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Sustainable Agriculture Practices in Uzbekistan: Investigating the Adoption and Impact of Sustainable Agricultural Practice

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Abstract
Uzbekistan stands at the threshold of a remarkable transformation towards a market-based economy, leveraging the achievements of initial reforms. As the country progresses on this path, there is a unique opportunity to further enhance the transition by adopting a green approach, thereby fostering a more sustainable and inclusive economy. Green policies not only promote efficient resource allocation but also contribute to the development of competitive enterprises and the equitable distribution of benefits. Recognizing the vital connection between economic growth and environmental sustainability, the Government of Uzbekistan has taken a proactive stance by introducing the 'Strategy for the Transition to a Green Economy.

INTRODUCTION

Land degradation in Uzbekistan has become a significant challenge, resulting in economic losses equivalent to 4 percent of the country's gross domestic product (GDP). This degradation is a consequence of interconnected environmental and resource-related issues. One of the key concerns is the excessive withdrawal and inefficient use of water, leading to a considerable decline in economic productivity. Specifically, Uzbekistan experiences a US$14 lower economic productivity per cubic meter of water used compared to upper-middle-income countries (UMICs). Additionally, approximately 50 percent of irrigated lands suffer from varying degrees of salinity, and up to 26 percent of croplands are severely degraded.

Addressing water use efficiency emerges as a critical priority, necessitating measures such as resource pricing, the adoption of water-saving technologies, and the implementation of withdrawal limits. It is also imperative to prioritize landscape restoration efforts to combat soil erosion and safeguard essential ecosystem functions. To ensure that policies are comprehensive and inclusive, it is crucial to conduct a distributional analysis of the impact of water pricing reforms on low-income communities.

Furthermore, the looming threat of climate change is poised to exacerbate the existing risks. Based on available data and models, the economic cost of climate change's physical impacts is estimated to reach 1 percent of GDP by 2030. This impact is anticipated to be most significant in the agricultural sector, followed by water and biodiversity loss, labor productivity, and increased weather hazards. Vulnerable communities, particularly those in the Ferghana Valley and Karakalpakstan regions, are projected to bear the brunt of climate change's adverse effects,

rendering Uzbekistan more socially vulnerable compared to neighboring Central Asian countries. Studies indicate that these communities experience twice the loss of income and consumption during drought and flood events compared to affected communities in neighboring nations.

Although Uzbekistan has outlined broad adaptation objectives in its Nationally Determined Contributions (NDCs), the formulation of a national adaptation strategy is crucial to guide the design and prioritization of adaptation actions in terms of cost-effectiveness. Given Uzbekistan's risk profile and environmental circumstances, specific measures such as catastrophic insurance for drought risk and nature-based adaptation should be considered. In designing and implementing adaptation actions, it is essential to involve local communities as key stakeholders.

By addressing land degradation, improving water use efficiency, and proactively responding to climate change, Uzbekistan can foster resilience, enhance sustainable development, and protect vulnerable communities. A comprehensive and coordinated approach that integrates environmental, economic, and social dimensions is paramount to steer Uzbekistan towards a more sustainable and prosperous future.

Literature review

Researchers in biophysical sciences often adopt a narrow, one-dimensional approach when managing climate risks and assessing vulnerability. They tend to provide detailed and technical information on specific and predictable sources of risk. In contrast, decision-makers take a more holistic and intuitive approach to risk management (Meinke et. al. 2006). This disparity can unintentionally overlook long-term and comprehensive opportunities to build adaptive capacity (Schwartz, et.al. 2006). Consequently, there is often a perceived lack of relevance between the broad, general demands for scientific input and the narrow, specific supply provided by researchers.

Recognizing the limitations of one-dimensional vulnerability assessments, some research institutions have formed multidisciplinary teams comprising both biophysical and social scientists. These teams have begun producing numerous vulnerability studies using a common approach of defining sets of indicators. For example, (Moss et. al. 2002) the United States Agency for International Development Famine Early Warning System (FEWS) program employs indices based on selected variables to measure vulnerability to food insecurity in Africa. These variables include crop risk, income risk, and coping strategies. Similarly, other institutions like the Pacific Northwest Laboratory and the South Pacific Applied Geoscience Commission (SOPAC) use index-based approaches with their own sets of variables to assess vulnerability.

