The Use of Surveillance Drones for Search and Rescue Operations: An Islamic Approach to Harm Prevention and Public Interest

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ABSTRACT

The integration of surveillance drone technology in Search and Rescue (SAR) operations is increasingly important in enhancing emergency response effectiveness, particularly in geographically diverse environments such as Negara Brunei Darussalam. Challenges such as dense jungle areas, extensive river networks, and limited physical access frequently hinder the implementation of conventional SAR operations, causing critical delays and increasing risks to victims and rescue personnel. This study examines the application of surveillance drones in improving SAR operations through real-time aerial monitoring, faster area coverage, and enhanced situational awareness. The study employs a qualitative approach through conceptual analysis of academic literature, journal articles, books, and official reports related to drone applications in SAR. This study also analyses drone technology use from an Islamic perspective, focusing on the principles of harm prevention and public interest. The maxim *La Darar wa La Dirar* is highlighted to demonstrate how drone use minimises potential harm during rescue missions, while *Maslahah Mursalah* supports the application of this technology for the overall benefit of society. Findings show that the integration of surveillance drones in SAR operations in Brunei is fully consistent with Islamic principles through enhanced efficiency, safety, and the protection of human life, thereby supporting wider implementation of this technology within the nation's emergency response strategy.

Keywords: Surveillance Drone; Search and Rescue; Islamic Jurisprudence; La Darar wa La Dirar; Maslahah Mursalah; Brunei Darussalam; UAV

INTRODUCTION

In recent years, the development of unmanned aerial vehicle (UAV) technology, commonly known as drones, has greatly improved the way emergency response operations are carried out around the world. Drones have become an important tool in Search and Rescue (SAR) missions because they can perform tasks that are difficult or time-consuming using traditional ground-based methods. Today, many drones are equipped with advanced technologies such as high-resolution cameras, infrared (IR) sensors that can detect body heat in low-light or smoky conditions, LiDAR systems for mapping, and artificial intelligence (AI) for analysing images in real time (Laghari, Jumani, Laghari, & Haque, 2023). These features allow rescue teams to monitor affected areas more effectively, cover larger locations in a shorter amount of time, and obtain better situational awareness. As a result, drones can help improve the chances of locating and rescuing victims quickly, especially during critical emergencies (Gotovac, 2020).

Negara Brunei Darussalam, as a small yet geographically diverse nation situated on the island of Borneo, presents a unique and challenging operational context for SAR activities. The country's terrain is mainly covered by approximately 70% tropical rainforest coverage, extensive river flows, and remote areas of limited physical

accessibility (Asian Forest Cooperation Organization, 2023). These environmental conditions pose considerable challenges to conventional SAR operations, frequently resulting in delayed response times and heightened risks to both victims and rescue personnel. In such circumstances, the adoption of surveillance drone technology becomes not merely advantageous but operationally imperative.

Besides its technological aspect, the use of drone technology into search and rescue operations also raises ethical and Islamic legal (fiqh) considerations, especially within the context of a Muslim-majority nation governed under the *Melayu Islam Beraja* (MIB) philosophy. Islam, as a comprehensive way of life, provides a reliable framework for evaluating contemporary practices and technologies through established legal principles. Two foundational maxims of Islamic jurisprudence (*fiqh*) are of particular relevance to this study. The first is the principle of *La Darar wa La Dirar*, establishing that harm shall neither be inflicted on oneself nor reciprocated on others (Alamudi, 2024). The second is *Maslahah Mursalah*, referring to unrestricted public interest that provides the basis for endorsing innovations that yield broad societal benefit (Zakiah, 2023).

The use of drones is also considered one of the ways in which drone technology can be applied due to its benefits and its ability to demonstrate the spirit of helping one another among humanity. Allah states in **Surah Al-Ma'idah, verse 2**:

وَتَعَاوَنُوْا عَلَى الْبِ ِر وَالتَّقْوٰ ى

Which means: **"And cooperate in righteousness and piety."**

The main aim of this study is to explore how surveillance drones can be used to improve SAR operations, while also ensuring that their use is in line with Islamic legal values. Rather than relying on a single source, the research brings together insights from academic journals, books, official reports, and Islamic legal texts to build a well-rounded understanding of where drone technology stands in the world of emergency response.

