Indonesian Journal Of Psychology ISSN 3163-2556

Vol.1, No. 2, September 2026

The Impact of Forest and Land Fire Smoke Exposure on Community Mental Health: A Literature Review

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(Received: June 26, 2026; Revised: August 21, 2026; Accepted: September 10, 2026)

Abstract

Forest and land fires (karhutla) produce smoke exposure, disrupt daily activities, and may affect community mental health. This article aims to examine the relationships among forest and land fires, smoke exposure, environmental change, and mental health, particularly in the Indonesian context. The study used a narrative literature review of 25 sources comprising empirical studies, scientific reviews, and contextual sources. The synthesis covers psychological stress, anxiety, symptoms of depression and post-traumatic stress, changes in social routines, the vulnerability of children and adolescents, and environmental loss (solastalgia). The findings are mixed. Some studies report psychological distress related to physical complaints and perceptions of hazardous pollution, whereas other studies found no increase in specific psychological symptoms during the observation period. Broader reviews identify depression, anxiety, and post-traumatic stress symptoms as frequently studied outcomes, especially among groups with direct exposure or evacuation experience. These findings cannot yet be generalised to all of Indonesian society. Local research is needed to measure psychological impacts directly while taking into account exposure intensity, social conditions, and psychosocial support.

Keywords: *forest and land fires; haze; mental health; psychological stress; solastalgia*

1. Introduction

Haze from forest and land fires is a public health problem that relates not only to physical disorders but also potentially affects the mental health and psychological well-being of communities. Although the effects of haze on respiratory health have been widely studied, evidence on its psychological effects remains relatively limited and not entirely consistent. The review by Eisenman and Galway (2022) shows that exposure to wildfire smoke may be associated with psychological distress and reduced emotional well-being, particularly in prolonged or recurrent smoke episodes. The impacts reported in the literature include worry, stress, anxiety, depressed mood, sleep disturbance, feelings of isolation, and uncertainty. However, these findings do not mean that everyone exposed to smoke will develop a mental disorder; responses may differ according to the intensity and duration of exposure, prior experiences, health conditions, individual resources, and social support (Eisenman & Galway, 2022).

These psychological impacts need to be understood in a context broader than exposure to pollutants alone. Restrictions on outdoor activities, fewer opportunities for social interaction, disruption of work and routines, physical complaints, perceptions of health risk, and unclear or changing air-quality information may be interacting pathways to psychological well-being. The conceptual model discussed by Eisenman and Galway (2022) places these mechanisms at the level of the individual, social and community networks, living and working conditions, and the ecological environment. In the Southeast Asian context, the systematic review by Ramakreshnan et al. (2018) also discusses the health impacts of haze, including psychological aspects.

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Nevertheless, the relative contribution of each mechanism and the direction of causal relationships cannot yet be established firmly because the available evidence remains limited and heterogeneous.

The environment is an important part of the context of human life and well-being. It provides space for activities, for building social relationships, for earning a livelihood, and for experiencing psychological restoration. When the environment is damaged or becomes a source of threat, the effects relate not only to physical change but may also affect the sense of safety, routines, perceptions of the future, and the individual's relationship with the place where he or she lives. In this context, forest and land fires (karhutla) need to be understood as both an ecological problem and a public health problem with a potential psychological dimension.

Forest and land fires can produce smoke that spreads beyond the fire site, degrades air quality, restricts outdoor activities, alters educational and work activities, and heightens concern about the health of oneself and one's family. For communities living near fire-affected areas, the experience may be accompanied by direct threat, damage to homes or livelihoods, and the possibility of evacuation. For communities that are not near the hotspots, smoke exposure and disruption of daily activities can still be a source of discomfort and uncertainty. The experience of karhutla is therefore not uniform: the intensity and form of its impact may differ according to location, duration of exposure, socioeconomic conditions, and individuals' direct experience.

