SCIENTIFIC CULTURE

www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 6454-6465
Open Access. Online & Print

DOI: 10.5281/zenodo.19511805

CRIMINAL LIABILITY FOR DAMAGES CAUSED BY NON-IONIZING RADIATION FROM MOBILE NETWORKS: TOWARDS MAQASID-AL-SHARIAH IN ACHIEVING SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Received: 21/01/2026
Accepted: 25/03/2026

ABSTRACT

The expansion of mobile communication technology has significantly increased human exposure to non-ionizing radiation (NIR) emitted from mobile network base stations, antennas, and other wireless technologies. Although NIR has generally been perceived as less harmful than ionizing radiation, increasing scientific concern regarding its potential health effects suggests that prolonged or uncontrolled exposure may pose risks to human health and the environment. These concerns highlight the need for clearer legal accountability and regulatory oversight regarding radiation exposure associated with telecommunications infrastructure. This study examines the issue of criminal liability for damages arising from exposure to non-ionizing radiation emitted by mobile networks through the lens of the Maqasid al-Shariah framework, while linking the analysis to the developmental perspective of the United Nations Sustainable Development Goals (SDGs). By integrating these perspectives, the study seeks to contribute to the broader discourse on legal responsibility, public health protection, and sustainable technological development. Methodologically, the study adopts a qualitative approach based on doctrinal legal analysis. It draws on the principles of criminal law, environmental law, and telecommunications law to evaluate the regulatory and legal dimensions of NIR exposure. The analysis is further strengthened by the Maqasid al-Shariah framework, which emphasizes the preservation of life, intellect, property, and public interest. Within this framework, the concept of public welfare (maslahah) provides a normative basis for safeguarding human health in the context of modern technological development. The study highlights the potential criminal liability of telecommunication companies arising from negligence, regulatory violations, or reckless conduct in the operation of telecommunications infrastructure, while also emphasizing the value of aligning Maqasid al-Shariah principles with the developmental goals of the United Nations SDGs.

KEYWORDS: Non-ionizing Radiation; Criminal Liability; Maqasid al-Shariah; Mobile Networks; Sustainable Development Goals.

1. INTRODUCTION

The rapid development of digital communication technologies has significantly reshaped modern society by enhancing connectivity, stimulating economic growth, and accelerating technological advancement. Mobile communication networks, including base stations and antennas, have become indispensable components of contemporary life. However, this expansion has also resulted in increased human exposure to non-ionizing radiation (NIR) emitted from telecommunications infrastructure. Although NIR is generally considered less harmful than ionizing radiation, growing concerns remain regarding its potential health and environmental implications (World Health Organization, 2014). These concerns have stimulated increasing scholarly attention toward the need for effective legal and regulatory frameworks to govern the development and deployment of modern communication technologies (Bilal, 2012).

From a legal standpoint, the issue of criminal liability for damages or injuries arising from exposure to telecommunications infrastructure has received relatively limited attention. Existing legal and regulatory frameworks primarily emphasize technical compliance and administrative regulation rather than criminal accountability (ICNIRP, 2020). Consequently, questions have emerged regarding whether current legal mechanisms are sufficiently robust to address potential harms associated with technological infrastructure. The absence of clear legal guidelines on criminal liability may undermine the effectiveness of regulatory frameworks and limit the capacity of the law to provide adequate protection for the public.

Within the broader framework of global governance, the United Nations' Sustainable Development Goals (SDGs) emphasize the importance of balancing technological advancement with human health, environmental protection, and institutional accountability. In particular, SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 16 (Peace, Justice, and Strong Institutions) underscore the need for effective governance structures capable of managing risks associated with technological development and use (United Nations, 2015). Ensuring that telecommunications infrastructure is deployed in a safe, responsible, and accountable manner is therefore an essential component of sustainable development.

Beyond conventional legal frameworks, Islamic legal philosophy offers an alternative normative perspective for evaluating issues related to public welfare and technological governance. The concept of Maqasid al-Shariah, which represents the higher objectives of Islamic law, provides a comprehensive framework for safeguarding fundamental human interests. These objectives include the protection of life (hifz al-nafs), intellect (hifz al-'aql), property (hifz al-mal), religion (hifz al-din), and lineage (hifz al-nasl). The concept of prevention of harm (dar' al-mafasid) and promotion of public welfare (maslahah) is the core concept in this model (Kamali, 2008; Muhammad, 2001; Shams, 2004). In the context of modern technology, this would imply that all economic and technological activities should not pose any risk to the individual and the community.

