

The Role of the World Meteorological Organization (WMO) in Mitigating Natural Disasters in Laos 2024 Through the Climate Risk and Early Warning Systems (CREWS) Program

Finna Kharisma Marulitta*¹, Gonda Yumitro²

^{1,2} Department of International Relation, Universitas Muhammadiyah Malang, Indonesia

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*Email:xxxxxxxxxxxxxxxxxx

Abstract

Developing countries face significant challenges in managing climate-related disaster risks due to limitations in technical capacity, institutional frameworks, and early warning systems. Lao DPR is one of the countries with high vulnerability to hydrometeorological disasters, particularly floods. The World Meteorological Organization (WMO) through its flagship programs, the Climate Risk and Early Warning Systems (CREWS), aims to assist high-risk countries in developing impact-based early warning systems. This study aims to analyze the role of WMO through the CREWS program in disaster mitigation efforts in Laos, using the 2024 major flood as a case study. The research adopts a descriptive qualitative approach and is analyzed through the theoretical framework of the role of international organizations from a liberalist perspective as proposed by Kelly-Kate S. Pease, specifically focusing on the roles of problem solver, capacity builder, and aid provider. The method involves a literature study approach, with data collected from books, journals, internet sources, and other written references as the foundation for the analysis. The findings reveal that prior to the intervention, Lao DPR faced significant limitations in infrastructure, risk data, and inter-agency coordination. Through the CREWS program, WMO contributed to strengthening the technical capacity of the Department of Meteorology and Hydrology (DMH) of Lao DPR, modernizing weather stations, and implementing an impact-based forecasting approach. This study finds that WMO's intervention through CREWS has encouraged improved disaster preparedness and response at both national and community levels, although challenges remain in system integration and funding sustainability.

Keywords: WMO, CREWS, disaster mitigation, early warning systems, Laos, climate change

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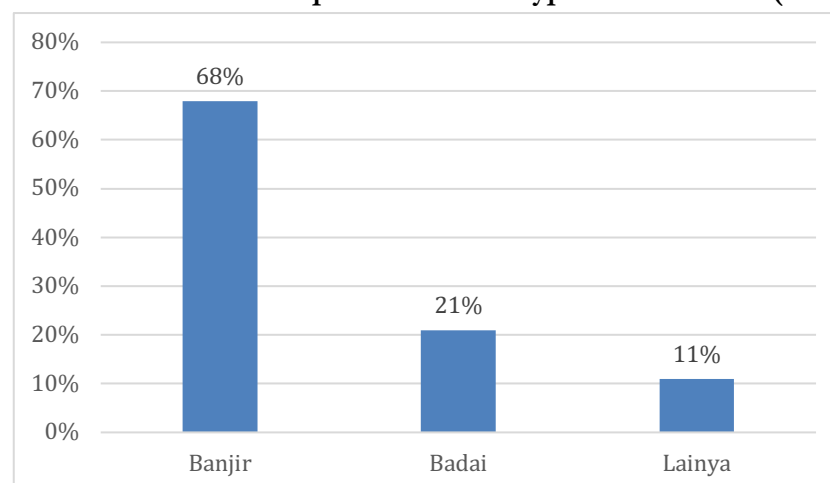
INTRODUCTION

Global climate change is significantly increasing the frequency and intensity of hydrometeorological disasters, such as floods and tropical storms, which have a major impact especially on developing countries in the Southeast Asia region (Ayu, 2022). Developing countries, which generally have limitations in early warning systems and institutional preparedness, are the most vulnerable groups to hydrometeorological disasters. In this context, the existence of international organizations that focus on climate risk mitigation and strengthening state capacity is very important (Allis, et.al, 2019).

