INTER-AGENCY WORKING GROUP
ON POPULATION PROJECTION

THE 2020 CENSUS-BASED NATIONAL POPULATION PROJECTION

DOCUMENTATION REPORT

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Table of Contents

List of Tables

List of Figures

Acronyms

ASDR	Age-specific death rate
ASFR	Age-specific fertility rate
BPE	Base population estimation
BI	Bureau of Immigration
CEB	Children ever born
CMR	Child mortality rate
CFO	Commission on Filipino Overseas
CPD	Commission on Population and Development
CPH	Census of Population and Housing
CRVS	Civil registration and vital statistics
DAPPS	Demography Analysis and Population Projection System
IAWGPP	Inter-agency Working Group on Population Projection
IMR	Infant mortality rate
LE	Life expectancy
LT	Life table
NDHS	National Demographic and Health Survey
NMR	Net migration rate
NNM	Net number of migrants
PASEX	Population Analysis System
PES	Post-enumeration survey
PGR	Population growth rate
POPCEN	Census of Population
PSA	Philippine Statistics Authority
UPPI	University of the Philippines Population Institute
SWG	Small working group
SWGBP	Small working group on base population
TFR	Total Fertility Rate
UN	United Nations
UNDESA	United Nations Department of Economics and Social Affairs
UNFPA	United Nations Population Fund
UNIGME	United Nations Inter-agency Group for Child Mortality Estimation
UNPD	United Nations Population Division
USCB	United States Census Bureau

I.

Introduction

Population projection is an important outcome of a population census. Calculations generated from population projections provide policymakers and planners with important information to assess future demands for resources and services. In 2020, the Philippines was one of the countries that conducted a decennial Census of Population and Housing (CPH) the official results of which were released in July 2021. The Philippine Statistics Authority (PSA), together with the Commission on Population and Development (CPD) initiated the formation of an expert group to comprise the Inter-agency Working Group on Population Projection (IAWGPP). The CPD organized an experts' group meeting in September 2022 to discuss the appropriate and context-based methods on population projections that consider the effect of the COVID-19 pandemic. Following the experts' group meeting, the membership to the IAWGPP and the Small Working Group (SWG) on Base Population, Fertility, Mortality, and Migration was finalized. Dr. Grace T. Cruz, then Director of the UP Population Institute (UPPI), serves as the Chair of the IAWGPP.

The first meeting of the IAWGPP was conducted online on October 19, 2022. The terms of reference for the IAWGPP and the different SWGs were discussed. The PSA Secretariat informed the committees of the availability of data inputs for the projection such as age-sex structure from the 2020 CPH, and yearly vital registration from 2015-2020 (births and deaths). However, new total fertility rate (TFR) estimates and other selected health indicators from the 2022 National Demographic and Health Survey are still not available, as well as the data on migration and estimates of TFR from the 2020 CPH. It was agreed that a 35-year population projection would be estimated at the national level, similar to the projection horizon of the previous rounds of population projections.

II.
Methodology

A meeting with the United Nations Population Division (UNPD) experts was organized by the UNFPA-Philippines to consult on the various methodologies to be explored for the 2020 Census-based population projection.

The IAWGPP members had a virtual meeting with Dr. Patrick Gerland, Chief of the Population Estimates and Projection Section of the UNPD, Dr. Alessio Cangiano, Technical Specialist for Population Census and Demographic Data at the United Nations Population Fund (UNFPA), and Dr. Timothy Miller of UNPD.

The presentation and discussion of methodologies for population projections focused on the differences between the deterministic and probabilistic approaches. The deterministic approach projects mortality, fertility, and migration through extrapolation, parametric modeling, and assumptions based on experts' assessment of the characteristics of the population. Different scenarios are set, such as assumptions on the pace of fertility and mortality decline and the level of migration. With assumptions on the base population, the inputs are then used to estimate population projection using a cohort-component method. On the other hand, the probabilistic approach relies more on past patterns to predict likely trajectories of fertility, mortality, and migration. Similar to the deterministic approach, the estimates from the probabilistic models are used with base population assumptions in a cohort component framework to estimate the population projections.

The IAWGPP agreed to use the cohort-component method, which has been used in previous population projections. The cohort component method considers the demographic processes of fertility, mortality, and migration in projecting the population. It is based on the balancing equation:

$$P_2 = P_1 + B_{1,2} - D_{1,2} + M_{1,2}$$

Where:

$P_2 =$	Population at Period 2
$P_1 =$	Population at Period 1
$B_{1,2} =$	Births between Period 1 and Period 2
$D_{1,2} =$	Deaths between Period 1 and Period 2
$M_{1,2} =$	Migration between Period 1 and Period 2

Several statistical tools can be used to implement population projection. For instance, the Demographic Analysis and Population Projections System (DAPPS) Version 3.3 software, along with the Population Analysis System (PASEX), both of which were developed by the United States Census Bureau (USCB), can be utilized for the 2020 Census-based population projection. DAPPS is a program designed to aid users in performing demographic analysis and population projections at the national and sub-national levels (USCB, 2021) while the PASEX is a set of Microsoft Excel workbooks that computes frequently used procedures and methods in basic demographic analysis (USCB, 2014).

