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Will Food Be Affordable to Filipinos by 2030? Alternative Expenditure Policies toward Ending Hunger by 2030

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Abstract

The current inflationary period has placed the spotlight on hunger and food insecurity, as the current Philippine Development Plan has strongly emphasized the attainment of food affordability for all Filipinos. This study offers a scenario analysis using computable general equilibrium modeling of household purchasing power and affordability of a diet with sufficient energy, protein, and Vitamin A. Scenarios posited are as follows: Reference scenario, which projects forward from recent past trends; the Subsidy scenario, based on producer support; and Productivity, which is a long-term government investment focusing on general services.

The scenario analysis finds the following: Under current economic trends, most Filipino households will be able to afford adequate levels of energy and protein by 2030, but not Vitamin A. The Reference scenario is also associated with higher relative consumer and producer prices, as well as far greater levels of output. Despite attenuation of sharp changes in the consumer price of Rice & corn, changes in energy/nutrient intakes under the Subsidy scenario are just equal to those of the Reference scenario. The Productivity scenario entails significantly faster increases in energy, protein, and Vitamin A intake compared with the previous scenarios. The Productivity scenario also leads to smaller changes in price and greater changes in quantity compared with the other scenarios. Implications for policy may be summarized as follows: a) Maintaining overall growth in the range of 5 – 6 percent per year is key to improving diet quality and thereby an affordable energy- and protein-sufficient diet; b) The slightly favorable impact of rice subsidies on the price of rice and on energy/nutrient intake of households may not be worth the added risk of fiscal instability; c) The scenario analysis tend to justify investing in general services such as R&D and infrastructure, as the preferred strategy to achieving affordable diets.

Keywords: computable general equilibrium, food security, scenario analysis, agricultural subsidy, producer support, general services support

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Will Food Be Affordable to Filipinos by 2030? Alternative Expenditure Policies toward Ending Hunger

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1. Introduction

1.1. *Rationale of the study*

Based on various indicators, Filipinos seem to not be eating enough food. According to the Social Weather Stations' (SWS) subjective self-rating indicator, the proportion of households experiencing involuntary hunger was 11.7 percent in 2022, down from its all-time peak of 21.1 percent in 2020, and also far below its previous peak of 19.9 percent in 2012 (SWS, 2023). However, the 2022 figures are basically unchanged since 1998, when the time series started.

Another set of indicators is based on nutrition, which introduces objective, scientific measurement of the health benefits from food. The key macronutrients are carbohydrates, proteins, and fats termed as energy sources (measured in Calories). Based on the Food Balance Sheet (FBS) of the Philippine Statistics Authority (PSA), energy intake per capita in 2014 already reached 2,390 calories per day, 32 percent higher than the Estimated Average Requirement (EAR) of 1,810 calories. Similarly, protein intake per capita had already reached 77.9 gm/day in 2015, 38 percent higher than the EAR of 56.5 gm/day (PSA, 2018).

In contrast however, the Food Consumption Survey (FCS) of DOST-FNRI in 2018-19 found that only 21.8 percent of households in the country had adequate levels of energy intake. Levels of adequacy was much higher for protein at 55.1 percent (DOST-FNRI, 2022a). As the FCS is based on direct household level data, it more closely informs actual accessibility of food at the household level, in contrast with the FBS, which informs availability of food at the aggregate level.

Meanwhile, the Biochemical Survey of DOST-FNRI covers measurements of key micronutrients, namely, iron, iodine, and Vitamin A (DOST-FNRI, 2022b). Iron deficiency is proxied by anemia, measured using hemoglobin level; overall, anemia is of "mild" public significance, affecting 10.4% of the population in 2018-19, although the level of public significance rising to *moderate* for pregnant women (23.0 percent) and *severe* for children aged 6-11 months (43.1 percent). Iodine deficiency was already rated mild back in 2000.

Optimal iodine nutrition is noted among school-age children since 2003. However, iodine deficiency still exists among pregnant and lactating women, while pockets of iodine deficiency are observed among older persons (DOST-FNRI, 2022b). Finally based on serum retinol, Vitamin A deficiency is found to be a moderate public health problem for children aged 6 to 71 months (15.5 percent prevalence), but mild for other population groups (1.0 to 3.0 percent prevalence). Likewise, only 22.6 percent of households had adequate levels of Vitamin A

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intake (DOST-FNRI, 2022a). These and other nutrition gaps (see Section 2) are a serious public policy concern in view of the Philippines' commitment to the Sustainable Development Goals (SDGs).

The PDP identifies food affordability as a key barrier to food security and proper nutrition and identifies strategies accordingly. Nutrition is a multidimensional phenomenon, so is not reducible to a single factor; nonetheless, there is no denying that making food affordable is a key prerequisite to improving nutrient intake. Hence, the Philippine Development Plan (PDP) 2023-2028 subchapter 3.1 "Ensure Food Security and Proper Nutrition", is embedded in Chapter 3 "Reduce Vulnerabilities and Protect Purchasing Power". Within the sub-chapter the outcomes to be pursued are: (a) sufficient and stable supply of food commodities attained; (b) access of consumers to affordable, safe, and nutritious food expanded; and (c) nutrition across all ages improved.

Recent trends however point to serious threats to food affordability: during and after the covid-19 pandemic, inflation stayed within target rate (2 – 4 percent) in 2020 and 2021, but breached it in 2022 at 5.8 percent, with food inflation keeping apace at 5.7 percent. In 2023 food inflation ramped up 8.7 percent (January to September). Food groups experiencing rapid price inflation from 2022 onward are vegetables (particularly onions), oils and fats, sugar and confectionary, and vegetables (PSA, 2023).

Containment of food price inflation can be broadly divided into two approaches. First is the **subsidized self-sufficiency** approach which favors extending subsidies to farmers and fisherfolk, combined with trade protection measures, to ensure that food is produced entirely within the country at affordable prices. Second is the **competitiveness** approach, that favors boosting productivity through innovation, allowing competition to determine allocation of resources towards sectors of comparative advantage. While the current PDP contains language that seems to favor the latter approach, in fact the programs receiving the largest expenditure outlay from 2022 onward are subsidy programs focusing on National Commodity Programs, with emphasis on rice.

1.2. *Method of the study*

Several global studies have conducted scenario analysis of policy and investment pathways towards attaining SDG 2. A common modeling approach is computable general equilibrium (CGE) modeling, which incorporates supply-demand relationships across all the economic sectors, encompasses factor markets, and the major economic institutions, including the rest of the world (ROW). Using CGE modeling, the cost of achieving chronic hunger global targets are estimated at 8 percent of global food market value per annum (Laborde and Torero, 2023). Recent CGE analysis seems to have been found useful to policymakers in making decisions, e.g. DTI studies adopting scenario analysis to assess accession to RCEP, and PIDS studies adopting scenario analysis to assess rice tariffication. For the Philippines, there has yet to be a CGE analysis covering policy scenarios for SDG 2.

This current study performs just such an analysis, which allows household level disaggregation by expenditure quantile (in this study, by centile). The CGE analysis makes possible projections for 2030 on food consumption, translated into nutrient intake, which can be compared with official nutritional guidelines. **Holding preferences constant**, the comparison implies an assessment of affordability of a nutrient-adequate diet, at least for several key nutrients.

The scenarios will provide quantitative assessment of policies related to food supply, productivity of the agrifood system, and food prices. The analysis is highly relevant to

policymakers considering their strong advocacy of zero hunger and malnutrition SDG. The study may help elaborate further the direction and thrust of alternative approaches related to food security and nutrition as exemplified in the PDP, and in recent government policies.

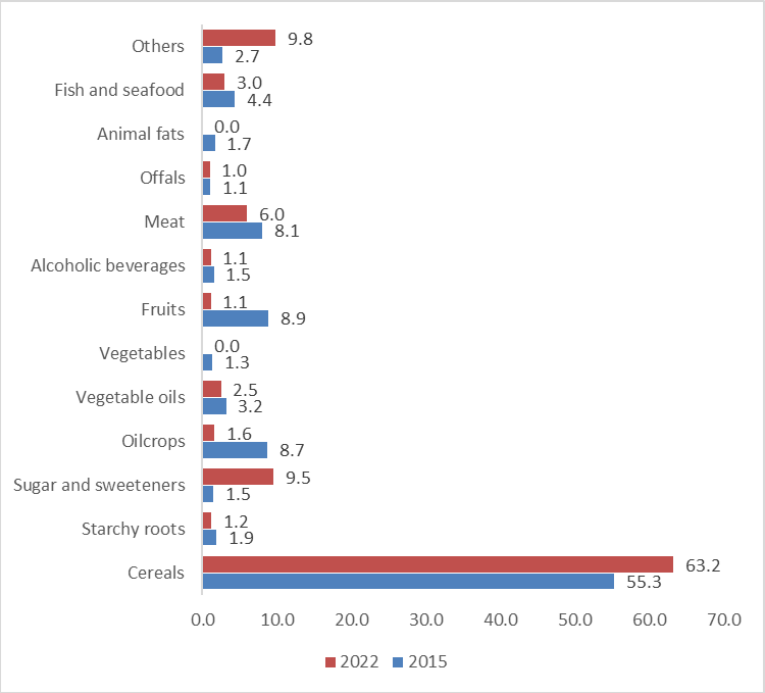
2. Trends and policies

2.1. *Food and nutrition trends*

Availability indicators

Nutrient energy and protein availability has been increasing over time and far in excess of estimated average requirement. By 2022, per capita available energy had reached 2,914 calories per day, 21.9 percent higher than the previous figure for 2014. Similarly, per capita available proteins had reached 88.0 gm/day, 13.0 percent higher than the 2014 figure (PSA, 2023). The bulk of energy intake is obtained from cereals, with its share rising from 55 percent in 2015 to 63 percent in 2022 (Figure 1).

Figure 1: Contributions of food groups to per capita calorie availability, 2015 and 2022 (%)



Source: PSA (2016, 2022).

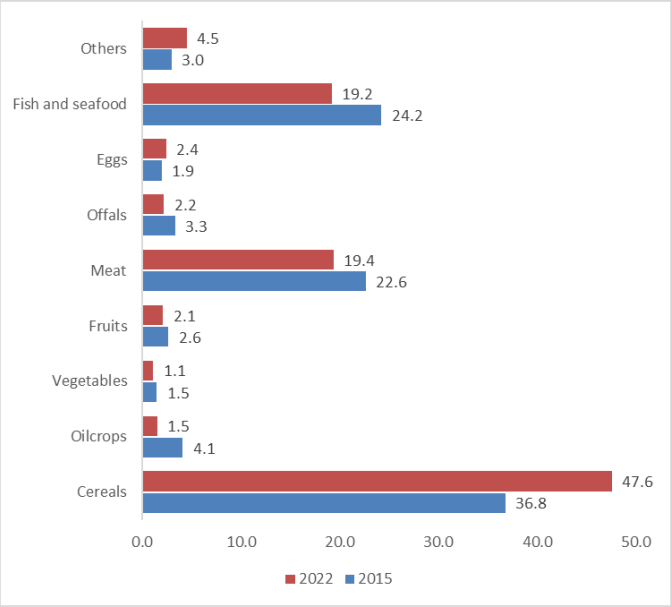
Also listed are the chart are other food groups accounting for at least one percent share of energy intake in 2015; of these, the largest shares in 2015 after cereals is oilcrops, meat, fish and seafood. The pattern of energy contribution is different in 2022, with larger shares for fruit, energy, vegetable oils, and sugar and sweeteners.

Likewise per capita protein availability in 2022 reached 86.0 gm/day, 10.4 percent higher than the figure in 2015 (Figure 2). The major sources of protein in 2015 (i.e., food groups contributing more than 1 percent of protein availability) are cereals (37 percent), fish and seafood (24 percent), and meat (23 percent). By 2022, the cereal share rose to 48 percent, though that of fish and seafood has declined (19 percent), as well as meat (19 percent).

Energy and nutrient intake indicators

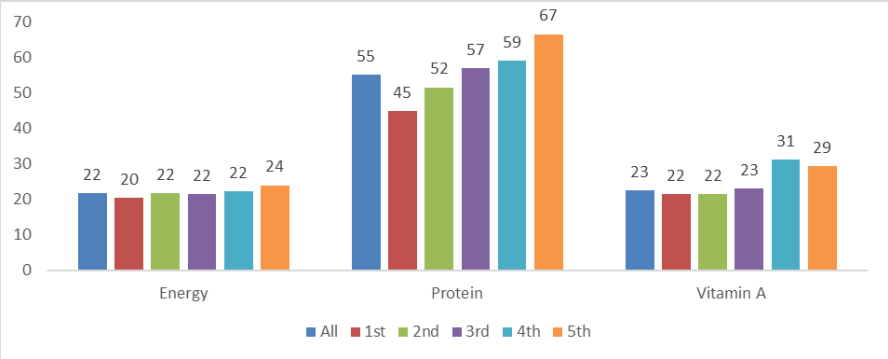
Household energy intake adequacy is far below 100 percent for calories, protein, and Vitamin A. The following focuses on the macronutrients (energy and protein), and Vitamin A among the micronutrients, given the findings of the Biochemical Survey reported above; moreover, Philippines is included among the 64 priority countries for nationwide Vitamin A supplementation among children.[4] The FCS 2018-19 reports adequacy rates at the household level, i.e. the percentage of households whose total intake across members equals or exceeds the Recommended Energy Intake (REI) and EAR, summed across members. The data are disaggregated by wealth quintile (constructed using a household asset index) in Figure 3.

Figure 2: Contributions of food groups to per capita protein availability, 2015 and 2022 (%)



Source: PSA (2016, 2022).

