



Over the past decade, Nigeria has been grappling with a threat of a new kind: improvised landmines. As federal authorities step up efforts to address the issue, this policy brief explores the potential of technologies such as airborne remote sensing and artificial intelligence (AI) to enhance landmine detection.

# **Key findings**

- After declaring its conventional landmine clearance obligations complete in 2011, Nigeria now faces a new threat from improvised landmines throughout its northeastern region.
- Improvised landmines caused over 613 casualties in Nigeria from January to September 2024, 64% of them civilians.
- The number of casualties quadrupled between 2022 and 2024 compared to the entire 2011–2021 period.
- The military exclusively manages Nigeria's current detection process and relies heavily on manual tools, particularly handheld metal detectors, which are slow and risky for operators.
- The combination of airborne remote sensing and AI has shown promising results in military and academic experiments, especially by the

- North Atlantic Treaty Organization and Harvard University, in detecting improvised landmines. These methods offer the potential for safer and faster detection over vast areas, which traditional techniques cannot achieve.
- Stringent regulations on unmanned aerial vehicles (UAVs) enforced by the Nigerian Civil Aviation Authority could hinder airborne remote sensing trials by humanitarian and other external actors, creating legal obstacles to be considered in future project planning.
- Data ownership, activity oversight, storage protocols and the sourcing of detection devices could pose additional challenges unless Nigerian state authorities are wellinformed and centrally involved in all external detection initiatives.

#### Recommendations

Federal and state authorities:

- Explore alternative methods to speed up detection and minimise risks to human security. Prioritise humanitarian trials involving airborne remote sensing and Al in affected areas.
- Authorise humanitarian actors to expand beyond information sharing and Explosive Ordnance Risk Education to contribute directly to detection and clearance operations.
- Consider Nigeria's large-scale contamination and urgent need for advanced tools as strong justification for initiating practical humanitarian tests of new technologies.
- Grant special derogations to expert entities to ease legal restrictions on drone use. The

development of Nigeria's national mine action strategy, currently underway with support from the International Committee of the Red Cross, offers a timely opportunity to formalise such measures.

#### Potential partners:

- Provide assurances that address political stumbling blocks around data ownership, oversight and security.
- Engage local expertise and institutions to source UAVs and sensors and to manage data storage and domestic processing of the data collected.

#### Introduction

In 2011, Nigeria declared the complete clearance of conventional landmines left by the 1967–1970 Biafra War on its soil.¹ However, over the past decade, the country has faced a new and growing threat: improvised landmines. Their proliferation has been driven by the increased operations of non-state armed groups (NSAGs), such as Boko Haram and its breakout factions in the northeastern states of Borno, Adamawa and Yobe.

Improvised landmines are a subcategory of improvised explosive devices (IEDs). Because they are victimtriggered and tactically used as industrial landmines, they fall under the scope of the Anti-Personnel Mine Ban Convention (APMBC). This study uses the terms 'improvised landmines' and 'improvised devices' interchangeably to refer to improvised step-activated landmines. Similarly, 'conventional landmines' will refer to factory-made and standardised landmines.

Improvised landmines have claimed thousands of lives over recent decades, placing Nigeria at the top of landmine-related death toll statistics in Africa and globally and forcing massive population displacements.<sup>2</sup> Civilians, especially children and women, are the most affected. From 2011 to September 2024, Nigeria had recorded 2 874 casualties, including military personnel and civilians.<sup>3</sup>

Further, the spread of improvised landmines has had severe consequences on northeastern Nigeria's socioeconomic life. They have killed and displaced people, and disrupted economic activities, such as agriculture and commerce. They have rendered vast tracts of farmland inaccessible, directly undermining rural livelihoods, reducing food production and driving many households into chronic food insecurity.<sup>4</sup>

In this dire context, the Nigerian government has taken decisive action by mobilising the federal army to clear contaminated areas and establishing the National Mine Action Centre (NMAC). The government has also partnered with humanitarian organisations to support Explosive Ordnance Risk Education and facilitate information sharing for early reaction. These collaborations extend to jointly managing the needs of Internally Displaced People.