With the support of the UNFPA-Philippines, Dr. Nobuko Mizoguchi, USCB Training and Statistical Development Chief, and Dr. Anne Morse, USCB Survey Statistician were invited to facilitate the DAPPS Training workshop for the members of IAWGPP on August 1-11, 2023. The two-week workshop was intended to:

1. finalize the components of population projection: base population, fertility, mortality, and migration,
2. produce population estimates and projections at the national level, and
3. familiarize with software applications such as DAPSS used to generate population projections.

This report documents the processes undertaken by the different SWGs and the IAWGPP, the challenges encountered, and the decisions made to finalize the different assumptions for the 2020 Census-based population projection.

III.

From demographic analysis to population projections: Data gaps, data quality issues and inconsistencies

An important step in the preparation for population projection is the demographic analysis of data which involves the understanding and evaluation of demographic data, levels and trends based on comparison. Most often, this involves choices about the quality of various data sources and the most appropriate methods to use, based on the balancing equation, and sometimes interpreted through broader comparisons, i.e., how the measurements compare to regional/world patterns.

In other words, demographic analysis as an initial step to population projection is done to evaluate and adjust data necessary to obtain accurate inputs for population projection. In the same token, the outputs of population projections are also used to evaluate data for demographic analysis. This iterative process and linkage between the demographic analysis and population projection is depicted in Figure 1.

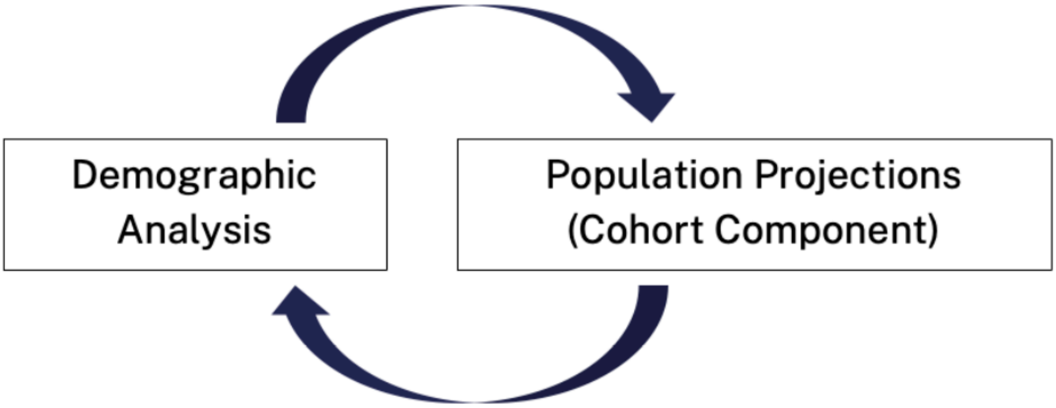

Figure 1: From demographic analysis to population projections

The process of conducting population projection begins with a population by age and sex distribution. This is projected forward based on the components of demographic change: births, deaths and migration, thus, projected population year by year is based on assumed estimated age-specific fertility rate (ASFR), age-specific death rate (ASDR) and net migration rate (NMR).

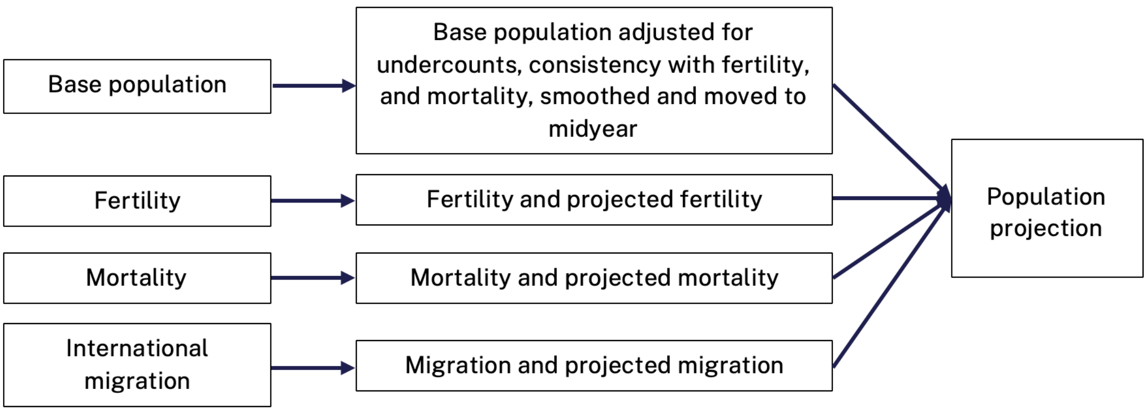

Figure 2: Process of population projection based on cohort component method

A. Base Population

The assessment of data quality for the base population inputs was done through the following methodologies:

- Computation of age-sex accuracy indices such as Whipple's Index, Myers' Blended Index, and the UN Age-sex Accuracy Index.
- Visual inspection of the age-sex pyramids
- Analysis of the Census counts by cohort of CPH of 2010 and 2020, and 2015 POPCEN
- Calculation of the rate of natural increase based on CRVS data on births and deaths
- Application of the same procedure used in the 2010 Census based population projection to estimate the 0-4 population in 2020
- Use the BPE, a PASEX workbook that allows the estimation of population under age 10 using the reported population of age 10 and above and estimates of fertility and mortality.
- Project the expected population in 2020 using the cohort component method through DAPPS and using the 2010 Census population and the new fertility, mortality and migration data collected after 2020.

Data Inputs

1. Population counts by age and sex from the 2010 CPH, 2015 Census of Population (POPCEN) and the 2020 CPH
2. Number of registered births and deaths from 2010 to 2022 from the CRVS
3. ASFR of women 15-49 years old from the 2017 NDHS, 2022 NDHS and the 2020 CPH
4. Projected age-specific survival rates from the

The evaluation of base population data resulted to the following observations:

1. **Age-sex distribution data is fairly accurate.** The Myers' and UN indices of the 2010-2020 CPH were either more or less accurate or accurate, respectively. The Whipple's index for 2020 CPH was highly accurate while the 2010 CPH and 2015 POPCEN were fairly accurate.

Year	Whipple's	Myer's	UN
2010	108.5	1.6	17.9
2015	106.8	1.3	17.9
2020	103.3	1.0	19.5
	<=105 Highly accurate 105-109.9 Fairly accurate 110-124.9 Approximate data 125-174.9 Rough data >=175 Very rough data	1-19 More or less accurate 20-44 Inaccurate 45-90 Very inaccurate	< 20 Accurate 20-40 Inaccurate > 40 Highly inaccurate

Table 1. Indices for age-sex data quality: 2010, 2015 and 2020 CPH

2. **Narrower bars from age 15 and below in 2015 POPCEN and 2020 CPH.** Compared to the 2010 CPH, both the 2015 POPCEN and 2020 CPH show a narrower bar for younger ages (from age 15 and below).

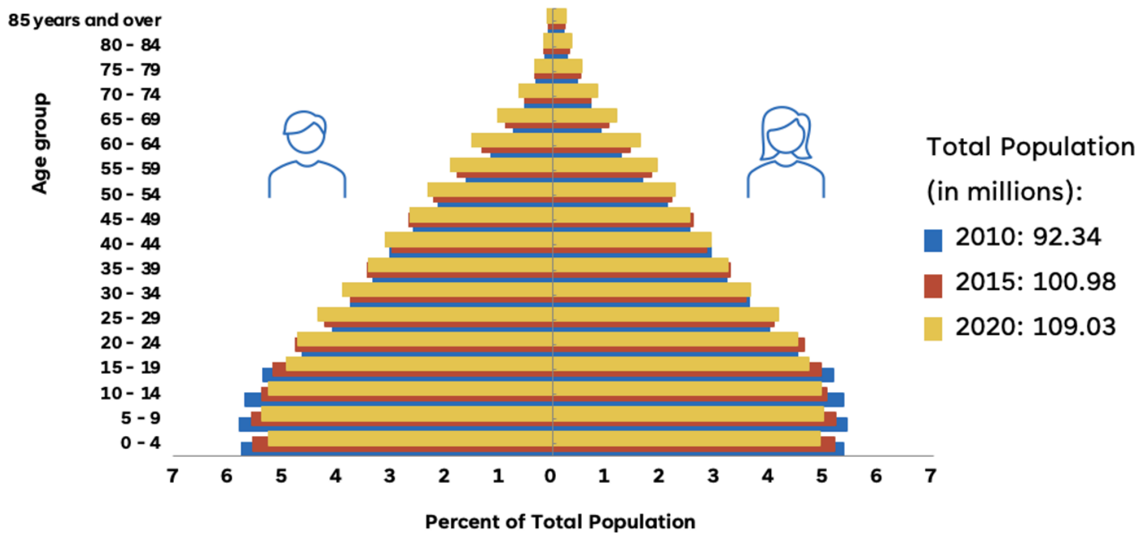

Figure 3. Age-sex pyramid: 2010, 2015 and 2020 CPH

3. **Increasing cohort size in the 0-4, 5-9 age groups.** Contrary to expectations, the cohort of those ages 0-4 in 2010 increased in 2015 (from 10,234,000 to 10,843,000) and in 2020 (11,091,000). Similarly, the cohorts of ages 5-9 and 10-14 in 2010 also increased in number in 2015, as they grew older.

