Disaster history as a reflection of human–environment relations: An ecological approach to disaster studies in Indonesia

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Abstract. This study assesses disaster history in Indonesia through the lens of human-nature relations, as understood within the framework of cultural ecology. This research examines how cultural relationships with nature reshape disaster history over time and what emerges as a more eco-conscious perspective on disaster history. This is a comprehensive, qualitative, library-based research assessment of historical, ethnographic, and ecological observations to validate regionally specific narratives of disaster history across the geographically disparate islands. Findings reveal that diverse and intricate populations possess traditional environmental knowledge that positions them in phases of disaster history, requiring either adaptive or ethically motivated responses. For instance, *Smong* in Simeulue, *Subak* in Bali, and *Sedekah Bumi* in Java revere nature to harmonious, spiritual, or ecological ethical ends, cultivating sustainable community resilience over integrative pattern of history. However, findings suggest that these patterns fluctuate in more developed settings with modernization. By contrast, they occur at an alarming rate as populations distance themselves from an ecocentric worldview to a more anthropocentric appreciation, precipitating the swift destruction of ecosystems and anthropogenic disasters. Ultimately, the findings suggest that without local, educated know-how coupled with scientifically substantiated best practices, sustainable, eco-conscious, and culturally relevant approaches to disaster prevention do not exist. To appreciate disaster history, people must respect the shared mutual benefit history with the environment.

1 Introduction

Indonesia is one of the countries with the highest levels of disasters worldwide. Hectically, the Indonesian archipelago lies between the three major tectonic plates of the world: the Indo-Australian, Eurasian, and Pacific plates, making it vulnerable to earthquakes, volcanic eruptions, tsunamis, floods, and landslides. Thus, the region's geology puts it in a precarious situation; however, it creates a dichotomy - a country filled with natural wealth, but one that is inevitably susceptible to recurring natural disasters. Moreover, upon examining the history of disasters in Indonesia, it's not merely a natural story of the archipelago, but also a socio-political and socio-cultural response of the people in the region to changes in their environment.

It's common to study disasters from geological, technical, and mitigation perspectives. However, historical and cultural approaches to disasters are made more rarely. Yet, over the long history of the nation, which boasts a diverse population, the history of catastrophe becomes a form of collective consciousness in shaping identity [1]. The folklore, royal chronicles, and colonial archives contain notes of discoveries made by people related to disasters and observations about phenomena linked to disasters. Therefore, it can be said that the history of catastrophe is not merely a qualitative analysis of anthropological development over time, but an analysis of how phenomena compel people to exist in a new way in relation to nature.

According to Geertz's approach to cultural ecology, humans' approach to nature is not merely to push nature into a field of physical advancement; nature also breathes and interacts with humans [2]. Therefore, a natural disaster is not simply a disaster that devastates; it's a phenomenon that is a social event with meaning. It becomes a communicative space between man and nature; through an ecological communicative perspective, moral, spiritual, and environmental qualifiers are established and rendered as an indication of what works in the balance of life.

From ancient times to the present, the peoples of the archipelago have employed traditional ecological knowledge systems that enable them to interpret and respond meaningfully to disasters when they occur. For example, when a natural disaster occurs within Javanese culture, it is articulated as "*lelayu bumi*", a discourse of movement awakening from nature to man as a sense of purification attempt when moral balances are out of whack. In Simeulue, the tsunami tale has been ingrained in the *Smong* oral tradition and then taught through religious contexts; this means they must be careful with

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their exploitation of the sea. Therefore, this type of local knowledge relates to how people perceive phenomena that they feel are important to their societal value systems.

Yet, as modernity emerged, it altered the relationship humans had with nature. Industrial revolutions, urbanization, and economic expansion have created a demand on nature at a rate faster than what can be naturally sustained. Thus, many disasters that occur are less a result of naturally occurring forces beyond the scope of what anyone can control and more a consequence of human actions that overstepped what could be done in accordance with dynamic sustainability, leading to deforestation, pollution, land-use change, and unsustainable development. Thus, the systems that once existed, in which humans respected and maintained equilibrium with nature, became systems that facilitated human domination.

