

THE EL NIÑO–SOUTHERN OSCILLATION AND FOOD CONSUMER PRICE INDEX IN LANDLOCKED DEVELOPING COUNTRIES

CRISTINA COSLET

PhD Student, ASEM Doctoral School,
Department of International Economic Relations,
Academy of Economic Studies of Moldova, Chisinau, Republic of Moldova
e-mail: ccoslet@gmail.com
ORCID ID: 0009-0001-1129-5516

Abstract: Landlocked Developing Countries (LLDCs) are highly vulnerable and often are affected by high levels of poverty and food insecurity conditions, due to limited market access, high transportation costs, and reliance on food imports, which increases their exposure to climatic shocks. Domestic food prices play an important role in determining food security conditions in these countries as it directly affects households’ purchasing power and access to food. Understanding how the LLDCs react to different weather shocks is therefore important in order to be able to inform governments and international community about targeted interventions and support preparedness to minimize the impacts on food security and protect vulnerable populations. A key driver of weather extremes is El Niño Southern Oscillation (ENSO) phenomena, which has two phases El Niño and La Niña, each associated with extreme weather events such as floods, droughts, and storms, which are a major driver of agricultural production changes, yet the connections between ENSO and inflationary pressure remained underexplored in LLDCs. This paper addressed this gap, by combining econometric analysis with a wide range of dataset, providing evidence for symmetric and asymmetric impact on domestic food prices, using data on Food Consumer Price Index, with the series for all countries extending until September 2024. ENSO is measured using the Oceanic Niño Index (ONI), with standard thresholds to identify El Niño, La Niña and Neutral months. The panel covers thirty LLDCs over 2000–2024, excluding two LLDC namely Central African Republic and South Sudan due to data unavailability. This analysis reveals that the mean FCPI value increased significantly during La Nina periods and slightly during El Nino periods as compared with the mean FCPI during neutral period. Preliminary results point to a strong and persistent inflationary pressure during La Niña periods, estimated between 0.7 and 1.5 percent, while El Niño periods show a generally weaker and more mixed response. These findings highlight the asymmetric nature of ENSO impacts on food CPI. For LLDCs, where food security conditions are already fragile, the impacts brought by La Niña exacerbate the already existent structural vulnerabilities, increasing food insecurity levels in LLDCs.

Keywords: Food CPI; El Niño–Southern Oscillation (ENSO); Landlocked Developing Countries (LLDCs); climate shocks; domestic prices; panel data.

JEL Classification: Q110, Q020, Q540.

1. INTRODUCTION

Since the period of the so-called Great Inflation, which stretched from mid-1960s to the early 1980s, inflation has been a central concern for governments worldwide, particularly in developing countries. This concern has persisted over the years, and returned to central stage in recent years, after the negative effects of the COVID-19 pandemic and the Russian-Ukraine war caused spikes in inflation in many countries, underlining the importance of careful assessment of the inflation triggers. Price spikes of basic food items are especially critical, as they negatively impact household purchasing power and welfare, as well as can lead to increased poverty, social unrest and economic instability. High and persistent inflation distorts market price signals, creating inefficiencies in resource allocation, and disproportionately affects poor and vulnerably households, leading to increased levels of food insecurity (Amrouk, 2023; Spencer, 1975; Hayek, 1960; Colciago, Samarina, & de Hann, 2019; Easterly & Fisher, 2001; Romer & Romer, 1998; Bulir, 2001). The latest estimates indicate that in 2024 about 295.3 million people, representing 22.6 percent of the analysed population faced high levels of acute food insecurity in 53 countries

Annual International Scientific Conference
“Competitiveness and Innovation in the Knowledge Economy”
September 26-27, 2025
Chisinau, Republic of Moldova

