# Cereal Production, Undernourishment and Food Insecurity in South Asia

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**Abstract**

South Asia remains one of the major strongholds of hunger in the world, despite the fact that, following the Green Revolution, cereal production in the countries of this region tripled during the second half of the 20th century. This study examines the role played by this increase in cereal production in improving the region's nutrition and food security situation. We study the association between the different aspects of food security and cereal production in South Asia that have prevailed over the past 25 years. We find a beneficial role of the production and yield of cereals in lowering the extent of undernourishment. A 1% increase in cereal production and yield is associated with upto 0.84% decrease in the prevalence of undernourishment. The impact is significant over a period of three years. The positive effect is particularly evident in the case of rice and maize production. An improvement is seen in the aspects of availability, stability and utilisation of food security but not in the aspect of access. These findings are robust to alternative specifications and techniques. The results explain, in part, the means by which South Asian nations have managed to stall relative increases in extreme hunger and food insecurity.

**Key Words: cereal production; undernourishment; food security; South Asia**
**JEL Codes : O11, O13, 053, Q18**

## Introduction

In November 2019, the Government of Pakistan decided to immediately release an additional sum of Rs.6 billion (about US$38 million) to Utility Stores Corporation, the state-run grocery outlet[1]. The step was taken in order to provide subsidized food items for the poor households suffering from a seasonal spike in cereal and vegetable prices.

Combatting food insecurity has long been a major concern of governments across South Asia. Poverty alleviation measures include delivery of subsidized cereals through public distribution systems (as mentioned above), food stamps, mid-day meals for school children, food for work programmes and provision of nutritional supplements to mothers and children. During the past twenty-five years measures such as these have helped reduce the proportion of malnourished and food insecure populations in all eight countries of the region (FAOSTAT, 2016). The Millennium Development Goal (MDG) of reducing poverty by half was also achieved in time (IFPRI, 2016). The proportion of undernourished in South Asia's total population fell significantly from 23.9% in the early 1990s to 14.9% for the 2016-2018 period (Table 1). While the prevalence has fallen in all the eight countries of the region, the reduction has been most spectacular in Bangladesh and Nepal: in the former, the proportion of undernourished in the country's population halved from 32.8% estimated in 1990-1992 to 14.7% in 2016-2018 while the decrease was even greater in the latter, from 22.8% to 8.7% of the population. Nevertheless and despite this progress in relative terms about 278.5 million inhabitants of the region (corresponding to 14.7% of the population) are still estimated as being unable to meet their dietary needs (FAO et al., 2019). India, the largest and most populous country of the region, alone, accounts for a quarter of the world's total food insecure population. One Indian in seven (194 million or 14.5%) remains food insecure and one in three children under five years of age manifests stunted growth.

**Table 1. Undernourishment Trends in South Asia**

**Figure 1. Average dietary composition in South Asian countries in 2017**

A major objective of the South Asian governments' food security policies over the years has been to achieve self-sufficiency in staple grains, mainly rice, wheat and maize (Pingali, 2004). Cereals account for half to three-quarters of average caloric intake in the countries of

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[1] https://www.brecorder.com/2019/11/08/542733/govt-to-disburse-rs6bn-for-utility-stores-corporation-immediately/

the region (Figure 1). Throughout the past half century, considerable effort was made across the region to attain self-sufficiency in cereal production. Agricultural research centers focused on producing new high-yield varieties better suited to South Asia's soils and climate. Subsidies were provided on agricultural inputs including seeds, fertilizers, machinery, irrigation and electricity for tube wells. Small farmers were provided with cash benefits and subsidized credit. Efforts were made to improve access to agricultural credit and to reduce its cost (FAO, 2014). Programmes for agricultural insurance in case of natural and climatic disasters were established and extended. Another governmental measure aimed at improving production and protecting farmers from sharp market price fluctuations has been the minimum support price of cereals fixed every year. Some policy measures especially targeted the region's large number of small-holders, helping them improve their yield through better access to quality seeds, farm markets, credit and information. Thanks to these policy measures, South Asia has, over the past years, managed to enhance its cereal production as well as its yield and productivity. Most countries have succeeded in raising cereal yield two or three-fold since the beginning of the Green Revolution in the 1960s, and India and Pakistan have become practically self-sufficient in cereal production. Today, India, Pakistan and Bangladesh are among the world's largest producers of rice, with India and Pakistan among the top rice exporters. India exported close to 13 million tons of cereals in 2017 while Pakistan exported about 3 million tons.

What has been the role of these attempts at food self-sufficiency in achieving food security? Is strong focus on increasing cereal production a significant factor in driving the fall in undernutrition seen in South Asia? Which of the four pillars of food security (availability, access, utilization and stability) as defined by FAO (2009) are most relevant?

Extant literature has analyzed the role played in determining food security by household factors such as farm size (Aidoo et al., 2013; Muche, 2014), access to credit (Gebre, 2012), income (Matchaya and Chilonda, 2012), and education of the household head (Magana-Lemus et al., 2016). Smith and al. (2017) report low levels of education, weak social networks, less social capital, low household income and unemployment to be the five characteristics associated with the largest increase in the likelihood of experiencing food insecurity around the world. Imai *et al.* (2014) show that rural Indian children's nutritional status, as exhibited in their likelihood of being stunted or underweight, improves with women's education and empowerment. Rahman and Mishra, 2019) report that being engaged in a non-agricultural livelihood has a positive effect on the overall food expenditure of rural

Indian households, especially on non-cereal items. Kuma et al. (2019) find that income from coffee production is a significant determinant of the food security of smallholding Ethiopian farmers.

The role of factors such as population growth (Hall et al. 2017), conflict (Martin-Shields and Stojetz, 2019) and climate change (Bocchiola et al., 2019; Fao, 2015; Kang et al., 2009) has also been examined at the macroeconomic level with respect to cross-country food security. Asian Development Bank (2013) report that an increase of 1% in food price leads to a 0.4% increase in the prevalence of undernourishment. Brinkman et al. (2010) show that household food security, as measured by dietary diversity, reduced by 5 percent in Nepal, 8 percent in the Niger, and 23 percent in Haiti due to increased food prices and the financial crisis of 2007-08. Soriano and Garrido (2016) affirm that it takes two years for income growth to improve the nutrition situation in a sample of 22 developing countries. The indirect impact of income growth on undernourishment through social investments accounts for 50% of its total impact. Fontan and Mughal (2019) find evidence of significant beneficial effects of public agricultural spending on nutrition and food security in Africa but only for those countries allocating greater proportions of their budgets to agriculture.

While some studies have examined the role of agricultural income and expenditure on food security, the contribution of increasing cereal production and yields to the enhancement of a country's food security has so far received less attention. In its September 2019 report, FAO mention that persistent conflict and unfavourable climatic conditions in countries such as Afghanistan, Bangladesh and Pakistan affect agricultural production (including that of staples) which in turn renders the population food insecure (FAO, 2019). In this study, we analyze the cereal production – food security relationship in the context of South Asia by exploring macroeconomic data on the eight countries from South Asia for the period from 1991 to 2015. We examine both the aggregate cereal production as well as the production of the region's three principal staple crops: rice, wheat and maize. We study the relationship between production, nutrition and food security in both its temporal and spatial dimensions. Our findings indicate the beneficial role of the aforementioned focus on improving the production and yield of cereals and thus on South Asia's overall nutrition and food security situation. A 1% increase in cereal production and yield is found to be associated with as much as a 0.84 percent lower incidence of under-nutrition. The result mainly applies to the rice production and not to that of wheat. We find that an increase in South Asia's cereal production improves the availability, stability and utilization dimensions of the region's food

security, but has no significant effect on the access dimension. These findings have useful policy implications in a developing-country context.