The World Meteorological Organization (WMO), a specialized agency of the United Nations established in 1950, has a global mandate to strengthen meteorological systems and mitigate climate risks in developing countries. WMO has a global mandate to coordinate operational meteorological, climatological and hydrological activities, and to support its member countries in improving risk-based early warning systems, climate data collection and strengthening national meteorological services institutions (WMO, 2023). As a concrete form of this mandate, WMO together with the World Bank (GFDRR) and UNDRR launched the Climate Risk and Early Warning Systems (CREWS) program in 2015. CREWS aims to increase the capacity of developing countries in building early warning systems that are inclusive, risk-based, and responsive to local needs (CREWS Initiative, 2022). The main focus of this program is to strengthen national institutions (such as the Department of Meteorology and Hydrology), introduce impact-based forecasting technology, and build multi-sector coordination in disaster risk reduction.

One of the strategic target countries of this program is Lao DPR, which is known as one of the most disaster-prone countries in Southeast Asia. Based on historical data between 1966 and 2018, Lao DPR experienced 49 major disasters, with more than 11 million people affected, and total economic losses reaching USD 802.6 million, of which 68% were caused by floods and 21% by tropical cyclones (World Bank, 2021).

Diagram 1: Distribution Graph of Disaster Types in Lao DPR (1966–2018)



Source: World Meteorological Organization, Final CREWS Cambodia and Lao PDR Project Proposal (Geneva: WMO, 2021)

Based on this background, this article addresses the following research question: How does the World Meteorological Organization contribute to strengthening hydrometeorological disaster mitigation in Lao PDR through the CREWS program? This article examines the role of WMO through the CREWS program in enhancing Lao PDR's capacity to mitigate hydrometeorological disaster risks. By focusing on institutional strengthening, impact-based forecasting, and coordination among stakeholders, this study seeks to explain how WMO contributes to disaster resilience in a developing country context.

LITERATURE REVIEW

Several previous studies have evaluated the effectiveness of international programs in disaster risk mitigation. For example, the study by Thomalla et al. (2006) demonstrates the importance of local and community-based approaches in an effective early warning system. Meanwhile, a study by UNDRR (2019) emphasized that collaboration between national institutions and international organizations is a key factor in strengthening climate adaptation capacity. However, specific research on the role of WMO through the CREWS program in Lao DPR, especially since active interventions began in 2022, is still very limited (CREWS Initiative, 2024).

This gap is the basis of this research, namely to understand how international organizations' intervention strategies can respond to the weaknesses of national systems in climate risk mitigation in developing countries. Thus, this study specifically examines the strategic role of WMO through the CREWS program in supporting the disaster mitigation system in Lao DPR, with an emphasis on the period 2022–2024 as the active implementation period. This study not only provides empirical contributions to the evaluation of CREWS policy in Lao DPR, but also provides theoretical contributions to the study of the role of international organizations within the framework of liberalism, especially in their capacity as problem solvers, capacity builders, and aid providers as stated by Kelly-Kate S. Pease (2019).

The Role of International Organizations in the Perspective of Liberalism by Kelly-Kate S. Pease

International organizations in the view of liberalism have a very important position in creating a more stable and peaceful world order. In the literature of international relations, especially in the liberal perspective, international organizations are understood not only as diplomatic forums, but also as independent actors capable of influencing state behavior, resolving transnational issues, and building more inclusive and collaborative global governance. One of the academics who comprehensively discusses the roles of international organizations is Kelly-Kate S. Pease, who in her book *International Organizations: Perspectives on Global Governance* (2019) explains five main roles that can be played by international organizations, namely: Problem Solver, Collective Action Mechanism, Capacity Builder, Common Global Good Provider, and Aid Provider (Kelly-Kate, 2019).

