

Navigating challenges and opportunities: AI's contribution to Pakistan's sustainable development goals agenda – a narrative review

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Abstract

Sustainable Developmental Goals (SDGs) were introduced by the United Nations to ensure the sustainable progress of mankind through various domains. Pakistan, a low-middle-income country, faces many challenges in achieving SDGs. Artificial Intelligence is a rapidly evolving technology presenting significant importance in achieving SDGs. Therefore, this narrative review aimed to evaluate the artificial intelligence technologies that have been utilized globally and nationally which can be implemented in Pakistan focusing on Goal 3 (Good Health and Well-being) of SDGs. AI has been utilized primarily in high-income countries aiming to improve healthcare, thereby progressing towards achieving different targets of Goal 3 of SDGs. Pakistan lacks such initiatives with modest to no improvement across different SDGs. Therefore, Pakistan can adapt initiatives undertaken by resourceful countries to achieve its own SDGs.

Keywords: Sustainable Development, Goals, Artificial Intelligence, Health Care, Technology.

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Introduction

In 2015, the United Nations (UN) proposed 17 SDGs aiming at various domains, including healthcare by the year 2030, as illustrated in figure 1. The SDGs were set for the year 2030 because they provided a realistic timeline globally. The SDGs were integrated and indivisible, recognizing that action in one area will affect outcomes in others. Pakistan, the fifth populous country is a major player in achieving SDGs globally. Pakistan faces significant challenges in terms of environment, healthcare, poverty, and education. Hence, any solutions implemented to tackle these in Pakistan would have a considerable impact globally.

Artificial Intelligence (AI) is a rapidly evolving disruptive

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technology that works with the intelligence of machines and software. AI is broadly based on two types: Machine Learning (ML) and Deep Learning (DL). AI models aim to replicate human cognitive functions which include tasks like reasoning, decision-making, and solving problems. AI has a wide range of applications across various domains including education, finance, entertainment, and healthcare. To facilitate achieving SDGs, AI can play a crucial role.

Looking at the global applicability of AI, many national governments have implemented and regulated AI in various areas through their personalized national action plans.¹ However, such AI implementation programmes have largely been initiated by high-income and upper-middle countries. On the other hand, many developing nations are lagging behind in terms of initiatives for the implementation of AI due to many restraints such as limited resources, financial barriers, a skilled workforce, concerns regarding data privacy, and the digital divide.



Figure-1: Sustainable Developmental Goals. Current Healthcare Challenges in Pakistan

Healthcare and education form the backbone for the progress of any country since they encompass and affect many of the SDGs. UN's SDG 3 "Good Health and Wellbeing" and SDG 4 "Education" focus on the promotion of well-being at all ages of individuals which is essential for sustainable development and education for all boys and girls completing their primary education by 2030. AI has been utilized for diagnostic purposes and treatment planning in hospitals which can lead to better outcomes for the patients.² Such findings provide valuable insights regarding the potential role of AI in achieving healthcare SDGs.

According to the International Monetary Fund (IMF), it has been estimated that in order for Pakistan to achieve SDGs by 2030, 16% of GDP should be allocated.³ There are various ways to measure SDGs which include SDG tracker, Global SDG indicators database, and other frameworks. The overall index score for Pakistan in the year 2021 was reported to be 57.7 across the 17 SDGs.⁴ These scores are reported to be an improvement over the scores of 2020, measuring a 3 percent increase. Despite these statistics, Pakistan has shown to be heading towards modest improvement across various SDGs, with significant improvement not achieved so far due to different challenges such as quality of education, job creation, poverty, access to health, and the internet.

Interdependencies of the SDGs are not static in terms of time and space; however, they vary geographically. Therefore, it is necessary to evaluate these interdependencies of SDGs as it is of paramount importance for achieving coherent and consistent towards achieving these goals on a local and worldwide level. Furthermore, developing nations like Pakistan face diverse challenges in achieving the SDGs needed for inclusive and sustainable growth which can be achieved using AI. Considering the potential impact of Pakistan's progress on the overall SDGs, therefore, this narrative aimed to review the artificial intelligence technologies that have been utilized globally and nationally which can be implemented in Pakistan focusing on Goal 3 of SDGs.