The study is organized as follows: In Section 2, we briefly describe the food security and cereal production situation of South Asian countries. Section 3 introduces the data and estimated model as well as empirical methodology. Results are presented and discussed in Section 4 and robustness measures in Section 5. Finally we present our Conclusion and policy implications.

## 2. Food security and cereal production in South Asia

## 2.1. State of hunger and food insecurity

One in nine human beings (about 820 million) still suffers from hunger (FAO, IFAD, UNICEF, WFP and WHO, 2019). In South Asia, the numbers of undernourished have marginally declined since the 1990s (Table 1). India, which accounts for 70% of the region's hunger has seen a 36% drop in the prevalence of undernourishment in the past quarter of a century despite a 48% increase in population (FAOSTAT, 2019). While the numbers have fallen in the other countries of the region, the situation in Afghanistan, Bangladesh and Pakistan has been challenging (FAO, 2019). In Afghanistan, the undernourished population doubled from 3.8 million in 1990-1992 to 10.6 million in 2016-2018 whereas in Pakistan, the number soared from 28.7 million to 40 million during the same period. In Afghanistan, decades of war and internal strife, earthquakes and failed crops have meant that the majority of the population lacks both access to food and the means of obtaining food. Population growth rates that are among the highest in the world have exacerbated the problem. Bangladesh, which had made significant strides in tackling under-nutrition in the past decades, is struggling to adequately shelter the over a million Rohingya refugees fleeing conflict in Myanmar. Similarly, Pakistan has been hosting millions of Afghan refugees for nearly four decades. Floods in the upper parts of the country and drought in the arid South-West and South-East have affected the country's food security situation.

In South Asia, average per capita calorie consumption is low by world standards, ranging in 2017 from 2090 kilocalories a day in Afghanistan to 2673 in Nepal (FAOSTAT). Inhabitants of Bangladesh, Nepal and Sri Lanka mainly rely on rice for their caloric intake while wheat is the chief source of calories in Afghanistan and Pakistan. The population of India's northern

and western states likewise depends on wheat whereas rice is the staple food in the southern and eastern states. In traditionally rice-consuming parts of the region such as Bangladesh, rising incomes coupled with urbanization are leading to higher demand for wheat-based products.

Given the high dependence on cereals for covering caloric requirements (Figure 1), national food security policies have mainly focused on improving availability and access to affordable staple food. These policy interventions target the pricing and supply mechanisms as well as providing direct financial support programmes. All the countries of the region maintain public distribution systems supplying cereals at below-market prices. For this purpose, cereals are procured domestically, at pre-defined support prices or imported in case of insufficient domestic production. These systems assume an indispensable role in food importing countries such as Afghanistan and Bangladesh during global price spikes like those seen in 2007-2008[2]. Bangladesh, India and Pakistan maintain large-scale public grain reserves to counter such contingencies. India's Targeted Public Distribution System (TPDS) aims at improving the food security situation of 800 million poor by providing ten kilos of subsidized food grains per family every month. However, these distribution systems involve large subsidies and constantly struggle to identify and target the poor. Their reach is partial at best and losses are high in the presence of poor storage and delivery mechanisms (Iqbal and Amjad, 2010). In addition to distribution programmes, several schemes aim at improving nutrition and food security, directly or indirectly, by providing the poor with access to food through initiatives such as Mid-day Meal Programme and the National Rural Employment Guarantee Scheme (India), the Ehsas Programme (Pakistan) and Samurdhi Food Stamp Programme (Sri Lanka). India's Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) is the world's largest public works programme[3]. It guarantees up to hundred days of unskilled manual work on public projects during the lean seasons, at the statutory minimum wage, to all rural households. This allows poor households to smooth their food consumption and thus avoid food insecurity. Pakistan's Ehsas programme is an all-encompassing social protection programme with 115 policy actions involving cash and asset transfers, subsidized loans, healthcare insurance, food vouchers, vocational training and scholarships aimed at alleviating hunger, poverty and economic disparity[4].

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[2] Between January 2007 and April 2008, the price of coarse rice in Bangladesh and wheat in Afghanistan nearly doubled (World Bank, 2010).
[3] See for instance: https://pubs.iied.org/G04267/
[4] See for instance: https://www.globalvillagespace.com/ehsaas-a-so-called-welfare-program/

In addition to these government initiatives, international development agencies and Non-Governmental Organizations also run food support programmes, across the region, in areas hit by natural calamities, conflict and poverty.

## 2.2. State of cereal production

In 2018, South Asia produced more than 448 million tons of cereals, or about 15% of the global production (FAOSTAT, 2019). The region's share in the world production is far below its proportion of the world population, despite the Green Revolution of the 1960s and subsequent years which led to sharp increases in the region's cereal output. South Asia's cereal production today is more than twice that of Africa. The latter must import nearly half of its cereal requirements (201 million tons) compared with 16 million tons in the case of South Asia (FAOSTAT, 2019). South Asia's cereal yield grew threefold from 1961 to 2018 (Table 2). In comparison, cereal yield in Africa, as a whole, almost doubled during the same period. Today, South Asia produces about twice as much per hectare (31,802 hectograms/hectare) as Africa does (16,433 hectograms/hectare). Bangladesh by far leads the way with a yield of 44,112 hectograms per hectare, almost three times the level of 1961. However the country must still import large quantities of cereals, mainly wheat[5]. In contrast, India and Pakistan, despite their low yields of 31,608 hectograms per hectare and 31,708 hectograms per hectare respectively, have managed to become self-sufficient in cereal production. These two countries achieved the highest growth in cereal yield of the region during the 1961 – 2018 period, corresponding to 234% and 270% respectively.

**Table 2. Evolution of cereal yield per hectare in South Asia (1961 – 2018)**
**Figure 2. Cereal production in South Asian countries (share of total crops)**

The predominance of cereal production varies widely among the countries of the region (Figure 2). In four out of eight countries, cereals represent more than 70% of the total crop production, reaching as high as 91% in Afghanistan.  However, in India, the Maldives and Sri Lanka cereals account for less than half the crop production. With the exception of Bangladesh, cereals amount to less than half the value of agricultural production in all the countries of South Asia. This is due to the significant production of high value crops such as

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[5] Bangladesh produces about 1 million tons of wheat and has to import nearly 6 million tons (source: https://www.dhakatribune.com/bangladesh/agriculture/2019/07/29/wheat-demand-growing-fast-in-bangladesh ).

cotton, sugarcane and spices. South Asia produced 394 million tons of sugarcane in 2017 (FAOSTAT, 2019). The production of rice and wheat, in comparison, was 238 million tons and 146 million tons respectively (Table 3).

