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Food Security and Economic Growth: Tracing Food Demand and Supply Factors to Mitigate Prevalence of Undernourishment in Asian Countries

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Abstract

The issue of food security has constantly been at the front line of intensive debate among researchers worldwide. Food security is a multilayered notion embracing time and space dimensions. The complexity of the concept of food security makes it difficult to thrash out its drivers. Prevalence of Undernourishment (POU) finds its manifestation in the food security phenomenon. As a linchpin of food security, the present study has focused on POU by using three-fold analyses to find out its trends, frequencies, and determinants. The study has identified the factors responsible for the prevalence of undernourishment in 31 Asian countries, subdivided into five regions i.e. Central Asia, Eastern Asia, Southern Asia, Southeast Asia, and Western Asia over the period of 1990-2017. The study has applied pool regression to estimate POU based on food demand and supply factors. In trend analysis, it is explored that the majority of the countries have followed a quadratic trend. The frequency analysis has revealed the distinct patterns of relationship between GDPPC growth rates and POU exhibiting that the maximum number of observations falls in the negative range of economic growth rate for all the groups of countries with varying ranges of POU. In econometric analysis, using dummies for the different regions of Asia, it is found that food demand and supply factors are highly significant and negatively associated with POU. Moreover, the study enlists some policy implications from the prism of both the food demand and supply sides factors to lessen POU.

Keywords: Food Security, Undernourishment, Economic Growth, Food Demand, Food Supply

1. Introduction

The World is confronting with arduous social, economic, security and governance challenges. History reveals that many countries have dealt with these challenges and transformed them into opportunities through effective planning, development strategies and good governance. To meet these challenges, a collection of 17 global goals, popularly known as Sustainable Development Goals (SDGs) set by the United Nations General Assembly are introduced in 2015 and the focus of these goals is to achieve a better and more sustainable future for all. One of these global goals is to "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture". Attaining food security is of enormous importance for human development and peace in any nation. The rising trends of food insecurity augmented the number of hungry people amounting to 8.9 percent of the world population comprising 690 million people which exhibits that every one out of ten persons is vulnerable to food insecurity (FAO, 2020).

The prevalence of undernourishment (POU) has become a mounting threat to food insecurity globally. Asia has become the nerve centre of undernourished people as more than 50 percent of the world's undernourished population i.e.381 million people live in Asian countries. According to FAO (2020), Africa (19.1 percent of POU) stands out with the highest rate of POU among Asia (8.3 percent), Latin America and the Caribbean regions (7.4 percent). Within Asia, the region of Southern Asia is the hotbed of POU with 13.4 percent whereas Western Asia and South-eastern Asia follow suit with 11.2 percent and 9.8 percent, respectively. Two sub-regions of Asia namely Central Asia and Eastern Asia are depicting the ranges of POU of 2.7 percent and less than 2.5 percent, respectively. The projected values of POU in 2030 suggest that the whole of Asia would be showing some progress from 8.3 percent to 6.6 percent and ranked off track. South-eastern Asia and Southern Asia would also follow the same trend. Central Asia and Eastern Asia are projected as on track while Western Asia is classified as off track with no progress or worsening.

Economic growth being the component of economic development provides the base for human development which works through both the demand and supply side factors as it enlarges the consumers' choices of consumption through increased income level and enhances the level of human capital. Economic growth via income level enables households to improve their standard of livings by investing in human capital i.e. health and education. Similarly, it enhances the production of commodity-producing sectors which ensures availability, accessibility, and utilization of food. So, economic growth is an important factor related to human growth and welfare as it affects the food demand and supply factors to mitigate the prevalence of undernourishment.

The trickle-down hypothesis of economic growth was put into doubt by the proponents of human development which states that increasing the size of the cake does not matter but how the cake is distributed is an important factor for economic development. Hence the problem of food security cannot be fully addressed without taking into consideration how the benefits of growth are distributed among the masses (Dollar and Kraay, 2000; Smith and Haddad, 2002; Alderman et al., 2003; Richard and Adams, 2004; Donaldson, 2008). So, the issue of the

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prevalence of undernourishment should be dealt with a holistic approach encompassing both policies of demand and supply side factors related to macroeconomics, agriculture, technology, trade, pricing and marketing, infrastructure, poverty alleviation and social sector, population, education and health. However, the scope of this paper is limited to tracing the food demand and supply side factors related to the prevalence of undernourishment (POU) and growth.

The present study is an attempt to explore the relationship between the prevalence of undernourishment and economic growth with a particular focus on Asian countries which are the hub of the prevalence of undernourishment in the World. This study would be a valuable addition to the literature on food security as it is the sole contribution of this study that it made a trend analysis, frequency analysis and econometric analysis of economic growth and prevalence of undernourishment. Further, the study disaggregates the Asian region into different sub-regions to trace out the gravity of the issue of food security region-wise. Another significant contribution of the present study is that it encompasses both the food demand and supply factors in investigating the prevalence of undernourishment in Asian countries.

The paper is structured as: Section 2 explains the associated empirical work. Section 3 is about the conceptual framework and research methodology. Section 4 gives the trend analysis prevalence of undernourishment in Asia. Section 5 provides the frequency analysis of the prevalence of undernourishment and economic growth. Section 6 comprises an econometric analysis related to food demand-supply factors and the prevalence of undernourishment while section 7 concludes the study along with policy implications.

2. Associated Empirical Work at a Glance

The available empirical literature has been classified into two types of studies i.e. effect of economic growth on human development and the effect of economic growth on undernutrition.

2.1. Effect of Economic Growth on Human Development

Reyes and Useche (2019) analyzed the association among economic growth, competitiveness and human development in Caribbean countries and Latin American countries for the period 2006 to 2015. The study found no statistically significant relationship between human development and economic growth. There has been a growing motivation among economists to think beyond the GDP and focus on human development, especially education and health. In this regard, Chikalipah and Makina (2019) investigated the two-way association between human development and economic growth in Zambia for the period 1970-2015 by applying vector error correction and cointegration model techniques. Findings demonstrated that human development and economic growth were cointegrated. Further, in the short run, no evidence of the two-way causal influence was observed between human development and economic growth. Khan et al (2018) elaborated on the influence of economic growth on the human development index and terrorism in Pakistan over the period from 1990 to 2016. The authors concluded that economic growth had no contribution towards human development in Pakistan. He and Li (2019) analyzed short run and the long-run relationship between economic growth and life expectancy for 65 countries over the period 1980-2014 by using panel cointegration tests. The findings showed a positive and significant long-run association between GDP and life expectancy in most countries, but the specific association differ across age levels. Moreover, population ageing is influencing the relationship between economic growth and life expectancy. Similarly, He and Li (2018) investigated that there was insignificant relation between economic growth and life expectancy below the level of threshold when inflation had excluded by using data from 85 countries for the period 1981-2014. Mustafa et al (2017) posited the three-way association among human development, trade and economic growth in a large panel of twelve Asian countries over the period 1970 to 2011 by using a system of theoretical equations. Authors concluded that human development affected positively economic growth Moreover, the policies of trade liberalization also had a role in achieving human development as well as higher economic growth. Holyachi and Kengnal (2017) investigated a causal relationship among economic growth, private health expenditures and infant mortality rate in India for the period 1995-2013 by using the Granger causality framework. The results explored that the GDP, Infant Mortality rate and private health expenditures were co-integrated. Further, there was no short-run influence between all these variables. Hami (2016) elucidated the impact of economic growth on life expectancy by taking Iran as a case study over the period from 1966 to 2013. The study used the Vector Error Correction Model and the results revealed that economic growth had a significant and positive impact on life expectancy in Iran. Sarkodie and Owusu (2016) examined the causal nexus among child mortality, GDP, fertility rate and food production index by taking Ghana as a case study during the period 1971-2013. The findings revealed that GDP and household consumption had decreased the mortality rate of the child in Ghana. Mehmood et al. (2014) highlighted the relationship between literacy, economic growth and health expenditures in a sample of 26 Asian countries over the period 1990-2012 by using the Pool Mean Group (PMG) technique. The findings showed the presence of long-run association among literacy rate, economic growth and health expenditures. Furthermore, improved health raised higher productivity and life expectancy. Desai (2012) explored how economic growth, literacy rate and population growth had a link with each other by taking India as a case study and concluded that for the economic situation literacy rate is one of

