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Food and Nutrient Intake Response to Food Prices and Government Programs: Implications for the Recent Economic Shocks

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Abstract

The study aims to estimate the short-term impact of the recent rounds of food price inflation and the COVID19 crisis by estimating a household food demand system, converted to energy and nutrient intakes. It demonstrates that recent food and nutrition surveys conducted by the Philippine government are a valuable source of information about household behavior and the impact of economic shocks. It offers a novel methodology for incorporating computing selection effects in determinants in estimating price and income elasticities. The study was nevertheless able to determine that the COVID19 social protection programs played a significant role in preventing further deterioration in nutrient intakes and worsening of malnutrition. Notwithstanding rapid economic growth, the recent inflation episodes pose a major threat to nutrient intakes and nutrition security. Income policies in the form of targeted cash transfers are an important, albeit expensive way to counter adverse nutrition impacts of economic contraction**.** Ameliorating the impact of price increases during inflation episodes should assume priority in policy research and response.

Keywords: food demand, economic contraction, price inflation, price and income elasticity, nutrient intake, food policy

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Food and Nutrient Intake Response to Food Prices and Government Programs: Implications for the Recent Economic Shocks

Roehlano M. Briones*

1. Introduction

Even before the Coronavirus 2019 (COVID19) pandemic, the nutritional status of Filipino children was already serious concern, with the stunting rate at 28.8 percent in 2019 (DOST-FNRI, 2019). In March 2020, the COVID19 pandemic reached the Philippines. As a result of the COVID19 community quarantines and worldwide economic contraction, Gross Domestic Product (GDP) underwent a unprecedented decline in 2020. Though the economy recovered somewhat in 2021, GDP in 2nd quarter 2022 is still lower by 5.6 percent compared to 4th quarter 2019. The economic contraction has likely led to dramatic increases in poverty, though the Social Amelioration Package (SAP) of the government likely mitigated the decline (Reyes, 2021). Following the output and employment contraction in 2020 was rising inflation in 2021-22, as world prices of crude oil, fertilizer, and food reached historic peaks. These economic shocks are likely to have had adverse impact on food consumption and nutrient intake at the household level, leading to worsening nutritional status. This will push the Sustainable Development Goal (SDG) of ending hunger and malnutrition by 2030 further out of reach.

There is however little information about the size of household level consumption impacts of these economic shocks. This study aims to establish an empirical relationship between economic adjustments in the form of prices, income and expenditure, and government programs, and household and individual food consumption and nutrient intake. In doing so, it will provide a valuable input in the design of short- and long-term programs for addressing household food insecurity and malnutrition. The key evaluation questions for this study are as follows:

- By how much did household food consumption and nutrient intake decline in response to recent economic shocks?
- By how much does individual level consumption and nutrient intake vary given changes in household consumption?
- What can we infer about the design of government programs in terms of ensuring food security and proper nutrition in the event of economic shocks?

The study aims to estimate the short-term impact of the recent rounds of food price inflation and the COVID19 crisis. In doing so it develops a policy tool that may also serve to evaluate nutrition impacts of long term economic change, and its implication for achieving SDG 2 by 2030, namely ending hunger and malnutrition. Specifically, the study aims to:

1. Examine patterns of response of household and individual food consumption and nutrient intake to changes in food prices, household income and expenditure, and public programs;
2. Estimate elasticities of consumption and nutrient intake with respect to price and expenditure and possibly income;
3. Estimate transmission elasticities from household price and expenditure to individual food consumption and nutrient intake;

4. Based on these patterns and responses, to estimate the impact of recent bouts of inflation and economic contraction in 2020 - 2022, as well as accompanying safety nets, on household food consumption and nutrient intake;
5. Draw policy implications about the design of government programs in terms of ensuring food security and proper nutrition in the event of economic shocks.

2. Recent economic trends

2.1 Overview

This section reviews economic and household welfare indicators from secondary official sources, focusing on the most recent period. Philippine Statistics Authority (PSA) official statistics provide the economic indicators, as well as trends in poverty and per capita consumption in selected years. Per capita consumption is obtained by recall method, in raw, as-purchased form, over the past week.

Another estimate of per capita consumption uses the one-day intake as measured by direct weighing under the National Nutrition Survey (NNS) conducted by the Food and Nutrition Research Institute (DOST-FNRI) of the Department of Science and Technology (DOST). Data on household consumption measures the quantity of food reckoned in raw, as-purchased form, but accounts for household (plate) wastage, hence the resulting figure pertains to consumption as quantity of food actually eaten, expressed in raw form. In 2018-19, DOST-FNRI conducted the Expanded NNS, which covers information on: socioeconomic status; food consumption and nutrient intake; anthropometric measures; biomedical measures; clinical and health practices; maternal health and nutrition; infant and young child feeding practices; food security; and participation in government programs.

2.2 Output and employment

GDP underwent severe contraction in 2020, led by a fall in investment, though 2021 has seen a strong recovery

Quarterly GDP growth (year-on-year) was still a decent 6.1% average for 2019, but a contraction already began in first quarter of 2020, deepening to an unprecedented level in the second quarter. This continued over the succeeding quarters, reversing only the first quarter of 2021. Growth has remained consistently high over the succeeding quarters. By component, during the contraction phase all components also fell sharply except for Government consumption; the worst performing were investment and exports. In the recovery phase, all the components also recovered, with the biggest recovery for investment.

The COVID-19 pandemic was likewise associated with a sharp rise in unemployment and underemployment, which had recovered to pre-pandemic levels by late-2021.

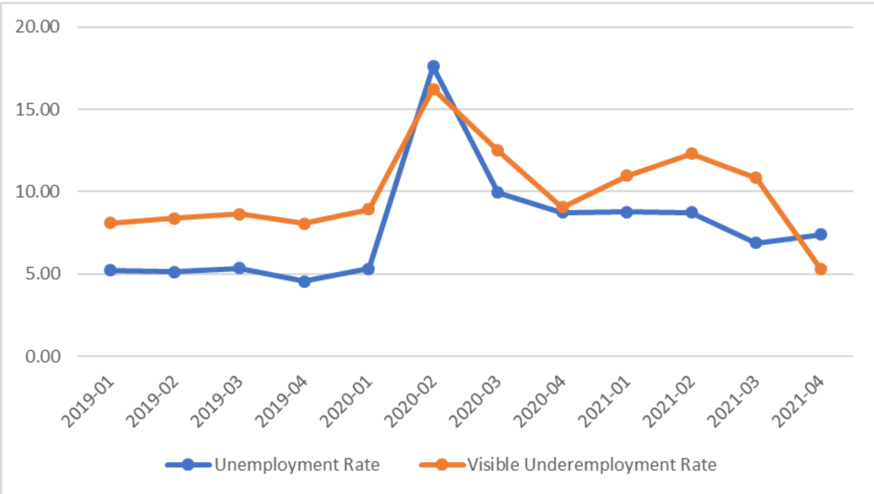
Quarterly unemployment rate held steady at around 5% over 2019 and first quarter of 2020. The visible underemployment rate, which is the share of workers who work under forty hours a week and seek more hours of work per week, had also been fairly steady at around 8-9 percent. In the second quarter there was a sharp spike in both measures, with rate of unemployment even exceeding that of visible underemployment, although the decline had already begun even in the third quarter. By 2021, unemployment remained elevated above 2019 levels, whereas visible underemployment again began to rise in early 2021, before dipping even below 2019 levels by late 2021.

Table 1: Year-on-year quarterly growth of GDP by expenditure component, 2018 – 2022 (%)

	2019				2020				2021	2022
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Household consumption	5.9	0.2	-15.3	-9.2	-7.3	10.0	8.6	13.8	7.8	7.4
Government consumption	9.3	7.0	21.8	5.8	5.0	3.6	11.1	20.8	14.2	20.5
Gross capital formation	3.7	-12.3	-51.8	-38.8	-31.7	20.4	20.5	9.1	7.7	7.4
Exports	2.6	-3.6	-33.2	-15.3	-10.7	10.4	4.3	12.7	14.3	14.5
Imports	2.5	-7.2	-37.2	-20.6	-20.6	15.4	13.6	7.0	7.8	7.8
GDP	6.1	-0.7	-16.9	-11.6	-8.2	8.2	7.4	7.1	7.5	9.3

Note: 2022 pertains to the average of quarters 1 and 2.
Source: PSA (2022).

Figure 1: Quarterly rate of unemployment and visible underemployment, 2019 – 2021 (%)



Source: PSA (2022).

The Bayanihan programs of government provided substantial social protection to households in 2022.

The Bayanihan Heal as One Act (Bayanihan 1) was passed by late March, 2020, within a couple of weeks of the declaration of the State of National Calamity owing to COVID19. The law authorized a cash transfer program known as SAP, provided to beneficiaries of the Pantawid Pamilyang Pilipino Program (4Ps) of the government, the on-going social protection scheme aimed at the poor. In September the same year, the Bayanihan II was passed, continuing social protection schemes of Bayanihan 1. It also expanding labor market measures through cash for work, such as the Tulong Panghanapbuhay sa Ating Disadvantaged/Displaced Workers (TUPAD and access to capital at concessional rates aimed at micro, small, and medium enterprises. These social protection measures made up the bulk of the fiscal response to COVID19, amounting to about 2.5 percent of GDP (Cho and Johnson, 2022).

Several key food items have undergone severe price inflation since 2021.

Economic contraction in 2020 compounded an on-going bout with inflation starting in 2022. Previously in 2018, inflation had been driven by rice prices at 7.3 percent, whereas the overall inflation rate was 4.3 percent. In 2019, rice prices actually declined owing to Republic Act (RA) 11203, the Act liberalizing the rice industry. Prices remained generally stable through to 2021 (Table 2). Inflation started to become a problem across-the-board in 2022, with the overall rate (in annual terms reaching 7.7%, breaching by far the Bangko Sentral ng Pilipinas (BSP) ceiling of 4 percent. Fats & oil hit 20 percent, followed by Vegetables at 15 percent, Meat reached 12 percent, and wheat-based products at 10 percent, followed closely by Fish and Dairy. Not shown in the Table is sugar and confectionary products, whose price index rose by an astonishing 33 percent from January to October 2022. Overall the food inflation rate was 10 percent. The main drivers were world prices of crude oil and cereals; even rice reversed to positive growth in 2022 (though at a mild 2.5 percent) as world fertilizer prices began to exert pressure on rice prices.

Table 2: Annual inflation rate, 2019 – 2022 (%)

	2019	2021	2022
Rice	-4.2	-0.7	2.5
Flour, bread, bakery products	3.5	2.0	9.8
Fish	3.9	6.4	9.4
Meat	3.8	13.4	11.5
Fruits	5.2	-0.1	4.9
Vegetables	2.7	4.8	16.0
Dairy	2.4	1.1	8.7
Fats & oil	1.6	5.6	20.4
Other food	4.5	1.3	8.1
Food	1.5	4.5	9.8
All items	2.4	3.9	7.7

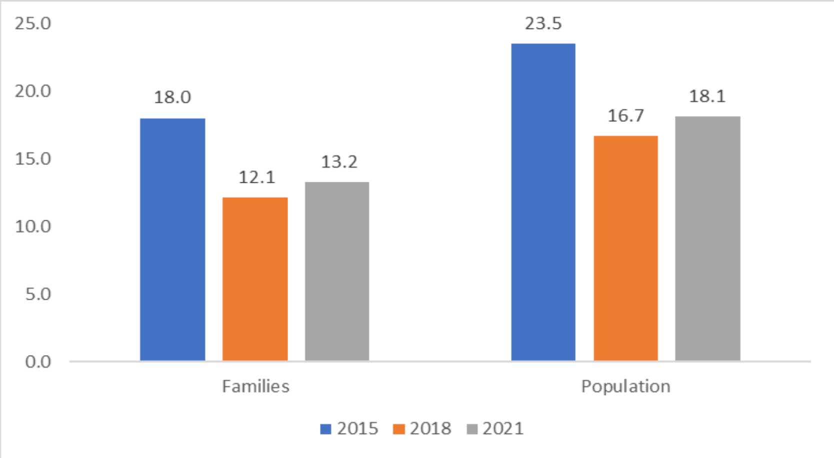
Note: 2022 figures are computed as the average of montly year-on-year inflation rates for January to October.
Source: PSA (2022).

