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Navigating Climate Change and Food Security in South Asia: Challenges and Strategic Approaches

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ABSTRACT

This study examines the impact of climate change on food security in South Asia, focusing on agricultural vulnerabilities, socio-economic disparities, and policy responses. South Asia, home to 25% of the global population, faces rising temperatures, erratic rainfall, and glacial retreat, reducing staple crop yields by 6-10%. Natural disasters, such as Pakistan's 2022 floods, have worsened food insecurity, affecting over 809 million people. This study utilizes both quantitative and qualitative methods to analyze the impact of climate change on food security in South Asia. The quantitative analysis is based on secondary data obtained from international organizations such as FAO, World Bank, and ICIMOD, applying statistical tools to examine trends in climate patterns, agricultural yields, and food security indicators. The qualitative analysis involves policy evaluations and case studies to assess socio-economic disparities and adaptation challenges. Findings reveal significant declines in wheat and rice yields, increased food insecurity, and policy gaps. Regional frameworks like the SAARC Food Bank remain underutilized due to geopolitical and operational challenges. To address these issues, the study recommends adopting climate-resilient crops, improving irrigation systems, strengthening regional cooperation, and empowering marginalized groups to enhance food security and sustainable development.

Introduction

South Asia, comprising eight countries including India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, Maldives, and Afghanistan, is highly vulnerable to climate change impacts. Home to 25% of the global population, the region depends heavily on agriculture, employing over 40% of the workforce and contributing significantly to GDP. However, reliance on climate-sensitive agricultural practices makes it particularly susceptible to rising temperatures, changing precipitation, glacial retreat, and extreme weather events. Erratic weather, such as heatwaves and irregular rainfall, has reduced wheat and rice production in India and Pakistan by 6-10% in recent years (FAO, 2023c). Rapid Himalayan glacier retreat—23% coverage lost since 2000 (ICIMOD, 2023b)—threatens water supplies for key river basins. Natural disasters, including Pakistan's 2022 floods, destroyed 4 million acres of crops, causing $15 billion in damages (World Bank, 2022).

South Asia's mean annual temperature has risen by 1.5°C since pre-industrial levels, with projections of up to 3°C by century's end. This warming is reducing agricultural yields significantly, with India experiencing a 6-10% drop in wheat and rice yields due to heatwaves and erratic rainfall (FAO, 2023a). Groundwater depletion in India and Bangladesh, which rely on it for 60% of irrigation, exacerbates water scarcity. Glacier retreat impacts rivers like the Indus, Ganges, and Brahmaputra, vital to millions of farmers (ICIMOD, 2023a).

Natural disasters worsen food security challenges. Bangladesh faces cyclones like Cyclone Amphan (2020), causing $13 billion in damages. Nepal and Bhutan experience frequent landslides and floods, disrupting transportation and food distribution (Prasain, 2024). Socio-economic vulnerabilities, including poverty, lack of technology, and infrastructure gaps, deepen the crisis. Over 809 million South Asians are food insecure, with the region also having the highest malnourishment rate at 15.6% (FAO, 2023b). Small farmers owning less than two hectares of land (70% in India and Pakistan) struggle to adopt climate-resilient practices (Pakistan Bureau of Statistics, 2010). Furthermore, urban food inflation, such as Sri Lanka's 80% rate in 2022, further strains low-income households.

While drought-resistant crops and crop insurance offer promise, such as SAARC faces logistic and funding challenges. This study explores these vulnerabilities, evaluates strategies, and proposes actionable recommendations to build sustainable food systems in South Asia.

Literature Review

Climate change has significantly impacted agriculture and food security worldwide, with South Asia being particularly vulnerable due to its reliance on agriculture for livelihoods and GDP (FAO, 2023a). Global agricultural productivity has declined by 1-2% per decade since 1980s due to climate variability (FAO, 2023b). In South Asia, staple crops such as rice, wheat, and maize face reduced yields, with studies predicting that wheat yields in India could drop by 10% by 2050 due to rising temperatures (Challinor et al., 2014). Similarly, rice production in Bangladesh is highly susceptible to erratic monsoons and sea-level rise. Glacial melting in the Himalayas disrupts irrigation-dependent water flows, further exacerbating agricultural vulnerability (Romshoo et al., 2022).

While biophysical impacts are extensively studied, socio-economic dimensions of climate-induced food insecurity receive less attention. Rural community's dependent on subsistence farming face significant risks, while urban populations experience food price inflation and shortages. Gender aspects, including the disproportionate impact on women farmers, remain underexplored in regional research.

Most adaptation measures which focus on productive processes that are less affected by climate risks such as water stress production technology and practices. These measures include drought-tolerant crops, efficient watering techniques and agroforestry. For instance, companies that grew drought-stress-tolerant rice in water-poor conditions in India have recorded a 15-20% yield increase (Soriano et al., 2017). However, it was observed that adoption of these measures is not uniform, due to socio-economic factors such as high cost, resource constraints and poor extension services.

Policy analyses are characterized by identification of strong and weak points of the process. Regional organizations, such as the SAARC Food Bank and the South Asia Climate Change Adaptation Framework are also meant to promote regional cooperation. However, the efforts are hampered by challenges like bureaucratic hurdles, ineffective cooperation among member states. National policies such as Pakistan's National Food Security Policy (2018) and India's National Action Plan on Climate Change (NAPCC), focus is on food security, but face limitations due to inadequate funding, non-standardized policy, and execution problems at the regional level.

This review underscores the need to bridge gaps in understanding socio-economic impacts and to evaluate the effectiveness of policies addressing food security in South Asia.