While the index-based approach is valuable for studying trends within a specific region, it may be less robust for comparing vulnerability across different regions. The selection of variables to create vulnerability indicators may vary in importance between regions. Additionally, limitations of the index approach include subjectivity in variable selection and the frequent lack of sufficient information to establish the index.

In many cases, index-based approaches end up measuring what can be measured rather than what should be measured. These limitations have prompted researchers to shift their focus. Instead of quantifying the vulnerability of a site or region, they now assess the vulnerability of selected variables to specific stressors. This alternative approach examines the sensitivity of a system to different stressors, identifies thresholds at which the system is considered damaged, measures susceptibility based on sensitivity and exposure to stressors, and estimates the system's ability to adapt and respond to changing circumstances. Notably, this approach explicitly considers the untapped adaptive potential historically demonstrated in regions like Africa, South Asia, and the Andes, where societies have shown resilience and survival in the face of severe climate-related challenges.

Research Methodology

1. Research Objective:

The objective of this research is to assess the economic costs and impacts of natural disasters and land degradation in Uzbekistan, focusing on their effects on different segments of society and the agricultural sector. The aim is to identify the risks associated with these phenomena and propose measures for sustainable land management and disaster risk reduction.

2. Data Collection:

Primary Data: Primary data can be collected through surveys, interviews, and field observations. This can include collecting information on the economic losses caused by natural disasters, the well-being of affected communities, land cover characteristics, and agricultural productivity.

Secondary Data: Secondary data can be collected from relevant sources such as research papers, government reports, statistical databases, and international organizations. This data can provide information on GDP, population demographics, land use, disaster records, and previous studies on natural disasters and land degradation in Uzbekistan.

3. Data Analysis:

Quantitative Analysis: Quantitative analysis can be performed to estimate the economic costs associated with natural disasters and land degradation. This can involve calculating the percentage of GDP attributed to asset losses and well-being losses. Statistical techniques can be applied to analyze the relationship between different variables, such as population exposure, asset values, and socioeconomic resilience.

Qualitative Analysis: Qualitative analysis can be conducted to understand the drivers and impacts of land degradation, the challenges faced by rural communities, and the effectiveness of existing land management practices. This can involve thematic analysis of interviews and qualitative data from field observations.

Results and discussions

In Uzbekistan, the economic cost associated with natural disasters is estimated to be 0.57 percent of GDP. While the country exhibits relatively low exposure to natural hazards in terms

of assets and population on average, the impact on low-income communities is significantly greater. In fact, asset losses for this vulnerable population group are nearly twice as high as those for other segments of society.

Assessing the risk of natural disasters involves examining the population and assets located in areas prone to such events. The risk to assets can be quantified by calculating the average monetary value of damages incurred during disasters. Meanwhile, the risk to well-being is determined by assessing the ratio of expected asset losses to the socioeconomic resilience of the affected population.