2.3 Poverty

After a sharp decline in 2015 – 2018, poverty increased in 2018-21, though the 2021 level is still below that of 2015.

One may easily guess that household welfare was negatively impacted by these economic shocks. This is confirmed by poverty estimates for 2021 (Figure 2).

Figure 2: Poverty incidence of families and of population, Philippines, 2015 – 2021 (%)



Source: PSA (2022).

For the population, the incidence of poverty was 18.1 percent, up from the historic low of 16.7 percent in 2018. Likewise, the incidence of family poverty was 13.2 percent in 2018, up from 12.1 percent in 2018. Fortunately the reversal was not sharp enough to reverse all the poverty gains made from 2015, probably because of the strong recovery of employment and economic growth in 2021.

3. Recent trends in food consumption and nutrition

3.1 Food consumption and expenditure

Before the recent economic shocks, per capita consumption of several key food items had been declining.

PSA survey data on per capita consumption is available from 1999 onward for selected years (Table 3). Up to 2012 the PSA (then through the former Bureau of Agricultural Statistics) conducted a Survey of Food Demand, while in 2018, PSA used the Family Income and Expenditure Survey (FIES) to generate measures of per capita consumption. Per capita consumption had been rising up to 2012 for Rice, Pandesal, Eggplant, Ampalaya, Chicken, Milkfish, Tilapia, and Roundscad. However from 2012 to 2018, PSA recorded a decline in per capita consumption, though some caution must be placed on interpreting these estimates given the difference in data source. Nonetheless there were sharp reductions in Rice (9.6 percent), Pork (32.6 percent), Chicken (14.8 percent), and Roundscad (31.6 percent).

Table 3: Per capita consumption of selected items, Philippines

	1999-2000	2008-2009	2012	2018
		in kg/year		
Rice	105.8	119.1	114.3	103.3
Corn	10.9	7.1	10.3	9.1
Pandesal	.	4.2	6.3	.
Camote	7.4	4.1	4.3	.
Cassava	6.9	3.1	2.8	.
Eggplant	3.9	4.2	4.1	.
Ampalaya	1.1	2.5	2.4	.
Tomato	3.2	2.6	3.2	.
Banana	22.4	16.7	.	.
Mango	3.3	3.2	3.5	.
Pork	11.2	9.2	9.5	6.4
Beef	2.8	1.2	0.9	.
Chicken	7.4	7.9	8.1	6.9
Milkfish	2.9	4.2	3.7	3.0
Tilapia	.	4.7	4.8	3.6
Roundscad	.	5.4	5.7	3.9

Sources: PSA (2022).

In the 2010s, per capita consumption of most major food groups has been falling, except vegetables.

The remaining tables for consumption at the household level are derived from NNS, where the series starts in 1978 up to 2018-2019 (DOST-FNRI, 2022a and 2022b). NNS were conducted every five years except in 1982, and 2018-19. For the major food groups per capita consumption had been falling over the thirty-year period from 1978 to 2018-19, except for meat, where per capita consumption more than doubled over the period (Table 4). However in the 2010s, even meat consumption (together with the rest of the food groups) also suffered a decline in per capita consumption.

Table 4: Per capita consumption of food items, 1978 – 2019

	1978	1982	1987	1993	2003	2008	2013	2015	2018-19
					In gm/day				
Cereals & cereal products	367	356	345	340	364	361	346	358	315
Rice & rice products	308	304	303	282	303	317	299	308	276
Fish & fish products	102	113	111	99	104	110	109	101	94
Meat & meat products	23	32	37	34	61	58	65	61	58
Vegetables	145	130	111	106	111	110	114	123	126
Fruits	104	102	107	77	54	54	41	37	34

Sources: DOST-DOST-FNRI (2022a).

The following discussion focuses on data from the 2018-19 NNS. Disaggregated consumption estimates are available at the household level, while nutrient intake and nutritional status are available at the individual level. Mean household size was 4.2 members. The NNS also collects data on household assets, which are combined using principal component analysis into a wealth index to sort households into quintiles, referred to as Poorest, Poor, Middle, Rich, and Richest.

Increasing wealth is associated with lower consumption of cereals and vegetables, and rising consumption of animal products, fats & oils, and fruit.

Estimates of mean one-day food consumption at the household level for 2018-19 are shown in Table 5. Average daily intake for a family of 4.5 members is about 3 kg of food, of which 1.2 kg is Cereals & cereal products, of which 88 percent is rice by weight. This is followed by Fish and fish products at 339 gms per day; on annual basis per capita this amounts to about 29.5 kg of fish & fish products, making this food group by far the most significant source of animal protein. The next most significant is Meat & meat products, followed by Milk & milk products, then Poultry. In per capita terms, Vegetable and Fruit consumption add up to 133 gm per day, a stunning 67 percent below the World Health Organisation (WHO) dietary recommendation of 400 gms of fruits and vegetables per day (preferrably in five different servings).

Household consumption of Rice, Sugars & syrups, and Vegetables is highest for the Poorest quintile, and least for the Richest quintile, implying that (holding prices constant), these food groups are inferior goods (increasing income is associated with lower quantity consumed). Meanwhile household consumption of Fish & fish products, Meat & meat products, Poultry, Eggs, Milk & milk products, and Fruits are increasing with wealth quintile; the biggest difference between the household consumption of the Richest and of Poorest is largest for Meat & products (320 percent), followed by Poultry (294 percent), and Milk & milk products (238 percent).

Table 5: Mean one-day household food consumption by food group and wealth quintile, Philippines, 2018

	All	Poorest	Poor	Middle	Rich	Richest
	(in gms per day)					
Cereals & cereal products	1,213	1,269	1,254	1,230	1,172	1,105
Rice & rice products	1,064	1,068	1,094	1,098	1,053	985
Starchy roots & tubers	38	48	28	30	39	48
Sugars & syrups	32	34	33	32	31	30
Fats & oils	53	42	54	55	55	68
Fish & fish products	339	304	330	344	351	377
Meat & meat products	214	87	151	227	286	366
Poultry	113	50	77	111	158	197
Eggs	82	59	81	89	90	95
Milk & milk products	188	91	139	196	248	308
Vegetables	468	503	467	453	436	481
Fruits	122	112	89	119	128	178
Others	159	135	147	169	167	176
Total	3,021	2,734	2,850	3,055	3,161	3,429

Sources: DOST-DOST-FNRI (2022a).

As household wealth increases, food expenditure rises for all the food groups.

The NNS collects data on household spending on food, called household food cost; items consumed but not purchased, e.g. produced at home, or received as gifts, are imputed a price at the prevailing local market price. For all the major food groups, household spending increases by wealth quintile of household (Table 6). One-day food spending of Richest households is about Php 366, more than double that of Poorest households (Php 181) and 44 percent higher than average (Php 254). The fact that spending increases for inferior goods implies increasing unit value (in Php per gm), probably capturing increasing quality of Rice & rice products, Sugars & syrups, and Vegetables.

Table 6: Mean food cost of households, by major food group and wealth quintile, Philippines, 2018 - 19

	All	Poorest	Poor	Middle	Rich	Richest
			In Php per day			
Cereals & cereal products	71.5	66.9	68.8	69.7	72.5	82.4
Rice & rice products	50.4	49.3	50.1	50.1	50.4	52.4
Starchy roots & tubers	2.2	1.6	1.2	1.9	2.8	4.2
Sugars & syrups	4.0	2.9	3.8	3.9	4.5	5.5
Fats & oils	5.3	3.9	4.6	5.2	6.2	7.3
Fish & fish products	42.8	32.3	28.0	43.2	47.1	58.1
Meat & meat products	37.1	14.3	24.4	37.7	49.8	62.4
Poultry	18.1	7.8	12.2	17.1	25.3	33.0
Eggs	10.4	7.4	10.6	10.7	11.2	13.0
Milk	11.1	4.8	7.3	10.0	14.5	22.1
Vegetables	26.6	22.5	24.0	25.8	28.4	34.4
Fruits	5.6	2.9	3.7	5.0	6.5	11.3
Others	18.9	14.1	27.2	19.9	17.2	32.1
Total	253.6	181.3	215.6	250.1	286.0	365.8

Sources: DOST-FNRI (2022a).

Food consumption is concentrated in animal proteins and cereals; increasing wealth is associated with decreasing expenditure shares of inferior goods.

The average household devotes nearly half of food expenditure on animal proteins (47.1 percent); another 28 percent is allocated to cereals, of which rice alone is already about 20 percent (Table 7). Vegetables accounts for about a tenth of the food budget. As wealth quintile increases, expenditure share of cereals and vegetables tend to decline; the Poorest quintile spends about 27 percent of its food budget for rice, and 12.4 percent for vegetables, compared with only 14 percent and 9 percent, respectively, for the richest quintile.

Table 7: Expenditure shares of the major food groups,

	All	Poorest	Poor	Middle	Rich	Richest
Cereals & cereal products	28.2	36.9	31.9	27.9	25.4	22.5
Rice & rice products	19.9	27.2	23.2	20.0	17.6	14.3
Starchy roots & tubers	0.9	0.9	0.6	0.7	1.0	1.1
Sugars & syrups	1.6	1.6	1.7	1.5	1.6	1.5
Fats & oils	2.1	2.1	2.1	2.1	2.2	2.0
Fish & fish products	16.9	17.8	13.0	17.3	16.5	15.9
Meat & meat products	14.6	7.9	11.3	15.1	17.4	17.1
Poultry	7.1	4.3	5.6	6.8	8.8	9.0
Eggs	4.1	4.1	4.9	4.3	3.9	3.6
Milk	4.4	2.6	3.4	4.0	5.1	6.0
Vegetables	10.5	12.4	11.1	10.3	9.9	9.4
Fruits	2.2	1.6	1.7	2.0	2.3	3.1
Others	7.5	7.7	12.6	8.0	6.0	8.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: DOST-FNRI (2022a).

3.2 Nutritional status

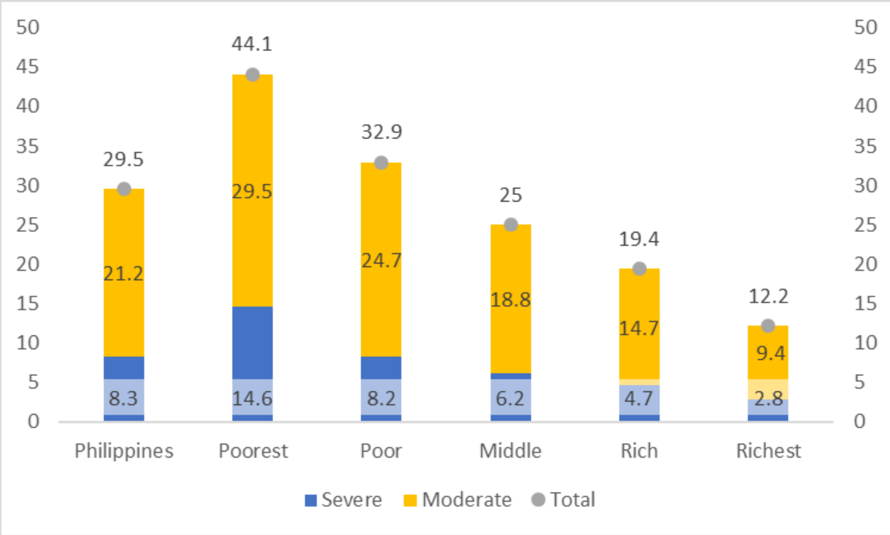
The Expanded NNS provides information on nutritional status using Anthropometric Survey and Biochemical Survey. Among the measurements made, the focus here are on the most critical malnutrition indicators, namely stunting prevalence among children under-5, and prevalence of iron and Vitamin A deficiency.

Prevalence of stunting among children under-5 remains seriously high, reaching alarming levels among the Poorest quintile.