Each of these roles represents a specific function of international organizations in responding to global challenges. As a Problem Solver, international organizations are present to provide solutions to problems that cannot be resolved unilaterally by countries. For example, in the context of climate change and hydrometeorological disasters, organizations such as the World Meteorological Organization (WMO) play a role in helping developing countries such as

Lao DPR that have limited disaster mitigation systems, especially early warning systems. This role is concretely realized through the Climate Risk and Early Warning Systems (CREWS) program launched by WMO to improve the preparedness of vulnerable countries to climate risks. Furthermore, the role as a Capacity Builder refers to the function of international organizations in strengthening the capacity of member countries, both in terms of technical, institutional, and human resources. In the case of Lao DPR, CREWS is present by providing technical training, institutional support to the Department of Meteorology and Hydrology (DMH), and assisting in the preparation of risk maps and the reactivation of the LaoDI disaster information system. Meanwhile, as an Aid Provider, international organizations also act as a channel for technical and financial assistance, especially to countries with limited budgets. The CREWS program provides funding sourced from various donor countries to support the implementation of climate adaptation programs in Lao DPR, making it a tangible form of the aid provider's role.

However, of the five roles proposed by Kelly-Kate S. Pease, the author in this study only uses the three most relevant roles, namely: problem solver, capacity builder, and aid provider. The other two roles, namely collective action mechanism and common global good provider, are not used in this study because the context of their application is more often found in multinational economic cooperation and the provision of broad international standards, not in the form of technical programs focused on one country such as the case of Lao DPR (Kelly-Kate, 2019). In addition, the collective function and distribution of global public goods are not dominant elements in the implementation of the CREWS program, which is more focused on strengthening internal capacity and providing direct support to recipient countries.

Thus, the theoretical framework in this study uses the concept of the role of international organizations in the perspective of liberalism by Kelly-Kate S. Pease, emphasizing three main functions that are considered relevant in the context of WMO through the CREWS program in Lao DPR. The three roles will be analyzed in relation to the implementation of the program in the period 2022–2024, with a case study of the 2024 Lao DPR flood as the context for testing the implementation of the program.

RESEARCH METHODOLOGY

This study uses a literature study approach because in the process the data collected comes from books, journals, the internet, or other written literature as a basis for writing. The literature study method is data collection by searching for information through books, newspapers, and other literature that aims to compile a theory (Arikunto, 2006). This literature study method is a theoretical study, reference and other literature studies related to culture, values and norms that develop in research (Sugiyono, 2012). Data sources in the study came from the CREWS annual report, the CREWS Lao DPR project proposal, the progress report on the implementation of the program from 2022 to 2024, and the publication of the WMO regarding the role and mandate of its organization. In addition, additional data were obtained from supporting documents such as the United Nations Office for Disaster Risk Reduction (UNDRR) report (2020), disaster data from EM-DAT, and academic publications relevant to the theoretical framework of liberalism and the role of international organizations.

DISCUSSION

WMO's Role as a Problem Solver in Disaster Risk Mitigation in Lao DPR

The weakening of Lao PDR's disaster mitigation system before 2022 is a serious challenge that requires urgent intervention. Limited institutional capacity, weak coordination between agencies, and the lack of accurate historical data are hampering disaster risk reduction efforts in the country. The national LaoDI database, which is supposed to be a hub for disaster impact information, has been inactive and out of date, hampering evidence-based risk analysis and emergency planning (WMO, 2024). In addition, the existing early warning system only functions to detect extreme weather events without estimating the possible socio-economic impacts (from the fact file). As a result, the Lao government and society are often late in anticipating and responding to disasters. Coordination between institutions such as the Department of Meteorology and Hydrology (DMH) and disaster management institutions is also not optimal, creating overlapping roles and slowing down the decision-making process in emergency situations (WMO, 2024).

In response to these conditions, the World Meteorological Organization (WMO) through the Climate Risk and Early Warning Systems (CREWS) program took strategic steps by introducing an impact-based forecasting approach in Lao DPR (WMO, 2024). This approach does not only focus on predicting extreme weather events, but also integrates estimates of the impact on people, infrastructure, and vital social services. Thus, the warnings issued do not only inform about the potential for flooding or storms, but also estimate who will be affected, how much damage may occur, and what mitigation steps need to be taken immediately (WMO, 2024). To support this change, WMO is building an impact-based flood forecasting system using advanced hydrological models such as Continuum and REFLEX, and reviving the LaoDI database system to record and analyze disaster impacts in real time.

