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# A Study of Greenhouse Gas Emissions in Afghanistan

**Nasrin Faqiri, Ahmad Fawad Faqiri**

***Abstract*: Afghanistan stands as one of the leading contributors to global greenhouse gas emissions, yet it remains one of the most susceptible nations to the adverse impacts of climate change. This vulnerability is underscored by recurrent episodes of droughts, floods, and landslides, exacerbated by the nation's exposure to natural disasters. However, the crux of this vulnerability lies not solely in exposure but also in the heightened sensitivity of the Afghan populace to these calamities. In light of Afghanistan's poverty and relatively underdeveloped status, any immediate expectation of curtailing greenhouse gas emissions appears unrealistic and unjust. The nation faces a paradoxical challenge balancing burgeoning emissions, inevitable amid developmental strides, with safe-guarding the interests of the impoverished populace. The heart of this challenge lies in ensuring that the trajectory of rising emissions aligns with uplifting the socioeconomic status of the vulnerable. This research delves into the complex interplay between Afghanistan's greenhouse gas emissions, its developmental trajectory, and the vulnerability of its population to climate change. By scrutinizing these facets, it aims to unearth pathways that reconcile developmental needs with environmental consciousness, with a paramount focus on securing the most marginalized against the dire consequences of climate change.***

***Keywords*: Drought, Flood, Greenhouse Gases, Vulnerability.**

## I. INTRODUCTION

Afghanistan, amidst its complex socio-political landscape and economic challenges, stands as a noteworthy contributor to global greenhouse gas (GHG) emissions. Despite being among the top emitters, this nation finds itself uniquely vulnerable to the adverse impacts of climate change [1]. The interconnectedness between Afghanistan's emission patterns and its susceptibility to climatic events like droughts, floods, and landslides signifies a critical nexus requiring deeper investigation. This study aims to delve into the intricate relationship between Afghanistan's greenhouse gas emissions and its vulnerability to climate change induced disasters. The vulnerability of the Afghan population to such environmental hazards extends beyond mere exposure and finds its roots in multifaceted dimensions encompassing socioeconomic, cultural, and political aspects. Understanding this interplay is pivotal in devising effective strategies to mitigate the detrimental effects on the country's populace.

Greenhouse gas emissions have become a significant concern globally due to their contribution to climate change and its associated impacts. Understanding the sources and trends of greenhouse gas emissions in specific regions is crucial for developing effective mitigation strategies. This literature review aims to provide an overview of research findings related to greenhouse gas emissions in Afghanistan. Riahi et al. (2011) present the Representative Concentration Pathway (RCP) 8.5 scenario, which represents a high greenhouse gas emissions trajectory. This research finding suggests that Afghanistan's greenhouse gas emissions may follow a similar trajectory if appropriate mitigation measures are not implemented [2]. Riahi et al. (2017) provide an overview of the Shared Socioeconomic Pathways (SSPs) and their implications for greenhouse gas emissions. The study highlights the importance of considering socioeconomic factors in understanding and projecting future emissions. This research finding emphasizes the need to incorporate socioeconomic factors in analyzing greenhouse gas emissions in Afghanistan [3]. Mora et al. (2018) discuss the broad threat to humanity from cumulative climate hazards intensified by greenhouse gas emissions. The study emphasizes the need for urgent action to mitigate emissions and reduce the impacts of climate change. This research finding underscores the importance of addressing greenhouse gas emissions in Afghanistan to mitigate the potential risks and hazards associated with climate change [4]. Stolar off et al. (2018) analyze the energy use and life cycle greenhouse gas emissions of drones for commercial package delivery. The study highlights the potential environmental impacts of drone technology. This research finding suggests that assessing the emissions associated with emerging technologies, such as drones, can provide insights into the overall greenhouse gas emissions in Afghanistan [5]. Gillingham and Stock (2018) discuss the cost of reducing greenhouse gas emissions. The study highlights the economic implications of mitigation strategies. This research finding suggests that understanding the cost effectiveness of mitigation measures can inform policy decisions in Afghanistan [6]. Sarkodie and Strezov (2019) examine the relationship between foreign direct investments, economic development, energy consumption, and greenhouse gas emissions in developing countries. The study emphasizes the need to consider economic factors and energy consumption patterns when analyzing greenhouse gas emissions in Afghanistan. This research finding suggests that economic development and energy consumption may be significant drivers of emissions in the country [7].