**Table 3. Evolution of rice, wheat and maize production in South Asia (1991-2017) (tons)**

## 3. Model, data and methodology

## 3.1. Model and data

We empirically examine the relationship between undernourishment/food security and cereal production in South Asia. We consider a population to be food secure when all individuals, at all times, have physical and economic access to adequate, safe and nutritious food to meet their dietary needs. Although, as Hoddinott (1999) put it "there exist approximately 200 definitions and 450 indicators of food security", the above definition has the merit of emphasizing the four aspects of food security as defined by FAO (2009), namely availability, access, stability and utilization.

Our parsimonious baseline model for undernourishment / food security can be given as:

Undernourishment_prevalence/food security $i,t$ = f (lncereal_prod $i,t$, lngdp_per_capita $i,t$, popgrowth $i,t$, inflation $i,t$, gfce $i,t$, climatologicaldisaster $i,t$, terrorkilledmillion $i,t$, foodcrisis) (1)

where 'i' represents the corresponding South Asian country and 't' the year of the observation.

Dependent variables:

We take the prevalence of undernourishment (PoU) in each country as our baseline indicator. This indicator relates to the second Sustainable Development Goal (SDG). Objective 2.1 of the SDGs calls for ending hunger by 2030 and ensuring access by all the people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round (United Nations, 2015). Prevalence of under-nutrition is the indicator commonly used in the literature to monitor severe or chronic food security (see for instance FAO, 2017; FAO, 2019; Martin-Shields and Stojetz, 2019; Ray, 2007). It is computed from aggregated country-level data on food available for human consumption, compiled annually for most countries in the world in FAO's Food Balance Sheets (FAO, 2019). The indicator estimates the proportion of the population that lacks enough dietary

energy for a healthy, active life, and is computed by comparing the distribution of average, daily dietary energy consumption in a country's population with the distribution of dietary energy needs derived from the composition of the population by age, gender and physical activity levels.

This indicator is useful in measuring long-term trends of hunger but does not monitor progress in achieving SDG Target 2.2 which calls for eradicating all forms of malnutrition. Moderate (or less severe) levels of food insecurity, defined as uncertain access to food of sufficient quality and/or quantity, but not so extreme that it causes insufficient dietary energy intake, can increase the risk of seemingly divergent forms of malnutrition (**FAO, IFAD, UNICEF, WFP and WHO, 2019**). People experiencing moderate food insecurity face uncertainties about their ability to obtain food, and have to compromise on the quality and/or quantity of the food they consume. We study the association of cereal production with the four aspects of food security:

Availability corresponds to the supply of a sufficient quantity of nutritious food to all individuals, and can be measured by the indicator 'dietary energy supply as a percentage of average dietary energy requirement'. This indicator helps measure whether food insecurity in the country is mainly due to insufficiency of the food supply or to inadequate means of distribution.

Access indicates the physical and economic capacity of all individuals to acquire a sufficient quantity of nutritious food, and can be proxied by FAO's domestic food price index. The index, first introduced in 1996, is a measure of the monthly change in international prices of a basket of 23 food commodities and a total of 73 price series (FAO, 2013). The base period is 2002–2004.

Stability refers to a consistent supply of nutritious food through effective management of price shocks arising from local or international economic or weather fluctuations. This aspect of food security can be measured by using variability of net per capita food production. This indicator corresponds to the variability of the food net per capita production measured in constant 2004-2006 international dollars (3-year average). It compares the variations of the per capita food production across countries and time.

Finally, utilization reflects the biological capacity of individuals to absorb nutritious food so that all the human body's physiological needs are met. This aspect underscores the importance of non-food inputs in food security, highlighted in the 1996 World Food Summit and could be proxied by health and sanitation indicators. We employ two alternate variables as proxy for individual food absorption capacity, namely the percentage of population using

improved sanitation facilities and the mortality rate of under five children. The former points to the overall sanitary environment and living conditions in the country, whereas the latter reflects the prevalence of life-threatening diseases in the country.

Variables of interest:

Three variables of interest: the quantity, per capita production and cereal yield, all taken in logs, are alternately included in the model. We also consider South Asia's three main cereals (rice, wheat and maize). As discussed earlier, rice and wheat are the region's main staple crops. Maize is also cultivated throughout the region, particularly on less-productive land, and serves as a source of animal feed in addition to human consumption.

We assess the role of the diversity of nutritious food available to the consumers in driving food security by including the share of dietary energy derived from cereals, roots and tubers as an explanatory variable. Previous studies have already demonstrated a link between diversity of food supply and food security (see Arimond and Ruel, 2004 ; Dillon et al., 2015 ; Hoddinott and Yohannes, 2002 ; Kumar et al., 2015 ; Ruel, 2002).

Controls:

We control for a number of economic, demographic, political and natural factors that are reported in the literature to be significant drivers of hunger and food insecurity. Economic development is deemed a key factor in decreasing hunger in developing countries (FAO, IFAD, WFP, 2015; FAO, 2015; Fontan-Sers and Mughal, 2019). Rising economic tide lifts the levels of food consumption and hence alleviates food insecurity as long as this growth is pro-poor. South Asia is one of the world's fastest growing regions with an average growth of 6.7% in 2018 (World Bank, 2019). GDP per capita is taken as the indicator of economic development.

Another relevant factor is population growth. Confronted with limited resources and economic opportunities, any rapid increase in population can impede efforts to reduce hunger.

It is important to include inflation in the model. Rising prices affect the poor proportionally more and could hit their food purchasing power particularly hard. Consequently, inflation, especially food price inflation has an adverse effect on food security (Cathie and Herrmann, 1988; Kalkuhl and al., 2016).

Government plays a crucial role in determining a country's nutrition and food security situation through public spending on agriculture, tackling hunger and alleviating poverty

(Cuesta et al., 2013; Magana-Lemus et al., 2016 ; Muche et al., 2014 ; Zakari et al., 2014). Countries with a low public agricultural expenditure per worker are found to have higher incidence of hunger (FAO, 2012 p. 6). We include government spending as a share of GDP to proxy government involvement in the economy.

Meteorological shocks such as cyclones, floods or drought resulting from failure of seasonal rains could jeopardize availability or access to food. South Asia is one of the world regions most hit by climate-related catastrophes. Floods are a recurrent phenomenon across the whole region, particularly during the monsoon season that lasts from June to September. Occasional droughts have devastated considerable areas of Afghanistan, Pakistan, India and Bangladesh. We include a binary variable to account for food shortage, crop failure and famine to gauge the influence of such disasters on food security.

Yet another factor is the role of terrorism. Conflict and violence hurt economic activity, destroy lives, damage assets and could thereby aggravate hunger. South Asia has long suffered from ethnic, religious, communal and political terrorist activity. Over 67,000 people are reported to have been killed in terrorist attacks in the region since 1990 (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). We take terrorism related casualties per million population as an indicator of terrorist activity in South Asia.

Finally, we include a dummy variable for the 2007-2008 food crises to account for the detrimental effect of the food price shock on hunger in the developing countries (Brinkman et al., 2010).

