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The Impact of Climate Change on Zero Hunger in South Asia

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Abstract

Climate change has raised ample concerns about achieving zero hunger. The goal of the study is to investigate the link between climate change and eradicating hunger in Asian nations. The data span is from 2001 to 2020 from World Bank and KOF. The effect was investigated using the Pool Mean Grouped/Panel Autoregressive Distributed Lag Model which shows that climate change, both in the short-run and long-run, hinders progress toward achieving zero hunger. The conclusion shows that in the long run, a rise in per capita income, globalization, and labor force participation boosts the progress towards achieving zero hunger but, in the short run, per capita income has a significant effect, and globalization and labor force participation have an insignificant effect on zero hunger. Finally, this study offers some recommendations to achieve zero hunger.

Keywords: Climate Change; Zero Hunger; Panel Autoregressive Distributed Lag Model; Asian Countries

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The Impact of Climate Change on Zero Hunger in South Asia

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Abstract

Climate change has raised ample concerns about achieving zero hunger. The goal of the study is to investigate the link between climate change and eradicating hunger in Asian nations. The data span is from 2001 to 2020 from World Bank and KOF. The effect was investigated using the Pool Mean Grouped/Panel Autoregressive Distributed Lag Model which shows that climate change, both in the short-run and long-run, hinders progress toward achieving zero hunger. The conclusion shows that in the long run, a rise in per capita income, globalization, and labor force participation boosts the progress towards achieving zero hunger but, in the short run, per capita income has a significant effect, and globalization and labor force participation have an insignificant effect on zero hunger. Finally, this study offers some recommendations to achieve zero hunger.

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Introduction

The 2nd Sustainable Development Goal (SDG2) proposes the ambitious goal of eradicating malnutrition globally by 2030, building on the advancements made under earlier initiatives to do so (such as the Millennium Development Goals) (UN, 2015 b). The total eradication of malnutrition will need a multifaceted effort that recognizes that the "last mile" will be the most challenging (Chandy, Kato, & Kharas, 2015). The upcoming

move will be faced with dealing with increasingly severe resource and environmental restrictions (Rockström, et al., 2011; Tilman, & Clark, 2014) even as the population continues to grow and the need for food rises (Samir, & Lutz, 2017). Having a rising desire for nutritious diets (Bodirsky et al., 2015; Tilman & Clark, 2014). By declining crop output, raising food costs, limiting access to food, and worsening health consequences, climate change makes ending starvation even more



difficult (Springmann, et al., [2016](#); Sulser, et al., [2015](#); Willenbockel, 2015).

The "Zero Hunger" as a sustainability goal was endorsed by the U.N General Assembly in 2015 which takes into account the concerns regarding the sustainability of worldwide food supply chains. A developing transformation of research and common knowledge is demonstrated by the recognition of the connections between physical well-being, atmosphere, and farming. The decreasing amount of plant and animal life, a rise in insect strain, eroding soil, losses of organic material in the soil, greenhouse gas releases, eutrophication, and contamination of lakes and rivers are only a few of these well-known effects (IPCC. [2013](#), Diaz, & Rosenberg; Zaks, 2011, Matson, et al., [1997](#)).

One of the seventeen Sustainable Development Goals set by the UN in 2015 is recognized as "No Hunger," or SDG 2. SDG 2's explicit mission is to eradicate malnutrition, attain safety from hunger, enhance diets, and support environmentally friendly farming. The UN reports that approximately 690 million individuals suffer from hunger, which represents below 10% of the world population. Hunger is "a difficult or unpleasant feeling brought on by insufficient dietary energy consumption or food insufficiency refers to hunger. The percentage of a population whose daily nutritional consumption is below a certain threshold is known as starvation, a country-specific standard, expressed as the number of calories needed to perform a passive or relatively modest workout (FAO. [2008](#)).