the main indicators in a country that also enhances the human capital of that country. Boozer et al (2003) examined a two-way association between human development and economic growth and explored that human development played a crucial role in elaborating the growth trajectories. Shome and Tondon (2010) pointed out the link between human development and economic growth in five ASEAN countries by developing life expectancy and education indexes. The results showed that growth and development did not move in tandem in ASEAN countries. Leung and Wang (2010) examined the relationship among life expectancy, economic growth and health care in the neoclassical growth framework and found that longevity and health care were welfare promoting and growth. Nishiyama (2009) worked out the influence of economic growth on the infant mortality rate by taking data from 83 developing countries over 40 years. The findings suggested that positive economic growth might have a mixed and weak influence on infant mortality, but negative economic growth has an adverse and strong influence. Further, statistical evidence showed the conflicting results of the impact of economic growth on poverty alleviation in the literature. Ranis and Stewart (2000) investigated the linkage between human development and economic growth from two chains by taking a sample of 35 to 76 developing countries according to specific variables available for the period 1960 to 1972 through cross-country regression. The findings explored a significant relation in both directions, through public expenditures on education & health and the income distribution and rate of investment in human development to the economic growth chain. Brady et al. (2007) reassessed the influence of economic growth on well-being by considering less developed countries over the period 1980 to 2003. Findings revealed that GDP had a positive and significant influence on male and female life expectancy and caloric consumption.

2.2. Effect of Economic Growth on Undernutrition

Ravallion (1990) theorized about the effect of income on undernutrition. The author revealed that the frequency of adequate nutrition or the under-nutrition depth was unlikely to be influenced by the income gains or losses incurred by the houses that were nutritionally deprived. In the developing world, malnutrition is a broad issue. Wolfe and Behrman (1983) examined that is income overestimated to determine adequate nutrition. The authors used the data of 1167 women aged 15 to 45 in Managua by using ordinary least squares (OLS) estimation. Results show that income is not an important factor in nutrition in all developing nations. Moreover, with respect to the household size the economies of scale are important to determine the nutrition of the household. Smith and Haddad (2002) analyzed how potent economic growth decreases undernutrition by using pooled ordinary least squares (OLS), random effects (RE), and fixed-effects (FE) regressions. The authors used data from 63 developing countries over the period from 1970 to 1996. Findings revealed that economic growth decreases undernutrition by facilitating public and private investment in 4 key factors that are associated with the status of nutrition: education of women, the status of women, quality of the healthy environment and food availability. Haddad et al (2003) worked on that how rapidly the malnutrition of children responds to the growth of income. To find out the answer to this question, the authors used two types of data, one from a sample of households from 12 countries and the second from cross-country data of 61 countries over the period 1970 to 1995. From both analyses, the authors revealed the same results a rise in income at the national and household level implies the same rates of reduction in malnutrition.

Leenes et al (2010) estimated the relationship among income, food supply and consumption by taking GDP per capita as the income indicator. This study compared the pattern of food consumption in 57 countries in 2001. Authors pointed out that wherever and whenever economic growth occurs, consumption of food explores the identical change in direction.

Macroeconomic growth has been considered a main policy instrument in developing countries to improve nutrition and health (Ali and Rehman, 2015; Khalil and Ali, 2016; Sajid and Ali, 2018; Senturk and Ali, 2021). Hence, Subramanyam et al (2011) assessed the relationship between the changes in the state of per capita income as well as the risk of undernutrition among children. For this analysis, data had been collected from the National Family Health Survey (NFHS) conducted from 1992 to 1993, 1998 to 1999 and 2005 to 2006 by taking the case study of India. Findings showed that there existed an inverse relationship between the risk of undernutrition among children and economic growth.

3. Conceptual Framework and Research Methodology

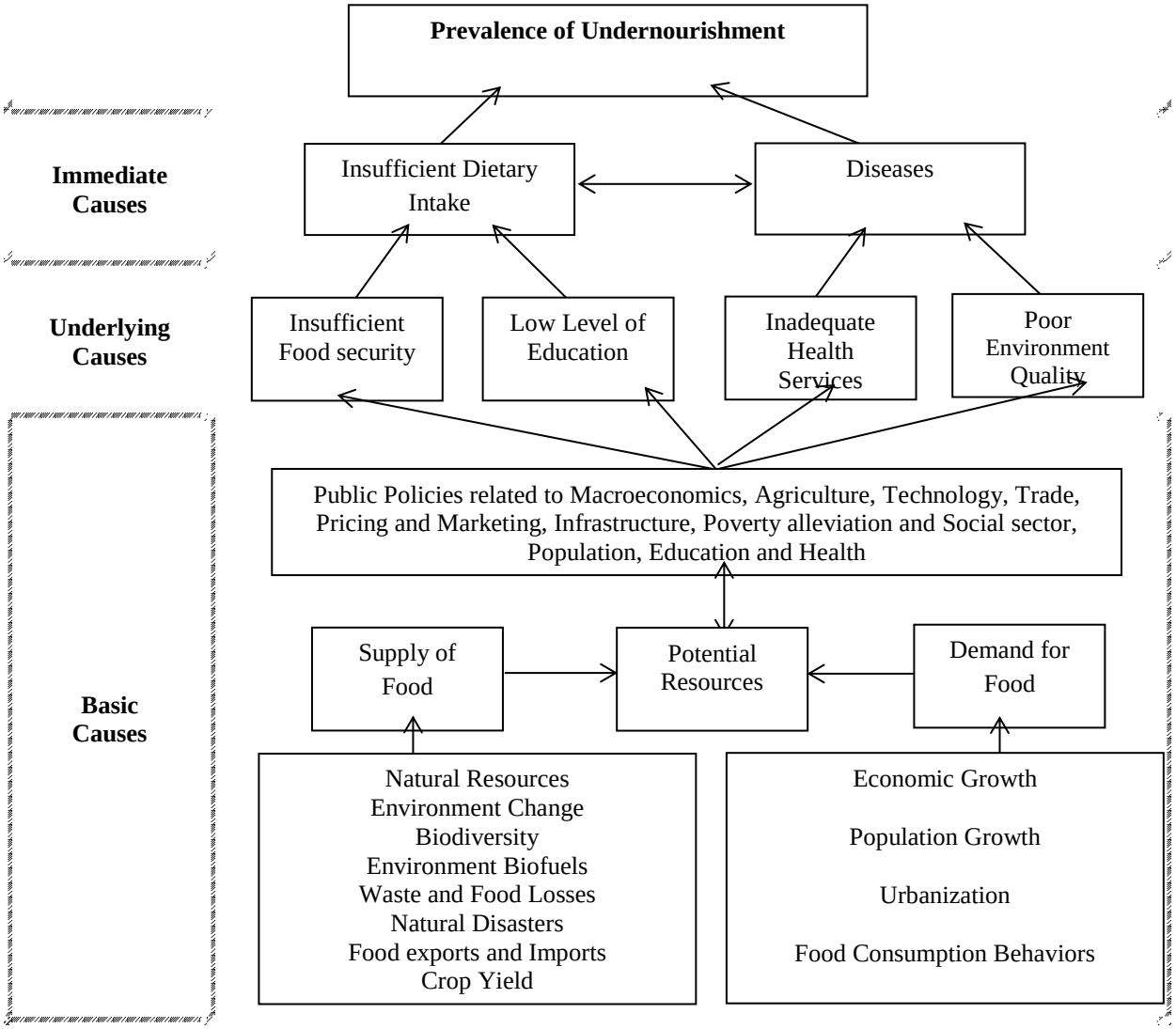
This section has been structured to give a detailed overview of the conceptual framework and research methodology undertaken for the analysis of one of the aspects of food security which is the prevalence of undernourishment.