Material and Methods

This study utilizes both quantitative and qualitative methods to analyze the impact of climate change on food security in South Asia. The quantitative analysis is based on secondary data obtained from international organizations such as FAO, World Bank, and ICIMOD, applying statistical tools to examine trends in climate patterns, agricultural yields, and food security indicators. The qualitative analysis involves policy evaluations and case studies to assess socio-economic disparities and adaptation challenges. The manuscript studies agricultural vulnerabilities, socio economic disparity, policy reactions on increasing temperature, erratic rain, glacial retreat and natural disaster. The secondary data for quantitative analysis was sourced from revered international institutions such as; Food and Agriculture Organization (FAO), World Bank, International Centre for Integrated Mountain Development (ICIMOD) and the national statistical departments, for the period 2000–2023. Using advanced statistical techniques, the impact of climate factors on the yields of crop, such as wheat and rice. Through our research, we find that climate change has a very big impact on food supply and yields of wheat and rice falling 6 to 10 percent. In addition, this study identified poverty, the lack of access to irrigation and the climate fluctuations as key drivers of food insecurity. This study determined how different regions were affected by these factors in different degrees and pointed out areas that needed more targeted solutions to deal with food insecurities.

The qualitative analysis was carried out by analyzing policy deficits, socioeconomic limitations and adaptive strategies by compiling data from official reports, scholarly inquiries. In addition, three case examinations were done to look at impacts explicit to place: Heat stress was additionally exacerbated in Punjab and Haryana semi-arid wheat developing provinces of India because of climate change, flood administration stayed troublesome in Pakistan regardless of the 2022 flood which caused $15 billion of devastation, and expanding sea level driven saline intrusion was significant to seaward farmlands in Bangladesh. The goal of the study was to address the issues of climate change and food security in India and Pakistan. In this paper, this paper studied initiatives such as the National Action Plan on Climate Change of India and National Food Security Policy of Pakistan, and regional efforts such as the SAARC Food Bank. Patterns were there and it was concerning. All of this was for a good reason, but such policies normally do not yield the anticipated results because there is always bureaucratic red tape, scarce resources, and missing

pieces of implementation. These challenges are wide ranging and go far beyond impacting the people in the region (Ingram et al., 2010).

For the qualitative analysis, data compiled from official reports, scholarly investigations, were utilized to analyze policy deficits, socioeconomic limitations, and adaptive strategies. Three case examinations were performed to evaluate impacts specific to place: the wheat-growing semi-arid provinces of Punjab and Haryana in India endured heat stress exacerbated by climate change; flood management in Pakistan stayed problematic in the wake of the catastrophic 2022 floods, which wrought $15 billion in destruction; and in Bangladesh, rising sea levels induced saline infiltration jeopardizing vital coastal farmlands. The study aimed at tackling climate change and food security in India and Pakistan. This paper examined initiatives like India's National Action Plan on Climate Change and Pakistan's National Food Security Policy, as well as regional efforts like the SAARC Food Bank. The analysis revealed some concerning patterns. Despite good intentions, policies often fall short due to bureaucratic red tape, limited resources, and gaps in implementation. These challenges have far-reaching consequences, affecting the lives and livelihoods of people across the region.

By integrating quantitative and qualitative approaches, this study offers a comprehensive evaluation of climate change's effects on food security in South Asia. The mixed-methods design allows for quantitative validation of climate impacts on agricultural productivity and food insecurity, while the qualitative insights provide context on socio-economic disparities, adaptation challenges, and regional cooperation gaps. This dual approach ensures a holistic understanding of the interconnected challenges and potential solutions for enhancing food security in the region.

Climate Trends Analysis

Temperature Trends South Asia has already experienced the rise in mean temperatures, approximately 1.5°C above pre-industrial levels, disrupting agricultural practices that are highly sensitive to heat stress. Projections under high-emission scenarios indicate a further increase of up to 3°C by 2100, exacerbating risks to staple crops like wheat and rice. Heatwaves, now occurring with greater frequency, lead to reduced pollination, grain filling, and overall yield. For example, in India, heat stress in 2022 reduced wheat yields in Punjab and Haryana, with farmers reporting harvest delays and quality deterioration. These trends underscore the urgent needs for adopting heat-tolerant crop varieties and enhancing early-warning systems for extreme weather events.

Precipitation Variability Precipitation in South Asia is becoming increasingly erratic, as evidenced by prolonged dry spells in arid regions like Rajasthan and intensified monsoonal activity in flood-prone zones such as Bangladesh. Unpredictable rainfall disrupts planting schedules and crop growth cycles, resulting in significant yield variability. In Pakistan, erratic monsoons contributed to catastrophic floods in 2022, which submerged 4.4 million acres of farmland and displaced millions, indicating the need for improved water management systems and resilient agricultural infrastructure.

Glacial Retreat The Himalayan glaciers, which serve as critical water sources for major river systems like the Ganges, Brahmaputra, and Indus, have seen a 23% decline in coverage since 2000. This annual retreat, currently estimated at 1.5%, poses a severe threat to irrigation-dependent agriculture downstream. Statistical correlations ($R = -0.72$) between glacial retreat and agricultural productivity show that future decline poses a danger to food producers across the world if the trend continues unchecked. As glacial meltwater decreases by 2050 it can worsen water availability during the growing season and this may reduce the crop yield enormously. Measures, which might

help to reduce these effects, include adjustments in irrigation technology and water management systems.

