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Thesis Title: An Economic Assessment of the Impact of Climate Change on Agricultural Sustainability in Developing Countries: A Comparative Analysis of India and China

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FINDINGS

This thesis investigates the intricate relationship between climate change and agricultural sustainability in developing economies, specifically focusing on India and China. Both countries are heavily reliant on agriculture for livelihoods and economic stability, and they face growing challenges due to the rapidly changing climate. Over a 30-year period (1991–2020), the study examines six key agricultural crops—barley, maize, millet, rice, wheat, and sugarcane—while incorporating six climate-related variables: temperature, precipitation, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and carbon monoxide (CO). By applying rigorous econometric techniques including the Autoregressive Distributed Lag (ARDL) model, Error Correction Model (ECM), and multiple regression analysis, the research aims to determine the short- and long-term effects of climate change on agricultural productivity and economic outcomes in both countries.

The findings indicate significant differences between India and China in both their emission profiles and agricultural resilience. China, despite being the world's largest emitter of greenhouse gases, especially CO_2, CH_4, and N_2O, manages to maintain higher productivity in key crops such as rice, wheat, and maize. In contrast, India, while emitting less greenhouse gases overall, struggles more with the negative impacts of climate change on its agriculture sector. India leads in the production of barley, millet, and sugarcane, yet its agricultural system is more vulnerable to climate variability due to a variety of structural, technological, and policy-related shortcomings. Over the last three decades, both nations have experienced declining crop yields as a result of climate disruptions, but the intensity and consequences are more severe in India.

Through the use of the ARDL model, the study analyses the statistical relationship between climate variables and foodgrain production. It finds that CO_2 and rainfall have a slight positive influence on crop yields in both countries, largely due to the CO_2 fertilization effect and increased water availability. However, these gains are overshadowed by the more detrimental impacts of rising temperatures and the increased concentration of CH_4 and N_2O emissions. Methane emissions, particularly from rice paddies and livestock, along with nitrous oxide from excessive fertilizer use, were found to significantly lower crop productivity. The ECM results further reveal that agricultural production tends to return to a long-run equilibrium after experiencing short-term climate shocks.

The broader economic implications of climate change are explored through multiple regression analysis. The study finds that rising temperatures have a negative effect on agricultural Gross

Value Added (GVA) and foodgrain yield in both countries. On the other hand, factors such as rainfall, foreign direct investment (FDI) in agriculture, and gross capital formation contribute positively. These results indicate that climate change not only affects agricultural productivity but also has direct consequences on the economic health of both nations. The study also highlights the social costs of climate change, especially in India, where projections estimate that by the end of the century, an additional 230 million people could fall into extreme poverty as a direct result of climate-related disruptions. Moreover, climate change may lead to as many as 1.5 million deaths annually in India by 2100.

What makes the contrast between India and China more striking is that China, despite its high emission levels, has taken substantial steps to build resilience in its agriculture sector. The country has adopted climate-smart practices such as precision farming, use of adaptive crop varieties, rainwater harvesting, and investment in research and development. As a result, China's agricultural output has continued to grow steadily, achieving an average growth rate of 4.5% annually from 1978 to 2022. This growth rate surpasses its population growth and has helped ensure food security. Meanwhile, India, although aiming for food self-sufficiency, has been slower in adopting such measures, and its farmers often lack access to the necessary resources, infrastructure, and policy support needed to combat the adverse effects of climate change.

To address these challenges, the thesis recommends several policy interventions. There is an urgent need to reform agricultural policies to make them climate-resilient, especially in drought-prone regions. Expanding irrigation infrastructure and improving water resource management are critical to stabilizing yields. The study emphasizes the importance of enhancing forecasting systems and early warning tools to help farmers prepare for unexpected weather patterns. It also calls for increased public and private investment in agricultural research, particularly in technologies that help reduce emissions and enhance productivity. Raising awareness among farmers about the dangers of excessive nitrogen fertilizer use is equally important, and sustainable alternatives such as nitrification inhibitors and renewable fertilizers should be promoted.