3.1. Conceptual Framework

The issue of food security is an offshoot of multiple factors working at global, national and individual levels. The threats to food securities emanate from both the demand and supply side factors (Pieterset al. 2013). The conceptual framework depicted in Figure 1 elaborates the schematic relations of all the causes of the prevalence of undernourishment. These causes are broadly classified into three layers i.e. basic, underlying, and immediate causes. The basic causes operate at national and global levels that are related to public policies focusing efficient utilization of potential resources being affected by the demand and supply factors of food. The underlying

causes function at both global and individual levels which are related to insufficient food security, low level of education, inadequate health services and poor environmental quality. The immediate causes that prevail at the household or individual level can be traced back to insufficient dietary intake and diseases (Engle et al., 1999; Smith and Haddad, 2000; Reinhard, 2002: Pieterset al. 2013; Ali, 2018).

Figure 1: A Schematic Analysis of the Prevalence of Undernourishment



Source: Own elaboration based on UNICEF (1990), Bokelon *et al.* (2005) and Pieters *et al.* (2013)

3.2. Research Methodology

The study is based on three-fold analyses of the prevalence of undernourishment in 31 Asian countries subdivided into five regions Central Asia, Eastern Asia, Southern Asia, Southeast Asia and Western Asia. The reason for selecting this part of the World is that these countries are highly vulnerable with respect to food security (FAO, 2019). Firstly, trend analysis has been conducted to determine linear and quadratic trends in the countries. Secondly, frequency analysis has been applied to determine the relationship between economic growth and the prevalence of undernourishment using the annual average compound growth rate against different ranges of undernourishment. Finally, we have conducted a panel data analysis by using the econometric tool of pool regression to estimate food demand and supply side factors of POU.

Two models are separately estimated for tracing out the threats to food security. None of the earlier studies has made such an analysis and it is exclusively the contribution of this study in the literature on food security.

On the demand side, the following model has been estimated to capture the impact of demand for food factors on POU:

$$Y_{it} = \delta + \sum_{v=1}^{3} \delta_v X_{vit} + \sum_{n=0}^{5} \lambda_n D_{ni} + \varepsilon_{it}$$

where y_{it} is POU in country *i* and year *t*, δ is v x1 vector of parameters, X_{it} are the v explanatory variables: GDPPC, Percentage of Population with access to improved drinking water sources and Urban Population growth (annual %), λ_n are the n x 1 vector of parameters and D_{ni} are regional dummies and ε_{it} is the white noise error term.

On the supply side, the following model has been estimated to capture the impact of supply of food factors on POU:

$$Y_{it} = \beta + \sum_{v=1}^{4} \theta_v X_{vit} + \sum_{v=0}^{5} \gamma_n D_{ni} + \varepsilon_{it}$$

where y_{it} is POU in country *i* and year *t*, δ is v x1 vector of parameters, X_{it} are the v explanatory variables: Food exports (% of merchandise exports, Food imports (% of merchandise imports), Agricultural land (% of land area), Cereal yield (kg per hectare) and CO2 emissions (metric tons per capita) γ_n are the n x 1 vector of parameters and D_{ni} are regional dummies and ε_{it} is the white noise error term.

4. Prevalence of Undernourishment (POU): A Trend Analysis

The issue of food security has now become a burning issue worldwide. It is a very wide and complex concept having multiple dimensions such as availably, stability, utility and affordability (Naiken, 2002; Dijk and Meijerink, 2014). All of these dimensions have different indicators for analysis. The focus of the present paper is on POU which is associated with the access aspect of food security. It is generally measured by the percentage of the population persistently falling short of food intake to meet their dietary energy requirements. The measurement of POU depends on the comparison of daily dietary intake with the minimum threshold level of dietary energy requirements keeping in view the age, sex, location and norms (FAO, 2019).

According to the latest FAO report on food security and nutrition (2019), both the access indicators of food security i.e. the prevalence of undernourishment and the number of undernourished people have fallen steadily from 14.5 to 10.6 percent and 947.2 to 785.4 million respectively during 2005-2015 afterwards assumes the rising trend from 10.6 to10.8 percent and 785.4 to 821.6 million respectively during 2015-2018 at globally. The report exhibits that out of the total World population of 7632.8 million, the total number of undernourished people is 821.6 million in 2018. Among the undernourished people, 513.9 million live in Asia, a 256.1million in Africa, 42.5 million in Latin America and the Caribbean,2.6 million in Oceania, Northern America and Europe and 6.5 million in others. It is observed from the findings of the report that 62.6 percent of total undernourished people belong to Asia which is the highest in the World. The Asia continent is divided into five sub-regions namely, Central Asia, Southern Asia, Eastern Asia, Western Asia and South-Eastern Asia. In the last decade, the overall trend of POU in Asia is gradually declining and the same trend has been observed in all the sub-regions of Asia except for Western Asia where POU has increased from 9 percent in 2009 to 12.4 percent in 2018. The worst scenario of POU among these sub-regions of Asia is seen in South Asia where POU stands with the highest value of 14.7 percent as compared to the lowest level of POU in Central Asia having a value of 5.7 percent in 2018. To examine whether the trend of POU in Asia is rising, constant or declining, we have taken a sample of 31 Asian countries from 1990 to 2017. Table 1 shows the sample of five sub-regions of Asian countries, Central Asia (8 countries), Eastern Asia (3 countries), Southern Asia (8 countries), Southeast Asia (8 countries), and Western Asia (4 countries). To select the sample of Asian countries, two benchmarks have been fixed i) the study has excluded those countries whose POU level was lower than 5 percent and ii) those countries are not selected whose POU has remained persistent over the period of study.