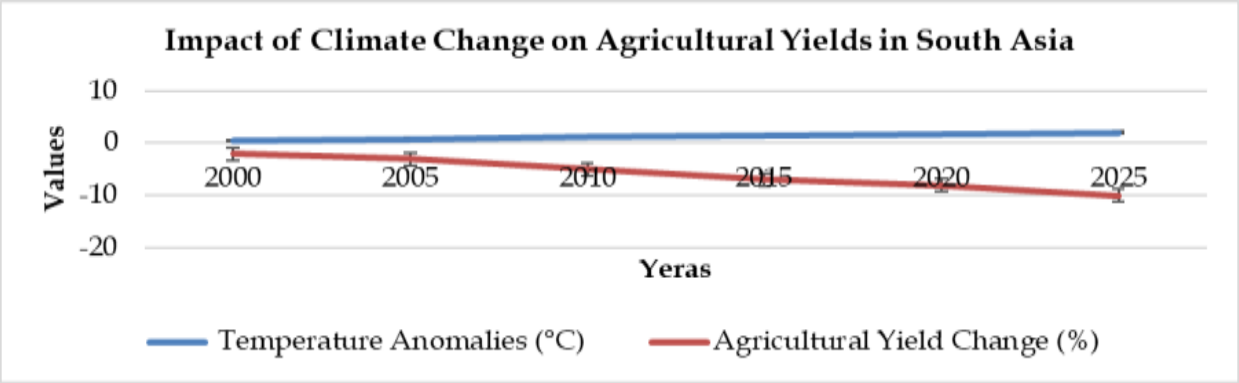

Figure 1: *Impacts of Climate Change on Agricultural yields in South Asia.*

Figure shows the yearly increase in temperature anomalies and the performance of agricultural production to signify the current urgency to develop adaptive measures.

Agricultural Productivity Impacts

South Asia is especially exposed to climate variability in the agricultural area; rice, wheat, and maize reacting severely to heat, drought, and flood stresses.

- **India:** Heat stress has caused wheat yield declines of 6–10% in major producing states. The 2022 season recorded 12 additional heat stress days compared to historical averages, leading to reduced grain quality and higher economic losses for farmers.
- **Pakistan:** The 2022 floods led to $15 billion in crop losses, with delayed planting cycles and residual soil degradation impacting subsequent harvests. Long term effects also include reduced soil fertility and raised soil salinity levels in flood effected regions.
- **Bangladesh:** The sea level has continued to rise, leading to increased salinity in the farmlands thereby defining the 20% of arable land. Southeast Asia's 30 million rice farmers are experiencing yield losses and falling incomes and require funding for salt-tolerant crops and sustainable aquaculture.

Statistical findings reinforce these observations. A regression analysis ($R^2 = 0.68$) indicates a strong negative relationship between temperature anomalies and crop productivity, with higher-than-average temperatures explaining 68% of yield variations. Similarly, flood frequency accounts for 25% of agricultural losses, emphasizing the urgent need for enhanced flood management systems and resilient farming techniques.

Food Insecurity Prevalence

South Asian is categorized as a region that has high level of food insecurity; current malnutrition prevalence is estimated 15.6 percent. It is worsened by socio-economic vulnerabilities, low ability to adapt and climate induced disruptions on food production and supply chain.

- **Bangladesh:** The index of malnourishment had reached 17%; therefore, coastal provinces suffer from salinity intrusion and low agricultural productivity. To address these challenges, improving livelihoods and market access for smallholder farmers are essential strategies for enhancing food security at the community level.

- **Sri Lanka:** Food inflation increased to 78% last year due to economic fluctuations aggravated by climate shocks that led to high food prices in 2022. The stress is on how economic vulnerability also contributes to climate impacts, underlining the macroeconomic stability for food security planning concern.
- **Pakistan:** There was a 30 percent decline in households' calories intake after the floods in 2022. Women and children are at risk owing to complications that arise from limited access to food and health-care services.

Using Principal Component Analysis (PCA), it is identified that poverty rates, inadequate irrigation facilities and climatic change influences food insecurity. The findings on high risk areas are that they share cross-cutting vulnerabilities, for instance, Sindh province of Pakistan and the Sundarbans of Bangladesh. Special remedial measures that address such systemic challenges are critical to improve food security in the region.