This study is not limited to technical or operational discussions alone. By situating drone technology within the framework of Islamic ethics, this paper contributes to a growing body of scholarship seeking to harmonise modern technological innovation with Islamic values. It is argued that the adoption of surveillance drones in SAR operations is not only operationally justified but is fully consistent with — and actively encouraged by — Islamic principles of harm prevention and the pursuit of public good.

Problem Statement

In SAR missions, time is the most critical factor, as operations involve human lives. The nature of SAR often requires searching large areas within a very short timeframe (Sven Mayer, 2019). Despite this urgency, conventional SAR methods face several persistent and interconnected challenges in Brunei Darussalam that demand immediate attention.

Approximately 70% of Brunei Darussalam is covered by tropical rainforest, while extensive river systems and wetlands further complicate land-based access. These conditions render conventional SAR methods ineffective, particularly across large and difficult-to-reach areas. The use of drones as an alternative in SAR missions can significantly improve operational efficiency in terms of cost and time savings compared to helicopter operations, as they require fewer personnel and shorter preparation periods (Bashyam, 2019). In reality, every minute of delay in a SAR mission reduces the victim's chance of survival.

The challenges of operating in difficult terrain also place considerable physical risk on rescue team members. As noted by Rashid et al. (2023), complex SAR environments are dangerous even for well-trained operators, and the design of SAR tools must prioritise the safety of both victims and rescuers. Despite the proven global effectiveness of UAV technology in SAR, its systematic integration into Brunei's national emergency response framework remains underdeveloped, with no established protocol or policy infrastructure governing drone deployment in SAR contexts (Drone Technology Development, 2025).

Another important issue is the lack of research on drone technology from the perspective of Islamic jurisprudence. Most existing studies on the use of drones in Search and Rescue (SAR) focus mainly on their technical capabilities and operational effectiveness, while very few discuss whether their use is consistent with Islamic legal and ethical principles. In particular, there is limited research that applies the principles of ***La Darar wa La Dirar*** and ***Maslahah Mursalah*** to the use of surveillance drones in SAR operations. As a result, policymakers and relevant authorities in Brunei Darussalam and other Muslim-majority countries have limited scholarly guidance when making decisions about adopting drone technology in a way that is consistent with Shariah principles.

Research Objective

This study aims to examine the application of surveillance drone technology in enhancing Search and Rescue (SAR) operations in Negara Brunei Darussalam through the Islamic jurisprudential principles of *La Darar wa La Dirar* (prevention of harm) and *Maslahah Mursalah* (public interest), in order to determine whether the integration of such technology into Brunei's national emergency response strategy is consistent with Islamic values.

METHODOLOGY

This study using a qualitative research design, as it aims to interpret and synthesize existing knowledge rather than collect localize data in the field (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Conceptual analysis serves as the primary analytical method, helping this study gain a clearer use of surveillance drones in Search and Rescue (SAR) operations from both operational and Islamic jurisprudential perspectives (Jabarullah & Hussain, 2019). This approach aligns with the exploratory nature of the study and seeks to address identified scholarly gaps.

Data were gathered from four categories of sources: peer-reviewed academic journals concerning UAV technology and SAR; classical and contemporary Islamic legal texts; official reports and government documents regarding emergency response and drone technology in Brunei; and conference proceedings from the fields of engineering and Islamic studies. Sources were selected based on their relevance to the study's core themes: drone capabilities in SAR, Brunei's geographical context, and Islamic jurisprudential principles governing harm and public interest (Mohsin, 2025; Chand et al., 2025).

The analysis was conducted in two stages. First, the operational evidence base for drone-assisted SAR was reviewed and synthesized to establish the technology's effectiveness and its relevance to SAR challenges in Brunei (Bashyam & Guggenheim, 2019; Vincent-Lambert et al., 2023). Second, two Islamic jurisprudential principles—*La Darar wa La Dirar* (no harm and no reciprocating harm) and *Maslahah Mursalah* (public interest)—were conceptually applied to these findings to determine their compatibility with drone usage in SAR and to formulate policy and religious implications for Brunei's national emergency response strategy (Mamat, 2020; Al-Qaradawi, 1994).