The effectiveness of this new approach was tested in a major flood event that hit Lao DPR in 2024. Facing potential flooding in the Xekong and Xe Don river basins, the impact-based forecasting system was able to provide early warnings up to five days before the peak of the event. The warnings not only informed of the high rainfall, but also estimated the number of people who had to be evacuated and the potential damage to public facilities such as schools and hospitals (WMO, 2024). As a result, the Lao government's response speed increased significantly compared to previous flood incidents. Evacuations were carried out faster, aid distribution was more targeted, and losses were reduced. In addition, the accuracy of the impact predictions generated through this new system has been proven to reduce the gap between estimates and reality on the ground, showing a major change in the effectiveness of the disaster mitigation system in Lao DPR (WMO, 2024).

To provide a more systematic overview of the progress achieved, the annual progress in the implementation of the CREWS program in Lao DPR from 2022 to 2024 is summarized in the following table, which shows the relationship between the main activities, the issues addressed, and the achievements achieved.

Table 1. WMO's Role as a Problem Solver in Lao DPR (2022-2024)

Year	Main Activities	Problems Solved	Achievements
2022	Initial validation of the early warning system through RIMES Assessment.	Identify major gaps in forecast quality, disaster SOPs, technical capacity.	Short-medium term strategic recommendations; preparation of national EWS reform.
	Nowcasting and Flash Flood Forecasting (SeAFFGS) Training.	Weaknesses of rapid forecasting and flash flood prediction.	Lao DPR Forecaster trained using SeAFFGS for more accurate flash flood predictions
2023	Integration of the 72-hour Rapid Assessment system and the use of GIS.	Limitations of rapid post-disaster assessment.	The Lao government is able to produce impact reports within 72 hours of a disaster.
	Development of national flood and drought risk maps.	Lack of up-to-date data-based risk maps for planning.	Finalization of national multi-hazard maps to support contingency planning.
2024	Revitalization of LaoDi (Disaster Information System).	The national disaster information system is inactive and outdated.	LaoDi is back online, with disaster loss database from 1990-2023, supporting data-driven decision making
	Implementation of the Early Warnings for All (EW4All) Roadmap	Lack of a national roadmap for universal early warning coverage.	EW4All national roadmap approved; 20% of national funds for early warning mobilized.
	Operationalization of Impact-Based Forecasting (IBF) in the Sekong and Se Don basins.	The old forecasting system was only hazard-based, not impact-based.	IBF is actively used on two major rivers of Lao DPR, predicting flood impacts up to 5 days in advance.
	Improvement of automatic early warning system (Warning Bulletins System).	Slow dissemination of disaster information.	Operational risk-based warning bulletin platform to accelerate emergency decisions.

Source: Authors Analysis from WMO, 2024

RoleThe World Meteorological Organization (WMO) as a problem solver is evident from its efforts in responding to systemic problems that occur in Lao DPR, such as the lack of an effective early warning system and limited access to accurate climate data. The Climate Risk and Early Warning Systems (CREWS) program is the main solution offered by WMO to address these problems. Through this program, WMO identifies the root causes of flood disaster mitigation and builds an early warning system based on data and risk. This risk-based approach is able to minimize loss of life and material losses by providing sufficient time for the people and government of Lao DPR to take preventive action. In addition, WMO also facilitates mapping of flood-prone areas using satellite technology and science-based meteorological analysis. This makes WMO not only an observer, but also an active actor in solving disaster problems in developing countries such as Lao DPR (Kurowski et. al., 2023).

WMO's Role as a Capacity Builder in Strengthening National Institutions

In the context of this research, capacity builder refers to the role of international organizations in improving technical, institutional, and human resource capabilities in developing countries to manage disaster risks independently and sustainably. In the CREWS program implemented in Lao DPR, capacity building focused on modernizing weather forecasting systems, improving the quality of disaster risk data, technical training for government institutions, and developing an impact-based early warning system.