The Food and Agriculture Organization, [2008](#) notes that climate change has a detrimental effect on crop output (FAO. [2008](#)). Food costs will rise dramatically if the changing climate causes a decrease in crop production and food availability at a time when demand for food is rising due to an increase in population. This, coupled with poverty, results in an increase in global hunger which means that we go far away from zero hunger point (Chutney, W. ([2019](#))). Some information about people's subjective experiences

of malnutrition in eighteen nations located in Southern Africa in which (GDP) per capita of these countries increased over time, there was a corresponding improvement in food security. In other words, economic growth was positively associated with better access to food and reduced food insecurity (Verpoorten et al., [2013](#)).

The Sustainable Development Goal, also known as SDG 2, aims to eradicate hunger, enhance food safety, enhance diets, and develop environmentally friendly farming. It suggests that radical economic and political shifts will address the availability of food sustainability. The distinct objectives of SDG 2 cover farmer earnings, markets and possibilities for adding value, farming research, and extension, trading distortions, ecological problems including farming productivity, biodiversity, sustainable production systems, and public health concerns including eradicating hunger and malnutrition, focuses on stunting and dehydration, and the dietary demands of women. SDG 2 distinguishes itself as a target that is intrinsically multidisciplinary by addressing the global food system. In fact, the SDG of "Zero Hunger" is an example of how the different SDGs should be viewed as a single cohesive unit (Nilsson, M., Griggs. [2016](#)).

It has been explored how SDG 2 has influenced studies regarding channels to sustainable farming. This is because the Zero Hunger target and present-day understanding of farming systems point to the necessity of an important shift of agriculture towards management based on ecological standards. Studies revealed that, despite the second SDG's relative youth, ecological scholars and academics in related disciplines like soil sciences have only a little connection with it thus far (Goicoechea, and Antolín. ([2017](#)), Pandey, R. ([2017](#)), Winkler, et al., ([2017](#)), Wright, et al., ([2016](#)).

What Is Hunger?

Hunger is an unpleasant feeling brought on by deficient nourishment intake. "Food shortage" refers to hunger. The FAO defines

undernourishment as the percentage of a population whose energy intake from food is below a predetermined, nation-specific limit, expressed in terms of the number of calories needed to perform inactive or low tasks (FAO. [2008](#)).

Acute, chronic, and hidden hunger are the three categories that distinguish them. Lack of food over a predetermined time is known as acute hunger (or starvation). It is one of the most severe types of hunger, and it frequently coexists with wars, floods, and other natural with unnatural catastrophes. Persistent malnutrition is for a long-time hunger. More food is absorbed by the body than is necessary.

Starvation, a protracted, severe lack of the energies required to sustain a healthy body, is the end result of hunger for someone. To live, the starved body makes an effort to slow down its digestion process and redistribute energy to its most important organs. As caloric consumption declines, non-essential processes become slower. As the heartbeat rate slows, blood pressure drops. The operation of the kidneys is affected, and the body's defense mechanism deteriorates. As the body's requirements for maintaining heat are less, the person begins to feel chilly. Muscle recovery receives less energy, which results in physical weariness (Liebersohn, A. D. [2004](#)).

What Are the Causes of Hunger?

The basic reasons for hunger are briefly covered in this subsection, which results in numerous possibilities. Hunger and poverty go hand in hand, as is widely recognized. The main factor causing hunger is poverty. It is significantly difficult to purchase food or to grow food for consumption when they are in hardship. Hunger fosters poverty by impairing one's physical and mental well-being as well as their capacity to learn and work for a living (FAO. 2017,2018,2019, Tyagi, A. C. [2017](#), Young, A. [2005](#), WHES. 2018, Orner, M. [2014](#), Scrimshaw, N. S. [1994](#)).

The amount of food generated in developing nations is significantly different from that in advanced nations due to a shortage of effective farming techniques (Samberg, L. [2021](#)). Additionally, farming techniques and rules meant to boost crop production may have unexpected repercussions, such as the deterioration of accessible groundwater or the depletion of available soil (Watts, J. [2017](#); Zalidis, et al., [2002](#)).

The Sustainable Development Goals

Goal 1 is No poverty – by 2030, eradicate poverty in all its manifestations. According to the UNDP, poverty results in less access to wholesome food, hygiene, and fresh water.