Figure 3. Share of households whose per capita energy and nutrient intake meet REI and EAR, Philippines, 2018-19, by wealth quintile



Source: DOST-FNRI (2022a).

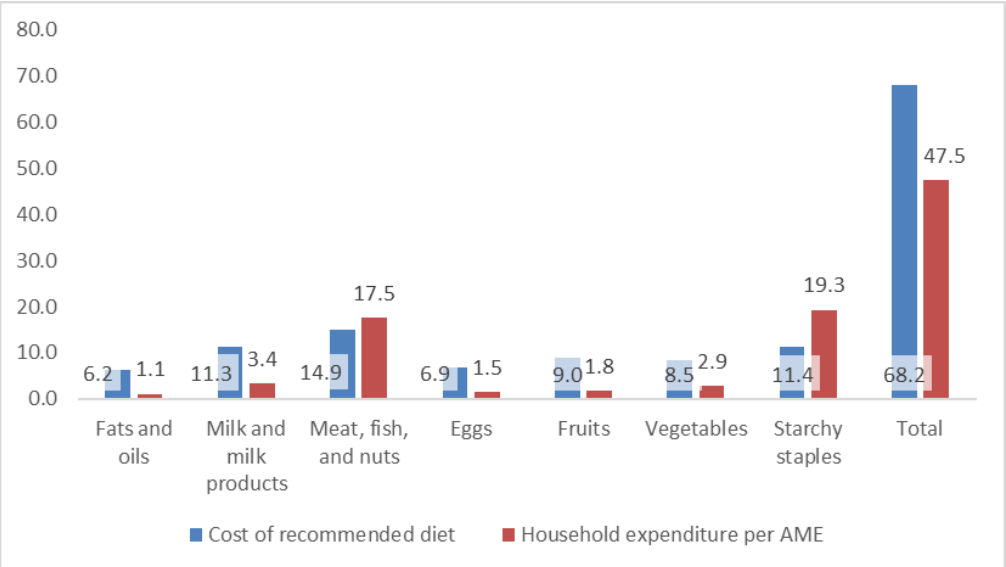
[4] https://data.unicef.org/wp-content/uploads/2023/02/Vitamin-A-supplementation-2000-2022-with-priority-country-lists-for-UNICEF-web-14-Sept-2023.xlsx.

In the case of energy, household energy intake adequacy varies only narrowly across the wealth quintiles, though there is a slight tendency to increase adequacy rates, from 20 percent for the lowest (poorest) quintile, up to 24 percent for the highest (richest) quintile. Likewise variations are also narrow for Vitamin A intake, from 22 percent for the lowest quintile, rising to 31 percent for the fourth quintile, and back down to 29 percent for the top quintile (indicating failure of monotonicity of Vitamin A intake adequacy to wealth level). Variations range more widely for protein intake adequacy, from 45 percent for the lowest quintile, up to 67 percent for the highest quintile.

Affordability indicators

In 2015, average household spending fell short of the average spending required to purchase a healthy diet. Estimates of the cost of a recommended (i.e. healthy) diet are compiled by World Bank (Mbuya et al, 2021). Figure 4 reports estimates of the daily cost of recommended individual diet, and actual household expenditure per adult male equivalent (AME). The total cost of purchasing the recommended diet was Php 68.2 per day, whereas actual spending of households was only Php 47.50 on average (30 percent lower). By food group, households were underspending for fats and oils, milk and milk products, eggs, fruits, and vegetables. Meanwhile there is *overspending* for meat, fish, and nuts, and starchy staples (mostly rice).

Figure 4: Per capita cost of recommended diet and average household expenditure, by food group, 2015 (Php per day)

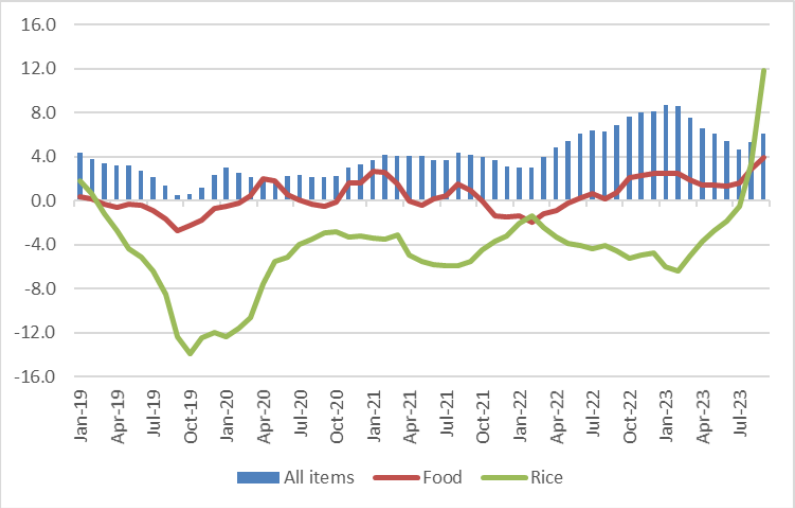


Source: DOST-FNRI (2022a).

Accelerating food inflation since 2022 further threatens food affordability. The comparisons data likely hold true after 2015 especially with inflation (both overall and for food in particular) stayed under the Bangko Sentral ng Pilipinas (BSP) target ceiling of 4 percent, except in 2018 when rice prices surged under the interventionist regime administered by the National Food Authority (NFA). That regime was dismantled in 2019 and followed by several years in which inflation was benign despite the disruption caused by the Covid-19 pandemic. Figure 5 shows the overall inflation rate, which after the start of 2019, stayed below the BSP ceiling until March of 2022, after which it accelerated to peak at 8.6 percent in February 2023.

Also shown in Figure 5 are the *difference inflation* rates for food and rice. This is the item inflation rate minus the All items inflation rate. If below the horizontal axis, then the inflation rate of the item is lower than that of All items, implying a **decrease** in the price of the item relative to the price of the All items basket. If above the horizontal axis, then the inflation rate of the item in question is above that of All items, implying an **increase** in the price of the item relative to the price of the All items basket. Difference inflation rates for food was negative from March 2019 to February 2020, and stayed near zero until September 2022, meaning it mostly tracked the overall inflation rate. However, from October 2022 onward, the average difference inflation rate for food was 2.2 percent, which is the annual rate at which is the relative price of food has been increasing between October 2022 to September 2023.

Figure 5: Monthly year-on-year ctual and difference inflation rates, 2019 – 2023 (%)



Source: PSA (2023).

A key driver of the negative difference inflation rate for food was rice, which accounts for 25.5 percent of the food basket. Rice experienced negative difference inflation rates over a long spell from March 2019, the month when the Republic Act (RA) 11203 or Rice Tariffication Law came into effect, all the way to July 2023. That month, India decided to ban exports of non-Basmati rice, and instituted further restrictions in subsequent months. From July to September, the benchmark price of Thai rice increased 14 percent, while that of Viet Nam rose 22 percent.[5] Given that Philippines' sizable imports, e.g. 3.72 million tons in 2022 (International Trade Center, 2023), these increases have fueled domestic rice price inflation.

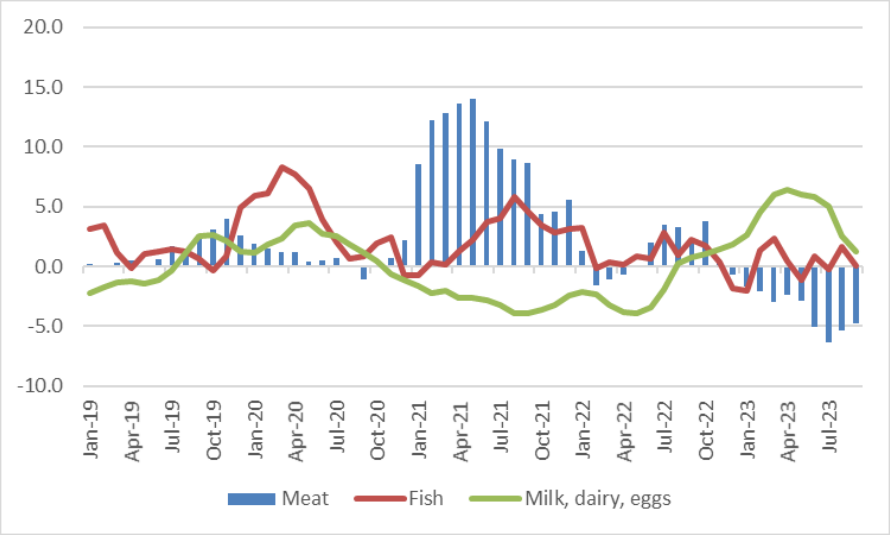
The difference inflation rates for animal products are shown in Figure 6. Meat and meat products (18.5% of the food basket) experienced positive difference inflation rates over most of the period, owing to the depredations of African Swine Fever (ASF), with difference rates peaking in 2022. For most of 2023 though difference rates were *negative* as the swine industry slowly recovered from ASF. Meanwhile Fish and seafood (16.3 percent of the food basket) have mostly tracked overall inflation in 2022-23, though surges had been registered in early 2020 and mid-2021. Milk, dairy, and eggs have mostly stayed in the negative territory until end-2022.

Lastly, difference inflation rates are shown for plant-based items in Figure 7. Monthly rates have been most erratic by far; Vegetables (including tubers), with a 8.1 percent weight in the

[5] https://www.ifpri.org/blog/global-rice-markets-face-stresses-el-ni%C3%B1o-india-export-restrictions.

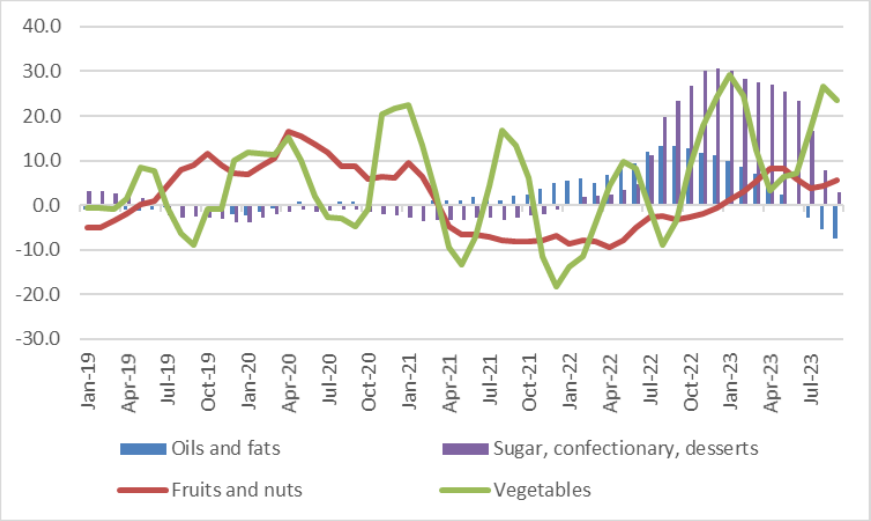
consumer basket, have experienced the highest difference rates in August – September, coinciding with the surge in rice prices. The previous peaks were in December 2022 – February 2023 when onion prices surged. Over the period 2019-2023, plant-based products are experienced positive difference rates (meaning relative prices were becoming higher), from 2.5 percent for Oils and fats, 1.6 percent for Fruits and nuts, and a whopping 5.3 and 5.0 percent for Vegetables and Sugar, confectionary, and deserts, respectively.

Figure 6: Monthly year-on-year difference inflation rates, animal products, 2019 – 2023 (%)



Source: PSA (2023).

Figure 7: Monthly year-on-year difference inflation rates, plant-based products, 2019 – 2023 (%)



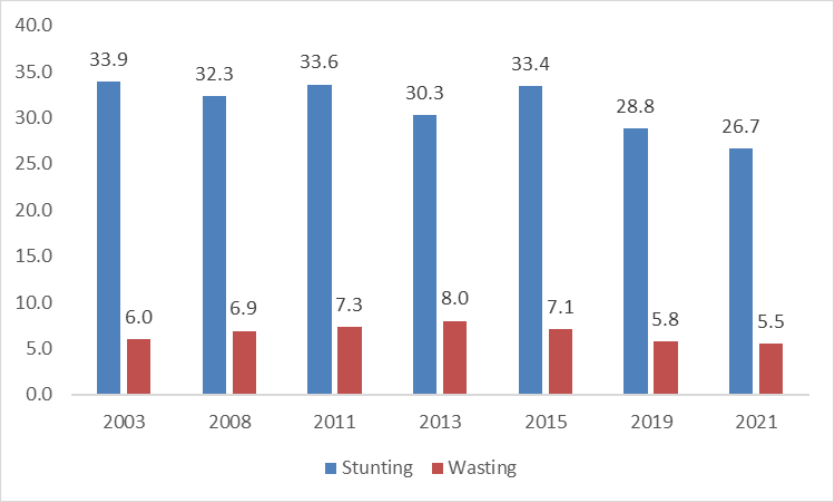
Source: PSA (2023).

Anthropometric measures

Reduced affordability of an affordable diet will eventually affect nutritional status of individuals, as gauged by anthropometric measures. The most important sets of anthropometric measures are height-for-age – a measure of stunting for children – and weight-for-height – a measure of wasting. Stunting measures *chronic malnutrition* while wasting measures *acute*

malnutrition. The critical group are children aged 0 – 59 months (Figure 8). In 2003, more than one-third of the nation's children under 5 were stunted, while six percent were wasted. Sadly, over the next two decades, stunting prevalence had dropped only 7.1 percentage points to 26.7 percent in 2021; wasting dropped 0.6 percentage points to 5.5 percent by 2021. There is no monotonic decline in these measures, despite rising living standards over the same period; stunting prevalence actually increased 2008 – 2011, and 2013-2015, before showing a more consistent decline from 2015 to 2021. Likewise wasting increased consistently from 2005 to 2013, but more consistently falling from 2013 to 2021.