While the government's efforts are commendable, responding to improvised landmines remains an immense

challenge. Their makeshift nature allows for easy production and widespread deployment by NSAGs leading to a high rate of land contamination across the region. Compounding the issue is the continued reliance on traditional detection tools, such as metal detectors, which, despite their reliability, are slow and limit the speed and scale of clearance operations.

Therefore, there is a pressing need to explore alternatives that have shown promising results in combination with existing tools. Considering their potential in detecting IEDs, the combination of airborne remote sensing and artificial intelligence (AI) appears to be a viable option in Nigeria's response.

From 2011 to September 2024, Nigeria had recorded 2 874 casualties of improvised landmines

In line with the above, this policy brief explores opportunities to leverage humanitarian large-scale airborne remote sensing benefits in Nigeria's response to IEDs in its northeastern part. It is informed by an extensive literature review and stakeholder consultations held from 9–13 September 2024. It aims to contribute to continental efforts in exploring the opportunities and risks of mainstreaming technologies in the national mine action plans of AU member states.

## **Cost of improvised landmines**

Nigeria has been grappling with landmines and explosive remnants of war (ERW) since the Biafra War in its southeastern region.<sup>5</sup> The armed conflict between the Nigerian army and Biafran secessionists left vast areas contaminated with conventional landmines and ERW, the majority of which the Nigerians stepped up efforts to clear until the late 2000s.<sup>6</sup> According to the country's declaration at the Eleventh Meeting of States Parties to the APMBC, held from 28 November – 2 December 2011, in Phnom Penh, Cambodia, 75 178 square kilometres were affected.<sup>7</sup> The country declared completion of its obligations under Article 5 of the APMBC during the same conference.<sup>8</sup>

However, as Nigeria was poised to celebrate gains in landmine and ERW clearance in its southeast,

Boko Haram and its breakout factions' uprising in the early 2010s brought new explosive-related challenges. The country's challenge shifted from conventional landmines to a dangerous confrontation with improvised

landmines, widely spread across its northeastern region. In the hardest-hit states – Borno, Adamawa and Yobe – armed groups have deployed various IED types, including vehicle-borne, body-worn and improvised landmines.

Chart 1: Areas affected by improvised landmines



Source: Author. Visualisation: Zenge Simakoloyi, ISS

# Car-mounted IED



Source: UNMAS Facebook post

## A Nigerian soldier disarming an improvised landmine



Source: Defence Visual Information Distribution Service

Given their similarity to conventional ones, in terms of use and activation, improvised landmines are covered by the APMBC under the 'omnibus clause' requiring equal treatment for arms with similar effects.<sup>9</sup>

The spread of improvised landmines in Nigeria stems from two main factors. ERW, left on the battlegrounds, are an available supply for NSAGs to repurpose their metal and chemical components to make unconventional landmines. <sup>10</sup> Similar to conventional landmines, they are often placed on roads and around NSAG strongholds as tactical weapons to restrict the movement of Nigerian armed forces.

Land contaminated by improvised landmines has severely hindered farming, commerce, access to school and other essential public services

Besides repurposing available IEDs, NSAGs have developed rustic but effective techniques to make improvised landmines and IEDs in general. They compress animal waste, combining it with lethal metal fragments and compression materials. Pressurised livestock waste produces methane, which becomes highly explosive when mixed with air, typically in concentrations between 5% and 15%.<sup>11</sup>

NSAGs' generalised use of improvised landmines and the spread of ERW have dire impacts on Nigeria's human security. However, the current contamination scope remains unknown. Vast portions of virgin arable land and farmland have been contaminated, threatening the region's – and, to some extent, the country's – food security.

According to humanitarian sources and Nigerian state authorities, transporting harvested crops to trading zones has become perilous because of improvised landmines along the roads throughout northeastern Nigeria, including in key farming areas. <sup>14</sup> As farming became impossible in some areas and transporting crops to markets grew increasingly hazardous, many farmers were forced to relocate to safer areas, where they had to rebuild their livelihoods and social networks. <sup>15</sup>

Given that Indigenous communities already occupied the resettlement areas, newcomers could access only small plots of land for subsistence farming. For people who once cultivated hectares and relied on crop sales to support their families, this shift proved especially difficult. Although tensions between newcomers and host communities exist, experts note that open violence is rare. With incomes barely covering daily needs, some families have become dislocated, and children have dropped out of school.