In psychological research, it is important to distinguish between transient stress responses, emotional distress, symptoms of anxiety or depression, symptoms of post-traumatic stress, and mental disorders established through clinical assessment. Physical complaints caused by smoke do not in themselves prove the presence of a mental disorder. However, physical symptoms, the perception that the environment is hazardous, and uncertainty about when the situation will improve may interact with emotional responses. Ho et al. (2014), in a study of the 2013 South Asian haze crisis, reported mild psychological stress related to physical symptoms and respondents' perceptions of how dangerous the pollution level was. In contrast, a study of haze in Pekanbaru cited in the sources compiled found no increase in acute stress, anxiety, or PTSD during the observation period (Mulia et al., 2021b). This difference shows that psychological responses cannot be assumed to be uniform.

The broader literature on wildfire exposure also places depression, PTSD, and anxiety among the frequently studied outcomes. The review by Teigen et al. (2026) reported that the studies they examined frequently assessed depression, PTSD, and anxiety, and indicated that direct exposure, seeing fire or smoke, and evacuation were associated with worse mental health outcomes. The percentages in that review describe the proportion of studies that examined a particular outcome, not the prevalence of mental disorders in the population.

In addition to smoke exposure and direct threat, environmental damage may produce experiences of loss related to place, identity, livelihood, and a sense of connection with nature. The concept of solastalgia can help explain the distress a person experiences when a familiar and meaningful environment changes or is damaged, even though the individual continues to live in that place (Vela Sandquist et al., 2025). However, this concept should not be taken as evidence that everyone living in karhutla-affected areas experiences mental health problems. Such experiences need to be studied empirically and understood in context.

Based on this description, this article aims to synthesise the literature compiled on the relationships among karhutla, smoke exposure, environmental change, and mental health. Specifically, the review addresses (1) psychological stress related to smoke exposure; (2) depression, anxiety, and post-traumatic symptoms; (3) changes in mood and disruption of routines; (4) implications for children and adolescents; and (5) environmental loss, preparedness, and psychological recovery. The review also identifies the limitations of the evidence and the research needs relevant to Indonesia.

2. Method

This article used a narrative literature review approach. The approach was chosen to summarise and discuss findings from diverse types of sources related to karhutla, haze, environmental change, mental health, disasters, and psychological recovery. The manuscript was prepared on the basis of 25 sources compiled after duplicate sources were removed. The sources include empirical studies, systematic reviews or scoping reviews, scientific articles on environmental and health contexts, and a number of news items and educational materials.

Information from these sources was grouped thematically into five areas: (1) smoke exposure and psychological stress; (2) depression, anxiety, and post-traumatic stress symptoms; (3) mood changes and social activity; (4) children and adolescents; and (5) environmental loss, preparedness, and recovery. The synthesis was conducted by comparing the focus, type of evidence, and conclusions reported in each source, while maintaining the distinction between findings that measured mental health directly and sources that provided context only.

This review is not a systematic review and did not use a fully replicable selection protocol. Information on databases, search strategy, year range, keywords, and inclusion–exclusion criteria was not fully documented in the materials available. A formal risk-of-bias assessment was also not conducted. A number of reference entries still require checking against the original articles, bibliographic metadata, and publisher links. The results of this review should therefore be read as a preliminary narrative synthesis, not as a prevalence estimate or a causal conclusion. News items and educational materials were used as contextual sources and were not treated as equivalent to empirical studies.

3. Results and Discussion

3.1 Smoke Exposure and Psychological Stress

Exposure to karhutla smoke may occur as a repeated experience and is not always accompanied by a direct threat of fire. The smell of smoke, reduced air quality, irritation or physical complaints, restrictions on activities, and worry about the health of family members may become interrelated stressors. Under such circumstances, psychological responses may be influenced not only by measurable environmental conditions but also by individuals' appraisal of the threat, their ability to control the situation, and their access to information and support.

Ho et al. (2014) examined the impact of the 2013 South Asian haze crisis through an online survey of 298 respondents. The study reported mild psychological stress on the measures used, but did not find levels that met the threshold for acute stress reaction syndrome. Stress was related to the number of physical symptoms experienced and to the perception that pollution was at a hazardous level. This finding suggests that risk

perception and the experience of physical symptoms may be part of the psychological response to haze. However, the survey design and population context need to be considered before the results are applied to Indonesian communities.