Figure 8: Prevalence of stunting and wasting, children aged 0-5,



Source: PSA (2023b).

2.2. *Achieving affordable food for Filipinos*

Development targets and strategies

The national development plan has identified targets and strategies towards ending hunger, malnutrition, and making food affordable.

SDG 2 targets for hunger and malnutrition (UN 2015) are as follows:

> 2.1. By 2030, end hunger, and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious, and sufficient food all year round;
>
> 2.2. By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the needs of adolescent girls, pregnant and lactating women and older persons.

The "internationally agreed targets" in 2.2 refer to: achieve a 40% reduction in the number of children under-5 who are stunted; and reduce and maintain childhood wasting to less than 5% (WHO, 2014).

PDP 2023-2028 estimates the share of households reaching adequate energy intake (energy intake adequacy) is estimated at 26.6 percent at the 2023 baseline. Meanwhile prevalence of stunting among children under-5 in 2021 was 26.7 percent, with the figure estimated at 25.2 percent in 2023. PDP targets for malnutrition include the following: for energy intake adequacy, 32.6 percent by 2028; for prevalence of stunting for children under-5, 17.9 percent.

Given recent trends in food affordability, the question now is whether these targets are attainable, and what policy pathways are needed to achieve these targets. The current PDP strategies to achieve Outcome 3.1(a) "sufficient and stable supply of food commodities attained" refer to strategies outlined in Chapter 5, "Modernizing agriculture and agribusiness". Under this Chapter are Four Outcomes, of which most relevant to food affordability are: Outcome 1: *Efficiency of AFF production enhanced*; and Outcome 2: *Access to markets and AFF-based enterprises expanded*. Note that the latter is aligned with Outcome (b) under sub-chapter 3.1, namely "access of consumers to affordable, safe, and nutritious food expanded", although from the supply perspective.

Under Outcome 1, the more relevant strategies are:

- Consolidate/cluster farms;
- Create and facilitate adoption of improved technology;
- Improve access of primary producers to production requirements (land, water, bio-resources, capital).

Meanwhile for Outcome 2 the most relevant strategies are:

- Improve physical and digital infrastructure;
- Improve the regulatory system for greater private sector investments;
- Protect local AFF against unfair competition and supply/price manipulation.

Programs of the Department of Agriculture

Over time the DA's programs have been enjoying a rising budget, focusing on input subsidies, especially rice. The size and prioritization of programs for agriculture can be seen in the central government budget, specifically for the DA. Table 1 summarizes data found in the series of General Appropriations Act (GAAs), except 2024 which is obtained from the National Expenditure Program (NEP). New appropriations of the DA more than doubled over the period 2018 – 2024, from Php 53.34 billion to Php 105.91. A large proportion of DA appropriations are for National Programs, namely: National Programs for Rice, Corn, High Value Crops Development, Organic Agriculture, Livestock, and Urban and Peri-Urban Agriculture. Of these, the programs listed in Table 1 are those that can be linked to specific commodities.

Table 1: Budget for DA and its commodity banner programs, 2018 – 2024 (Php billions)

	2018	2019	2020	2021	2022	2023	2024[b]
DA	53.34	47.29	62.29	58.66	68.57	98.86	105.91
Commodity NPs[a]	19.30	11.73	10.96	20.00	23.94	41.63	39.91
Rice	11.75	7.45	6.95	15.52	15.77	30.30	29.05
Corn	2.98	1.56	1.46	1.52	1.50	5.02	5.28
High value crops	2.98	1.55	1.44	1.79	1.52	1.80	1.94
Livestock	1.59	1.18	1.11	1.17	5.15	4.50	3.64

[a]National Programs that are linked to specific commodities or sets of commodities.

[b]NEP figures.

Source: DBM (2023a, 2023b).

These National Commodity Programs accounted for 36 percent of the DA budget in 2018, rising to a 42 percent share in 2024; note that their share actually dipped to as low as 18 percent in 2020, but has since recovered its share in the budget. Note the dominance of Rice among the National Commodity Programs, accounting for a 73 percent share in 2024, up from 63 percent in 2018.

The national programs in turn are allocated to the following sub-programs: Production Support Services (PSS); Extension Support, Education and Training Services (ESETS); Provision of Agricultural Equipment and Facilities (PAEF); Research and Development (R&D); and Irrigation Network Services (INS). PSS and PAEF are mostly classified as subsidies on private goods, whereas ESETS, R&D, and INS, are closer to public goods. The allocation across these sub-programs is shown in Table 2. Note that the PSS and PAEF have nearly tripled in size between 2018 and 2024, now accounting for 38 percent of the DA budget, up from 23 percent in 2018. Total allocation for ESETS, R&D, and INS has in fact fallen from Php 6.89 billion in 2018 to Php 5.96 billion in 2024.

Table 2: Allocation to sub-programs of the Commodity National Programs, 2018 – 2021 (Php billion)

	2018	2019	2020	2021	2022	2023	2024
PSS and PAEF	12.41	5.23	6.72	16.22	19.40	37.17	33.95
Rice	7.01	2.59	4.19	13.08	12.85	27.60	24.31
Corn	2.08	0.89	0.94	1.06	1.05	4.39	4.66
High value crops	2.26	0.93	0.89	1.23	0.96	1.26	1.39
Livestock	1.06	0.82	0.70	0.84	4.54	3.91	3.59
ESETS, R&D, INS	6.89	6.50	4.24	3.79	4.54	4.46	5.96
Rice	4.74	4.86	2.75	2.43	2.92	2.69	4.74
Corn	0.90	0.67	0.52	0.46	0.45	0.63	0.62
High value crops	0.72	0.62	0.56	0.56	0.56	0.55	0.55
Livestock	0.53	0.36	0.41	0.33	0.61	0.59	0.05

Source: DBM (2023a, 2023b).

2.3. *Agricultural policy indicators*

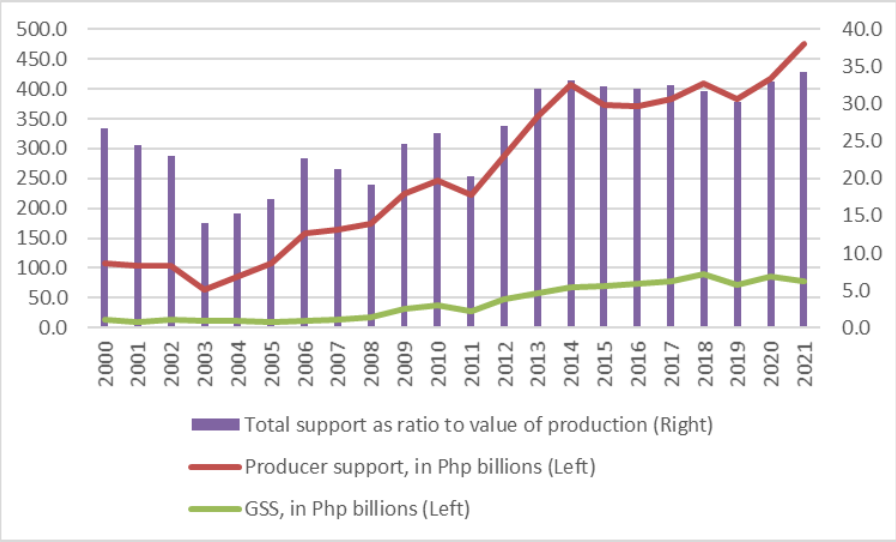
Production and general services support have been rising steadily since the early 2000s, both in absolute terms and as a ratio to the value of agricultural output. Support for agriculture takes the form of direct budgetary outlays (as seen above), or support policies that provide an economic advantage, such as dollar rationing under fixed exchange rates. For agriculture, since the 19990s, the most important form of market price support has been agricultural protection in the form of tariffs and quantitative restrictions (QRs).

The Organisation for Economic Cooperation and Development (OECD) compiles data on agricultural policy support for a set of countries including the Philippines. The broad categories of support are: Producer support, which is "annual monetary value of gross transfers from consumers and taxpayers to agricultural producers, measured at the farm gate level, arising from policies that support agriculture, regardless of their nature, objectives or impacts on farm production or income*"* (OECD, 2016, p. 105). It therefore combines indirect price support and direct budgetary support. Meanwhile the value of gross transfers from "policy measures that create enabling conditions for the primary agricultural sector through development of private

or public services, and through institutions and infrastructures" is called General Services Support or GSS (OECD, 2016, p. 16).

According to Figure 9, over the OECD time series (2000 – 2021), the ratio of total support (sum of producer support and GSS) bottomed out at 13 percent in 2003, rising fairly steadily until peaking at 34 percent by 2021. By far the larger contributor to total support is Producer support rather than GSS; the peak level of GSS is Php 89.5 billion in 2018, while that of Producer support was Php 475.4 billion in 2021.

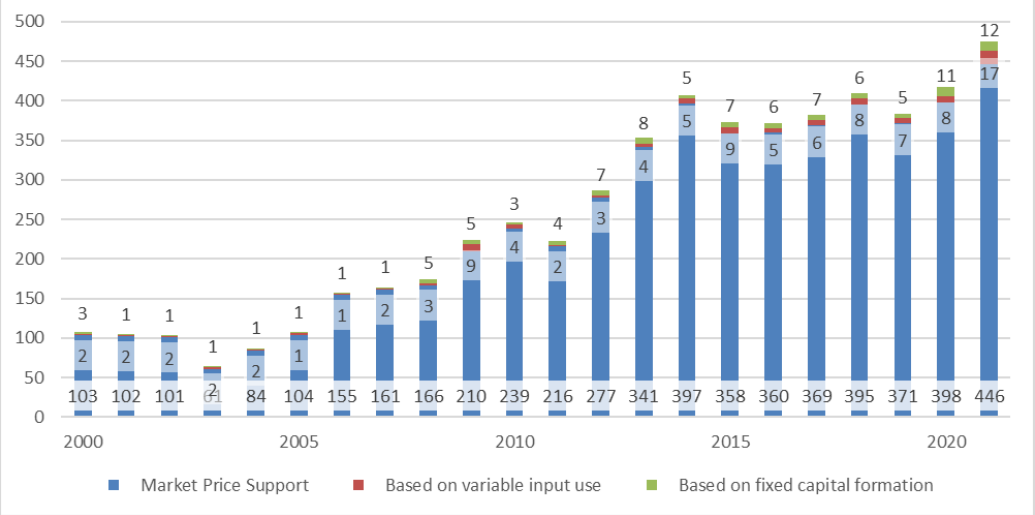
Figure 9: Estimates of producer support, GSS, and total support, 2000 - 2021



Source: OECD (2023).

The breakdown of Producer support is shown in Figure 10. Producer support is mostly in the form of market price support. However input support has been increasing over time, from just Php 5 billion in 2000, rising to Php 29 billion in 2021. The combination of enormous market price support with substantial input support implies strong adherence to a policy of subsidized self-sufficiency on the part of successive Philippine governments.

Figure 10: Composition of producer support, 2000 – 2021, Php billions



Source: OECD (2023).

Input subsidy is broken down into support for variable inputs (seeds, planting materials, growers, fertilizers, pharmaceuticals, other chemicals) as well as for fixed capital formation (i.e. acquisition of equipment and machinery). Since 2014, the growth of variable input subsidy has outpaced that of fixed capital formation, such that by 2021 it accounted for 59 percent of total input subsidy. The OECD time series ends before the entry of the current administration; after 2021, it has dramatically expanded input subsidies over those of the previous administration.

3. Literature Review

3.1. *Food security and nutrition*

A recent review of food security and nutrition trends of the Philippines finds that the country has made considerable headway in reducing hunger and malnutrition (Galang, 2022). However, compared with other countries in Southeast Asia, the pace of improvement has lagged considerably. In the case of stunting prevalence, for instance, the decline in just about a fifth the rate achieved by countries such as Viet Nam. Nutrient-adequate diets are unaffordable to one-third of households owing to high prices and low purchasing power. As pointed out earlier, estimate that the daily cost of recommended diet has been estimated to be in excess of average food expenditure by 44 percent. This is consistent with global evidence on the link between food prices, household incomes, and nutrition, e.g. Headey and Ruel (2022).

Briones (2022a) found that household nutrient intake likely suffered a serious setback owing to the economic crisis brought about by COVID19 in 2020. Furthermore, despite subsequent economic recovery in 2021-22, food inflation in 2021-2022 further reduced household intake of energy and key nutrients. In turn this may be expected to have serious consequences on nutritional status as gauged by anthropometric indicators such as stunting, wasting, and underweight (Agdeppa et al, 2022).

3.2. *Policy approach*

Agricultural policy has traditionally been driven by a two-pronged approach to self-sufficiency, namely *trade protection* to keep out imports, combined with *input subsidy and price support* to expand domestic production. Policy pronouncements to the contrary, recent public expenditure programs centered on Department of Agriculture (DA) still focuses on self-sufficiency through single-commodity banner programs, especially for rice. The focus should instead be on public goods such as the agricultural innovation system, infrastructure, biosecurity, and climate smart agriculture; as well as programs to overcome barriers to collective action and economies of scale (World Bank, 2023).

The latter is part of a “market approach” described in Briones (2022b), which also eschews using trade protection to pursue self-sufficiency, in view of embracing comparative advantage and investing in long term competitiveness. He points out that, since the late-1980s, policies have oscillated between traditional and market-oriented reforms, which the current regime retaining considerable levels of protection on the most sensitive agricultural commodities such as rice, maize, sugar, meat, fish, root crops and tubers, and vegetables. These are the same commodities which contribute most to energy and nutrient intake of Filipinos (Briones 2022a).