Table 1: Sample of Asian Countries

Central Asia	Eastern Asia	Southern Asia	South-Eastern Asia	Western Asia
Armenia	China	Afghanistan	Cambodia	Iraq
Azerbaijan	Korea	Bangladesh	Indonesia	Jordan
Georgia	Mongolia	India	Lao	Oman
Kazakhstan		Iran	Myanmar	Yemen
Kyrgyzstan		Maldives	Philippines	
Tajikistan		Nepal	Thailand	
Turkmenistan		Pakistan	Timor-Leste	
Uzbekistan		Sri Lanka	Viet Nam	

For each country, the linear regressions are estimated to find out the linear trend by taking POU as regressand and time period (T) as regressors.

$$POU_t = \beta_0 + \beta_1 T + \varepsilon_t \quad (1)$$

Where equation (1) shows a linear trend with β_0, $\beta_1$andε_t is the intercept, trend coefficient and error term respectively.

The second-order polynomial regressions for measuring quadratic trends are estimated for each country by taking POU as regressand and time period (T) and its square (T^2) as regressors.

$$POU_t = \beta_0 + \beta_1 T + \beta_2 T^2 + \varepsilon_t \quad (2)$$

In second-order polynomial regression, β_1 alone does not measure the change in POU with respect to T because it is not reasonable to hold T^2 fixed while T is changing. By writing the estimated equation as:

$$\widehat{POU}_t = \hat{\beta}_0 + \hat{\beta}_1 T + \hat{\beta}_2 T^2 \quad (3)$$

We get the approximation

$$\frac{\Delta \widehat{POU}}{\Delta T} \approx \hat{\beta}_1 + 2\hat{\beta}_2 T \quad (4)$$

It shows that the slope of the link between T and POU depends on the value of T and the estimated slope is:

$$\hat{\beta}_1 + 2\hat{\beta}_2 T$$

It is clear from equation (3) that with $\hat{\beta}_1 > 0$ and $\hat{\beta}_2 < 0$, the function has a turning point showing maxima and it is obtained by dividing the coefficient on T by twice the absolute value of the coefficient on T^2.

$$\dot{T} = \left| \hat{\beta}_1 / 2\hat{\beta}_2 \right|$$

The coefficients' of the slope of the quadratic trend ($\beta_1 + 2\beta_2 T$) i.e. β_1 and β_2 jointly tell about the direction and speed of the trend. The parameter β_1 tells about the direction and $\beta 2$ determines its speed. Hence the slope of second order polynomial determines four different patterns of trends for the POU as follows:

i. When $\beta 1 > 0$ and $\beta 2 < 0$, there is an increase in undernourishment at a decreasing rate i.e. function reaching to maximum or slope of the trend decreasing over time
ii. When $\beta_1 < 0$ and $\beta 2 < 0$, there is a reduction of undernourishment at an increasing rate i.e. function is turning down from the maximum point
iii. When $\beta_1 < 0$ and $\beta 2 > 0$, there is a reduction of Undernourishment at a decreasing rate i.e. the function is reaching a minimum.
iv. When $\beta_1 > 0$ and $\beta 2 > 0$, there is an increase in undernourishment at an increasing rate i.e. the function is turning up from the minimum point or the slope of the trend is increasing with time.

Table 2 analyzes the pattern of trends of POU in the Asian continent. To classify the countries with respect to the nature of the trend, the following rules should be followed.

i) The countries with linear trends must have a higher adjusted R^2 with a significant coefficient value than the adjusted R^2 of the quadratic trend with a significant coefficient value. It means that there will be a reduction of undernourishment if adjusted R^2 of linear regression > adjusted R^2 of polynomial regression.
ii) A quadratic trend of undernourishment exists if the adjusted R^2 of the polynomial regression with a significant coefficient value ≥ the adjusted R^2 of linear regression with a significant coefficient value. It means that the countries with a quadratic trend show an increase in undernourishment.

Table 2 depicts that the adjusted R^2 of polynomial regressions in 21 out of 31 countries is greater than the adjusted R^2 of linear models. It shows 9 countries follow a linear trend i.e. Azerbaijan, Turkmenistan, India, Nepal, Pakistan, Cambodia, Lao, Myanmar and Timor-Leste[4] and the rest of the other countries follow the quadratic trend. It is worth mentioning that the adjusted R^2 of the polynomial regression in the case of Pakistan and Timor Leste is greater than the linear regression's coefficient, but the linear coefficient is significant and the polynomial regression coefficients are not significant that's why Pakistan has a linear trend in the prevalence of undernourishment. It is the rule of thumb that the significance of the coefficient is more important than that of the value of the adjusted R^2 in determining the trend of the prevalence of undernourishment for example if the value of the coefficient is significant with a low R^2 then the trend would be determined accordingly.

The sample of the selected countries with POU is divided into four groups with respect to the β_1 and $\beta_2$coefficients of quadratic polynomial regressions. These four groups of countries are shown in Table 3. The group-I shows the countries where undernourishment deterioration at a decreasing rate meaning that there is an increase in undernourishment at a decreasing rate while in group-IV undernourishment deterioration is at an increasing rate meaning that there is an increase in undernourishment at an increasing rate. The group of countries showing improvement in undernourishment at an increasing rate falls in group II meaning that there is a reduction of undernourishment at an increasing rate and in group-III undernourishment improvement at a decreasing rate meaning that there is a reduction of undernourishment at a decreasing rate.

[4]Moreover, India, Cambodia, Lao and Myanmar have same R^2 but with insignificant β_2 lead these countries to fall in linear trend. Moreover, there is one exceptional case of a country Yemen which neither fulfills the criterion of linear not the quadratic trend.

It is obvious from Table 3 all 21 countries with quadratic trends lie in the first three groups and no country has appeared in group-IV. In group-I, there are 10 countries where undernourishment deterioration is at a decreasing rate i.e. Kazakhstan, Tajikistan, Uzbekistan(Central Asia), Korea (Eastern Asia), Afghanistan, Iran, Maldives, Sri Lanka (Southern Asia), Indonesia(South-Eastern Asia), Iraq (Western Asia). In group II, there are only 2 countries with improvement in undernourishment at an increasing rate i.e. Kyrgyzstan (Central Asia) and Mongolia (Eastern Asia). Whereas in group III, 9 countries appear with undernourishment improvement at a decreasing rate which are Armenia, Georgia (Central Asia), China (Eastern Asia), Bangladesh (Southern Asia), Philippines, Thailand, Viet Nam (South-Eastern Asia), Jordan and Oman (Western Asia).