and territories ((FSIN) & (GNAFC), 2025). The primary drivers of food insecurity are conflict, followed by weather extremes and economic shocks, with the latter two contributing to more than half of food insecure people (96.1 and 59.4 million people, respectively). Thus, with weather extremes and economic shocks combined accounting for more than half of estimates food insecure people, it is important to investigate how climatic anomalies can fuel inflation levels and exacerbate food insecurity. A key driver of weather extremes is El Niño Southern Oscillation (ENSO) phenomena, which has two phases El Niño and La Niña, each associated with extreme weather events such as floods, droughts, and storms, which in turn disrupt agricultural production and economic activity as well as lead to increased food price and inflation (Brenner, 2002; Iizumi, 2014; Cashin, 2017). See **Map 2** and **Map 3** in the Annex to identify the areas affected by the El Niño and La Niña. Evidence also suggests that El Niño is associated with social unrest in commodity-dependent countries that rely on imported food to cover their domestic food needs, such as LLDCs (LLDCs) (S.M. Hsiang, 2011). This analysis examines the impact of ENSO’s El Niño and La Niña events on the food component of the CPI (FCPI) for countries from the group LLDCs (*As of September 2025, the UN classifies 32 Landlocked Developing Countries see <https://unctad.org/topic/landlocked-developing-countries/list-of-LLDCs>, the map of LLDCs can be found in the Annex 1.*), which as of September 2025, also include Republic of Moldova (United Nations., 2025). Due to their geographical disadvantage, being landlocked can impede trade, connectivity, development and economic growth, It is likely that LLDCs are more vulnerable to weather shocks, which likely have a more severe effect on them compared to other countries by (Sachs, 2005). Even LLDCs not directly hit by ENSO-driven weather shocks remain exposed through international trade and financial channels. This paper examines the relationship between ENSO phases and domestic food inflation in LLDCs and investigates whether, and to what extent, the phases of the El Niño Southern Oscillation (ENSO), El Niño and La Niña, affect domestic food prices. The analysis uses monthly FAOSTAT Food CPI data for 30 LLDCs over the period from 2000 to 2024, combined with monthly food CPI data from FAOSTAT with ENSO indicators such as the Oceanic Niño Index (ONI) and the Multivariate ENSO Index Version 2 (MEI.v2). The analysis applies fixed-effects panel regressions with clustered standard errors to isolate the causal effects of ENSO on food inflation, while controlling for macroeconomic and climatic variables including exchange rate movements, food import dependency, agricultural GDP share, rainfall anomalies, drought indices, and oil prices. The final section discusses policy implications for early-warning systems, preparedness, and stabilization measures in structurally constrained economies.

2. DATA AND METHOD

As of September 2025, there are 32 countries LLDCs, namely Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Central African Republic, Chad, Eswatini (Swaziland), Ethiopia, Kazakhstan, Kyrgyzstan, Lao People’s Democratic Republic, Lesotho, Malawi, Mali, Republic of Moldova, Mongolia, Nepal, Niger, North Macedonia, Paraguay, Rwanda, South Sudan, Tajikistan, Turkmenistan, Uganda, Uzbekistan, Zambia and Zimbabwe (United Nations., 2025). Not all LLDCs are directly affected by the ENSO-induced extreme weather, see **Map 1** in the Annex, in only 18 countries (*ENSO leads to changes in rainfall patters, and can create drought, excessive rains and floods in: Afghanistan, Armenia, Azerbaijan, Bhutan, Bolivia, Botswana, Eswatini (Swaziland), Kazakhstan, Kyrgyzstan, Lao People’s Democratic Republic, Lesotho, Malawi, Paraguay, Tajikistan, Turkmenistan, Uzbekistan, Zambia and Zimbabwe.*) ENSO leads to changes in rainfall patters. However, we will still include them in the analysis, as they can endure possible indirect effects through trade, internation commodity prices and financial channels transmission. To capture changes in the domestic food prices in LLDCs, this paper uses data on monthly consumer prices, food indices (2015=100) available from FAOSTAT (FAO , 2024), with the series for all countries available until September 2024. Changes in the food consumer price indices are assessed by computing the cumulative changes in food CPIs

Annual International Scientific Conference
“Competitiveness and Innovation in the Knowledge Economy”
September 26-27, 2025
Chisinau, Republic of Moldova

for each of the LLDCs. An aggregate FCPI is also derived for the group by computing a population-weighted average FCPI. Population data is taken from FAOSTAT. The Oceanic Niño Index (ONI) (NOAA, Cold & Warm Episodes by Season, 2025), one of the most widely used metrics for tracking El Niño and La Niña events (Wei, 2024), is used as the primary ENSO indicator, with thresholds of $\pm 0.5^{\circ}\text{C}$ for El Niño and La Niña, respectively. For robustness, the Multivariate ENSO Index, Version 2 (MEI.v2) is also employed (NOAA, 2025). Data for control variables were collected from used are the monthly Global Food Price Index (FAO FFPI, nominal and real terms) from FAO (FAO, 2025), monthly Oil prices from FRED (FRED Graph, 2025), exchange rates from International Financial Statistics (IFS) of the IMF (IMF, 2025). Country structural variables include food import dependence, agricultural GDP share, and gross per capita food production index from FAOSTAT (FAO, 2024). The analysis focuses on the period between January 2001 (when less gaps are available in the datasets) and September 2024 (latest data available for the food CPI in FAOSTAT). Population data are drawn from FAOSTAT and are used to compute population-weighted aggregates for the LLDC group. Conceptual framework is described in Figure 1.