Stunting among children under-5 (referring to children 0 – 59 months old whose height-for-age is two standard deviations below the median of WHO Child Growth Standards) represents chronic undernutrition in the critical early period of a person's growth. It is predictive of economic outcomes related to cognitive development and health, such as test scords, education, and wages (Horton and Hoddinott, 2014). In the Philippines, childhood stunting prevalence was 44.7 percent in 1989, falling gradually to 33.1 percent in 2005, with essentially no improvement (and even a slight worsening) over the next decade, reaching 33.4 percent in 2015 (Herrin, 2016).

In 2018, childhood stunting prevalence improved to 29.5 percent, but remains very serious (Figure 4). Stunting is certainly correlated with wealth status as can be seen by breaking down childhood stunting by wealth quintile; what is alarming is that the Poorest quintile has a stunting prevalence of 44.1 percent, close to the national level back in 1989. Prevalence of severe childhood stunting is also correlated with household wealth; among the poorest quintile, nearly 15 percent of children under-5 are subject to severe stunting.

Figure 3: Stunting prevalence among children under-5, by degree of stunting and wealth quintile of household (%)



Sources: DOST-FNRI (2022).

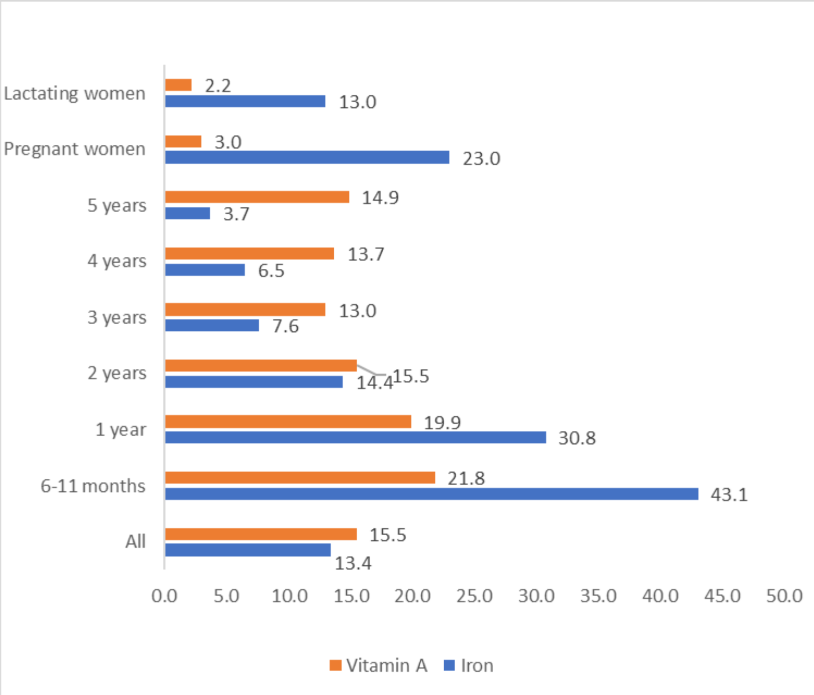
Prevalence of anemia and Vitamin A deficiency is most severe among children six months to one year old.

Deficiency of iron and Vitamin A among children under-5 appears moderate at 13.4 and 15.5 percent, respectively (Figure 5). Iron deficiency though reaches as high as 43.1 percent among children 6-11 momths old, while Vitamin A deficiency reaches 21.8 percent; and children 1 – 2 years old also suffer very high deficiency prevalence (Figure 5). By age 5 iron deficiency has fallen to a low 3.7 percent, whereas Vitamin A deficiency falls to the average rate of 14.9 percent.

Iron and Vitamin A deficiency among children under-5 is also correlated with household wealth quintile.

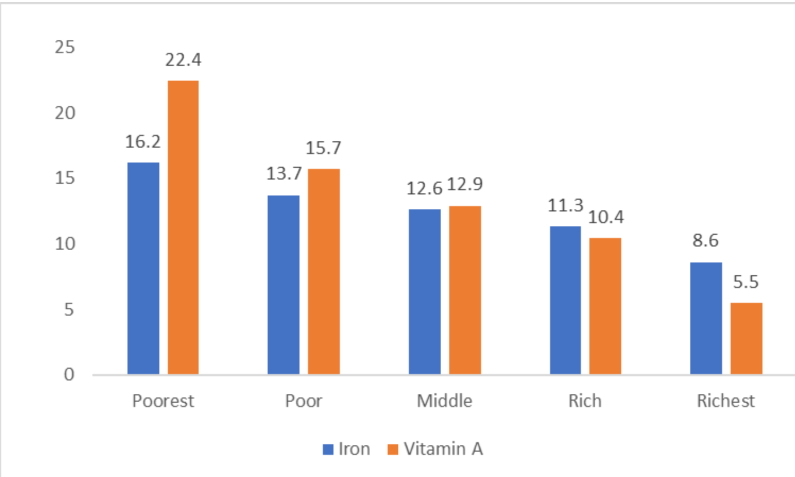
Prevalence of iron and Vitamin A deficiency among children under-5 is correlated not only with the age of the child, but also the household wealth quintile (Figure 6). The highest prevalence of iron and Vitamin A deficiency is among the Poorest quintile, reaching 16.2 percent for iron deficiency, and 22.4 percent for Vitamin A deficiency. Prevalence declines over the quintiles, falling to 8.6 percent and 5.5 percent among the Richest quintile of iron and Vitamin A deficiency, respectively.

Figure 4: Prevalence of anemia and Vitamin A deficiency among children, pregnant, and lactating women, Philippines, 2018-19 (%)



Source: DOST-FNRI (2022b).

Figure 5: Prevalence of iron and Vitamin A deficiency among children under-5, by wealth quintile, Philippines, 2018-19 (%)



Source: DOST-FNRI (2022b).

3.3 Nutrient intake

Household level

The expanded NNS computes energy and nutrient intake by applying the Household Dietary Evaluation System to convert from raw as-purchased form to cooked; this is combined with the Philippine Food Composition Table available online, to compute caloric and nutrient values. Adequacy rate based on share of households with adequate intake, was assessed using the Philippine Dietary Reference Intakes based on caloric and nutrient intakes per capita (DOST-FNRI, 2022a), respectively referred to as Recommended Energy Intake (REI) and Estimated Average Requirement (EAR).

Only a minority of households meet dietary norms for intake of energy, iron, and Vitamin A, though the rate of adequacy rises with wealth quintile.

While a majority of households meet the EAR for protein, only about a fifth meet EAR for Vitamin A and REI, while only 6 percent meet the EAR for iron (Table 8). For energy and nutrient intake, adequacy rate tends to rise with wealth quintile, except Vitamin A. In the case of protein intake, only a minority of households in the poorest quintile meets the EAR, rising to two thirds in the richest quintile.

Table 8: Share of households whose per capita energy and nutrient intake meet REI and EAR, Philippines, 2018-19 (%)

	Energy	Protein	Iron	Vitamin A
All	21.8	55.1	5.8	22.6
Poorest	20.4	44.9	4.7	21.5
Poor	21.8	51.6	5.6	21.5
Middle	21.5	56.9	5.5	23.1
Rich	22.2	59.0	5.5	23.0
Richest	24.0	66.8	8.2	24.4

Source: DOST-FNRI (2022a).

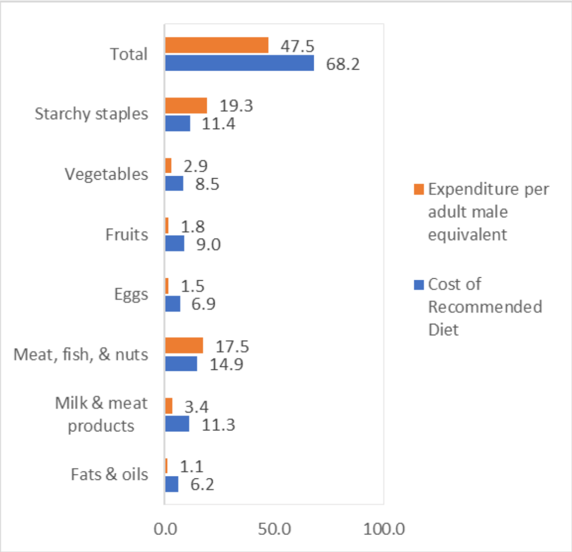
One reason for the inability to meet dietary intake recommendations is low affordability of nutritious food, especially fruits and vegetables.

Mbuya et al (2021) computed the cost of meeting minimum requirements for a healthy diet in 2015. The Cost of a Nutritious Diet (CoRD) incorporates dietary guidelines (food "pyramids"), involving a quantity to be consumed within each food group, to reach nutritional needs and avoid diet-related non-communicable diseases for an adult male, while adhering to cultural norms of commonly eaten foods. They find some misallocation of food expenditures based on 2015 food expenditure figures, per adult male equivalent (AME). Filipino households allocate 44 percent more on starchy staples, and 17 percent more for Meat, fish, and nuts, than is warranted by dietary guidelines (Figure 7). Likewise excess allocation is found for Fats & oils (17 percent). On the other hand, there is under consumption of Vegetables, Fruit, and Milk and meat products. Overall however, the daily CoRD of Php 68.2 far exceeds the 2015 average food expenditure at Php 47.5 per day. This comparison suggests that, even correcting for misallocation for healthy diets, Filipino households still find a nutritious diet unaffordable.

Part of the reason for unaffordability of a healthy diet is high cost of nutritious food.

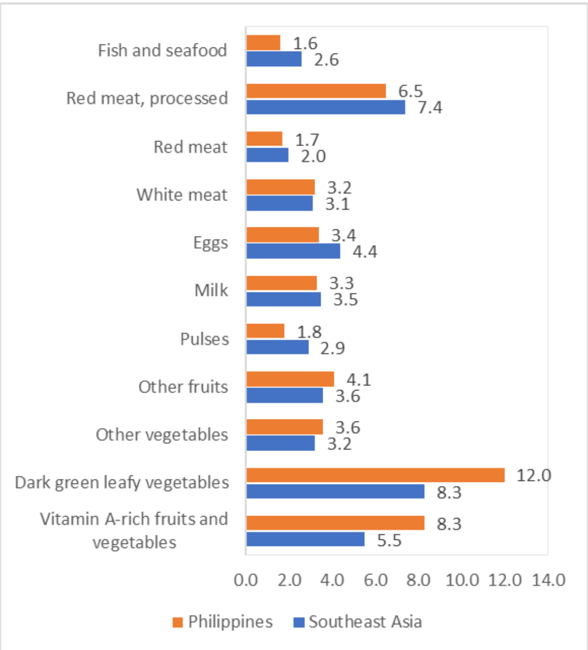
World Bank data for 2011 offers valid price comparisons across developing countries, including the Philippines. Prices are standardized across food groups by normalizing based on caloric content. Price per calorie for most vegetables and fruits in the Philippines exceeds that of the average for Southeast Asia (Figure 8); indeed, its cost exceeds that in lower middle income countries. On the other hand, animal-sourced food groups is cheaper per calorie in the Philippines than in Southeast Asia.

Figure 6: Daily Cost of Recommended Diet and Expenditure per Adult Male Equivalent, 2015



Source: Mbuya et al (2021).

Figure 7: Cost per 1,000 kcal by food category, Philippines and Southeast Asia, 2011



Source: Mbuya et al (2021).

Cereals accounts for the bulk of energy intake, and close to half of protein and iron intake of households, while Vitamin A is mostly obtained from animal protein sources.

The shares in total energy and nutrient intake by food group are shown in Table 9. Note that cereals and cereal products are the largest contributors to energy and protein intake, consistent with the estimates in Figure 7. Of these, Rice & rice products alone contribute the majority of energy intake (56 percent) and much of the protein and iron intakes (36 and 32 percent, respectively). Meanwhile, Vitamin A is mostly obtained from animal protein sources; the sum of Fish & fish products, Meat & meat products, Poultry, Eggs, and Milk, account for 76 percent of Vitamin A intake; the next most significant source of Vitamin A is Vegetables at 18 percent. The animal protein sources are also the biggest contributor of protein (47 percent) and 2nd-biggest contributor to iron intake (31 percent).