The paper is structured as follows: it begins with an Introduction, which outlines the research problem, objectives, and significance of the study. This is followed by a Literature Review, divided into theoretical and conceptual frameworks, examining non-ionizing radiation, criminal liability, Maqasid al-Shariah, and the Sustainable Development Goals. The Method and Materials section explain the qualitative doctrinal and interdisciplinary approach, inclusion and exclusion criteria, and the analytical framework employed. The Results and Discussion section presents the findings from literature and legal analysis, highlighting the interplay of law, ethics, and regulatory governance. This is followed by the Implications of the Study, illustrating the practical and policy relevance of the findings. The paper concludes with sections on Conclusion and Policy Recommendations, Limitations of the Study, and Future Directions, providing guidance for policymakers, regulators, and future research.

2. LITERATURE REVIEW

2.1. Theoretical Framework

One of the most relevant theories for understanding the regulation of potential environmental and health risks arising from contemporary technologies is the Precautionary Principle. This principle is widely recognized in international environmental law as a guiding framework for decision-making in situations where scientific uncertainty exists regarding possible harm to human health and the environment. It is based on the premise that when an activity poses threats of serious or irreversible damage, the lack of full scientific certainty should not be used as a justification for postponing measures aimed at preventing environmental degradation (Raffensperger & Tickner, 1999).

The origins of the precautionary principle can be traced to environmental policy developments in

Europe during the 1970s, after which it gradually became integrated into international environmental governance. The principle was formally articulated in Principle 15 of the Rio Declaration on Environment and Development, which states that precautionary measures should be taken to protect the environment whenever there are threats of serious or irreversible damage, even when scientific evidence remains inconclusive (United Nations, 1992). Since then, the precautionary principle has become an important normative guideline in environmental protection and in the regulation of health and safety risks.

This principle is particularly relevant to the issue of criminal liability for damages potentially caused by non-ionizing radiation (NIR) from mobile telecommunications networks (Suleiman, n.d.; Tamam, 2002). Although scientific research has not conclusively established the long-term health consequences of NIR exposure, concerns remain regarding possible adverse effects associated with prolonged exposure (World Health Organization, 2014). In this context, the precautionary principle provides a useful basis for developing regulatory policies that prioritize the protection of human health, environmental safety, and sustainable technological development.

From a legal perspective, the precautionary principle also provides a basis for holding telecommunications operators accountable in cases involving negligence, non-compliance with regulatory standards, or failure to implement safety measures. The principle supports the argument that telecommunications operators should adopt preventive measures, including adherence to strict exposure limits for ionizing and non-ionizing radiation, as well as continuous monitoring and environmental impact assessments related to telecommunication infrastructure.

Furthermore, the precautionary principle aligns with the ethical objectives of Maqasid al-Shariah, particularly the protection of life (hifz al-nafs) and the promotion of public welfare (maslahah). Islamic legal philosophy emphasizes the prevention of harm (dar' al-mafasid) before it occurs, which closely parallels the preventive approach embodied in the precautionary principle. Consequently, this theoretical alignment provides a meaningful framework for integrating Islamic legal principles with contemporary environmental protection strategies.

In addition, the precautionary approach contributes to the realization of the United Nations Sustainable Development Goals (SDGs) by ensuring that technological advancement does not compromise public health or environmental sustainability. Through the application of precautionary legal principles in telecommunications governance, technological development can be pursued within a framework that prioritizes safety, accountability, and long-term sustainability.

2.2. Conceptual Framework

Non-Ionizing Radiation from Mobile Networks

The first key variable in this study is non-ionizing radiation (NIR) emitted from mobile telecommunications infrastructure. In recent decades, the rapid expansion of telecommunications infrastructure has significantly increased human exposure to electromagnetic fields. Although non-ionizing radiation is generally considered less hazardous than ionizing radiation, concerns remain regarding its potential long-term effects on human health and the environment.

Non-ionizing radiation refers to electromagnetic radiation that has relatively low energy and does not possess sufficient power to ionize atoms or molecules. It is commonly emitted by wireless communication technologies, including mobile phones, base stations, and communication antennas. According to the World Health Organization, non-ionizing radiation includes radiofrequency electromagnetic fields widely used in telecommunications infrastructure worldwide. As the number of mobile towers continues to grow, environmental exposure to electromagnetic fields has increased correspondingly (Al-Asha, n.d.; Al-Tuwairiqi, n.d.; El-Gammal, 2010). This development has raised public concerns regarding the biological and health effects of electromagnetic radiation exposure (Al-Ghamri, 2006).