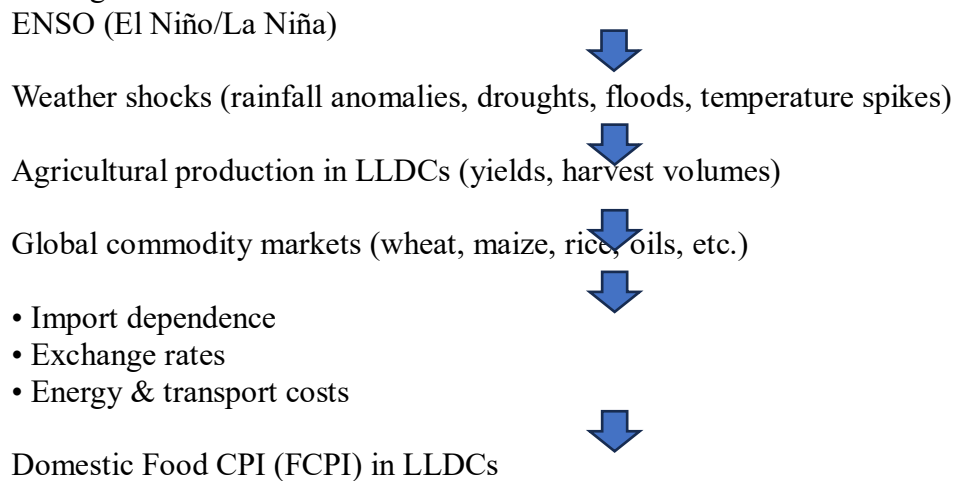


Figure 1. Conceptual framework: pathways from ENSO to food inflation in LLDCs.

Source: Author's own elaboration.

Based on the ONI dataset, 7 El Niño and 9 La Niña events were identified between 2000 and 2023, spanning multiple months or even years, see below. Notably, the most recent La Niña, lasting from 2020 to 2023, was highly unusual for an event that normally lasts from 9 to 12 months.

El Niño Periods:

- June 2002 to March 2003 (10 months).
- August 2004 to March 2005 (8 months).
- October 2006 to February 2007 (5 months).
- August 2009 to April 2010 (9 months).
- October 2014 to May 2016 (20 months).
- October 2018 to June 2019 (9 months).
- June 2023 to May 2024 (11 months).

La Niña Periods:

- January 2000 to March 2001 (15 months).
- December 2005 to April 2006 (5 months).
- August 2007 to May 2008 (10 months).
- December 2008 to April 2009 (5 months).
- July 2010 to June 2011 (12 months).
- September 2011 to April 2012 (8 months).
- September 2016 to April 2017 (8 months).

October 2017 to May 2018 (8 months).

September 2020 to February 2023 (30 months). Based on the ONI dataset, 7 El Niño and 9 La Niña events were identified between 2000 and 2023, spanning multiple months or even years, see below. Notably, the most recent La Niña, lasting from 2020 to 2023, was highly unusual for an event that normally lasts from 9 to 12 months.

El Niño Periods:

June 2002 to March 2003 (10 months).

August 2004 to March 2005 (8 months).

October 2006 to February 2007 (5 months).

August 2009 to April 2010 (9 months).

October 2014 to May 2016 (20 months).

October 2018 to June 2019 (9 months).

June 2023 to May 2024 (11 months).

La Niña Periods:

January 2000 to March 2001 (15 months).

December 2005 to April 2006 (5 months).

August 2007 to May 2008 (10 months).

December 2008 to April 2009 (5 months).

July 2010 to June 2011 (12 months).

September 2011 to April 2012 (8 months).

September 2016 to April 2017 (8 months).

October 2017 to May 2018 (8 months).

September 2020 to February 2023 (30 months).