Age group	01-May-10	01-Aug-15	01-May-20
0-4	10,234	10,819	11,069
5-9	10,322	10,843	11,271
10-14	10,180	10,494	11,091
15-19	9,705	10,191	10,483
20-24	8,409	9,467	10,025
25-29	7,424	8,360	9,229
30-34	6,773	7,342	8,171
35-39	6,014	6,743	7,222
40-44	5,472	5,849	6,529
45-49	4,681	5,284	5,599
50-54	3,895	4,431	4,965
55-59	2,987	3,607	4,137
60-64	2,228	2,761	3,375
65-69	1,498	1,916	2,398
70-74	1,143	1,220	1,578
75-79	707	859	932
80-84	394	475	570
85 and over	272	317	389

Table 2. Cohort analysis: 2010, 2015 and 2020 CPH

4. **Estimated 2020 population based on CRVS data on births and deaths suggest a 1.8 million difference from the actual 2020 Census count.** The actual 2020 Census count is higher than the estimated population from natural increase (births – deaths).

Year	Estimated midyear population
2015	100,800,945
2016	102,210,509
2017	103,494,933
2018	104,787,502
2019	106,042,787
2020	107,209,099

Table 3. Estimated mid year population based on CRVS data

5. **There is discrepancy in the expected and enumerated population for ages 0-4 in 2020 CPH**. Using the following data inputs, the expected 0-4 population in 2020 was estimated.

1. Population by 5-year age group, by sex as of May 1, 2010
2. Population by 5-year age group, by sex as of May 1, 2020
3. ASFR of women 15-49 years old from the 2017 and 2022 NDHSs
4. ASFR of women 15-49 years old from the 2020 CPH using P/F Ratio
5. Life expectancy estimates of age-sex specific survival ratios (projected: 2010-2015)

The SWGBP used eight methodologies to compute the estimated 0-4 population. Based on the 2020 CPH, the population of ages 0-4 is 11,069,479. As seen in Table 4, the estimated population based on the 8 methods yielded a lower count than the actual population count.

Year	Computed TFR	Estimated 0-4 (2020)	Difference (Estimated births minus 2020 CPH)
1. Interpolated ASFRs of 2017 NDHS and 2022 NDHS	2.4	10,135,148	-934,331
2. ASFR of 2022 NDHS	2.0	8,159,472	-2,910,007
3. ASFRs from 2020 CPH using P/F ratio	2.0	8,031,501	-3,037,978
4. Interpolated ASFRs 2022 NDHS and from 2020 CPH using P/F ratio	2.1	7,776,607	-3,292,872
5. Average ASFRs of 2017 NDHS and 2022 NDHS	2.3	9,724,676	-1,344,803
6. ASFRs of 2017 NDHS and from 2020 CPH using P/F ratio	2.4	9,766,606	-1,302,873
7. ASFRs from 2010 and 2020 CPH using P/F ratio	2.6	10,465,976	-603,503
8. Interpolated ASFRs of 2017 NDHS and 2022 NDHS at midyear July 1, 2020	2.0	8,379,593	-2,689,886

Table 4. Estimated population of 0-4 based on 8 methods of estimation

The overcount of the population in the 0-4 age group is an unusual finding, deviating from the usual trend. Assessments of previous censuses consistently revealed an undercount in this age category. For instance, in the 2010 CPH, the 0-4 age group was under-enumerated by 499,231 (PSA, 2016). Commonly employed methodologies for data adjustment primarily address under-enumeration in this age group, as it is more likely to occur than over-enumeration.

Given the lack of a robust basis for adjustment and considering the challenges in data collection during the COVID-19 period, the SWG on Base Population thought that it is best not to make further adjustments to the population figures for this particular age group which Dr. Nobuko Mizugochi agreed.

6. **Estimates using BPE from PASEX also yielded significant discrepancy in the 2020 CPH for those under 10 years old.** In addition, the BPE which is a PASEX workbook that allows the estimation of population under age 10 using the reported population for ages 10 and above and estimates of fertility and mortality, also show significant discrepancy in the 2020 count for population under age 10 (see Figures 4.a and 4.b)