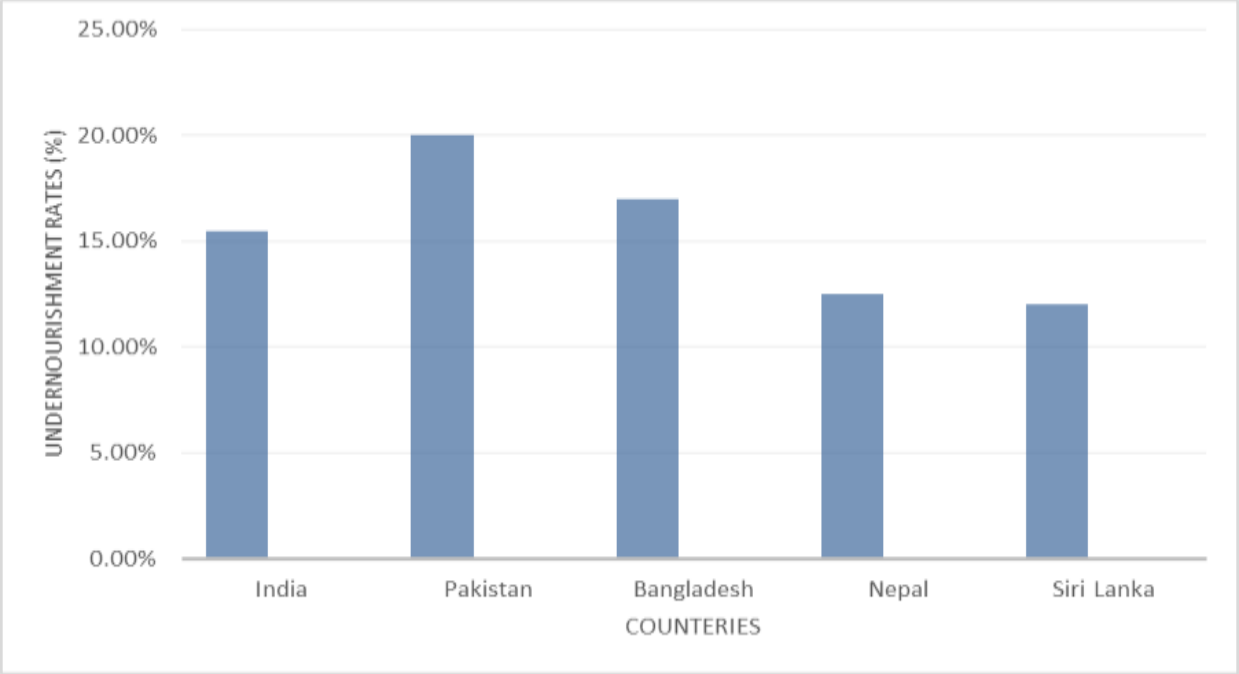

Figure 2: *Regional Vulnerability to Food Insecurity.*

Qualitative Analysis

In this study, the qualitative aspect enriches the understanding of the factors that surrounds food security in South Asia, the problem of regional variations, difficulties in policy implementation, and the perceptions of the stakeholders. To achieve this, the study employs use of case studies and policies analysis to examine the socio-political, economic and institutional factors that underpin food insecurity in the region.

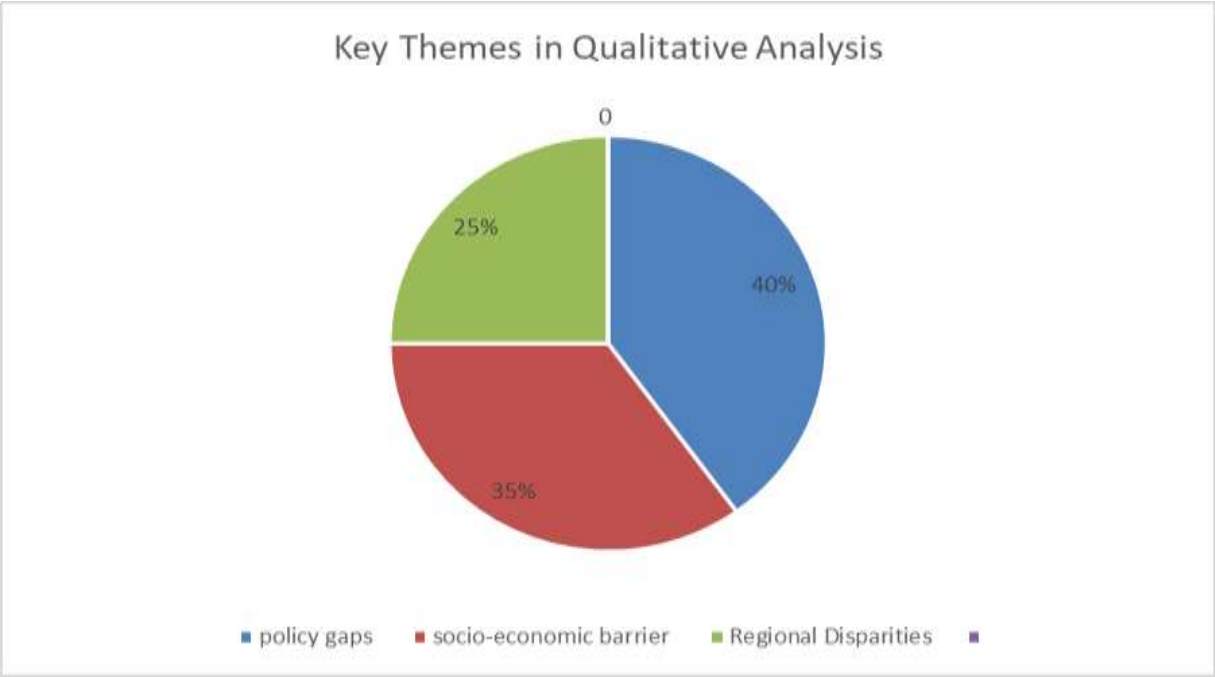

Figure 3: *key Themes in Qualitative Analysis*

Case Studies: Localized Impacts of Climate Change

India: Drought-Resistant Crops and Policy Measures

India, a global leader in agricultural production, faces significant challenges from climate change, particularly in semi-arid regions like Punjab and Haryana. Heat waves and irregular rainfall severely impact agriculture, which employs 50% of the population and is a key economic driver. Wheat production, vital to India's crop output, is especially vulnerable to climate stress. For instance, heat stress during the grain-filling phase has caused yield losses of 6-10% (FAO, 2023). In 2022, an additional 12 days of heat stress disrupted wheat cultivation, heavily affecting small farmers who lack the resources to mitigate these impacts.

India has introduced drought-resistant crops like heat-tolerant wheat and water-efficient rice, which have boosted yields by 15-20% in semi-arid regions. However, the adoption rate remains low at 25%, as smallholder farmers struggle to afford these seeds and lack access to extension services for implementation.

