

Empowerment of Future Frontline Indonesian Weather and Climate Information

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Abstract

Climate change increases the frequency and intensity of hydrometeorological disasters in Indonesia. However, community climate literacy is still limited, thus hampering the speed of mitigation and adaptation efforts. For this reason, a program to empower prospective vanguards of weather and climate information is held as a strategic partner of BMKG in delivering information effectively and contextually. This program is in the form of interactive webinars, online discussions, and in the future can be in the form of field training, which will be collaborated with environmentally conscious family activities (Kadarling) to increase community capacity and climate literacy. This approach is expected to strengthen an inclusive early warning system and community resilience in dealing with climate change. The main outcome of this activity is primarily the increased knowledge about weather, seasons, and climate in Indonesia, along with the enhanced networking among researchers and observers of weather and climate from various backgrounds. This is evidenced by the relatively increased number of members in the WhatsApp group that was formed, which is still related to the webinar that was held.

Keywords - The vanguard of weather and climate information, climate change, disaster mitigation

Abstrak

Perubahan iklim meningkatkan frekuensi dan intensitas bencana hidrometeorologi di Indonesia. Namun, literasi iklim masyarakat masih terbatas, sehingga menghambat kecepatan upaya mitigasi dan adaptasi. Oleh karena itu, diselenggarakan program pemberdayaan calon pelopor informasi cuaca dan iklim sebagai mitra strategis BMKG dalam menyampaikan informasi secara efektif dan kontekstual. Program ini dilaksanakan dalam bentuk webinar interaktif, diskusi daring, dan ke depannya dapat dikembangkan menjadi pelatihan lapangan yang akan dikolaborasikan dengan kegiatan keluarga sadar lingkungan (Kadarling) untuk meningkatkan kapasitas dan literasi iklim masyarakat. Pendekatan ini diharapkan dapat memperkuat sistem peringatan dini yang inklusif serta ketahanan masyarakat dalam menghadapi perubahan iklim. Hasil utama dari kegiatan ini adalah meningkatnya pengetahuan tentang cuaca, musim, dan iklim di Indonesia, serta terbentuknya jejaring yang lebih luas antara peneliti dan pemerhati cuaca serta iklim dari berbagai latar belakang. Hal ini dibuktikan dengan bertambahnya jumlah anggota dalam grup WhatsApp yang dibentuk sebagai tindak lanjut dari webinar yang telah dilaksanakan.

Kata kunci - Pelopor informasi cuaca dan iklim, perubahan iklim, mitigasi bencana

INTRODUCTION

Climate change has become a global issue that has a direct impact on various aspects of life, especially in the form of increasing intensity and frequency of hydrometeorological disasters such as floods, droughts, and other extreme weather (IPCC, 2021). In Indonesia, this phenomenon is increasingly occurring and has significant socio-economic impacts, especially for vulnerable communities in disaster-prone areas.

Although information about climate change is increasingly reported through various media, the level of public understanding of this issue is still uneven. Some people are starting to realize that climate change is closely related to the disasters they experience, but others still consider this issue as a matter for the government or academics alone, not as a problem that requires active community involvement (Wahyuni & Nugroho, 2020). In fact, in the context of climate change adaptation and mitigation, community climate literacy is the main key to encouraging behavioral change and increasing community resilience.

Our experience in organizing a number of webinars and climate information dissemination activities shows an increasingly positive public response. The public shows great interest in understanding more about climate change, extreme weather, and mitigation steps that can be taken at the individual and community levels. This is a signal that awareness is growing, but still needs to be strengthened through a structured, consistent, and easily understood approach by the general public.

Global momentum, such as the commemoration of World Meteorological Day, also emphasizes the importance of the involvement of all parties. The theme of 2024, "At the Frontlines of Climate Change Action", and 2025, "Closing the Early Warning Gap Together", emphasizes the urgency of building an inclusive early warning and climate resilience system. In this context, the pentahelix approach involving governments, the private sector, academia, communities, and the mass media is crucial in expanding the reach of climate change education and mitigation (WMO, 2024).