Pakistan, a low-middle-income developing country, consists of a healthcare system divided into public and private sectors with differences in the level of affordability, quality of care, and services offered to the patients. Generally, most of the individuals living in Pakistan face difficulties in accessing healthcare facilities primarily due to lack of affordability, access, and services available in their vicinities. This has led to avoidance behaviour among many patients as they do not have treatment that is available and affordable for them.

According to the World Health Organisation (WHO) recommendations, a total of 6% of the country's GDP should be allocated to healthcare.⁵ Furthermore, IMF suggests Pakistan would need to almost triple its healthcare spending in terms of GDP-from the current 2.8 percent to 8.2 percent by 2030-to meet the SDG targets and perform at a commensurate level with high-performing peer countries.⁶ However, Pakistan falls short of this goal with a current allocation of 0.5-0.8%, as compared to the 6% of GDP set by WHO. In recent times, Pakistan has largely faced issues related to healthcare that include childhood vaccinations (polio), maternal and child health, and nutrition. Moreover, the lack of trained personnel which includes doctors, nurses, and paramedic staff further hampers the already compromised existing healthcare infrastructure. The majority of the healthcare facilities are concentrated in the urban and large populated cities, thereby depriving the majority of the population residing in the rural areas of healthcare services.

AI's Global Role in SDG Achievement and Pakistan's Path Forward

AI has been utilized rigorously in healthcare which contributes to achieving different targets under Goal 3 of SDGs, as illustrated in figure 2. AI has primarily been deployed in developed countries, which can be replicated in developing, resource-deprived countries.

Target 3.1 Maternal Mortality: According to the WHO, the maternal mortality rate is unacceptably high. Therefore, the first target under the UN's SDGs 3 describes the pledges toward a reduction in the global maternal mortality ratio to below 70 per 100,000 live births by the year 2030.⁷ This can be achieved through improving access to quality maternal healthcare, including antenatal care, skilled care during childbirth, and care and support in the weeks after childbirth. AI can help improve access to healthcare for mothers and children in low-resource settings by enabling remote consultations with healthcare professionals. In terms of Pakistan, many women reside in rural areas with limited to no access to healthcare facilities. Implementation of AI enabling remote patient consultations can be of significant outcomes to improve maternal health.

An AI-based model was developed in a study by Sufriyana et al where the system led to improved diagnosis of preeclampsia detection in early and late stages along with gestational diabetes with low rates of false positivity.⁸ From a Pakistani perspective, such models when introduced into less accessible areas can help improve and monitor maternal health to reduce postpartum complications. However, such devices should be cost-



Figure-2: Targets under Goal 3 of Sustainable Developmental Goals

effective along with being easily accessible. AI-powered wearable devices and mobile apps can continuously monitor maternal health parameters, such as blood pressure, heart rate, and foetal movements. Any deviations from normal values can trigger automated alerts, allowing for timely medical interventions, even in remote or underserved areas. Such tools can be of valuable importance in Pakistan which is scarce in its resources in terms of health and facing high maternal mortality rates.

With the advent of AI, it has become possible for healthcare professionals to identify stillbirths' ante-natally with data of patients including medical history, current pregnancy complications, and maternal features. This ML prediction model for stillbirths led to a slight improvement in the Australian cohort of patients.⁹ Considering the high stillbirth rates in Pakistan, such AI-based models can be replicated in order to reduce the risk of miscarriages and stillbirths.

Target 3.2 Neonatal and Child Mortality: Preventing neonatal and childhood mortalities is a significant challenge for healthcare systems, therefore it forms one of the targets for SDG Goal 3. This target aims to end preventable deaths of new borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births. Achieving this target requires improving access to

quality healthcare for mothers and children, including immunizations, nutrition, and treatment for common childhood illnesses.

Pakistan faces high rates of new born and child mortality under the age of 5 years due to several factors such as complications related to premature births, congenital disorders, lack of vaccinations, high-risk deliveries, poor breastfeeding practices, and during-delivery complications. In well-developed countries, AI has been implemented that significantly reduces the mortality rates of this

age group of children.¹⁰ A study by Gao and colleagues developed ML algorithms using urine and blood samples among 81 pregnant females. This model was found to be capable of predicting preterm births among the cohorts of low and middle-income countries including Karachi, Pakistan.¹¹ Given Pakistan's geographical resource disparities, such AI-based models can be implemented in rural areas of Pakistan in order to alleviate early childhood mortality rates.

