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AI GOVERNANCE FOR SUSTAINABLE DEVELOPMENT: POLICY, ETHICS, AND REGULATION FRAMEWORK FOR PAKISTAN

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Abstract
Artificial Intelligence (AI) has emerged as a transformative force across economic, social, and environmental sectors, offering immense potential for sustainable development. Pakistan's National Artificial Intelligence Policy 2025 marks a significant milestone in integrating AI with national priorities for innovation, inclusivity, and sustainability. This paper examines the comprehensive framework of AI governance outlined in the policy, focusing on its policy, ethical, and regulatory dimensions. The policy's six strategic pillars, AI innovation ecosystems, awareness and readiness, secure AI environments, sectoral transformation, infrastructure development, and international collaboration collectively aim to foster responsible AI-driven growth. The ethical framework prioritizes transparency, accountability, fairness, privacy, inclusivity, and human oversight to safeguard public trust and human dignity. The regulatory framework adopts a risk-based approach with provisions for sandboxes, oversight bodies, and adaptive legal structures to balance innovation with protection. Additionally, the policy aligns with the United Nations Sustainable Development Goals (SDGs), integrating AI applications into healthcare, agriculture, education, and governance to promote social equity and environmental stewardship. However, challenges such as funding continuity, institutional capacity, data protection, and coordination mechanisms remain critical to its effective implementation. The study concludes that Pakistan's AI governance model, while ambitious and ethically grounded, requires sustained institutional support, legal enforcement, and cross-sectoral collaboration to realize its vision of an inclusive, sustainable, and AI-empowered future.

1. INTRODUCTION

Artificial Intelligence (AI) represents a critical driver of global transformation across economic, social, and environmental domains, pressing countries to strategically govern its development and deployment. Pakistan's National Artificial Intelligence Policy 2025 is a landmark initiative reflecting the government's comprehensive approach to harness AI for sustainable development, innovation, and digital empowerment [1, 2]. The policy, approved by the federal cabinet in July 2025, is structured around six strategic pillars, including AI innovation ecosystems, public awareness and readiness, secure AI infrastructure, sectoral transformation, computational resources, and international collaborations. It aims to responsibly

integrate AI into key sectors such as health, education, agriculture, and governance, with a strong emphasis on ethical governance, data protection, inclusivity, and alignment with international standards [1, 2]. The policy not only targets economic growth but also social equity and environmental sustainability, gearing Pakistan towards becoming a knowledge-based economy capable of thriving in the digital age. This ambitious roadmap prioritizes capacity building through mass training, scholarships, and internships, alongside regulatory measures like sandboxes and oversight bodies, underscoring transparency, accountability, and human-centered AI application [1]. To better illustrate the structure and operational priorities of Pakistan's *National Artificial Intelligence Policy 2025*, the six strategic pillars and their respective focus areas are summarized in Table 1. Each pillar represents a core component of the policy's multidimensional approach to AI governance, emphasizing innovation, inclusivity, ethical deployment, and international collaboration. Together, these pillars form an integrated policy ecosystem aimed at leveraging AI for sustainable socio-economic growth and digital transformation.

Table 1. Strategic Pillars of Pakistan's National Artificial Intelligence Policy 2025 and Their Key Objectives

Pillar	Focus Area	Key Objectives and Actions	Expected Outcomes
1. AI Innovation Ecosystem	Research, startups, and funding	Establish National AI Fund, Centers of Excellence, and venture capital support for AI startups	Accelerated innovation, commercialization, and entrepreneurship
2. AI Awareness and Readiness	Human resource development	Train 200,000 individuals annually, 3,000 scholarships, 20,000 internships	Skilled and inclusive AI workforce
3. Secure AI Ecosystem	Governance, data protection, and ethics	Develop AI sandboxes, ethical guidelines, cybersecurity frameworks	Public trust, safe AI experimentation, and accountability
4. Sectoral Transformation	Application in key sectors	Deploy AI in education, healthcare, agriculture, and governance	Improved service delivery and sustainable socio-economic outcomes
5. AI Infrastructure	Computing and data resources	Build national compute grid, data repositories, and cloud platforms	Strengthened AI R&D capabilities
6. International Collaboration	Global partnerships and standards	Joint research, capacity building, and adherence to global norms	Global integration and technology transfer