Modernity has also changed how humans come to know about disasters. The tales and stories that once populated public consciousness have slowly been debunked by science and technology. Nations seek disaster management agencies, early warning systems, and data-technology-oriented mitigation efforts. While these systems are critical for success, they often undermine the social and cultural approaches that could situate embedded resiliency for local populations.

Thus, history teaches us that there are many valuable lessons to be learned from how people rise to the challenge and adapt in the wake of a natural disaster. There is always a trail of knowledge, solidarity, and social innovation found in the wake of any natural disaster. For example, in Bali, the *Subak* system is more than an agricultural irrigation system; it's a water disaster mitigation system based on the *Tri Hita Karana* philosophy, which articulates balance between man, nature, and God. In Maluku, a tradition known as *Sasi Laut exists,* which helps coastal ecosystems remain sustainable, thereby preventing societies from facing ecological disasters due to excessive exploitation of natural resources. This suggests that disaster narratives often have a cultural connection that is rich in environmental value.

To read between the lines of history through disasters from an ecological perspective means to reinterpret what it means to be in a relationship with nature as two entities that influence each other. People are not just victims; they are actors who ultimately determine whether a balance exists or not by exerting too great a force on interconnected ecosystems. Natural disasters can be interpreted as nature "speaking" when humans exert too much or too little agency; people disrupt the balance when the tipping point is reached, and downpours, landslides, and wildfires ensue.

The goal of this study is to chart the history of disasters in Indonesia as representative of man-nature relationship through a cultural ecology perspective through historical analysis and traditional narratives attempting to make meaning based upon collectives that could transform how people think about nature from an alternative approach that modernity has cut off in an attempt to separate people from their environments when, in fact, the archipelago tradition supports an integrated approach.

Based upon this background, this paper will explore two findings of the history of disasters in Indonesia relative to an ecological perspective: first, how the narrative history is a component of traditional environmental knowledge; second, how this information reflects a change over time relative to humankind and nature based upon modernity and ecological change. Therefore, with this perspective taken into consideration, it is hoped that positive findings will emerge, which will bolster the assertion that the historical narrative of disasters is more than just an overwhelming historical experience, but one filled with ecological sense, social solidarity, and a human collective consciousness toward life on this fragile earth.

2 Methodology

This research employs a qualitative approach as its primary source of analysis, with the research undertaken based on a literature review. The reason behind this approach is that research doesn't seek to measure things quantitatively. Instead, it assesses meaning, particularly concerning the human-nature relationship, as discerned from various disaster narratives explored across parts of the Indonesian archipelago over time. Literature research suggests that researchers can identify multiple primary and secondary written sources relevant to the topic of interest, specifically disaster and ecological relationships. Such sources can be found in history books, scientific journal articles, colonial collections, traditional manuscripts, and ethnographic inventories containing disaster narratives from across the archipelago.

Within the context of this research, the approach applied is the cultural ecology approach, which posits that humans and nature are two distinct entities that interact to form a single life system [3]. Therefore, the researchers do not engage with each disaster narrative as geological/physical phenomena, but instead as social texts derived from the cultural values, symbols, and meanings of the environment, considering how and in what ways they occur, are observed, and how their meanings become manifest through inter-societal dynamics over time. Thus, researchers assume that meaning can or cannot be rendered regarding what people's perceptions of disasters mean socially, spiritually, and ecologically, which can either develop or change over time, particularly when modernity comes into play, shifting previously held notions as they evolve over time.

The means of data analysis for this research are interpretive and descriptive. Therefore, researchers read all the prior existing disaster narrative sources, select what's available, categorize potential significance therein, and then interpret through thematic developments derived from the application of the analysis whereby themes emerge based on relevance - such as perceptions about nature, perceptions about ecological traditional knowledge systems, and how human-nature relationships manifested or did not as a result of modernity. Therefore, research is not undertaken merely to document disaster developments, but to assess the significance of the meaning structures associated with it [4]. The outcome of

such interpretive processes is subsequently derived through thematic developments into findings that convey a more interdisciplinary historical, cultural, and ecological understanding of the experiences of the Indonesian populace in relation to disasters as they unfold over time.

The goal is not to establish a general law about disasters; instead, the goal is to assess a socially and culturally significant reality about what it means to endure the natural world. Extensive literature research aims to expand the existing knowledge about disaster realities in Indonesia over time, through an interdisciplinary lens that considers human interest and development in relation to and in opposition to nature. This research also provides a theoretical contribution to the cultural ecology approach and disaster historiography in Indonesia.