LITERATURE REVIEW

UAV and Drone Technology in Search and Rescue Operations

The use of unmanned aerial vehicles (UAVs) in search and rescue (SAR) operations has expanded rapidly over the past decade, with numerous studies documenting their transformative potential (Chand et al., 2025; Tovanche-Picon et al., 2023). Chand et al. (2025) provide a comprehensive global overview of UAV applications in SAR, highlighting their versatility, rapid deployment capabilities, high mobility, and ability to survey vast, hazardous areas inaccessible to rescue personnel. Yusuf et al. (2020) also document the operational benefits of UAVs in SAR, explaining that their ease of use, low maintenance costs compared to manned aircraft, and high mobility enable them to reach areas inaccessible to humans. Bashyam and Guggenheim (2019), in a foundational study from the Massachusetts Institute of Technology, compare the two principal categories of UAVs — fixed-

wing and rotary — across three performance factors: flight range, image quality, and degree of control. Fixed-wing UAVs offer superior range suited for wide-area searches, while rotary UAVs offer hovering ability ideal for risky searches of specific zones. Critically, UAVs can lower the cost of aerial SAR by two to three times compared to helicopter operations, making drone-assisted SAR operationally and economically accessible for a wider range of contexts including Brunei.

Recent progress in image analysis and classification methods, particularly those based on machine learning, allow software to discern the environment, geographical features, evidence left by a missing subject, and the subject itself from UAV-acquired images (Bashyam & Guggenheim, 2019). Ewers et al. (2025) further demonstrate that deep reinforcement learning can generate alternative UAV flight paths in forested terrain, significantly increasing the probability of victim detection in challenging environments such as Brunei's tropical rainforest.

SAR Challenges in Brunei Darussalam

The specific geographical conditions of Brunei Darussalam present unique and persistent challenges for Search and Rescue (SAR) operations (Asian Forest Cooperation Organization, 2023). Qazzaz et al. (2024) identified challenging terrain—including dense forests, mountainous areas, and river systems—as a primary cause of delays in SAR response times; they demonstrated through simulation modeling that optimizing UAV connectivity reduces the time required to locate missing persons in such environments. Drone Technology Development (2025) also noted that drone technology in Brunei remains in the development stage, with a gap existing between the technical readiness of drone platforms and their actual integration into the national emergency response framework.

Tekgis Sdn Bhd (2013), an early provider of UAV services in Brunei, highlighted the geographical challenges that make aerial surveillance an important requirement rather than an optional tool. Rashid et al. (2023), in their study on robotics in SAR, noted that challenging and hazardous SAR conditions may expose rescue personnel to various physical dangers., and that the design of SAR tools must prioritize the safety of rescuers alongside that of victims. This dual dimension of harm—affecting both victims and rescuers—forms the core of the Islamic jurisprudential analysis conducted in this study (Mamat, 2020; Mohamad & Arizan, 2021).

La Darar wa La Dirar in Contemporary Applications

The Islamic legal maxim *La Darar wa La Dirar* — harm shall neither be inflicted nor reciprocated — is one of the five universal maxims of Islamic jurisprudence, originating from a hadith of the Prophet Muhammad (peace be upon him). Mohamad and Arizan (2021) demonstrate how this maxim was applied to justify Malaysian government directives during COVID-19, establishing a robust precedent for applying this classical maxim to modern public safety interventions. Mamat (2020) classifies the application of this maxim into three categories: preventing harm before it occurs, elimination of harm after it occurs, and minimisation of harm when complete removal is impractical. All three categories are directly applicable to drone-assisted SAR operations.