3.3. *Scenario analysis using general equilibrium modeling*

Previous applications

Scenario analysis, in this Report, involves economic modeling to represent actual or hypothetical trends in production, consumption, and even trade. This method has been applied to examine the attainment of SDG 2 at the global level, which in turn leads to estimates of the requisite investment cost. MIRAGRODEP, a global CGE model currently being maintained by the International Food Policy Research Institute (IFPRI), was applied for scenario analysis on three targets of SDG 2, namely *ending hunger, doubling incomes and economic productivity of small-scale* producers, and *producing food sustainably and resiliently* (Laborde et al, 2020). They estimate that an additional USD 35 billion annually from donors and countries (14 and 19 billion, respectively) can prevent hunger for 490 million persons by 2030, whereas no additional effort leads to remaining 660 million hunger persons by 2030.

Another application of MIRAGRODEP finds that chronic hunger can be brought down to 5% level by 2030 using investments in farm productivity and reduction of food loss and waste; additional expenditures on safety nets are needed to address remaining hunger. Cost of both efforts comes to around 8 percent of global food market value (Laborde and Torero, 2023).

The building blocks of a CGE scenario analysis for the Philippines has been developed in a series of papers: Briones (2017) provides productivity growth scenarios and its implications for the agro-industry and the economy as a whole, using a CGE model for the Philippines, the Agricultural Multi-market Model for Policy Evaluation (AMPLE-CGE). The AMPLE-CGE was then applied to welfare impacts of rice tariffication in Briones (2019), as well as the impact of agricultural trade liberalization (Briones, 2020).

Some key updates need to be applied to the AMPLE-CGE data to make it useful for the current scenario analysis. First, it currently uses data from the 2012 input-output table to compile its Social Accounting Matrix (SAM). This needs to be updated as the 2018 input-output table is now available. This table will be used as a basis to compile a social accounting matrix (SAM), together with 2018 national income accounts (NIA), also available from PSA. Second, demand side parameters of AMPLE-CGE are calibrated rather than econometrically estimated. Briones (2022a) estimates food demand elasticities from primary data, using a specific functional form, namely the quadratic Almost Ideal Demand System (QAIDS), estimated in Briones (2022a).

Limitations in CGE modeling

The long-term analysis contemplated in this study involves a dynamic recursive solution strategy, corresponding to successively solving the model with updated values of exogenous variables. In particular, current investment accumulates to augment capital stock; population grows as a matter of underlying demographics (fertility rate in excess of mortality rate); and so on. Among the key long term features of economic development is *structural change*, namely the decline in agriculture as a share in GDP and employment as per capita income grows, is a well-recognized phenomenon in economic development (Kuznets, 1973). It is also well known that the typical dynamic recursive CGE models may not capture structural change very well (Roson and Britz, 2021).

As in Briones (2023), the theoretical literature on structural change (within a neoclassical Walrasian framework of CGEs) can be understood from the supply side or the demand side. On the supply side are factor endowment effects, which require agriculture to be relatively less capital-intensive than the relatively expanding sectors (industry and services). On the demand side are non-homothetic effects in which demand for food (the main output of agriculture)

follows the Engel relationship to income. Comin et al (2021) conduct a careful analysis of the issue of structural change in both real-world data and as simulated in long term CGE scenarios. Their econometric analysis suggests that non-homotheticity in household demand account for over 80 percent of structural change in a pooled cross-section, time series sample of countries; unfortunately, the more widely used CGE demand systems based on Stone-Geary or even price-independent linear (PIGL) preferences (the basis of AIDS) are unable to reproduce features of structural change. They recommend adopting a generalized nonhomothetic Constant Elasticity of Substitution (CES) preferences to for greater modeling flexibility in representing the effect of non-homothetic demand for agricultural products.

4. Analytical method

4.1. *Deriving nutrient intake*

In the following, malnutrition is measured using adequacy of nutrient intake, namely for energy, protein and Vitamin A. Nutrient intake in turn is converted from the nutrient content of food. We suppose the following notation: *i* indexes goods, *k* indexes nutrient types, *h* indexes households, q_{hi} is the quantity consumed of *i* by household *h*, c_i^k is the content of *k* in a unit of *i*, N_h^k is the total nutrient intake by *h* of *k*, s_{hi}^k is the share of nutrient *k* from *i* for household *h*. Then we have Equation (1):

$$N_h^k = \sum_i c_i^k q_{hi} \,. \tag{1}$$

Changes in N_h^k are determined by changes in q_{hi}^k:

$$\frac{\Delta N_h^k}{N_{h0}^k} = \sum_i s_{hi0}^k \frac{\Delta q_{hi}}{q_{hi0}} \tag{2}$$

Here the subscript "0" denotes the baseline level of the variable. The percentage change in the intake of nutrient *k* equals the percentage change in the consumption of each good, weighted by the share of that good in the total intake of *k*.

The goods of the AMPLE-CGE are listed in the Annex. The food goods correspond to nutrient content, for which estimates per edible gram are shown in Table 3.

Table 3: Nutrient content of food goods, per edible gram

	Calories	Proteins (gm)	Vitamin A (IU)
Palay	0.85	0.02	0.00
Maize	3.65	0.09	0.01
Coconut	2.18	0.02	0.00
Sugarcane	0.39	0.00	0.00
Banana	0.61	0.01	0.44
Mango	0.41	0.01	7.47
Pineapple	0.17	0.00	0.19
Coffee	0.01	0.00	0.00
Cassava	1.18	0.01	0.10
Sweet potato	0.86	0.02	145.87
Other fruits	0.52	0.00	0.54

	Calories	Proteins (gm)	Vitamin A (IU)
Leafy & stem vegetables	0.13	0.02	44.68
Fruit vegetables	0.18	0.01	8.83
Onion	0.36	0.01	0.00
Other crops	0.02	0.00	0.00
Hog	0.74	0.18	0.05
Cattle	1.25	0.13	0.00
Chicken	1.84	0.21	1.24
Other livestock	0.05	0.00	0.40
Eggs	1.36	0.12	0.48
Fishing	0.22	0.05	0.21
Seaweed aquaculture	3.00	0.33	24.00
Other aquaculture	0.85	0.20	0.00
Meat	0.74	0.18	0.05
Processed meat & fish	2.23	0.16	0.00
Processed fruit & vegetables	0.61	0.01	0.26
Fats & oil	8.62	0.00	0.00
Milk & dairy	0.42	0.03	0.47
Rice & corn	1.30	0.03	0.00
Other food	4.37	0.09	0.11
Sugar & sugar products	3.87	0.00	0.00
Beverages	0.41	0.00	0.00
Alcoholic beverages	0.43	0.01	0.00

Source: www.google.com, and PSA (2013).

4.2. *Food affordability and the household module*

Consumption is determined by market prices and household income. Further notation is hereby introduced, namely p_i as the respective market prices of i, $i = 1, 2, ..., M,$ and y_h, the income of household h. The relationship is summarized in a demand function of h for i:

$$q_i = q_i\left(p_1, p_2, ..., p_M, y_h\right).$$

The demand function results from maximizing of household utility subject to market prices and a given income.

The combination of prices and income results in household **purchasing power**, which is closely related to **affordability**. Increases in income increases purchasing power; likewise, a reduction in price of a good, which amplifies purchasing power for all goods, but especially of the good with a reduction in price. All else equal, increases in purchasing power will tend to increase consumption of normal goods, and thereby nutrient intake. Hence, for normal goods:

$$\Delta y_h > 0 \rightarrow \Delta q_{hi} > 0;$$

$$\Delta p_h < 0 \rightarrow \Delta q_{hi} > 0.$$

Obviously, we are not ruling out here the tendency of many households to prefer nutrient-thin diets heavy in ultra-processed, sugar- and fat-laden foods. Such a preference implies that, with the same purchasing power, households can already improve their nutritional status by making

a behavioral switch to a healthier diet. Our focus in this study though is to evaluate scenarios of household purchasing power and food affordability.

Changes in nutrient intake and comparison with nutritional guidelines are determined in a household module, consisting of observations of the FCS 2018-2019, aggregated into centiles; ranking of observed households is done according to total cost of one-day food intake. Also derived from the FCS household module are the nutrient adequacy gaps. Changes in prices and household income are obtained from the AMPLE-CGE model under various scenarios. Allowing free household choice based on its preferences, affordability can be assessed based on the magnitude of remaining nutrient intake adequacy by 2030.

4.3. *Description AMPLE-CGE*

Overview

The algebraic structure of the AMPLE-CGE is largely identical with that of Briones (2020). The complete set of equations and definitions is available from the author on request. It is written in the General Algebraic Modeling System (GAMS), which is used to code, compile, and solve the model (using the CONOPT solver package).

Household block

The first set of equations pertains to a household block. There is only one household in AMPLE-CGE (household disaggregation is done only household module). Consumption is modeled as a linear expenditure system (LES) based on Stone-Geary preferences. We opt for this more standard approach to CGE modeling (with modest non-homotheticity effects), anticipating potential issues with representing structural change in the long run.

Factors of production are agricultural labor, industry-service labor, capital, and land; in the model land is used only for crop production. Factor income of households equals endowments of labor and capital, valued at their respective factor prices, and the net revenue from sale of crops. The disposable income of households is factor income less direct taxes, plus transfers from government and ROW (converted to local currency at the market exchange rate, i.e. the peso price of a unit of USD).

Business firm block

The second set of equations pertains to the business firm block. Gross output equals a factor of production component, i.e. value added, plus an intermediate input component, both in fixed proportions. Unit intermediate input requirements of gross supply result in intermediate input demand. Price of gross supply equals price of value added, plus payments for net indirect taxes (expressed in ad valorem rates to value added), and payments for intermediate inputs. The “net” in net indirect taxes incorporates tax expenditures and subsidies, which may be large enough to make tax payments negative (corresponding to positive net subsidies).

Outside of crops, production of value added is a constant elasticity of substitution (CES) function of labor and capital. Crop production is a nested process in which value added per unit land area (ha) is a Cobb-Douglas combination of agricultural labor and capital; gross output incorporates intermediate inputs (in Leontieff fixed proportions as with non-crops). However, the supply of land to each crop is incentivized by net revenue per ha. In the outer nest, temporary crop land allocates to the temporary crops according to net revenue maximization with the constraint of a constant elasticity of transformation (CET) of temporary crop land to its specific land use. Similarly, perennial crop land is allocated to the perennial crops in a

similar manner with its own CET. Within the inner nest, overall land is allocated to temporary and perennial crops also under CET.

Finally, capital is mobile across sectors; agricultural labor is mobile across agricultural sectors; and industry-service labor is mobile across industry-service sectors. Aggregate labor is split into agricultural labor and industry-service labor according to a CET function.

Trade block

Imports arise from Armington-distinguished demand based on home versus foreign (ROW) versions of each importable good. Armington demand arises from a CES combination of the home and foreign versions, over which revenue is maximized, subject to import price and the price of the home market version. The import price is the fixed border price plus tariffs (small open economy assumption). Likewise, exports arise from domestic supply allocated to different markets, namely a home market and a foreign market, each with a differentiated version of the good. The domestic supply transforms to either version according to a CET function, following cost-minimization subject to the price of the home market version and a given export prices (small open economy assumption). The exchange rate is flexible subject to fixed foreign savings.

Other demand and closure

Consumer demand of government follows a fixed-shares, Cobb-Douglas allocation. Investment demand results from a fixed share allocation out of aggregate savings, the sum of household, government, and foreign savings. Closure conditions are as follows:

- Available capital stock equals total demand for capital, resulting in market clearing price of capital;
- Available agricultural labor equals total demand for agricultural labor, resulting in a market-clearing price of agricultural labor;
- Available industry-service labor equals total demand for industry-service labor, resulting in a market-clearing price of industry-service labor;
- Demand for the home version equals supply to the home market, resulting in a market-clearing price of the home version;
- The CPI normalizes to its baseline level (unity).

4.4. *Model data*

The data of the model is compiled mostly from the 2018 Input-Output Table of the PSA.[6] The Table is available in 240 sectors, which are then aggregated into the 55 AMPLE-CGE sectors according to the mapping provided in the Annex. The IO table is re-organized into the format of a Social Accounting Matrix (SAM), requiring the following supplemental information:

- PSA Income and Outlay Accounts:
  - Table G. Income and Outlay Account in General Government Annual 2018 to 2020 at current prices

[6] https://procurement.psa.gov.ph/sites/default/files/2018%20IOSPBI%20Form%205.pdf.

- Table D. Consolidated Accounts IV: External Transactions

- Department of Finance (DOF) data
  - Bureau of Customs monthly import reports
  - Bureau of Treasury Table 3: National government revenues, by major type of tax

Furthermore, the Operating Surplus IO entries are split into land and capital as follows:

- Land factor payments accrue only to crops;
- IO Operating Surplus is divided into land factor payments and capital factor payments using cost and returns data of PSA.

Selected SAM entries is further adjusted to eliminate negative values for QDH_G and QSH_G, as well as ensure overall SAM balance.

Additional data needed by the model are as follows:

- Initial stock of capital: derived by the perpetual inventory method using the time series of gross domestic capital formation (in constant prices) from 1946 to 2018 available from PSA;
- Wages of agricultural labor relative to industry-service labor derived from the Decent Work Statistics (PSA, 2021)
- Population and crop area harvested for 2018 is obtained from PSA Openstat.

4.5. *Model calibration*

Key variables to be calibrated are the intercept terms and coefficients of the model equations (Annex A). Calibration is done using the model data, together with imputed elasticities.