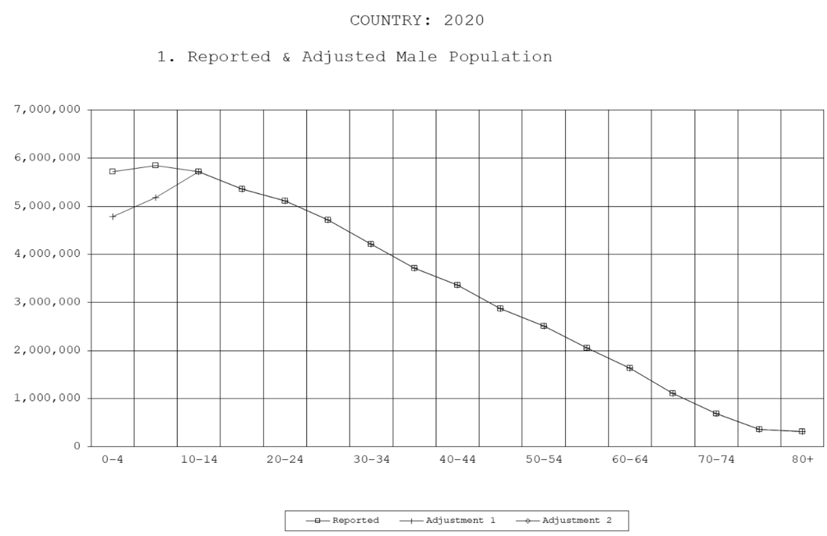

Figure 4.a. Reported and adjusted male population based on BPE

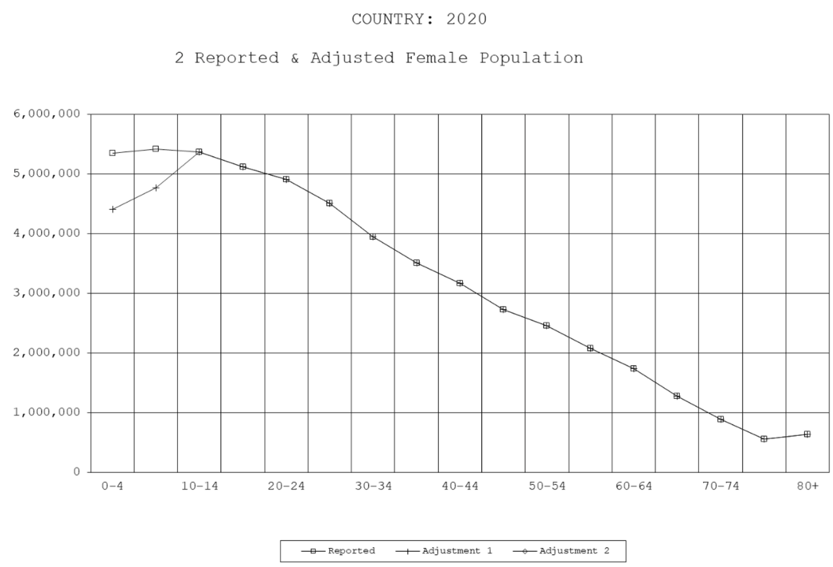

Figure 4.b. Reported and adjusted female population based on BPE

7. **There is significant discrepancy in expected and actual population count in 2020.** Using the 2010 Census counts and the estimated levels of fertility, mortality and migration that occurred during 2010-2020, the estimated 2020 Census count is lower by 2.77 million than the actual Census count of 2020.