Scholarly studies indicate that the global expansion of telecommunications infrastructure has significantly increased environmental exposure to radiofrequency electromagnetic fields. Although most scientific studies suggest that exposure levels remain within established safety limits and are unlikely to cause severe health effects, concerns persist regarding the long-term consequences of continuous exposure. These concerns have become more prominent with the rapid deployment of advanced mobile technologies such as 4G and 5G networks.

In response to these concerns, several international regulatory bodies have developed safety guidelines governing exposure to electromagnetic radiation. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has established widely accepted

international standards designed to protect the public from potential adverse health effects (ICNIRP, 2020). These guidelines have been adopted by many national regulatory authorities and telecommunications regulators worldwide.

Despite the existence of these regulatory guidelines, some researchers argue that limited scientific knowledge regarding the long-term effects of electromagnetic radiation exposure remains a challenge for regulators. Environmental health scholars emphasize the importance of incorporating preventive safety mechanisms into technological development to ensure that exposure levels remain within acceptable safety limits (Hardell & Sage, 2008; Tamam, 2009). This concern has contributed to the adoption of precautionary regulatory approaches in telecommunications governance.

Furthermore, the increasing density of telecommunications infrastructure in urban areas may elevate exposure levels to electromagnetic radiation. This raises important questions regarding the responsibilities of governments and telecommunications corporations in protecting public health and environmental safety. Consequently, issues of legal accountability have become increasingly significant within the broader framework of environmental law and technological regulation.

2.3. Criminal Liability for Technological or Environmental Harm

In situations whereby exposure to electromagnetic radiation results from negligence, regulatory violations, or reckless conduct, criminal liability may arise. Criminal liability functions as a mediating factor in determining whether telecommunications operators, corporations, or regulatory authorities can be held legally responsible for damages resulting from radiation exposure (Abdul Malik, n.d.; Obaid, n.d.).

Criminal liability refers to the legal responsibility imposed on individuals or organizations whose actions cause harm to others due to negligence, recklessness, or intentional misconduct. Within the context of environmental governance, criminal law plays an important role in preventing activities that may harm public health or ecological systems (Salaho, n.d.; Hilal, 2011; Faure & Heine, 2017). Environmental criminal law also serves as an important regulatory mechanism for industries whose operations pose environmental risks.

Scholars have argued that criminal law can be an effective tool for enforcing compliance with environmental and public health regulations. In cases where corporations fail to comply with regulatory standards or neglect to implement safety mechanisms, criminal sanctions may be applied when significant harm occurs to individuals or communities (Farber, 2010). This is particularly relevant for industries associated with technological risks.

However, telecommunications regulation in many jurisdictions primarily emphasizes administrative sanctions rather than criminal liability. Researchers note that telecommunications companies are typically required to comply with technical safety regulations, but criminal liability is rarely invoked unless substantial negligence can be demonstrated (Brownsword, 2008). This regulatory approach may limit the effectiveness of legal mechanisms designed to ensure corporate accountability (Al-Gharib, 2000).

Another significant challenge in applying criminal law to technological or environmental harm is the difficulty of establishing a clear causal relationship between radiation exposure and specific health outcomes. Scientific uncertainty often complicates the process of proving criminal liability in environmental risk cases (Omerović, Albakjaji, & Žilić-Ćurić, 2023). As a result, legal scholars have emphasized the need to develop stronger regulatory frameworks capable of addressing emerging technological risks (Tilan, n.d.; Faure & Heine, 2017). Nevertheless, the growing recognition of environmental criminal law highlights its importance in promoting corporate accountability and strengthening public trust in industries such as telecommunications.

2.4. Maqasid al-Shariah

Maqasid al-Shariah refers to the higher objectives and purposes of Islamic law. This conceptual framework was developed by Islamic jurists to ensure that legal rulings promote human welfare and prevent harm in society. According to Abu Ishaq al-Shatibi, the primary objectives of Shariah include the protection of religion, life, intellect, lineage, and property (Kamali, 2008).

Within contemporary legal discourse, Maqasid al-Shariah is often applied as a normative framework for interpreting legal responsibility and promoting social welfare. Key objectives include the protection of life (hifz al-nafs), intellect (hifz al-'aql), property (hifz al-mal), and the broader pursuit of public interest (maslahah) (Kamali, 2008; Auda, 2008). These objectives emphasize the prevention of harm and the promotion of societal welfare as central principles of Islamic law.