Furthermore, land contaminated by improvised landmines has severely hindered farming, commerce, access to school and other essential public services, such as healthcare and administrative facilities, particularly in rural areas where human mobility is significantly restricted.<sup>19</sup> While clashes between



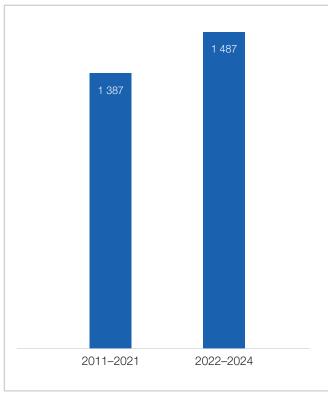
PRESSURISED LIVESTOCK
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newcomers and local communities over land have not yet occurred, they remain a risk if underlying tensions and frustrations are not well-managed.<sup>20</sup>

According to government sources, improvised landmines and ERW have had a severe impact on civilians. These sources reported 613 casualties in northeastern Nigeria from January to September 2024.<sup>21</sup> Consultations with humanitarian actors noted 571 casualties, with civilians accounting for 371 of the victims, about 65%.<sup>22</sup> This corroborates the deadly trend observed over the past decade in Nigeria, as illustrated in Chart 2.

More interestingly, the chart indicates a substantial rise in the average annual number of victims between 2022 and 2024. From 2011–2021, 1 387 casualties caused by improvised landmines and ERW were recorded, an average of about 138 victims a year. However, this number nearly quadrupled to an estimated 495 casualties per year from 2022–2024. Two main factors explain this dramatic rise: the intensified use of landmines by NSAGs in northeastern Nigeria over the past five years and improved casualty reporting during the same period.<sup>23</sup>

Chart 2: Explosive ordnance casualties in Nigeria, 2011–2021 and 2022–2024



Source: The Landmine Monitor 2021, 2022, 2023 and 2024

# Response challenges

After Nigeria's accession to the APMBC, it undertook extensive clearance operations with support from specialised humanitarian organisations, such as the International Committee of the Red Cross (ICRC).<sup>24</sup> After years of effort, the country declared the complete clearance of contaminated lands in its southeast, although some residual contamination is still suspected.<sup>25</sup>

The number of victims of improvised landmines quadrupled to an estimated 495 casualties per year from 2022–2024

Despite its conventional mine-free declaration in 2011, the treaty has not yet been domesticated into Nigerian law.<sup>26</sup> According to the federal constitution, all international conventions must be domesticated to be enforceable within Nigeria's borders.<sup>27</sup> Government officials maintain, however, that the country has adhered to its core obligations, including clearance and helping victims. A similar trajectory applies to the Convention on Cluster Munitions (CCM), which Nigeria joined in 2010. Efforts to domesticate both treaties are underway.

Several factors explain Nigeria's slow domestication of both the APMBC and CCM. Since the country had fulfilled its APMBC obligations, domestication of the convention was no longer seen as pressing, according to an independent source.<sup>28</sup> Regarding the CCM, the absence of cluster munition contamination and the destruction of national stockpiles have reduced the perceived need for domestication.<sup>29</sup>

The Nigerian government and the ICRC have jointly developed a draft bill to domesticate the APMBC, which was submitted to the Ministry of Defence for review as of September 2024.<sup>30</sup> A similar process is underway to domesticate the CCM.<sup>31</sup> The next expected steps are approval by the Nigerian legislature and enactment by the President.

At the same time, the country has established a national structure, the NMAC, to coordinate and oversee ongoing mine action activities.<sup>32</sup> Headquartered in Maiduguri, the capital city of Borno State, the NMAC is steered by a national coordinator from the Ministry of Defence,

supported by 12 staff members drawn from key ministries, such as interior and humanitarian affairs.