Table 9: Contribution to energy and nutrient intake of households, by food group, Philippines, 2018-19 (%)

	Energy	Protein	Iron	Vitamin A
Cereals & cereal products	68.0	45.4	45.8	3.4
Rice & rice products	56.6	36.5	32.4	0.1
Starchy roots & tubers	0.6	0.3	1.0	0.1
Sugars & syrups	1.8	0.1	0.3	-
Fats & oils	6.4	0.8	1.0	0.2
Fish & fish products	3.5	19.0	10.8	18.6
Meat & meat products	7.5	13.4	11.6	23.2
Poultry	2.0	7.9	3.5	19.3
Eggs	1.6	4.3	3.9	8.3
Milk	1.6	2.4	1.4	6.1
Vegetables	2.2	3.2	8.7	18.4
Fruits	1.2	0.4	1.8	0.8
Others	3.6	2.8	10.2	1.6
Total	100.0	100.0	100.0	100.0

Source: DOST-FNRI (2022a).

The lower the wealth quintile, the greater the dependence on cereals, and the lower the reliance on animal sources for key nutrients.

The patterns in consumption and expenditure discussed earlier has unavoidable implications for energy and nutrient intake. The higher wealth quintiles tend to consume less cereals, and more animal protein sources. Hence contribution of cereals to energy, protein, and iron intake declines with wealth, while contribution of fish, meat, and poultry to energy, protein, iron, and even Vitamin A intake increases with wealth (Table 10).

Individual level

Age group is a key determinant of energy and nutrient intake adequacy.

DOST-FNRI (2022b) also presents measures of nutrient intake at the individual level, using individual consumption data (Table 10). For protein intake, the younger the age group, the greater the percent adequacy. Meanwhile for energy intake, calorie adequcy is all below twenty percent, falling to just 9.1 percent for adolescents. Vitamin A intake adequcy is highest for Infants and preschoolers at 43 percent, declining to 13 percent for Adolescents. Among these groups, pregnant and lactating women have the lowest levels of adequacy for energy, protein, iron, and Vitamin A.

Table 10: Share of household intake of energy and selected nutrients from cereals and fish, meat and poultry, by wealth quintile (%)

	Poorest	Poor	Middle	Rich	Richest
Energy					
Cereals & cereal products	75.0	71.5	67.7	64.0	59.7
Rice & rice products	60.9	59.8	57.4	54.0	49.5
Fish, meat, and poultry	7.7	10.4	13.2	16.1	19.1
Protein					
Cereals & cereal products	54.6	49.6	44.9	41.1	36.5
Rice & rice products	43.2	40.2	36.9	33.3	28.7
Fish, meat, and poultry	31.3	36.1	40.6	44.7	49.2
Iron					
Cereals & cereal products	49.2	48.1	45.7	44.5	41.2
Rice & rice products	38.5	35.8	32.4	29.8	25.7
Fish, meat, and poultry	20.6	23.9	26.6	28.4	30.1
Vitamin A					
Cereals & cereal products	3.9	3.7	3.6	3.1	2.8
Rice & rice products	0.1	-	0.2	0.1	0.1
Fish, meat, and poultry	51.5	56.6	63.6	65.9	64.9

The share of households meeting recommended nutrient intake levels fell from 2015 to 2018-19.

DOST-FNRI (2022b) also provide information the share of individuals meeting nutrient intake recommendations in 2015; the differences in share are reported in Table 11. Across age groups and types of nutrients, the share of households meeting nutritional forms has fallen from 2015 to 2018-19, except for energy and protein intake of Lactating mothers. The largest declines have been registered for Vitamin A intake of Infants & preschool, Schoolage children, as well as of Pregnant women; also suffering serious decline has been Protein intake of Schoolage children and of Pregnant women, and Energy intake of Schoolage children.

Table 11: Share of individuals meeting REI and EAR, by age group, Philippines, 2018-19 (%)

	Energy (REI)	Protein (EAR)	Iron (EAR)	Vitamin A (EAR)
Infants & preschool	18.4	70.8	4.7	43.2
Schoolage	13.9	67.5	6.3	24.6
Adolescents	9.1	43.9	7.7	13.0
Adults	18.4	45.8	7.8	15.1
Elderly	15.2	27.2	6.4	13.8
Pregnant women	15.1	17.2	7.9	8.2
Lactating mothers	11.7	19.0	7.7	5.5

Sources: DOST-FNRI (2022b).

Table 12: Change in share of individuals meeting REI and EAR by age group, Philippines, 2015 vs 2018-19 (percentage points)

	Energy (REI)	Protein (EAR)	Iron (EAR)	Vitamin A (EAR)
Infants & preschool	-4.8	-5.8	-1.0	-14.2
Schoolage	-6.6	-8.6	-0.8	-9.0
Adolescents	-1.5	-3.9	-0.8	-5.7
Adults	-3.2	-4.3	-1.1	-2.9
Elderly	-2.2	-2.6	-0.7	-0.3
Pregnant women	-1.0	-6.6	-1.0	-9.3
Lactating mothers	1.9	5.4	-0.6	-3.8

Sources: DOST-FNRI (2022b).

3.4 Government programs

The NNS records household and individual participation in government programs. The following focuses only on programs recorded in the NNS, that may plausibly affect food consumption, namely: Pantawid Pamilyang Pilipino Program (4Ps) and the Growth Promotion Program (GMP).

The 4Ps is a conditional cash transfer program of government in continous implementation since its pilot phase in 2008. It was finally institutionalized under Republic Act (RA) No. 11310 last 2019. Eligible households are those under the poverty line, as identified under the National Household Targeting System. Conditionalities for receiving cash include:

- For pregnant women: availment of pre-natal services, give birth in a health facility attended by a skilled health professional, and receive post-partum and post-natal care;
- For children 0-5: receive regular preventive health and nutrition services
- For children 3 – 5 years: attend daycare or pre-school clases;
- For children 5 – 18 years: attend primary or secondary education classes 85 percent of the time.

The GMP meanwhile is a nutrition intervention aimed at collection of data on child weight, to assess interventions to be suggested to parents during counselling sessions. Nutrition workers will educate parents on the various interventions so as to improve child growth. GMP uses data as a vehicle for health promotion (DOST-FNRI, 2022).

Majority of households have participated in GMP but only minority in poorest wealth quintile participate in the 4Ps.

About 71 percent of individuals aged 0 – 71 months participated in GMP. A higher share of individuals residing in rural areas participated (73 percent). Participation by quintile group is similar, with a slight tendency for the middle groups to participate more, compared with the Poorest and Richest groups. The Expanded NNS 2018 also provides data on household participation in the 4Ps for the poorest quintile (Table 8). Only 43 percent of households in the Poorest quintile reported participation in the 4Ps. The share is higher among Rural households in the Poorest quintile, compared with Urban households.

Table 13: Share of households and individuals participating in selected government programs, Philippines, 2018-19 (%)

	4Ps households, lowest wealth quintile	GMP individuals (0-71 months)
All	-	70.6
By place of residence		
Urban	33.5	62.7
Rural	45.8	72.9
By wealth quintile:		
Poorest	42.7	68.3
Poor	-	73.1
Middle	-	71.6
Rich	-	70.9
Richest	-	68.6

Source: DOST-FNRI (2022).

4. Review of literature and methodology

4.1 Conceptual framework

Nutrient intake response begins with a estimating a model of food demand, which is then converted into intake of energy, protein, iron, and Vitamin A using the FCT of FNRI. Food demand and nutrient intake is estimated at two levels: first is the household level, which results in per capita demand and nutrient intake; the second is the individual level, where individual consumption is the outcome of a sharing rool over the pool of household food demand, also converted to nutrient intake using FCT. Household demand estimation is in turn is based on the standard model of a household denoted *h, h* = 1, 2, ..., *N*, consuming food items indexed by *i, i* =1, 2, ..., M_h, corresponding to quantities $q_{ih} \geq 0$ for each item and in each period. These quantities must be purchased at market price p_i. observing the constraint $m_h = \sum_{i=1}^{M} p_i q_{ih}$. Consumption is motivated by maximization of a utility function $U_h(q_{1h}, q_{2h}, ..., q_{Mh})$. Under standard regularity conditions, maximization implies, by the implicit function theorem:

$$q_{ih} = f_h(p_1, p_2, ..., p_M, M_h) \quad (1)$$

Denote the expenditure share of item *i* in the budget of household *h* as s_{ih}:

$$s_{ih} = \frac{p_i q_{ih}}{M_h}.$$

An estimate of point-response to a change in consumer price is the **elasticity of consumption with respect to price** ε_{ik} where *k* is an alternative index of *i*:

$$\varepsilon_{ikh} - \frac{\partial q_{ih}}{\partial p_k} \frac{p_k}{q_{ih}}. \quad (2)$$

The nourishment provided by food is assumed to be measured by a number of indicators j = 1, 2, .., O, with household nutrient intake given by R_{jh}. Supposing nourishment content per unit of each food item is given by a constant a_{ij}, given say by the FCT, then:

$$R_{jh} = \sum_{i=1}^{N} a_{ij} q_{ijh} \tag{3}$$

We may also define share of item i in overall nourishment R_{jh} as:

$$SR_{ih}^{j} = \frac{a_i q_{ih}}{R_{jh}}.$$

The demand function in (1) also renders R_{jh} a function of prices and the budget, with its own elasticity terms, with obvious notation:

$$\varepsilon_{ikh}^{j} = \sum_{k}^{M} s_{ih}^{j} \varepsilon_{ik} \tag{4}$$

If the focus is limited to food demand, then under separability conditions, the i items may be limited to food items, M_h total expenditure on food, with M_h derived as function of overall income y_h. The *specific* functional form of *f,* as well as applications of demand estimation, is subject to a considerable literature, reviewed briefly below with focus on the Philippines.

4.2 Studies focused on nutrient intake

Quisumbing (1986) provided a comprehensive review of food demand studies up to that year, showing that demand estimation has been an active field of research among economists. Earlier studies made extensive use of time series data, e.g. Pante (1971) estimated static and dynamic demand functions for food, beverages and tobacco, durables, and miscellaneous, using data from 1949 – 1974. From the mid-1970s onward, demand estimation turned towards cross section data, available from the Family Income and Expenditure Survey (FIES) under the National Census and Statistics Office (now absorbed in the PSA), e.g. Goldman and Ranade (1976). Arboleda (1982) applied the extended Linear Expenditure System (LES) to the 1975 FIES, although he obtained unrealistic results; Canlas (1983) also adopted LES-based approach and obtained more consistent estimates. Another source of cross-sectional data were the Food Consumption Surveys (FCS) of the Ministry of Agriculture. Most studies used single-equation double-log (i.e. Cobb-Douglas-type) approaches, e.g. Bouis (1982), and Regalado (1984).

The NNS data was used for food demand estimation by Quisumbing et al (1988). The study utilized the FCS components of the NNS for 1978 and 1982. Single equation estimation is applied following Pitt (1983), with quantity consumped per adult equivalent per commodity group is the dependent variable. Independent variables are logarithms of prices, together with total food expenditure, and dummy variables for occupation and year. Owing to numerous zero consumption observations, parameter estimates are obtained using a Tobit regression.

For a complete simulation, the total food expenditure in turn is estimated using a different data set, namely the Family Income and Expenditure Survey now conducted by PSA. The overall demand estimate uses the translog form. Combined with supply side estimates, Quisumbing et al are able to simulate equilibrium adjustments in energy intake with given policies (e.g. income transfers and food price subsidies.