Target 3.3 Infectious Diseases: Infectious diseases are one of the most important causes of morbidities and mortalities worldwide forming an essential target of SDG Goal 3. This target aims to end the epidemics of AIDS, tuberculosis, neglected tropical diseases, combat hepatitis, water-borne diseases, and other communicable diseases. Globally, regional variations exist as some diseases are more prevalent in some regions as compared to other regions. Therefore, the UN has generalized the most common communicable disease globally, for which modalities needed to be introduced to attenuate its spread along with associated morbidities and mortalities.

Tuberculosis (TB) belongs to the Big Three Infectious Diseases along with Malaria and AIDS, being responsible for morbidities and mortalities globally, along with Pakistan. Therefore, these pathologies are specifically targeted in Goal 3 of SDGs whereby policies and modalities need to be implemented in order to mitigate its spread worldwide.

Considering the global health challenge that is TB, a study by Saybani and colleagues developed an Artificial Immune Recognition System (AIRS) based on an ML algorithm (support vector machine) aiming for efficient diagnosis of TB. This study's model was able to diagnose patients suffering from TB with 100% sensitivity, specificity, and accuracy.¹² According to WHO, TB is highly epidemic in Pakistan with 510,000 new cases emerging every year and approximately emergence of 15,000 TB patients with drug resistance.¹³ With these statistics, there is a strong need in Pakistan for the development and implementation of timely diagnosis of such patients as remaining unidentified increases its chances of spreading to uninfected individuals many folds.

Worldwide, there have been an estimated 247 million cases and 619,000 deaths from malaria epidemics mainly from African and South Asian Countries.¹⁴ Considering the alarming situation from these epidemics, Goal 3 of SDGs emphasizes the need to decrease morbidities and mortalities associated with Malaria. Malaria diagnosis is time-consuming requiring many health care services. To overcome this, ML models have been generated that utilize digital-in-line holographic microscopy data to detect infected red blood cells achieving an accuracy of greater than 95%.¹⁵ From Pakistan's perspective, an estimated prevalence has been reported of 23%, with a higher contribution towards this prevalence from Karachi, the most populous city of Pakistan.¹⁶ There is a dire need for the implementation of modalities to improve and mitigate the transmission of malaria, with AI technologies to diagnose and treat such patients have the potential to significantly improve morbidity and mortality rates.

Target 3.4 Non-communicable Diseases: NCDs have been major contributors to global mortalities, especially amongst low-income and low-middle-income countries along with individuals with low socioeconomic status.¹⁷ Hence, another important target emphasized by the UN under Goal 3 for reducing mortalities by one-third from non-communicable diseases (NCDs) through prevention and treatment. In 2019, of the 55 million deaths worldwide, 44 million were from NCDs.¹⁷ Considering the major contribution of NCDs in global mortalities, different modalities have been introduced to tackle preventable and treatable deaths by NCDs, which includes AI. In recent years, decision-making models utilizing AI have been created that assist clinicians in making better decisions to decrease morbidities and mortalities.¹⁸ Moreover, mobile applications have been developed that help both clinicians and patients in making sure medication adherence is achieved in patients with NCDs.¹⁸ These applications operate by sending reminders to the

patients to take their medications, which improves compliance among them. Such applications can be introduced in Pakistan where the disease burden of NCDs directly contributes to significant morbidities and mortalities.