At the policy level, initiatives like the National Mission for Sustainable Agriculture (NMSA) under the National Action Plan on Climate Change (NAPCC) promote soil health, water conservation, and agroforestry. Additionally, schemes like the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aim to improve irrigation efficiency. Despite progress, challenges such as unequal resource distribution, bureaucratic inefficiencies, and inadequate support for small-scale farmers hinder their effectiveness (Dave & Stewart, 2023).

Pakistan: Flood Impacts and Recovery Strategies

Pakistan, south Asian country, is one of the most vulnerable countries affected by climate change, as seen by the disastrous floods that hit it in 2022. The agriculture sector suffered significantly due to its contribution of 40% of the population and 20% of the GDP. The floods inundated 4.4 million acres of farmland, losses exceeding $15 billion (World Bank, 2022). Sindh and Balochistan

suffered from siltation. The problems of increasing salinity levels prejudicing crop and the production of food grains, especially wheat and rice in the long run.

To mitigate this challenge, Pakistan has tried to introduce adaptation strategies such as crop insurance schemes to enable farmers. However, this kind of programs are still underutilized because only 25% of the farmers under the programs benefit from it because of lack of awareness, delay in implementation of the programs by relevant authorities, and poor understanding of how to handle funds by farmers in the rural areas. However, reconstruction of the breached irrigation channels and roads in the flooded districts has been relatively slow because of delayed funding and inter-ministerial coordination problems.

Measures under the National water policy intend water management efforts for flood mitigation and management infrastructure, however, political instabilities and financial crises have slowed these efforts. Although small scale reservoirs have been constructed, population control measures have not been effectively provided.

Consequently, this evaluation underlines enhanced governance, funding, and communal support required for Pakistan to build its climate change adaptation to eliminate far-reaching effects.

Bangladesh: Coastal Vulnerabilities and Regional Collaboration

Climate change and other natural disasters are critical issues in Bangladesh and the population is threatened with an annual flood, rising sea level, saline water infiltration into the delta through both rivers, and cyclones from the Bay of Bengal. Some of these problems are worst felt in agriculture since most people (40%) depend on it for employment. This has made about 20% of coastal farmlands unproductive for normal rainfall rice cultivation, and has also reduce yield by 10% in regions that have been affected by the high salinity (FAO, 2023). Cyclones for instance the Amphan (2020) have inflicted devastating impacts, including $13 billion in construction damage, while also disrupting food systems and undermining farm economies.

To overcome these problems Bangladesh has developed salt-tolerant rice varieties for example BRRI dhan 67, but farmers do not use them due to high prices, poor marketing networks and inadequate knowledge. Other fishing related income generating activities such as integrated rice fish farming has also proved useful in enhancing food and income security among the coastal farmers.

On the regional level, Bangladesh is involved in many initiatives including SAARC Food Bank, aims to address food shortage. However, it often fails due to bureaucratic hurdles, geopolitical and national interests. Furthermore, lack of funds and the fragile structures like flood walls and shelters widen risks in affected coastal regions.

To strengthen the ability of Bangladesh to adapt to climate change and protect the poor, state needs to expand the production of salt-tolerant crops, create better climate-proof structures, and develop better governance and regional cooperation to maintain latter’s food security in the longer run.

Results

This section highlights the multifaceted impacts of climate change on agricultural productivity, food supply disruptions, and the socio-economic implications across South Asia. It also explores disruptions in food supply chains due to extreme climate events and their socio-economic effects, such as rising food prices and rural-urban migration. The analysis highlights the differing vulnerabilities of rural and urban populations while assessing national and local adaptation strategies in South Asia.

Impact of Climate Change

Agricultural Productivity Declines

Climate change significantly impacts crop yields in South Asia due to rising temperatures and irregular weather patterns. In India, wheat, a key staple and income source, has faced a 6-10% production decline in major agricultural regions like Punjab and Haryana (FAO, 2023; IPCC, 2022). This drop is attributed to heat stress during grain filling, farmers' inability to adjust planting periods, and limited access to heat-resistant varieties.

Likewise, in Bangladesh, Yields of rice crops in the country have reduced by 8-12 percentages because of climate change induced irregular rainfall, cyclone, and coastal flood, which all the affect monsoon climate and damage crops. Soil salinity has been rising due to high sea levels, making extensive farming regions unsustainable and thus decreasing farmers' earnings (FAO, 2023). Moreover, glacier retreat in Himalayas poses a risk for the agriculture at the go down area through irrigation in the Ganges, Indus, and Brahmaputra basins. ICIMOD (2023) reports a 23% glacier decline since 2000, causing water shortages during dry seasons, disrupting irrigation schedules, and reducing crop production.

Food Supply Disruptions

Climate change-related disasters like floods and cyclones have severely impacted agriculture and food security in South Asia. Cyclone Amphan (2020) caused $13 billion in losses in Bangladesh, destroying crops, infrastructure, and storage, leading to months of food shortages (Prasain, 2024). Similarly, Pakistan's 2022 floods devastated 4.4 million acres of farmland, reducing rice and wheat yields, damaging irrigation infrastructure, and increasing soil salinity (World Bank, 2022). These events disrupted food production and supply chains, deepening food insecurity in urban and rural areas. Without improved adaptive capacity, South Asia will struggle to feed its population amid a changing climate.