In modern contexts, the scope of Maqasid al-Shariah has expanded to address contemporary social challenges, including environmental protection and technological governance. The framework emphasizes the importance of public interest and the prevention of harm (dar' al-mafasid), both of which are central to Islamic legal philosophy (Auda, 2008).

From an environmental perspective, the protection of life and intellect requires safeguarding society from environmental hazards that may threaten human health or well-being (Kamali, 2010). Consequently, technological activities that pose potential health risks must be carefully regulated to prevent harm to individuals and communities.

The integration of Maqasid al-Shariah with modern legal systems therefore offers valuable ethical guidance for environmental governance and technological risk management. By emphasizing harm prevention and the promotion of public welfare, this framework provides important insights for regulating emerging technologies and ensuring responsible innovation.

2.5. Sustainable Development Goals (SDGs)

The United Nations Sustainable Development Goals (SDGs) were adopted in 2015 as part of the global agenda for sustainable development. The SDGs consist of seventeen interconnected goals aimed at addressing major global challenges such as poverty eradication, environmental protection, public health, and good governance (United Nations, 2015). Technological innovation plays a central role in sustainable development. Modern communication technologies contribute significantly to economic growth, social connectivity, and industrial development. However, scholars emphasize the importance of balancing technological advancement with environmental protection and social responsibility.

The integration of regulatory accountability and ethical governance is essential for achieving the SDGs. In the context of telecommunications governance, this framework contributes particularly to SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 16 (Peace, Justice, and Strong Institutions) (United Nations, 2015; Sachs, 2015). SDG 3 emphasizes the protection of public health and the reduction of environmental health risks. Regulating exposure to environmental hazards, including electromagnetic radiation, forms an important component of public health governance. Similarly, SDG 9 promotes sustainable industrialization and responsible technological innovation. However, technological advancement must occur within a regulatory framework that ensures environmental sustainability and public safety.

Finally, SDG 16 highlights the importance of effective legal institutions, regulatory accountability, and the rule of law. Strong legal frameworks, including mechanisms for criminal liability, are essential to ensure that corporations and regulatory authorities comply with established safety standards. Such legal accountability plays a crucial role in promoting sustainable development and maintaining public trust in technological systems.

2.6. Method and Materials

This study adopts a qualitative research approach, specifically a doctrinal and interdisciplinary method, to examine the concept of criminal liability in relation to potential damage caused by non-ionizing radiation (NIR) emitted from mobile telecommunications networks. Qualitative research is appropriate for this study because it enables the analysis of complex social, legal, and ethical issues that cannot easily be quantified (Creswell & Poth, 2018). The doctrinal legal method involves the systematic examination and interpretation of legal rules, judicial decisions, and legal literature to clarify the structure and development of the law (Gutteridge, 2005).

In addition to doctrinal analysis, the study adopts an interdisciplinary approach by integrating perspectives from criminal law, environmental law, telecommunications regulation, and Islamic legal philosophy. This interdisciplinary framework allows for a comprehensive examination of the interaction between legal regulations and ethical principles in addressing potential harm arising from mobile network technologies. By combining these disciplinary perspectives, the study provides a more holistic understanding of how legal and ethical frameworks can collectively regulate technological risks.

The research relies on both primary and secondary sources. Primary sources include statutory provisions, regulatory instruments, and judicial decisions relating to criminal liability, environmental protection, and telecommunications regulation. Secondary sources consist of academic books, journal articles, policy reports, and international guidelines on electromagnetic radiation and public health. Key reference materials include guidelines issued by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the World Health Organization (WHO) (WHO, 2014; ICNIRP, 2020).

Additional scholarly works addressing the concept of Maqasid al-Shariah are also examined, particularly those discussing the principles of hifz al-nafs (protection of life), hifz al-'aql (protection of intellect), hifz al-mal (protection of property), and maslahah (public welfare) (Kamali, 2008; Auda, 2008).

To ensure the credibility and relevance of the study, specific inclusion criteria were established. Legal materials included in the study consist of statutes, regulations, and judicial decisions relating to criminal liability, environmental protection, and telecommunications governance across different jurisdictions (Faure & Heine, 2017; Brownsword, 2008). Scholarly publications such as peer-reviewed journal articles and academic books addressing non-ionizing radiation, public health governance, legal accountability, and the principles of Maqasid al-Shariah were also included (Kamali, 2008; Auda, 2008). Furthermore, international guidelines from reputable global organizations—including the World Health Organization (WHO), the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and United Nations frameworks on electromagnetic fields and sustainable development—were incorporated into the analysis (WHO, 2014; ICNIRP, 2020; United Nations, 2015). To maintain contemporary relevance, the study primarily considers materials published within the last twenty years (2004–2024) (Creswell & Poth, 2018). Only English-language publications were included to ensure accurate interpretation and analysis (Creswell & Poth, 2018).