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Hertwich et al. (2019) review material efficiency strategies to reduce greenhouse gas emissions associated with buildings, vehicles, and electronics. The study emphasizes the importance of considering material efficiency in emission reduction efforts. This research finding suggests that adopting material efficiency strategies in Afghanistan's construction and transportation sectors can contribute to lowering greenhouse gas emissions [8]. Lamb et al. (2021) provide a comprehensive review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. The study identifies key sectors contributing to emissions, such as energy, agriculture, and transportation. This research finding highlights the importance of sector specific analysis to understand the sources of greenhouse gas emissions in Afghanistan [9]. Based on the reviewed research findings, there is a need for comprehensive and up-to-date data on greenhouse gas emissions and vulnerability to it in Afghanistan.

The paper is organized around the theme of "Climate Change and Vulnerability to it in Afghanistan," where in it explores the greenhouse gas emissions and societal vulnerability in Afghanistan; Results and Discussion, where findings are presented and critically analyzed; and Conclusion, providing a comprehensive summary of the paper's key in sights and concluding remarks [21].

## II. CLIMATE CHANGE AND VULNERABILITY TO IT IN AFGHANISTAN

This section thoroughly analyzes greenhouse gas emissions in Afghanistan and their impact on temperature and precipitation patterns. It delves into the consequences of climate change, such as increased vulnerability to droughts, floods, and related risks. Moreover, it examines the social vulnerabilities in Afghan communities and highlights how climate change affects their structures and ability to adapt.

### A. Emission of Greenhouse Gases

Afghanistan contributes approximately 0.05% of the global aggregate of greenhouse gas emissions. Over the past few decades, Afghanistan has witnessed a doubling of its greenhouse gas emissions since 1995. Comparative analysis depicted in Table 1 underscores that, with the exception of Tajikistan, Afghanistan's emissions register lower than those of all neighboring countries [10][18][19].

**Table- I: Emission of Greenhouse Gases in Afghanistan and its Neighbors [10]**

| Country | Total GHG Emissions | Total GHG Percentage in the World |
|---|---|---|
| Tajikistan | 22.83 | 0.04 % |
| Afghanistan | 29.12 | 0.05 % |
| Turkmenistan | 128.92 | 0.24 % |
| Uzbekistan | 227.21 | 0.42 % |
| Pakistan | 546.10 | 1.02 % |
| Iran | 951.98 | 1.77 % |
| China | 15684.63 | 29.16 % |

In Afghanistan, greenhouse gas emissions differ greatly from global averages. While globally, energy and industrial sectors contribute nearly 60% of emissions, in Afghanistan, they only make up about 20%. Conversely, sectors like agriculture, land use, and waste, which typically contribute less than 20% globally, collectively account for over half of Afghanistan's emissions. This skewed distribution reflects the underdeveloped state of energy and industry in the country, as supported by data in Fig. 1 and Fig. 2, highlighting the stark contrast between Afghanistan's emissions and global trends.