Mental health is becoming a leading disorder worldwide, with a prediction that half the world's population will experience mental health disorders. To mitigate the prevalence of mental health disorders and offer support, many different modalities have been introduced to help people. A study by Narzieve and colleagues developed an AI-based application that detects smartphone typing without relying on the content typed to detect depression.¹⁹ Such ML algorithms detect the patterns to predict whether an individual might be at risk of developing depression. Pakistan faces significant challenges in terms of mental health disorders due to the stigma created for individuals seeking support.²⁰ It has been reported that Pakistan has one of the worst mental health indicators with less than 500 psychiatrists for its population, with an estimated more than 4% population suffering from some mental health disturbances.²¹ Hence, the implementation of AI-based applications, especially in Pakistan, helps individuals to deal with their mental health disorders without going through societal pressures and perspectives. A recent study conducted in Pakistan by Khan et al describes the deployment of motion sensors for recognizing anxiety behaviour. According to the results of this study, the motion sensors had an accuracy of over 92% for detecting anxiety behaviour.²² Such utilizing and deployment of AI locally signifies the realization of importance of AI for betterment in healthcare and achieving SDGs.

Target 3.5 Substance Abuse: Substance abuse is a major concern worldwide as it has been estimated that more than 100,000 deaths are reported each year.²³ Many of these deaths are related to overdose related to opioids. In terms of Pakistan, concerns have been raised about substance abuse as 6% of the total population, precisely, 9% of male adults and 2.9% of female adults were involved in consuming substances other than alcohol and tobacco.²⁴ So, the UN proposed the introduction of preventing and treating substance abuse as one of the targets for Goal 3.

In a study by Hassanpour and colleagues, they evaluated substance abuse risk on deep neural networks and data from social media applications like Instagram.²⁵ This study found that DL approaches can be used to identify substance abusers such as alcohol consumption and allowing data for the development of interventions as well. Considering the alarming increase in substance

abuse in Pakistan, such AI algorithms can be implemented to prevent and treat substance abusers.

A study by Rezbaul and colleagues developed an AI-based smartphone application to assess the risk of misuse of opioids in the working population. This study concluded that the application yielded promising results in predicting and offering mitigation plans for disease prevention and detection thereby helping in opioid crises.²⁶ Such applications can also be utilized in the Pakistani population as most of the individuals are equipped with smartphones, thereby, facilitating its implementation.

Target 3.6 Road Traffic: Target 3.6 is one of the SDGs adopted by the UN in 2015. It aims to halve the number of global deaths and injuries from road traffic accidents (RTA) by 2030. According to the WHO, RTA injuries are the eighth leading cause of death globally, and the first among people aged 5-29 years. In 2016, there were an estimated 1.35 million RTA deaths worldwide, with low- and middle-income countries accounting for more than 90% of them.²⁷

AI-based telehealth has strides in facilitating healthcare as in cases of RTA, telehealth can enable healthcare professionals to conduct remote consultations.²⁸ Additionally, AI-assisted robotic surgeries can also be performed remotely by surgeons on accident victims, reducing the need for long-distance transportation of patients.²⁸ Furthermore, AI can assist emergency room staff by quickly analyzing medical records, images, and vital signs of accident victims. Thereby improving the prognosis of such patients.²⁸

According to WHO's latest data available for Pakistan, RTA in Pakistan contributed to 1.93% of the overall mortality rate with a 95th global ranking out of all the countries.²⁹ Considering the seriousness of such incidents, Pakistan can adopt similar initiatives from developed countries to improve patient outcomes in cases of RTA.

Target 3.7 Sexual and Reproductive Health: Access to reproductive health care services has been a challenging goal to achieve due to the diversity in terms of culture observed globally. However, AI can help in achieving Target 3.7 by providing various solutions for improving sexual and reproductive healthcare services. According to WHO, an estimated 1.1 billion women of reproductive age have a need for guidance on family planning.²⁹ Of these women, 77.5% have had their needs for modern contraceptive methods met.²⁹ Every year, between 2015 and 2019, there were about 121 million unintended pregnancies among women of reproductive age.³⁰ So, to

overcome such challenges, different AI-based models have been introduced.