Policy Framework

Pakistan's National Artificial Intelligence Policy 2025 outlines a comprehensive and forward-looking policy framework designed to propel the country towards becoming a responsible and knowledge-based economy through the ethical and innovative adoption of AI technologies. This framework is built upon six strategic pillars that collectively foster an ecosystem conducive to sustainable development, social inclusion, and economic growth. The first pillar, AI Innovation Ecosystem, focuses on establishing a National AI Fund (NAIF) by allocating 30 percent of the existing R&D Fund managed by Ignite, a government technology financing body. It also encompasses the creation of Centers of Excellence across major cities and venture funds aimed at accelerating AI research, development, and commercialization, thus nurturing local innovation and startup growth [1, 3]. AI Awareness and Readiness is the second pillar, which centers on building a skilled AI workforce and enhancing public AI literacy. The policy commits to training 200,000 individuals annually, awarding 3,000 scholarships, and offering 20,000 paid internships to support capacity building. It emphasizes inclusivity by

targeting marginalized groups to ensure equitable access to AI education and opportunities [4]. The third pillar, Secure AI Ecosystem, addresses governance and regulatory frameworks that promote transparency, data protection, and ethical AI use. It introduces regulatory sandboxes for safe AI experimentation, cybersecurity protocols, and frameworks promoting accountability and public trust in AI systems [5, 6]. Sectoral Transformation represents the fourth pillar, prioritizing AI deployment across vital sectors including education, healthcare, agriculture, and governance. Tailored roadmaps and workforce upskilling initiatives aim to enhance service delivery and foster sustainable outcomes in line with national development goals [3, 7]. The fifth pillar, AI Infrastructure, envisions the development of a national compute grid, centralized data repositories, AI hubs, and cloud-based platforms to support scalable research and development. This infrastructure underpins innovation by providing shared resources essential for academia, industry, and startups [6]. Finally, International Partnerships and Collaborations facilitate global cooperation through joint research, cross-border projects, and adherence to international standards, positioning Pakistan as an active participant in the global AI landscape while attracting investment and knowledge exchange [6]. Collectively, this well-articulated policy framework aims to responsibly harness AI for Pakistan's sustainable development by driving innovation, securing ethical safeguards, and ensuring inclusive growth aligned with global commitments such as the UN Sustainable Development Goals (SDGs) [3, 6, 7].

Ethical Framework

Pakistan's National AI Policy 2025 establishes a comprehensive ethical framework that is foundational to the responsible development and deployment of artificial intelligence technologies, ensuring AI advances contribute positively to sustainable development while safeguarding human dignity and rights. The ethical framework is built around core principles of transparency, accountability, fairness, privacy, inclusivity, and human oversight, which collectively serve to protect individuals and society from potential harms associated with AI [1]. Transparency requires that AI systems, especially those influencing critical public services, governance, or individual rights, disclose their decision-making processes in an understandable manner. This openness enables affected individuals and stakeholders to comprehend how AI outcomes are generated, fostering trust and easing public acceptance. Accountability mechanisms are embedded by mandating regular audits and impact assessments, including independent external reviews to identify and correct algorithmic biases, discriminatory practices, or unintended consequences [1].

Privacy and data protection are central to the ethical framework. The policy aligns with the forthcoming Personal Data Protection Bill, emphasizing strict regulations on data collection, storage, and usage. It mandates principles such as data minimization (collecting only necessary data), clear informed consent from data subjects, and strict controls on data sharing to prevent misuse. An independent regulatory authority is proposed to oversee these protections, enforce compliance, and address grievances related to data breaches or misuse [1, 8]. Crucially, the framework promotes equitable access and AI literacy to close digital divides. By incorporating inclusive education and training programs that specifically target underserved and vulnerable communities, the policy strives to democratize AI benefits and prevent socio-economic disparities from widening. This approach supports gender equity, regional balance, and empowerment of marginalized groups [9]. Human oversight remains indispensable, with the policy requiring that AI-powered decisions which affect human lives or liberties incorporate human judgment. This "human-in-the-loop" principle ensures that machines augment rather than replace human decision-makers, preserving ethical responsibility and intervention capacity in critical contexts [10]. Overall, Pakistan's ethical AI governance framework proactively addresses risks related to bias, privacy violations, and exclusion while promoting AI's transformative potential for sustainable development. It provides a clear, actionable roadmap to embed ethics in AI's lifecycle, from design to deployment, making ethical governance a cornerstone of the country's digital advancement and alignment with international best practices and UN Sustainable Development Goals [11].