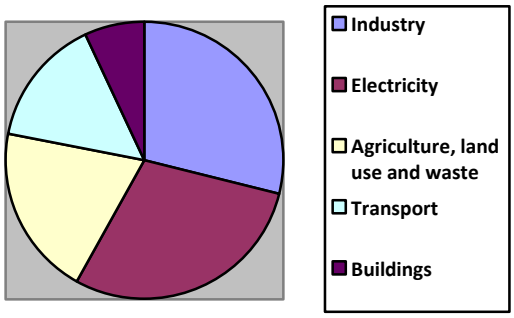


**Fig. 1. Global Greenhouse Gas Emission by Sector in 2022 [10]**

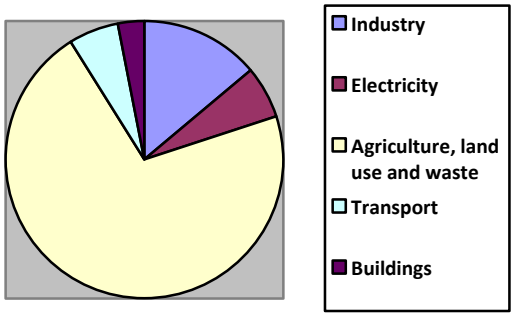


**Fig. 2. Afghanistan Greenhouse Gas Emission by Sector in 2022 [10][20]**

As per the findings outlined by the Afghanistan National Environmental Protection Agency, projections indicate a significant increase in greenhouse gas emissions within Afghanistan. It is estimated that the total volume of greenhouse gas emissions is anticipated to surpass 50 million metric tons of carbon dioxide equivalent by the year 2030. This projection is visually represented in Fig. 3.

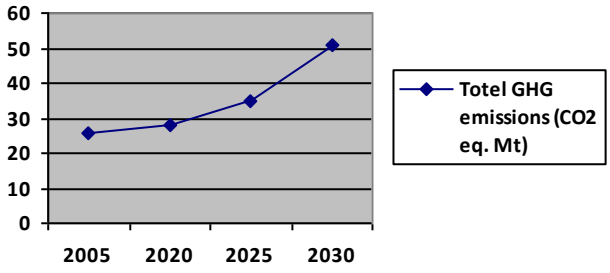


**Fig. 3. Total GHG Emission**

*a. GHG Impact on Temperature in Afghanistan*

In Afghanistan, there has been a discernible upward trend in average temperatures, as highlighted by the INC report, indicating an annual increase of 0.6°C since 1960, equivalent to 0.13°C per decade.

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Projections for the future indicate a sustained trajectory of rising temperatures, with estimations forecasting an escalation ranging between 1.4 to 4°C by the 2060s and a more pronounced increase spanning 2.0 to 6.2°C by the 2090s. The Intended Nationally Determined Contribution (INDC) report delineates potential temperature scenarios, as illustrated in Fig. 4. An 'optimistic' outlook anticipates a 1.5°C rise by 2050 and an approximate 2.5°C increase by 2100. Conversely, a 'pessimistic' scenario portends a sharper ascent, projecting a 3°C temperature hike by 2050, culminating in a potentially alarming surge of up to 7°C by the close of the 21st century [11][12].

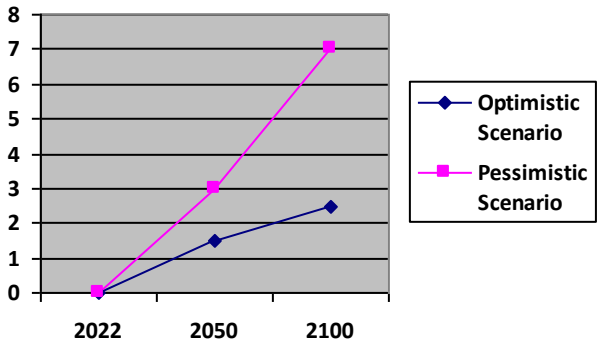


**Fig. 4. Temperature Increases Projection by 2100 in Afghanistan**

*b. GHG Impact on Rainfall in Afghanistan*

Since 1960, Afghanistan has experienced a marginal decline in average rainfall, registering a reduction of approximately 5.0 mm per month or 2% per decade. Recent assessments, notably by the Afghanistan National Environmental Protection Agency, corroborate this trend, particularly noting a slight decrease in spring rainfall. Additionally, Savij et al. (2009) have forecasted a diverse spectrum of rainfall variations spanning from a potential decline of -31% to an increase of +28% by the year 2090, projecting an annual average change ranging between -5% and -8%. However, it is crucial to recognize that Afghanistan's intricate topographical landscape signifies those localized responses to precipitation alterations are likely to vary significantly. Consequently, numerous regions may exhibit distinct patterns deviating from broader regional changes in rainfall dynamics [13].