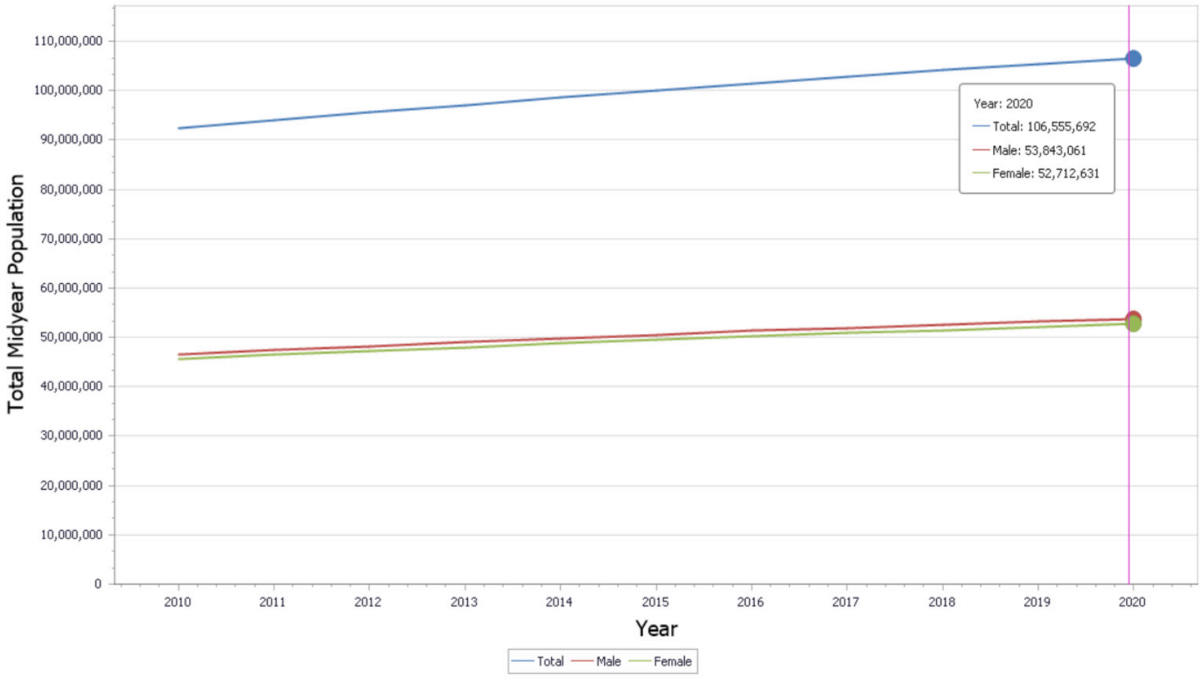

Figure 5. Estimated and actual population count for 2020

In summary, the SWG on base population found that there is no substantial age heaping in the 2020 CPH. However, there is a lack of consistency in cohort population for age groups below 15 years for Census years 2010, 2015 and 2020. While the visual inspection of the age-pyramid indicates declining population in younger ages, cohort analysis suggests a different pattern. Compared to previous censuses, in the 2020 CPH, there is a higher number of 0-4 population counts. Finally, when the 2010 CPH count was used along with the estimated levels of fertility, mortality, and migration between 2010 and 2020, the estimated 2020 Census is lower than the actual counts.

These discrepancies can be attributed to several factors such as recall issues of household members. There is a four-month difference between the reference date of the 2020 CPH and the actual enumeration (1 May 2020 and 1 September 2020). Also, there were a lot of population movements during the COVID-19 pandemic, thus, the definition of "usual residence" may have become ambiguous (UN, 2021).

Despite the identification of significant discrepancies in the total 2020 Census count particularly in the younger age groups, the SWG for base population recommends **the use of the official 2020 census count as the base population** for the projections. The decision was made after consultation with the staff of the Philippines Statistics Authority, and Drs. Mizugochi and Morse. There is no known methodology to adjust for overcounting as most existing methods are intended to adjust for undercounting in the younger age groups. Moreover, given that this is the first time that such discrepancy was observed, there is a need for PSA to delve into the matter and identify the reasons for such observation. In the absence of a plausible justification, the SWGBP agreed to adhere to the official results of the 2020 CPH.

B. Fertility

Data Inputs

1. Number of registered births from civil registration and vital statistics (CRVS) from 2017 to 2022
2. TFR and ASFR from the National Demographic and Health Survey from 2013 to 2022,
3. Number of women, children ever born and children born alive and population counts from the 2020 CPH
4. Adjusted midyear population projections using the population growth rate (PGR) based on the 2020 CPH.

Fertility is the main driver of population change. This will also have an important impact in the cohort component method in population projection. There are two aspects of fertility that need to be projected: the level and the age pattern.

Similar to the base population, the SWG on Fertility conducted data quality assessment as an initial step. This was done in several ways:

1. **Assessment of ASFRs/TFRs from the CRVS.** The reported number of registered births were adjusted based on the level of completeness of birth registration from the 2020 CPH which was

at 90.6. This was the level of registration for age 0 and was applied for all the ages in the CRVS data from 2017-2020.

In the CRVS data, there were reported births from women under the age of 15, as well as for those in the older ages (50 and above). Since the number of cases for under 15 is still small to merit a separate age group, these cases were added to the ages 15-19, while births from women over 50 were added to births of women in the age group 45-49. Similarly, births from mothers with unknown ages were distributed proportionally across the age groups. In the computation of TFR from the CRVS, the denominator for the 2017-2022 was adjusted to the midyear population using the PGR of 2015-2020 Census.

2. **Computation of TFR/ASFR from the 2020 CPH using the P/F ratio method.** The TFR based on the 2020 CPH is 2.3, down from a TFR of 3.1 in 2010.
3. **Assessment of TFRs from the NDHS (1983 to 2022).** There is a slow and gradual decline in TFR based on the NDHS data, although it registered the fastest decline in 2022: from 2.7 in 2017 to 1.9 in 2022.
4. **Comparison of TFR tends based on NDHS, CRVS and the CPH.** The TFR level from the CRVS declined from 2.3 in 2017, to 2.2 in 2018 until 2019. By 2020, the TFR reached 2.0 and declined further to 1.8 in 2021. In 2022, the TFR bounced back to 1.9. The TFR from the 2020 CPH is 2.3, which is higher than the 2022 NDHS and 2020/21 CRVS.