Regulatory Framework

Pakistan's National AI Policy 2025 outlines a forward-thinking regulatory framework designed to govern AI technologies effectively while fostering innovation and protecting public interests. Recognizing the complexity and rapid evolution of AI, the framework establishes clear legal and institutional mechanisms to ensure responsible AI use across sectors, mitigate risks, and uphold ethical standards critical for sustainable development. The policy defines AI comprehensively, categorizing systems based on risk profiles, with high-risk applications—such as those affecting healthcare, law enforcement, and critical infrastructure—subject to stricter oversight. This risk-based approach enables targeted regulation that balances innovation incentives with the need for safety and ethical compliance [4].

Central to the regulatory framework is the establishment of regulatory sandboxes—controlled environments where AI technologies can be tested under real-world conditions with regulatory supervision. These sandboxes facilitate experimentation and innovation while allowing authorities to assess impacts, ensure compliance, and develop adaptive regulations responsive to emerging challenges [6]. The framework also foresees the creation of specialized regulatory bodies or an AI oversight council tasked with certification, auditing, and compliance enforcement. These bodies will coordinate with existing data protection authorities to uphold privacy and data security mandates, manage AI-related dispute resolution, and provide guidance on algorithmic accountability [12].

To strengthen legal safeguards, the framework proposes the enactment of legislation explicitly addressing AI's operational boundaries, liability, transparency requirements, and prohibition of discriminatory or harmful AI uses. It includes provisions for judicial oversight to monitor surveillance applications and ensure that AI deployment respects fundamental rights and freedoms [4]. Additionally, inter-agency coordination mechanisms are emphasized to streamline governance across ministries and departments, ensuring holistic policy implementation and minimizing regulatory fragmentation [6]. Together, these regulatory elements establish a robust legal ecosystem that encourages innovation, protects citizens, and embeds accountability, thereby enabling AI to be a trusted tool for Pakistan's sustainable development while adhering to global governance standards and best practices.

Implementation Roadmap

The successful realization of Pakistan's AI governance framework for sustainable development hinges on a well-structured implementation roadmap that ensures coordinated efforts among government, academia, industry, and civil society. The National AI Policy 2025 provides clear strategic milestones and mechanisms to monitor progress, foster innovation, and build capacity across the country. A principal feature of the roadmap is an ambitious skills development program targeting the training of one million AI professionals by 2030. This includes awarding 3,000 annual scholarships and facilitating 20,000 internships to cultivate a diverse, future-ready workforce that can meet the demands of an AI-powered economy. Special emphasis is placed on inclusivity by prioritizing women, persons with disabilities, and rural youth, aiming to democratize access and participation in the AI ecosystem [3].

To stimulate innovation, the policy establishes a National AI Innovation Fund and AI Venture Fund designed to channel public investment into startups and research, while attracting private sector participation. These funds underpin the creation of Centers of Excellence in AI located in major cities, which will serve as hubs for research, development, and incubation of AI-driven solutions adapted to Pakistan's socio-economic challenges [3, 13].

The roadmap includes operationalizing 50,000 AI-driven civic projects and deploying 1,000 indigenously developed AI products over five years. These initiatives are aimed at transforming public service delivery across sectors such as healthcare, agriculture, education, and governance through AI-enhanced efficiency and inclusivity.

Governance structures are also emphasized, with the formation of an AI Council and a comprehensive Master Plan and Action Matrix tasked with overseeing policy implementation, ensuring regulatory compliance, and facilitating national and international cooperation. Cybersecurity and data protection protocols are reinforced to protect citizen data and safeguard AI systems against digital threats.

International collaboration through partnerships and adherence to global AI norms further supports the pragmatic and ethical rollout of AI in Pakistan [12]. Pakistan's AI policy implementation roadmap is a multi-dimensional framework that integrates capacity building, innovation funding, sectoral AI adoption, and governance oversight to achieve sustainable, inclusive digital transformation aligned with global best practices and the United Nations Sustainable Development Goals (SDGs).

Sustainable Development Integration

Pakistan's National AI Policy 2025 is explicitly designed to integrate artificial intelligence technologies as catalysts for sustainable development, aligning its implementation with the United Nations SDGs and national socio-economic priorities. The policy envisions AI as a transformative enabler to address critical developmental challenges while fostering inclusive growth and environmental sustainability [1]. The integration of AI into Pakistan's sustainable development agenda is grounded in a multidimensional governance approach that connects policy, ethical, and regulatory mechanisms. This interconnected structure ensures that AI deployment contributes not only to technological innovation but also to social welfare, transparency, and ecological balance. Figure 1 presents a conceptual model illustrating how these governance dimensions align to achieve Pakistan's broader vision of sustainable and inclusive growth.