Meanwhile, the study of haze in Pekanbaru in 2019 cited in the review sources found no increase in acute stress, anxiety, or PTSD during the period studied, even though poor air quality was associated with physical health problems (Mulia et al., 2021b). These differing results should not be viewed as an absolute contradiction. Differences in population, duration and intensity of exposure, timing of measurement, social conditions, instruments, and the definition of outcomes may produce unequal findings. A null finding in one study also does not prove that psychological impacts cannot occur in other groups or in different periods.

The main implication is that the level of air pollution cannot be used as a substitute for measuring mental health. Future research needs to measure environmental exposure and psychological conditions separately, and to consider variables such as health worries, physical complaints, sleep disturbance, activity restrictions, and perceived ability to cope with the situation.

3.2 Depression, Anxiety, and Post-Traumatic Stress Symptoms

Depression, anxiety, and PTSD are outcomes that are widely studied in the mental health literature after fire exposure. The quantitative review of wildfire exposure by Teigen et al. (2026) reported that depression, PTSD, and anxiety are among the most frequently studied outcomes. In that review, direct exposure to fire, seeing fire or smoke, and evacuation were reported to be associated with worse mental health outcomes. This finding shows the importance of distinguishing between indirect exposure in the form of haze and experiences involving direct threat, loss, or displacement.

Even so, results from reviews across regions and types of fires cannot be directly assumed to represent the prevalence or pattern of mental disorders in Indonesia. Karhutla in Indonesia has its own ecological and social context, including peatland fires, transboundary smoke exposure, impacts on livelihoods, and disruption of community activities. Evidence from broader reviews of mental disorders after disasters can provide a general framework (Keya et al., 2023), while the review of climate-related extreme weather events helps show the diversity of mental health outcomes and measurement instruments (Thomson et al., 2026). However, these sources do not all focus on karhutla, so their relevance needs to be stated proportionately.

Conceptually, anxiety symptoms may relate to a persistent perception of threat; depressive symptoms may arise in the context of loss, fatigue, or disruption of daily functioning; and post-traumatic symptoms are more relevant to study in individuals who experience or witness traumatic events. This description is an interpretive framework, not evidence that these mechanisms have been demonstrated in all karhutla-affected populations. Research needs to use appropriate instruments, state the measurement period, and distinguish screening results from clinical diagnoses.

3.3 Mood Changes and Disruption of Social Routines

Psychological impacts are not seen only in clinical symptoms. Changes in mood, irritation, worry, frustration, and reduced opportunities to carry out daily activities may also be part of people's experience during haze. The study “Transboundary Vegetation Fire Smoke and Expressed Sentiment: Evidence from Twitter” (Du et al., 2024) used social media data to examine sentiment expressed during transboundary vegetation fire smoke exposure in Southeast Asia. A summary published by MIT reported stronger changes in sentiment when the

smoke originated from another country (Dizikes, 2024). Because the information available in the initial materials consisted mainly of summaries, details of the methods, effect sizes, and publication metadata need to be verified in the original journal article.

Social media data may be an additional indicator of public response, but they cannot replace representative surveys or psychological assessment. Social media users do not represent all age groups, social classes, or regions; in addition, posts are influenced by internet access, platform usage patterns, and other events occurring at the same time. Sentiment analysis is therefore better understood as one source of information about public expression, not as a direct measure of the prevalence of mental disorders.

Haze can also change family, school, work, recreational, and social routines. News about the extension of distance learning during haze, for example, describes disruption to learning activities and caregiving (Stiaji, 2026). Such disruption may add to families' practical burden, but news reports are not sufficient to conclude that changes in routine directly cause psychological disorders. Further research needs to measure functional impact, caregiving burden, access to safe spaces, and the quality of social support directly.

3.4 Children and Adolescents as a Group Requiring Attention

Children and adolescents need attention in the mental health response to karhutla because their learning, play, mobility, and social interaction may be disrupted when air quality deteriorates or schools change their activities. The impact depends not only on environmental exposure but also on adults' responses, the stability of family routines, the ability to understand risk information, and access to support. However, children and adolescents should not be treated as a group that automatically experiences psychological disorders; their responses need to be assessed according to each individual's experiences and needs.