However, a formal approach alone is not enough. An informal strategy is needed that can reach grassroots communities more flexibly and empower local actors as trusted information providers. This is what underlies the initiative to form and empower the Indonesian Weather and Climate Information Vanguard Candidates. This program does not intend to take over the role of BMKG as an official institution, but rather to be a complement and strategic partner in delivering accurate, contextual, and timely information to the public.

Informal education and ongoing training are key instruments in preparing these vanguards to be able to understand weather and climate data, answer community questions, and assist in the dissemination of community-based early warning information. They act as a bridge between scientific information sources and the wider community, as well as agents of change in their respective environments (Susanti et al., 2021).

As a follow-up to the previous training, on March 22, 2025, advanced training was held for prospective frontliners. This activity was attended by hundreds of participants from 26 provinces in Indonesia with diverse professional backgrounds, such as teachers, lecturers, researchers, students, ASN, media practitioners, to private sector workers. Their presence shows the need and great interest in connecting, updating knowledge about national climate conditions, and strengthening the network of communities that are aware of and resilient to climate change.

Given this urgency and opportunity, the program to empower prospective vanguards of weather and climate information becomes very relevant to be carried out sustainably as part of the efforts of universities and the government to increase resilience and reduce the gap in public understanding of early warning and climate change.

METHOD

As a follow-up to the need to increase weather and climate literacy among the public, especially those who are concerned with climate change and hydrometeorological disasters, this activity is

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designed with an adaptive approach to Indonesia's geographical and social conditions. Given the vast area and mobility challenges, an inclusive and efficient implementation strategy is very important to ensure broad public participation.

In this context, the implementation of activities is carried out online through webinar media. This approach is considered the most feasible to reach participants from various regions in Indonesia, including areas that are classified as remote, underdeveloped, or difficult to access physically. By utilizing the internet, participants from various geographic and professional backgrounds gain equal access to training materials, discussions, and interactions with experts.

The webinar was held interactively by presenting several speakers from various strategic institutions, who have competence in the fields of meteorology, climatology, and climate policy. On this occasion, several speakers were presented, namely Prof. Dwikorita Karnawati (BMKG), Prof. Eddy Hermawan (BRIN), Dr. Joko Wiratmo MP and Dr. Plato M Siregar from ITB, Prof. Iskhaq Iskandar from UNSRI, Prof. Rahmat Gernowo from UNDIP, and Prof. Halmar Halide from UNHAS. Also appearing was the expert staff of the Minister of Culture, Prof. Ismunandar. The presence of these academics and practitioners enriched the participants' perspectives on the dynamics of weather and climate, both in scientific and applied contexts.

The interaction between participants and speakers does not stop at the webinar session. Continuous communication is also built through the formation of an online discussion group based on a short message application. This group is a forum for exchanging information, deepening material, and networking new ideas that originate from the needs and challenges in each region. In it, a space for friendship is created that encourages the process of mutual learning and mutual support among prospective vanguards of weather and climate information.

As part of strengthening the results of online training, field activities are also being prepared to be implemented in July 2025. This activity will be held in the fostered area on the southern slopes of Mount Manglayang, West Java 6°52'32"S 107°44'37"E (ISTF, 2025). The main objective is to transform meteorological and climatological science into real practices in the field, while strengthening the connection between science, local communities, and community-based mitigation actions.

RESULT AND DISCUSSION

Global climate change is increasingly evident from the increase in the earth's surface temperature, which has now increased by 1.54°C since the pre-industrial era. The impacts of this increase in temperature are very complex and interrelated, one of which is a drastic change in the hydrological cycle that worsens the intensity and frequency of hydrometeorological disasters such as floods, droughts, and tropical storms. Throughout the world, including Indonesia, these disasters are now spreading more widely and are more destructive. Therefore, weather and climate information and early warnings are vital instruments in disaster mitigation efforts, as well as a call for the birth of a vanguard that is ready to convey this information to the community effectively. One of the biggest challenges today is how to turn early warnings into early action. The global water and food crisis is increasingly becoming an unavoidable reality if we fail to control the rate of climate change. Without an efficient early warning system that can be understood by all levels of society, the risk of disaster will increase.