3 Result and discussion

3.1 The historical narrative of disasters as traditional ecological knowledge

The narrative history of disasters, therefore, is bound to the geographical and cultural context that becomes the basis through which people understand nature [5]. From antiquity, the people of the archipelago have existed in symbiosis with active volcanoes, a source of large rivers and vast oceans that exacerbate disaster possibilities [6]. Such geographical constructions necessitate a form of knowledge, belief system, and explanation for navigating the human-nature interface [7]. This means that the historical narrative of disasters is not only recorded in oral history, ancient manuscripts, and stories that surround events, but also becomes a form of ecological knowledge that can be learned about and passed down across generations.

For instance, in many parts of Indonesia, disasters are often regarded as spiritually significant phenomena. Nature is anthropomorphized with sentience, will, and moral power. Therefore, when an earthquake occurs, a volcano erupts, or a severe flood overflows, it's understood to be a natural response to human imbalance [8]. These understandings are based on a highly ecologically aware traditional society, as they recognize that their actions can have a significant impact on the balance of nature, both socially and morally. Thus, in a culture that relies on practicality, the morality of one's actions manifests as the signifier of how nature responds [9].

The most important moral to take away from the tale of disaster history is the knowledge derived from the tale constructed around the 1815 eruption of Mount Tambora on Sumbawa. The Tambora volcano is one of the most extensive eruptions in world history, causing climate changes that spanned the globe. But on a more regional note, people come to learn such geological phenomena less as a geological byproduct and more as a natural "wrath" that results from human excess and warfare. This illustrates how the disaster narrative becomes so closely connected to morality and environmental ethics that it forges a link between the meaning acquired from multidisciplinary elements associated with this information and what constitutes part of the local society's Traditional Ecological Knowledge (TEK) [10].

Another narrative originates from the oral tradition of the Minangkabau people, where mountain eruptions or large floods are believed to occur because humans disrespect customs and upset the natural balance [11]. In the old tambo-tambo, disasters articulate what must happen so that humans turn back to those values that continue to preserve life and care for it. Thus, disasters become not only calamitous events but also moral quandaries, providing a vehicle for social learning to restore balance with nature.

Similarly, the cosmological perspective of Javanese life creates one's positionality with nature when one recognizes how humans interact on a king-to-peasant level or male-to-God frame [12]. When earthquakes occur or Merapi spews ash, or drought persists for too long, it suggests that the relationship between king and peasant, or man and God, is out of balance. Yet this is not to say that kings and peasants or men and women do not have power; it's a moral observation framed around "harmony" and "peace" [13]. These are the means by which a stabilized existence can be sustained in the natural world. Therefore, the disaster narrative is not only a moral cautionary tale but also a necessary means of socio-natural disruption stabilization.

Beyond Java and Sumatra, an ecological system exists within the socio-cultural ecology of the Bali Region. *Tri Hita Karana* emphasizes the need for harmonious relationships among humans, between humans and nature, and between humans and God. For example, one established connection is through water, where *Subak* serves as an intermediary for agricultural-based waters (astronomical) but also a means of drought and flood prevention through harmonious travel across the natural landscape. These narrative rituals manifest as literal embodiments of lived Traditional Ecological Knowledge.

Similarly, in coastal regions like Aceh, a narrative tradition exists to transmit awareness of certain significant tsunami events that become part of their socio-ecological legacy. One noted tale is that of *Smong* in Simeulue Island. The story goes that "*smong*" (big waves) is something that children should learn from a young age, even in simplistic vernacular. Therefore, when Aceh was submerged by the tsunami in 2004, many on Simeulue escaped with their lives because they knew how to interpret the natural signs that emerged from their tale. This illustrates how narrative tradition can serve as a vehicle for effective disaster mitigation, drawing on local knowledge.

This local knowledge is what Berkes refers to as Traditional Ecological Knowledge (TEK), where traditional societies are the primary producers of ecological knowledge from this long-standing field engagement [14]. TEK not only concerns the technical components of the natural world, but also the spiritual values of nature, as well as ethical considerations and social regulations, which make human-nature dynamics all the more complicated. In the case of Indonesia's disaster narrative, this serves as an effective vehicle for TEK dissemination because TEKs are often

mythologized, folktale-like, or religiously integrated narratives that can be easily memorized and passed down through generations.