Materials were excluded from the study if they were deemed irrelevant, unreliable, or methodologically weak. Legal cases unrelated to environmental protection, telecommunications regulation, or criminal liability were excluded (Faure & Heine, 2017). Similarly, non-scholarly sources such as blog posts, opinion articles, and unverified online content were omitted due to concerns regarding credibility (Creswell & Poth, 2018). In addition, outdated guidelines or standards that are no longer applicable or valid were excluded from the analysis (ICNIRP, 2020). Duplicate publications and materials written in languages other than English were also excluded to maintain consistency and reliability in the analysis (Creswell & Poth, 2018).

The collected data were analyzed using qualitative content analysis and thematic analysis. Legal provisions, regulatory frameworks, and academic literature were systematically reviewed to identify key themes relating to criminal accountability, regulatory gaps, and ethical obligations in the governance of NIR exposure. The analysis also evaluated the extent to which contemporary legal frameworks align with the principles of Maqasid al-Shariah and their relevance to the achievement of selected Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation and Infrastructure), and SDG 16 (Peace, Justice and Strong Institutions) (United Nations, 2015; Sachs, 2015). Through this methodological approach, the study develops a normative and practical framework for addressing the legal and ethical challenges associated with non-ionizing radiation from mobile telecommunications networks. The framework integrates contemporary legal analysis with Islamic ethical principles to promote responsible technological governance and sustainable development.

3. RESULTS AND DISCUSSION OF FINDINGS

This section presents and discusses the findings derived from the literature and legal materials analyzed in the study.

First, the analysis of existing literature and regulatory frameworks indicates that the rapid proliferation of mobile telecommunications networks has significantly increased human exposure to non-ionizing radiation (NIR). Although NIR is generally considered less harmful than ionizing radiation, several studies suggest that prolonged exposure may pose potential health risks affecting neurological, reproductive, and cardiovascular systems (Repacholi, 2012; Hardell & Sage, 2008). The deployment of advanced telecommunications technologies such as 4G and 5G networks has further intensified public concerns regarding radiation exposure. In response to these concerns, international organizations such as the World Health Organization (WHO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) have established exposure guidelines intended to safeguard public health (WHO, 2014; ICNIRP, 2020). However, the analysis reveals that the implementation and monitoring of these guidelines vary significantly across different jurisdictions. Doctrinal examination of regulatory frameworks in selected countries indicates that monitoring and enforcement mechanisms are often inadequate. In many cases, compliance with exposure limits largely depends on voluntary adherence by telecommunications companies rather than strict regulatory enforcement (Brownsword, 2008). This situation highlights the

need for stronger institutional mechanisms to ensure effective oversight of telecommunications infrastructure.

Furthermore, the study underscores the importance of adopting an interdisciplinary regulatory approach. While environmental law provides principles for pollution control and environmental protection, telecommunications law establishes technical standards for radiation exposure. However, the intersection between legal regulation and public health policy remains insufficiently developed (Faure & Heine, 2017). The analysis therefore reveals a regulatory gap that requires stronger coordination between legal frameworks, public health institutions, and technological governance systems. Beyond regulatory considerations, ethical concerns also arise in relation to technological expansion. While mobile telecommunications networks contribute significantly to economic development and global connectivity, insufficient safety monitoring raises questions regarding corporate responsibility and regulatory accountability. Incorporating precautionary and public health ethics into telecommunications governance can help mitigate potential risks by emphasizing the principle that technological innovation should not compromise human well-being (Raffensperger & Tickner, 1999).

Second, the doctrinal analysis of criminal liability for radiation-related harm indicates that existing legal frameworks remain limited in addressing potential damages arising from NIR exposure. In many jurisdictions, regulatory systems focus primarily on administrative compliance mechanisms rather than criminal sanctions. As a result, negligent or reckless conduct by telecommunications operators may remain inadequately addressed (Faure & Heine, 2017). Criminal sanctions are generally applied only in cases involving gross negligence or intentional misconduct. This creates a legal gap in situations where harm arises due to regulatory oversight, inadequate monitoring, or systemic failures in telecommunications governance. Comparative analysis of legal systems across different countries reveals that some jurisdictions have introduced criminal liability provisions for corporate environmental harm. In certain cases, strict liability frameworks have been applied to activities posing risks to public health and environmental safety. These legal mechanisms demonstrate that criminal liability can function as an effective deterrent against corporate misconduct (Farber, 2010). The analysis further shows that ambiguous legal provisions often weaken regulatory accountability. When liability standards remain unclear, corporations may exploit legal loopholes, leading to diminished public trust in regulatory institutions (Brownsword, 2008). Establishing clearer legal standards for negligence, recklessness, and corporate liability is therefore essential for ensuring effective telecommunications governance and protecting public health.