Socio-Economic Implications

Rural vs. Urban Food Insecurity

The social and economic consequences resulting from climate change differ in rural areas where food insecurity is greatly linked with farming. The FAO (2023) projects that more than 809 million people in South Asia suffer from moderate and severe food insecurity, and the problem mainly affects the countryside. Smallholder farmers are most at risk because most farming practices in the region are climate-sensitive, and they have very little access to adaptation resources. For instance, the farmers using less than two hectares of land in India and Pakistan are constrained to adopt climate change adaptive technologies due to high cost and lack of access to credit.

Although the urban dwelling populations may not directly depend on production of agriculture commodities for food, they are also not immune from food insecurity. Rural disruptions relate strongly to food supply lead price increases, disproportionately affecting low income earners in the urban area. For a long time, inflation in Pakistan was high when the country experienced floods, and this directly labeled a rise in food prices, which influenced the economic pressure on vulnerable urban centers (Lal et al., 2011).

Climate-Induced Migration and Poverty

Climate-induced migration represents another critical socio-economic consequence of food insecurity in South Asia. These disasters include floods, droughts and cyclones through which compounded hardship of affected rural communities prompt them move to urban areas look for

other means of sustaining themselves. This migration can lead to deterioration of living standard inasmuch as it produces higher rates of poverty, overcrowding as well as strain on the available resources amongst the dwellers of urban area. Households from rural areas in Pakistan, especially the one affected by the 2022 floods, reduced their consumption of calories by 30 % , women and children are usually the most affected since they are not privileged to quality healthcare and food as compared to men. Such trends worsen the currently existing social and economic disparities and especially, affect vulnerable groups. The same is true in other cyclone-affected coastal areas of Bangladesh where cyclones and sea surges wash away millions of small farming families leaving them poor (Adger et al., 2009).

The socio-economic effects of climate change therefore cut across a wide range of aspects including food security, income and security and overall sustainability. To overcome these challenges, targeted development policies are needed for rural development, poverty and vulnerable groups' protection.

Adaptation Strategies

Drought-Resistant Crops

Climate variability has made drought resistant crop varieties a key adaptation measure in the South Asian region. India has been cultivating heat tolerant wheat and water-efficient rice with varying degree of acceptability which lies between 20–25 % (Kumar et al., 2020). These crops have improved yields under water stress, which means that productivity losses due to rising temperatures and unpredictable rainfall may be offset with these drought-resistant crops.

In Bangladesh, as a result of the desired agricultural trends in the saline zones of the coastal belts, the salt-tolerant rice variety- BRRI dhan 67 is being grown. However, the adoption of modern varieties of these crops is hampered by financial problems, low brand recognition, and insufficient distribution of products. Despite the predicted benefits of such innovations being most beneficial to smallholder farmers, they lack the necessary capital to scale up the use of such techniques.

Regional Initiatives

At the regional level an effort like the SAARC food bank can play a crucial role to address food insecurity during climate related disasters. Initially created to help ensure emergency food stocks, the Food Bank is intended to serve to encourage collective comprehensiveness in countering food deficits among the SAARC nations. However, the effectiveness has been reduced over the years by following factors, which include; logistical issues, inter-union competition issues, weak coordination and competition among member states arising from geopolitical rivalry. The activities of the Food Bank are further hampered by internal structural inefficiencies and a relatively slow mobilization of resources, which means that the organization cannot practically respond to emergencies.

The adaptation strategies such as Water-saving crops and localized ones are having a potential in addressing food insecurity. However, the solutions should overcome such factors as financial constraints, inadequacies of institutions and lack of regional integration. Focusing on the settlements which needs smallholder farmers' attention, expanding and improving the funding, and eliminating the operational bottlenecks. By addressing these challenges, South Asia can enhance its resilience to climate change.

Findings

The findings of this study highlight critical insights into the interplay between climate change, socio-economic disparities, and policy effectiveness in addressing food security challenges.

Exacerbation of Food Insecurity

Food scarcity has also been exacerbated by climate change which has affected countries in South Asia where most of the affected people rely on farming. Drought, floods and saline intrusion have been recurrent in the delta region and have greatly affected crop production hence food security and nutrition status in the region. These shortcomings like lack of adequate storage and distribution infrastructure result into increased post-harvest losses and food wastage.

Socio-Economic Disparities

Marginalized communities face compounded challenges due to limited access to financial resources, technology, and infrastructure. Newly adapted Climate vulnerability risk states that smallholder farmers, who form a significant proportion of the agricultural labor force, are more vulnerable to climate change influenced risks. Gender dimensions however, amplify these vulnerabilities since women farmers do not have land rights, credit and extension services.

Policy Gaps

Current policies and programs are already in place but their attainments are still unsteady due to poor compliance, inadequate financial support and regional disparities. For example, though India's NAPCC and Pakistan's National Food Security Policy outline comprehensive framework, their effectiveness is hampered by poor coordination between departments and resource allocation. Likewise, regional projects, for instance, the SAARC Food Bank also need drastic reforms to make its functional arrangements more efficient and enable timely implementation.

Discussion

This section provides a detailed comparative analysis of adaptation strategies and evaluates the effectiveness of national and regional policies in addressing food security risks exacerbated by climate change.

Comparative Analysis

Differences in Adaptation Strategies

Adaptation strategies in India, Pakistan, and Bangladesh highlight progress and challenges shaped by their unique contexts:

India: India has advanced climate adaptation through the National Action Plan on Climate Change (NAPCC), promoting drought-resistant crops, water conservation, and micro-irrigation under the National Mission for Sustainable Agriculture (NMSA). However, marginalized smallholders face barriers like limited subsidies, bureaucratic delays, and high initial costs, restricting their access to these technologies.