The Intended Nationally Determined Contribution (INDC) does not indicate an overall global decline in rainfall but rather delineates alterations in precipitation patterns, notably observable in the northcentral and eastern highlands. The INDC anticipates a potential reduction of 5-10% in spring rainfall, offset by augmented precipitation during the fall and winter seasons. Nevertheless, the projected decrease in spring rainfall poses a substantial concern, particularly for the cultivation of the llama crop. This apprehension is further compounded by the concurrent rise in water evaporation rates due to escalating temperatures, exacerbating the potential agricultural challenges associated with decreased spring precipitation.

*c. GHG Impact on Droughts and Floods in Afghanistan*

Drought, an adverse consequence of climate change predominantly observed in arid and semi-arid regions worldwide, manifests uniquely in Afghanistan. Here, the occurrence of drought takes the form of recurrent local droughts transpiring every three to five years, distinct from the countrywide drought cycles recurring at longer intervals of approximately 20 to 30 years. These distinct patterns of drought occurrence delineate the contextualized nature of aridity challenges faced by Afghanistan, shaping the frequency and scale of the resultant environmental and socioeconomic impacts within the region [14].

Drawing upon drought disaster data, the predominant occurrences encompassing the years 1999–2001 and 2007/08 emerge as the most frequently documented events, occasionally expanded to 1999–2002 and 2007–10. Additionally, more localized drought incidences have been noted, including those in 1969, 1971–73, and 2006, contributing to the compendium of drought episodes within Afghanistan's historical record [15].

Afghanistan experiences periodic flash floods, primarily prevalent between February and June, with exceptions noted in the Kabul River region due to monsoon rainfall typically occurring in August and September. Areas unaffected by monsoon rains witness heavy rainfall and snow at the year's onset, leading to significant floods. River inundations during snowmelt periods are a recurring phenomenon, typically observed in June and July [16][17]. Approximately half of Afghanistan's population faces the threat of flooding, with an estimated 15% categorized as being at high risk of such events.

## B. Social Vulnerability

The social susceptibility of Afghanistan to the impacts of greenhouse gases manifests across multifaceted domains. This vulnerability is evident in several dimensions, notably in the realm of water resource accessibility, diminished agricultural yields, decreased livestock numbers, patterns of migration, constraints in obtaining potable water, conflicts arising from land access, increased indebtedness, compromised health outcomes, and challenges pertaining to educational access. These aspects collectively illustrate the intricate and wide-ranging ways in which Afghanistan's societal fabric is affected by and grapples with the ramifications of greenhouse gas induced changes [22].

*a. Fundamental Impacts of Unexpected Climate Events on Human Lives, and Strategies for Coping and Survival*

In 2008, as per reports from the USDA Foreign Agricultural Services and The Ministry of Agriculture, Irrigation, and Livestock (MAIL) in 2009, insufficient rain and below average snowfall caused a 40 to 55% decrease in wheat production in the country. Compared to the data from 2007, a normal year, the impact of the drought was significantly greater in dry land (58% decrease) than in irrigated land (16% decrease).

According to the 2004 FAO/WFP report on Afghanistan, the 2001 drought in Kandahar caused a 40% drop in wheat production compared to normal years, and fruit orchards decreased by 50-75%.

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In 2004, water scarcity led to a further decline in wheat production by 37%. This scarcity also resulted in a 68% decrease in llama production and a 38% reduction in water-dependent agricultural products.