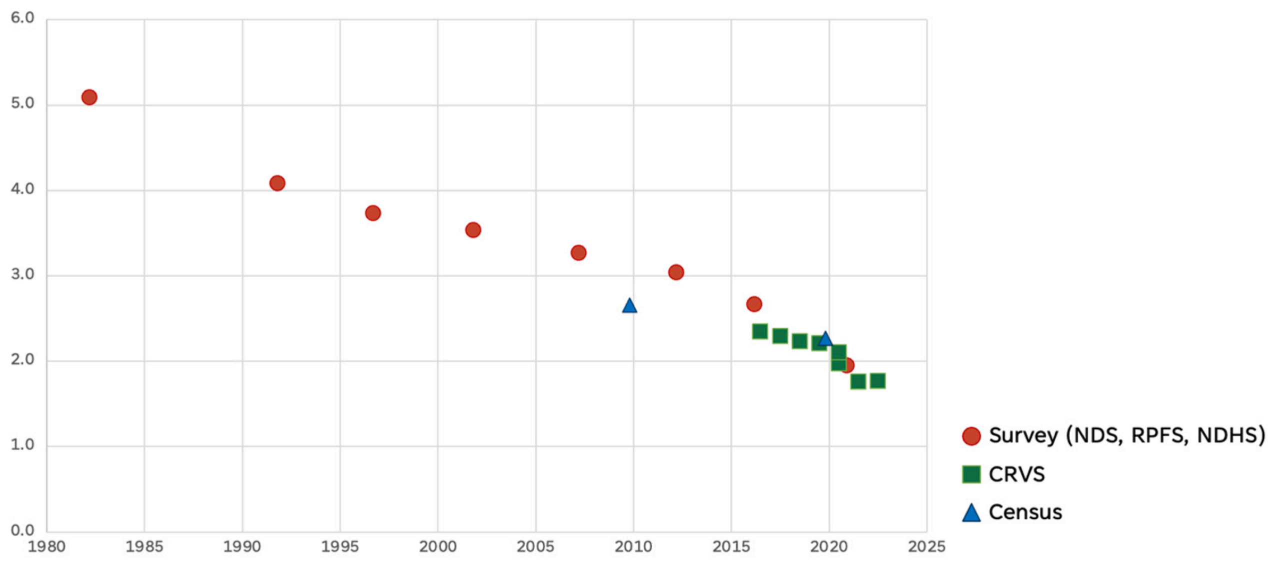

Figure 6. TFRs: 1983-2022, various sources

5. Assessment of ASFR pattern (1983-2022)

The ASFR patterns from NDHS and CRVS are fairly consistent, but the 2020 CPH data shows a different pattern, where there is a higher rate at older ages 35 years and over (Figure 7).

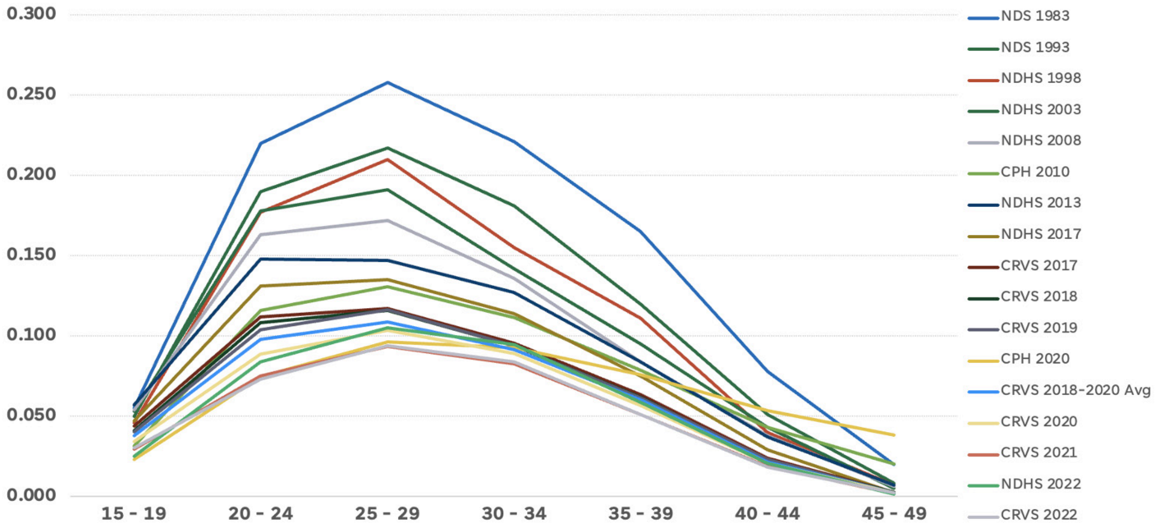

Figure 7. ASFRs: 1983-2022, various sources

Once the quality of fertility input data has been established, the SWG on Fertility identified the baseline TFR and ASFR pattern. It recommended the use of the CRVS for baseline TFR and ASFR pattern based on the average adjusted registered births from 2018-2020, which is 2.1 (Table 5). This level took into account the pre-pandemic and early pandemic level of births. In terms of ASFR pattern, an adjustment was suggested by the SWG: projected ASFR pattern will be based on the 2021 ASFR from the CRVS for ages 20-49 and the 2022 NDHS for the 15-19 age group. The NDHS has a lower ASFR for this age group compared to the ASFR pattern from CRVS.