Table 4 gives the definitions and sources of the variables included in the study while the summary statistics of these variables are given in Table 5. The dataset is an unbalanced panel pertaining to the 1991 – 2015 period. While several indicators included in the model have relatively few missing observations, some, such as food price index, have high numbers of missing observations, particularly for Afghanistan. On average there are 17.7 observations per country in the baseline model against a possible maximum of 25.


**Table 4. Variable definitions and sources**
**Table 5. Summary statistics**


## 3.2. Methodology

The estimation proceeds as follows. In the first step, we alternately study the relationship between undernourishment prevalence on the one hand and indicators pertaining to the production of cereals on the other. The three indicators account for the quantity of cereals produced, per capita production and per hectare yield. We also examine undernourishment's association with the production of rice, wheat and maize in South Asia. These estimations are carried out using Fixed-effects panel estimator. The Hausman Specification test invariably maintains a P-value of 0.00 indicating that use of fixed-effect rather than random-effect estimator is preferable.

In the second step, we consider cereal production's association with the four aspects of food security, namely availability, access, stability and utilization.

In the final step, we test the robustness of our estimates. First, we check if it is the diversity of food supply and not merely cereal production that influences undernourishment. Second, we take heterogeneity into account in by alternately excluding the two outliers in our dataset. The Maldives are the smallest country of the region, with negligible cereal production. The country is the most prosperous among South Asian countries and is close to eliminating hunger. At the other extreme, India corresponds to 75% of the region's population and an even greater share of its output.

Third, we account for the possibility of time lags. To this end, we carry out the estimations on the one, two, three, four and five-year lagged values of cereal production instead of the variable in level used in the baseline model. Finally, we estimate the baseline model using alternative econometric techniques to consider the possible dynamic structure of the underlying model. We employ Arellano and Bond, System GMM and Dynamic Panel Data (DPD) estimators to tackle potential endogeneity and auto-correlation issues (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998). The Arellano–Bond model is consistent when T is small. It not only uses the second lags of the dependent variable but also all available proceeding lags; it poses the difficulty however that lagged levels are often poor instruments for first differences, especially for variables that are close to a random walk (Perez Truglia, 2009). System GMM has the quality of good small-sample properties, allows for weakly exogenous regressors and takes account of the endogeneity of the lagged dependent variable but is not efficient for large T, small N panels such as ours (Roodman, 2009a). The Dynamic Panel Data technique is considered more efficient in that it tackles endogeneity problems of the regressors and incorporates fixed-effects (Roodman, 2009b).

## 4. Findings

Table 6 shows results of various production-related specifications. The association of undernourishment prevalence with cereal production, per capita production and yield, and all the three production indicators is found to be statistically significant and strong (Columns 1 - 3). The sign of the three coefficients is negative suggesting the existence of a negative relationship between PoU and cereal production. Marginal effects given at the bottom of the table show that a 1% increase in cereal production is associated with a 0.42% decrease in the proportion of undernourished; the decrease in the latter, 0.6% is even stronger in the case of a 1% increase in per capita production and 0.84% in the case of per hectare yield. Higher production of staples not only improves their timely availability, particularly in the rural areas, but also improves economic access for the large number of farmers in South Asia with small holdings. Crop yields for small land-holders in South Asia are often low by international standards, which leaves many of them food insecure (see for instance Ahmad et al., 2015). Increase in per hectare production raises household income and enhances purchasing power.

Crop-wise estimates show a similarly strong result for rice production (Column 4). A 1% increase in rice production is found to be associated with a 0.32% fall in undernourishment. Rice is the principal staple for most of the population in the region. The coefficient for wheat production is found to be insignificant (p-value = 0.17). This is possibly due to the fact that wheat is the primary staple in only two countries of the region and an increase in wheat production does not substantially change the region's overall nutrition situation.

We find that cereal production is among three main factors driving undernourishment rates; population growth rate and government consumption expenditure as share of GDP are found to be the two other strong factors. All things considered, high population growth intuitively leads to high incidence of under- and mal-nutrition.

Although population growth across the region has dropped from the highs seen in the 1970s and the 80s, it continues to present a barrier to actions aimed at lifting the region's population out of poverty and hunger. South Asia's population increased from 1.16 billion in 1991 to 1.81 billion in 2018 (World Bank, 2019). This increase corresponds to twice the population of the United States of America

Higher public spending, in contrast, leads to a lower proportion of undernourished population. Government spending can influence hunger directly through food provision schemes, and through pricing, subsidy and distribution mechanisms, as well as indirectly through investment in physical infrastructure and human development targeting the poor.
With the exception of these variables, the coefficients of other explanatory variables are mostly found to be statistically insignificant.


**Table 6. Undernourishment and cereal production - production indicators**
**Table 7. Food security and cereal production – the four dimensions**


The results presented above are also borne out in the estimates of multiple dimensions of food security reported in Table 7. Cereal production significantly and beneficially influences the availability, stability and utilization aspects of food security. The adequacy of dietary energy supply substantially increases (Column 1), the variability of per capita food production falls (Column 3), and health indicators improve (Columns 4 and 5). A 1% increase in grain production is associated with about 0.09% improvement in the adequacy of dietary energy supply and a 0.86% decrease in the variability of domestic per capita production. These findings again highlight the strong link we observed earlier between higher grain production and the improvement in South Asia's nutritional situation. Increased domestic production also helps the public storage and distribution systems to better protect the population from fluctuations in grain prices in the international market. In addition, greater food availability and price stability ultimately lead to improving the biological capacity of nutrition absorbtion, reflected in better access to sanitation facilities and lower incidence of child mortality.

The financial access dimension represented by the Food Price Index variable (Column 2) does not significantly correlate with cereal production (p-value = 0.475)    . Thanks to strong cereal price subsidy policies and other safety nets in force across the region, shortfall in domestic grain production does not significantly increase local food prices, thereby dampening the adverse impact of cereal production on food access. This result highlights the relative success of South Asian governments' sustained food price monitory mechanisms in sheltering the population from strong negative price shocks resulting from crop failures and climate hazards.

At the same time, the result raises doubt over the pertinence of food price index as an indicator of food security's access dimension. The association of cereal production with both the prevalence of undernourishment and the three dimensions of food security points to a possible non-negligible improvement in access to food. First, the availability and access dimensions are inseparably linked (Pinstrup-Andersen, 2009). Second, access increases not only from additional household income but also as a result of protection from negative price shocks. Third, improvement in sanitation and health outcomes also results from enhanced financial access to food. This shows that dimensions of food security should, in principal, all react to positive change in cereal production.

All things considered, the evidence of a beneficial effect of cereal production in South Asia on the region's nutrition and food security situation seems to be substantial.


## 5. Robustness Measures

We carry out a number of estimations to check for the robustness of our findings.

First, we explore the possibility that the drop in under-nutrition rates is a consequence of an increasingly diversified diet, more so than mere additional production of staples. Our evidence contradicts this possibility (Table 8, Column 1). We find that the share of cereals in South Asia's average caloric intake does not appear to influence the proportion of undernourished population in the region. South Asia's poor derive a very high share of their calorie requirement from cereal grains. Improved availability of staples seems to help them significantly whereas access to other sources of calorie does not appear to change the hunger situation. Food security in South Asia therefore responds more to the production of cereals than to their share in daily nutritional intake. This insignificant relationship between undernutrition and production diversity corroborates the findings of Sibhatu and al. (2015) in the context of Ethiopia and Kenya.