For many villages across the archipelago where traditional living patterns emerge without much initiative from technological advancement, disasters are not seen as isolated incidents extricated from daily life. Instead, as nature emerges sentient in and of itself, with its own language, when mountains erupt or rivers overflow, practical measures are taken beyond immediate survival solutions. Yet, rituals are executed to plead for balance and restore it via *Sedekah Bumi*, *Merti Desa,* or *Kenduri Laut*. Thus, a spiritual relationship emerges through practice, where humans become aware of their limitations in capability and respect nature's will more than they would in human-to-nature transactions in their daily lives.

Furthermore, the disaster narrative has an undeniable social dimension in the formation of human collective identity. When people go through disasters together, their bonds are reinforced through solidarity. For example, in the Mt. Merapi region, where Merapi is located, there are social constructions that address the specific phenomenon of a figure arising that bonds humankind and the natural world. This figure serves as a spiritual mediator and, essentially, a life-saving designator for meaning from nature's given information. Thus, the phenomenon is socially played out, with lived and learned experience cultivated from a great deal of community resilience efforts.

Where, however, the "unscientific" development of colonialism came into play to promote the exclusion of local knowledge, it fell prey to this. For instance, when Dutch emissaries report on disaster situations documenting the 1883 Krakatau eruption disaster in Indonesia, little is taken from retrospective observations of what local communities saw or did with it - socioeconomic interpretations made possible via science dominate the established canonization of what's happening in this area. Yet in this case, a modern-day contrast doesn't overshadow it, as Krakatau is "a mountain that scolds the people." This illustrates a drastic shift in interpretive response: one operates under a modern informational hegemony, while the other operates under an ecological, symbiotic reality.

Such narratives function as a treasure trove of TEK from an anthropological standpoint; when people observe these movements happening over time in their communities, and disasters occur more frequently, they relate to natural movements and facilitate phenomenological realities that have predictive ability, learned from memory. Therefore, in Nias, the narrative that gets told creates a predictability that cultural stipulations about homes by rivers or the ocean emerge due to disproportionate flooding; the Bugis tell stories relative to ocean storms that create narratives about interactive imbalance when too much fishing is done versus reverence for the gods who lead them both to and from the water and their endeavors - cultural early warning systems emerge relative to narratives surrounding disasters.

Disasters emerge based on TEK, which is documented in elements of stories learned best by children through fairy tales or songs, or community gatherings/rituals that bestow such narratives upon them. Indigenous populations weave these narratives into the holistic social curriculum for children, fostering ecological sensibility. The kids learn how to read natural indicators; they respect what's at stake in terms of resources; they understand what happens based on imbalance, and thus the narrative surrounding disasters also serves as a generator of equity value systems for ecological inheritance purposes, generation after generation.

Yet since globalization, many of these localized systems have been marginalized. The move toward modernization, urbanization efforts, and standardized homogenization of education systems transforms traditional disaster narratives into a marginalized realm, where technocratic response knowledge emerges at the substitutionary cost of localized wisdom, which has proven invaluable over time to ecological resilience efforts. Thus, too often when such narratives fall by the wayside, it's tragically ironic - it's tragically ironic for culture, but also for social mechanisms that once grasped the systems holistically for intergenerational socio-ecological well-being, to be more naturally facilitated than attempts to the contrary would ever recommend, merely establishing status-quo levels.

Therefore, the historical narrative relative to disasters relative to the Indonesian region can function as traditional ecological knowledge that acts as an end-point which connects spiritual belief systems, practical responsiveness and moral developments into one domain that teaches survivors of hazardous threat situations how to respond but implements naturally occurring yet ethically devalued value systems so humanity learns how to live responsibly with nature with such narratives retold to find associated value systems from localized wisdoms that inevitably represent a more humane, sustainable effort for disaster mitigation systems today.