Third, the findings also highlight the relevance of Maqasid al-Shariah as an ethical framework for evaluating the governance of technological risks associated with NIR exposure. The objectives of Shariah law emphasize the protection of life (hifz al-nafs), intellect (hifz al-'aql), property (hifz al-mal), and the promotion of public welfare (maslahah) (Kamali, 2008; Auda, 2008). These principles align closely with contemporary public health ethics and regulatory efforts aimed at preventing harm. From a doctrinal perspective, the principle of hifz al-nafs supports the adoption of strict exposure limits and monitoring mechanisms to safeguard human life and health. Similarly, the principle of hifz al-'aql justifies regulatory measures aimed at protecting cognitive health from potential risks associated with electromagnetic radiation exposure (Kamali, 2010).

The integration of Maqasid al-Shariah into regulatory governance also strengthens the ethical foundations of corporate accountability. Under this framework, telecommunications operators and regulatory authorities bear not only legal obligations but also moral responsibilities to safeguard public welfare. This dual responsibility enhances the legitimacy of regulatory institutions and promotes responsible technological development (Auda, 2008; Brownsword, 2008). In jurisdictions where Shariah principles influence legal systems, the application of Maqasid al-Shariah can help bridge the gap between legal regulation and ethical governance. By prioritizing harm prevention and public welfare, the framework supports regulatory strategies that ensure technological advancement occurs in a manner consistent with societal well-being and environmental sustainability (Kamali, 2008).

Fourth, the study further reveals that strengthening the regulation of NIR exposure—combined with the application of criminal liability and ethical governance—contributes to the achievement of several Sustainable Development Goals (SDGs). Indeed, SDG 3 (Good Health and Well-Being) is advanced through regulatory measures that limit exposure to environmental health hazards such as electromagnetic radiation (United Nations, 2015; WHO, 2014). Ensuring safe telecommunications infrastructure directly supports public health protection. Also, SDG 9 (Industry, Innovation, and

Infrastructure) is promoted by encouraging technological innovation while maintaining responsible regulatory oversight. Sustainable industrial development requires infrastructure that supports economic growth without compromising environmental or social welfare (Sachs, 2015; ICNIRP, 2020). Hence, SDG 16 (Peace, Justice, and Strong Institutions) is strengthened through the establishment of effective legal frameworks that promote transparency, accountability, and corporate responsibility. The application of criminal liability mechanisms—combined with ethical governance frameworks such as Maqasid al-Shariah—helps ensure that regulatory institutions operate in a fair and trustworthy manner (Faure & Heine, 2017).

Overall, the integration of legal analysis, ethical principles, and sustainable development perspectives provides a holistic governance framework for addressing the risks associated with non-ionizing radiation exposure. Through the combination of doctrinal legal analysis, interdisciplinary perspectives, and ethical considerations, the study proposes a framework that links technological innovation with public welfare and sustainable development, thereby promoting both legal accountability and moral legitimacy in telecommunications governance (Auda, 2008; Brownsword, 2008).

4. IMPLICATIONS OF THE STUDY

The findings of this study highlight the need for stronger governance and regulatory oversight of non-ionizing radiation (NIR) emitted from mobile telecommunications infrastructure. Governments and regulatory authorities should implement more effective monitoring and management mechanisms, including stricter exposure limits, regular safety audits, and transparent public disclosure of radiation levels. Such regulatory measures are necessary to ensure compliance with health and safety standards and to protect public health. Without adequate monitoring and enforcement, prolonged exposure to NIR may pose potential health risks, thereby increasing the long-term public health burden on society. Effective regulation is therefore essential to ensure that technological advancement occurs without compromising the well-being of the population.

The study also reveals important weaknesses within existing criminal liability frameworks in addressing negligence or reckless conduct associated with the management of telecommunications infrastructure. Strengthening the legal framework governing corporate responsibility is therefore essential. Governments, legislative bodies, and judicial institutions should establish clearer liability standards and enforcement mechanisms to address negligent or reckless actions by telecommunications operators and regulatory authorities. A stronger criminal liability framework would enhance corporate accountability, improve regulatory compliance, and increase public trust in the governance of telecommunications technologies.

