



Artificial Intelligence for Conflict Early Warning in Africa's Fragile States: Opportunities, Architectures, and Ethical Challenges

A. D. Hussain^{1,2*}, E. O. Ogunmola³

¹Department of Conflict, Peace and Strategic Studies, Afe Babalola University, Ado-Ekiti, Nigeria.

²Centre for Peace and Strategic Studies, University of Ilorin, Nigeria.

³Department of Conflict, Peace and Strategic Studies, Afe Babalola University, Ado-Ekiti, Nigeria.



ABSTRACT: The processes of maintaining peace and security in Africa's fragile states are compounded by interplay of factors. These conditions engender complex and fast-changing conflict dynamics that are hard to monitor using everyday methods. Artificial Intelligence (AI) presents unique challenges in its ability to process vast and real-time data from diverse sources to reveal conflict signals at its latent stage. The adoption of AI in conflict early warning systems (CEWS) thus presents an innovative approach to managing and preventing conflict in Africa's fragile states. This paper explores the potential of AI towards enhancing CEWS that will predict, track and prevent conflict through data-driven insights. Integrated narrative review of literatures that is guided by structured brainstorming on challenges and impacts of AI technologies was employed as the methodology for this study. The study concludes that AI has the capacity to improve the accuracy and timeliness of conflict predictions but does not address contextual limitations in fragile states. However, significant challenges remain, such as data quality issues, algorithmic biases, and the need for human oversight. Furthermore, fragile states often lack the technical expertise and infrastructure required to fully implement AI solutions. Governments and international organisations must therefore invest in AI capacity-building, ensure data governance standards are met and foster collaboration between technology developers and peacebuilding experts. By integrating AI into national and regional security frameworks, fragile states can better anticipate and prevent conflicts, ultimately contributing to long-term peace and stability in their region.

KEYWORDS: Artificial Intelligence, Conflict Early warning, Fragile States, Peacebuilding

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I. INTRODUCTION

Inability to provide basic needs of life for its masses, security challenges and weak governance structures have unabatedly characterised fragile states in Africa. The Fragile States Index (FSI) identifies security apparatus, reliance on external interventions and factionalised elites as key indicators of state fragility. These, according to Glawion et al., 2019 have accounted for why these states struggle with political instability, social unrest and economic vulnerabilities. It is important to acknowledge that the manifestation of these indicators may vary significantly between and within countries. The concept of fragile states has been criticised for its focus on deficiencies and shortcomings in governance. This contradicts the notion that the states are entirely dysfunctional and suggests that local structures may play a crucial role in maintaining some level of stability. It is argued that resilience of local socio-political structures in some of these states facilitate understanding and building

upon existing capacities rather than solely focusing on perceived deficiencies.

Zoellick, (2008) observed that about one billion people live in fragile states, including a disproportionate number of world's extreme poor. They are blighted by armed conflicts, communal violence, political instability as well as human displacement. These countries also account for most wars around the world which further exposed fragile states to tough peace and security challenges in the recent time. While technology offers potential advantages, its deployment also presents some concerns. The objectives of this study are to investigate how AI can strengthen CEWS in fragile African states. It also set out to examine the opportunities that AI presents, the architecture, and its emerging ethical challenges.

Fragile states in Africa are confronted with myriad of challenges in deploying technology for conflict prevention and management. Inadequate infrastructure and resources create great barriers to implementing

*Corresponding author: hussain.ad@unilorin.edu.ng

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technological solutions in fragile states. El-Jardali *et al.*, (2023) observe that weak technological infrastructure and lack of access to reliable electricity can deter the adoption of effective digital technology in fragile states. The fourth industrial revolution (4IR) presents AI-driven predictive analysis that will transform the handling of conflict from reaction to prevention. Interestingly, while conventional approaches to security sector reform (SSR) have focused on state-centric solutions, there is growing recognition of the need for more inclusive strategies. Donais, (2018) argued that the needed strategy should be able to reconcile different understandings of ownership, acknowledge non-state security provision and strengthen state and community relations instead. This shift reflects the complex reality on the ground, where governance, order, and security are often produced through interactions between multiple actors and institutions rather than the state alone (Abrahamsen, 2016). By implication, a sustainable security in fragile states can only emerge from an endogenous process that is driven by the insiders.

Privacy issues and computer literacy gaps among the population have impeded the successful deployment of digital technology for peacebuilding intervention in fragile states. Moreover, the rapidly changing nature of conflicts in these states may quickly render the existing technological solutions obsolete, requiring constant adaptation and updates (Woodward, 2017). Despite these challenges, technology still holds promise for conflict management in fragile states. While there is growing literature on the use of AI in governance, security and CEWS, very few studies have examined how AI can be expressly adapted to the intricate realities of Africa's fragile regions. Available literatures often highlight the practical potential of AI but ignore the contextual barriers that impede implementation in fragile environments. There exists inadequate conversation on ethical risks of AI application in conflict-sensitive contexts. This lack of integrated analysis leaves a gap in understanding the pathways through which AI can be responsibly and effectively adopted for CEWS in Africa. In solving this problem, this study attempts to synthesise existing knowledge to propose a framework for effective AI adoption in Africa.