Table 2: Trends of Prevalence of Undernourishment in Asian Countries

Country	Obs.	Direction of Linear Trend Coefficient (β_1)	Adjusted R^2	Direction of Linear Trend Coefficient (β_1)	Direction of Quadratic Trend Coefficient (β_2)	Adjusted R^2	Type of Trend
Central Asia							
Armenia	27	(-)***	0.85	(-)***	(+)*	0.87	Quadratic
Azerbaijan	27	(-)***	0.80	(-)***	(+)	0.82	Linear
Georgia	27	(-)***	0.53	(-)***	(+)***	0.84	Quadratic
Kazakhstan	27	(-)***	0.26	(+)***	(-)***	0.57	Quadratic
Kyrgyzstan	27	(-)***	0.88	(-)	(-)***	0.91	Quadratic
Tajikistan	27	(+)	0.03	(+)***	(-)***	0.89	Quadratic
Turkmenistan	27	(-)***	0.70	(-)***	(+)	0.72	Linear
Uzbekistan	27	(+)	0.03	(+)***	(-)***	0.52	Quadratic
Eastern Asia							
China	27	(-)***	0.94	(-)***	(+)**	0.95	Quadratic
Korea	27	(+)***	0.76	(+)***	(-)***	0.83	Quadratic
Mongolia	27	(-)***	0.77	(-)	(-)**	0.81	Quadratic
Southern Asia							
Afghanistan	27	(-)***	0.50	(+)	(-)*	0.56	Quadratic
Bangladesh	27	(-)***	0.76	(-)***	(+)***	0.86	Quadratic
India	27	(-)***	0.72	(-)***	(+)	0.72	Linear
Iran	27	(+)**	0.17	(+)***	(-)***	0.46	Quadratic
Maldives	27	(-)*	0.11	(+)*	(-)**	0.27	Quadratic
Nepal	27	(-)***	0.90	(-)***	(-)	0.91	Linear
Pakistan	27	(-)***	0.29	(+)	(-)	0.33	Linear
Sri Lanka	27	(-)***	0.69	(+)***	(-)***	0.90	Quadratic
South-Eastern Asia							
Cambodia	27	(-)***	0.81	(-)**	(-)	0.81	Linear
Indonesia	27	(-)***	0.57	(+)**	(-)***	0.77	Quadratic
Lao	27	(-)***	0.96	(-)***	(-)	0.96	Linear
Myanmar	27	(-)***	0.98	(-)***	(-)	0.98	Linear
Philippines	27	(-)***	0.91	(-)***	(+)***	0.96	Quadratic
Thailand	27	(-)***	0.88	(-)***	(+)***	0.98	Quadratic
Timor-Leste	27	(-)***	0.74	(-)	(-)	0.76	Linear
Viet Nam	27	(-)***	0.94	(-)***	(+)***	0.99	Quadratic
Western Asia							
Iraq	27	(+)***	0.45	(+)***	(-)***	0.69	Quadratic
Jordan	27	(+)***	0.35	(-)	(+)*	0.42	Quadratic
Oman	27	(-)***	0.91	(-)***	(+)**	0.92	Quadratic
Yemen	27	(-)	0.01	(-)	(+)	0.30	

Source: Authors' elaboration, Note: *, ** &*** show the significance level at 10%, 5% and 1% respectively.

Table 3: Countries with Quadratic Trend of Prevalence of Undernourishment (1990-2017)

I
Undernourishment deterioration
at a decreasing rate
(Increase in Undernourishment)
$\beta_1 > 0$
$\beta_2 < 0$

Central Asia	Eastern Asia	Southern Asia	South-Eastern Asia	Western Asia
Kazakhstan Tajikistan Uzbekistan	Korea	Afghanistan Iran Maldives Sri Lanka	Indonesia	Iraq

(10 Countries)

II
Undernourishment improvement
at an increasing rate
(Reduction of Undernourishment)
$\beta_1 < 0$
$\beta_2 < 0$

Central Asia	Eastern Asia
Kyrgyzstan	Mongolia

(02 Countries)

III
Undernourishment Improvement
at a decreasing rate
(Reduction of Undernourishment)
$\beta_1 < 0$
$\beta_2 > 0$

Central Asia	Eastern Asia	Southern Asia	South Eastern Asia	Western Asia
Armenia Georgia	China	Bangladesh	Philippines Thailand Viet Nam	Jordan Oman

(09 Countries)

IV
Undernourishment deterioration
at an increasing rate
(Increase in Undernourishment)
$\beta_1 > 0$
$\beta_2 > 0$

(No Country has been found to experience this trend)

5. Prevalence of Undernourishment and Economic Growth: A Frequency Analysis

Here Table 4 shows the frequency analysis of two variables namely GDPPC growth rate and Prevalence of undernourishment which has been conducted for the classified group of countries. We have calculated the annual compound growth rates of both variables over five periods: 1990-1995, 1995-2000, 2000-2005, 2005-2010 and 2010-2017. There are total of 154 observations in all. We have defined three ranges i.e. Rate < 0%, 0-5% and 5.01-10% for GDPPC. We have sorted the countries by fixing GDPPC at specified ranges with respect to POU ranges i.e. Rate > 0%, -5% - 0% and -10% - 5.01%.

For the linear group, there is a total of 45 observations with nine countries having the maximum and minimum values of the POU 0.06 (Azerbaijan) and -0.34 (Azerbaijan) respectively. In the same fashion, the maximum and minimum values of the GDPPC growth rate are 0.044 (Azerbaijan) and -2.33 (Pakistan) respectively. There are 13 observations with respect to GDPPC and 3 observations with respect to POU which fall outside the prescribed ranges. After sorting out the outliers, the linear trend group is left with 31 observations out of 45 observations.

Analyzing the linear trend group with respect to the compound annual growth rate of GDP per capita, there are 6 out of 31 observations under the range of 5.01% to 10% which shows highest growth rates are mainly achieved by Southern Asia and Southeast Asian countries (Nepal, Timor-Leste, Pakistan, Cambodia and Lao). In the range of 0% to 5%, 5 out of 31 observations are witnessed for Southern Asia and Southeast Asian countries (India, Myanmar, Cambodia and Lao). However, 20 out of 31 observations fall in the range of less than zero experienced by Central Asia, Southern Asia and Southeast Asian countries (Azerbaijan, Turkmenistan, Nepal, Pakistan, India, Cambodia, Loa, Timor-Leste and Myanmar). Comparing growth rates with undernourishment reductions, it is observed that the linear trend group with 15 out of 31 observations stands out the highest in the range of 0% to -5% practised by Central Asia, Southern Asia and Southeast Asian countries (Turkmenistan, Nepal, Pakistan, India, Cambodia, Loa, Timor-Leste and Myanmar). Further, there are 8 out of 31 observations

in the range of -5.01% to -10% related to Central Asia, Southern Asia and Southeast Asian countries (Azerbaijan, Nepal, India, Cambodia, Loa, and Myanmar). For an increase in undernourishment range i.e. greater than zero, there are also 8 out of 31 observations which are seen in Central Asia, Southern Asia and Southeast Asian countries (Azerbaijan, Turkmenistan, Nepal, Pakistan, Loa and Timor-Leste).