Maslahah Mursalah and Technological Innovation

The principle of *Maslahah Mursalah* refers to unrestricted public interest not explicitly addressed in Islamic scripture. Al-Qaradawi (1994) establishes it as a legitimate source of Islamic legal reasoning, emphasising that the preservation of human life is among the highest objectives of Shariah. Laludin (2019) elaborates on al-Imam al-Ghazali's framework of five necessities, with the preservation of life (*hifz al-nafs*) as the first and highest — providing the strongest possible Islamic justification for any technology that demonstrably saves lives. Arip et al. (2025) demonstrate that *Maslahah Mursalah* has been applied to modern technological systems including artificial intelligence, establishing an important precedent for its application to drone technology in SAR.

FINDINGS AND DISCUSSION

Operational Benefits of Surveillance Drones in SAR

Previous study show that surveillance drones provide several operational advantages over conventional search and rescue (SAR) methods, especially in challenging environments such as those found in Brunei Darussalam. The literature identifies three main operational benefits of using drones in SAR operations.

First, the real-time monitoring capability of drones allows rescue teams to receive live visual intelligence from the air without entering dangerous terrain. Vincent-Lambert et al. (2023), in a scoping review of 21 studies on UAVs in SAR operations, found that drones increase both safety and efficiency of rescue operations through victim detection, risk assessment, equipment delivery, and communication restoration. This way it can prevents harms to the rescue team and also the victims. Second, drones are capable of covering far larger areas in significantly less time compared to ground-based teams. Bashyam and Guggenheim (2019) demonstrate that fixed-wing and rotary UAVs serve complementary roles suited to Brunei's varied terrain, while Ewers et al. (2025) show that deep reinforcement learning algorithms can generate more efficient search paths in forested enviroments. Third, enhanced situational awareness through live aerial imagery directly improves overall SAR coordination. UAV Coach (2024) confirms that drones provide real-time aerial views, track individual movements, and gather critical intelligence without physical presence at the location. Drones equipped with thermal cameras further detect human heat signatures in low-visibility conditions at night or beneath dense tropical tree cover, especially if the drones system is integrated with a new AI for more precise detection. (IEEE Public Safety Technology, 2023).

Application of La Darar wa La Dirar to Drone SAR

The principle of *La Darar wa La Dirar* provides an important Islamic jurisprudential foundation for supporting the use of drones in Search and Rescue (SAR) operations. This principle can be understood through three main ways in which drone technology helps to prevent and reduce harm.

First, drones help prevent potential harm before it happens by reducing the need for rescue personnel to enter dangerous environments. Rashid et al. (2023) highlighted that SAR technologies should consider the safety of both rescuers and victims. By using drones to examine terrain conditions, locate possible risks, and gather information before deployment, rescue teams can make safer decisions and reduce unnecessary risks.

Second, drones help reduce existing harm by improving the speed of victim detection. Qazzaz et al. (2024) found that improvements in UAV communication systems can reduce the time needed to locate missing individuals, especially in difficult environments. As explained by Mamat (2020), the principle of avoiding harm takes priority over achieving benefits, meaning that using drones can be more appropriate than relying on slower traditional methods that may increase the danger faced by victims.

Third, drones can help minimise harm when immediate rescue is not possible by supporting victims through the delivery of essential supplies, maintaining communication links, and monitoring their condition continuously (Vincent-Lambert et al., 2023). Therefore, the use of drones in SAR operations reflects the objectives of *La Darar wa La Dirar* by helping to prevent harm, reduce risks, and protect human life.

Application of Maslahah Mursalah to Drone SAR

The principle of Maslahah Mursalah provides another important Islamic perspective that supports the use of drones in Search and Rescue (SAR) operations. According to Al-Qaradawi (1994) and Laludin (2019), the protection of human life (*hifz al-nafs*) is one of the most important objectives of Shariah and is considered the highest priority among the five essential objectives. The application of surveillance drones in SAR supports this objective because research has shown that drones can improve rescue operations and assist in locating victims in situations where traditional methods may be less efficient (Chand et al., 2025; Vincent-Lambert et al., 2023).