The policy prioritizes AI applications in key sectors such as healthcare, education, agriculture, and governance. For instance, AI-driven diagnostics and telemedicine initiatives aim to improve healthcare access and quality, especially in underserved areas. In education, personalized learning platforms and AI-powered digital literacy programs seek to enhance educational outcomes and bridge regional disparities. Precision farming supported by AI analytics intends to optimize agricultural productivity and climate resilience, addressing food security sustainably. Governance transformation through AI-based e-governance systems aims to increase transparency, streamline public service delivery, and strengthen citizen engagement [1, 7].

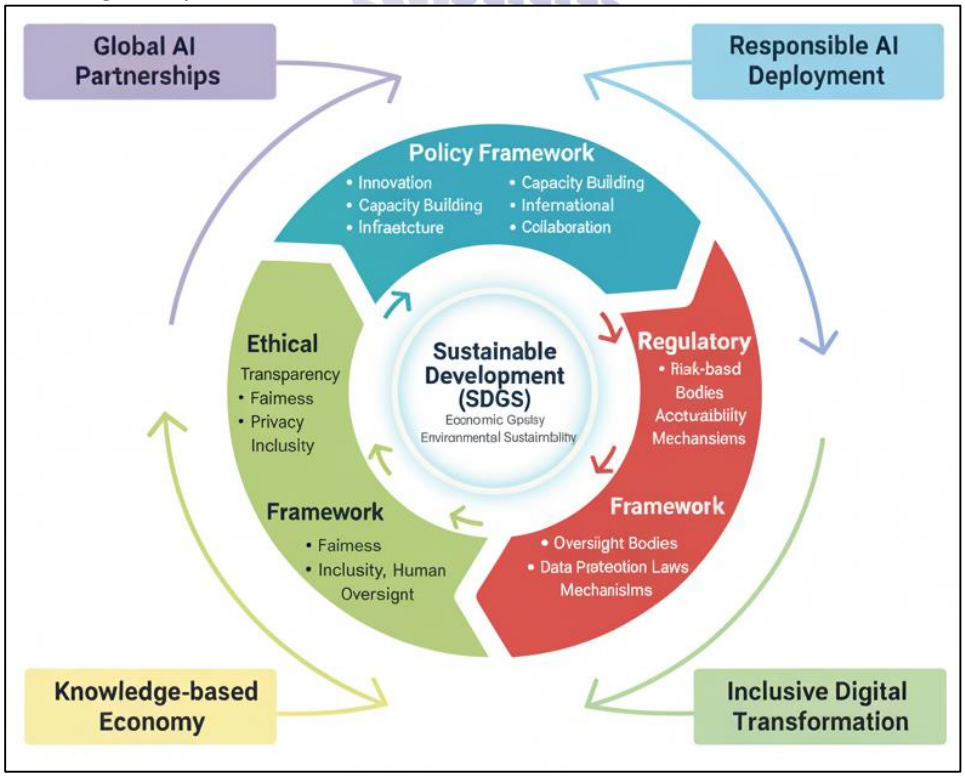

Figure 1. Conceptual Framework for AI Governance and Sustainable Development in Pakistan.

The figure illustrates the interconnection between policy, ethical, and regulatory dimensions of Pakistan's National AI Policy 2025 within the context of sustainable development. The framework shows how AI governance mechanisms policy design, ethical safeguards, and regulatory oversight jointly contribute to achieving economic growth, social inclusion, and environmental sustainability, aligned with the United Nations Sustainable Development Goals (SDGs).

A crucial dimension of this integration is workforce development, with targeted training programs intended to build a future-ready labor force capable of utilizing AI technologies responsibly and innovatively. The policy emphasizes inclusive capacity building, ensuring women, rural populations, and marginalized communities benefit equitably from AI advancements, thereby reducing socio-economic gaps and fostering digital inclusion [14]. Environmental considerations are also embedded by promoting AI tools that enhance resource efficiency and climate adaptation measures. The policy encourages responsible AI deployment that minimizes environmental footprints and supports green technologies. Moreover, Pakistan's AI strategy underscores collaboration with international organizations and adherence to global standards, enhancing knowledge transfer and harmonizing efforts towards sustainable AI innovation [15]. This comprehensive integration of AI with sustainable development objectives positions Pakistan to harness cutting-edge technologies to accelerate progress towards economic prosperity, social equity, and environmental stewardship, thereby making AI a pivotal instrument for national development and global commitments [1, 7, 12]. (