Table 4: Frequency Analysis of Compound Average Annual Growth Rate of GDP Per-Capita and POU for the Periods 1990-1995, 1995-2000, 2000-2005, 2005-2010, 2010-2017.

I
Undernourishment deterioration at a decreasing rate

Undernourishment Rate Change	GDPPC Growth Rate Change				
		Rate < 0%	0-5%	5.01-10%	
	Rate > 0%	20	01	02	23
	-5% - 0%	05	03	02	10
	-10% - 5.01%	04	01	0	05
		29	05	04	38

(10 Countries)

II
Undernourishment improvement at an increasing rate

Undernourishment Rate Change	GDPPC Growth Rate Change				
		Rate < 0%	0-5%	5.01-10%	
	Rate > 0%	02	0	0	02
	-5% - 0%	02	0	0	02
	-10% - 5.01%	03	01	0	04
		07	01	0	08

(02 Countries)

III
Undernourishment Improvement at a decreasing rate

Undernourishment Rate Change	GDPPC Growth Rate Change				
		Rate < 0%	0-5%	5.01-10%	
	Rate > 0%	10	0	0	10
	-5% - 0%	06	2	3	11
	-10% - 5.01%	05	4	0	09
		21	06	03	30

(09 Countries)

Linear Trend Group

Undernourishment Rate Change	GDPPC Growth Rate Change				
		Rate < 0%	0-5%	5.01-10%	
	Rate > 0%	05	01	02	08
	-5% - 0%	11	02	02	15
	-10% - 5.01%	04	02	02	08
		20	05	06	31

(09 Countries)

Now we analyze the countries showing quadratic trends. In group-I, out of a total of 50 observations, there are 38 observations left after accounting for 8 observations with respect to GDPPC and 4 observations with respect to POU as outliers. The maximum and minimum values for both POU and GDPPC are 0.27 (Uzbekistan) and -0.12(Kazakhstan), 1.23(Kazakhstan) and -2.56(Maldives) respectively. The highest economic growth rate is captured in the range of 0% to5% with 5 out of 38 observations enjoyed by Central Asia, Southern Asia and Southeast Asian countries(Indonesia, Tajikistan, Sri Lanka) whereas 4 out of 38 observations fall in the range of 5.01% to 10% shown by Southern Asia and Western Asian countries (Maldives, Iraq, Sri Lanka). There are 29 out of 38 observations which show negative economic growth rates and are generally located in all the specified regions of Asia (Indonesia, Tajikistan, Sri Lanka).

For reduction in undernourishment, 10 out of 38 observations are recorded under the range of 0% to -5% in Central Asia, Southern Asia and East Asian countries (Kazakhstan, Tajikistan, Korea, Iran, Sri Lanka and Maldives) and 5 out of 38 observations in -5.01% to -10% lie in Central, Southern Asia, Southeast Asian countries (Afghanistan, Uzbekistan, Indonesia). The increasing undernourishment is observed in 23 out of 38 observations shown by all the specified regions of Asia (Kazakhstan, Tajikistan, Uzbekistan, Korea, Afghanistan, Iran, Maldives, Sri Lanka, Indonesia, and Iraq).

In group II, 8 observations fall in the specified ranges after deducting two outliers from the total of 10 observations of two countries. The maximum and minimum values for both POU and GDPPC are 0.09 (Magnolia) and -0.10 (Kyrgyzstan), 0.89 (Magnolia) and -2.11(Kyrgyzstan) respectively. No observation is recorded in the range of 5.01% to 10% and only one observation i.e. Kyrgyzstan out of 8 observations lies in the 0% to 5% range of economic growth rate. Seven out of 8observations exhibit negative economic growth rates for the regions of central Asia and East Asia (Kyrgyzstan, Magnolia). Turning to the reduction in undernourishment, 2 out of 8 observations come under the category of 0% to -5%, 4 out of 8 observations fall in

the range -5.01% to -10%, while for an increase in undernourishment, 2 out of 8 observations come in the range of greater than zero are related to same regions and countries.

In group III, the total observations of 45 are reduced to 30 after adjusting for outliers (12 for GDPPC and 7 for POU). The maximum value of GDPPC is 0.38 (Philippines) while the minimum value is -1.90 (Jordan) similarly, the maximum value of POU is 0.10 (Georgia) while the minimum value is -0.18 (Armenia). Focusing on economic growth rates between 0% to 5%, group III depicts the highest growth rates with 6 out of 30 observations mainly experienced by all the specified regions of Asia except Eastern Asia (Armenia, Thailand, Vietnam, Jordan Bangladesh) and 3 out of 30 observations popup with the countries of East Asia, Southern Asia, Southeast Asian (China, Bangladesh, Philippines). However, 21 out of 30 observations come up with a negative economic growth rate which is a large number spread out in all specified regions of Asia (Armenia, Georgia, China, Bangladesh, Philippines, Thailand, Oman Jordan, and Vietnam). For reduction in undernourishment, 11 out of 30 observations in the range of 0% to -5%, and 9 out of 30 observations in the range of -5.01% to -10%. The range of 0% to -5%lies are all the specified Asian regions (Armenia, Georgia, China, Philippines, Oman, Vietnam, Bangladesh) whereas the range of -5.01% to 10% lies in all the Asian regions except Southern Asia (China, Thailand, Vietnam, Armenia and Jordon). With incremental undernourishment, 10 out of 30 observations show up in all the specified Asian regions except East Asia (Armenia, Georgia, Bangladesh, Philippines, Thailand, Jordon and Oman).

In a nutshell, the above analysis presents three distinct patterns of the relationship between GDPPC growth rates and POU.

- The compound annual GDPPC growth rates between the ranges of 0% to 5% are escorted by 0% to -5% reductions in POU (7 out of 17 observations).
- The compound annual GDPPC growth rates between 5.01% to 10 percent are also accompanied by reductions in POU between -5.01% to -10% (2 out of 13 observations).
- The negative compound annual GDPPC growth rates are accompanied simultaneously by a 0% to -5% reduction in POU (24 out of 77 observations) and an increase in POU (37 out of 77 observations).
- The interesting thing to note is that the maximum number of observations falls in the negative range of economic growth rate for all the groups of countries with varying ranges of POU. For group-I and III, an increase in undernourishment is most frequently observed with negative economic growth rates (20 and 10 observations in Group-I and Group III respectively). However, the reduction in undernourishment is observed in the range of negative economic growth with 11 observations in the linear trend group. In Group II the highest frequency (03 observations) for the reduction in undernourishment is recorded in -5.01% to -10% brackets under the negative economic growth range. Hence Group I and III jointly depict the increase in undernourishment with the highest number of observations in the negative economic growth ranges whereas the Group II and Linear trend groups experience the reduction in undernourishment under the range of negative economic growth rates.