As a concrete manifestation of efforts to strengthen national capacity, the CREWS program has produced several important achievements in Lao DPR between 2022 and 2024. These achievements include the development of new systems, the implementation of technical training, increasing the number of participants, and increasing the capacity to issue risk-based warnings. The following is a table of the annual development of the CREWS program in Lao DPR:

Table 2 Progress of CREWS Project Lao DPR (2022-2024)

Year	New System/Institution Output	Number of Trainings	Number of Participants	Warning Level Issued
2022	Preparation of the Early Warning System (EWS) baseline system, formation of a plan to establish a National Disaster Risk Reduction Forum (DRR Forum)	2 initial technical training programs related to weather and flood forecasting	± 45 people	Not yet (preparation stage)
2023	Activation of the National Multi-Stakeholder Forum for DRR, establishment of the National Technical Working Group (TWG) for Integrated Water Resource Management (IWRM) and Early Warnings for All (EW4ALL), preparation of standard protocols for Impact-Based Forecasting (IBF)	4 advanced training programs including an introduction to the 72-Hour Rapid Assessment and impact-based forecasting	± 120 people	2 impact-based flood forecasts published
2024	Finalization of the EW4ALL National Roadmap, active implementation of Impact-Based Forecasting (IBF) in the Xekong and Xe Don Rivers, reactivation of the LaoDI national system, and preparation of community-based and inclusive EWS guidelines.	5 advanced training programs on impact-based flood simulation and use of GIS for rapid response	± 250 people	6 impact-based flood forecasts are issued and used nationally

Source: Authors Analysis from WMO, 2024

From the data presented in the table, it can be seen that there has been a progressive increase in Lao PDR's disaster mitigation capacity every year. In 2022, activities are still focused on the initial assessment of the early warning system and institutional preparation. Entering

2023, there has been a significant increase with the activation of the Multi-stakeholder Disaster Risk Reduction (DRR) Forum and the establishment of a National Working Group for water risk management and impact-based early warning. The number of trainings implemented has also increased from two programs in 2022 to four programs in 2023, and continues to grow to five programs in 2024, with a deeper coverage of materials such as advanced impact-based forecasting and flood simulations. Participation in training also shows an increasing trend, from around 45 people in 2022 to more than 250 people by the end of 2024, covering central and local government officials, as well as local communities.

From an operational perspective, Lao DPR' capacity to issue early warnings has also increased significantly, from no impact-based warnings in 2022 to two early warnings in 2023 and six impact-based warnings actively used during major floods in 2024. This demonstrates the success of the CREWS program not only in strengthening individual capacity but also in increasing the effectiveness of institutions in dealing with disaster risks. With these achievements, it is clear that WMO through the CREWS program has succeeded in carrying out its capacity building function effectively in Lao DPR. This capacity building is an important foundation in supporting national disaster preparedness, while also building long-term climate resilience in the country.

WMO's Role as an Aid Provider in Providing Technical and Financial Assistance

In addition to acting as a problem solver and capacity builder, the World Meteorological Organization (WMO) through the Climate Risk and Early Warning Systems (CREWS) program also plays a significant role as an aid provider in supporting disaster mitigation efforts in Lao DPR. This role is realized through the provision of technical, financial, and operational support that strengthens Lao DPR' national resilience to climate risks. Since 2022, CREWS has channeled strategic funding to support various components of the national capacity building program. The funds are focused on the development and modernization of impact-based early warning systems, the development of risk data infrastructure, and funding for technical training at various levels of government (CREWS, 2022). This funding is not only used for the purchase of weather forecasting equipment, but also for the preparation of multi-hazard risk maps and the rehabilitation of LaoDI's national information system.