- Land use elasticities:

  sigH = -0.5

  sigHP = -0.5

  sigHT = -2.0

- Labor sector allocation elasticity

  sigL = -0.5

- CES value added function elasticities uniformly set at 2.0;
- Armington elasticities are uniformly set at 4.0;
- CET export-domestic elasticity uniformly set at 2.0 (absolute value);

Imputation of LES elasticities is more involved. As stated in the Literature Review section, demand elasticities are imputed from Briones et al (2022), whose own-price and income elasticities are reproduced in Table 4.

Table 4: Estimates of income and own-price elasticities of demand using a quadratic Almost Ideal Demand System with selection effects

	Income elasticities	Own-price elasticites
Rice	0.75	-0.69
Other cereals	1.75	-1.81
Fish	0.98	-0.83
Meat	1.22	-0.82
Poultry	0.73	-0.61
Fruit	0.98	-2.27
Vegetables	1.09	-0.96
Dairy	1.65	-0.89
Fats & oils	1.69	-0.38
Other food	-2.49	-1.34

Source: Briones et al (2022).

The estimates in Table 4 are then expanded and applied to the relevant elasticities of the LES. In bold are income elasticities of non-food manufactures and of services, set at unity or higher. Italicized are income elasticities of Palay, Maize, and Rice & corn, as well as Other food, Animal feed, and Chemicals & plastics. The imputation of 0.10 for the first three items sets aside the high 0.75 estimate for Rice in Table 4 for reasons given by Bouis and Haddad (1992). Other food and Animal feed are simply equated to that of rice and corn. Finally, Chemicals & plastics are adjusted to ensure weighted income elasticities sum up to unity.

Table 5: LES elasticities for AMPLE-CGE

	Income/expenditure	Own-price
Palay	0.10	-0.69
Maize	0.10	-0.69
Coconut	1.69	-0.90
Sugarcane	1.69	-0.90
Banana	0.98	-2.27
Mango	0.98	-2.27
Pineapple	0.98	-2.27
Coffee	0.98	-1.34
Cassava	1.09	-1.34
Sweet potato	1.09	-1.34
Other fruits	0.98	-1.34
Leafy & stem vegetables	1.09	-0.96
Fruit vegetables	0.98	-0.96
Onion	1.09	-0.96
Other crops	1.00	-1.34
Hog	1.22	-0.82
Cattle	1.22	-0.82
Chicken	0.73	-0.61
Other livestock	1.22	-0.82
Eggs	0.73	-0.61
Fishing	0.98	-0.83
Seaweed aquaculture	0.98	-0.96
Other aquaculture	0.98	-0.83

	Income/expenditure	Own-price
Other agri-related activity	1.00	-0.90
Mining	1.00	-0.90
Meat fresh and processed	1.22	-0.82
Processed fish	0.98	-0.83
Processed fruit & vegetables	1.09	-0.96
Fats & oil	1.69	-0.38
Milk & dairy	1.66	-0.89
Rice & corn	0.10	-0.69
Other food	0.10	-1.34
Sugar & sugar products	1.77	-1.34
Beverages	1.77	-1.34
Animal feeds	0.10	-0.90
Alcoholic beverages	1.77	-0.90
Tobacco	1.00	-0.90
Textiles, apparel, footwear	1.00	-0.90
Wood, paper, printing	1.00	-0.90
Chemicals & plastics	1.49	-0.90
Fertilizers	1.00	-0.90
Mineral & metal products	1.00	-0.90
Electronic & electrical equipment, devices	1.00	-0.90
Machinery & vehicles	1.00	-0.90
Other manufacturing	1.00	-0.90
Electricity, gas & water	1.10	-0.90
Construction	1.10	-0.90
Trade	1.20	-0.90
Transport & logistics	1.20	-0.90
Food & accommodation	1.20	-0.90
Information & communications	1.20	-0.90
Finance & real estate	1.20	-0.90
Professional & technical	1.10	-0.90
Public sector	1.20	-0.90
Other services	1.20	-0.90

Source: Authors' imputation.

4.6. *Household module*

The household module summarizes information available from the FCS 2018-2019. Given household *h,* we define the household recommended nutrient intake $RENI_h$ as the sum of RENI of the household members, respectively for energy, protein, and Vitamin A; "energy" here is included among the nutrients (although it is technically defined as the ability of the body to do work as a result of intake of macronutrients, namely fats, proteins, and carbohydrates). The household nutrient intake NI_h is likewise the sum of nutrient intake of household members, respectively for energy, protein, and Vitamin A. For a group of households numbered $h = 1, 2, N_h$, we define a binary inadequacy variable $IC_h = 0, 1$, where $IC_h = 1$ when $NI_h \leq RENI_h$, $IC_h = 0$ otherwise. The share of households for which $IC_h = 1$ (nutrient intake is below the recommended requirement) is estimated from the FCS as follows: 75.6 percent for energy, 65.4 percent for protein; and 87.5 percent for Vitamin A.

The inadequate intake rate *IAR* is defined as follows:

$$IAR = IC_h \frac{\sum_{h=1}^{N_h} RENI_h}{\sum_{h=1}^{h} NI_h} - 1. \qquad (3)$$

The *IAR* is the percentage change in NI_h that suffices to just achieve $RENI_h$ (among households who fall short of $RENI_h$).

The household module aggregates the households of the FCS into 100 centiles. In the absence of income information, households are sorted by size of total daily food cost. IAR by centile are shown in Tables 6 and 7.

Table 6: IAR by centile and nutrient type, bottom set of households, 2018-19 (%)

Centile	Energy	Protein	Vitamin A	Centile	Energy	Protein	Vitamin A
1	84.4	132.8	266.5	26	38.4	32.6	43.0
2	76.7	108.2	188.0	27	48.4	41.9	125.6
3	67.4	86.4	120.9	28	43.0	36.1	136.8
4	56.9	69.8	134.7	29	35.5	27.8	59.7
5	58.0	73.0	122.4	30	35.5	29.2	68.2
6	47.2	56.2	89.9	31	40.7	33.9	68.0
7	57.5	66.8	121.8	32	31.8	27.9	37.5
8	45.8	58.4	101.6	33	38.0	30.5	44.4
9	45.5	52.5	138.4	34	31.3	25.1	41.3
10	48.3	58.6	112.7	35	31.5	25.7	93.0
11	51.3	58.9	95.7	36	33.0	24.7	84.8
12	54.8	57.4	109.2	37	39.1	34.6	63.8
13	44.5	50.9	19.7	38	35.0	31.1	104.5
14	53.6	52.3	104.7	39	37.4	29.9	89.2
15	43.1	43.3	95.1	40	34.2	28.1	98.1
16	40.7	40.2	148.2	41	30.6	22.6	121.6
17	41.9	45.1	127.7	42	33.1	25.3	88.2
18	47.2	47.5	69.7	43	28.2	19.8	42.5
19	45.6	42.3	119.8	44	28.9	20.5	50.7
20	51.1	51.4	102.9	45	33.6	26.5	57.8
21	48.9	41.6	132.3	46	28.7	19.8	121.9
22	37.2	37.7	117.3	47	30.3	22.1	55.3
23	37.7	35.9	104.2	48	29.5	19.6	76.6
24	43.3	42.3	143.9	49	35.4	23.4	96.3
25	42.0	41.8	101.5	50	30.6	19.2	32.2

Note: missing entry denotes absence of an intake gap.

Source of basic data: DOST-FNRI (2021a).

Nearly all the centiles suffer from energy inadequacy (99 out of 100); 83 out of the centiles suffer from protein inadequacy; and 93 out of 100 centiles for Vitamin A. While there is no monotonic decrease in IAR by centile, although there is certainly a strong negative correlation between centile and inadequacy rate. The bottom 1 percent of households require a 84.4 percent increase in total energy intake to reach the aggregate target RENI; the required increase is

larger for protein at 132.8 percent, and higher still for Vitamin A at 266.6 percent. For the 50th centile the required increases are smaller, i.e. 30.6 percent for energy, 19.2 percent for protein, and 32.2 percent for Vitamin A. The 100th centile suffers no nutrient inadequacy at all, though the 99th centile still requires a 0.8 percent increase in energy intake to reach its RENI.

Table 7: IAR by centile and nutrient type, top set of households, 2018-19 (%)

Centile	Energy	Protein	Vitamin A	Centile	Energy	Protein	Vitamin A
51	24.7	15.7	52.9	76	20.8	8.2	37.9
52	24.0	15.2	29.7	77	16.9	4.5	16.2
53	21.8	13.2	51.3	78	13.9	0.4	37.1
54	22.3	13.3	29.7	79	15.4	3.1	5.5
55	23.6	15.5	37.7	80	14.0		3.4
56	20.1	12.4	49.0	81	17.7	3.2	18.7
57	22.3	14.6	34.9	82	17.6	4.8	35.2
58	20.8	14.1	31.7	83	16.2	2.1	19.8
59	25.1	15.9	38.7	84	12.8		31.4
60	21.2	10.0	36.0	85	16.8		12.9
61	25.3	14.4	45.8	86	14.1		
62	19.9	9.4	9.3	87	12.2		7.7
63	20.1	7.2	3.3	88	12.9		25.5
64	19.4	9.2	33.9	89	10.8		9.9
65	19.2	7.8	24.7	90	13.5		9.5
66	20.1	8.3	26.7	91	12.1		15.4
67	18.4	7.2	30.3	92	11.3		
68	21.1	10.9	32.6	93	10.6		4.2
69	19.7	9.5	25.1	94	11.5		42.1
70	20.7	8.4	14.9	95	5.7		2.4
71	17.1	7.3	41.7	96	3.8		
72	17.8	4.5	43.5	97	7.1		
73	17.9	4.4		98	7.1		
74	18.4	7.4	25.3	99	0.8		
75	14.4	1.1	36.8	100			

Note: missing entry denotes absence of an intake gap.

Source of basic data: DOST-FNRI (2021a).

Consider periods 0 (beginning of interval) and 1 (end of interval). Estimates of $NI_{h1}/NI_{h0}-1$ are available according to Equation (2). Supposing that $RENI_{h0}=RENI_{h1}$, i.e. demographic structure of the baseline carries over to 2030. Then IAR_1 can be estimated using the following formula:

$$\left[IAR_0-\left(\frac{NI_{h1}}{NI_{h0}}-1\right)\right]\frac{NI_{h0}}{NI_{h1}}=\frac{RENI_h-NI_{h1}}{NI_{h1}}=IAR_1\,. \tag{4}$$

4.7. *Definition of scenarios*

Overview

The scenarios are solved over the period beginning 2018, the model baseline, to 2030, the endline for the SDGs, in a dynamic recursive manner. Three scenarios are posited, one of which is a Reference scenario, which projects forward from recent past trends. Based on the discussion in Section 2.3, alternative policy approaches to food affordability are represented in two additional scenarios. First is the Subsidy scenario, which represents the current policy thrust of emphasizing Producer support, involving large budgetary outlays for agricultural subsidies. Second is the more long-term budgetary allocation focusing on GSS, especially on agricultural R&D and other public goods (connectivity infrastructure, public facilities, etc.) While Section 3 has shown that by far the largest component of agricultural support is agricultural protection, we opt not to incorporate this in the current analysis as the issue of agricultural protection has been already analyzed in Briones (2020).

Reference scenario

There are numerous exogenous variables in the model; the ones most salient to defining the reference scenario are as follows:

- Population – based on population projections of PSA
- Government consumption – set at 2 percent growth (real terms) over the period
- Foreign savings – set at 2 percent growth over the period
- Border prices of imports

The last apply experience from 2018 to 2023 documented both in the World Bank Pink sheet and inflationary/deflationary episodes in the Philippines, with growth rates (expressed in decimals) shown in Table 7.

Table 8: Annual change in border price of selected agri-food system commodities, 2018 – 23 (%)

	2019	2020	2021	2022	2023
Palay	-30	36	-16	8	44
Maize	0	20	33	17	-37
Onion	0	0	0	40	40
Hog	0	5	5	0	0
Fats & oil	30	40	20	-33	-10
Rice	-30	36	-16	8	44
Sugar & products	7	10	31	1	47
Fertilizers	-23	15	154	-45	-32

Source: Authors' imputation.

Domestic price adjustment for goods subject to import QRs can be represented by some adjustment in the border price; these relate mainly to Rice (wherein repeal of the QR in 2019 led to dramatic decline in the domestic price of rice, and Onion where a *de facto* QR was imposed in 2022 – 2023 using the Sanitary and Phytosanitary import clearance.

Alternative scenarios

The only difference between the Reference and Subsidy scenario is that the latter includes a subsidy term. While the AMPLE-CGE initially experimented with input subsidy shocks, model solution was not forthcoming. Hence, an output subsidy was adopted instead, where the shock consists of a reduction in net tax levied on the sector. Only one sector is selected, namely rice, where the baseline *ad valorem* tax rate on value added is 0.13 percent. This tax rate is added to the following percentage point entries by year, namely: -1.00 (2019); -2.00 (2020); -3.00 (2021); and stable rate thereafter. In short, the tax rate turns negative as follows: -0.87 percent in 2022; -0.287 percent in 2023; -5.87 percent in 2024, and the subsequent years.

Finally for the Productivity scenario, the exogenous variable changes are reset to the Reference scenario values (i.e. discarding the Subsidy scenario). As the scenario label denotes, the policy thrust is investment towards accelerated growth in productivity. This is achieved in part by allocating expenditures on long-term productivity measures, such as the following strategies identified in the PDP, among others: Consolidate/cluster farms; create and facilitate adoption of improved technology; Improve physical and digital infrastructure. A whole slew of investments is also identified in the National Agriculture and Fisheries Modernization and Industrialization Plan 2021 – 2030, along the lines of General Services Support.