Pakistan: Pakistan's efforts focus on flood recovery and resilience, as outlined in the National Food Security Policy (2018). Despite ambitious goals for food security and disaster preparedness, political instability, outdated infrastructure, and funding constraints limit progress. Smallholder farmers face financial and technical challenges in adopting climate-resilient practices.

Bangladesh: Bangladesh prioritizes coastal resilience, promoting salt-tolerant crops and constructing embankments and cyclone shelters. While these initiatives show promise, large-scale implementation struggles with funding gaps. Reliance on international aid makes Bangladesh vulnerable to resource uncertainties.

Each country must address funding, governance, and inclusivity challenges to enhance climate adaptation outcomes.

Socio-Economic Factors

There is a strong relation between the different areas of adaptation strategies and socio-economic factors. Poor resources, education, and financing enhance the difficulty of adopting effective climate resilience in agricultural practices.

Smallholder Farmers: The survey reveals that there are numerous challenges that smallholders in the three countries have to contend with in transitioning to Climate Smart Agriculture. For example, credit constraints and limited market access in Pakistan hampers farmers' ability to put money into better seeds, irrigation or better store. Pak Bureau of Statistic pointed out that more than 60% of the smallholders work on thin margins, so their little leverage to indulge in R& D or take risks. Small land holding and the differential administration of the subsidies make these farmers even more vulnerable in the Indian context.

Gender Disparities: Despite the fact that women have an important contribution to agriculture, they are seriously disadvantaged in the access to inputs and policy making. In Bangladesh, women contribute significantly in the post-harvest activities where credit and training facilities are beyond their access. This gender inequality risks undermining sustainable agricultural growth in particular and development in general. These inequalities must be identified and redressed in order to realize food security in that part of the world.

Policy Effectiveness

Strengths and Weaknesses

Pakistan: While the National Food Security Policy aims to make constructive changes in food security practices it was set out in 2018. That of agricultural extension focuses on crop diversification, disaster risk management, and physical infrastructure. However, due to lack of coherent and clear implementation, the policy fails and also due to lack of adequate funding. For instance, even though the policy emphasizes on need to enhance irrigation, development of leaning most of these projects is slowed down by bureaucratic processes and concomitant political insecurity.

India: India's NAPCC has played an important role in Development of sustainable agriculture and in adapting to climate change. There are positive effects being recorded in pilot areas through the implementation of the mission on micro irrigation, soil health cards and agroforestry. Nevertheless, the program's access is still restricted. These initiatives particularly remain unable to positively impact marginal and sometimes even unaware smallholder farmers with restricted financial capacity. In addition, there has been a problem with the coordination among the different departments and as result there is poor implementation of policies at the state level.

SAARC Food Bank: It will be in this context that members of the South Asian Association for Regional Cooperation (SAARC) Food Bank shall undertake the following. It is clear that the sight loss has the capacity for this type of initiative, but it also possess operational ineffectiveness. Member states are usually reluctant to honor their promises; there is no adequate mechanism for early mobilization of resources that can significantly reduce the impact of this situation. Improving the effectiveness and efficiency of operations that relate to regional cooperation as well as increasing accountability frameworks could go a long way in improving the outcomes of the Food Bank.

Implementation Challenges

Bureaucratic hurdles, like delay in the release of funds and lack of accountability undermines the effectiveness that adaptation policies. In Pakistan especially, projects that are supported by donor

funding encounter long processing periods than necessary hence decreasing their efficiency. Likewise, in India subsidies given under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) are not provided on time, Cheques are issued at the end of rainy season and most of the farmers are unable to use water conservation technologies during critical time.

Stakeholder engagement involvement is another challenge. The policies across the region lack proper mechanisms to involve the grassroots stakeholders. At one level, it reduces the applicability and relevance of initiatives. For instance, as mentioned earlier, India has its National Metropolitan Planning System Act (NMSA); however, the implementation of such an Act is still more or less centralized even though it introduced the concept of people's participation in the planning process. Increased mobilization of stakeholders can enable the consideration of the unique needs of each group so as to improve policy take up.

Conclusion

South Asia faces significant challenges in ensuring food security due to climate change, which has led to declining agricultural productivity, food supply disruptions, and socio-economic vulnerabilities. The region's reliance on climate-sensitive agriculture, coupled with inadequate infrastructure and policy implementation gaps, exacerbates these challenges. Addressing these issues requires a holistic approach that integrates climate-resilient strategies, regional cooperation, and inclusive policies. Without urgent action, the region will struggle to achieve sustainable development and food security in the face of a changing climate.

Recommendations

Significantly improved food security in South Asia needs a combination of robust policies complemented by the bottom-up approaches and strategies at country level. Key recommendations include:

1. Enhancing Policy Implementation: Strengthen inter-departmental coordination and streamline fund disbursement processes to ensure timely and effective implementation of policies.
2. Empowering Marginalized Groups: Promote inclusive policies that address the specific needs of smallholder farmers and women, ensuring equitable access to resources, training, and decision-making platforms.
3. Strengthening Regional Collaboration: Revitalize the SAARC Food Bank through enhanced accountability mechanisms and improved resource mobilization strategies.
4. Leveraging Technology and Innovation: Invest in research and development of climate-resilient crops, precision agriculture, and efficient irrigation systems to enhance agricultural productivity and resilience.
5. Building Climate-Resilient Infrastructure: Develop robust storage, transportation, and disaster management systems to mitigate post-harvest losses and enhance food distribution.