A similar approach from price and income change to nutrient intake was taken in Orbeta and Alba (1998), part of a group of studies under the Microeconomic Impacts of Macroeconomic Adjustment Policies (MIMAP) Project of the Philippine Institute for Development Studies (Herrin et al , 1992; Orbeta, 1994). Orbeta and Alba (1998) uses the FIES and estimates a full demand system with eight food items (and one nonfood item). The estimating model is the AIDS demand system (Deaton and Muelbauer, 1980), in its linear approximate version. Additional variables were included in the estimation, to control for household demographics (age and education of the household head, age composition of household members) and region of residence. To avoid the problem of unconsumed items, the study simply dropped zero observations. Using the price and income impacts of the 1988-92 tariff reform from a CGE model, they simulate changes in consumption and ultimately calorie and protein intake. They find that no only does the tariff reform have a progressive impact on incomes (lower income groups receive a larger relative income boost), it is even more progressive in terms of expanding macronutrient availability. Lower income households had a larger increase in calorie and protein intakes.

4.3 Consumption studies

Also applying the AIDS is Huang and David (1993), this time using United States Department of Agriculture balance sheet data across countries, one of which is Philippines. Meanwhile the quadratic extension of the AIDS (Blundell et al, 1993) was applied by Balisacan (1994), also using the FIES.

An alternative approach outlined by Bouis (1990) and in subsequent papers sidesteps the need to estimate food demand from consumption data, relying on a demand system based food characteristics, and calibrated from a few key parameters. He found that during the expansion phase of the Philippine economy in the 1970s (prior to the crisis of the early 80s), nutritional status of low income urban groups did not improve despite lower cereal prices in real terms, owing to the decline in real wages. In urban areas nutrition likely improved marginally, as as rural wages declined to a lesser extent.

Several studies tended to focus on specific sub-sectors or locations of food demand, but often estimating the entire demand system as well. An example of this is Garcia et al (2005), which focused on fish demand, with data using the FIES. Estimation is conducted in three stages, i.e. the first stage estimates food expenditure, the second stage estimates fish expenditure, and the final stage estimates demand for 11 fish types. The final stage adopts the quadratic extension of the AIDS, with the Heckman correction for zero observations as suggested by Heien and Wessels (1990).

Another food group receiving attention in demand estimation is vegetables (Mutuc et al, 2007). Data is obtained from the FIES. They also do a multi-stage estimation, with the first stage aimed at estimating unit values of demand items, the second stage to model the relationship between vegetable expenditures and total expenditures, and the third stage to model the vegetable food demand system using the quadratic AIDS, classified in eleven types. Also relying on FIES data and using quadratic AIDS is a study on meat consumption (Malabayabas et al, 2009),

Meanwhile, Lantican et al (2016) used the linear approximate form of AIDS in their study on rice; BAS (2013) applying the single-equation, double-logarithmic specification, to estimate demand parameters for selected food commodities. Both these studies drew their data from the Survey of Food Demand of PSA.

Fujii (2016) and Bairagi et al (2022) focus on the location of residence, the former on urban food demand, the latter on the food basket composition of urban and rural households. Both make use of the FIES and the quadratic AIDS.

4.4 Role of government programs

As malnutrition indicators for Philippines worsened in the 2010s, PIDS revived emphasis on the topic by a series of studies related to nutrition programs and policies. The series kicked off in 2016 with Herrin (2016), which focused on stunting among preschool children. The paper underscored importance of maternal nutrition and health, and key interventions, which include infant and young child feeding and micronutrient supplementation, both of which relate to nutrient intake.

Ulep et al (2021) report a statistical study based on a data set with high stunting prevalence (38.5 percent), with prevalence rising to 45 percent among the poor (versus 32 percent for non-poor). Over half of stunting prevalence is due to maternal factors, while dietary diversity and iron supplementation account for 12 percent and 5 percent of child stunting, respectively.

Another set of studies focus on nutrition program implementation. A follow-up study of Herrin et al (2018) focused on LGUs as the frontline in service delivery to end child stuning in the Philippines. It affirms the effectiveness of "The First 1000 days" strategy, which include complementary feeding and micronutrient supplementation. LGU implementation should be accompanied by monitoring and evaluation towards consistent service delivery.

Dacuycuy et al (2019) as well as Abrigo and Tam (2019) as well as offer case studies of LGU nutrition programs. The latter recommends based on the experience of Zamboanga del Norte that LGUs need to focus limited resources on high-impact interventions, including infant and young child feeding, and micronutrient supplementation among at-risk children.

5. Empirical strategy for household demand

5.1 Data source

The method of this study combines the various techniques that have been implemented in past studies. The data source for household food demand is the FNRI, using the FCS for 2013, 2015, and 2018, using information on household food intake, food cost, demographic characteristics, year, and participation in selected government programs. The FCS also includes data on occupations, coded as follows:

0 - Special Occupations

1 - Official of Gov't, Corporate Exec, Mngr, Managing Prop, Supv.

2 - Professional

3 - Technicians & Associate Professionals

4 - Clerks

5 - Service Workers & Shop and Market Sales Workers

6 - Farmers, Forestry Workers & Fishermen

7 - Craft & Related Trades Workers

8 - Plant & Machine Operators and Assemblers

9 - Elem. Occupation: Laborers & Unskilled Workers

10 - Housekeeper, Pensioner, Student & No Occupation

11 - No PSOC

99 - Not applicable (<10y)

9999 - Missing

As argued by Bouis, surveys of food intake based on direct measurement is a better source of data than food expenditure surveys, which are prone to measurement errors that end up exaggerating expenditure elasticities of demand. For instance in the Philippines, the calorie-to-expenditure elasticity falls within the 0.40 – 0.52 range when using food expenditure surveys, but declines to 0.13 to 0.17 when using food intake surveys (Bouis et al, 1992).

Based on the categories of Table 7, the estimation is based on ten food groups, as follows:

1. Rice - Rice & rice products
2. Other cereals – Cereals & cereal products aside from Rice & rice products
3. Fish – Fish & fish products
4. Meat – Meat & meat products
5. Poultry – Poultry and Eggs
6. Fruit
7. Vegetables
8. Dairy – Milk
9. Fats & oils
10. Other food – Starchy roots & tubers; Sugar & syrups; Others

The unit values of the foregoing food groups (obtained by dividing food group expenditure by food intake) is taken as the food group price. Expenditures shares for the full data set (2013, 2015, 2018) at the sample mean is summarized in Table 14; also shown are unit values, and the share of households who have positive consumption over the food group. Rice (and rice products) accounts for a quarter of food expenditure; the next largest food group by expenditure share is Fish at 18 percent; the food group with lowest share is Fruit at 1.5 percent. On a per kg basis the most expensive food group is Other cereals, followed by Fats & oils, and then Meat. The last column shows that nearly all households consume Rice, while nearly nine-tenths consume Vegetables. However, zero consumption accounts for a substantial share of the the rest of the food groups (except Other food). The least consumed item is Fruit at just 21 percent of households; only 35 percent consume Dairy, and less than half consume Meat.

Table 14: Mean values of selected variables, by food group, FCS

	Expenditure shares (%)	Unit values (Php per kg)	Share of consuming households (%)
Rice	25.4	47.4	96.8
Other cereals	6.6	322.8	59.7
Fish	18.0	115.7	78.4
Meat	11.2	167.0	49.1
Poultry	8.5	138.0	55.7
Fruit	1.5	58.8	21.0
Vegetables	9.8	89.8	88.9
Dairy	3.6	88.8	35.1
Fats & oils	2.3	140.4	82.9
Other food	13.3	133.1	99.2

5.2 Case of purchased food groups

The regression model is the quadratic AIDS, specified for the food demand system. Ignorinthe problem of non-purchases, the system is specified as follows:

$$s_{ih} = \gamma_{0i} + \sum_{j}^{N} \gamma_{ij} \ln p_{jh} + \beta_i \ \ln(M_h / P_h) + \lambda_i [\ln(M_h / P_h)]^2 + \sum_k \delta_{ik} z_{kh} + \varepsilon_{ih} \qquad (1)$$

Here the *i*-term indexes food groups, while M_h denotes food expenditure. P_h is the Stone price index ($P_h = \sum_j s_{jh} \ln p_{jh}$); and z_{kh} denotes other control variables corresponding to household demographics, location, and survey period. Parameters to be estimated are $\alpha_i, \gamma_{ij}, \beta_i, \lambda_i, \delta_i$, while $\varepsilon_{ij} \sim N(0,1)$ is the error term. The expected value of (1) drops the error term and leaves a right hand side expression denoted here as *QuAIDS.*

Utility maximizing subject to an expenditure constraint entails the following:

$\gamma_{ij} = \gamma_{ij}$ (symmetry);

$\sum_i \gamma_{0i} = 1; \sum_i \gamma_{ij} = 0; \sum_i \beta_i = 0; \sum_i \lambda_i = 0$ (adding up).

If so then the parameters of one of the N^{th} equations can be recovered by estimating the *N-1* equations. The symmetry restriction is handled here using the seemingly unrelated regression technique (SUR), using the appropriate set of commands in STATA.

Elasticity terms are evaluated at *QuAIDS*. Expenditure elasticity for food group *i,* denoted ηm_{ih}, is computed by using $\ln s_{ih} = \ln p_i + \ln q_{ih} - \ln m_h$, and performing logarithmic differentiation on Equation (1):

$$\eta m_{ih} = 1 + \frac{1}{s_{ih}}\left[\beta_{ih} + 2\lambda_{ih}\left(\frac{\ln M_h}{P_h}\right)\right] \qquad (2)$$

A similar technique implies the own- and cross-price elasticity terms, denoted ε_{ij}. In the following, u_{ij} is the Kronecker unit, with $u_{ii} = 1,\ u_{ij} = 0, i \neq j$:

$$\eta p_{ijh} = -u_{ij} + \frac{1}{s_{ih}}\left[\gamma_{ijh} - s_{jh}\left\{\beta_i + 2\lambda_i \ln\left(\frac{M}{P}\right)\right\}\right] \qquad (3)$$

Elasticities should also adhere to the following under utility maximization:

$$\sum_i s_{ih}\eta m_{ih} = 1\ ;$$

$$\sum_j \eta p_{ijh} + \eta m_{ih} = 0\ .$$

This pertains to household demand as a function of prices and food expenditure. Household demand needs to be related to household income in order to make linkages to macro variables such as GDP. For this purpose, the FIES is utilized. Denote consumer price index for food and for all items as $CPIF_h, CPI_h$, respectively. Least squres regression is applied to estimate a double-log equation with the usual error term:

$$\ln\frac{m_h}{CPIF_h} = \alpha_0 + \alpha_1 \ln\frac{y_h}{CPI_h} + \varepsilon m_h$$

Taking expectations yields

$$\ln m_h = a_0 + \alpha_1 \ln(y_h)\ ,\ a_0 = \alpha_0 + \ln CPIF_h - \alpha_1 \ln CPI_h\ . \qquad (4)$$

Case of zero purchases for some food groups

Some food groups of policy interest may not be purchased at all by some households, i.e. not all households consume rice (they be maize and wheat eaters). To account for zero purchases, the Heckman selection model posits a latent random variable y_{ij} such that q_{ih} is observed conditional on $w_{ih} > 0$. In turn, w_{ih} is determined by independent variables denoted $x_1, x_2, \ldots$, and an error term ν_{ih} such that:

$$w_{ih} = \mu_{0i} + \sum_l \mu_{il} x_{lh} + \nu_{ih},\ \nu_{ih} \sim N(0,1)\ . \qquad (5)$$

Crucially, the error terms are correlated with a correlation term $\rho_i > 0$, implying an omitted variable problem in directly estimating (1).

Denote the standard normal density, and cumulative normal density functions, by ϕ, Φ, respectively. Taking the expected value of (5), and using the formula for moments of a truncated bivariate normal distribution (Greene, 2017), letting $\overline{w}_{ih} = E\left[w_{ih}\right]$:

$$E\left[q_{ih} \mid w_{ih} > 0\right] = E\left[q_{ih} \mid \nu_{ih} > -\left(\mu_{0i} + \sum_{l} \mu_{il} x_{lh}\right)\right]$$

$$= QuAIDS + \rho_i \frac{\phi\left(\overline{w}_{ih}\right)}{\Phi\left(\overline{w}_{ih}\right)} \quad (6)$$

The ratio term is shortened to *IMR*, the Inverse-Mills ratio. Estimation follows the procedure outlined by Heckman's two step estimator: first is to estimate (5), using probit regression, imposing w_{ih} to be a binary variable with $w_{ih} > 0$ when q_{ih} is observed, 0 otherwie. The regression is then used to obtain predicted values $\hat{w}_{ih} = \sum_{l} \hat{\mu}_{ilh} x_{ilh}$, where "^" denotes the value of the estimator. Then obtain $IMR(\hat{r})$, to augment the original *QuAIDS* as in (6), to be estimated in the usual manner.