International Collaboration and Partnerships

A defining pillar of Pakistan's National AI Policy 2025 is its commitment to international collaboration and partnerships, recognizing that AI governance and innovation transcend national borders and require global cooperation. The policy strategically emphasizes forging bilateral and multilateral relationships with international organizations, technology leaders, research institutions, and global AI forums to enhance Pakistan's capabilities and align its regulatory framework with global norms and standards [1]. Pakistan actively seeks to join global AI governance dialogues and platforms, enabling knowledge exchange and cooperation on shared challenges such as ethical AI use, data sovereignty, and cybersecurity. Partnerships with international bodies like UNESCO, the Asian Development Bank, and global technology companies have played a critical role in shaping the policy and continue to support its implementation through technical assistance and joint research projects [1, 16]. The policy advocates collaboration on cross-border AI research and development projects, supporting innovation ecosystems that leverage international expertise and investment. Through AI diplomacy, Pakistan aims to position itself as a proactive participant in global AI governance, attracting ethical AI investments, sharing best practices, and contributing to the establishment of interoperable AI standards to facilitate global trade and technology transfer [1].

Such partnerships are designed not only to accelerate Pakistan's AI maturity but also to ensure the country's AI ecosystem responds effectively to international ethical, legal, and security considerations. This global engagement underpins Pakistan's ambition to be a responsible, inclusive leader in AI innovation in South Asia and beyond, integrating international benchmarks into national frameworks for sustainable development.

Implementation Challenges

While Pakistan's National AI Policy 2025 presents an ambitious and comprehensive framework for AI governance aligned with sustainable development, translating this vision into actionable outcomes poses significant challenges. Key among these are funding sustainability, institutional capacity, effective coordination, and regulatory enforcement. The policy's goal to train one million AI professionals and establish extensive innovation infrastructure requires sustained and substantial financial resources. However, consistent funding allocation remains uncertain amidst competing national priorities, risking resource dilution and delayed implementation (Irum Khan, 2025). Similarly, Pakistan's public sector faces limited experience with cutting-edge AI research and development, necessitating stronger public-private partnerships and incentivizing private sector-led entrepreneurship to fill capability gaps [12].

Coordination across federal and provincial governments, academia, and industry poses another hurdle. Clear mechanisms for governance, accountability, and transparent inter-agency collaboration need further development to minimize bureaucratic bottlenecks and overlapping mandates. Without streamlined coordination and phased implementation plans, ambitious targets may become unattainable [17, 18]. Data sharing and privacy protection are additional complex challenges. Effective AI deployment depends on high-quality, accessible datasets across departments, yet concerns regarding data sovereignty, interoperability, and privacy hinder large-scale data integration. The policy's strong ethical commitments require translation into enforceable legal provisions and operational mechanisms such as tiered penalties, independent audits, and grievance redress, which are still in evolution. Absent these, ethical safeguards risk being aspirational rather than actionable [19, 20].

Finally, infrastructure disparities—particularly uneven internet access outside urban centers—could slow AI adoption in rural areas, undermining digital inclusion goals. Monitoring early implementation milestones such as the establishment of the AI Council and disbursement of initial grants will be critical indicators of success. Failure at these stages could erode public confidence and reduce momentum [12]. In summary, while Pakistan's AI policy has laid a solid foundation, overcoming these execution realities will be essential to transform the policy's promise into tangible, ethical, and inclusive AI-driven development outcomes. Leveraging lessons from regional peers, adopting phased timelines, prioritizing capacity building, and ensuring accountable governance are key strategies recommended to address these challenges.

Conclusion

Pakistan's National Artificial Intelligence Policy 2025 represents a visionary step toward embedding AI within the country's sustainable development agenda. By combining innovation-driven growth with ethical safeguards and robust regulatory mechanisms, the policy sets a precedent for responsible AI adoption in developing economies. The comprehensive integration of AI into healthcare, education, agriculture, and governance demonstrates Pakistan's intent to use technology as a lever for socio-economic equity and environmental resilience. However, realizing these potential demands persistent policy execution, resource mobilization, and institutional coherence. Effective implementation will hinge on the establishment of dedicated oversight bodies, continuous capacity building, and transparent data governance mechanisms. Strengthening public-private partnerships and fostering international collaborations will further enhance AI maturity and global alignment. Overall, Pakistan's AI governance framework provides a model for balancing technological progress with ethical responsibility, ensuring that AI becomes a catalyst for inclusive and sustainable national transformation.

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