By addressing these critical areas, South Asian countries can build a resilient agricultural sector capable of mitigating food security risks and ensuring sustainable development in the face of climate change.

References

Adger, W. N., Lorenzoni, I., & O'Brien, K. L. (2009). *Adapting to climate change: Thresholds, values, governance*. Cambridge university press.

Challinor, A. J., Watson, J., Lobell, D. B., Howden, S. M., Smith, D. R., & Chhetri, N. (2014). A meta-analysis of crop yield under climate change and adaptation. *Nature Climate Change*, *4*(4), 287–291. https://doi.org/10.1038/nclimate2153.

Dave, A., & Stewart, H. (Eds.) (with Climate Security Roundtable, Board on Atmospheric Sciences and Climate, Intelligence Community Studies Board, Board on Environmental Change and Society, Division on Earth and Life Studies, Division on Engineering and Physical Sciences, Division of Behavioral and Social Sciences and Education, & National Academies of Sciences, Engineering, and Medicine). (2023). *Climate Security in South Asia*: Proceedings of a Workshop. National Academies Press. https://doi.org/10.17226/26926.

Adger, W. N., Lorenzoni, I., & O'Brien, K. L. (2009). *Adapting to climate change: Thresholds, values, governance*. Cambridge university press.

Challinor, A. J., Watson, J., Lobell, D. B., Howden, S. M., Smith, D. R., & Chhetri, N. (2014). A meta-analysis of crop yield under climate change and adaptation. *Nature Climate Change*, *4*(4), 287–291. https://doi.org/10.1038/nclimate2153

Dave, A., & Stewart, H. (Eds.) (with Climate Security Roundtable, Board on Atmospheric Sciences and Climate, Intelligence Community Studies Board, Board on Environmental Change and Society, Division on Earth and Life Studies, Division on Engineering and Physical Sciences, Division of Behavioral and Social Sciences and Education, & National Academies of Sciences, Engineering, and Medicine). (2023). *Climate Security in South Asia: Proceedings of a Workshop*. National Academies Press. https://doi.org/10.17226/26926

FAO. (2023a). *Latest IPCC Report Highlights the Critical Need to Transform Agrifood* [FAO Newsroom]. Food and Agriculture Organization. https://www.fao.org/newsroom/detail/latest-ipcc-report-highlights-the-critical-need-to-transform-agrifood-systems-as-a-way-to-mitigate-and-adapt-to-climate-change/?form=MG0AV3

FAO. (2023b). *Regional Overview of Food Security and Nutrition in Asia and the Pacific 2023*. Food and Agriculture Organization. https://www.fao.org/3/cb5317en/cb5317en.pdf

FAO. (2023c). *Statistical Yearbook World Food and Agriculture 2023*. Food and Agriculture Organization. https://openknowledge.fao.org/server/api/core/bitstreams/28cfd24e-81a9-4ebc-b2b5-4095fe5b1dab/content/cc8166en.html

ICIMOD. (2023a). *HI-WISE - Water, Ice, Society, Ecosystems in the Hindu Kush Himalaya*. International Centre for Integrated Mountain Development. https://hkh.icimod.org/hi-wise/

ICIMOD. (2023b). *Landmark Report on Impacts of Disappearing Snow and Ice in the Hindu Kush Himalaya – Current Emissions Path Threatens Two Billion People and is Accelerating Species Extinction*. International Centre for Integrated Mountain Development. https://www.icimod.org/press-release/landmark-report-on-impacts-of-disappearing-snow-and-ice-in-the-hindu-kush-himalaya-current-emissions-path-threatens-two-billion-people-and-is-accelerating-species-extinction/?form=MG0AV3

Ingram, J. S. I., Ericksen, P., & Liverman, D. M. (Eds.). (2010). *Food security and global environmental change*. Earthscan.

Lal, R., Sivakumar, M. V. K., & Faiz, S. M. A. (2011). *Climate Change and Food Security in South Asia*. Springer. https://link.springer.com/book/10.1007/978-90-481-9516-9

Pakistan Bureau of Statistics. (2010). *Agricultural Census 2010—Pakistan Report*. Pakistan Bureau of Statistics. http://www.pbs.gov.pk/sites/default/files//Agriculture%20Statistics/publications/Agricultural%20Census

Prasain, S. (2024, October 1). *Heavy rains inflict an estimated Rs17 billion loss on Nepal*. Kathmandu Post. https://kathmandupost.com/national/2024/10/01/heavy-rains-inflict-rs17-billion-loss-on-nepal?form=MG0AV3

Romshoo, S. A., Murtaza, K. O., Shah, W., Ramzan, T., Ameen, U., & Bhat, M. H. (2022). Anthropogenic climate change drives melting of glaciers in the Himalaya. *Environmental Science and Pollution Research*, *29*(35), 52732–52751. https://doi.org/10.1007/s11356-022-19524-0

Soriano, J. B., Wani, S. P., Rao, A. N., Anantha, K. H., Gowda, J. A. C., & Rathore, A. (2017). On-Farm Evaluation of Dry-Seeded Rice Cultivars and Cropping Systems in the Semi-Arid Region of India. *Philippine Journal of Science*, *146*(3), Article 3. http://philjournalsci.dost.gov.ph/

World Bank. (2022). *Pakistan: Flood Damages and Economic Losses Over USD 30 billion and Reconstruction Needs Over USD 16 billion—New Assessment*. https://www.worldbank.org/en/news/press-release/2022/10/28/pakistan-flood-damages-and-economic-losses-over-usd-30-billion-and-reconstruction-needs-over-usd-16-billion-new-assessme.