As the 2003 report by the Food and Agriculture Organization (FAO), nomadic com-munities predominantly subsist on a livestock-based economy. These communities encountered significant adversity during the severe drought spanning from 1998 to 2002, as well as the subsequent water scarcity experienced in 2004. The consequences of these environmental challenges were substantial, leading to the loss of livestock ranging from 50 to 75% among nomadic groups.

The occurrence of drought amplifies the likelihood of temporary migration among affected populations. Simultaneously, the absence of dedicated studies examining the correlation between unforeseen climatic occurrences and migration complicates the assessment of the precise influence exerted by environmental pressures and unexpected climatic events on driving migration decisions.

In the midst of the 2011 water scarcity crisis, a substantial proportion of Afghan households (constituting 37%) encountered unanticipated challenges within the potable water domain, predominantly attributed to the absence of water accessibility. This contrasted starkly with the 18% average incidence rate observed in 2007.

In regions characterized by irrigated lands, the scarcity of water resources, often attributed to hydrological drought, serves to escalate conflicts pertaining to the distribution and management of water bodies such as canals and rivers among communities situated upstream and downstream. Moreover, this scarcity occasionally exacerbates pre-existing tensions and animosities rooted in ethnic or political differences.

Afghan families turned to borrowing after selling assets during the 1998–2002 drought, resulting in high indebtedness for 60% of surveyed families by its end. Risk practices like credit-based instruments worsened inequality, acting as exploitative tools [11].

Food insecurity in families can prompt parents to send their children to work, resulting in temporary school absence. Parents often sacrifice their own meals to sustain their families, risking their health as they bear the primary economic responsibility. The impact of these challenges due to climate pressures remains difficult to quantify.

## III. RESULTS AND DISCUSSION

Afghanistan's vulnerability to climate change-induced risks has been starkly evident through our investigation. Analysis of historical climate data revealed an alarming trend of rising temperatures, with an annual increase of 0.6°C and a decade-wise rise of 0.13°C since 1960, far surpassing global averages. Concurrently, a notable reduction in average rainfall by approximately 5.0 mm per month or 2% per decade since 1960 exacerbates the risk of prolonged droughts, significantly impacting agriculture and water resources. The frequency and severity of extreme weather events, such as droughts occurring every 20 to 30 years and flash floods predominantly between February and June, highlight Afghanistan's susceptibility. River floods during June and July further compound the challenges, posing substantial risks to infrastructure, livelihoods, and public safety. Ad-dressing these vulnerabilities requires urgent action, encompassing measures to mitigate greenhouse gas emissions, enhance adaptive capacities, and implement resilient strategies.

Efforts to mitigate emissions, given Afghanistan's doubling of greenhouse gas emissions since 1995, are critical. Transitioning to renewable energy sources and sustainable development practices is imperative. Additionally, investments in infrastructure development, early warning systems, and empowering vulnerable communities through adaptive strategies are vital steps toward bolstering resilience. International cooperation and support remain essential in assisting Afghanistan's response to climate.

## IV. CONCLUSIONS

In summary, the study on greenhouse gas emissions in Afghanistan highlights the nation's vulnerability to climate change, marked by rising temperatures, diminishing rainfall, and frequent extreme weather events. Afghanistan faces a critical juncture where mitigating greenhouse gas emissions is essential, yet challenging due to developmental needs and socioeconomic constraints. Urgent measures are necessary, focusing on transitioning to renewable energy sources, sustainable development practices, and bolstering adaptive capacities. Empowering vulnerable communities through infrastructure investments, early warning systems, and adaptive strategies is crucial. International cooperation is indispensable, necessitating collaborative efforts in technology transfer, capacity building, and financial aid to fortify Afghanistan's resilience. Addressing this conundrum requires a delicate balance between emission reduction and sustainable development to secure a more resilient and sustainable future for Afghanistan amidst the impacts of a changing climate.

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