Furthermore, the study demonstrates the relevance of Maqasid al-Shariah as a normative ethical framework for responsible technological governance. The objectives of Shariah—particularly the preservation of life, intellect, property, and public welfare—provide important ethical guidance for policymakers and corporate actors in regulating emerging technologies. The integration of these ethical principles into governance structures can encourage decision-making processes that prioritize societal welfare alongside technical and legal requirements, especially in jurisdictions where Islamic legal philosophy influences public policy.

The regulation and management of NIR exposure also have broader implications for the achievement of the United Nations Sustainable Development Goals (SDGs). Effective regulatory frameworks contribute to the advancement of SDG 3 (Good Health and Well-Being) by minimizing potential health risks associated with electromagnetic radiation. Responsible technological governance also supports SDG 9 (Industry, Innovation, and Infrastructure) by ensuring that technological development occurs in a sustainable and socially responsible manner. Moreover, strengthening legal accountability mechanisms contributes to SDG 16 (Peace, Justice, and Strong Institutions) by promoting transparency, corporate responsibility, and the rule of law.

Overall, the study underscores the importance of adopting an integrated governance approach to address the societal implications of emerging technologies. The challenges associated with NIR exposure cannot be adequately addressed through a single disciplinary perspective. Instead, effective governance requires the integration of criminal law, environmental law, telecommunications regulation, and ethical principles derived from Maqasid al-Shariah. Such an interdisciplinary approach can help ensure that technological development aligns with societal values, public health protection, and sustainable development objectives.

4.1. Limitations of the Study

Despite its contributions, this study has several

limitations that should be acknowledged.

First, the research adopts a qualitative doctrinal and interdisciplinary approach. While this method allows for a comprehensive examination of legal frameworks, ethical principles, and regulatory policies, it does not provide empirical or quantitative evidence regarding the actual health impacts of non-ionizing radiation exposure. Consequently, the study relies primarily on secondary data and existing literature.

Second, the scope of the study is limited in terms of technical analysis. Although the research examines legal and ethical aspects of NIR exposure, it does not provide an in-depth analysis of the technical or engineering dimensions of radiation emissions from mobile telecommunications infrastructure. As a result, the study does not offer precise measurements or region-specific assessments of exposure risks.

Third, the findings may not be universally applicable across all jurisdictions. Differences in legal frameworks, regulatory enforcement mechanisms, and telecommunications governance structures across countries may influence how the study's conclusions apply in different contexts.

Finally, although the integration of Maqasid al-Shariah with contemporary legal frameworks provides valuable ethical insights, interpretations of Shariah objectives may vary among scholars and legal systems. This variation may influence how the ethical principles are applied in regulatory governance.

Despite these limitations, the study provides a foundational framework for understanding the legal, ethical, and sustainable development implications of non-ionizing radiation exposure from mobile telecommunications networks.

4.2. Future Directions of the Study

Future research can build upon the findings of this study in several important ways.

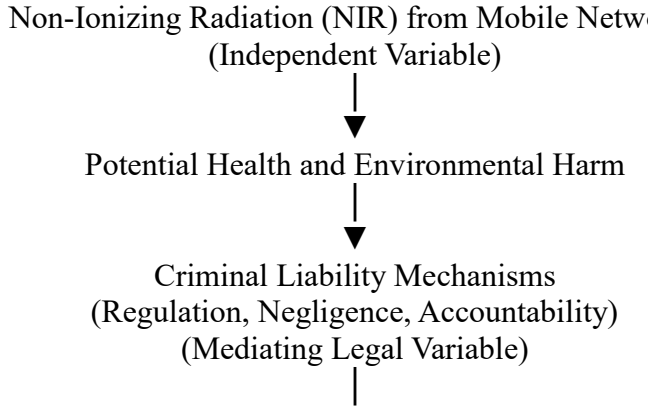
First, empirical studies are needed to measure and quantify levels of non-ionizing radiation exposure from mobile telecommunications infrastructure across different geographic regions. Such research would complement the doctrinal and qualitative findings of this study and provide more precise evidence regarding potential health and environmental risks.

Second, further research should investigate the long-term health effects of prolonged exposure to non-ionizing radiation, particularly among vulnerable populations such as children, pregnant women, and individuals with pre-existing medical conditions. These studies would provide valuable insights into the public health implications of telecommunications infrastructure.