Specifically, the Productivity scenario posits a 2 percent growth in the technology parameter for each of the crops; as well as technology parameter of labor for Hog, Chicken, Eggs, Seaweed culture, and Other aquaculture. Technology shocks begin only in 2025. To finance this, the government reduces consumption spending by 0.25 percentage points starting 2019. That is, it shifts funds from current expenditure to capital formation. However the productivity changes start having an effect after a six-year lag, beginning 2025, to underscore the long term nature of the investments and delay in pay-offs.

5. Findings from the analytical method

5.1. *Changes in macro variables*

The Reference scenario matches and continues current macro trends. Household expenditure grows slightly slower under the Subsidy scenario, while GDP and household expenditure grow faster under the Productivity scenario. Table 8 summarizes changes in GVA (in constant prices) as well as Household expenditures. Overall GDP growth from 2018-2024 was mediocre in 2018-24 (mirroring actual data, which was dragged down by poor performance during the Covid19 pandemic). GDP growth accelerates in 2018-30 across the scenarios, as does Household expenditure growth (lagging slightly behind GDP growth). There is hardly any difference between Reference and Subsidy scenarios (just a slightly slower Household expenditure growth in 2018-30 for the latter); however, growth rates are noticeably faster for both GDP and Household expenditure under the Productivity scenario.

Growth in agricultural GVA lags other sectors, but its relatively fast pace compared with past data evinces slow pace of structural change in the CGE scenarios. As can be seen, growth tends to be fastest for industry, followed by services, with agriculture lagging. However, the magnitude of the lag, especially for 2024-2030, in no way captures actual real world data on the relative growth of value added across sectors. This issue has been discussed previously (See Section 3.3 and 4.3). The model runs are therefore likely to overstate actual production growth especially for agriculture; the overestimate is even larger with the Productivity scenario owing to productivity growth estimates that are biased towards agricultural sectors. This is fully reflected in the rapid pace of growth of agriculture in 2025 – 30.

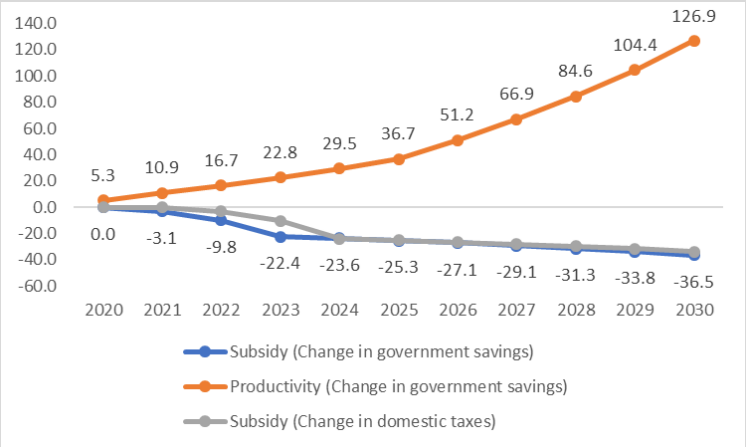
Table 9: Scenarios for average annual growth of selected macro variables, 2018 – 2030 (%)

	Reference		Subsidy		Productivity
	2018-24	2024-30	2018-24	2018-30	2025-30
In constant 2018 prices:					
GDP	2.8	6.0	2.8	6.0	6.2
Agriculture GVA	2.6	5.0	2.5	5.0	6.0
Industry GVA	3.2	7.3	3.2	7.3	7.5
Services GVA	2.6	5.4	2.6	5.4	5.5
Household expenditure	2.5	5.6	2.5	5.5	5.8

Source: Author's simulation.

Compared with the Reference scenario, the Subsidy scenario entails lower net domestic taxes and government savings, while Productivity scenario implies higher government savings. Figure 11 explores the fiscal implications of the alternative scenarios. The Subsidy scenario involves lower net domestic taxes, starting at Php 3.1 billion in 2021, dipping further by Php 9.8 billion in 2022, then Php 22.4 billion in 2023 and Php 23.6 billion in 2024; these figures broadly match increases in private goods subsidies of DA in 2021-24. Subsidies continue to rise moderately in the subsequent years reaching Php 36.5 billion in 2030. On the other hand, government savings will tend to go up almost by definition under the Productivity scenario, starting at Php 5.3 billion in 2020, rising to Php 126.9 in 2030.

Figure 11: Difference from reference scenario, annual government savings (Php billions)



Source: Author's simulation.

5.2. *Changes in Consumer price (relative to CPI)*

Under the Reference scenario, prices of most crops will be higher than the baseline, with changes being larger for Subsidy scenario. Prices are however lower than the baseline in case of the Productivity scenario. Table 9 focuses on consumer prices of crops. (To reiterate, the figures here are net of CPI change, suppressed to zero in the scenarios.) Except for Pineapple, and Fruit vegetables, consumer prices are all higher under the Reference scenario; the increases

range from 0.9 percent (Sweet potato) up to 11.5 percent (Banana). The Subsidy scenario introduces slightly greater changes in consumer price than in the Reference scenario. The sharpest contrast is with the Productivity scenario, where consumer price drops by 2030 for most of the crops (except Sugarcane, Coffee, and Other crops).

Table 10: Change in consumer prices of crops (excluding tobacco), relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	2018-30	2018-24	2018-30	2018-30
Palay	0.9	1.3	0.9	1.3	-0.1
Maize	2.5	6.5	2.9	6.9	-0.7
Coconut	2.3	7.8	2.7	8.1	-1.3
Sugarcane	2.3	9.4	2.7	9.9	1.8
Banana	2.7	11.5	3.1	12.0	-0.7
Mango	0.6	2.5	0.9	2.7	-6.8
Pineapple	-1.0	-2.6	-0.8	-2.4	-13.8
Coffee	2.2	7.5	2.5	7.8	3.2
Cassava	1.3	4.9	1.7	5.3	-5.4
Sweet potato	0.0	0.9	0.3	1.2	-7.8
Other fruits	0.7	3.3	1.0	3.5	-0.3
Leafy & stem vegetables	1.1	5.0	1.4	5.3	-3.7
Fruit vegetables	-0.4	-0.4	-0.2	-0.1	-4.3
Onion	5.8	5.7	6.1	6.0	-2.0
Other crops	3.4	12.6	3.8	13.0	5.0

Source: Authors' simulation.

For farmed animals and aquatic products, patterns of change across the scenarios are similar to that of crops, although the absolute changes tend to be smaller. Table 10 shows scenarios for farmed animals and aquatic products, with similar patterns of change as for Crops. Only Cattle and Fishing post an increase in price under the Productivity scenario.

Table 11: Change in consumer prices of farmed animals and aquatic products, relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	2018-30	2018-24	2018-30	2018-30
Hog	0.4	1.1	0.6	1.3	-1.9
Cattle	0.5	1.5	0.7	1.7	0.7
Chicken	0.1	0.6	0.3	0.8	-2.5
Other livestock	0.4	1.4	0.6	1.7	1.8
Eggs	0.4	1.5	0.6	1.7	-1.7
Fishing	0.2	0.5	0.4	0.7	0.6
Seaweed aquaculture	0.8	3.6	1.2	3.9	0.2
Other aquaculture	0.5	1.1	0.6	1.3	-1.2

Source: Authors' simulation.

For manufactured food and beverage, Fats & oil, Rice & corn, Sugar & sugar products experience sharp increases in price over the baseline. The Subsidy scenario greatly attenuates the price increases of Rice & corn, while the Productivity scenario suppresses price growth all around. The final set of changes in consumer price is shown in Table 11. Changes are much more muted under the Reference scenario, except for those driven by world market prices, namely Fats & oil, Rice & corn, and Sugar & sugar products. The Subsidy scenario puts a dent on the increases in consumer price of Rice & corn. Much more significant across-the-board containment in price are observed under the Productivity scenario, with only Fats & oil, and Sugar & sugar products still posting a positive change (over and above CPI inflation).

Table 12: Change in consumer prices of manufactured food and beverage, relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	2018-30	2018-24	2018-30	2018-30
Meat fresh and processed	0.0	0.1	0.1	0.3	-0.6
Processed fish	0.3	0.1	0.4	0.2	-0.1
Processed fruit & vegetables	0.6	1.9	0.6	2.0	-1.4
Fats & oil	6.7	6.5	6.8	6.6	4.8
Milk & dairy	-0.2	-1.0	-0.1	-0.9	-0.6
Rice & corn	2.5	6.3	0.0	3.6	0.9
Other food	0.3	0.5	0.4	0.6	0.0
Sugar & sugar products	5.3	6.5	5.5	6.7	5.1
Beverages	0.2	-0.2	0.4	-0.1	0.0
Animal feeds	0.3	0.3	0.4	0.4	-0.8
Alcoholic beverages	-0.5	-1.6	-0.3	-1.5	-1.2

Source: Authors' simulation.

5.3. *Changes in Producer price (relative to CPI)*

For crops, producer prices are higher than the baseline in the Reference and Subsidy scenarios, with changes being larger for the former. With few exceptions, producer prices are lower than the baseline under the Productivity scenario. Movements in consumer price, while seemingly unfavorable for consumer welfare, are paralleled by increases in Producer price, which imply improvements in producer (i.e. farmer) welfare (Table 12). Conversely, productivity gains tend to negate the price increases under the Productivity scenario.

Table 13: Change in producer prices of crops (excluding tobacco), relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	2018-30	2018-24	2018-30	2018-30
Palay	2.7	9.9	-1.7	5.1	0.8
Maize	1.4	5.7	1.8	6.1	-2.0
Coconut	2.5	8.4	2.9	8.8	-1.4
Sugarcane	2.3	9.5	2.7	9.9	1.8
Banana	1.7	8.0	2.1	8.4	-0.7
Mango	0.6	2.4	0.8	2.7	-6.7
Pineapple	-1.0	-2.5	-0.8	-2.3	-11.8
Coffee	3.9	14.2	4.4	14.7	5.7

	Reference		Subsidy		Productivity
	2018-24	2018-30	2018-24	2018-30	2018-30
Cassava	1.3	4.9	1.7	5.3	-5.4
Sweet potato	0.0	1.0	0.3	1.3	-8.0
Other fruits	1.9	8.3	2.3	8.7	0.1
Leafy & stem vegetables	1.2	5.3	1.5	5.7	-3.8
Fruit vegetables	-0.1	0.9	0.2	1.2	-6.7
Onion	-0.4	-0.5	-0.2	-0.3	-7.7
Other crops	3.4	13.5	3.8	13.9	5.0

Source: Authors' simulation.

Patterns of change in producer prices of farmed animals and aquatic products are similar to that of crops, except changes are smaller in absolute terms. Producer prices for farmed animals and aquatic products barely move under all the scenarios (Table 13).

Table 14: Change in producer prices of farmed animals and aquatic products, relative to baseline (%)

	Reference		Subsidy		Productivity
	2018-24	2018-30	2018-24	2018-30	2018-30
Hog	0.4	1.1	0.5	1.3	-2.0
Cattle	0.5	1.5	0.7	1.7	0.8
Chicken	0.1	0.6	0.3	0.8	-2.5
Other livestock	0.4	1.5	0.6	1.7	1.8
Eggs	0.4	1.5	0.6	1.7	-1.7
Fishing	0.2	0.5	0.4	0.7	0.6
Seaweed aquaculture	0.8	3.4	1.1	3.7	0.2
Other aquaculture	0.4	1.1	0.6	1.3	-1.2

Source: Author's simulation.

Nonetheless producer prices fall under the Productivity scenario in the case of Hog, Chicken, Eggs, and Other aquaculture, which are assumed to experience effective technical progress in 2018-30.

5.4. *Changes in Gross output*

Gross output by 2030 is far higher than the at the baseline, with changes being largest for the Productivity scenario, and least for the Reference scenario. Consistent with high rates of aggregate GVA growth for agriculture, the sector-specific outlook on output is highly optimistic (Table 14). The estimated growth of output in Table 13 is typically much larger than that shown by actual past recent data over similar intervals (Table 15), hence it may represent an overestimate of actual growth potential.

Table 15: Change in gross output of crops (excluding tobacco), relative to baseline (%)

	Reference		Subsidy		Productivity
	2018-24	2018-30	2018-24	2018-30	2018-30
Palay	16.1	48.5	18.8	52.0	58.3
Maize	21.7	60.8	22.1	61.3	73.2
Coconut	28.2	61.6	28.2	61.5	77.4
Sugarcane	33.6	83.3	33.6	83.2	91.8
Banana	13.7	48.7	13.6	48.4	67.8
Mango	16.0	59.4	16.1	59.3	74.3
Pineapple	17.3	65.0	17.4	65.0	93.8
Coffee	7.9	22.8	7.5	22.2	51.7
Cassava	15.6	57.8	15.7	57.6	74.4
Sweet potato	16.2	60.6	16.2	60.5	74.7
Other fruits	9.8	28.8	9.5	28.3	65.2
Leafy & stem vegetables	14.9	54.1	14.8	53.8	73.5
Fruit vegetables	15.3	52.5	14.9	51.7	107.4
Onion	44.4	99.9	44.5	99.8	118.1
Other crops	7.6	31.7	7.3	31.2	51.9

Source: Authors' simulation.

Table 16: Change in agricultural production, end-interval over beginning interval, selected crops (%)

	2016-2022	2010-2022
Palay	12.1	25.3
Corn	14.4	29.5
Abaca (dried raw fiber)	-5.6	2.0
Coconut (w/ husk)	8.0	-3.7
Rubber (coagulated cup lump)	14.6	5.2
Sugarcane	4.8	30.8
Tobacco	-15.5	17.8
Pineapple	11.6	34.4
Sweet Potato/Camote	5.4	3.2
Cassava	-7.1	21.8
Eggplant	5.3	19.2
Onion, bermuda	133.1	111.1
Peanut	12.9	6.4
Pechay	6.8	7.2
Tomato	2.8	6.0

Source: PSA (2023).