The news sources compiled discuss the possible impacts of fires on children's health and academic functioning (Nuruliar, 2026). Such sources can provide context, but claims about PTSD, depression, or declining achievement must be traced to the primary studies cited. An article on handling psychological disorders in child earthquake survivors provides a general picture of psychosocial support, safe spaces, play, drawing, and structured activities (Yusnaini & Uzakia, 2022). Because the context of that source is earthquakes, not karhutla, its recommendations can be used only as a general reference that must be adapted, not as direct evidence of the effectiveness of interventions for children affected by smoke.

In practice, support for children may include providing age-appropriate information, maintaining routines where possible, giving children room to ask questions and express their feelings, and identifying persistent changes in functioning. Psychosocial support does not replace professional evaluation when a child shows severe or persistent symptoms or symptoms that interfere with daily activities. The effectiveness of particular approaches in the karhutla context still needs to be tested through appropriately designed research.

3.5 Environmental Damage, Connection with Nature, and Solastalgia

Humans' relationship with nature is an important dimension in understanding the psychological impacts of environmental change. Forests and vegetation may have ecological, social, cultural, economic, and personal value. For some communities, the environment is not merely a physical backdrop but part of livelihood, community identity, memory, and a sense of belonging. When fire damages a meaningful environment, individuals may experience worry, sadness, or a sense of loss. The concept of solastalgia is used in the literature to describe distress related to environmental change that damages a place regarded as home or

familiar to the individual (Vela Sandquist et al., 2025). Even so, this concept must be used carefully and not treated as a clinical diagnosis.

The literature on biogenic volatile organic compounds from forests discusses possible links between compounds released by vegetation and several aspects of human health (Antonelli et al., 2020). Research on how wildfire smoke alters volatile organic compound emissions and photosynthesis in ponderosa pine provides evidence of physiological and emission changes in vegetation in the context of fire (Riches et al., 2024). However, these sources do not prove that changes in the compounds released by trees directly cause changes in the mental health of Indonesian communities. The relationships among vegetation damage, changes in environmental exposure, experiences of loss, and mental health require separate research.

Discussion of natural conditions and mental health should therefore not emphasise only the possible benefits of exposure to nature, but also the psychological consequences when the environment is damaged or access to meaningful natural spaces is disrupted. For the karhutla context, the pathways that need to be studied include loss of livelihood, disruption of place attachment, perceptions of the future of the environment, and changes in social activity. These pathways are hypotheses relevant to research, not causal conclusions established by the available sources.

3.6 Preparedness, Psychosocial Support, and Recovery

Preparedness can help communities understand risks, plan protective actions, and increase confidence in responding to emergencies. A source on improving self-efficacy and preparedness for the threat of forest and land fires discusses outreach, discussion, and simulation as efforts to increase community readiness (Iswadi et al., 2025). A source on disaster preparedness and mental recovery likewise emphasises the importance of readiness and support after disasters (T.W. et al., 2026). Although relevant to programme planning, increased self-efficacy or preparedness does not automatically indicate a reduction in stress, depression, anxiety, or PTSD.

Mental health support in the karhutla context needs to be integrated with risk communication, health services, social support, and the restoration of everyday life. Consistent and trustworthy information can help reduce uncertainty, while psychosocial support can help individuals recognise their needs and access help. Programmes need to be designed proportionately: not everyone needs a clinical intervention, but communities should have access to information, early support, and referral when needed.

Programme evaluation should not merely count participants or levels of knowledge. Relevant indicators may include changes in risk perception, self-efficacy, access to support, daily functioning, and psychological symptoms measured with validated instruments. Measurement before and after the programme, comparison groups where possible, and follow-up will help determine whether a programme truly provides benefit. In both research and services, privacy, consent, participant safety, and referral procedures need to be part of the design.

4. Implications for Psychological Research in Indonesia

First, field studies are needed that specifically measure the mental health of karhutla-affected communities in Indonesia. Research should not draw data only from areas that experienced fire directly but should also consider communities affected by transboundary haze. Exposure needs to be characterised through clear

indicators, such as duration, air quality level where available, distance from the fire location, activity disruption, evacuation experience, and loss of livelihood.