Considering the quality and heterogeneity of the existing literature on AI and CEWS, this study utilised an integrated narrative review approach. The choice of this method was informed by the need to integrate insights from varied sources that address AI adoption in fragile spaces. Unlike a systematic review, an integrated narrative review gives room for conceptual pattern identification and linking of theme that are relevant to fragile contexts in Africa. The three-stage review process

commenced with literature scooping across academic databases and grey literature repositories using keywords. This process was followed by screening of the retrieved studies for relevance with focus on works that examined the application of AI in security, governance and early warning systems. The third stage was subjecting the selected studies to structured brainstorming thematic synthesis process for mapping and categorisation of the opportunities, challenges and ethical risks of AI for CEWS.

II. STATE FRAGILITY AND GOVERNANCE DEFICIT

Economic instability, weak governance, and social fragmentation are interlinked challenges that characterize fragile states, leading to severe development impediments and heightened vulnerability to crises. Economic instability in Africa was created by weak governance structure. This has caused the state machineries to lack the capacity to manage conflicts and provide the required essential services (Chesterman *et al.*, 2007). Weak governance is, therefore, a defining characteristic of fragile states, often manifesting in a lack of political legitimacy and institutional capacity. According to Woldegiorgis, (2022), social fragmentation further compounds these issues, as hierarchical social structures and economic exclusion foster conflict and political instability, particularly in Africa. Ault & Spicer, (2013) emphasise that state fragility is often a predictor of poor economic outcomes, as these states fail to deliver essential functions to their citizens, leading to widespread poverty and economic stagnation. The multidimensional nature of state fragility therefore impacts global security risks by providing avenues for terrorism, human trafficking and violent conflicts (Islam Khan, 2019).

It is important to note that in regions like the Middle East, weak states such as Yemen and Libya illustrate the complex interplay of failing politics, interventionism, and social fragmentation, which hinder effective governance and development. The demographic trends in fragile states indicate that rapid population growth in these regions, coupled with weak governance, can lead to increased competition for scarce resources, thereby entrenching social divisions and instability (Goldstone *et al.*, 2014). Governance deficit, according to Nascimento & Medeiros, (2022), is the major root of state fragility with partial institutional capacities associated to poverty and social unrest. This governance failure thereby creates a vicious cycle where the inability to deliver services leads to further loss of legitimacy, as citizens lose confidence in their government. Addressing these challenges requires a comprehensive approach that includes fostering inclusive development and strengthening institutional capacities to break the cycle of fragility and promote stability.

This study is driven by theoretical frameworks that underpinned conflict prevention and peacebuilding works. Among the key theoretical frameworks in peace

and conflict studies is the concept of structural violence, which posits that social structures can harm individuals by preventing them from meeting their basic needs. This idea was proposed by Stewart, et al., (2002), who emphasises the importance of addressing root causes of conflict rather than merely responding to its symptoms. In an attempt to uncover the underlying social, economic and political factors that contribute to conflict, Government and policymakers can introduce preventive measures that will promote sustainability and peace. For example, when situations of inequality, political discriminations and lack of access to resources are addressed social tension can be mitigated before escalation into a full-blown violence. While examining the sociopsychological foundations of intractable conflicts, Bar-Tal, (2007) identify how collective memory and social identity influence group behaviour and opinions about others. This emphasises the role played by strong institutions in conflict prevention and peacebuilding processes. It is apt to submit that strong institutions are capable of promoting good governance, transparency and accountability which are essential ingredients for constructive conflict prevention and peacebuilding.

III. EVOLUTION OF CONFLICT EARLY WARNING SYSTEMS (CEWS)

The concept of CEWS can be traced back to the recognition that timely information is critical for preventing violence. The systems were initially reactive only by monitoring existing conflict instead of conflict prediction. There has been a paradigm shift towards more proactive approaches that emphasise the importance of anticipating conflicts before they escalate in the recent time. This evolution has been influenced by various factors, including the increasing complexity of conflicts in Africa, the need for timely interventions and the integration of new technologies. Early warning systems (EWS) play a crucial role in conflict prevention and mitigation of violence. These systems are systematically designed to predict unwanted events and uncover disasters that have the tendency of resulting to significant damage. In the context of conflict prevention, EWS aim to provide timely warnings to minimise loss of life and reduce economic and social impacts on vulnerable populations (Garcia & Fearnley, 2012). The importance of EWS in conflict prevention is underscored by their potential to improve information generation and system development. Early warning systems are therefore noted as significant tools for conflict prevention, offering the potential to mitigate violence and reduce societal costs.

The evolution of Conflict Early Warning Systems (CEWS) in Africa has been marked by significant advancements aimed at enhancing crisis prevention and response capabilities. At the beginning, CEWS was used for monitoring political violence and crises by

deployment of the technology to offer timely alerts and facilitate decision-making processes (Pashentsev & Kolotaev, 2025; Muggah & Whitlock, 2022).

