

# The Role of Artificial Intelligence in Creating a Robust Adaptive Social Protection System in Response to Disaster Mitigation and Climate Change Adaptation in Indonesia

Latika Putri Barliani

## Summary

The exhilarated pace of climate change will induce disaster that will impact society, where Adaptive Social Protection (ASP) is needed more than ever. To further leverage the potential of adaptive social protection, the role of Artificial Intelligence (AI) can transform the execution of disaster mitigation with the innovation developed by independent researchers or the Meteorology, Climatology, and Geophysical Agency (BMKG). To further elaborate on this topic, this Op-Ed explores how artificial intelligence can assist adaptive social protection programmes in reducing the severity of disasters, specifically what role(s) artificial intelligence plays in disaster mitigation. For successful AI implementation, centralising development within one government agency is crucial. This simplifies monitoring and evaluation while maintaining the communities involved in the process. Not only will it acquaint the communities with the programme, but also build trust to build a sustainable programme.

**Keywords:** Artificial Intelligence, Adaptive Social Protection, Disaster Mitigation, Climate Change Adaptation

## Introduction

Indonesia is no stranger to disaster as it is located on the Pacific Ring of Fire, and its position at the intersection of three major tectonic plates makes it highly susceptible to earthquakes, tsunamis, and volcanic eruptions (Internal Displacement Monitoring Centre & Asian Development Bank, 2023). In 2018 alone, 2,572 disasters struck Indonesia, resulting in 4,814 deaths, 21,000 injured, and more than 300 damaged houses. Three years later, in 2021, a total of 3,081 disasters were recorded, most of them induced by hydrometeorology causes such as rainfall, humidity, temperature, and wind changes (Maulana & Andriansyah, 2024). Large-scale disasters can easily impact people's livelihoods and destroy vital public services, which require years to recover and will need a huge amount of effort from governments and sometimes from international organisations (Syamsidik et al., 2021). This is why disaster mitigation is important and crucial to preventing such casualties to society and their properties.

Several efforts made by governments include the development of disaster-resistant infrastructure and educating the community

regarding disaster awareness, such as Earthquake and Tsunami Field School (Sekolah Lapang Gempa Bumi dan Tsunami/SLG) and Climate Field School (Sekolah Lapang Iklim/SLI) (BMKG, 2023) developed by the Meteorology, Climatology, and Geophysical Agency (Badan Meteorologi, Klimatologi, dan Geofisika/BMKG). These awareness efforts are also part of a larger program, Disaster Preparedness Village (Kampung Siaga Bencana/KSB), which focuses on community-based disaster mitigation, prioritising collective togetherness between local communities and respecting cultural aspects and regional processes. The village community, consisting of residents, youth, community leaders, NGOs, and the local village government, executes all of the activities within KSB. For example, KSB in Sumedang conducted slope reforestation, clean days, gotong royong, mitigation education, and advocacy in schools (Pangestu & Fedryansyah, 2023).

Advancements in disaster mitigation have also been made, especially with the development of artificial intelligence that can analyse vast amounts of data, identifying

patterns, trends, and associations within the data. As the data receives more feedback and information, the algorithms improve their performance in terms of accuracy (Ghaffarian et al., 2023). This leads to the research question, What role(s) does artificial intelligence play in disaster mitigation? Considering notable AI-driven disaster mitigation efforts have already been implemented, this Op-Ed will elaborate on how artificial intelligence can assist adaptive social protection programmes in reducing the severity of disasters.