Incorporating food price and expenditure in the selection model

The list of independent variables has two options: one is to include only demographic variables; another is to include demographic variables, together with prices and expenditure. Recent examples of the former are Mariscal and Werner (2018), and Lokuge et al (2019). For the latter there Koeshandrajana et al (2021), which includes expenditure, and Ashidigbi et al (2019), which includes prices and expenditure. This study adopts the latter option, for which latent variable model also includes price and expenditure varaibles. For instance, the marginal meat-eater (i.e. purchasing meat only once a month) may cease meat consumption entirely if meat price is sufficiently high, or if income drops sufficiently low. The validity of including price changes can be checked by examining the coefficients of these price variables in the first stage model.

In this case the marginal effect of a change in price and income on consumption consists of a direct effect captured by *QuAIDS*, and an indirect effect through the latent variable w_{ih}. The extant literature which adopts this first stage option appears not to have acknowledged the presence of an indirect effect.

It should be noted that, **conditional on strictly positive consumption**, the *QuAIDS* is consistent with utility maximization subject to constraints; hence, with this proviso, the usual restrictions will apply from the combination of differentiability, symmetry, and zero degree homogeneity in prices and income. However, considering the prior stochastic selection process into strictly positive consumption, these restrictions may be inapplicable once the inverse-Mills correction is applied.

Suppose (5) is specified as follows (non-price and expenditure terms suppressed):

$$w_{ih} = \mu_{oi} + \sum_{j} \mu_{ij} \ln p_{jh} + \mu_{1i} \ln m_h + \nu_{ih} \quad (7)$$

Performing the differentiation:

$$\frac{\partial IMR(\overline{w}_{ih})}{\partial \ln m_h} = -\mu_{1i} IMR(\overline{w}_{ih})\left[\overline{w}_{ih} + IMR(\overline{w}_{ih})\right];$$

$$\frac{\partial IMR(\overline{w}_{ih})}{\partial \ln p_{jh}} = -\mu_{ij} IMR(\overline{w}_{ih})\left[\overline{w}_{ih} + IMR(\overline{w}_{ih})\right] .$$

The adjusted elasticity formulas are therefore:

$$\eta m_{ih} = 1 + \frac{1}{s_{ih}}\left[\beta_{ih} + 2\lambda_{ih}\left(\frac{\ln M_h}{P_h}\right)\right] + \left(\frac{-\rho_i}{s_{ih}}\right)\mu_{1i} IMR(\overline{w}_{ih})\left[\overline{w}_{ih} + IMR(\overline{w}_{ih})\right] \tag{8}$$

$$\eta p_{ijh} = -u_{ij} + \frac{1}{s_{ih}}\left[\gamma_{ijh} - s_{jh}\left\{\beta_i + 2\lambda_i \ln\left(\frac{M}{P}\right)\right\}\right] + \left(\frac{-\rho_i}{s_h}\right)\mu_{ij} IMR(\overline{w}_{ih})\left[\overline{w}_{ih} + IMR(\overline{w}_{ih})\right] \tag{9}$$

Explanatory variables for the first stage probit estimation are as follows: prices (in logarithms); total food expenditure (in logarithms); and dummy variables for region and survey period (omitting region BARMM and 2013).

For the second stage, estimation is based on (6), with *z*-variables consisting of the following:

- Household demographics –educational attainment of mother, age of mother, dummy variable for skilled occupation of household head
- Household asset index – FCS wealth quintile (numbered 1 to 5, in logarithms)
- Region dummies (BARMM omitted) and survey year dummies (2013 omitted)

For households without mothers, household head age and education are used in the estimation. Skilled occupations cover codes 1 to 5, 7, and 8.

Simulations of nutrient intake and individual demand

Household food demand is readily translated to energy and nutrient intake using nutrient contents derived from FCT. The following applies to energy intake E_h, with corresponding energy content a_{ih} per unit of food group *i,* but can readily be applied to any selected nutrient intake:

$$E_h = \sum_{i=1}^{N} a_{ih} q_{ih}$$

Denote "%" as the percentage operator, e.g. $dq/q = \%q$; this implies:

$$\%E_h = \sum_i \left(\frac{a_{ih} q_i}{E_h} \%q_i\right).$$

The fractional term is simply the share of food group *i* in energy intake of household *h.* In turn, household demand change for a given set of price and income changes is approximated using the elasticity estimates; note though the smaller the price and income change, the better the approximation, as the elasticity formulas are based on point derivatives.

$$\%q_i \mid dp_j = \%p_j \eta p_{ij}$$

$$\%q_i \mid dm_h = \%m_h \left(\eta m_{ih}\right)$$

In addition to changes in food price and in nominal income, adjustment should also be made for changes in overall CPI, in accordance with Equation (4) under logarithmic differentiation:

$$\%m_h = \alpha_1 \%y_h + \left[\%CPIF - \alpha_1 \%CPI\right]$$

Lastly, for individual demand: One option is direct estimation of individual food demand as in equation (1) as suggested in Deaton (2018). Another option, taken in this paper, is to perform a double-log estimation using least squares, with consumption of group *i* for a given household member type as the dependent variable, and that the household.

6. Results of demand estimation

6.1 The selection model for household food demand

Price and expenditure variables are mostly statistically significant in predicting positive consumption.

The independent variables of the selection model are the prices (in logarithm), food expenditure (in logarithm), region dummies, and survey year dummy. Coefficients of price and expenditure variables from the probit regression are shown in Tables 15 and 16. The best-fitted model based on the latter is Rice, and least well fitted is Fish. The rest of the regressions have goodness-of-fit between 0.08 to 0.63 based on psuedo-R^2.

Table 15: Coefficients of price and expenditure variables, probit regressions

Explanatory variables	Dependent variable (Binary) Rice	Other food	Vegetables	Fats & oils	Fish
Rice	-0.334	-0.425	-0.070	0.117	-0.158
Other cereals	1.103	*-0.051**	-0.056	0.039	-0.035
Fish	*0.004**	*-0.060**	*-0.019**	*0.028**	-0.536
Meat	*-0.109**	0.016	*0.010**	-0.222	*0.027**
Poultry	-0.130	*-0.069**	-0.064	-0.221	*-0.008**
Fruit	-0.127	*-0.028**	*-0.020**	0.033	-0.004
Vegetables	0.159	-0.119	-0.047	-0.057	0.086
Dairy	*-0.042**	*-0.064**	-0.043	-0.028	*-0.008**
Fats & oils	-0.094	-0.172	*0.015**	-0.479	-0.042
Other food	0.109	-0.205	-0.114	*0.007**	-0.035
Expenditure	0.603	0.697	0.633	0.636	0.603
Pseudo-R2	0.634	0.191	0.133	0.152	0.634

*Not significant at 5 percent level.

Source: Author's calculation.

Price and expenditure variables are all statistically statistically significant in predicting positive consumption of Poultry and Meat food groups; only one price variable is not statistically significant in the probit regression for Other cereals and Fruit (Poultry for both). The majority of price and expenditure coefficients are statistically in all equations. Own-price coefficients are negative and statistically significant, as are expenditure coefficients.

Table 16: Coefficients of price and expenditure variables, probit regressions

Explanatory variables	Dependent varaible				
	Other cereals	Poultry	Meat	Fruit	Dairy
Rice	0.122	0.203	0.264	0.140	*-0.035**
Other cereals	-0.583	0.088	0.054	-0.006	0.028
Fish	*0.015*	0.041	0.109	0.090	0.066
Meat	-0.053	-0.156	-0.724	0.033	-0.065
Poultry	*0.007**	-0.767	-0.082	*-0.002**	-0.049
Fruit	*0.008*	0.058	0.065	-0.792	0.519
Vegetables	0.057	0.101	0.180	0.033	0.519
Dairy	-0.099	-0.054	-0.050	-0.037	-0.830
Fats & oils	0.086	-0.033	0.058	0.049	*0.002**
Other food	0.097	0.078	0.060	-0.022	-0.034
Food expenditure	0.421	0.505	0.736	0.456	0.663
Pseudo-R2	0.143	0.106	0.200	0.134	0.166

*Not significant at 5 percent level.

Source: Author's calculation.

6.2 Food demand estimation

Parameters of the household food demand system

For the estimated demand model, price and expenditure terms are mostly statistically significant; government programs have a mixed effect on expenditure shares.

The results of the demand system seemingly unrelated regression are relegated to the Appendix. STATA reports an analogue for adjusted R^2; goodness-of-fit using this measure is highest for Rice (0.37) and lowest for Fruit (0.03); goodness-of-fit is mostly below 0.20, which is low but not unusual given the cross-section nature of the data.

Expenditure terms are positive, as well as the squared expenditure terms. Moreover, expenditure terms are all significant. Hence, Engel curves slope upward and become steeper. Price terms are also significant, with some exceptions: dairy with the most number of non-significant price coefficients. Participation in 4Ps and GMP has positive effect on expenditure shares of some food groups, but negative on others; statistically insigificant coefficients for Fruits and Vegetables. Finally, household wealth reduces expenditure share of rice, fish, vegetables, but raises that of the other food groups.

Income elasticities of household food demand

Most food groups are normal goods, among which income elasticities of food demand range from 0.73 (Poultry) to 1.75 (Other cereals).

The food expenditure elasticities at the sample mean, both with selection effects, and the original QuAIDS formula, are shown in Table 17. Also shown are the income elasticities, using the estimated elasticity of food expenditure to income (using the double-log specification) of 0.5714. Poultry and Rice have nearly identical income elasticities (0.73 and 0.75, respectively).

Table 17: Elasticity of household consumption with respect to food expenditure and income, with and without selection effects

	With selection		Without selection	
	Food expenditure elasticity	Income elasticity	Food expenditure elasticity	Income elasticity
Rice	1.32	0.75	1.19	0.68
Other cereals	3.06	1.75	3.12	1.78
Fish	1.71	0.98	1.49	0.85
Meat	2.13	1.22	1.98	1.13
Poultry	1.29	0.73	1.42	0.81
Fruit	1.72	0.98	2.98	1.70
Vegetables	1.91	1.09	1.48	0.85
Dairy	2.88	1.65	3.09	1.77
Fats & oils	2.96	1.69	3.09	1.77
Others	-4.36	-2.49	-3.56	-2.04

Source: Author's calculation

Fish and Fruit demand are both close to unit elastic, while Vegetables income elasticity is 1.09. Note that for the majority of normal goods, incorporating selection effects reduces high values of income elasticity from QuAIDS (i.e. Other cereals, Poultry, Dairy, Fats & oils, and especially Fruit). The weighted average of income elasticities with and without selection effects is very similar (0.56 and 0.55, respectively).

Price elasticities of household food demand

For a majority of the food groups, demand is inelastic to own price; the most purchased food groups tend to be complementary goods except Other food.

Price elasticity estimates are shown in Table 18, using the full elasticity formula with selection effects. Own-price elasticities are all negative, and are inelastic (absolute value below unity) except for Other cereals, Fruit, and Other food. Rice, Fish, Meat, and Poultry tend to be complements with each other and the other food groups, though some obvious substitution effects are confirmed, such as Rice and Other cereals, and Other food with the rest of the food groups.