The African Union (AU) has played a pivotal role in the introduction of frameworks like the Africa Multi-Hazard Early Warning and Early Action System (AMHEWAS) which integrates disaster risk reduction strategies across multiple scales (Libertino et al., 2024). The AU also established the Continental Early Warning System with the aim of enhancing anticipation, preparedness and early response to conflicts across the continent. More so, the Africa CDC's event-based surveillance framework has been instrumental in improving real-time situational reports, specifically adopted during the COVID-19 pandemic (Mercy et al., 2023). Generally, these systems rely on data collected from various sources, including local communities, civil society organizations and international partners to provide timely warning about potential conflicts (Eze & Frimpong, 2020). The CEWS, in Africa, is supported by regional mechanisms such as the West Africa Network for Peacebuilding (WANEP), which plays a crucial role in information sharing and analysis at the regional level (Eze & Frimpong, 2020). The use of mobile platforms, such as Facebook, WhatsApp and X (formerly Twitter) have been recognised as effective means of facilitating communication between the masses and the authorities.

Despite these progresses, issues relating to data quality, coordination challenges, limited scope of analysis, ethical and privacy concern, and political will to act on the alert have continued to create 'warning-response gap' (Muggah & Whitlock, 2022). However, the evolution of Conflict Early Warning Systems in Africa reflects a growing understanding of the intricacies of conflict dynamics and the need for proactive measures to prevent violence. That is, the integration of the collected complex data and analysis techniques has continued to shape the effectiveness of CEWS in mitigating conflicts and disasters in Africa (Lahmood & Mutlak, 2024).

Future development of CEWS should focus on improving transparency, accessibility, and inter-system cooperation, while also addressing the need for more localised and participatory approaches (Zhang et al., 2024). As traditional conflict early warning systems is confronted with several limitations and challenges, it lacks transparency and data accessibility thereby hindering knowledge sharing and system development (Van Walraven, 1998). Da Silva et al., (2020) therefore, submit that public preparedness and risk perception greatly impact the effectiveness of early warning systems. Failing to account for these social dimensions can limit the EWS overall efficacy.

IV. PEACEBUILDING AND TECHNOLOGY

The intersection between peacebuilding theory and technology unveils an intricate context where digital tools can either make or mar the traditional peacebuilding efforts. This represents a dynamic and evolving field that seeks to harness technological advancements to enhance peace processes and conflict resolution. As conflicts become increasingly complex, the integration of technology into peacebuilding strategies offers new possibilities for addressing underlying issues and facilitating dialogue. The integration of technology into peacebuilding efforts can enhance these processes by providing new tools for communication, data analysis, and community engagement (Larrauri & Kahl, 2013). In order to understand coproduction of peacebuilding problems and technological solutions, Hirblinger et al., (2022) propose critical reflexivity as a Digital Peacebuilding framework. This framework encourages critical reflexivity in the use of technology by ensuring that technological interventions are contextually relevant and aligned with the goals of peacebuilding. The emerging field of IT peace research emphasises the importance of empirical studies and technical innovations that address the unique challenges posed by digital environments, such as insecurity and legal frameworks (Reuter et al., 2019). Furthermore, the potential of digital identity and online communities to impact on the marginalised youth reveals how technology can facilitate global citizenship and economic opportunities that will eventually contribute to peacebuilding. The use of information and communication technologies (ICTs) helps in facilitating dialogue and liberating the marginalised individuals but it possesses the ability to intensify existing inequalities and create new forms of conflict. It is therefore important to investigate the views about technology's role in fostering inclusivity, as it can also incite crises when wrongfully deployed (Firchow et al., 2016 and Tellidis & Kappler, 2015).

V. A THEORETICAL LENS: CRITICAL SECURITY STUDY

To critically interrogate the adoption of AI for CEWS in Africa's fragile states, this review is underpinned by the theoretical precepts of critical security studies (CSS). Beyond the traditional state-centric security hypotheses, this theory offers a strong framework for understanding the power dynamics, ethical issues and normative implications of adopting advanced computational technologies in Africa's fledgling socio-political landscape. This lens allows us to reframe the traditional security models that prioritise the

state as the primary referent entity (Miller, 2014 and Saleh, 2011).

This theory criticises the assumption that AI technologies are inherently neutral and objective by transcending its technical efficacies to examine the ethical and humanitarian risks; power imbalances and inequality; and human agency and inclusivity. This study challenges the narrow conception and propose for a broadened agenda that centres on human security which prioritise securing individuals and communities from pervasive threats to their rights, safety and livelihood.

Contextualizing this to the fragile state of Africa where states institutions are weak or predatory, that is, a system that is designed solely to protect the state from instability. This system is prone to perpetuating cycles of violence (Peoples & Vaughan-Williams, 2020). Adopting an AI-enabled CEWS, is paramount but the theory of Critical Security Study (CSS) compels us to ask if the AI system protect people? This means that ensuring early warnings benefit not just the security forces but also vulnerable communities.

CSS therefore focuses on analysing how security issues are framed, by whom, and to what extent. This is conceptualised by Browning & McDonald, (2013) as the process of deconstructing political security. Security is, therefore, not an objective condition but a socially constructed discourse that empowers certain actors. Viewing AI adoption through this prism reveals it as an act of knowledge production and power consolidation. The data used in training AI models becomes key site of power. Moreover, the algorithmic "black box" transfer the power to define what is knowable from local knowledge system to external technologists and the algorithms themselves. This is equipped with high potentials of disempowering the local peacebuilders.