Goal 2 is Zero hunger – by 2030, eradicate all types of malnutrition and starvation. In many countries, hunger and malnutrition are obstacles to progress.

Goal 5 is Gender equality – ending all forms that discriminate towards women and girls is essential for a future of sustainability in addition to being a fundamental human right. According to the UNDP, 35% of women have been victims of physical or sexual abuse. Additionally, it is projected that women earn 77% less than males for the same job.

Goal 13 is Climate action: by 2030, generate US \$100 billion annually to help poor nations. It is estimated that climate-related calamities cause hundreds of billions of dollars in average yearly economic damage. While the SDGs have received a lot of attention, eight objectives, and fourteen indicators make up SDG 2 (zero hunger), including malnutrition, food insecurity, and undernourishment. Similar to SDG 4, SDG 5 (gender equality) takes gender disparity and discrimination into account through nine objectives and fourteen indicators. There is broad agreement among academics that the SDGs are connected, and the investigation of connections between several SDGs in South Africa. It should come as no surprise that he finds proof of a connection between SDG 13 (cutting CO2

emissions) and SDG 7 (decreasing CO₂ consumption/improving energy efficiency). Measures for SDG 8 and SDG 13 are reported to work in tandem (Myklebust, [2019](#); Ngankam, [2019](#))

Literature Review

In September 2015, the United Nations adopted a resolution during a high-level Special Summit in New York, marking the beginning of the SDGs, aimed at addressing global priorities such as poverty, inequality, hunger, climate change, and social injustice.

The Sustainable Development Goals (SDGs) aim to reduce hunger and boost sustainable farming by 2030. To achieve these goals, it is essential to share resources fairly, improve farming methods, and use eco-friendly practices that support both food security and the environment.

Long-term hunger can cause serious problems like malnutrition, poor growth in children, and learning difficulties. In places with limited food, such as low-income areas or during crises, hunger can lead to suffering. The impact depends on whether hunger is a short-term issue or a prolonged state of need (The Hunger Project; 2008IICA, 2015).

The word "hunger" is often used to describe an ongoing lack of food, but it lacks precise meaning and does not capture the complex links between diet and health. This general use of the term can make it hard to understand the full range of malnutrition and its effects on health. It doesn't separate the different physical, mental, and social factors involved.

In Africa, food insecurity is caused by a mix of many issues. Widespread poverty makes people more vulnerable to food shortages, and unemployment weakens buying power, making hunger more likely. Unpredictable weather and repeated droughts make these problems worse. Corruption also plays a role, often misusing funds meant to improve food security. Solving hunger in Africa requires honest leadership and

comprehensive strategies that address poverty, unemployment, conflict, weather challenges, and corruption all at once to create lasting food security.

In 2022, a study by Affoh et al. explored the said link across 25 Sub-Saharan African nations from 1985 to 2018, using the Pool Mean Group (PMG) model. It found that higher temperatures negatively affect food accessibility and availability, but not food utilization. Increased rainfall correlates positively with food availability. Interestingly, higher carbon dioxide emissions also positively influence food availability in the region (Affoh & collaborators, [2022](#)).

Research Gap

This study will spotlight the main consequences of climate change in Asian countries. There is a critical lack of literature regarding climate change and zero hunger in underdeveloped Asian countries. Climate change affects different regions in distinct ways. A research gap could be to investigate how climate change impacts zero hunger goals in specific underdeveloped regions or countries. For instance, how does climate change affect food production and availability in certain underdeveloped Asian countries? To examine the causes of environmental degradation and its adverse impact on hunger levels, as well as to identify solutions to address these issues. Investigate the trade-offs between climate change and zero hunger in under-developed Asian countries. This research will close this gap. This study also contains several more significant factors that significantly contribute to ending hunger (explained in the section on the description of the variables section).

Research Methodology

The current study is designed to examine the impact of climate change on zero hunger for eight Asian countries from 2001 to 2020. Zero Hunger is a term used in the context of the SDGs by the United Nations to describe the aspiration of

eradicating all forms of hunger, malnutrition, and food insecurity (Lee, et al., 2016).