2.1 DESCRIPTIVE EVIDENCE

To gain an initial insight into how these climate phenomena may influence FCPI, I will start with a simple comparison of the average FCPI value for all ENSO phases: El Niño, La Niña, and Neutral. As shown in **Figure 2**, the average FCPI during Neutral periods is relatively stable. However, during El Niño periods, the FCPI does not increase noticeably, showing that El Niño-induced weather extreme does not necessary result in increased food prices. The most striking result is that during La Niña years, the average FCPI jumps to almost 12 percent, suggesting that in LLDCs La Niña events have a far more severe impact on food prices compared with the other two phases, mostly probably due to disruptions in agricultural output.

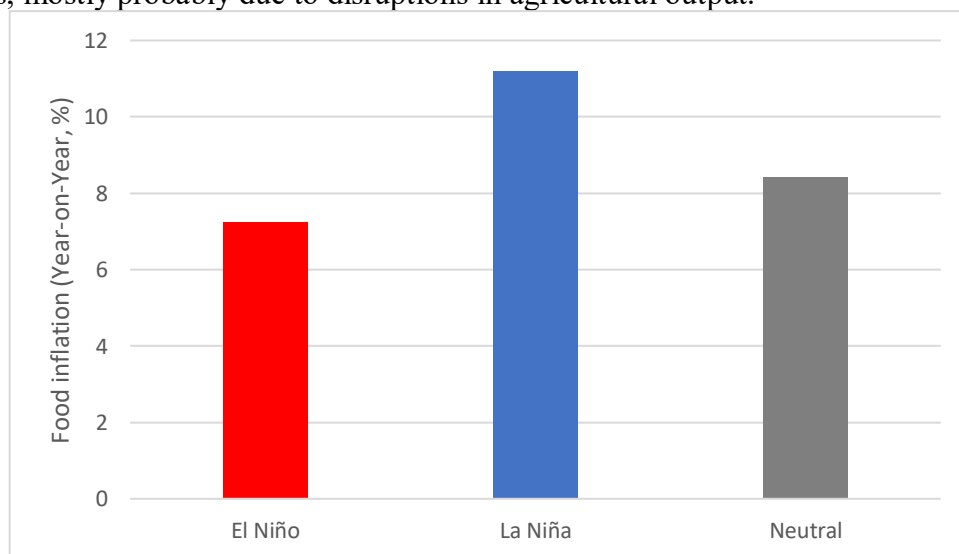


Figure 2. Comparison average FCPI values for El Niño, La Niña and neutral conditions.

Source: Author's own elaboration based on the data (2000-2023) from (FAO, 2025) and (NOAA, 2025)

Figure 3 shows the FCPI weighed by population of respective LLDCs for a period from January 2001 to September 2024 combined with El Niño, La Niña events. Over the last two decades domestic food prices spiked in 2007 and 2008 when a global economic crisis caused spikes in food prices, during 2010 and 2011, and more recently between 2019 and 2023 during the COVID-19 pandemic and the war in Ukraine.

Moving further beyond the descriptive analysis, in order to quantify the impact of ENSO events on FCPI in LLDCs, this paper uses a fixed-effects panel regression with clustered standard errors. As indicated by several studies, and the descriptive analysis in this paper above see **Figure 2**, El Niño and La Niña events have different impacts on inflationary pressures, suggesting that the effects of El Niño and La Niña are not symmetric. Thus, a need to decompose the ONI into two variables arise as follows:

$$EN_t = \max(ONI_t, 0), LN_t = \max(-ONI_t, 0) \quad (1)$$

where EN_t is the intensity of El Niño period (positive ONI) and LN_t is La Niña (negative ONI).