On the technical side, CREWS provides assistance in the form of intensive training on weather forecasting, the use of the SeAFFGS system for flash flood forecasting, and capacity building in the use of GIS platforms for rapid disaster impact analysis. This training includes more than 200 participants from various ministries and agencies in Lao DPR between 2022 and 2024, reflecting the expansion of the reach of technical assistance to relevant sectors. In addition, CREWS also supports the procurement of hardware and software needed for the revitalization of the LaoDI system, including the provision of new servers, data management software, and training of technical staff in managing the system³. This support directly contributes to improving the speed and accuracy of disaster impact data reporting, previously one of the main weaknesses of the Lao national system.

Furthermore, within the framework of the implementation of Early Warnings for All (EW4All), CREWS also assists in the mobilization of national financial resources. In 2024, Lao PDR managed to allocate 20% of national funding for strengthening the early warning system,

thanks to the technical assistance and advocacy carried out in the CREWS4 project. This shows that the assistance provided is not only temporary, but also directed at building a sustainable national financing mechanism. Thus, as an aid provider, WMO through the CREWS program not only provides short-term assistance, but also encourages Lao PDR to develop internal financing capacity to ensure the sustainability of the disaster mitigation system in the future.

CONCLUSION

Based on the results of the research and discussion that has been carried out, it can be concluded that the World Meteorological Organization (WMO) through the Climate Risk and Early Warning Systems (CREWS) program plays a significant role in strengthening the climate-based disaster mitigation system in Lao DPR in the period 2022-2024. This study proves that WMO has succeeded in carrying out the three main roles of international organizations according to the Kelly-Kate S. Pease concept, namely as a problem solver, capacity builder, and aid provider. (1) As a problem solver, WMO through CREWS is able to overcome fundamental problems in Lao DPR, such as the weak early warning system, the inactivity of the LaoDI disaster information system, and limitations in impact-based forecasting. This intervention increases the speed of response to disasters, especially during the major floods in 2024, where impact-based forecasting succeeded in providing more accurate and timely information to affected communities. (2) As a capacity builder, CREWS has successfully strengthened the technical capacity of the Lao PDR Department of Meteorology and Hydrology (DMH) and related institutions through a series of trainings, development of multi-hazard risk maps, activation of multi-stakeholder forums, and revitalization of risk information systems. Annual progress shows significant increases in the number of trainings, participants, and institutional outputs. (3) As an aid provider, CREWS provides crucial financial and technical support in building early warning infrastructure, strengthening risk data systems, and providing new technologies for impact-based forecasting. The program has also successfully encouraged the Lao PDR government to allocate a national budget for the early warning system strengthening program, which is an important step towards the sustainability of the program.

In general, this study emphasizes the importance of multilateral cooperation, strengthening national capacity, and technical and financial assistance from international organizations in building the resilience of developing countries to climate and disaster risks. However, this study has several limitations that need to be noted. First, the study only uses a literature study approach with secondary data sources such as official WMO documents, CREWS reports, and reports from other international institutions. Limited access to primary data and direct interviews with policymakers in Lao DPR, such as those from the Department of Meteorology and Hydrology (DMH) or beneficiary local communities, reduces the depth of analysis of the social and operational impacts of the CREWS program in the field. Second, the temporal scope of this study is limited from the period 2022-2024, so it has not been able to comprehensively evaluate the sustainability of the CREWS program and its long-term impact on increasing Lao DPR' climate resilience. Third, this study has not compared Lao DPR with

other CREWS recipient countries, so it does not provide a comparative perspective on the effectiveness of the program in different contexts.

Future research is encouraged to broaden the scope of analysis by comparing Greenpeace's role with that of other environmental non-governmental organizations (ENGOs) in addressing forest and land fires across different regions or countries. Comparative studies would provide a deeper understanding of how variations in political, institutional, and socio-environmental contexts influence the effectiveness of transnational environmental advocacy. In addition, future studies are recommended to examine the long-term impacts of Greenpeace's advocacy, community empowerment, and environmental campaigns on forest and land fire prevention, while incorporating perspectives from government institutions, local communities, and the private sector. Such an approach would contribute to a more comprehensive understanding of collaborative environmental governance and the sustainability of multi-stakeholder efforts in mitigating forest and land fires.

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