3.2 The human-nature relationship in modernity and disasters

As Indonesia advances toward modernity, its relationship between humans and nature undergoes a shift. Modernity, as a new paradigm, operates under the assumption that humans are at the center of every life aspect and that nature is a supplementary tool for socioeconomic growth and progress. Such anthropocentric tendencies override a previously established ecocentric perception where humans are merely a part of the larger ecosystem. Therefore, where a mystical relationship developed over generations is considered exploitative and utilitarian, it stands to reason that the natural consequence of such a new shift is the occurrence of more anthropogenic disasters. Flooding is prevalent in many cities, landslides are common in hilly regions, and forest fires are more frequent in Kalimantan and Sumatra due to human activities than natural occurrences. Deforestation and mass land-clearing acquisitions, driven by the expansion of palm oil estates and rapid infrastructure development for roads and buildings, indicate an unsustainable socioeconomic growth approach that undermines

ecosystems from within. Expansion and modernization without eco-awareness compels a faster trajectory for disaster potential than nature could do on its own

Thus, modern disasters can't be divorced from their socio-political and economic contexts. They are the product of inequities in power or resource distribution, where the poorest citizens are most susceptible to disasters due to either living in areas of risk or lacking sufficient socioeconomic security to survive [15]. Therefore, modern natural disasters are social disasters.

Modernity creates a "development paradox"; on the one hand, it seeks to bring progress, but on the other hand, it undermines the growing ecological foundation on which all existence relies. In this sense, the way disasters complicate matters in an Indonesian context is a result of a socioeconomic developmental philosophy that prioritizes rapid growth over the sustainability of life-supporting resources through ecosystems. They complicate things further because they exist in a single disaster housing ecology, encompassing society, politics, and economics, making life even more complicated.

The second way in which the human-nature relationship shifts in response to disasters is how they are viewed differently. In a previously established traditional system, disasters are natural alerts. In a modern framework, technical issues can be resolved through technological advancements or legal means. The government has established a disaster mitigation department, early warning systems, and construction embankment technology - that's wonderful - but often at the expense of cultural interjections and historical understandings that could foster social resilience better.

For example, one of the most discussed yearly occurrences in Jakarta is flooding. For the government, flooding is an issue of drainage/spatial mapping; for communities, flooding is an issue of how well or poorly humans have treated nature over the last century. The loss of water catchment, degradation of river quality, riverbank erosion, and littering all point to an awareness of socio-economic inequity in light of urban development and modernization. The Jakarta flood is not a natural concern, but a human concern related to the ecological crisis.

This human-nature relationship is inequitable. Furthermore, this inequity is compounded by industrialization and economic globalization. Estates, mines, and plantations are established without consultation with indigenous peoples or consideration of local ecological values. In other words, burning the forest for land acquisition is often done without an environmental assessment, which can have severe consequences for people elsewhere, as smoke from the fires crosses borders and health crises emerge. From a cultural ecological perspective, this suggests a gap in communication between humans and nature - an ecological determination is made due purely to an economic determination.

Where this human-nature relationship gets tangled, however, is with global climate change. Shifts in temperature, rainfall, and water levels impact ecosystems with more vulnerability than just the islands of Indonesia. However, a grand-scale approach makes it a national concept, encompassing national gatherings and policy, rather than focusing on localized endeavors. In fact, disaster stories that are historically more relevant to lessons learned for adaptation endorse mitigation efforts for participation.

Yet there are times when the connection has been made between the two realms, and human-nature relationships have been adjusted. For example, *Smong* has been integrated into the elementary school curriculum in Simeulue as a part of disaster education. This suggests that personal stories can coexist with scientifically evaluated possibilities for future natural developments within a culturally relative framework. This is a new kind of relationship that promotes both realms without giving preferential treatment to one over the other.

Furthermore, top-down, community-based efforts have emerged across Indonesia, suggesting a newfound appreciation for the ecological importance on both spiritual/natural levels. *'Jaga Leuweung'* in West Java and 'Preserving Rivers' in Sulawesi advocate for forests/water over industrial efforts, which have been shown to reduce human emotional/spiritual value over nature. These initiatives suggest a development where modernization does not trump current traditions, but floats alongside them.

Finally, modern-day ecological crises stem from humans separating themselves from nature as "the other." Nature becomes an object of study through modern systems of knowledge; humans become subjects who wield power over it. Therefore, an epistemological difference fosters a gap where humans fail to remember ecological empathy - what could have been a fair relationship grounded in dialogue becomes a monological value, where what nature said, if anything, fell on deaf ears. This is what gives birth to an environmental crisis.