Third, comparative legal studies examining regulatory frameworks and criminal liability mechanisms across different jurisdictions would provide deeper insights into best practices for telecommunications governance and corporate accountability.

Future research should also further explore the integration of Maqasid al-Shariah into contemporary regulatory frameworks governing emerging technologies. Such studies could examine how Islamic ethical principles can inform modern legal systems in promoting responsible technological development.

Finally, interdisciplinary research involving law, public health, environmental science, and engineering can contribute to the development of sustainable technological solutions. Such collaborative studies could explore ways to optimize telecommunications infrastructure while minimizing exposure to non-ionizing radiation, thereby contributing to the achievement of SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 16 (Peace, Justice, and Strong Institutions). Future empirical research may also test and validate the conceptual framework proposed in this study as shown in Figure 1.



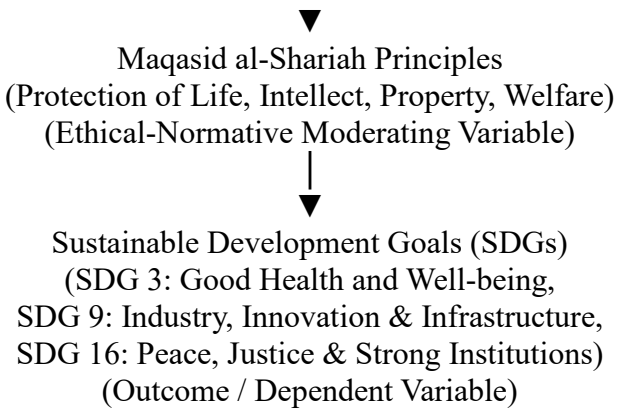


Figure 1: Conceptual Framework of the Study.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined the issue of criminal liability for damages potentially caused by non-ionizing radiation emitted from mobile telecommunications networks within the ethical framework of Maqasid al-Shariah and in relation to the United Nations Sustainable Development Goals (SDGs). The findings indicate that although non-ionizing radiation is generally considered less harmful than ionizing radiation, excessive or poorly managed exposure may still pose potential risks to human health and environmental safety. The study further demonstrates that the ethical principles embedded within Maqasid al-Shariah provide a valuable normative framework for evaluating the governance of emerging technologies. The objectives of protecting life, intellect, property, and public welfare reinforce the need for stronger regulatory oversight and responsible corporate conduct in managing technological risks. By integrating ethical principles with legal and regulatory frameworks, policymakers can promote governance structures that prioritize both technological progress and societal well-being. In addition, the study highlights the importance of aligning regulatory governance with global sustainable development priorities. Strengthening regulatory oversight and corporate accountability in the telecommunications sector contributes directly to the achievement of SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 16 (Peace, Justice, and Strong Institutions). Overall, the study demonstrates that a doctrinal, interdisciplinary, and ethical framework is essential for addressing the complex challenges associated with technological development. Ensuring that telecommunications infrastructure is managed responsibly will help safeguard public health, environmental sustainability, and legal accountability while supporting innovation and economic development. Based on the study's findings, the following policy recommendations are proposed:

1. Governments and regulatory bodies should enact laws establishing criminal liability for exposure to non-ionizing radiation (NIR). Provisions addressing negligence, reckless conduct, and corporate responsibility should include deterrent penalties to ensure compliance.
2. Continuous monitoring of NIR emissions, regular audits of telecommunication facilities, and public disclosure of NIR data are essential for safeguarding public health. Regulatory bodies should implement systems to penalize non-compliance while providing avenues for corrective action.
3. The principles of Maqasid al-Shariah should guide technology governance, emphasizing harm prevention and public welfare. Ethical responsibilities should complement legal obligations, ensuring that corporate and institutional actions align with societal safety and well-being.
4. Raising public awareness about NIR hazards, regulatory guidelines, and individual safety rights is crucial. Informed citizens and stakeholders can encourage responsible behavior from corporations and support adherence to safety standards.
5. Policy frameworks for mobile network infrastructure should align with SDGs. Infrastructure development and technological innovation must be balanced with public health, environmental sustainability, and institutional accountability.
6. Legal scholars, public health experts, environmental scientists, and Islamic scholars should collaborate to develop comprehensive legal and ethical frameworks. This interdisciplinary approach

ensures that technological advancement is accompanied by robust ethical standards and a focus on societal welfare.

Acknowledgements: Authors of this Article would like to thank the Governance and Policy Design Research Lab (GPDRL) of Prince Sultan University (PSU) for their financial and academic support to conduct this research and publish it in a reputable Journal.

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