Obendiek, & Seidl, (2023), therefore, argue that CSS demands skepticism towards technological solutionism which is the belief that technology alone can solve profound political problems. It forces the question: *cui bono* (who benefits?). The development and deployment of AI for CEWS is embedded within global political economies involving donors, multinational tech corporations and national governments. This analysis scrutinises whether these systems serve commercial interests and strategic goals of powerful states rather than the security needs of local populations. From this perspective, the discussion of ethical imperatives is not a mere add-on but a political struggle to resist. Unaccountable power and ensure these systems are subject to democratic oversight and aligned with the emancipatory goal of genuine human security. The application of CSS lens to analysing the adoption of AI for CEWS presents its potential for harnessing AI as a tool for emancipatory practice that enhances local agency that addresses root causes of conflict. This theory also reinforces existing hierarchies of power that enables new form of control.

VI. TECHNICAL ARCHITECTURES OF AI FOR CEWS: DATA ROLE

Artificial Intelligence (AI) plays a transformative role in handling complex security situations across various spheres. AI-driven systems assist in processing large amount of data, detecting discrepancies and identifying patterns that are often miss by traditional security systems (Folorunso et al., 2024). This capability enhances threat detection, enables automated response mechanisms, and contributes to the development of resilient security frameworks (Shahana et al., 2024). In cybersecurity, AI technologies empower security systems

for real-time data analyses by tracking the patterns that are indicative of malicious activities (Ntoutsu et al., 2020 and Thapaliya & Bokani, 2024). AI-driven algorithms can proactively detect and neutralise cyber threats before they inflict substantial damage, reducing response times and minimising the impact of security breaches.

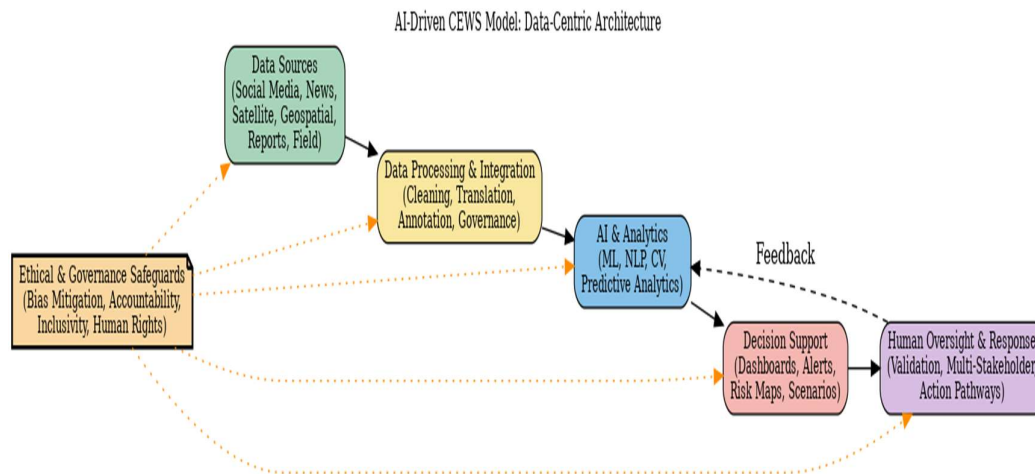


Figure 1: AI-Driven CEWS Model data -Centric Architecture

This above model highlights a data-centric architecture for an AI-driven CEWS in which every technical stratum is built on good data foundation. The process starts by ingesting diverse data streams which are stored and refined in a centralised data lake. This initial stage is critical, as the quality, diversity and integration of this raw data directly determine the system's overall accuracy and reliability. The analytical power of the system is realised through AI and machine learning, thereby, transform the refined data into actionable insights. This is to say that these technologies are entirely data pipeline dependent. The resulting analyses are then converted into intuitive dashboards, GIS maps and alerts that will make complex forecasts to be easily understood by stakeholders.

This architecture, however, closes the loop by directing these insights to policymakers, NGOs and communities in order to enable informed response and sound preventive strategies. The system's effectiveness therefore hinges on seamless flow from raw data to actionable intelligence. This underscores the fact that data is not just an input but the central and indispensable asset that powers every facet of CEWS.

It is important to acknowledge that AI offers powerful tools for identifying, mitigating, and

prevention of attacks, but one must not forget to state that AI also presents new challenges. That is, AI systems are susceptible to exploitation in sophisticated cyber-attacks, Shahana et al., (2024) therefore suggest the need for continual advancements in AI-driven security solutions. As AI continues to spread, its abilities to revolutionise human security therefore remains very important. It is against this backdrop that this study attempts to explore how AI can be deployed to enhance Conflict Early Warning System, identify key AI technologies applicable to CEWS and also analyse its challenges then propose solutions for AI adoption in fragile states.