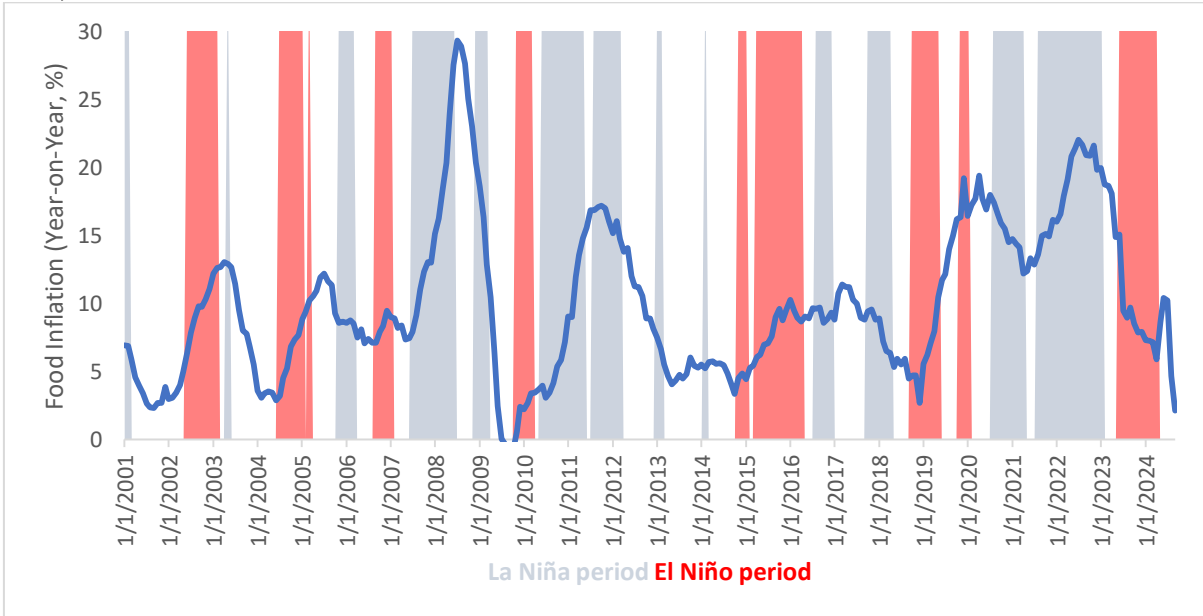


Figure 3. LLDC Population-weighted Food Inflation (Year-on-Year in %) with ENSO phases from 2001 to 2024

Source: FAOSTAT, 2024 and author’s own elaboration.

The asymmetric dynamic specification is as follows:

$$\Delta FCPI_{i,t} = \sum_{k=0}^{12} (\beta_k^{EN} EN_t - k + \beta_k^{LN} LN_t - k) + \Gamma X_{i,t} + \alpha_i + \delta_m + \epsilon_{i,t} \quad (2)$$

where $\Delta FCPI_{i,t}$ is the year-on-year percentage change in the FCPI for country i at time t ; β_k^{EN} and β_k^{LN} is the month-on-month impact of El Niño and La Niña events at lags $k = 0, \dots, 12$; Γ is the vector of coefficients on the control variable, including exchange rate, global food and oil prices, as well as other indicators; α_i denotes country fixed effects; δ_m is the months fixed effects controlling for seasonal food price patterns; and $\epsilon_{i,t}$ is the error, with standard error grouped at the country level to allow for heteroskedasticity. This way we will be able to detect delayed or shifted transmission of the effects of ENSO events on FCPI over 12 month-period. At group level, the national FCPI are aggregated using population weights as follows:

$$FCPI_t^{LLDC} = \frac{\sum_{i=1}^N (Pop_{i,t} \times FCPI_{i,t})}{\sum_{i=1}^N Pop_{i,t}}$$

where $FCPI_t^{LLDC}$ is the aggregate FCPI for month t , $Pop_{i,t}$ is the population of country i , and $FCPI_{i,t}$ is the national food CPI.

3. RESULTS

3.1 BASELINE ASYMMETRIC RESULTS WITH CONTROLS

The asymmetric dynamic specification, see Equation 2, was calculated with controls for exchange rate movements, global food prices and oil prices. The result reveals a strong asymmetry between El Niño and La Niña effect. La Niña events are associated with strong and statistically significant increases in FCPI, while El Niño shows weaker and less consistent effects. The result suggest that food inflation rises immediately during La Niña months and the impact persists across following months. By contrast, El Niño show less consistent effects and are smaller in magnitude. Control variables indicate that FAO Food Price Index and exchange rates add upward pressure on domestic FCPI, while oil prices does not normally have a significant effect.

Table 1. Selected regression results from the baseline asymmetric model with controls

Variable	Estimate	Std. Error	t value	Pr(> t)
l(EN,0)	-2.45	1.02	-2.39	0.023*
l(EN,1)	2.73	1.25	2.19	0.036*
l(LN,0)	4.61	1.9	2.42	0.022*
fpi_yoy	-0.311	0.096	-3.25	0.003**
oil_yoy	-0.013	0.024	-0.57	0.576

Source: Author’s own elaboration, Significance levels: * $p < 0.05$, ** $p < 0.01$.

