukrainian *Pinus sylvestris* L. forests using remote sensing data from earth observing satellites. *Ann. For. Res.* 65, 91–101. doi: 10.15287/afr.2022.2328

Tedja, B., Al Musadieq, M., Kusumawati, A., and Yulianto, E. (2024). Systematic literature review using PRISMA: exploring the influence of service quality and perceived value on satisfaction and intention to continue relationship. *Future Bus. J.* 10:39. doi: 10.1186/s43093-024-00326-4

Van Hensbergen, H., and Cedergren, J. (2020). Forest-related disasters: Three case studies and lessons for Management of Extreme Events. Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).

Wulandari, F., Budijanto, B., Bachri, S., and Utomo, D. H. (2023). The relationship between knowledge and disaster preparedness of undergraduates responding to forest fires. *J. Disaster Risk Stud.* 15:a1408. doi: 10.4102/jamba.v15i1.1408