6. Food Demand-Supply Factors and Prevalence of Undernourishment: An Econometric Analysis

In econometric analysis, six models are estimated on food demand and supply side factors by using pool regression to trace their impact on POU. In the first model of both the demand and supply sides, no regional dummy was incorporated while regional dummies were included in the rest of the models to encapsulate the regional effect. The results of food demand and supply side factors are shown in Table 6 and Table 7 respectively.

Table 6 exhibits the pool regression estimates of POU based on food demand factors. The coefficients of food demand factors i.e. GDPPC, percentage of the population with access to improved drinking water sources and urban population growth appear with a negative sign with a high significance level in all the models. The negative sign of GDPPC shows that an increase in GDPPC augments the availability, accessibility, affordability, and utilization of food which ultimately results in a reduction in POU. Higher GDDPC is a manifestation of the higher standard of livings with improved health and education facilities which come out with lower level POU. Similarly, access to improved drinking water facilitates the reduction in POU through the lower level of diseases because contaminated water and poor sanitation are strongly related to multiple diseases including dysentery, nausea, trachoma, typhoid diarrhoea and arsenicosis and cholera enhancing malabsorption of food nutrients. Moreover, the non-availability of safe water causes a deficiency of important minerals necessary for food absorption in the body such as calcium, magnesium, potassium, sodium, zinc, iron and bicarbonates which bring about POU. Urbanization may help to reduce POU through the provision of better infrastructure, resource management and service quality. Urban localities generally provide all basic amenities of life such as better civic services, fresh water, electricity, sanitation, environmental hazard controls, better education and health opportunities and enlarge consumer choices that make people aware of a balanced diet and access to multiple food alternatives to fulfil their nutrition requirements. Finally, regional dummies included in the models show that Central Asia and Western Asia witness a higher POU as compared rest of the three Asian regions.

Table 6: Pool Regression Estimates of POU based on Food Demand Factors

Dependent Variable: Prevalence of Undernourishment (POU)						
	1	2	3	4	5	6
Constant	58.36636 (0.0000)	66.28487 (0.0000)	57.17134 (0.0000)	58.54100 (0.0000)	56.44256 (0.0000)	58.33603 (0.0000)
GDPPC	-0.082200 (0.0497)	-0.132789 (0.0005)	-0.111685 (0.0059)	-0.082588 (0.0485)	-0.098840 (0.0181)	-0.082712 (0.0501)
Percentage of the Population with access to improved drinking water sources	-0.455383 (0.0000)	-0.464749 (0.0000)	-0.454283 (0.0000)	-0.459121 (0.0000)	-0.438660 (0.0000)	-0.455031 (0.0000)
Urban Population growth (annual %)	-0.699710 (0.0002)	-2.177958 (0.0000)	-0.588343 (0.0010)	-0.768473 (0.0001)	-0.753322 (0.0000)	-0.692753 (0.0005)
Central Asia Dummy	-----	-11.81118 (0.0000)	-----		-----	-----
Eastern Asia Dummy	-----	-----	9.342554 (0.0000)		-----	-----
Southern Asia Dummy	-----	-----	-----	1.185887 (0.1471)	-----	-----
South-Eastern Asia Dummy	-----	-----	-----	-----	3.109901 (0.0001)	-----
Western Asia Dummy	-----	-----	-----	-----	-----	-0.112467 (0.9194)
R^2	0.35	0.47	0.40	0.35	0.36	0.35

Table 7: Pool Regression Estimates of POU based on Food Supply Factors

Dependent Variable: Prevalence of Undernourishment (POU)						
	1	2	3	4	5	6
Constant	34.55125 (0.0000)	34.76954 (0.0000)	36.35242 (0.0000)	34.58486 (0.0000)	32.95000 (0.0000)	37.64841 (0.0000)
Food Trade Balance	-0.020685 (0.2662)	-0.036965 (0.0447)	-0.005570 (0.7476)	-0.002688 (0.8865)	-0.034481 (0.0653)	-0.037918 (0.0503)
Agricultural land (% of land area)	-0.090012 (0.0000)	-0.044222 (0.0353)	-0.125135 (0.0000)	-0.064176 (0.0020)	-0.064642 (0.0019)	-0.133987 (0.0000)
Cereal yield (kg per hectare)	-0.002401 (0.0000)	-0.002719 (0.0000)	-0.003015 (0.0000)	-0.002258 (0.0000)	-0.002653 (0.0000)	-0.002780 (0.0000)
CO2 emissions (metric tons per capita)	-1.524107 (0.0000)	-1.355395 (0.0000)	-1.599219 (0.0000)	-1.713861 (0.0000)	-1.437884 (0.0000)	-1.377022 (0.0000)
Central Asia Dummy	-----	-6.183302 (0.0000)	-----	-----	-----	-----
Eastern Asia Dummy	-----	-----	14.35700 (0.0000)	-----	-----	-----
Southern Asia Dummy	-----	-----	-----	-4.205669 (0.0000)	-----	-----
South-Eastern Asia Dummy	-----	-----	-----	-----	4.183163 (0.0000)	-----
Western Asia Dummy	-----	-----	-----	-----	-----	-4.428445 (0.0023)
R^2	0.25	0.28	0.35	0.26	0.26	0.26

Table 7 displays the pool regression estimates of POU based on food supply factors which are food trade balance measured by food exports (% of merchandise exports) fewer food imports (% of merchandise imports), agricultural land (% of land area), cereal yield (kg per hectare) and CO2 emissions (metric tons per capita). The coefficients of these variables in all the models are highly significant with negative signs with theoretical

robustness. The negative sign of trade balance implies that a country is a net importer of food to fulfil its food deficiencies which ultimately helps in lowering the POU. More availability of agricultural land for crop production will increase the supply of food and reduction in POU. Similarly, a high cereal yield ensures food security by provision and availability of food to the undernourished population.

Environmental quality is the essence of to issue of food security. High Co2 emission is an indicator of mass production and growth activities in a country. Almost all Asian countries are the victim of high Co2 emissions in pursuit of their GDP growth which ultimately translates into high living standards and availability of food resulting in POU. Out of five Asian regions, the regional dummies for Central Asia, Southern Asia and Western Asia appear with a negative sign which means that the POU in these regions is higher than those of the two regions.

7. Conclusions and Policy Recommendations

Food security is fundamental to the persistence of life on earth. It is one of the goals of sustainable development to reduce hunger and the prevalence of undernourishment. The study has aimed to explore the food security-growth nexus by envisaging three-layer analyses for Asian countries. Firstly, in trend analysis, the quadratic trend remained dominant in most of the countries. Secondly, in frequency analysis, Group I (undernourishment deterioration at a decreasing rate) and group III (undernourishment improvement at a decreasing rate) have collectively shown an increase in undernourishment with negative economic growth ranges with the highest number of observations. Moreover, Group II (undernourishment improvement at an increasing rate) and the linear trend group have witnessed a reduction in undernourishment with negative economic growth rates. Thirdly, the study has executed pooled regression analysis by tracing out the various food demand and supply side factors of undernourishment. All food demand and supply factors used in this study have exhibited a reduction in undernourishment with an increase in each of them. Hence, the study concludes that economic growth along with access to improve water, and urbanization are the cogent factors to reduce the prevalence of undernourishment. Through the prism of the food supply side, food trade balance, agriculture land, cereal yield along environmental degradation are found substantial factors to reduce the prevalence of undernourishment.