Additional robust checks were employed to check the validity of above findings. ENSO placebo test for El Niño and La Niña events are generally insignificant, suggesting the results are not caused by anticipation. Similarly, after residualizing FCPI with global and domestic controls, the La Niña effect remains strong and statistically significant, while El Niño effects largely disappear. I also examine the heterogeneity by food import dependence. The cumulative La Niña effect over 0 to 12 months was related with the food import dependency ratio to asses heterogeneity across the LLDCs. Marginal effects were estimated at the 10th, 50th, and 90th percentiles of distribution. Results reveal a clear patters: countries which rely on imports to cover their domestic needs face stronger inflationary pressure during La Niña see Table 2.

Table 2. La Niña marginal effects by food import dependence

Import Dependence	Estimate	95% CI	p-value
Low (p10)	0.37	[0.06, 0.68]	0.021
Median (p50)	0.39	[0.14, 0.63]	0.002
High (p90)	0.42	[0.21, 0.63]	<0.001

Source: Author’s own elaboration.

Overall, the results reveal that La Niña events cause persistent and strong inflationary pressure in LLDCs, especially in countries with high food import dependency, while El Niño events cause weaker and more heterogeneous effects. Dispersion analysis also indicates that variance in food inflation is substantially higher during La Niña periods. In Figure 4 bars represent cumulative effects of El Niño and La Niña phases with 95% confidence intervals. The estimated difference (Delta EN–LN) equals –6.9 percentage points, statistically significant at $p=0.00247$.

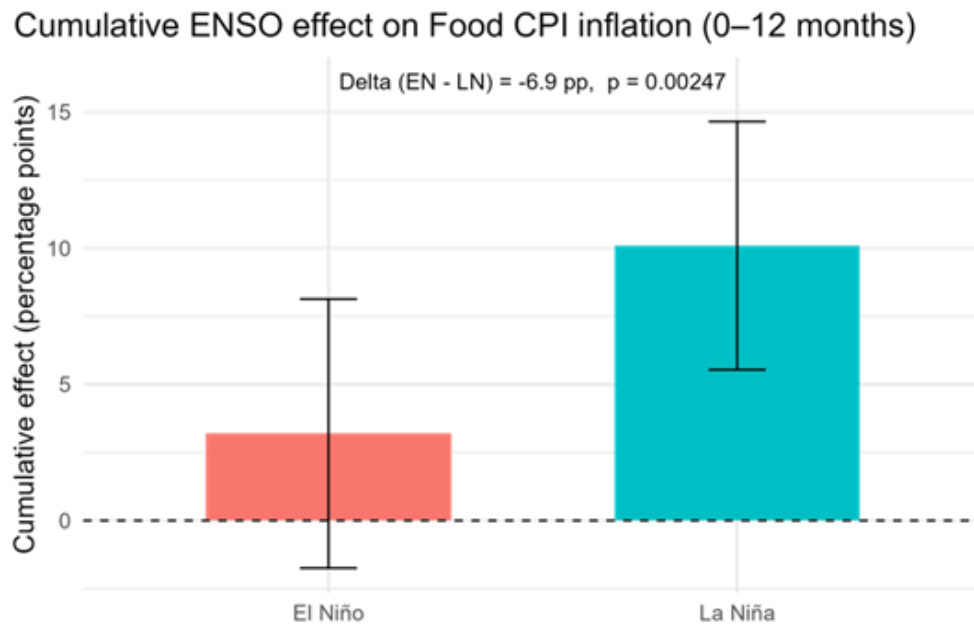


Figure 4. Cumulative effect of El Niño and La Niña shocks for a 0 to 12 month-period on Food CPI inflation in LLDCs.

Source: Author’s own elaboration using R.