Table 18: Price elasticities of household demand, with selection effects

Food group	Price variable				
	Rice	Other cereals	Fish	Meat	Poultry
Rice	-0.694	0.290	-0.180	-0.140	-0.124
Other cereals	0.217	-1.814	-0.260	-0.130	-0.031
Fish	-0.355	-0.152	-0.829	-0.087	-0.110
Meat	-0.211	-0.098	-0.108	-0.817	-0.258
Poultry	-0.232	0.028	-0.080	-0.171	-0.614
Fruit	-0.004	-0.007	0.155	0.020	-0.034
Vegetables	-0.310	-0.121	-0.034	0.059	-0.011
Dairy	-0.059	-0.084	-0.092	-0.159	-0.190
Fats & oils	-0.319	-0.042	-0.140	-0.098	-0.155
Other food	0.762	0.888	0.227	0.441	0.725

	Fruit	Vegetables	Dairy	Fats & oils	Other food
Rice	-0.049	-0.101	-0.056	-0.090	0.071
Other cereals	-0.139	-0.200	-0.130	-0.145	-0.440
Fish	-0.057	-0.029	-0.095	-0.123	-0.038
Meat	-0.078	0.018	-0.152	-0.119	-0.174
Poultry	-0.051	0.038	-0.074	-0.069	-0.076
Fruit	-2.267	0.038	-0.082	-0.034	0.653
Vegetables	-0.039	-0.959	-0.062	-0.071	-0.209
Dairy	-0.303	-0.179	-0.894	-0.100	-1.070
Fats & oils	0.029	-0.175	-0.087	-0.377	-1.562
Other food	0.907	0.683	0.786	0.829	-1.344

Source: Author's calculation

Table 19 shows the alternative elasticity calculation based only on the second stage QuAIDS, ignoring the secondary effects of price and expenditure on selection. Compared with the adjustments for expenditure elasticity, selection effects appear to have a smaller influence on price elasticity, although the Table 18 values tend to check some large own-price elasticities in Table 19, e.g. Other food, Dairy, and most especially, Fruit.

Table 19: Price elasticities of household demand, without selection effects

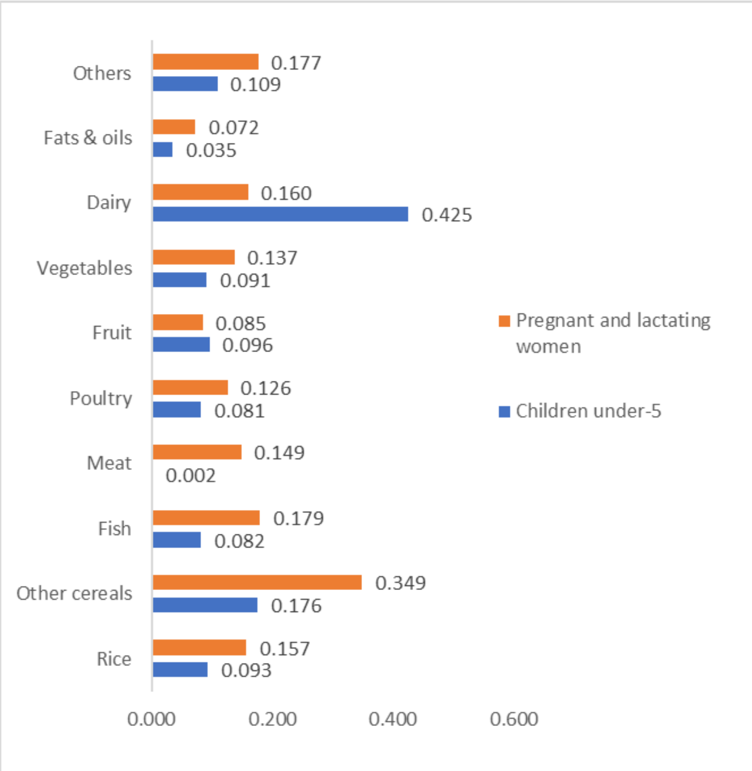
Food group	Price variable				
	Rice	Other cereals	Fish	Meat	Poultry
Rice	-0.622	0.052	-0.181	-0.116	-0.096
Other cereals	0.233	-1.890	-0.258	-0.137	-0.031
Fish	-0.271	-0.133	-0.541	-0.102	-0.106
Meat	-0.264	-0.109	-0.129	-0.674	-0.242
Poultry	-0.180	0.051	-0.070	-0.211	-0.811
Fruit	0.382	-0.024	0.401	0.111	-0.039
Vegetables	-0.264	-0.084	-0.021	0.052	0.032
Dairy	-0.070	-0.075	-0.071	-0.179	-0.206
Fats & oils	-0.293	-0.034	-0.134	-0.146	-0.202
Other food	0.277	0.829	0.159	0.459	0.646
	Fruit	Vegetables	Dairy	Fats & oils	Other food
Rice	-0.022	-0.135	-0.047	-0.070	0.047
Other cereals	-0.138	-0.192	-0.143	-0.134	-0.427
Fish	-0.054	-0.075	-0.091	-0.101	-0.019
Meat	-0.091	-0.017	-0.142	-0.130	-0.186
Poultry	-0.036	0.064	-0.088	-0.078	-0.056
Fruit	-4.445	0.128	-0.184	0.101	0.594
Vegetables	-0.026	-0.927	-0.033	-0.081	-0.133
Dairy	-0.140	-0.016	-1.154	-0.099	-1.081
Fats & oils	0.036	-0.187	-0.093	-0.480	-1.561
Other food	0.875	0.548	0.713	0.633	-1.577

Source: Author's calculation

Individual consumption elasticities

The estimated elasticities of individual to household consumption are summarized in Figure 8. Elasticities are all positive, but far below unity, implying a large departure from a constant sharing rule. For children under-5 the elasticities are highest for Dairy, and Other cereals; for pregnant and lactating women the elasticities are highest for Other cereals, followed by Fish.

Figure 8: Individual-to-household consumption elasticities, by household member type



6.3 Elasticities of energy and nutrient intake

Income elasticities

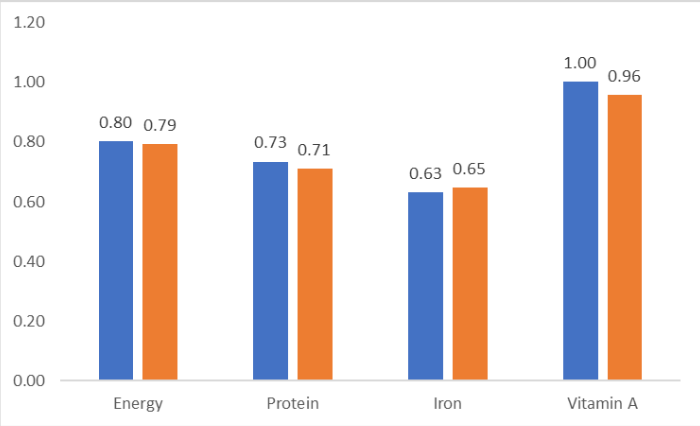
Income elasticities for energy and nutrient intake are very high, in the range of 0.80 to 1.0.

The resulting total elasticities of intake of calories, protein, iron, and Vitamin A, to changes in income are summarized in Figure 9. Note that incorporating selection effects has almost no quantitative influence on the energy and nutrient intake elasticities. The estimates for energy intake are far above the recommended range of 0.08 to 0.14 range suggested by Bouis and Haddad (1992). The possible reasons for breaching this range are taken up in the discussion of study limitations.

Price elasticities

Elasticity of energy and nutrient intake with respect to prices of the major food groups is shown in:

Figure 9: Intake elasticities with respect to income, energy and selected nutrients



Source: Author's calculation.

The food group with the largest price elasticity for energy and protein intake (in absolute terms) is Rice; a one-percent increase in the price of rice is enough to reduce energy intake by 0.39 percent, protein intake by 0.31 percent, and iron intake by 0.22 percent. Even Vitamin A intake declines by 0.22 percent, even though rice is not a source of Vitamin A, mainly due to complementarities with other food groups that contribute most to Vitamin A intake. The food group with the largest price elasticity for Protein intake (aside from Rice) is Fish, followed by Other food. For iron the largest price elasticities are for Other food, followed by Fish. Lastly for Vitamin A the largest price elasticities are for Poultry, Meat, and Fish.

Table 20: Intake elasticities with respect to price, energy and selected nutrients

With respect to price of:	Energy	Protein	Iron	Vitamin A
Rice	-0.39	-0.31	-0.22	-0.22
Other cereals	-0.01	-0.04	-0.07	-0.12
Fish	-0.17	-0.25	-0.17	-0.22
Meat	-0.15	-0.17	-0.13	-0.25
Poultry	-0.09	-0.12	-0.05	-0.26
Fruit	-0.03	0.00	-0.01	-0.08
Vegetables	-0.07	-0.04	-0.06	-0.17
Dairy	-0.04	-0.04	0.01	-0.13
Fats & oils	-0.06	-0.04	0.00	-0.08
Other food	-0.22	-0.18	-0.25	-0.20

Source: Author's calculation.

7. Simulated impacts of recent economic shocks: household level

7.1 Set-up of scenarios

Covid19 with and without Bayanihan social protection

Quantifying the impact of Bayanihan social protection programs involves an adjustment of the income shock term in the previous simulation, which adopts the GDP contraction of 2020 without accounting for transfers schemes to ameliorate loss of purchasing power of households. This corresponds to a nominal GDP contraction of 7.9 percent, an overall inflation rate of 2.4 percent, and a food inflation rate of 2.9 percent.

The household income shock **with** Bayanihan programs is estimated to be 5.63 percent higher than the baseline of **without** Bayanihan, based on the figures shown in Table xx, computed from Annual Poverty Indicators Survey (APIS) 2020. The average is compared with the estimated average income of SAP recipients reported in DWSD-WFP (2022). The COVID19 scenarios are applied to the elasticities evaluated at the sample mean of the FCS.

Table 21: Coverage and benefit estimates for Bayanihan social protection programs, 2020

	Coverage of households (%)	Amount per household (Php)
SAP	41.9	6,176
DOLE TUPAD	7.0	3,987
DOLE CAMP	6.0	5,383
DOLE AKAP	1.0	10,441
DA Rice Farmers Assistance	2.9	4,967
DSWD Relief Assistance	22.0	940
Other relief assistance from GPH	85.5	1,712
TOTAL (weighted average)	na	5,109

Sources: Cho and Johnson (2022); DSWD and WFP (2022).

Inflation with growth in 2022

Between October 2021 and October 2022, the overall inflation rate was 7.67 percent; this was exceeded by one of its biggest components, namely Food price inflation, at 9.79 percent. Alongside this was nominal GDP growth from 2nd quarter 2021 to 2nd quarter 2022 equal to 11.26 percent. Likewise these price and income shocks are applied to the elasticities evaluated at the sample mean of the FCS.

7.2 Results

COVID19 scenario

The economic shock of COVID19 caused energy and nutrient intakes to decline, with the severest contraction in Vitamin A intake.

Projected changes in energy, protein, iron, and Vitamin A intake within the COVID19 period (combining moderate inflation with severe income contraction) are shown in Table 22. Energy and nutrien intakes fall; the declines in energy, protein, and iron intake lie within the 6-7 percent range; however that of Vitamin A is 12 percent. The main major sources of decline in energy, protein, and iron, are Rice, Other cereals, Fish, and Meat, while that of Vitamin A decline are consumption of Vegetables, Fish, and Meat. At the individual level, declines for children under six are about half those of the household level, while that of pregnant and lactating mothers lies within the 1 – 2 percent range.

Table 22: Changes in intake of energy and selected nutrients, COVID19 2020 scenario, household and selected members (%)

	Energy	Protein	Iron	Vitamin A
Total household intake	-6.98	-6.70	-6.14	-12.11
By food group				
Rice	-2.42	-1.55	-1.41	0.00
Other cereals	-2.68	-2.15	-3.06	-0.80
Fish	-0.41	-2.14	-1.25	-2.18
Meat	-0.93	-1.58	-1.46	-2.87
Poultry	-0.25	-0.76	-0.49	-1.94
Fruit	-0.34	0.00	-0.69	-0.25
Vegetables	-0.37	-0.60	-1.36	-3.04
Dairy	-0.40	-0.45	-0.29	-1.50
Fats & oils	-1.25	0.00	-0.23	-0.04
Others	2.06	2.52	4.08	0.51
By individuals:				
Children under-5	-3.11	-3.73	-3.06	-5.63
Pregnant and lactating mothers	-1.16	-1.58	-1.22	-1.41

Source: Authors' calculation.