A study by Mills and colleagues reviewed different chatbots that are available. This study concluded that chatbots can be of significant value in improving the reproductive health of patients in need.³¹ Another study by Okeibunor and colleagues demonstrated that currently, ML and DL algorithms have primarily been utilized with the aim of detection, diagnosis, management, and monitoring for the delivery of different healthcare services, including reproductive health.³²

In Pakistan, many adolescents are at risk of poor reproductive health, which is associated with poor parenting, early childbearing, and pregnancy-related complications. Moreover, it has been reported that more than half of the pregnancies in adolescents end in abortion, in addition to stillbirths and miscarriages. These findings emphasize the need for the dire requirement of reproductive health care services in Pakistan. The utilization of chatbots in Pakistan for reproductive health guidance for patients can be a valuable and cost-effective modality as most of the individuals possess smartphones on which such chatbots can easily operate. AI-based algorithms for remote monitoring of patients for diagnosis, detection, and monitoring can be of utmost importance, especially in the resource-deprived rural areas of Pakistan.

Target 3.8 Universal Health Coverage: Polio is a highly infectious disease, where its wild poliovirus type 1 (WPV) is highly prevalent in Pakistan being responsible for more than 80 cases observed in the year 2022.³³ In Pakistan, WPV transmission has never been interrupted which is the reason for its current incidence.³³ On the other hand, globally, a reduction of more than 99% of cases of poliovirus has been observed due to the steady and continuous administration of the polio vaccine. Pakistan faces various challenges in polio vaccine administration which include poor training, job insecurity, low salaries, threat of violence and danger, and geospatial instability.³⁴ In recent times, the lessons learned from COVID-19 vaccine administration and distribution, and geospatial assisted decision support framework were introduced by Shayegh and colleagues.³⁵ This framework comprised a collection of information such as demographics, high-risk areas, healthcare facilities, and environmental factors using AI models to help improve vaccine administration and break the transmission cycle.³⁵ Such AI-based geospatial technology can be implemented in Pakistan by collecting all the relevant information and identifying high-risk areas of not only polio cases but also TB, whose prevalence in Pakistan has been emphasized. This can

lead to improvement in terms of vaccine administration and collection of data, which is of paramount importance.

In a study by Kazi and colleagues, they developed an AI-based personalized application to improve childhood immunization coverage in children in Pakistan. This study found that the application developed presented feasibility, acceptability, and usability among the population.³⁶ Such studies that are being initiated in Pakistan are important pieces of evidence as researchers understand the role of AI in achieving SDGs, particularly Goal 3.

Pakistan's Progress in Achieving SDGs

Pakistan faces significant challenges in achieving different SDGs, according to a report by the Sustainable Development Solutions Network (SDSN) and Bertelsmann Stiftung³⁷ All South Asian nations, in particular, are falling short of SDG 15 (Life on Land), which refers to biodiversity conservation. The study compares nations' performance on target and indicator levels.³⁷ A study by Sarkar and colleagues evaluated the progress of South Asian Countries in achieving SDGs 2030.³⁸ According to the study, the majority of SDGs, including 1, 5, 8, 11, and 14–17, remain difficult to accomplish even though the countries have made considerable progress towards them.³⁸

Since adopting the SDGs as its own national development agenda through a unanimous National Assembly Resolution in 2016, Pakistan has made progress towards achieving the SDGs. The UN in Pakistan has been providing policy and technical support to the Government of Pakistan to achieve the SDGs in Pakistan.³⁹

Key points about Pakistan's progress towards the SDGs:

1. Pakistan's SDG Global Rank is 129 out of 193 in 2021, improved by five ranks from the previous year.⁴
2. Pakistan's performance is only on track against Goal 13 (Climate Action), while all other goals' progress is either moderately improving or stagnating and worsening in the case of Goal 15 (Life on Land).⁴
3. Pakistan's progress in achieving quality education (SDG 4) is dismal, with the primary school completion rate stagnating at 67%.⁴
4. Pakistan's first-ever SDGs status report presents data on 133 SDG indicators with their corresponding latest values. Overall, the report assesses Pakistan's progress on the SDGs as "modest".⁴
5. The UN in Pakistan is committed to supporting the Government of Pakistan as it responds to the development needs and its global commitments

around the SDGs. The UN partners have been working together more closely to increase effectiveness, alignment with national priorities, and efficiency at country, regional, and global levels.