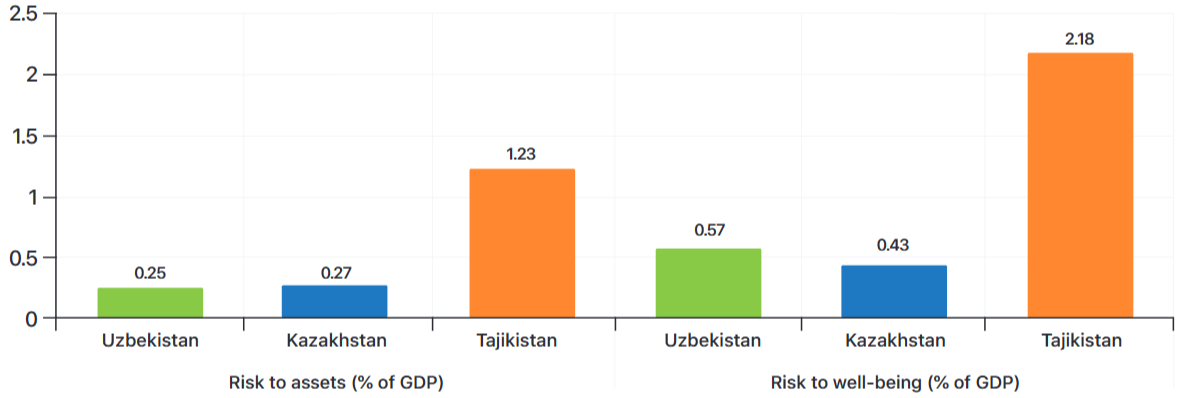

Figure 1. Risk to assets and well-being

Uzbekistan's low risk to assets can be attributed to the fact that only a small portion of the country's population is exposed to natural disasters. However, it is important to note that the exposed population primarily consists of individuals from low-income households. Consequently, while their asset losses from natural disasters may be relatively lower compared to regional averages (equivalent to 0.25 percent of GDP), their well-being losses are significantly higher, amounting to 0.57 percent of GDP (Hallegatte et al., 2017). This underscores the disproportionate impact of natural disasters on the well-being of low-income communities in Uzbekistan.

Land degradation in Uzbekistan carries significant costs for both rural communities and the overall national economy. In 2016, the losses incurred amounted to approximately 3-4 percent of the country's GDP. This estimation is based on comprehensive studies that utilize mapping techniques to assess land cover characteristics and their corresponding economic value. By analyzing changes in land cover over time, known as the "total economic value of ecosystems" approach, the costs associated with land degradation are calculated.

Remarkably, the economic losses resulting from land degradation surpass the estimated expenses required to implement protective measures for the land. In fact, the active destruction of land leads to losses that are five times higher than the projected costs of land protection measures (Quillérou et al., 2016). A significant loss of ecosystem services, valued at approximately US$0.85 billion, occurred between 2001 and 2009 due to changes in land use and land cover. This loss corresponds to 3 percent or more of the country's GDP in 2009 (Mirzabaev et al., 2016).

These findings underscore the pressing need for sustainable land management practices in Uzbekistan to mitigate the detrimental impacts of land degradation. By prioritizing land

protection measures and adopting responsible land use policies, the country can safeguard its ecosystems, support rural communities, and ensure the long-term resilience and productivity of its economy.

Land resources play a vital role in the natural assets and environment, serving various purposes such as agricultural production, forestry, biodiversity conservation, carbon sequestration, and ecosystem productivity. However, land degradation poses significant economic implications. The main drivers of land degradation include soil erosion, unsustainable land use practices, excessive water use for irrigation leading to soil waterlogging and salinization, and unsustainable livestock grazing practices (Nkonya, Mirzabaev, and von Braun, 2016).

One area where land degradation is evident is in the pasturelands, which have experienced extensive deterioration since the 1990s. Unsustainable use of pastures for livestock grazing, lack of proper management, and other human activities have contributed to this degradation. Biodiversity and habitat degradation present another challenge, as they are closely linked to the deterioration of natural ecosystems. This degradation results in the loss of crucial ecosystem services that are essential for a productive and resilient landscape, with implications for agriculture, communities, and the overall landscape resilience.

Inadequate irrigation practices have also led to land degradation and salinization, posing a major environmental problem. This problem causes the loss of topsoil and nutrients, leading to reduced soil fertility and productivity (Zhao et al., 2019). Improper irrigation techniques and poor drainage contribute to secondary salinization in irrigated lands (as depicted in Figure 2). High groundwater levels further exacerbate this issue. Approximately 50 percent of irrigated lands in Uzbekistan face varying degrees of salinity, which poses a threat to food security (Zhao et al., 2019). Soil salinization negatively impacts crop yields, with cotton being particularly affected. Depending on the level of soil salinity, cotton yields can experience reductions ranging from 20 to 80 percent.

Addressing land degradation and salinization in Uzbekistan is crucial to ensure sustainable agricultural practices, food security, and the long-term productivity of the land. Implementing proper land management techniques, improving irrigation practices, and adopting measures to mitigate soil salinity are essential steps toward restoring the health and fertility of the land, supporting sustainable agriculture, and preserving the well-being of rural communities.