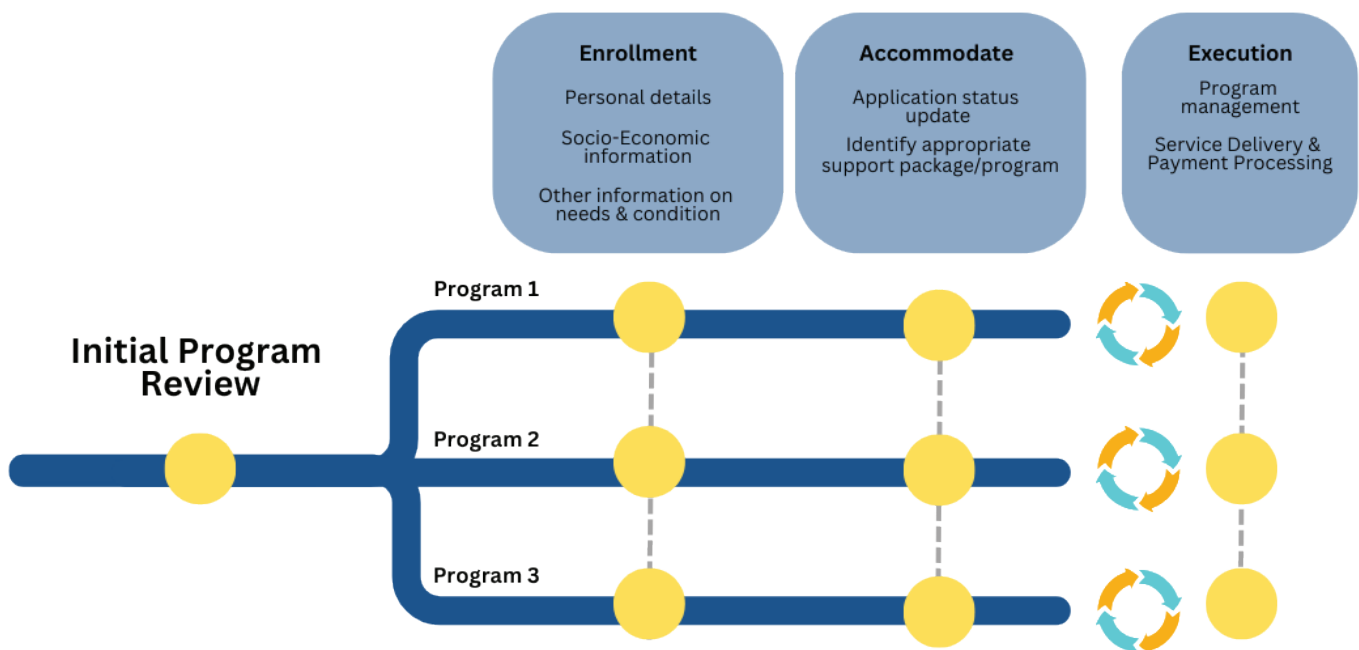
**Data and Information - Social Registry**

Data and information are one of the key pillars of ASP and one of the foundational elements to build upon artificial intelligence. Essentially, there is a requirement to allocate resources toward gaining a deeper comprehension of risk and the susceptibility of households to unexpected events within the social protection sector.

This understanding is crucial for identifying the individuals most vulnerable to specific shocks, forming the groundwork for tailoring effective programme designs, and inserting

the right data into the system (Bowen et al., 2020). Indonesia has established a single targeting approach for social assistance initiatives but lacks an integrated system for managing information (OECD, 2019), with its various data sources managed by each ministry/institution, such as population data, social welfare, education, health, disaster, social security programme, micro small and medium enterprise, women and children, agricultural, fisheries and other data sources. However, each party still manages this rich data in a segmented manner without being connected.

On the other hand, through Presidential Regulation Number 39 of 2019, President Jokowi established One Data Indonesia (Satu Data Indonesia/SDI) as the government's data management policy to produce data that is accurate, up-to-date, integrated, and accountable, as well as easy to access and share between central agencies and areas. With a plan starting as early as 2020, the Indonesian government is on the road to integrating social registries into its social protection scheme (BNPB, 2022).



**Figure 1.** Gateway for social registry multiple programmes  
 Source: Author, 2024 (Adapted from Bowen et al., 2020 & World Bank, n.d.)

When fully developed, social registries can act as an entry point for one or several programmes. When multiple programmes utilise a shared or integrated social registry, they can serve a significant role in social policy by facilitating the coordination of efforts to reach targeted populations (Bowen et al., 2020).

## **AI in Adaptive Social Protection**

### **Disaster Mitigation**

When disaster strikes, communities are taking action to stay safe. People in low-lying areas escape to higher ground, like meadows or rice fields, and those by the coast seek refuge in the hills. Injured residents rely on their families and neighbours for initial care. If someone needs more extensive medical attention, the younger individual or the village chief will transport them by car to the closest clinic or hospital (Ayuningtyas et al., 2021). To prevent further casualties in the process of mitigation, AI plays a crucial role in forecasting disasters, hence giving citizens much more time to be more prepared to face disasters.

Indonesia has introduced an early warning system and has been developing it further since then. For example, in Palu, Central Sulawesi, the AI method has been implemented for post-earthquake damage mapping, which is expected to be useful in high-risk scenarios. These detailed post-earthquake damage maps are valuable tools. Planners, engineers, and governments can use them to create evacuation plans and hazard reduction strategies. This, in turn, can minimise casualties and guide future development and rebuilding efforts (Syifa et al., 2019). Another application of AI is seen in Geographic Information System (Sistem Informasi Geografis/SIG), which is employed as a tool to analyse geographic information in support of disaster mitigation efforts in Indonesia.

The BMKG has been building a network of digital seismographs since 2006 and has adopted a standardised monitoring, processing, and dissemination system with developed countries to enhance the speed of earthquake and tsunami information dissemination. Currently, in 2023, BMKG has made significant progress, operating over 521 sensitive seismograph sensors to detect and record earthquake activity. They have also achieved remarkable progress in information dissemination by establishing a real-time earthquake information system through the Warning Receiver System New Generation (WRS NewGen). This enables the public to receive earthquake information within 2 to 3 minutes (Maulana & Andriansyah, 2024).