Literature on climate change highlighted numerous indicators such as temperature, rise in sea level, precipitation, carbon dioxide emissions (CO₂), and ocean acidification. Numerous empirical studies used CO₂ as a metric of climate

change. Variables of the study were taken from World Bank (2022) and KOF (2021). Zero hunger is a dependent variable, and independent variables are the climate change index, globalization index, per capita income measured at 2015-constant US dollars, and labor force participation measured as a percentage of the total labor force employed.

Table 1

Description of variables.

Variables	Abbreviation	Data Sources	Unit
Zero Hunger	HZ	World Bank (2022)	Index
Climate Change	CC	World Bank (2022)	Index
Globalization Index	GI	KOF (2021)	Index
Per Capita Income	PCI	World Bank (2022)	PCI measured in constant-2015 US dollars
Labor force Participation	LFP	World Bank (2022)	Percentage of labor force employed

The expression below was formulated to quantify the effect of climate change along with other variables on zero hunger.

$$ZH = f(CC, GI, PCI, LFP) \tag{1}$$

Where ZH represents zero hunger, CC denotes climate change, PCI represents per capita income LFP represents labor force participation and GI denotes globalization index. To get efficient and dependable estimation, the variables of this study are mentioned in Equation 1. Again, all the variables were converted into log form for the double log model and specified in equation 2 to achieve the objectives of this research study.

$$\ln ZH_{it} = \beta_0 + \beta_{1it}CC_{it} + \beta_{2it}GI_{it} + \beta_{3it}PCI_{it} + \beta_{4it}LFP_{it} + \varepsilon_{it} \tag{2}$$

Where i represents each country of this study, t represents time, β_0 denotes the intercept, β_1 to β_4 represent slope coefficients of each independent variable, and ε denotes the residual term.

Cross-sectional dependence tests and unit root tests were conducted before quantifying the influence of climate change along with other variables on zero hunger. Most economic time series have unit-root problems. An econometric model produces unreliable results when variables

of the model have unit roots (Chang, et al., 2019). Unit root test is necessary for all variables used in the study. The presence of cross-sectional dependence makes estimators inefficient, and these estimators produce a biased standard error. The growing financial and economic integration among countries can cause a violation of the assumption of the first-generation unit root test as countries are cross-sectional units in this study (Barbieri, 2009). Therefore, the Pesaran CD test was applied to check the cross-sectional dependence in each variable. Cross-sectionally dependent IPS test was used to check the problem of unit root in all variables. The Hausman test was conducted to select the appropriate estimation technique. The H₀ shows that PMG-ARDL is the appropriate estimation technique whereas the null hypothesis posits that the Mean group model is the appropriate estimation technique.

PMG-ARDL test was used to check the effect of climate change on zero hunger as the results of the Hausman test and CIPS test suggest PMG-ARDL as an appropriate estimation technique. PMG-ARDL test can be used when all series are stationary at level, first difference, or in mixed integration order i.e., some are stationary at level,

and some are stationary at first difference (Shin & Smith, 1999). This study also satisfies the basic assumption of PMG-ARDL i.e., the number of time periods (T) must be greater than the number of cross-sectional units (N). Econometricians consider PMG-ARDL as a superior estimation technique as it can resolve the problem of endogeneity and can test the hypothesis using long-run coefficients which is difficult using the Engle-Granger technique (Grange, 1987). Another advantage of the PMG estimator is its ability to estimate both short-run and long-run coefficients simultaneously. It allows heterogeneity in an intercept, error variance, and short-run coefficients while long-run coefficients must be homogeneous. The extensive usage of common technology, solvency problems, and arbitrage are some reasons that produce long-run relations among variables across groups.