A. AI Technologies in Conflict Prevention

AI is increasingly used for conflict prediction and management globally, enhancing early warning systems and decision-making processes. AI-powered analytics facilitate deeper conflict analysis, enabling policymakers to develop proactive strategies for conflict prevention and resolution, thereby promoting sustainable peace (Mandokhail, 2024). Machine Learning (ML) algorithms, such as gradient tree boosting and multilayer perceptron, have been shown to effectively predict civil conflicts in sub-Saharan Africa, thus, enabling proactive measures to mitigate potential violence (Musumba et al., 2021). In a conflict prevention context, ML algorithms is capable of

analysing large dataset in order to recognise trends and patterns that may indicate conflict tendencies. ML techniques, such as Recurrent Neural Networks (RNNs), have shown promise in forecasting violence by identifying historical patterns, which can inform long-term conflict escalation trends (Malone, 2022). Muchlinski et al. (2020) employed Convolutional Neural Networks to measure electoral violence through social media analysis. This showcased how ML can enhance the accuracy of conflict detection by processing vast amounts of textual data. David et al. (2023), also argue that AI has the ability to support anticipatory actions in humanitarian responses by linking early warning systems to actionable insights, thereby enhancing situation awareness and enabling proactive measures. This predictive capability is crucial in locations where prompt changes can easily instigate violent conflicts.

Predictive analytics plays pivotal role in conflict prevention by utilising statistical algorithms and ML techniques to detect the possibility of future consequences based on historical data. Predictive models are capable of forecasting areas at risk of conflict by reviewing economic indicators, social media posts, conflict datasets and other related information. This approach, if employed, will assist governments and organisations to effectively allocate resources to deploy preventive measures before conflicts escalate. Effective intervention strategy that will give room for detailed analysis and simulation of conflict dynamics can therefore be achieved when predictive analytics is adopted.

Big data refers to the vast volumes of structured and unstructured data generated every second from various sources. These sources include social media, satellite imagery and economic reports. The analysis of big data can provide insights into the underlying factors contributing to conflict, such as resource scarcity, social inequality and political instability. Wählisch, (2019), submits that big data technologies can enhance peacebuilding efforts by providing real-time information that informs decision-making processes. This capability is particularly valuable in fragile states, where traditional data collection methods may be limited or unreliable. Moreover, big data analytics can facilitate the identification of social networks and power dynamics within conflict-affected areas. Luna-Pla, (2024) explain how network analysis can reveal power elites and their influence on conflict dynamics, thereby providing critical insights for peacebuilding initiatives. By understanding these networks, scholars can design interventions that will target the root causes of conflict and promote social cohesion. Mueller, (2024) designed a global dataset on conflict forecasts, utilizing natural language processing and machine learning to predict sudden outbreaks of violence in peaceful countries. This application illustrates how big data can enhance situational awareness and enable timely interventions in conflict-prone areas.

It is important to note that these technologies combine to offer transformative tools for analysing complex datasets, conflict prediction and facilitation of prompt interventions. By leveraging these technologies, stakeholders can enhance their ability to anticipate conflicts, understand underlying causes, and implement timely interventions. However, it is crucial to navigate the associated ethical challenges to ensure that these technologies contribute positively to peacebuilding efforts. Cortright, Fairhurst, & Wall (Eds.) (2017) therefore cautioned that its integration into armed conflicts raises some ethical concerns and threat notwithstanding its potential to fatalities and destruction. As AI systems are increasingly employed in sensitive areas such as conflict management, establishing robust ethical frameworks will be crucial to mitigate risks associated with their deployment.

B. From Prediction to Response: Tech-driven Initiatives in Peacebuilding

Successful technology-based peacebuilding initiatives have emerged across various regions, demonstrating the potential of digital tools to foster dialogue and inclusivity. For instance, in Libya and Yemen, the United Nations deployed artificial intelligence and natural language processing to engage thousands in local dialects in a view to facilitate real-time polling and dialogue among conflict stakeholders (Alavi et al., 2022). Additionally, the integration of digital methods in peace mediation has been shown to enhance negotiations by balancing data-driven insights with future-oriented scenario planning, as evidenced in qualitative studies from Yemen (Wählisch, 2019 and Hirblinger et al., 2023). Furthermore, initiatives like the Internet of Things (IoT) in Sudan and Colombia have highlighted the importance of gender inclusivity in peacebuilding, empowering women to participate actively in peace processes (Oyekanmi & Ojo, 2024). Lastly, the Russian-Chinese Technology Park initiative aims to leverage information and communication technologies to promote development and peace in conflict-affected areas like Syria. These examples illustrate the transformative role of technology in fostering peace and inclusivity in diverse contexts.

The integration of technology into peacebuilding initiatives has yielded numerous successful examples across the world. These initiatives leverage advancements ICT, AI and data analytics to enhance conflict resolution and promote sustainable peace. Effective technology-based peacebuilding initiatives abound in varying contexts around the globe. The adoption of various digital tools has been pivotal in educating communities about conflict resolution in Cambodia. A study by Sanchez & Chamucero (2017) highlight how ICT supports

teaching strategies that promote psycho-socio and emotional well-being among the children and the adolescents in Cambodia. Educators, have through the use of digital platforms, engage young people in conflict resolution training that will eventually foster the skills that contribute to a culture of peace. This initiative not only empowers youth but also helps to mitigate future conflicts by equipping them with the tools to manage disputes constructively. Mandokhail (2024) examines how its deployment can guide effective peacekeeping interventions by allowing policymakers to develop proactive approach to conflict prevention and resolution. The use of technology has bridged geographical gaps by enabling real-time communication and negotiation between conflicting parties (Mahmoud, 2023).