### **Climate Change Projection to Enhance People's Adaptation**

The exhilaration of climate change has been the concern of every country, with indicators like the increasing global temperature, more extreme heat and heat waves, more intense drought, water scarcity, evolving precipitation patterns and flooding, ecosystem changes, and biodiversity loss (Gomstyn, 2024). According to “Indonesia Climate Actions Towards 2030” developed by The Ministry of Environment and Forestry, Indonesia has been building strategic collaborations with government agencies, academics, and the private sector while focusing their efforts on forest, land rehabilitation, biodiversity conservation, and the development of urban green spaces (Ministry of Environment and Forestry, 2023).

In assisting Indonesia's climate actions, incorporating AI into its system will help mitigate its risks and help the citizens adapt. The AI analyses data, forecasts future climate conditions, and suggests solutions to reduce the effects of climate change. AI helps us grasp the worldwide effects of climate change by creating powerful weather prediction and environmental monitoring tools.

It analyses climate data to forecast weather patterns, extreme conditions, and the social and economic consequences of climate change, including how precipitation will be affected. With this information, policymakers can stay informed about threats like rising sea levels, natural disasters like earthquakes and hurricanes, temperature fluctuations, habitat destruction, and species loss and make suitable adjustments whilst informing related parties (Xin et al., n.d.).

### **Quick identification of community groups based on their level of vulnerability**

According to Indonesian Regulation No. 39 of the Year 1999 regarding human rights, people aged 65 or older, children, people experiencing poverty, pregnant women, and people with disabilities are considered vulnerable communities. However, the Rencana Aksi Nasional Hak Asasi Manusia 2015-2019 (RANHAM 2015-2019) expands the definition to include women in general, refugees, immigrant workers, and indigenous people.

These communities have a different level of vulnerability that needs to be catered especially in times of disaster and climate change. A diverse range of research (Sarachaga & Espino, 2019; Aswani et al., 2019; Hizbaron et al., 2018) highlights the usage of the vulnerability assessment model, which allows the identification of vulnerable communities from economic, demographic, psychological, political, and physical aspects amidst other things. Ideally, hazard data should integrate the vulnerability assessment model as a part of the disaster risk system (Hizbaron et al., 2018). Based on the previous advancements, several early warning systems models, such as real-time data analysis, predictive models, targeted alerts, and evacuation planning, should support disaster risk systems. This is to keep vulnerable communities' data accurate, updated, and developed as the database of programme beneficiaries.

### **Implication of Implementing AI in Adaptive Social Protection**

Since Indonesia has already introduced AI in disaster mitigation, implementing AI in a broader area, such as adaptive social protection, is not a new concept. However, programme design and budget allocation will need some adjustments.

Indonesia has established ASP-related programmes at both the national and sub-national levels. The integration of AI into social protection programs is not without its challenges. Factors to be considered, such as coverage, relevance, accessibility, accuracy, and information security (Syamsulhakim, 2023), might hinder AI integration into these programmes and require careful consideration. Furthermore, the dynamic nature of data for vulnerable groups, which needs to be constantly updated, poses a significant hurdle. However, proper planning and implementation can lead to a more robust ASP system.

Implementing AI also necessitates addressing budgetary concerns since this will require the allocation of human and monetary resources, tools, and even a new financing mechanism. Forecast-based financing disburses humanitarian funds based on forecast information from previously agreed-upon activities that reduce risk, enhance preparedness and response, and make disaster risk reduction in overall humanitarian assistance more effective. The International Federation of Red Cross and Red Crescent Societies (IFRC) has developed a six-step scheme to implement forecast-based financing, which can be adapted for AI-powered social protection programmes. These steps involve understanding risk scenarios, identifying available forecasts, formulating early actions, identifying danger levels, creating standard operating procedures or early action guidelines, and validating them with key stakeholders (German Humanitarian Assistance et al., 2023).



**Figure 2.** Forecast-based Financing Implementation Scheme  
 Source: Author, 2024 (Adapted from German Humanitarian Assistance et al., 2023 & Bwire, n.d.)

## Conclusion

To summarise, implementing AI in adaptive social protection, especially in disaster mitigation and climate change adaptation, brings significant changes on the road to a more responsive system. Breakthroughs such as the early warning systems developed by the Meteorology, Climatology, and Geophysical Agency (BMKG), from digital seismographs to real-time earthquake information systems (Warning Receiver System New Generation), assisted with Forecast-based Financing (FbF), will create a robust adaptive social protection system.

However, it is important to note that implementing AI in the scheme of adaptive social protection can get overwhelming very quickly, especially when integrating it into an already-established programme and compiling information from different parties, as well as the implications it can have.

It is important to keep it central when integrating AI into a social protection system, in a sense where a single government agency should be responsible for its development so that it would be easier to monitor and evaluate its progress. Another thing to note is that since ASP is such a community-centric concept, involving the citizens at every step of its development would be ideal; not only will it familiarise them with the programme, but it will also build trust between the government and citizens, which is crucial in building a sustainable programme.

### Disclaimer

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