4. CONCLUSION

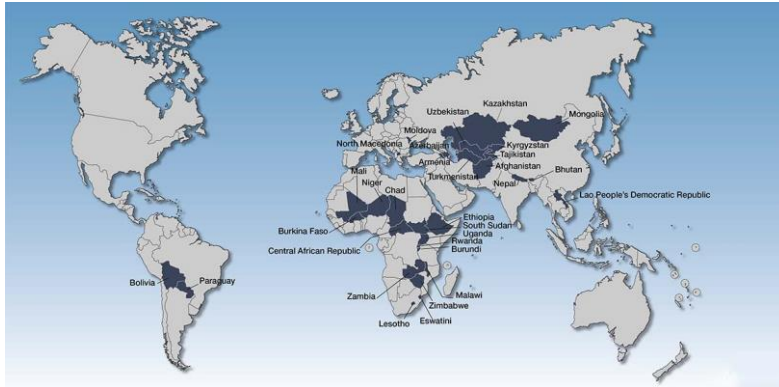
Landlocked Developing Countries (LLDCs) face structural vulnerabilities that increase their exposure to food price shocks from global weather extremes. This study provides robust evidence that the El Niño–Southern Oscillation (ENSO) has asymmetric effects on FCPI in LLDCs. La Niña events are consistently associated with strong and persistent increases in FCPI, while El Niño events cause a weaker and more heterogeneous effect. The results point to a strong and persistent inflationary pressure during La Niña periods, estimated between 0.7 and 1.5 percent, while El Niño periods show a generally weaker and more mixed response. These asymmetries remain robust to placebo tests and residualization checks, underscoring that the La Niña effect does not have a spurious correlation. Heterogeneity analysis also show that LLDCs with higher food import dependency experience significantly bigger inflationary pressure due to La Niña, confirming that structural vulnerabilities on external food supplies exacerbate the vulnerability. These findings highlight the urgent need to integrate ENSO-related risks into food security monitoring and early warning systems and policy frameworks for LLDCs. Strengthening early warning systems, diversifying import sources, improving storage and transport infrastructure, supporting farmers with agricultural inputs and capital, and building resilience to avert the negative impact of global price shocks are essential steps to mitigate the inflationary effects of La Niña events. Future research could extend this analysis by applying local projection methods (Jorda. O., 2005) or dynamic structural models, and by incorporating additional economic and agricultural data such as GDP per capita, remittances, conflicts and cereal imports. These approaches could provide a deeper insight into the transmission mechanisms linking ENSO events and food security outcomes in LLDCs.

References

1. (FSIN), F. S., & (GNAFC), G. N. (2025). *Global Report on Food Crisis 2025*. Rome. doi:<https://doi.org/10.71958/wfp130664>
2. Amrouk, E. (2023). *Food inflation in net food importing developing countries (NFIDCs): characterizing the increase and the effect of currency movements*. Rome: FAO. Retrieved from

Annual International Scientific Conference
“Competitiveness and Innovation in the Knowledge Economy”
September 26-27, 2025
Chisinau, Republic of Moldova

- <https://openknowledge.fao.org/server/api/core/bitstreams/924989b4-5647-4942-bc0f-077b912c88ce/content>
3. Brenner, A. (2002). El Niño and World Primary Commodity Prices: Warm Water or Hot Air? *The Review of Economics and Statistics*, 176-183.
 4. Bulir, A. (2001). *Income inequality: does inflation matter?* IMF.
 5. Cashin, P. M. (2017). Fair weather or foul? The macroeconomic effects of El Niño. *Journal of International Economics*, 37-54.
 6. Colciago, A., Samarina, A., & de Hann, J. (2019). Central bank policies and income and wealth inequality: a survey. *Journal of Economic Surveys*, 33., 1199-1231.
 7. Easterly, W., & Fisher, S. (2001). Inflation and the poor. *Journal of Money, Credit and Banking.*, 160-178.
 8. FAO . (2024). *Consumer price indices*. Retrieved September 25, 2025, from FAOSTAT: <https://www.fao.org/faostat/en/#data/CP>
 9. FAO. (2025). *FAOSTAT*. Retrieved from <https://www.fao.org/faostat/en/#home>
 10. FAO. (2025, 08 25). *World Food Situation*. Retrieved from FAO Food Price Index: <https://www.fao.org/worldfoodsituation/foodpricesindex/en>
 11. *FRED Graph*. (2025, 05 20). Retrieved from <https://fred.stlouisfed.org/graph/?g=ko34>
 12. Hayek, F. (1960). The constitution of liberty. *The University of Chicago Press.* .
 13. Iizumi, T. L.-J. (2014, May 15). Impacts of El Niño Southern Oscillation on the global yields of major crops. *Nature Communications*. Retrieved from Nature Communications: <https://www.nature.com/articles/ncomms4712#citeas>
 14. IMF. (2025). *Exchange Rates (ER)*. Retrieved from International Monetary Fund: <https://data.imf.org/en/datasets/IMF.STA:ER>
 15. Jorda, O. (2005). Estimation and inference of impulse responses by local projections. 161-182.
 16. NOAA. (2025, 09 25). Retrieved from Cold & Warm Episodes by Season: https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php
 17. NOAA. (2025). *Cold & Warm Episodes by Season*. Retrieved from Climate Prediction Centre in National Oceanic and Atmospheric Administration (NOAA): https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php
 18. NOAA. (2025, 08 25). *Multivariate ENSO Index Version 2 (MEI.v2)*. Retrieved from Physical Sciences Laboratory: <https://psl.noaa.gov/enso/mei/>
 19. Romer, C., & Romer, D. (1998). Monetary policy and the well-being of poor. *Working Paper Series*.
 20. S.M. Hsiang, K. M. (2011). Civil conflicts are associated with the global climate. *Nature*, 438-441.
 21. Sachs, J. (2005). *The End of Poverty: Economic Possibilities for Our Time*. New York: Penguin Books.
 22. Spencer, R. (1975). *Inflation, unemployment and Hayek*. St. Louis, USA, Federal Reserve Bank of St. Louis. doi:<https://fraser.stlouisfed.org/title/review-federal-reserve-bank-st-louis-820/may-1975-24383?page=6>
 23. United Nations. (2025). *About landlocked developing countries (LLDCs)*. Retrieved from <https://www.un.org/en/landlocked/about-landlocked-developing-countries>
 24. United Nations. (2025). *About landlocked developing countries (LLDCs)*. Retrieved from <https://www.un.org/en/landlocked/about-landlocked-developing-countries>
 25. Wei, L. (2024). Summary of Commonly Used ENSO Indices. *Highlights in Science, Engineering and Technology*, 88, 687-694. Retrieved from <https://drpress.org/ojs/index.php/HSET/article/view/19062/18625>