The actual data also capture the impacts of environmental shocks that are not captured by CGE scenarios. We posit that supply-side risk is another serious constraint to agricultural investment not captured by CGE models, even the more sophisticated non-homothetic approaches of Comin et al (2021) and Roson and Britz (2021) reviewed earlier. Inspection of the AMPLE-CGE SAM shows that capital share in sector value added averages 0.63 for agricultural sectors, 0.70 for industrial sectors, and 0.57 for services sectors, i.e. much lower than in agriculture. Whereas in CGE models the quantity of capital equates its underlying opportunity cost to its value of marginal product, in agricultural markets a sizable wedge might exist between these

two variables in the presence of risk, which seems highly idiosyncratic to agriculture (Komarek et al, 2020).

Patterns of change of farmed animals, aquatic products, and manufactured food and beverage, mirror that of crops, although the Subsidy scenario is almost identical with that of the Reference scenario. Growth rates of farmed animals and aquatic products share the optimistic outlook for the crops (Table 16). Rapid growth for manufactured food and beverage is however more in line with actual trends (Table 17). From 2010 to 2022, manufacture of food increased by 62 percent in real terms, while that of beverages increased by 66 percent.

Table 17: Change in gross output of farmed animals and aquatic products, relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	**2018-30**	**2018-24**	**2018-30**	**2018-30**
Other livestock	15.8	63.9	15.6	63.4	72.8
Eggs	15.6	64.6	15.2	64.0	71.2
Fishing	13.7	54.3	13.6	54.0	61.2
Seaweed aquaculture	15.3	62.7	15.0	62.1	67.7
Other aquaculture	12.6	48.5	12.5	48.4	54.2
Other livestock	15.6	59.9	15.6	59.8	62.8
Eggs	16.4	61.3	16.3	61.0	67.5
Fishing	15.3	58.7	15.3	58.5	63.6

Source: Authors' simulation.

Table 18: Change in gross output of manufactured food and beverage, relative to baseline (%)

	Reference		**Subsidy**		**Productivity**
	2018-24	2018-30	2018-24	2018-30	2018-30
Meat fresh and processed	13.8	51.7	13.9	51.7	58.1
Processed fish	13.7	53.5	13.8	53.5	58.5
Processed fruit & vegetables	14.2	52.1	14.5	52.4	69.4
Fats & oil	34.4	70.2	34.5	70.2	80.9
Milk & dairy	15.1	58.2	15.3	58.4	62.6
Rice & corn	15.6	47.5	18.0	50.8	56.4
Other food	16.5	62.6	16.7	62.7	66.8
Sugar & sugar products	39.4	94.9	39.5	94.8	100.1
Beverages	17.0	65.4	17.1	65.4	67.8
Animal feeds	14.2	56.0	14.2	55.8	64.5
Alcoholic beverages	15.9	63.1	15.9	63.0	66.9

Source: Authors' simulation.

Faster productivity growth in upstream agriculture spills over into faster output growth in associated food and beverage manufacturing. The Productivity scenario shows that food and beverage manufacturing sectors share the optimistic growth projections of the agricultural sectors, despite there being no manufacturing-specific increment in technological progress.

This highlights an oft-noted constraint to growth of agricultural value adding, which is limitations in acquiring raw material requirements from agriculture (Adriano and Adriano, 2023).

5.5. *Projected IAR by 2030*

By 2030, under the Reference scenario only eight out of the bottom 14 centiles will still suffer from intake adequacy gaps for energy, 10 out of the bottom 12 for protein, and 53 out of the 100 centiles for Vitamin A. Estimates of IAR for 2030, using Equation (4), are shown in Table 19 and Table 20. Under the Reference scenario, the increase in household income and expenditure, combined with changes in consumer price, greatly diminish intake adequacy gaps compared with the baseline figures of Tables 5 and 7. For energy, only 8 centiles (all in the bottom 14) will suffer from intake adequacy gaps, compared with 99 at the baseline. For protein, only 10 centiles (out of the bottom 12) will suffer from intake adequacy gaps, compared with 83 at the baseline. Lastly, for Vitamin A, only 53 centiles will continue to suffer from intake adequacy gaps, compared with 94 at the baseline.

By 2030, under the Reference scenario the remaining intake adequacy gaps range from 0.3 to 20.7 percent for energy, 0.3 to 47.6 percent for protein, 1.4 to 132.3 percent for Vitamin A, with lower centiles tending towards larger intake gaps. The gaps are of course much narrower in 2030 than in the baseline. The bottom centile will only have a 47.6 percent increase in protein intake compared with a 84.4 percent requirement at the baseline; for Vitamin A the required increase is down to 132.3 percent, compared with 266.6 percent at the baseline.

Table 19: Projected IAR by nutrient type and scenario, bottom fifty centiles, 2030 (%)

Centile	Energy			Protein			Vitamin A		
	Ref	Sub	Pro	Ref	Sub	Pro	Ref	Sub	Pro
1	20.7	20.7	15.6	47.6	47.6	42.2	132.3	132.3	123.9
2	15.6	15.6	10.5	32.3	32.3	27.3	83.0	83.0	76.1
3	9.4	9.4	4.5	18.5	18.5	14.0	40.5	40.5	35.1
4	2.6	2.6		8.1	8.1	3.9	49.3	49.3	43.5
5	3.3	3.3		10.1	10.1	5.8	41.5	41.5	36.0
6							20.9	20.9	16.2
7	2.9	2.9		6.2	6.2	2.0	41.3	41.3	35.7
8				0.9	0.9		28.4	28.4	23.4
9							51.9	51.9	45.8
10				1.1	1.1		35.5	35.5	30.1
11				1.3	1.3		24.7	24.7	19.7
12	1.1	1.1		0.3	0.3		33.3	33.3	28.0
13									
14	0.3	0.3					30.5	30.5	25.3
15							24.4	24.4	19.4
16							58.2	58.2	51.9
17							45.2	45.2	39.3
18							8.2	8.2	3.8
19							40.2	40.2	34.5
20							29.4	29.4	24.1
21							48.2	48.2	42.2
22							38.6	38.6	33.0

Centile	Energy			Protein			Vitamin A		
	Ref	Sub	Pro	Ref	Sub	Pro	Ref	Sub	Pro
23							30.2	30.2	24.9
24							55.6	55.6	49.3
25							28.5	28.5	23.3
26									
27							43.9	43.9	38.1
28							51.1	51.1	44.9
29							1.9	1.9	
30							7.3	7.3	2.9
31							7.2	7.2	2.8
32									
33									
34									
35							23.2	23.2	18.2
36							17.9	17.9	13.1
37							4.5	4.5	0.3
38							30.5	30.5	25.2
39							20.7	20.7	15.8
40							26.4	26.4	21.3
41							41.4	41.4	35.6
42							20.1	20.1	15.2
43									
44									
45							0.7	0.7	
46							41.6	41.6	35.8
47									
48							12.7	12.7	8.1
49							25.3	25.3	20.1
50									

Note:

1. Missing entry implies intake adequacy attained at baseline.
2. Ref – Reference scenario; Sub – Subsidy scenario; Pro – Productivity scenario.

Source: Authors' calculation.

Table 20: Projected IAR by nutrient type, top fifty centiles, 2030 (%)

Centile	Energy			Protein			Vitamin A		
	Ref	Sub	Pro	Ref	Sub	Pro	Ref	Sub	Pro
51							35.6	35.6	30.0
52									
53							31.0	31.0	25.6
54									
55							2.4	2.4	
56							25.1	25.1	20.0
57									
58									
59							4.1	4.1	
60									
61							17.8	17.8	13.0
62									
63									
64									
65									
66									
67									
68									
69									
70									
71							9.4	9.4	4.9
72							13.0	13.0	8.3
73									
74									
75							1.0	1.0	
76							2.8	2.8	
77									
78							1.4	1.4	
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94							10.3	10.3	5.7
95									

Centile	Energy			Protein			Vitamin A		
	Ref	Sub	Pro	Ref	Sub	Pro	Ref	Sub	Pro
96									
97									
98									
99									
100									

Note:

1. Missing entry implies intake adequacy attained at baseline.
2. Ref – Reference scenario; Sub – Subsidy scenario; Pro – Productivity scenario.

Source: Authors' calculation.

By 2030, the Subsidy scenario will have no noticeable change over the Reference scenario across all nutrient intakes. On balance, the Subsidy scenario introduces only small changes to household expenditure and consumer price; it turns out, these are too small to make any noticeable change from the 2030 projections of the Reference scenario. Despite the lower price of rice under this scenario, about 45 percent of calorie availability of Filipinos already obtained from non-cereal sources, hence policies that focus on just they key staple may be insufficient to make a serious dent in the size of total calorie intake.

By 2030, under the Productivity scenario only three bottom centiles will suffer from intake adequacy gaps for energy, 6 out of the bottom 7 centiles for protein, and 46 of the 100 centiles for Vitamin A. In contrast, much larger gains toward nutrient adequacy are expected under the Productivity scenario. A more sizable bump in nutrient intake is found for this Productivity scenario, owing to larger gains in household purchasing power compared with the other scenarios.

By 2030, under the Productivity scenario the remaining intake adequacy gaps range from 4.5 to 15.6 percent for energy, 2.0 to 42.2 percent for protein, and 5.7 to 123.9 percent for Vitamin A, with lower centiles tender towards larger intake gaps. Similarly, the larger gains under the Productivity imply smaller remaining gaps by 2030. For instance, for the first centile, the remaining gaps are 15.6 percent for energy, 42.2 percent for protein, and 123.9 percent for Vitamin A, compared with gaps of 84.4 percent, 132.8 percent, and 266.6 percent for energy, protein, and Vitamin A, respectively at the baseline.

6. Conclusion

6.1. *Synthesis of key findings*

Under current economic trends, most Filipino households will be able to afford adequate levels of energy and protein by 2030, but not Vitamin A. Food affordability in an era of rapid inflation has assumed a paramount importance in public policy. The scenario analysis offers some reassurance that resumption of past trends should bring an affordable diet with sufficient macronutrients within the reach of all but the poorest Filipino households. However a Vitamin A – adequate diet will still remain beyond the reach of most but the richest Filipino households.

The Reference scenario is also associated with higher relative consumer and producer prices, as well as far greater levels of output. Affordability is achieved in the Reference case with rapid increases in output, which leads to higher household expenditure and lower relative consumer prices of food. Across centiles, changes in energy intake are about 52 percent, in protein intake around 57 percent, and in Vitamin A intake around 56 percent.

Despite attenuation of sharp changes in the consumer price of Rice & corn, changes in energy/nutrient intakes under the Subsidy scenario are just equal to those of the Reference scenario. The Subsidy scenario is directed toward cheaper consumer price of rice; even as it succeeds in achieving this target, it hardly increases energy/nutrient intake over what is already performed under the Reference scenario, given the diversity of nutrient intake from various food sources other than Rice.

The Productivity scenario entails significantly faster increases in energy, protein, and Vitamin A intake compared with the previous scenarios. A more sizable increase in energy/nutrient intake is achieved through the Productivity scenario, which represents expenditure policies which aim at long-term productivity growth in agricultural sectors.

The Productivity scenario also leads to smaller changes in price and greater changes in quantity compared with the other scenarios. The pathway towards Productivity impacts goes through faster increases in quantity, and larger increases in household expenditure as well as in greater reductions on the whole for food consumer prices.

6.2. *Policy implications*

1. *Maintaining overall growth in the range of 5 – 6 percent per year is key to improving dietary quality for an energy- and protein-sufficient diet.*

The eruption of inflationary pressures in the economy has provoked an unprecedented set of policies such as bloating the DA budget, imposition of price ceilings in rice, and other affordability measures such as Kadiwa sales of Php 25.00 per kg rice. However the CGE scenario analysis of this paper shows that consistent income growth, coupled by a return to trend in consumer prices, are sufficient to achieve food affordability for most of the population with regard to energy and protein. The interrelationships at general equilibrium imply that the two are connected – rapid economic expansion overall is accompanied by slower but still sustained growth of agriculture, and therefore easing up of food prices.

2. *The slightly favorable impact of rice subsidies on the price of rice and on energy/nutrient intake of households may not be worth the added risk of fiscal instability.*

The bulk of the DA budget is being deployed to support producers, expand domestic supply, and keep down consumer prices, especially for rice. In fact, the subsidies accomplish little in terms of outcomes such as faster improvements in nutrient intake of households. The added financial burden is however substantial (about Php 30 to 40 billion per year, which the government can itself ill afford in an era of fiscal imbalance. The projected deficit in 2024 might be lowered by 4 percent if this spending were avoided, hastening attainment of the deficit target of 3 percent of GDP by 2028.

3. *The scenario analysis tend to justify investing in general services such as R&D and infrastructure, as the preferred strategy to achieving affordable diets.*

Price spikes especially in key staples tend to provoke immediate and expensive responses from government, such as the retail price ceiling on well-milled and regular-milled rice, followed by Php 15,000 subsidy for thousands of small rice retailers. The competitiveness approach to food affordability has suffered relative neglect as it involves investment in long gestating projects

such as connectivity infrastructure, R&D, and extension and commercialization of resulting technologies. Note that prices do tend to normalize in competitive markets, as price increases incentivize the very adjustments conducive to market stability, Success at investments in productivity is not guaranteed, and involve lags in realizing benefits, such as from commercializing/upscaling R&D products, building new infrastructure, etc. Nonetheless, well-designed investments may well be worth the short-term uncertainties. Hn the long run, the productivity approach may well be the more reliable way to expand food supplies and tame food inflation.