In addition, the benefits of drone technology can go beyond individual rescue cases and contribute to the wider community. As drone technology becomes more affordable, rescue agencies can conduct more operations using available resources, which may increase the ability to protect human lives on a larger scale (Bashyam & Guggenheim, 2019). This reflects the concept of *Maslahah Mursalah*, which considers the acceptance of new practices or technologies based on their ability to provide public benefit while remaining consistent with Islamic principles. Therefore, the use of drones in SAR can be viewed as a technology that supports the objectives of Shariah, particularly in protecting human life and promoting the welfare of society.

Overall Alignment with Islamic Values

When the principles of *La Darar wa La Dirar* (no harm and no reciprocating harm) and *Maslahah Mursalah* (public interest) are considered together, a clear picture emerges: the use of surveillance drones in Search and Rescue (SAR) operations is not only permissible in Islam but can be argued to constitute a collective obligation (*fard kifayah*) for a society capable of employing them (Mohsin, 2025). Islam places immense value on human life, and Shariah consistently mandates the use of the best available means to safeguard it (Al-Qaradawi, 1994; Laludin, 2019).

Mohsin (2025) demonstrates that Muslim-majority nations share core ethical principles—including human dignity, justice, and public welfare—and that *ijtihad* (independent legal reasoning) is required to adapt Shariah to the context of modern technology. This study applies such *ijtihad* to the context of SAR drones in Brunei and finds no conflict between the use of this technology and Islamic principles. Mohamad and Arizan (2021) confirm that the use of technology to prevent harm—even if not explicitly addressed by authorities—is legitimate and consistent with *La Darar wa La Dirar*, provided the actions align with that jurisprudential maxim. This implies that authorities in Brunei need not await a specific *fatwa* regarding SAR drones before taking action; existing principles provide a sufficient basis for such measures (Hibaturohman, 2024; Rsisinternational, 2025).

Implications for Brunei Darussalam's Emergency Response Strategy

The findings of this study carry significant implications for Brunei's national emergency response strategy at three levels. At the operational level, formal protocols for drone deployment in SAR should be established, including technical specifications for jungle and river terrain, standard operating procedures, and operator training programmes (Drone Technology Development, 2025). At the policy level, a governance framework that integrates Islamic ethical considerations and technical safety standards into SAR drone policy should be developed under Brunei's MIB philosophy (Rsisinternational, 2025). At the religious level, the active engagement of the Majlis Ugama Islam Brunei (MUIB) to evaluate and endorse drone use in SAR would strengthen the Islamic legitimacy of the technology and build public confidence among Brunei's Muslim community (Hibaturohman, 2024).

CONCLUSION

This study examined the application of surveillance drone technology in Search and Rescue (SAR) operations in Negara Brunei Darussalam based on the Islamic jurisprudential principles of *La Darar wa La Dirar* and *Maslahah Mursalah*. The findings indicate that surveillance drones can improve SAR operations through capabilities such as real-time aerial monitoring, wider area coverage, thermal imaging, and improved operational efficiency. These advantages help address some of the geographical and logistical challenges faced by SAR agencies in Brunei Darussalam.

From an Islamic jurisprudential perspective, the use of drone technology in SAR operations is considered compatible with Islamic values as it contributes to the protection of human life and the prevention of harm. The principle of *La Darar wa La Dirar* is reflected through the ability of drones to reduce risks faced by both rescuers and victims by supporting safer and more effective rescue processes. Meanwhile, *Maslahah Mursalah* is demonstrated through the benefits that drone technology provides to society, particularly in improving the chances of saving lives and enhancing emergency response capabilities. Therefore, the adoption of drone

technology in SAR may be considered a beneficial innovation that supports the objectives of Shariah, especially in protecting human life (*hifz al-nafs*).

This study acknowledges its limitations as a conceptual study based on literature analysis without empirical field data. Future research should focus on empirical testing of SAR drone operations in Brunei's terrain, the development of specific fatwas by the Majlis Ugama Islam Brunei, and comparative studies across Muslim-majority nations with similar geographic challenges. It is hoped that this study provides a principled foundation for policymakers, emergency management authorities, and religious scholars in Brunei to make informed, Shariah-aligned decisions regarding the wider deployment of drone technology in national emergency response strategies.

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