COVID19 with Bayanihan

The Bayanihan social protection schemes ameliorated the negative energy and nutrient intake impact of COVID-19 by one-half or more.

The impact of the COVID19 with Bayanihan is shown in Table 23. As the average income transfer falls short of the average economic contraction due to COVID19, the decline in energy and nutrient intake cannot entirely be reversed. Nonetheless the decline is much less than in the previous scenario, at around 2.5 – 2.6 percent for energy, protein, and iron, and 6.5 percent for Vitamin A. Although the fall in income is 71 percent smaller than in the previous scenario, the decline in energy and nutrient intake is smaller by only 47-65 percent, showing that even partial reversal of nutrient and energy intake declines is a highly expensive proposition for government.

Table 23: Changes in intake of energy and selected nutrients, COVID19 with Bayanihan, household and selected members (%)

	Energy	Protein	Iron	Vitamin A
Total household intake	-2.47	-2.56	-2.58	-6.46
By food group				
Rice	-0.01	-0.01	-0.01	0.00
Other cereals	-1.56	-1.25	-1.78	-0.46
Fish	-0.22	-1.14	-0.66	-1.16
Meat	-0.42	-0.70	-0.65	-1.28
Poultry	-0.10	-0.31	-0.20	-0.78
Fruit	-0.28	0.00	-0.56	-0.20
Vegetables	-0.23	-0.38	-0.86	-1.91
Dairy	-0.25	-0.28	-0.18	-0.94
Fats & oils	-0.63	0.00	-0.11	-0.02
Others	1.23	1.50	2.43	0.30
By individuals:				
Children under-5	-1.83	-2.24	-1.85	-3.49
Pregnant and lactating mothers	-0.43	-0.71	-0.56	-0.72
Total household intake	-2.47	-2.56	-2.58	-6.46

Source: Authors' calculation.

Inflation with growth in 2022

Despite rapid economic growth in 2022, the accelerated inflation in food prices in the period caused a slight to moderate decline in energy, protein, and iron intake, and a moderate decline in Vitamin A intake.

The rapid economic recovery from 2021 onward has raised hopes of reversing the projected decline in energy and nutrient intake from the COVID19 pandemic. Unfortunately, the accelerating food price inflation that happened to coincide with recovery is enough to sustain the decrease energy and nutrient intakes two years after the pandemic. Fortunately, the declines are quite small, in the range of 0.6 to 1.3 percent for energy, protein, and iron. The decline in Vitamin A is however more serious, at 5.4 percent; the fall is mostly due to price increases for Meat, Poultry, and Vegetable. Another source of concern is the unusually high reduction in nutrient intake of Children under-5; this is largely due to the high Dairy price increases.

Table 24: Changes in intake of energy and selected nutrients, Inflation with growth scenario, household and selected members (%)

	Energy	Protein	Iron	Vitamin A
Total household intake	-0.57	-1.26	-0.34	-5.39
By food group				
Rice	0.94	0.60	0.55	0.00
Other cereals	-1.39	-1.12	-1.59	-0.41
Fish	-0.18	-0.96	-0.56	-0.98
Meat	-0.43	-0.73	-0.67	-1.33
Poultry	-0.13	-0.41	-0.26	-1.04
Fruit	0.07	0.00	0.15	0.05

Vegetables	-0.18	-0.29	-0.66	-1.47
Dairy	-0.15	-0.17	-0.11	-0.56
Fats & oils	-0.59	0.00	-0.11	-0.02
Others	1.48	1.81	2.92	0.37
By individuals:				
Children under-5	-1.01	-1.33	-0.99	-2.02
Pregnant and lactating mothers	-0.08	-0.46	-0.17	-0.46

Source: Authors' calculation.

8. Conclusion

8.1 Contributions and limitations of the study

Analysis of changes in nutrient intake as a response to economic shocks were common in the 1980s and 1990s, but recently economic shocks from 2020 onward have been relatively understudied.

This study is an attempt to remedy this gap in the literature by updating demand elasticity estimates, combinining it nutrient content information, and applying the resulting model to simulate the impact of the recent COVID19 household income shock, and the 2021-22 inflation spikes.

Recent food and nutrition surveys conducted by the Philippine government are a valuable source of information about household behavior and the impact of economic shocks.

The Philippines has regularly conducted FCS based on food intake and direct weighing; however a review of past studies found that its use in food demand estimation seems to have ceased in the 1980s and 1990s, largely displaced by income and expenditure survey data. This paper shows that FCS is a viable source of data for such modeling approaches, in particular the flexible functional form with variable expenditure elasticities known as the AIDS. Demand modeling in turn is shown to be an invaluable tool for evaluating the impact of economic shocks, and therefore of offsetting policy measures.

Selection effects are important determinants in consumption and should be taken into account in calculating consumption response to prices and income.

In using FCS (and household survey data for that matter), some technical issues need to be addressed. One emphasized in this paper is sample selection effects, which lead to zero consumption of nutritionally meaningful food groups for some sample households. When the selection model includes price and expenditure variables, as is plausible, then the standard elasticity formulas need to be adjusted. This paper outlines the empirical strategy for making the appropriate adjustment.

The current study is limited by its selection of commodity aggregates in the estimation.

Bouis and Haddad (1992) mention another source of measurement error in estimating calorie income elasticities (and by extension, other nutrient elasticities), namely the change in composition of a food group towards higher quality items (in terms of taste and packaging or presentation), but with lower energy and nutrient content per unit weight. They find other sources of measurement error more important, but that is because their specific data set seems to have stable food group characteristics, e.g price per kg for rice and corn vary little by household income. In contrast, we find in the FCS data for this study, a correlation of 0.24 between total household expenditure and unit value of rice; a correlation of 0.19 with that of unit value of other cereal; 0.10 with that of unit value of meat; and 0.09 with that of unit value of poultry. The correlations are all statistically significant at 5 percent level. One way to address this is to disaggregate beyond the ten food groups adopted here; however the trade off is to aggravate the selection problem already discussed. Addressing this issue is beyond the scope of this paper; further research is needed to more thoroughly address issues related to aggregation.

Notwithstanding these technical issues, the study was nevertheless able to determine that the that the COVID19 social protection programs played a significant role in preventing further deterioration in nutrient intakes and worsening of malnutrition. Moreover, the study also found that, notwithstanding rapid economic growth, the recent inflation episodes pose a major threat to nutrient intakes and nutrition security.

8.2 Implications for policy

Income policies in the form of targeted cash transfers are an important, albeit expensive way to counter adverse nutrition impacts of economic contraction.

The simulation analysis conducted in this study shows that the Bayanihan programs were an effective way to counter the adverse nutrition impacts of economic contraction brought about by the COVID19 pandemic. However, these programs are very expensive and are not sustainable. One way to keep the fiscal cost down is to target cash transfers to the most vulnerable groups, i.e. the poorest households.

Ameliorating the impact of price increases during inflation episodes should assume priority in policy research and response.

There is a tendency to downplay welfare impacts of price increases during periods of rapid economic growth, believing the latter more than cancels out the former. This is not always the case though, as the analysis of the 2021-22 episode done in this paper shows. Hence each inflationary episode should be examined individually to determine the net effect of economic changes on household food security. If the net impact is negative and quantitatively significant then framing the appropriate policy response assumes high priority.

Cost-effective policies to improve food affordability, such as trade liberalization, should be pursued aggressively when nutrition security is under threat.

A common tendency of policymakers is to favor price subisidies in order to keep food affordable. Consumer subsidies are however financially unsustainable; hence, for instance, the tantalizing promise of "Php 20 rice" could not in fact be delivered owing to high fiscal cost, and the opportunities foregone from an expensive food subsidy scheme. Much more cost-effective are trade liberalization measures. The food groups that contribute most to energy, protein, and micronutrient intake of Filipinos, namely Rice, Other cereals, Fish, Meat, and Poultry, are all produced under high levels of trade protection against cheaper imports. This has the unfortunate consequence of reducing affordability of nutrient-rich foods. The sooner the government dismantles high tariffs and overly strict (and often arbitrary) application of sanitary and phytosanitary standards on these major consumer goods, the more affordable these items become especially to the poor.

Productivity improvement along the value chain for rice, animal protein, and vegetables, are have the potential for simultaneously raising incomes and making food more affordable to the poor.

Productivity improvement, beginning from farm production , and extending through out the food value chain, has the potential of boosting competitiveness against cheap imports, raising incomes of food producers , processors, and distributors. By lowering production and logistics cost, productivity improvements also tend to make food more affordable. Identifying the right investments, and sutiable actors along the value chain, to realize these productivity improvements, poses a real challenge to agro-industrial policy; however the potential benefits are too large to ignore this particular approach to food policy.

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10. Appendix Tables

Appendix Table 1: Parameters of the Demand Model

Explanatory variables	Dependent variable (in expenditure shares) Rice	Other cereals	Fish	Meat	Poultry	Fruit	Vegetables	Dairy	Fats & oils
Rice	0.1052	0.0245	-0.0331	-0.0172	-0.0121	0.0062	-0.0218	_-0.0001_*	-0.0057
Other cereals	0.0245	-0.0494	-0.0078	_0.0002_*	0.0072	0.0001	-0.0035	_-0.0002_*	_0.0004_*
Fish	-0.0331	-0.0078	0.1006	_-0.0022_*	-0.0029	0.0065	0.0028	_-0.0001_*	-0.0020
Meat	-0.0172	_0.0002_*	-0.0022	0.0487	-0.0148	0.0021	0.0104	-0.0036	-0.0023
Poultry	-0.0121	0.0072	-0.0029	-0.0148	0.0187	_-0.0001_*	0.0082	-0.0045	-0.0036
Fruit	0.0062	_0.0001_	0.0065	0.0021	_-0.0001_*	-0.0518	0.0024	-0.0023	0.0020
Vegetables	-0.0218	-0.0035	0.0028	0.0104	0.0082	0.0024	0.0124	0.0017	-0.0032
Dairy	_-0.0001_*	_-0.0002_*	_-0.0001_	-0.0036	-0.0045	-0.0023	0.0017	_-0.0028_*	_-0.0010_*
Fats & oils	-0.0057	_0.0004_	-0.0020	-0.0023	-0.0036	0.0020	-0.0032	_-0.0010_*	0.0133
Food expenditure	_0.0160_	0.0729	0.0244	0.0428	0.0307	0.0262	0.0425	0.0206	0.0248
Quadratic term	0.0039	0.0083	0.0082	0.0083	0.0005	_0.0005_*	_0.0008_*	0.0059	0.0030
IMR	-0.1401	0.0174	-0.2248	-0.0424	0.0427	0.0707	-0.1653	0.0182	0.0117
4Ps	0.0221	0.0032	-0.0112	-0.0081	_-0.0038_*	_-0.0001_*	_0.0000_*	-0.0062	_0.0008_*
GMP	_0.0046_*	0.0006	_-0.0032_*	_-0.0058_*	-0.0153	_0.0019_*	_-0.0014_*	0.0281	-0.0039
Age	-0.0006	_-0.0001_*	0.0010	-0.0018	-0.0033	0.0002	0.0002	-0.0001	_0.0000_
Education	-0.0199	0.0000	_-0.0013_	0.0053	0.0077	0.0027	_-0.0001_*	0.0041	0.0015
Marital status	0.0270	0.0006	_0.0012_*	-0.0150	-0.0124	-0.0035	_0.0027_*	-0.0066	_0.0009_
Occupation	-0.0095	-0.0043	_0.0023_*	0.0097	0.0069	_0.0010_*	-0.0057	0.0057	0.0008
Urbanity	-0.0097	0.0020	-0.0082	0.0094	0.0077	_0.0013_*	-0.0083	_-0.0001_*	_-0.0010_*
Wealth	-0.0466	0.0033	-0.0070	0.0349	0.0158	0.0032	-0.0099	0.0124	0.0019
"R-squared"	0.37	0.16	0.09	0.13	0.06	0.03	0.06	0.05	0.13

Source: Author's calculation.