Owing to basic causes, food demand and supply factors jointly constitute the potential resources of the country and through the channel of government macroeconomic policies influence the underlying causes which ultimately affect the immediate causes of the prevalence of undernourishment. The study furnishes some policies implications as follows:

- Economic growth plays a pivotal role by conglomerating many factors relating to the potential resources of the country which help policymakers in devising macroeconomic policies to reduce POU.
- Ensuring access to improved drinking water enhances the absorption of food nutrition which translates into high protection against diseases and a reduction in undernourishment.
- More urban localities may be proposed as these have better access to basic enmities of life such as better health and education services, enlarged consumer choices and a better environment which facilities to lessen POU.
- The food trade balance guarantees an elastic food supply in case of food deficiency in a country and creates food security.
- The provision of agricultural land and cereal yield secures the food supply which ultimately POU.
- A society of high mass production correlates with high Co2 emission is an indicator of mass production and growth activities that diminishes POU.

References

Akira Nishiyama (2009). The Asymmetrical Impact of Economic Growth on Infant Mortality in Developing Countries.

Alderman, H., Hoogeveen, H., & Rossi, M. (2005). *Reducing child malnutrition in Tanzania-combined effects of income growth and program interventions*. The World Bank.

Ali, A. (2018). Issue of income inequality under the perceptive of macroeconomic instability. *Pakistan Economic and Social Review*, *56*(1), 121-155.

Ali, A., & Rehman, H. U. (2015). Macroeconomic instability and its impact on gross domestic product: an empirical analysis of Pakistan. *Pakistan Economic and Social Review*, 285-316.

Asumadu-Sarkodie, S., &Owusu, P. A. (2016). The casual nexus between child mortality rate, fertility rate, GDP, household final consumption expenditure, and food production index. *Cogent Economics & Finance*, *4*(1), 1191985.

Boozer, M., Ranis, G., Stewart, F., &Suri, T. (2003). Paths to success: the relationship between human development and economic growth. *Yale University Economic Growth Center Discussion Paper*, (874).

Chikalipah, S., & Makina, D. (2019). Economic growth and human development: Evidence from Zambia. *Sustainable Development*, *27*(6), 1023-1033.

Desai, V. S. (2012). Importance of literacy in India's economic growth. *International Journal of Economics and Research*, *3*(2), 112-124.

Dollar, D. and Kraay, A. (2000). Growth Is Good for the Poor. Development Research Group, The World Bank, 20433

Donaldson, J. a. (2008). Growth is Good for Whom, When, How? Economic Growth and Poverty Reduction in Exceptional Cases. *World Development*, 36(11), 2127– 2143.

Engle, P. L., Menon, P., & Haddad, L. (1999). Care and nutrition: concepts and measurement. *World Development*, *27*(8), 1309-1337.

Gerbens-Leenes, P. W., Nonhebel, S., &Krol, M. S. (2010). Food consumption patterns and economic growth. Increasing affluence and the use of natural resources. *Appetite*, *55*(3), 597-608.

Haddad, L., Alderman, H., Appleton, S., Song, L., & Yohannes, Y. (2003). Reducing child malnutrition: How far does income growth take us?. *The World Bank Economic Review*, *17*(1), 107-131.

He, L., & Li, N . (2018). The linkages between life expectancy and economic growth: some new evidence. *Empirical Economics*, 1-22.

He, L., & Li, N. (2019). The threshold effect of longevity: life expectancy and economic growth. *Applied Economics Letters*, *26*(14), 1210-1213.

Heltberg, R. (2009). Malnutrition, poverty, and economic growth. *Health Economics*, *18*(S1), S77-S88.

Kengnal, P., & Holyachi, S. (2017). The Causal relationship between Infant mortality rate, Health expenditure and Economic growth in India. *International Journal of Public Health Research*, *7*(1), 799-806.

Khalil, A., & Ali, A. (2016). Rising Population and Food Insecurity Linkages in Pakistan: Testing Malthusian Population Growth Theory. *International Journal of Economics and Empirical Research (IJEER)*, *4*(1), 1-8.

Khan, N. H., Ju, Y., & Hassan, S. T. (2018).Modeling the impact of economic growth and terrorism on the human development index: collecting evidence from Pakistan. *Environmental Science and Pollution Research*, *25*(34), 34661-34673.

Lecture, H. A. M., &Timmer, C. P. (2004). Food Security and Economic Growth: An Asian Perspective.

Mahyar, H. (2016). Economic growth and life expectancy: The case of Iran. *Studies in Business and Economics*, *11*(1), 80-87.

Mehmood, B., Raza, S. H., & Mureed, S. (2014). Health expenditure, literacy and economic growth: PMG evidence from Asian countries. *Euro-Asian Journal of Economics and Finance*, *2*(4), 408-417.

Mustafa, G., Rizov, M., & Kernohan, D. (2017). Growth, human development, and trade: The Asian experience. *Economic Modelling*, *61*, 93-101.

Ramirez, A., Ranis, G., & Stewart, F. (1997). *Economic growth and human development* (No. 787).Center Discussion Paper.

Ravallion, M. (1990). Income effects on undernutrition. *Economic development and cultural change*, *38*(3), 489-515.

Reyes, G. E., & Useche, A. J. (2019). Competitiveness, economic growth and human development in Latin American and Caribbean countries 2006-2015. *Competitiveness Review: An International Business Journal*.

Richard, H. and Adams, J. (2004). Economic Growth, Inequality and Poverty: Estimating the Growth Elasticity of Poverty. World Development, 32(12), 1989– 2014.

Sajid, A., & Ali, A. (2018). Inclusive Growth and Macroeconomic Situations in South Asia: An Empirical Analysis. *Bulletin of Business and Economics (BBE)*, *7*(3), 97-109.

Şentürk, İ., & Ali, A. (2021). Socioeconomic Determinants of Gender-Specific Life Expectancy in Turkey: A Time Series Analysis. *Sosyoekonomi*, *29*(49), 85-111.

Shome, S., &Tondon, S. (2010). Balancing human development with economic growth: a study of ASEAN 5. *Annals of the University of Petroşani, Economics*, *10*(1), 335-348.

Smith, L. C., & Haddad, L. (2002). How potent is economic growth in reducing undernutrition? What are the pathways of impact? New cross-country evidence. *Economic Development and Cultural Change*, *51*(1), 55-76.

Subramanyam, M. A., Kawachi, I., Berkman, L. F., & Subramanian, S. V. (2011). Is economic growth associated with reduction in child undernutrition in India?. *PLoS medicine*, *8*(3).

Suri, T., Boozer, M. A., Ranis, G., & Stewart, F. (2011). Paths to success: The relationship between human development and economic growth. *World Development*, *39*(4), 506-522.

Wolfe, B. L., & Behrman, J. R. (1983). Is income overrated in determining adequate nutrition?. *Economic Development and Cultural Change*, *31*(3), 525-549.