Second, longitudinal designs would help explain changes in psychological conditions from the exposure phase through the acute phase to recovery. Cross-sectional studies can describe associations at one point in time but have limitations in determining temporal order and cause–effect relationships. Research also needs to consider confounding factors, including pre-event health conditions, history of psychological problems, socioeconomic status, social support, and prior disaster experience.

Third, instruments must be chosen according to the research objectives and the linguistic and cultural context. Measurements of stress, anxiety, depression, post-traumatic symptoms, well-being, and solastalgia are not interchangeable. Screening scores indicate the need for further examination and do not in themselves establish a clinical diagnosis. Researchers need to report instrument validity, sample characteristics, reference periods, and the limits of interpretation.

Fourth, groups with special needs—including children and adolescents, older adults, individuals with pre-existing health conditions, exposed workers, and families who have lost their livelihoods—need to be included without assuming that all members of these groups experience the same impact. A qualitative approach can complement quantitative data by exploring the meaning of the environment, experiences of uncertainty, coping strategies, and the forms of support that communities find helpful.

Fifth, research and policy need to link the psychological perspective with environmental health, disaster management, education, and social welfare. An interdisciplinary framework enables researchers to distinguish the influence of physical exposure, social disruption, economic loss, and changes in the relationship with the environment. Such collaboration is important so that the response to karhutla focuses not only on fire control and physical impacts but also attends to the psychosocial needs of communities.

5. Limitations of the Review

This review has several limitations. First, the review used a narrative approach and did not apply a fully documented systematic review protocol. It therefore cannot ensure that all relevant studies were identified. Second, the sources compiled vary in quality and purpose: some are empirical studies or scientific reviews, whereas others are news items and educational materials. Such contextual sources cannot be used as direct evidence of prevalence or causal relationships.

Third, a number of references do not yet have complete bibliographic metadata or have not been verified against the original publication. Details of findings that derive from secondary summaries therefore need to be rechecked. Fourth, international evidence on wildfires cannot always be generalised to the Indonesian karhutla context. Differences in ecology, exposure patterns, population characteristics, infrastructure, and support systems may affect the results. Fifth, this review did not conduct a meta-analysis and did not produce a pooled estimate of the prevalence of mental disorders. The conclusions should be read as a preliminary narrative synthesis and as a basis for formulating a research agenda.

6. Conclusion

Exposure to forest and land fire (karhutla) smoke is potentially related to community mental health through various pathways, including physical complaints caused by smoke exposure, perceptions of health threat,

disruption of daily activities, experiences of evacuation or loss, and environmental changes that affect the lives of individuals and communities. On the basis of the literature reviewed, the reported psychological impacts vary. A study of the South Asian haze crisis showed mild psychological stress related to physical symptoms and perceptions of pollution hazard, whereas a study in Pekanbaru found no increase in acute stress, anxiety, or post-traumatic stress disorder (PTSD) symptoms during the observation period. Meanwhile, broader reviews of wildfires identify depression, anxiety, and PTSD as widely studied mental health outcomes, especially in the context of direct fire exposure and evacuation experience.

These findings show that the relationship between karhutla smoke exposure and mental health is complex and cannot be generalised uniformly to all affected communities. The available evidence is also not yet adequate to establish the magnitude of the impact of smoke exposure on the mental health of Indonesian communities. Further research is therefore needed to examine the relationship between the level and duration of smoke exposure and communities' psychological conditions, to distinguish emotional distress from clinically diagnosed mental disorders, and to identify the roles of individual, social, and environmental factors. In addition, the psychological impacts of disrupted daily activities, loss of a sense of safety, and changes in connection with the living environment need attention in future research.

Karhutla smoke exposure should therefore be considered an environmental factor potentially related to community mental health, although this relationship cannot be assumed to be causal without adequate empirical evidence. This review underscores the importance of including mental health in karhutla management and recovery efforts through monitoring of psychological conditions, appropriate risk communication, strengthened social support, and the provision of psychosocial services according to community needs. Such efforts need to be accompanied by further research to strengthen the evidence on the form, magnitude, and influencing factors of the impact of karhutla smoke exposure on community mental health, particularly in Indonesia.

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