Second, we test whether our findings are sensitive to the presence of outliers in our dataset. As discussed in Section 3.2, the Maldives and India represent two major outliers in the region, being at opposite ends of the spectrum in terms of area, population and agricultural production. The alternate exclusion of these two (Columns 2 – 3) does not affect the negative relationship between undernourishment and cereal production found in the baseline estimations.

Third, we explore the possibility of a lagged effect of cereal production. As with estimation at levels, the significant negative association persists when one, two and three-year lags of cereal production are employed. However, the significance of the association dissipates beyond three lags.

**Table 8. Undernourishment and cereal production - Alternative estimates**
**Table 9. Undernourishment and cereal production – Dynamic model estimates**

Finally, we consider the dynamic structure underlying our baseline specification by estimating three models, System GMM, Arellano and Bond and Linear DPD. The results of these estimations corroborate our main finding of a significant salutary effect of cereal production on undernourishment in South Asia (Table 9). The association between cereal production and under-nutrition prevalence remains negative and statistically significant at the 1% level regardless of the technique employed. A 1% increase in cereal production, according to the System GMM estimate, corresponds to a 0.024% fall in undernourishment rates. The corresponding decrease in hunger, according to the Arellano and Bond and Linear DPD models is 0.132% and 0.373%. These estimated effects are somewhat smaller than those found with fixed-effect models, suggesting that the baseline model results might be biased upwards.

## 6. Conclusion

The United Nations declared the 2016 to 2025 period Decade of Action on Nutrition. In particular focus in this regard are the countries of Sub-Saharan Africa and South Asia, two regions where a significant proportion of the population still face hunger. South Asia alone is home to a third of the world's undernourished (FAO, IFAD, WFP, UNICEF, WHO, 2019). Despite strong economic growth over the past quarter of a century that brought millions out of poverty, many in this region still lack sufficient food to satisfy dietary energy requirements. One of the objectives of South Asian countries' food policies over these decades has been to attain self-sufficiency in cereal production. Thanks to strong agricultural performance since the Green Revolution, production of wheat, rice and other cereal crops has doubled or tripled across the region. Nonetheless, the production of most of the countries in the region continues to fall short of the needs of a rapidly rising population, leaving the countries exposed to global price shocks. The need for self-sufficiency in staple grains was

acutely felt during the food price hike of 2007-2008 (Pingali, 2015). In this study, we examined the role cereal production plays in driving South Asia's nutrition and food security situation. We found that higher production and better yield are associated with a lower proportion of undernourished population. This is particularly the case with rice, the main source of calories for much of South Asia's population. In rural areas, farmers retain part of their cereal production for home consumption. Similarly, landless labourers working in the fields are, in part, paid in grains. Increased cereal production is beneficial even in urban areas due to the subsidized supply of domestic food production.

Our findings suggest a positive effect of policies aimed at enhancing cereal production in South Asia. Governments should consequently step up efforts to improve crop yields which still lag far behind the levels achieved in the developed countries. Focusing on developing drought-resistant crop varieties, providing farmers with better quality seeds, information and technology, managing water distribution more efficiently and reducing post-harvest grain losses can all be pertinent policy steps in this direction.

Climate change is a looming challenge and South Asia is one of the regions hardest hit. The frequency of floods, droughts and extreme temperatures is increasing and farmers are already having to change their sowing practises to minimize crop loss (Aryal et al., 2019). The region is at risk of becoming the world's principal concentration of food insecure people by the middle of this century and the region's cereal production is feared to drop by 30% by the end of this century (IPCC, 2014).

Finally, combatting hunger in the region should not be at the cost of neglecting malnutrition. Large numbers of South Asia's inhabitants are deficient in proteins and micronutrient deficiency is rife among children and women. Work on enhancing dietary quality and diversity should therefore go hand in hand with measures to increase quantity.

**Acknowledgements**:

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**Figures and Tables:**

**Figure 1. Average dietary composition in South Asian countries (2017)**
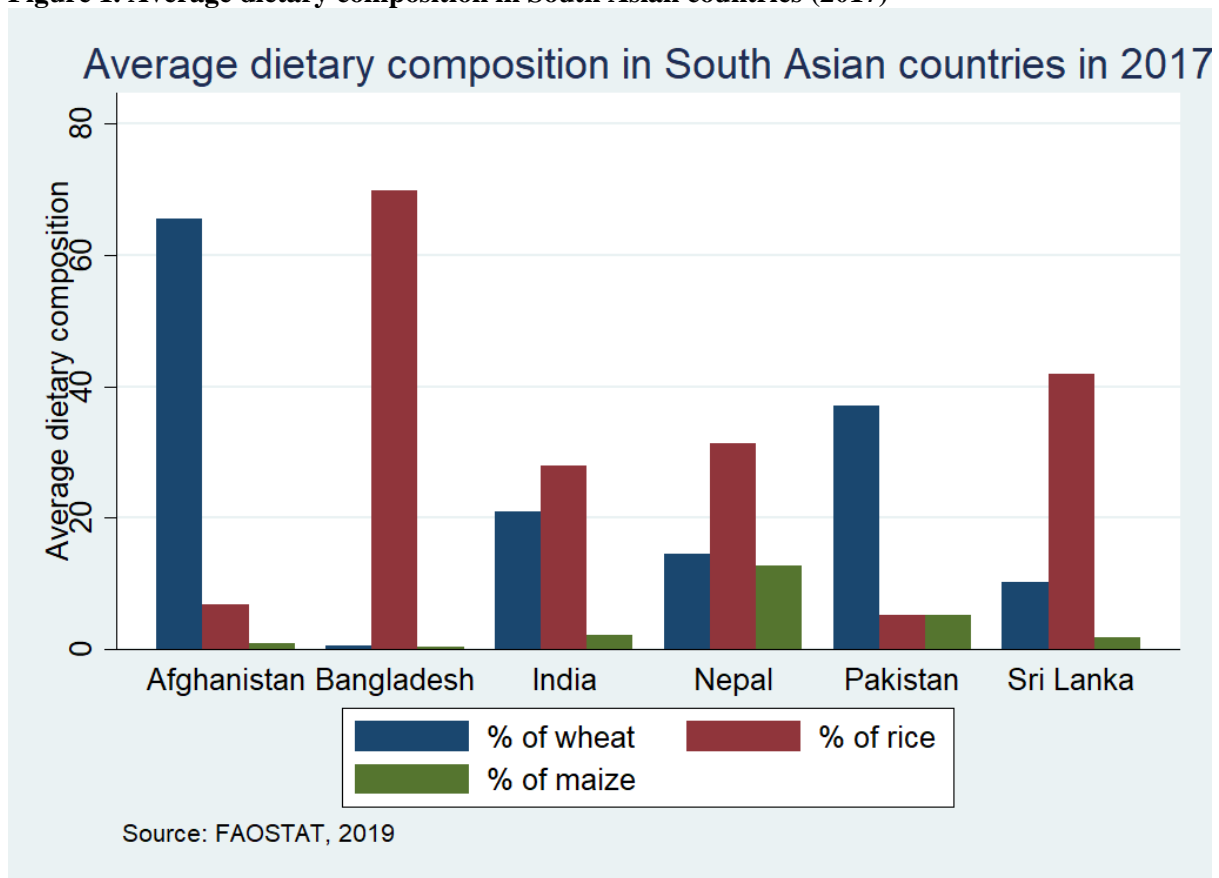
**Figure 2: Cereal production in South Asian countries (share of total crops)**