Video conferencing tools and social media platforms have been used to facilitate stakeholders' engagement in dialogue with a view to share perspectives and evolve conflict resolution strategies notwithstanding the challenges presented by physical separation and ongoing conflict. This initiative underscores the potential of technology to foster communication in highly fragmented environments. The UN Peace Initiatives dataset, highlighted in the study by Clayton et al., (2020) help in providing insights into the numerous initiatives undertaken by the UN to promote global peace and security. These initiatives often incorporate technological tools for monitoring and reporting on conflict situations, enhancing the UN's ability to respond effectively to emerging conflict.

VII. CRITICAL CHALLENGES AND ETHICAL RISKS

The literatures reveal that there exist significant challenges in the adoption of AI into CEWS in Africa. Data governance challenges ranked most among several challenges militating against adoption of AI for CEWS. It is noteworthy to emphasise that data is highly essential for the effective functioning of AI-driven systems. AI technology is highly dependent on large amount of accurate and up-to-date information to predict and track manifestation of conflicts. Gellers & Gunkel, (2023) in his critic of a study by Amnesty International reveals that many fragile states lack of reliable data sources, coupled with problems like incomplete datasets, unreliable reporting and limited access to information, severely hinders the potential of AI in conflict early warning. For example, data collection is often inhibited by logistical challenges and security risks in regions affected by conflict or political instability thereby making it difficult to gather consistent and accurate information.

Moreover, data quality issues such as inconsistencies in how data is recorded, fragmented data sources and biases in data reporting can skew AI predictions and limit the effectiveness of conflict early warning systems (Oloyede & Owen, 2025). In Sub-Saharan African region, where access to technology is limited, obtaining high-quality data from sources like satellite imagery, geospatial mapping or social media platforms is often a logistical challenge. The availability of accurate real-time data is crucial for detecting early warning signs of conflict and tracking conflict dynamics. Therefore, addressing the issue of data quality and availability is vital to the success of AI-powered CEWS.

Another critical challenge to the adoption of AI in CEWS is algorithmic biases and the ethical implications of AI applications. AI systems are not immune to the biases inherent in the data they are trained on and these biases can have significant resultant effect when applied to the conflict prevention context. In particular, AI systems may inadvertently perpetuate existing social, political or economic inequalities by prioritizing certain groups or regions over others based on lop-sided data inputs (O'Neil, 2016). A good example of such bias is the misrepresentation of use of Hausa language during 2015 Presidential Campaigns by late President Muhammadu Buhari in Nigeria. A campaign statement calling for community self-defence was flagged by the opposition parties and circulated as violent extremism on various social media platforms. Because the AI system relies heavily on Natural Language Processing (NLP) models primarily trained on English language datasets and limited Hausa translations, it sent skewed threats and fuelled grievances across the Nigerian political landscape. In an instance when the data used in training the AI systems predominantly reflects the perspectives of more powerful or politically influential groups, the AI model may fail to identify early warning signs among the marginalised communities, worsening the very issues that it is designed to address.

Additionally, the use of AI in conflict prediction raises important ethical considerations related to the potential for misuse, accountability and transparency. The adoption of AI systems by governments or international organizations in fragile states must be guided by strict ethical frameworks to ensure that AI-driven decisions do not lead to inadvertent damage or infringement of human rights. Hickok, (2020) noted that AI models used to predict conflict escalation could potentially lead to the militarisation of responses based on inaccurate predictions and then aggravating tensions rather than building peace.

To mitigate these risks, it is essential to establish transparent AI systems that are regularly audited for biases and errors. Moreover, ethical frameworks should be developed to guide the use of AI in conflict-sensitive contexts, ensuring that AI applications are used responsibly and do not undermine human rights or social stability. Collaboration between AI researchers,

peacebuilding experts, and human rights organizations is necessary to create safeguards that minimize biases and ensure the ethical use of AI in conflict prevention.

Another significant barrier to the successful adoption of AI into CEWS in fragile states is the infrastructural deficit and lack of technical expertise. Specialised knowledge in the fields of machine learning, data science and natural language processing is required to drive the AI systems. This knowledge is greatly lacking in many African countries, particularly in fragile states where resources are limited (Pérez & Zhu, 2021). The lack of local expertise in these technical areas also poses great challenge in both the design and implementation of AI-driven conflict prevention systems. Even when AI technologies are introduced, the ability to effectively manage and update these systems requires continuous technical support and training, which may not be readily available in conflict-affected regions.

In addition to technical expertise and infrastructural deficits, limited access to reliable electricity, internet connectivity and computing power, further militate against the adoption of AI systems. As African region struggle with inadequate technological infrastructure, it often results in delays and failures in the execution of AI-driven conflict early warning mechanisms. The lack of data centres and cloud computing infrastructure hitherto makes it difficult to process large datasets required for AI applications in conflict prevention. Meanwhile, the risk of technological determinism, confusing correlation with accusation, biased training of data will always lead to skewed predictions.