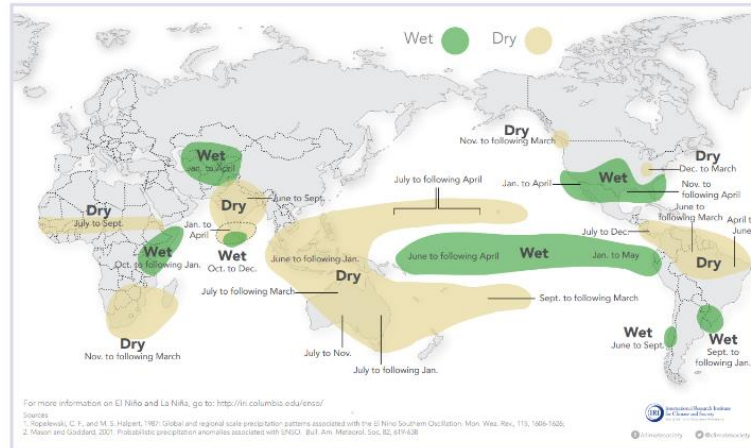


Map 1: Map of Landlocked Developing Countries

Source: <https://unctad.org/fr/node/2976>

El Niño and Rainfall

El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.

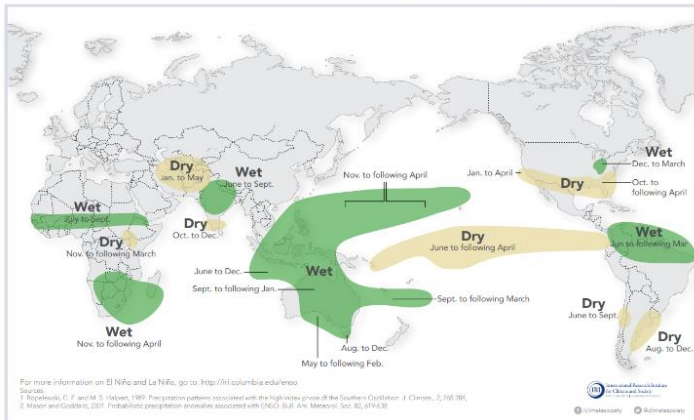


Map 2: Typical precipitation patterns under El Niño and La Niña conditions (teleconnection)

Source: <https://www.weather.gov/fwd/teleconnections>

La Niña and Rainfall

La Niña conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one La Niña to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.



Map 3: Typical precipitation patterns under El Niño and La Niña conditions (teleconnection)

Source: <https://www.weather.gov/fwd/teleconnections>