Source: FAOSTAT, 2019
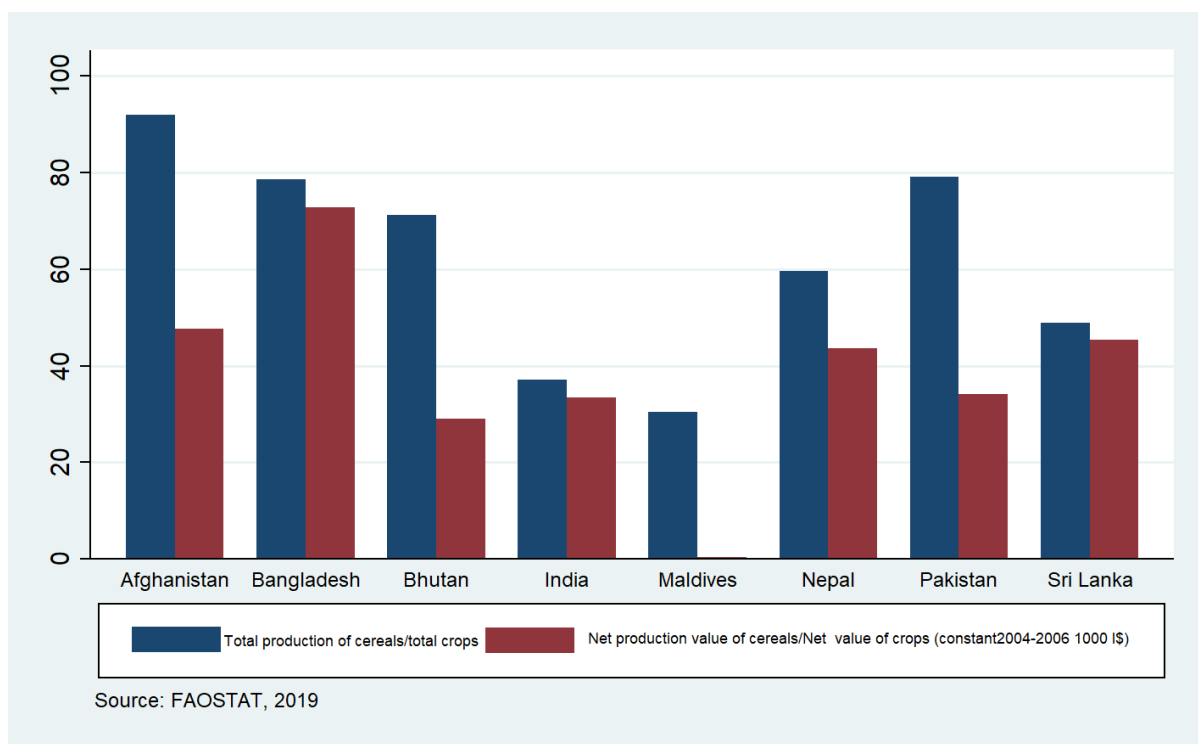
**Table 1: Undernourishment Trends in South Asia**

|  | Number of Undernourished | | Undernourishment Prevalence | |
| --- | --- | --- | --- | --- |
|  | 1990-1992 | 2016-2018 | 1990-1992 | 2016-2018 |
| South Asia | 291.2 | 277.7 | 23.90% | 14.90% |
| Afghanistan | 3.8 | 10.6 | 29.50% | 29.80% |
| Bangladesh | 36 | 24.2 | 32.80% | 14.70% |
| India | 210.1 | 194.4 | 23.70% | 14.50% |
| Maldives | < 0.1 | < 0.1 | 12.20% | 10.30% |
| Nepal | 4.2 | 2.5 | 22.80% | 8.70% |
| Pakistan | 28.7 | 40 | 25.10% | 20,3% |
| Sri Lanka | 5.4 | 1.9 | 9% | 22% |

Source: FAOSTAT, 2019

**Table 2. Evolution of cereal yields in South Asia (Hg/HA) - 1961 - 2017**

| | 1961 | 1970 | 1980 | 1990 | 2000 | 2017 | Evolution (%) 1961-2017 |
|---|---|---|---|---|---|---|---|
| Afghanistan | 11,151 | 11,151 | 13,490 | 12,006 | 8,063 | 20,247 | 81.57% |
| Bangladesh | 16,811 | 16,662 | 20,058 | 24,906 | 33,844 | 44,112 | 162.40% |
| Bhutan | 14,408 | 14,367 | 14,250 | 10,350 | 14,379 | 33,710 | 133.97% |
| India | 9,473 | 11,348 | 13,500 | 18,912 | 22,942 | 31,608 | 233.66% |
| Maldives | 8,883 | 8,922 | 8,500 | 10,000 | 14,855 | 25,686 | 189.16% |
| Nepal | 18,466 | 17,825 | 16,871 | 19,201 | 21,363 | 27,957 | 51.40% |
| Pakistan | 8,564 | 12,297 | 16,131 | 17,664 | 24,079 | 31,708 | 270.25% |
| Sri Lanka | 17,654 | 21,547 | 25,011 | 29,650 | 33,382 | 31,836 | 80.33% |
| **South Asia** | **10,118** | **11,835** | **14,170** | **18,935** | **23,488** | **31,802** | **214.31%** |
| **Africa** | **8,102** | **9,075** | **11,309** | **11,805** | **12,699** | **16,433** | **102.83%** |
| **Least developed countries** | **10,725** | **11,176** | **13,253** | **13,788** | **16,008** | **15,559** | **45.07%** |

*Source: FAOSTAT, 2019*

**Table 3. Evolution of rice, wheat and maize production in South Asia- 1991 - 2017** (tons)

| | Rice | | | Wheat | | | Maize | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1991 | 2000 | 2017 | 1991 | 2000 | 2017 | 1991 | 2000 | 2017 |
| Afghanistan | 333,000 | 260,000 | 338,420 | 1,650,000 | 1,469,000 | 4,280,776 | 480,000 | 115,000 | 173,912 |
| Bangladesh | 26,777,904 | 37,627,500 | 48,980,000 | 890,000 | 840,000 | 1,311,473 | 3,350 | 10,000 | 3,025,392 |
| Bhutan | 55,157 | 44,300 | 86,385 | 5,000 | 4,350 | 3,818 | 40,000 | 48,500 | 90,263 |
| India | 111,151,408 | 127,464,896 | 168,500,000 | 55,134,496 | 76,368,896 | 98,510,000 | 8,961,700 | 12,043,200 | 28,720,000 |
| Nepal | 3,222,540 | 4,216,465 | 5,230,327 | 835,970 | 1,183,530 | 1,879,191 | 1,204,710 | 1,414,850 | 2,300,121 |
| Pakistan | 4,864,650 | 7,203,900 | 11,174,700 | 14,565,000 | 21,078,600 | 26,674,000 | 1,203,100 | 1,643,200 | 5,701,400 |
| Sri Lanka | 2,389,000 | 2,859,900 | 1,620,544 | | | | 34,050 | 31,050 | 195,744 |
| South Asia | 148,793,659 | 179,676,961 | 238,569,477 | 72,190,466 | 100,944,376 | 146,659,258 | 11,886,910 | 15,247,300 | 41,430,069 |