Keeping in view the stationarity results i.e., CIPS and Hausman test, the model specified in equation 1 was converted to PMG-ARDL form which is expressed in equation 3.

$$\begin{aligned} \Delta ZH_{it} = & \alpha_i + \theta_i ZH_{i,t-1} + \beta_{1,i} CCI_{i,t} + \beta_{2,i} GI_{i,t} + \beta_{3,i} PCI_{i,t} \\ & + \beta_{4,i} LFP_{i,t} + \sum_{j=1}^{p-1} \lambda_{ij} ZH_{j,t-1} + \sum_{j=0}^{q-1} \delta_{1ij} CCI_{i,t-j} \\ & + \sum_{j=0}^{q-1} \delta_{2ij} GI_{i,t-j} + \sum_{j=0}^{q-1} \delta_{3ij} PCI_{i,t-j} \\ & + \sum_{j=0}^{q-1} \delta_{4ij} LFP_{i,t-j} \varepsilon_{ij} \end{aligned} \quad (3)$$

Whereas ΔZH_{it} denotes the first difference of ZH, $ZH_{i,t-1}$ denotes the error term, $\Delta ZH_{j,t-1}$ shows the one lag of ΔZH , α_i is the intercept of the model, β_1 , β_2 , β_3 , and β_4 are the long-run slope coefficients which measure the long-run relationship of zero hunger with all independent variables, and short-run slope coefficients which measure the effects of

all independent variables on zero hunger in short-run.

Results and Discussion

Table 2 consists of descriptive statistics of variables. The mean values of the zero hunger index of Afghanistan, Bangladesh, India, Iran, Myanmar, Pakistan, Nepal, Sri Lanka, and Timor-Leste are 4.84, 2.85, 3.24, 1.47, 3.26, 3.85, 2.55, 1.57 and 4.35 respectively. Timor-Leste reveals the highest mean value and Iran has the lowest mean value of the zero hunger index. The mean values of the climate change index of Afghanistan, Bangladesh, India, Iran, Myanmar, Pakistan, Nepal, Sri Lanka, and Timor-Leste are 4.97, 4.10, 3.24, 4.75, 4.67, 4.29, 4.21, 4.78 and 4.53. Afghanistan shows the highest mean value and India has the lowest mean value of the climate change index. The mean value of income per capita of Pakistan, Afghanistan, Bangladesh, India, Iran, Nepal, Myanmar, Sri Lanka, and Timor-Leste are 499.75, 1043.62, 1303.33, 954.73, 760.59, 1083.35, 633.30, 1194.10 and 910.35 respectively. India has the highest mean value and Afghanistan has the lowest mean value of per capita income. The mean value of the globalization index of Afghanistan, Bangladesh, India, Iran, Myanmar, Pakistan, Nepal, Sri Lanka, and Timor-Leste is 34.08, 46.88, 58.51, 50.61, 37.24, 52.56, 58, 57.90, and 40.76 respectively. India has the highest and Afghanistan has the lowest mean value of the globalization index. The mean values of the labor force participation rate of Afghanistan, Bangladesh, India, Iran, Myanmar, Pakistan, Nepal, Sri Lanka, and Timor-Leste are 46.77, 57.61, 52.84, 66.11, 40.33, 53.61, 50.87, 53.40, 67.87 respectively. Timor-Leste has the highest and Myanmar has the lowest mean value of labor force participation.

Table 2

Descriptive statistics

Variables	Afghanistan	Bangladesh	India	Iran	Myanmar	Pakistan	Nepal	Sri Lanka	Timor-Leste
ZHI									
Mean	4.84	2.85	3.24	1.47	3.26	3.85	2.55	1.57	4.35