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8. Annex: Mapping of IO sectors to AMPLE-CGE sectors

	IO Sector	AMPLE-CGE Sector
1	Palay	Palay
2	Corn	Maize
3	Coconut including copra	Coconut
4	Sugarcane including muscovado sugar-making in the farm	Sugarcane
5	Banana	Banana
6	Mango	Mango
7	Pineapple	Pineapple
8	Coffee	Coffee
9	Cassava	Cassava
10	Rubber	Other crops
11	Cacao	Other crops
12	Abaca	Other crops
13	Tobacco	Other crops
14	Sweet potato	Sweet potato
15	Citrus fruits	Other fruits
16	Papaya	Other fruits
17	Other fruits, n.e.c.	Other fruits
18	Leafy and stem vegetables	Leafy & stem vegetables
19	Fruit bearing vegetables	Fruit vegetables
20	Onion	Onion
21	Horticultural specialties and nursery products	Other crops
22	Other agricultural crops, n.e.c.	Other crops
23	Hog farming	Hog
24	Cattle farming	Cattle
25	Carabao farming	Other livestock
26	Goat farming	Other livestock
27	Dairy farming	Other livestock
28	Chicken	Chicken
29	Egg production	Eggs
30	Other poultry, livestock and animals, n.e.c.	Other livestock
31	Forestry and logging	Other agri-related activity
32	Ocean fishing (including fish corals)	Fishing
33	Inland and coastal fishing	Fishing
34	Prawn culture and Operation of fish farms and nurseries	Other aquaculture
35	Pearl culture and pearl shell gathering	Other aquaculture
36	Seaweeds farming	Seaweed aquaculture
37	Mollusks and other crustacean farm operations (except prawn farm operations) and other fishing activities, n.e.c	Other aquaculture
38	Support activities to agriculture, forestry and fishing	Other agri-related activity
39	Coal and ligmite	Mining
40	Crude petroleum and natural gas	Mining
41	Gold and other precious metal ores	Mining

	IO Sector	AMPLE-CGE Sector
42	Nickel ores	Mining
43	Copper ores	Mining
44	Quarrying of stone, clay, gravel and sand	Mining
45	Other mining and quarrying	Mining
46	Slaughtering and meat packing	Meat fresh and processed
47	Production, processing and preserving of meat and meat products	Meat fresh and processed
48	Canning/packing of fish and other marine products	Processed fish
49	Other types of processing of fish and other marine products	Processed fish
50	Processing and preserving of fruits and vegetables	Processed fruit & vegetables
51	Virgin coconut oil, dessicated coconut, and nata de coco	Fats & oil
52	Vegetable and animal oils and fats, n.e.c.	Fats & oil
53	Milk and cream	Milk & dairy
54	Butter, cheese and curd	Milk & dairy
55	Ice cream and sherbet, ice drop, ice candy and other flavored ices	Milk & dairy
56	Other dairy products, n.e.c.	Milk & dairy
57	Rice/corn milling	Rice & corn
58	Grain and vegetable mill products, except rice and corn	Other food
59	Starches and starch products	Other food
60	Bakery products	Other food
61	Sugar other sugarcane products	Sugar & sugar products
62	Cocoa, chocolate and sugar confectionery	Sugar & sugar products
63	Macaroni, noodles, couscous and similar farinaceous products	Other food
64	Prepared meals and dishes	Other food
65	Food supplements from herbs and other plants	Other food
66	Coffee roasting and processing	Beverages
67	Food products, n.e.c.	Other food
68	Animal feeds	Animal feeds
69	Alcoholic liquors and wine	Alcoholic beverages
70	Malt liquors and malt	Alcoholic beverages
71	Soft drinks	Beverages
72	Drinks flavored with fruit juices, syrups or other materials	Beverages
73	Drinking water and mineral water	Beverages
74	Other beverages, n.e.c.	Beverages
75	Cigarettes	Tobacco
76	Cigars and chewing and smoking tobacco, snuff	Tobacco
77	Tobacco leaf flue-curing and re-drying and other tobacco manufacturing, n.e.c.	Tobacco
78	Spinning, texturizing, weaving and finishing of textiles	Textiles, apparel, footwear
79	Knitted and crocheted fabrics	Textiles, apparel, footwear

	IO Sector	AMPLE-CGE Sector
80	Knitted or crocheted hosiery, underwear and outerwear when knitted or crocheted directly into shape	Textiles, apparel, footwear
81	Knitted and crocheted fabrics, n.e.c.	Textiles, apparel, footwear
82	Made-up textile articles, except wearing apparel	Textiles, apparel, footwear
83	Carpets and rugs	Textiles, apparel, footwear
84	Cordage, rope, twine and netting	Textiles, apparel, footwear
85	Embroidered fabrics	Textiles, apparel, footwear
86	Other textiles, n.e.c.	Textiles, apparel, footwear
87	Ready-made garments manufacturing (excluding embroidered garments)	Textiles, apparel, footwear
88	Ready-made embroidered garments manufacturing	Textiles, apparel, footwear
89	Custom tailoring and dressmaking	Textiles, apparel, footwear
90	Other wearing apparel, n.e.c.	Textiles, apparel, footwear
91	Tanning and dressing of leather	Textiles, apparel, footwear
92	Products of leather and imitation leather	Textiles, apparel, footwear
93	Shoes	Textiles, apparel, footwear
94	Other footwear, n.e.c.	Textiles, apparel, footwear
95	Sawmilling and planing of wood	Wood, paper, printing
96	Veneer sheets and plywoods	Wood, paper, printing
97	Laminboard, particle board and other panels and board	Wood, paper, printing
98	Builders' carpentry and joinery; millworking	Wood, paper, printing
99	Wood carvings	Wood, paper, printing
100	Products of bamboo, cane, rattan and the like, and plaiting materials except furniture	Wood, paper, printing
101	Other products of wood, except furniture, n.e.c.	Wood, paper, printing
102	Pulp, paper and paperboard	Wood, paper, printing
103	Containers and boxes of paper and paperboard	Wood, paper, printing
104	Other articles of paper and paperboard	Wood, paper, printing
105	Printing, and service activities related to printing	Wood, paper, printing
106	Reproduction of recorded media	Wood, paper, printing
107	Refined petroleum products	Chemicals & plastics
108	Other petroleum products	Chemicals & plastics
109	Basic chemicals except fertilizers and nitrogen compounds	Chemicals & plastics
110	Fertilizers and nitrogen compounds	Fertilizers
111	Plastics in primary forms and of synthetic rubber	Chemicals & plastics
112	Pesticides and other agro- chemical products	Chemicals & plastics
113	Paints, varnishes and similar coatings, printing ink and mastics	Chemicals & plastics
114	Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	Chemicals & plastics
115	Other chemical products, n.e.c.	Chemicals & plastics
116	Basic pharmaceutical products and pharmaceutical preparations	Chemicals & plastics
117	Rubber products	Chemicals & plastics

	IO Sector	AMPLE-CGE Sector
118	Plastic products	Chemicals & plastics
119	Flat glass (including float glass)	Mineral & metal products
120	Glass and glass products	Mineral & metal products
121	Cement	Mineral & metal products
122	Other non-metallic mineral products, n.e.c.	Mineral & metal products
123	Basic iron and steel	Mineral & metal products
124	Casting/foundry of iron and steel	Mineral & metal products
125	Basic precious and non-ferrous metals	Mineral & metal products
126	Non-ferrous metal casting	Mineral & metal products
127	Structural metal products	Mineral & metal products
128	Metal containers	Mineral & metal products
129	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	Mineral & metal products
130	Cutlery, hand tools and general hardware	Mineral & metal products
131	Other fabricated metal products, n.e.c.	Mineral & metal products
132	Electronic valves and tubes	Electronic & electrical equipment, devices
133	Semi-conductor devices and other electronic components	Electronic & electrical equipment, devices
134	Computers and peripheral equipment and accessories	Electronic & electrical equipment, devices
135	Communication equipment	Electronic & electrical equipment, devices
136	Consumer electronics	Electronic & electrical equipment, devices
137	Measuring, testing, navigating and control equipment	Electronic & electrical equipment, devices
138	Watches and clocks	Electronic & electrical equipment, devices
139	Irradiation, electromedical and electrotherapeutic equipment	Electronic & electrical equipment, devices
140	Optical instruments and photographic equipment	Electronic & electrical equipment, devices
141	Magnetic and optical media	Electronic & electrical equipment, devices
142	Electric motors, generators and transformers and electric generating sets	Electronic & electrical equipment, devices
143	Batteries and accumulators	Electronic & electrical equipment, devices
144	Wiring and wiring devices	Electronic & electrical equipment, devices
145	Electric lighting equipment	Electronic & electrical equipment, devices
146	Domestic appliances	Electronic & electrical equipment, devices
147	Other electrical equipment	Electronic & electrical equipment, devices
148	Engines and turbines, except aircraft, vehicle and cycle engines	Machinery & vehicles
149	Pumps, compressors, taps and valves	Machinery & vehicles
150	Office machinery and equipment (except computers and peripheral equipment)	Machinery & vehicles
151	Other general purpose machinery	Machinery & vehicles
152	Agricultural and forestry machinery	Machinery & vehicles
153	Machinery for mining, quarrying and construction	Machinery & vehicles
154	Other special purpose machinery	Machinery & vehicles
155	Motor Vehicles, Trailers and Semi-Trailers	Machinery & vehicles
156	Building of Ships & boats	Machinery & vehicles
157	Railway locomotive and rolling stock	Machinery & vehicles

	IO Sector	AMPLE-CGE Sector
158	Air and spacecraft and related machinery	Machinery & vehicles
159	Motorcyles	Machinery & vehicles
160	Bicycles and invalid carriages	Machinery & vehicles
161	Other transport equipment, n.e.c.	Machinery & vehicles
162	Wood and rattan furniture (reed, wicker, and cane)	Other manufacturing
163	Plastic furniture	Other manufacturing
164	Furniture and fixtures of metal	Other manufacturing
165	Other furniture and fixtures,n.e.c.	Other manufacturing
166	Jewelry, bijouterie and related articles	Other manufacturing
167	Musical instruments	Other manufacturing
168	Sports goods	Other manufacturing
169	Games and toys	Other manufacturing
170	Medical and dental instruments and supplies	Other manufacturing
171	Other manufacturing, n.e.c.	Other manufacturing
172	Electric power generation, transmission and distribution	Electricity, gas & water
173	Steam and hot water supply; and manufacture and distribution of gas	Electricity, gas & water
174	Water collection, treatment and supply	Electricity, gas & water
175	Sewerage, and waste management and remediation activities	Electricity, gas & water
176	Construction	Construction
177	Wholesale trade, except of motor vehicles and motorcycles	Trade
178	Retail trade, except of motor vehicles and motorcycles	Trade
179	Sale and repair of motor vehicles and motorcycles	Trade
180	Railway transport	Transport & logistics
181	Bus line operation	Transport & logistics
182	Tourist buses and cars including chartered and rent-a-car	Transport & logistics
183	Public utility cars and taxicab operation	Transport & logistics
184	Jeepney and other land transport services	Transport & logistics
185	Road freight transport	Transport & logistics
186	Water transport	Transport & logistics
187	Air transport	Transport & logistics
188	Warehousing and storage	Transport & logistics
189	Support activities for transportation	Transport & logistics
190	Postal and courier activities	Transport & logistics
191	Short term acommodation activities	Food & accommodation
192	Other accommodation	Food & accommodation
193	Food and beverage service activities	Food & accommodation
194	Publishing activities	Information & communications
195	Motion picture, video and television programme activities	Information & communications
196	Sound recording and music publishing activities	Information & communications
197	Programming and broadcasting activities	Information & communications

	IO Sector	AMPLE-CGE Sector
198	Wired telecommunications activities	Information & communications
199	Wireless telecommunications activities	Information & communications
200	Satellite telecommunications activities	Information & communications
201	Other telecommunications activities, n.e.c.	Information & communications
202	Computer programming, consultancy and related activities	Information & communications
203	Information service	Information & communications
204	Banking Institutions	Finance & real estate
205	Non-banks	Finance & real estate
206	Life insurance	Finance & real estate
207	Non-life and other insurance activities	Finance & real estate
208	Activities auxiliary to financial intermediation	Finance & real estate
209	Real estate activities	Finance & real estate
210	Ownership of dwellings	Finance & real estate
211	Legal activities	Professional & technical
212	Accounting, bookeeping and auditing activities; tax consultancy	Professional & technical
213	Activities of head offices; management consultancy activities	Professional & technical
214	Architecture and engineering activities; technical testing and analysis	Professional & technical
215	Scientific research and development	Professional & technical
216	Advertising	Professional & technical
217	Market research and public opinion polling	Professional & technical
218	Specialized design activities	Professional & technical
219	Photographic activities	Professional & technical
220	Other professional, scientific and technical activities, n.e.c.	Professional & technical
221	Veterinary activities	Professional & technical
222	Rental and leasing activities	Finance & real estate
223	Employment activities	Professional & technical
224	Travel agency, tour operator, reservation service and related activities	Transport & logistics
225	Security and investigation activities	Professional & technical
226	Call center and related activities	Professional & technical
227	Other administrative and support service activities, n.e.c.	Professional & technical
228	Public Administration and Defense; Compulsory social security	Public sector
229	Public education	Public sector
230	Private education	Other services
231	Public human health	Public sector
232	Private human health	Other services
233	Social work activities	Other services
234	Arts, entertainment, and recreation	Other services
235	Repair of computers and personal and household goods	Other services

	IO Sector	AMPLE-CGE Sector
236	Spa, steam bath, slendering, and body building activities	Other services
237	Beauty treatment, personal grooming activities and other wellness activities, n.e.c.	Other services
238	Laundry services	Other services
239	Funeral and related activities	Other services
240	Other personal service activities	Other services