*Source: FAOSTAT, 2019*

**Table 4. Variable definitions and sources**

| Variables | Definition | Source |
|---|---|---|
| Undernutrition | Prevalence of undernourishment (%) (3-year average) | World Bank World Development Indicators database |
| Lncereal_prod | Production of cereals in log | FAOSTAT |
| lnperCapitaCerealProd | Production of cereals per capita in log | FAOSTAT |
| Lncereal_yield | Yield of cereals in log | FAOSTAT |
| ln rice | Production of tons of rice in log | FAOSTAT |
| ln wheat | Production of tons of wheat in log | FAOSTAT |
| ln maize | Production of tons of maize in log | FAOSTAT |
| Foodsupplydiversity | Share of dietary energy derived from cereals, roots and tubes | FAOSTAT |
| Average Dietary Energy Supply Adequacy | Dietary Energy Supply as a percentage of Average Dietary Energy Requirement | FAOSTAT |
| Food Price Index | Domestic food price index | FAOSTAT |
| Per capita food production variability | Variability of net per capita food production in constant 2004-2006 international dollars | FAOSTAT |
| Improved sanitation facilities (% of population with access) | percentage of population using improved sanitation facilities | FAOSTAT |
| Mortality | Mortality rate, under-5 (per 1,000 live births) | United Nations Population Division. World Population Prospects |
| Lngdp_per_capita | GDP per capita in log | World Bank national accounts data |
| Popgrowth | Growth in total population | United Nations Population Division. World Population Prospects |
| Inflation | Inflation, consumer prices (annual %) | International Monetary Fund, International Financial Statistics and data files. |
| Gfce | Public spending to GDP ratio | World Bank World Development Indicators database |
| Climatologicaldisaster | dummy variable taking the value of 1 for the year of Climatological disaster (drought, earthquake, flood, extreme temperature event) associated with food shortage, crop failure or famine | Emergency Events Database (EM-DAT) |
| terrorkilledmillion | terrorism related casualties per million population | Global Terrorism Database |
| Food crisis | Dummy variable taking 1 for 2007-2008 and zero otherwise | |

## Table 5. Summary statistics

| VARIABLES | N | mean | St. Dev. | min | max |
|---|---|---|---|---|---|
| Undernutrition | 175 | 22.79 | 8.98 | 5.20 | 46.70 |
| Lncereal_prod | 168 | 14.44 | 4.71 | 1.38 | 19.50 |
| Lnpercapitacerealprod | 168 | 4.7222 | 1.8245 | 0.0178 | 5.8506 |
| Lncereal_yield | 192 | 7.716 | 0.35 | 6.69 | 8.391 |
| Lnrice | 168 | 15.13 | 2.41 | 10.53 | 18.89 |
| lnwheat | 144 | 14.44 | 2.91 | 8.341 | 18.37 |
| lnmaize | 191 | 11.89 | 3.74 | 0.69 | 16.98 |
| foodsupplydiversity | 140 | 64.14 | 13.24 | 41 | 85 |
| Average Dietary Energy Supply Adequacy | 175 | 106.7 | 7.90 | 89 | 131 |
| Food Price Index | 104 | 6.280 | 2.02 | 2.66 | 9.50 |
| Per capita food production variability. | 184 | 6.274 | 6.39 | 0.90 | 35.10 |
| Improved sanitation facilities (% of population with access) | 192 | 46.34 | 24.66 | 6.20 | 98 |
| Mortality | 200 | 74.54 | 41.20 | 8.60 | 174.20 |
| Lngdp_per_capita | 171 | 6.593 | 0.75 | 5.45 | 8.56 |
| Popgrowth | 198 | 1.961 | 1.32 | -1.76 | 9.41 |
| Inflation | 186 | 7.281 | 4.92 | -18.10 | 30.55 |
| Gfce | 164 | 11.642 | 4.58 | 4.13 | 22.93 |
| terrorkilledmillion | 200 | 6.9943 | 19.99 | 0 | 170.61 |

## Table 6. Undernourishment and cereal production (Fixed-effect estimates)

| VARIABLES | (1) undernutrition | (2) undernutrition | (3) undernutrition | (4) undernutrition | (5) undernutrition | (6) undernutrition |
|---|---|---|---|---|---|---|
| Lncereal_prod | -11.73*** | | | | | |
| | (2.857) | | | | | |
| Lnpercapitacerealprod | | -16.3797*** | | | | |
| | | (3.1609) | | | | |
| Lncereal_yield | | | -21.53*** | | | |
| | | | (3.746) | | | |
| lnrice | | | | -9.313*** | | |
| | | | | (2.261) | | |
| lnwheat | | | | | -2.588 | |
| | | | | | (1.869) | |
| lnmaize | | | | | | -2.159*** |
| | | | | | | (0.212) |
| Lngdp_per_capita | -1.116 | -2.8634 | 1.918 | -3.407* | -3.305** | -2.001 |
| | (2.104) | (1.8216) | (2.223) | (1.915) | (1.306) | (1.327) |
| popgrowth | 4.150*** | 5.8926*** | 2.136*** | 3.044*** | 3.770*** | 2.716*** |
| | (1.136) | (0.9570) | (0.722) | (0.735) | (0.798) | (0.560) |
| inflation | -0.0839 | -0.0844 | -0.0994 | -0.0642 | -0.0162 | 0.0465 |

| | (0.0666) | (0.0633) | (0.0616) | (0.0657) | (0.0448) | (0.0497) |
|---|---|---|---|---|---|---|
| gfce | -1.508*** | -1.309*** | -0.835*** | -0.557*** | -1.150*** | -0.696*** |
| | (0.257) | (0.2437) | (0.194) | (0.206) | (0.158) | (0.156) |
| climatologicaldisaster | 0.425 | 0.2243 | 0.153 | -0.0339 | 0.389 | 0.303 |
| | (0.584) | (0.5628) | (0.545) | (0.600) | (0.437) | (0.444) |
| terrorkilledmillion | 0.0124 | 0.0087 | -0.0131 | -0.0362* | -0.00888 | -0.0234 |
| | (0.0230) | (0.0219) | (0.0183) | (0.0202) | (0.0141) | (0.0150) |
| foodcrisis | 0.478 | 0.6353 | 0.872 | 1.141 | 0.306 | 0.902 |
| | (0.920) | (0.8802) | (0.867) | (0.941) | (0.620) | (0.709) |
| Constant | 231.1*** | 127.4661*** | 184.8*** | 196.4*** | 88.54*** | 65.71*** |
| | (44.68) | (18.6747) | (21.91) | (31.78) | (28.98) | (7.931) |
| Marginal effects | -0.4202 | -0.60 | -0.842 | -0.3174 | -0.2352 | -0.0783 |
| Observations | 106 | 106 | 126 | 121 | 78 | 126 |
| R-squared | 0.741 | 0.762 | 0.673 | 0.637 | 0.807 | 0.780 |
| Number of id | 6 | 6 | 7 | 6 | 4 | 7 |