In Indonesia, the role of BMKG as a provider of weather and climate information must be strengthened by the presence of the vanguard, namely, individuals who are able to bridge scientific information into language and actions that are understood by everyday people. This is why public education and empowerment are the main strategies in dealing with this crisis. Global phenomena such as El Niño, La Niña, and other atmospheric dynamics are now increasingly influencing extreme weather in the Indonesian region (Wiratmo, 2024). Warmer sea surface temperatures increase the likelihood of tropical cyclones forming even in tropical areas that were previously considered safe. The influence of climate variability, such as ENSO, MJO, and IOD, as well as climate change, is causing

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weather and climate patterns to be disrupted, extreme rain and prolonged droughts, and other hydrometeorological disasters are forming (Wiratmo, 2020). This is where the importance of continuous dissemination of weather information lies, not only on a monthly or weekly scale, but even in hours and minutes when extreme weather is about to occur. For this, trained human resources are needed, have high climate literacy, and can convey this warning quickly and accurately.

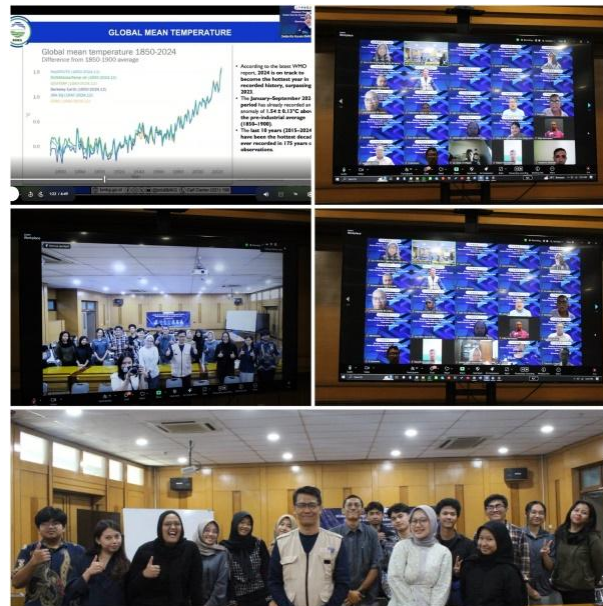


Figure 1.

Hybrid webinar activities of Indonesia's frontline weather and climate information

Preparation for a phenomenon like El Niño cannot be done suddenly. Early warning must be able to equip farmers, fishermen, and water resource managers to anticipate possible impacts. This requires an active role for the community in understanding and responding to early warnings, and this is where the importance of empowering the vanguard of weather and climate information lies. They are the link between technology and real action in the field. Especially in conditions where communication networks are still uneven, the existence of blank spots in the dissemination of information is a serious threat that must be overcome with a local, community-based approach. This effort requires not only infrastructure and technology, but also social and cultural readiness. Real actions such as early evacuation, preparation of evacuation routes, and preparedness exercises need to be carried out well in advance. This process will not run effectively without strong education and a clear division of tasks between information providers (upstream) and policy implementers and the community (downstream). The active role of the vanguard as facilitators, communicators, and educators is becoming increasingly essential within the framework of an information-based disaster mitigation system.

The La Niña and La Niña Modoki phenomena are concrete examples of how climate knowledge is crucial at the local level. In the Papua region, this phenomenon causes a significant increase in rainfall, especially in the southern part during the dry season (JJA and SON), and can even continue into the rainy season (DJF) in the case of La Niña Modoki.

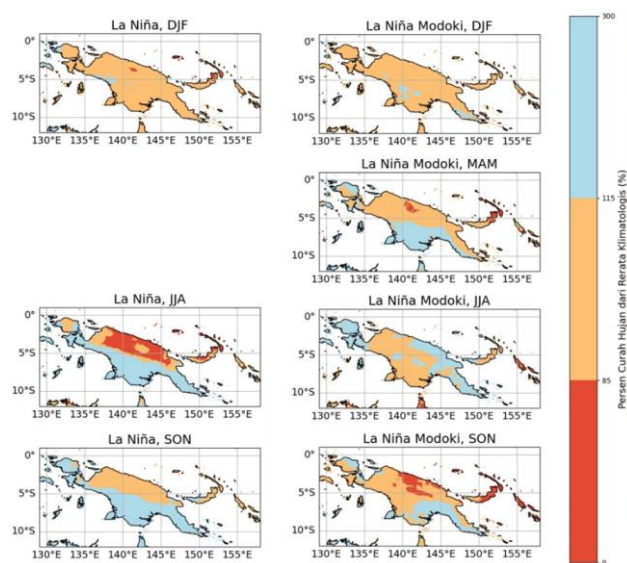


Figure 2.