The Way Forward for Pakistan

Pakistan can develop a centre of excellence, thereby monitoring the progress of SDGs, as presented in figure 3. Such monitoring systems based on a centre of excellence

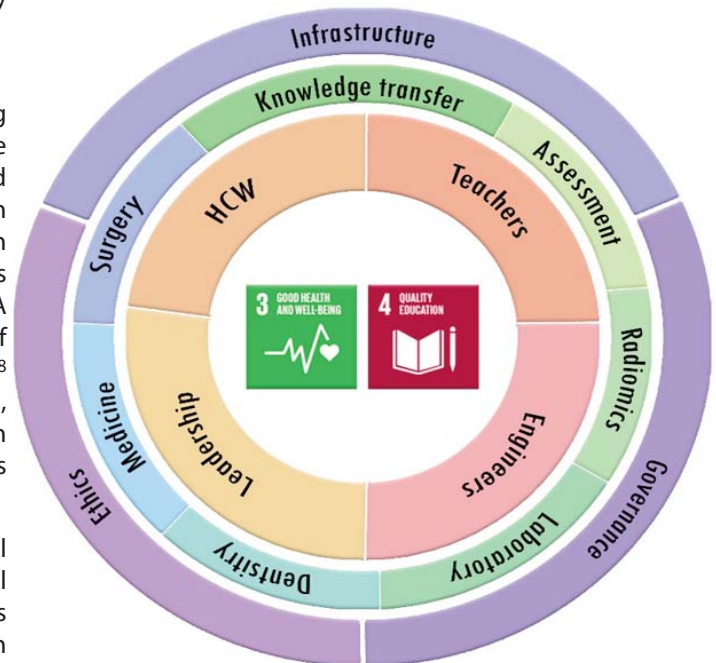


Figure-3: Monitoring of SDGs

Pakistan can leverage AI to achieve the SDGs by adopting the following strategies:

will help achieve SDGs and keep the progress in check.(Figure 3)

1. Develop a national AI strategy: Pakistan can develop a national AI strategy that outlines the country's priorities and goals for AI development and deployment. The strategy should also address ethical and regulatory issues related to AI use. The Global Strategic Institute for Sustainable Development (GSISD) can contribute to capacity building by providing training programmes, workshops, and educational opportunities.

2. Invest in AI research and development: Pakistan can invest in AI research and development to build the country's capacity in AI and develop innovative solutions to achieve the SDGs. This can be done through partnerships with universities, research institutions, and the private sector. The rapid growth of AI adoption will further permeate a wide range of industries and sectors,

which can benefit the country in achieving the SDGs.

3. Promote AI entrepreneurship: Pakistan can promote AI entrepreneurship by providing funding and support for start-ups and small and medium-sized enterprises (SMEs) that are developing AI solutions to achieve the SDGs. This can be done through incubators, accelerators, and other support programs.

4. Collaborate with international organizations: Pakistan can collaborate with international organizations such as the United Nations Development Programme (UNDP) and the International Telecommunication Union (ITU) to leverage their expertise and resources in AI for the SDGs.

5. Focus on specific SDGs: Pakistan can focus on specific SDGs where AI can have the greatest impact, such as SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), and SDG 9 (Industry, Innovation and Infrastructure). The public perception of AI and its connections to the SDGs can be analysed to identify areas where AI can have the most impact. UNESCO also affirms that the deployment of AI technologies in education should be purposed to enhance human capacities and to protect humans.

There were some limitations that were encountered in this study. Firstly, there is limited availability of up-to-date data on AI-initiatives, and its effect on SDGs in Pakistan that may impact the depth of analysis. Secondly, keeping in mind the broad nature of the topic, this narrative review may not cover all aspects comprehensively, hence some aspects maybe overlooked. Lastly, this study analyzed the potential benefits of using AI to achieve SDG goal 3, but did not address potential challenges and risks associated with implementation of AI in Pakistan.

Conclusion

In conclusion, developing countries like Pakistan may significantly contribute to the achievement of the UN's SDGs by utilizing AI-driven technology. In all societies and at all stages of development, the ethical use of AI can promote inclusive and sustainable growth, decrease poverty and inequality, enhance environmental sustainability, improve lives, and give people more control. The best opportunity to responsibly harness AI to speed up progress on the SDGs is through partnerships between governments, the corporate sector, and other stakeholders, including civil society. In order to realize the benefits of AI, the technology must be managed responsibly.

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