But not every component of modernity creates a negative relationship with humans and nature. Technology/science can render a positive relationship with nature as long as ecological ethics are involved, which comparison is shown in Table 1. For example, disaster mitigation technology, such as tsunami early warning systems, has saved countless lives since efforts have been made to implement them within Indonesia. However, the challenge lies not only in their scientifically established solutions but also in participatory ones, so that they're not only mechanistic but also humanistic.

Table 1. Comparison of ecocentric vs anthropocentric paradigm

Aspects	Ecocentric (Traditional)	Anthropocentric (Modern)
Views of Nature	Nature = living and spiritual entities	Nature = economic resources
Disaster response	Spiritual, ethical, communal	Technical, legal, technological
Knowledge system	Local wisdom & oral tradition	Modern science & formal policy
Moral values	Alignment, balance	Exploitation, efficiency
Long-term impact	Socio-ecological resilience	Environmental and social crises

Environmental learning becomes essential for restoring any fractured human-nature relationship during modernization efforts. Not only must ecologically motivated learning seek to promote the scientific elements involved with disasters, but it must also revive local narratives that bear significance. Hence, future generations learn how humans and nature must collaborate instead of working against each other, with nature never being rendered the enemy, but rather viewed as a partner that needs constant attention to maintain equilibrium, based on historical disasters from which this contextual learning can spring.

Thus, what this disaster history conveys to modern man is that there are messages within these disasters of limitation and an ethical sense of responsibility; disasters are unfortunate occurrences of material practicality, but also a moral reminder to reinstate the interconnectedness of nature. This is what many indigenous peoples still experience today, as nature becomes the guiding force that teaches people lessons through manifestations; thus, such an ideology must be revitalized and exist in modern times so that people never forget the natural inclination amidst modernization.

Fig 1. The cycle of human–nature relations in disaster history

Ultimately, the significance of disaster history for the human-nature relationship hinges on the uncertain perspective of how we all coexist in this world (Fig. 1). If modern human identity during modernization is seen through the dominion over others' exploitative self-interest, then the ecological future for humanity looks grim; if, however, this patterned method of modernity can be reconstructed through respect for local wisdom development connected with a more spiritual/oriented ethical engagement, then the human-nature relationship can be sprung back into balance. Therefore, disaster history shows us what's at stake not only with post-disaster events but also how we justify future decisions, all based on what's presumed to be ethical for all life development connected to life sustainability, based on what's truly valued beyond techno-centered, exploitative efforts.

4 Conclusion

The study concludes that disasters are no longer merely natural phenomena in the history of Indonesia, but rather a reflection of the complex socio-natural relations between humans and their environment. From a cultural ecological standpoint, the conventional disaster, the ships of environmental knowledge, is a success of a socio-natural relationship and, therefore, an ultimately convincing act of good citizenship. From *Smong* in Simeulue and *Subak* in Bali to *Sedekah Bumi* in Java, the attempts made from Sabang to Merauke come from an increasingly common worldview that treats nature as a living, breathing entity that deserves respect. The wisdom stems from traditional ecological knowledge, which understands how to maintain the best value system that, for centuries, has formed the foundation of socio-cultural and spiritual systems throughout the archipelago, equipping small communities to prepare for the threat of disasters.

Yet with the intervention of modernity and industrialization, such a socio-natural relationship has been complicated. With a human-centric paradigm that prioritizes humans over nature, exploitation of resources emerges without regard for ecological balance. Therefore, in the modern era, natural occurrences emerge as moral, social, and environmental disasters. The contemporary approach suggests that disasters are no longer a warning from nature about human undoing, but instead a technical problem that requires political and technological solutions.

However, a lesson learned through the history of disasters suggests that civilization will not achieve better treatment without understanding how best to survive in harmony with nature. Therefore, ecological sensitivity derived from local cultural values must be restored to become the basis of modern environmental ethics. The socio-natural relationship is not one of subjugation but one of collaboration. Nature is more than an economic supplier of revenue; it is a home with natural and spiritual realities. Thus, once removed from its natural place in a developed ecological balance, the historical perspective on disasters can serve as a cautionary tale for civilizations searching for survival within a global environmental system.

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