Rain characteristics on Papua Island during La Niña (left) and La Niña Modoki (right).

The rain characteristics in the image are adjusted to the definition by BMKG, namely if rainfall > 115% then it is categorized as above normal rain, rainfall between 85% and 115% is categorized as normal rain, and rainfall < 85% is categorized as below normal rain (Wiratmo & Pekerti, 2024).

Understanding these anomalies is crucial in planning the agricultural sector and disasters in the region. Unfortunately, limited data and climate literacy among the public are major obstacles in implementing policies based on climate predictions. Meanwhile, global climate change, as reported in the 6th Assessment Report of the IPCC, shows that global warming is not a temporary issue, but an almost irreversible process. With the world's population projected to reach 9 billion by 2035, pressure on natural resources will increase, and extreme weather events will become more frequent. Indonesia, although not a major emitter, is at the forefront of the impacts, especially in vulnerable areas such as Papua, Kalimantan, and the Indonesian Capital City (IKN), which is now experiencing a significant increase in extreme rainfall since 2000.

All of this shows that climate challenges are not only scientific, but also social and political. Therefore, cross-sector and cross-generational collaboration is needed to face this crisis. Empowering the vanguard of Indonesia's weather and climate information is not only an option, but a necessity to build an inclusive and sustainable climate resilience system. They are the bridge between science and action, between data and everyday life, and between warning and safety. One real illustration of the importance of integrating climate science in various fields is the damage to prehistoric cave paintings in the UNESCO Global Geopark Maros Pangkep, South Sulawesi. A video discussing this shows that climate change and ENSO anomalies have caused the peeling of paintings that are more than 51,000 years old. This study, which uses NASA historical climate data and artificial intelligence (AI), emphasizes the importance of collaboration in preserving cultural heritage while strengthening the argument that climate science must be applied across sectors.

Similarly, flood simulation in South Tapanuli using WRF ARW and WRF Hydro coupled models shows how rainfall and topography data play a role in increasing river discharge and flooding. This study not only proves the importance of hydrometeorological models in disaster mitigation but also underlines the need for real-time data and spatial planning policies that are responsive to climate risks. Finally, research on Solar Radiation Management (SRM) introduces a geoengineering approach to lowering the Earth's temperature through atmospheric modification. Studies in Papua and East Nusa

Tenggara show the potential of SRM in reducing extreme rainfall and the impact of tropical cyclones. Although still requiring further evaluation, this research encourages international collaboration and the development of climate technology in Indonesia.

Overall, all of these presentations emphasize that dealing with climate change requires a holistic approach, namely combining science, technology, education, and community empowerment. The vanguard of weather and climate information is key to uniting these efforts, so that every early warning can truly be transformed into early action that saves.

CONCLUSION

Global climate change has caused significant changes in the hydrological cycle that increase the frequency and intensity of hydrometeorological disasters in Indonesia. An effective early warning system and public understanding are the main keys to mitigating these risks. The role of BMKG as a provider of weather and climate information must be supported by the presence of a vanguard that is able to bridge scientific information to the public contextually and quickly. Empowering these potential vanguards is important to ensure that early warnings can be translated into real action, especially in areas with limited access to communication.

Climate phenomena such as El Niño, La Niña, and other atmospheric dynamics are increasingly influencing extreme weather patterns, so community-based preparedness is urgently needed. Cross-sectoral approaches, ongoing education, and strengthening social networks are the foundations for facing complex and multidimensional climate challenges. Case studies from various regions of Indonesia emphasize the need to integrate climate science into policy-making and mitigation actions. The vanguard of weather and climate information plays a strategic role as a liaison between scientific data and information, technology, and increasing community resilience and adaptation to increasingly unpredictable climate change. Structured, massive, and systematic climate action is urgently needed so that the issues of global warming, climate change, and hydrometeorological disasters can be better addressed.

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