Variables	Afghanistan	Bangladesh	India	Iran	Myanmar	Pakistan	Nepal	Sri Lanka	Timor-Leste
SD	1.11	.47	0.63	.169	1.26	.49	.81	.44	.78
Min	3.86	2.131	2.45	1.20	1.89	3.20	1.65	.10	3.48
Max	7.160	3.75	4.16	1.78	5.47	4.72	4.14	2.39	6.13
CCI									
Mean	4.97	4.10	3.24	4.75	4.67	4.29	4.21	4.78	4.53
SD	.78	.565	0.63	.57	.61	.63	.58	.38	.76
Min	3.56	3.385	2.45	4.10	3.85	3.19	3.41	4.15	3.15
Max	6.34	5.38	4.16	6.04	5.85	5.50	5.26	5.51	6.48
IPC									
Mean	499.75	1043.62	1303.33	954.73	760.59	1083.35	633.30	1194.10	910.35
SD	101.64	299.25	384.28	408.41	164.09	891.37	154.33	256.85	256.85
Min	354.03	666.07	777.73	353.95	556.37	1965.82	952.4	881.38	881.38
Max	608.39	1593.35	1944.32	1616.21	1061.49	4495.71	1452.85	1988.98	1988.98
GI									
Mean	34.08	46.88	58.51	50.61	37.24	52.56	58	57.90	40.76
SD	5.02	4.36	4.42	4.13	4.92	2.34	1.56	1.54	6.20
Min	24.11	38.31	48.37	39.37	32.05	47.35	54	54.14	30
Max	38.95	51.053	62.81	54.60	44.71	54.67	60	59.82	47.46
LFP									
Mean	46.77	57.61	52.84	66.11	40.33	53.61	50.87	53.40	67.87
SD	1.24	.77	2.91	3.33	.51	1.06	.57	.166	0.87
Min	41.58	56.09	47.56	60.15	39.67	51.47	50.03	48.45	3.14
Max	47.49	58.59	56.69	71.71	41.22	55.34	52.03	55.34	66.16

Table 3 presents the results of the principle component analysis carried out for the construction of the climate change index and zero hunger index. The table presents the correlation coefficients between variables, CO₂, and temperature, used in the construction of the climate change index and it also presents the correlation coefficients between variables, child

mortality and undernourishment used in the construction of the zero hunger index. Table 3 also shows the eigenvalues of each component of both indexes, the difference between the eigenvalue of each component, the proportion explained in both indexes by their respective components, and the cumulative variation caused in the index by its components.

Table 3

Results of Principle Component Analysis (PCA)

PCA outcome of climate change index				
Correlation Matrix				
Variables	Temperature	CO ₂		
Temperature	1	0.32		
CO ₂	0.32	1		
Component Analysis				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.11	.21	0.55	0.55
Comp2	.89		0.45	1.0000
Principle components Eigenvectors				

PCA outcome of climate change index				
Correlation Matrix				
Variables	Comp1	Unexplained		
Temperature	0.71	0.29		
CO ₂	0.71	0.29		
PCA outcome of Zero Hunger Index				
Correlation Matrix				
Variables	Temperature	CO ₂		
Undernourished People	1	0.45		
Child Mortality rate	0.45	1		
Component Analysis				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.73	1.45	0.86	0.86
Comp2	.27		0.14	1.0000
Principle components Eigenvectors				
Variables	Comp1	Unexplained		
Temperature	0.74	0.26		
CO ₂	0.74	0.26		

Table 4 presents the result of Pesaran's (1999) cross-sectional dependence test. The p-values of all variables are less than 0.01 which demonstrates that there is cross-sectional dependence among the cross-sectional units/countries of this study.

Table 4

Pesaran (1999) CD test

Variables	CD Test	P-value
ZHI	25.85	0.000
CCI	9.42	0.000
IPC	9.42	0.000
GI	21.88	0.000
LFP	10.72	0.000

After examining cross-sectional dependence in the dataset, CIPS, a second-generation unit root test, was carried out to examine the stationary of each variable. Table 5 presents the result of CIPS. The result of CIPS demonstrates that all variables of this study are stationary at levels except income per capita. The income per capita became stationary at first difference. Hence, the result of CIPS shows that there is a mixed order of integration among variables of this study.