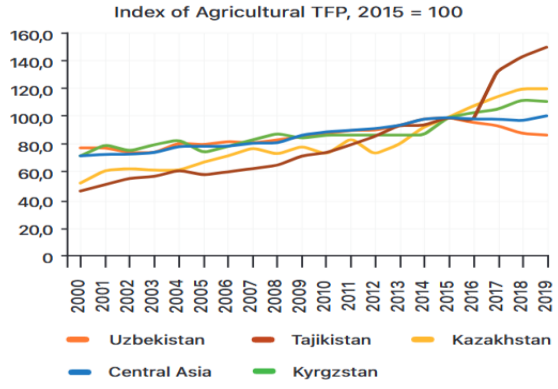

Figure 2. TFP in agriculture*

Crop type	2019 actual area
Wheat	1,319 (37%)
Other grains	266 (7%)
Fodder	262 (7%)
Cotton	1,065 (30%)
Potatoes	88 (2%)
Vegetables	216 (6%)
Fruits and berries	211 (6%)
Melons	54 (1%)
Wine grapes	119 (3%)
Total sowing areas, 1,000 ha (% of total)	3,599 (100%)

Table 1. Agricultural land use by crop**

Source: United States Department of Agriculture, Economic Research Service.*

*Source: World Bank 2020**.

Agricultural land productivity in Uzbekistan falls below the average for lower-middle-income countries (LMICs). A significant portion of Uzbekistan's croplands (26 percent) and rangelands (17 percent) are identified as land degradation hotspots, indicating the urgent need to address inefficient natural resource management (Mirzabaev et al., 2016). Failing to tackle these issues, particularly in the context of a changing climate, poses significant risks to the country's agricultural sector, which is crucial for the well-being of the rural population. Approximately 80 percent of Uzbekistan's poor reside in rural areas, heavily relying on agriculture for their livelihoods.

Furthermore, the total factor productivity (TFP) in the agricultural sector of Uzbekistan is considerably lower compared to the rest of the Central Asia region. The widespread land degradation observed in the country will increasingly impede productivity, earnings, and health outcomes, thereby undermining some of the potential benefits associated with urbanization efforts. It is imperative to address land degradation effectively to safeguard agricultural productivity, income generation, and the overall well-being of rural communities in Uzbekistan.

Limitations

It is important to acknowledge the limitations of the research, such as the availability and reliability of data, the representativeness of samples, and potential biases in the analysis. These limitations should be addressed and clearly communicated in the research report.

Conclusion

In conclusion, Uzbekistan faces significant challenges related to natural disasters and land degradation, both of which have profound economic and social implications. While the overall exposure to natural hazards may be relatively low in terms of assets and population, the impact on low-income communities is disproportionately higher. These vulnerable groups bear a greater burden in terms of asset losses and well-being, highlighting the need for targeted support and resilience-building measures.

Land degradation poses a significant threat to the country's rural communities and economy, with estimated losses amounting to a considerable percentage of GDP. The active destruction of land far outweighs the costs associated with protective measures, emphasizing the urgent need for sustainable land management practices. By implementing responsible land use policies, prioritizing land protection measures, and addressing the drivers of degradation such as soil erosion, unsustainable practices, and improper irrigation, Uzbekistan can safeguard its ecosystems, support rural communities, and ensure long-term economic resilience.

Addressing the issues of natural disasters and land degradation requires a multi-faceted approach, combining disaster risk reduction strategies, improved land management practices, and sustainable agriculture techniques. It is crucial to prioritize the well-being and resilience of vulnerable populations, particularly those in low-income communities, who are disproportionately affected by these challenges.

Furthermore, investing in research, monitoring, and data collection will enhance the understanding of the complex relationships between natural hazards, land degradation, and

their economic and social impacts. This knowledge will inform evidence-based policies and interventions aimed at mitigating risks, enhancing adaptive capacity, and promoting sustainable development in Uzbekistan.

Ultimately, by adopting a comprehensive and integrated approach, Uzbekistan can mitigate the costs and impacts of natural disasters, preserve its valuable land resources, and pave the way for a more sustainable and resilient future.

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