VIII. CASE STUDIES AND APPLICATIONS

Several African countries, particularly those qualified as fragile states, have made strides in piloting AI-driven systems for conflict early warning. These efforts are often in the early stages but provide valuable insights into the challenges and potential of AI applications in conflict prevention. The first AI technologies in conflict prevention systems in Africa was designed to monitor election related crises in Kenya. This idea was experimented by the Kenya Red Cross in conjunction with other civil organisations using AI to analyse real-time data from social media platforms, mobile phones and SMS systems. By applying sentiment analysis and machine learning techniques, AI tools can track provocative narratives and early warning signals of violence. These systems have been used to present early alerts to local authorities, humanitarian organizations and peacekeeping forces, thereby facilitating prompt response in high-risk areas (United Nations, 2019). In this context, the AI system leverages natural language processing (NLP) and predictive analytics to monitor

and analyse public discourse during election period, which are usually the root of Kenyan crises. While these systems have shown good potentials, issues bordering on data privacy, limited access to detailed datasets and technical capacity remain challenges.

Another country where attempts have been made to incorporate AI for monitoring and conflict prevention is Nigeria. Nigeria was heavily affected by internal conflicts such as insurgencies in the northeast and banditry thereby necessitating the need to evolve a conflict prevention mechanism. The Nigerian government, alongside various cooperating international organisations, have used AI to track violence patterns, particularly in the context of the Boko Haram insurgency. Machine learning algorithms have been employed to predict areas where attacks may occur, based on historical data, social media activity and even geospatial information derived from satellite imagery (TechCrunch, 2020). The National Intelligence Agency of Nigeria, in 2020, adopted AI to analyse security trends and track refugee movements across borders with the sole aim of predicting conflict-prone areas. The use of AI tools such as machine learning and predictive analytics helped enhance the capacity of the government to respond pre-emptively, though the deployment of these tools faced hurdles related to coordination between governmental agencies and data availability.

The last example for AI systems' adoption for peacebuilding and conflict monitoring in Africa is South Sudan. This is a nation with an ongoing civil conflict. AI-based platforms were deployed to analyse geospatial data and satellite imagery to track military movements and potential human rights violations in South Sudan. In furtherance to this, the use of AI to process open-source intelligence (OSINT) from social media has assisted the peacekeepers in identifying patterns of internal displacement and civil unrest in the country. In 2021, a joint initiative with the UN Peacekeeping Force developed AI systems that aim to identify risk factors that contribute to conflict escalation, such as resource competition and ethnic tensions (United Nations Peacekeeping, 2021). The programs have demonstrated the importance of accurate data collection and analysis, but they also highlighted the necessity for AI systems to be used in conjunction with human expertise to interpret complex social and political contexts in conflict zones. The table below presents comparison of AI-driven Conflict Early Warning System in Kenya, Nigeria and South-Sudan.

Table 1: Comparison of AI-driven Conflict Early Warning System in Kenya, Nigeria and South-Sudan

ASPECTS	KENYA	NIGERIA	SOUTH SUDAN
DATA TYPE	Open-source data (social media & news outlets) Survey data and Satellite Imagery (conflict spots)	Social Media; Mobile Phone Data; Satellite & Aerial Imagery	Humanitarian Aid Data; News Reports & Social Media; Geospatial Data
AI MODEL	Natural Language Processing (NLP)	Deep Learning (CNN, LSTM for text)	Supervised Learning (SVM, Decision Trees)
	Machine Learning (Random Forest)	Geospatial AI models (GIS, Clustering)	Unsupervised Learning (clustering)
	Sentiment analysis	AI Predictive Analytics (time series forecasting)	Anomaly Detection Algorithms
OUTCOMES	Timely detection of community tensions and imminent political crisis	Early Warning on Boko Haram activities, Kidnapping and Electoral/Communal conflict.	Early alert of crises along the border region and displaced persons camp.
	Enabled prompt response to 2017 post-election crisis	Detection of displacement and conflict hotspot.	Enhanced intervention deployment.
	Offered actionable insights to de-escalate the potential violence	Faster response by authority	Identification of crises-prone areas
LESSONS	Inaccuracy due to data Scarcity in the localities.	Reliance on certain social media platform led to data bias	Data reliability issues from NGOs and other interventionist sources.
	Local context is critical for improvement in AI predictions.	Need for handshake between the locally sourced and national dataset	Community engagement is vital to contextualise AI outputs.
	Privacy concerns with sensitive social media data	Trust and transparency are necessary for stakeholder buy-in	unpredictable conflict dynamics necessitate continuous model training

The examples from African fragile states and the lessons learned from global AI applications underscore both the transformative potential and the challenges of integrating AI into Conflict Early Warning Systems. While the technology holds significant promise for enhancing conflict prediction and prevention, the obstacles of data quality, algorithmic biases, and the need for technical expertise and infrastructure must be addressed. Drawing from global lessons, African states can improve their AI adoption strategies by focusing on data accuracy, ethical AI development, local expertise, and the necessary infrastructure to support these technologies. With careful planning and collaboration, AI can become a powerful tool in preventing conflict and promoting long-term peace in Africa's fragile states.