Table 5

CIPS Unit test

Level				1 st Difference		
	None	Constant	Constant & Trend	None	Constant	Constant & Trend
ZHI	-1.456	-3.67***	-3.79***	----	----	----

CCI	-3.064***	-2.99***	-4.056***	----	----	----
IPC	-1.443	-1.566	-1.875	-2.65***	-3.27***	-3.36***
GI	-1.663*	-2.430**	-2.358	----	----	----
LFP	-2.55***	-2.84***	-3.283***	----	----	----

Table 6 presents the results obtained from the Hausman test. The p-value of the Hausman test is greater than all three levels of significance i.e., one percent, five percent, and tenth percent which implies PMG/ARDL is the appropriate model. The results of the CIPS test and Hausman test suggest that PMG/ARDL is the appropriate estimation technique. Hence, the PMG/ARDL model was estimated to quantify the influence of climate change on zero hunger. Table 5 contains both short- and long-run coefficients of each independent variable and error correction term. The results demonstrate that long-run coefficients of climate change, income per capita, and globalization are significant at 1% whereas the long-run coefficient of labor force participation is significant at 5%. In the long run, the main regressor of this study, climate change, has a significant and positive causal relationship with zero hunger meaning that an increase in climate change increases hunger.

Climate uncertainties influence agricultural productivity negatively particularly, hamper the production of livestock and crops and cause surge in food insecurity and hunger. The overall research does not contain a study having the effect of climate change on hunger, but the findings of this study are verified indirectly by the findings of those who investigated the effect of climate change on food security. The result further shows that an increase in income per capita has a significant effect on the reduction in hunger. The long-run coefficient of globalization is negative which implies that globalization causes a decrease in hunger. Expansion in agricultural trade brought by globalization facilitated the supply of foods from developed countries to developing countries and hence, made able people in developing countries to import and purchase food items at stable and reasonable prices (Babinard & Pinstруп-Andersen, 2001). It is postulated that per head

income increase is associated with any improvement in the economy through growth and development. Economic growth causes an increase in income of the people and enhances their affordability. Hence, people become more food secure and consequently, they avert hunger. The role of an increase in per capita income in reducing hunger found by this study is corroborated by the findings (Akinbode et al., 2022).

The coefficient of the labor force participation rate is also negative meaning that an increase in the labor force decreases hunger. The effect of labor force participation on hunger found by this study is consistent with the findings of (Huang, et al., 2016) who found a positive association between food insecurity and unemployment. An increase in food insecurity consequently results in hunger.

The short-run coefficient of climate change is significant at 1% but negative which implies that, in the short-run, hunger reduces as climate change occurs. The short-run coefficient of income per capita is significant and negative which implies that an increase in income per capita causes a decrease in hunger. The short-run coefficients of globalization and labor force participation are insignificant. The short-run coefficient of globalization is positive which means that, in the short-run, globalization increases hunger.

Initially, globalization causes an increase in income inequality (Nilsson, 2016). and found that income inequality causes an increase in hunger (Akinbode et al., 2022) hence, globalization is considered the indirect causal factor of hunger in the short run. The short-run positive effect of globalization on hunger found by this study is consistent with the channel found by the study (Akinbode et al., 2022; Nilsson, 2016). The short-run coefficient of the labor force participation rate

is negative which implies that an increase in the labor force decreases hunger. The coefficient of the speed of adjustment/ error correction term is negative but significant at a 1% level of

significance which indicates that the model of this study is dynamically stable, and model will move to an equilibrium state in the long run.

Table 6

Results of PMG-ARDL

Variables	coefficients	Std error	T statistics	P-value
Long-Run Coefficient				
CCI	.1238704	.0358158	3.46	0.001
IPC	-.001095	.0000783	-13.98	0.000
GI	-1.292586	.1998883	-6.47	0.000
LFP	-.0454181	.020171	-2.25	0.024
Short-Run Coefficients				
ECT	-.1670419	.0506652	-3.30	0.001
CCI	.053469	.0185043	2.89	0.004
IPC	-.0003296	.0001413	-2.33	0.020
GI	.1456065	.2891968	0.50	0.615
LFP	-.0183839	.0151249	-1.22	0.224
Hausman Test				
Chi-Square Test value				0.67
P-value				0.88

Conclusion

Climate change presents formidable obstacles to agricultural productivity, directly impacting crop yields and overall food production. These events not only damage crops but also impede essential agricultural activities such as planting, harvesting,

and irrigation. Policies aimed at addressing climate change impacts on agriculture, promoting sustainable practices, improving social safety nets, and fostering equitable economic development are essential for advancing efforts to eradicate hunger in a changing climate.

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