While the domestication of the APMBC and CCM remains incomplete, Nigerian authorities have partnered with humanitarian actors – including the Mine Advisory Group, the Danish Refugee Council, the ICRC, and UNMAS – to support mine action in the three most contaminated states in northeastern Nigeria. The partnerships have helped clear large areas and facilitated the resettlement of 200 000 displaced people to their homelands. 4

However, the removal of improvised landmines and other explosive ordnance remains the exclusive responsibility of the Nigerian Army, which operates under the Ministry of Defence. Humanitarian actors are confined to roles in education and information sharing, aiming to support the army's Non-Technical Surveys (NTS). Their clearance expertise is largely untapped due to state security concerns and sensitivities around the NSAG threat.

Despite these efforts,<sup>35</sup> recent consultations with UNMAS experts show that improvised landmines continue to pose a serious threat in resettled areas. In fact, 89% of mines discovered in northeastern Nigeria were found in repopulated areas,<sup>36</sup> which account for 74% of all recorded mine-related incidents in the three worst-affected states.<sup>37</sup>

The use of airborne remote sensing combined with AI is one promising innovative alternative that complements existing improvised landmine detection

According to humanitarian sources, the resurgence in mine-related accidents is driven more by gaps in large-scale detection capacity than by new NSAG activity. This suggests the need for modernised equipment, improved survey methods and fuller use of humanitarian expertise in clearance operations.

Even with adherence to International Mine Action Standards, experts caution that close proximity to improvised devices still leads to deadly accidents. Both national and humanitarian stakeholders acknowledge a clear opportunity to enhance current detection approaches.<sup>38</sup>

#### **Need for innovative tools**

Nigeria's response challenges, especially concerning improvised landmine detection, call for innovative alternatives that complement ongoing efforts. One promising alternative is the use of airborne remote sensing combined with Al. This approach has been used by humanitarian actors in several contexts, including the Odyssey Project in Chad and demining efforts in Ukraine, to detect conventional landmines and ERW. While using airborne remote sensing and Al to detect improvised landmines is rare in humanitarian settings, the military and researchers have conducted several tests.



OF MINES DISCOVERED IN NORTHEASTERN NIGERIA WERE FOUND IN REPOPULATED AREAS For example, in June 2023, a team of North Atlantic Treaty Organization scientists undertook a large-scale test on IEDs that produced promising results in northern Canada.<sup>39</sup> A team of scientists and military personnel conducted the exercise, testing seven types of sensors mounted on Unmanned Aerial Vehicles (UAVs). These included radar and optical systems, as well as other sensors capable of detecting IEDs' electrical components, ground disturbances and command wires. Analysis of the data collected is destined to improve improvised landmine detection in military operational theatres.

Furthermore, an experiment by Harvard University scientists showed that airborne remote sensing can detect improvised landmines beneath the surface despite their varied shapes and compositions. <sup>40</sup> Ground-penetrating radars mounted on commercial rotary-wing drones achieved accurate detection in most trials.

Nigeria's current struggle with improvised landmines and their cost to human security make the country a suitable candidate for trials of airborne remote sensing and Al

Although the equipment used is similar to that of humanitarian organisations to detect conventional landmines and ERW, improvised landmine detection with airborne remote sensing and AI remains experimental and heavily militarised. For large-scale humanitarian clearance, multiple trials of similar devices on different terrains are required. Nigeria's current struggle with improvised landmines and their cost to human security make the country a suitable candidate.

Researchers have mounted multiple high-resolution cameras and thermal sensors to maximise detection capacities. This approach allows the system to cover large areas faster, enhancing the capacity to address the longstanding challenge of detecting improvised landmines.

Although the system is not a silver bullet and still needs to be used alongside traditional tools, it speeds up surveys, helps delineate hazardous areas and supports faster decision making.

#### Conditions for tests on the ground

Yet some conditions need to be met to carry out such tests. Overcoming legal constraints is the first requirement. In Nigeria, individuals or entities must comply with several legal requirements to fly a drone. These include being at least 16 years old, obtaining permits and approval from the Nigerian Civil Aviation Authority, getting a pilot certificate to fly UAVs and submitting flight plans.<sup>41</sup> Some restrictions related to weather conditions and safety are similarly imposed on drone operators.