IX. A FRAMEWORK FOR ADOPTION: POLICY AND GOVERNANCE RECOMMENDATIONS

Development of context-specific and ethical AI frameworks that aligned with the African Union's Digital Transformation Strategy is enhancing security capabilities, improving decision-making processes and addressing emerging threats. As AI technologies continue to evolve, their application in security contexts offers unprecedented opportunities for proactive threat detection, intelligence gathering,

and operational efficiency. This discussion outlines the significance of integrating AI into security frameworks and strategies for effective implementation. Training programs and capacity building on AI for policymakers and various stakeholders is very essential for its adoption Africa. A broad AI policy framework as well as the need for a robust infrastructure and ethical governance is needed in order to maximise AI benefits while mitigating risks (Folorunso et al., 2024). AI Ethics Board should be established by regional government to include civil society, academic experts and community representatives. This board is to have the mandate of reviewing AI models used in CEWS for detection of potential harms and offer context-specific guidance before its deployment. Education and training initiatives enhance AI literacy by enabling stakeholders to effectively integrate AI into various sectors, including conflict prevention, management and peacebuilding (Masunda, 2024). Furthermore, the promotion of public-private partnerships and international cooperation is vital for aligning local policies with global standards (Isagah & Musabila, 2020).

Introduction of AI ethics into educational curricula will therefore prepare future practitioners to engage in policy discussions and practical applications as well as ensuring that AI technologies are implemented responsibly and sustainably (Masunda, 2025). These training programs will, at

the end, empower fragile states to explore AI's transformative potential while addressing intrinsic challenges. The importance of the training initiatives includes but not limited to enhancing understanding of the AI technologies, fostering collaboration and knowledge sharing and building capacity for evidence-based decision-making. As the landscape of conflict continues to evolve, ongoing investment in training and capacity building will be essential for equipping stakeholders with the tools they need to navigate complex challenges effectively.

Investment in technical infrastructure is another crucial factor for capacity building in artificial intelligence (AI) within fragile states. An investment in AI technical infrastructure lays good foundation for sustainable development and economic resilience in fragile states. A detailed policy framework that is focused on developing digital infrastructure is highly essential. Folorunso *et al.*, (2024) identified digital infrastructures to include robust computing capacity and data governance systems in order to facilitate AI adoption and mitigate risks associated with underdeveloped regulatory environments. Enhancing digital skills through training programs is therefore central to empowering of the local populations to effectively engage with AI technologies (Abisoye & Akerele, 2022). The establishment of monitoring and measurement systems will enable governments to assess AI capabilities and impacts, thereby guiding policy decisions and fostering an environment conducive to innovation (Whittlestone & Clark, 2021). These investments will not only resolve immediate technological challenges but also facilitate a long-term stability and socio-economic progress in fragile states. Successful implementation of AI technologies in these contexts, therefore, requires robust infrastructure that can support data collection, processing and analysis. By enhancing data collection capabilities, facilitating connectivity and addressing resource gap, policymakers can create an enabling environment for the effective use of AI technologies. While challenges exist, targeted strategies such as public-private partnerships, capacity building initiatives, and international support can help overcome these obstacles and promote sustainable development in fragile contexts.

Introduction of regulatory sandboxes for Peace Tech where AI-driven CEWS can be trial tested in a controlled and low-risk environment before its actual deployment is also of essence. This will

afford the developers and peacebuilders to trial technologies with temporary exemptions from rigid regulations, while still being monitored for safety and ethical compliance. Moreover, the 2022 AU Data Policy Framework and the African Union Convention on Cyber Security and Personal Data Protection (Malabo Convention) already set out principles of data sovereignty and inclusiveness. Embedding CEWS within these protocols will enhance AI adoption while also building trust and legitimacy.

X. CONCLUSION AND FUTURE RESEARCH DIRECTION

The integration of AI into CEWS in Africa presents significant potential for enhancing the effectiveness of conflict prevention strategies. However, the identified gaps in AI adoption must be addressed to fully realise this potential. Bridging these gaps is critical for leveraging AI's capabilities in the context of Africa's complex socio-political landscape.

AI systems rely heavily on large datasets to function effectively, unavailability and poor data quality present a key gap in integrating AI into CEWS. Osee, (2024), however, noted that data is sparse, inconsistent or of low quality in many African regions. This gap hinders the ability of AI algorithms to accurately analyse trends and predict conflicts. Integration of AI into CEWS in Africa holds transformative potential. Africa will, therefore, harness AI's capabilities to improve conflict prevention and promote sustainable peace through enhanced data collection, transparent initiatives, ethical guidelines and collaborative frameworks.

To achieve the potential of AI in CEWS, future research must address three gaps. Among these is the need to assess AI's impact on conflict dynamics itself. Knowing that predictive analytics are not neutral, their potential to escalate tensions or create new vulnerabilities requires research on second-order effects of deploying algorithmic systems in fragile states. To mitigate bias and emplace relevance, a research that is tailored towards developing locally curated datasets is highly recommended. Continuous reliance on a universally sourced or non-representative data usually undermines context-specific signs and strengthens external viewpoints. Supporting the creation of community-centered, ethically obtained dataset is vital for building AI tools that are truly responsive to local realities and needs.

AUTHOR CONTRIBUTIONS

A.D. Hussain: Conceptualization, Methodology, Writing – original draft, Writing – review & editing.
E.O. Ogunmola: Validation, Writing – review & editing.
S.A. Haruna: Literature review, Writing – review & editing.
A.A. Garba: Project administration, Writing – review & editing.

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