Note: Columns 1 to 6 show estimations with logs of cereal production, per capita cereal production, cereal yield, and production in log of rice, wheat and maize alternately included as variables of interest. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## Table 7. Food security and cereal production

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Average Dietary Energy Supply Adequacy | Food Price Index | Per capita food production variability. | Improved sanitation facilities (% of population with access) | Mortality |
| **VARIABLES** | | | | | |
| Lncereal_prod | 9.068*** | -0.197 | -11.39*** | 12.52*** | -27.81*** |
| | (2.627) | (0.274) | (2.647) | (3.302) | (6.352) |
| Lngdp_per_capita | -2.713 | 0.444 | 12.38*** | 24.14*** | -72.62*** |
| | (1.935) | (0.298) | (1.841) | (2.296) | (4.417) |
| popgrowth | -4.495*** | -0.321** | 0.852 | -1.026 | 2.863** |
| | (1.045) | (0.150) | (0.563) | (0.702) | (1.351) |
| inflation | 0.104* | | -0.194** | -0.0967 | 0.384** |
| | (0.0613) | | (0.0756) | (0.0943) | (0.181) |
| gfce | 1.891*** | 0.136*** | 0.136 | 0.0463 | -1.873*** |
| | (0.237) | (0.0324) | (0.267) | (0.333) | (0.641) |
| climatologicaldisaster | -0.876 | -0.00633 | -0.731 | 0.105 | 1.609 |
| | (0.537) | (0.0650) | (0.760) | (0.948) | (1.823) |
| terrorkilledmillion | -0.0406* | 0.00973 | -0.0270 | -0.0371 | 0.143* |
| | (0.0211) | (0.00666) | (0.0323) | (0.0403) | (0.0776) |
| foodcrisis | -0.604 | -0.0408 | 2.750** | 1.300 | -3.830 |
| | (0.846) | (0.0825) | (1.146) | (1.430) | (2.751) |
| Constant | -37.26 | 5.460 | 105.9*** | -313.9*** | 1,002*** |
| | (41.08) | (3.885) | (35.57) | (44.37) | (85.36) |

| | | | | |
|---|---|---|---|---|
| Marginal effects | 0.0919 | -0.0557 | -0.8567 | 0.3115 | -0.2519 |
| Observations | 106 | 75 | 129 | 129 | 129 |
| R-squared | 0.696 | 0.420 | 0.421 | 0.780 | 0.887 |
| Number of id | 6 | 6 | 7 | 7 | 7 |

Notes: Columns 1 to 5 show estimations with Average Dietary Energy Supply Adequacy, Food Price Index, Per capita food production variability, Improved sanitation facilities and mortality as dependent variables respectively. Inflation is excluded from the list of explanatory variables when regressing food price index. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## Table 8. Undernourishment and cereal production - Alternative estimates

| VARIABLES | (1) undernutrition | (2) undernutrition | (3) undernutrition | (4) undernutrition |
|---|---|---|---|---|
| foodsupplydiversity | -0.432 | | | |
| | (0.360) | | | |
| lncereals | | -12.96*** | -7.634* | |
| | | (3.103) | (4.268) | |
| L.lncereal_prod | | | | -7.156** |
| | | | | (2.881) |
| Lngdp_per_capita | -10.35*** | -0.916 | -9.043 | -3.283 |
| | (3.206) | (2.161) | (5.992) | (2.183) |
| popgrowth | 3.817*** | 3.830*** | 2.891* | 4.612*** |
| | (0.909) | (1.176) | (1.583) | (1.298) |
| inflation | -0.0150 | -0.0822 | -0.0699 | 0.00418 |
| | (0.0759) | (0.0680) | (0.0833) | (0.0730) |
| gfce | -0.413 | -1.477*** | -1.266*** | -1.434*** |
| | (0.279) | (0.262) | (0.332) | (0.290) |
| climatologicaldisaster | 0.346 | 0.312 | 0.633 | 0.652 |
| | (0.710) | (0.605) | (0.706) | (0.635) |
| terrorkilledmillion | -0.0283 | 0.0130 | 0.0237 | 0.00957 |
| | (0.0325) | (0.0232) | (0.0268) | (0.0246) |
| foodcrisis | 0.307 | 0.470 | 0.160 | 0.277 |
| | (1.130) | (0.930) | (1.202) | (0.987) |
| Constant | 115.3*** | 258.2*** | 206.0*** | 165.9*** |
| | (38.71) | (50.13) | (50.11) | (46.37) |
| Marginal effects | -1.173 | -0.4553 | -0.2928 | -0.1614 |
| Observations | 111 | 101 | 83 | 102 |
| R-squared | 0.505 | 0.746 | 0.738 | 0.703 |
| Number of id | 7 | 5 | 5 | 6 |

Note: Column 1 shows estimation including food supply diversity as explanatory variable. Columns 2 and 3 show estimations using the dataset excluding Maldives and India respectively. Columns 4 shows estimation with one lag of the log of cereal production taken as the variable of interest. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

**Table 9. Undernourishment and cereal production – Dynamic model estimates**

| VARIABLES | (1) undernutrition | (2) undernutrition | (3) undernutrition |
|---|---|---|---|
| lncereals | -0.850*** | -4.049*** | -10.00*** |
| | (0.0807) | (0.580) | (1.559) |
| L.undernutrition | 0.912*** | 0.862*** | |
| | (0.0140) | (0.0188) | |
| lngdp_per_capita | 1.394*** | 1.155*** | -2.232* |
| | (0.214) | (0.424) | (1.247) |
| popgrowth | 0.600*** | 0.178 | 4.194*** |
| | (0.181) | (0.239) | (0.573) |
| inflation | 0.00207 | -0.0262* | -0.0283 |
| | (0.0107) | (0.0135) | (0.0354) |
| gfce | -0.177*** | -0.329*** | -1.754*** |
| | (0.0307) | (0.0596) | (0.147) |
| climatologicaldisaster | -0.0256 | 0.0405 | 0.674** |
| | (0.0998) | (0.116) | (0.311) |
| terrorkilledmillion | 0.0116*** | 0.0221*** | 0.0124 |
| | (0.00314) | (0.00445) | (0.0113) |
| foodcrisis | -0.594*** | -0.377** | 0.226 |
| | (0.133) | (0.179) | (0.455) |
| Constant | 7.419*** | 65.59*** | 211.2*** |
| | (2.334) | (9.348) | (23.11) |
| Marginal effects | -0.024 | -0.132 | -0.373 |
| Observations | 102 | 96 | 106 |
| Number of id | 6 | 6 | 6 |

Note:Colums 1 - 3 respectively show results for the System GMM, Arellano and Bond and Linear DPD models. Standard errors in parentheses, , , *** p<0.01, ** p<0.05, * p<0.1.