Pilots are prohibited from flying near airports, military and government facilities, over large crowds or across Nigeria's borders. They can only



GROUND-PENETRATING
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operate drones during the day and under optimal visibility conditions. Moreover, drones weighing more than 250 grams must be registered with the Nigerian Civil Aviation Authority. While these regulations are clear and justified, the bureaucracy involved in obtaining the requisite authorisations, could cause significant delays and even prevent airborne remote sensing trials in the country. Therefore, special derogations from state authorities are needed.

The second condition is to alleviate state concerns about the civilian use of UAVs. During stakeholder consultations, concerns about the dual use of drones, referring to their potential repurposing for illegal attacks, were frequently raised. Discussion between the ISS and the Nigerian Mine Action Centre revealed that fears of remote hacking by NSAGs underpin the state's reluctance to allow civilian drone use.

As one official explained: 'In Nigeria's current context, we are cautious about drones because insurgents use them for suicide bombing and surveillance.'42 This concern is supported by empirical research led by the ISS in northeast Nigeria.43

However, protection protocols exist to reduce hacking risks and prevent diversion. If well applied, they could address state concerns.

The third condition is to ensure state ownership of detection devices, including UAVs, sensors and Al systems. Both state authorities and experts have expressed doubts about the origin of these tools and the intent behind the data collection. Therefore, the Nigerian

Federal State should consider bilateral engagement with organisations that developed and tested these technologies. This would help build trust, clarify how the systems operate and identify the potential benefits for the country. Such an initiative would be commensurate with the NMAC's call for a paradigm shift in Nigeria's mine action strategy, one that reorientates priorities to focus more directly on the threat of improvised landmines.

#### Conclusion

Improvised landmines have had a serious impact on human security in Nigeria, claiming thousands of lives, disrupting economic activities and fracturing the social fabric in many parts of its northeastern region. Despite ongoing state efforts to respond effectively, the challenge remains immense due to persistent difficulties in detection. The Nigerian Army, which leads explosive clearance operations, continues to rely heavily on manual methods that require personnel to operate in close proximity to hazardous devices, increasing the risk of accidental detonation.

In this context, exploring alternative solutions that can accelerate detection and reduce the human cost is imperative. Experimental evidence has shown the promising potential of combining airborne remote sensing with Al. Although further validation is needed in real-world conditions, Nigeria's large-scale contamination makes it a strong candidate for field testing. To make such trials feasible, legal and political barriers must be addressed to enable on-the-ground testing and strengthen the state's response to improvised landmines.

#### **Notes**

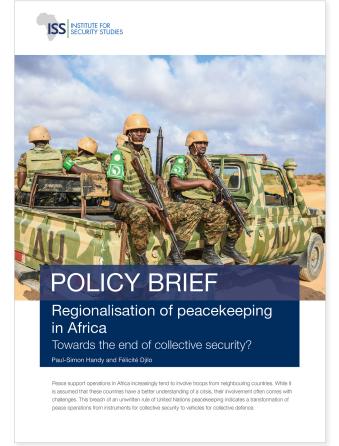
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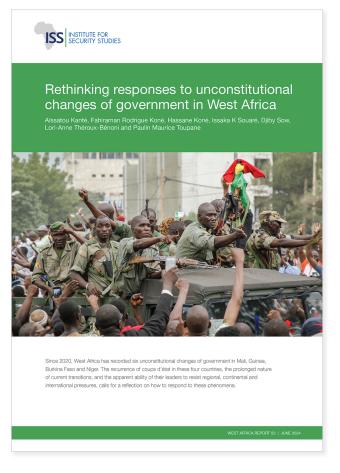
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The ISS is grateful for support from the members of the ISS Partnership Forum: the Hanns Seidel Foundation, the European Union, the Open Society Foundations and the governments of Denmark, Ireland, the Netherlands, Norway and Sweden.

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