Age	1983 NDS	1993 NDS	1998 NDHS	2003 NDHS	2008 NDHS	2010 CPH	2013 NDHS	2017 NDHS	2017 CRVS	2018 CRVS	2019 CRVS	2020 CPH	Avg 2018-2020 CRVS	2020 CRVS	2021 CRVS	2022 NDHS	2022 CRVS
15-19	0.055	0.050	0.046	0.053	0.054	0.045	0.057	0.047	0.045	0.042	0.040	0.023	0.038	0.034	0.030	0.025	0.030
20-24	0.220	0.190	0.177	0.178	0.163	0.142	0.148	0.131	0.113	0.107	0.102	0.075	0.098	0.089	0.075	0.084	0.073
25-29	0.258	0.217	0.210	0.191	0.172	0.153	0.147	0.135	0.115	0.114	0.114	0.096	0.109	0.103	0.094	0.105	0.094
30-34	0.221	0.181	0.155	0.142	0.136	0.127	0.127	0.114	0.095	0.095	0.096	0.093	0.092	0.089	0.083	0.095	0.084
35-39	0.165	0.120	0.111	0.095	0.084	0.089	0.084	0.075	0.065	0.064	0.063	0.076	0.062	0.057	0.051	0.058	0.051
40-44	0.078	0.051	0.040	0.043	0.038	0.046	0.037	0.029	0.023	0.022	0.023	0.053	0.022	0.02	0.019	0.021	0.018
45-49	0.020	0.008	0.007	0.005	0.006	0.020	0.007	0.002	0.003	0.003	0.002	0.038	0.002	0.002	0.002	0.002	0.002
TFR	**5.100**	**4.100**	**3.700**	**3.500**	**3.300**	**3.100**	**3.000**	**2.700**	**2.300**	**2.200**	**2.200**	**2.300**	2.100	**2.000**	**1.800**	**1.900**	**1.800**

Table 5. TFR and ASFR: 1983-2022, various sources

In previous rounds of population projections, assumptions were centered around the timing of achieving replacement-level fertility of 2.1, considering TFR and ASFR patterns. However, the 2020 Census-based population projection acknowledges that both the 2022 NDHS and the CRVS data indicate below replacement level of fertility for the country. Consequently, instead of assuming the pace of fertility decline and the timing of achieving a TFR of 2.1, the various projection scenarios were developed in collaboration with the CPD. The IAGWPP held discussions with Undersecretary Lisa Grace Bersales and other CPD officials to deliberate on the government's plan and future directions regarding population programs and policies.

The CPD reiterated its goal of helping couples achieve their desired fertility. The 2020 Census-based Population Projections, thus, proposed three possible scenarios on the level of fertility in the country until 2055:

- **Scenario 1:** The TFR will bounce back to the 2020 level of 2.100 in 2025 until 2055.
- **Scenario 2:** The below replacement level fertility of 1.946 in 2022 will be sustained, from 1.913 in 2025 and 1.900 from 2035 until 2055.
- **Scenario 3:** The TFR will continue to decline, from 1.946 in 2022 to 1.700 in 2055.

Table 6 presents the fertility projections based on the 3 fertility scenarios. The TFR for 2020 serves as the baseline, with TFR for 2021 and 2022 relying on actual data sourced from the 2022 NDHS. Projections for TFR from 2025 onward have been formulated. Scenario 1 as earlier indicated assumes a return to the 2020 TFR level in 2025 until 2055. In Scenario 2, the projected TFRs were generated using the TFR logistic function, incorporating data from the NDHS (2013-2022) and the CRVS (2017 to 2021 adjusted for completeness and age-distribution). The lower asymptote for this scenario is set at a TFR of 1.9. Similarly, the projected TFRs for Scenario 3 are based on the TFR logistic function utilizing data from NDHS (2013-2022) and the CRVS (2017-2021), adjustments made for completeness and age distribution. In this case, a TFR of 1.7 is employed as the lower asymptote.

Scenario	2020	2021	2022	2025	2030	2035	2040	2045	2050	2055
TFR of 2.1	2.090	1.946	1.946	2.100	2.100	2.100	2.100	2.100	2.100	2.100
Sustained below replacement TFR of 1.9	2.090	1.946	1.946	1.913	1.901	1.900	1.900	1.900	1.900	1.900
Continuous decline of TFR to 1.7	2.090	1.946	1.946	1.744	1.706	1.701	1.700	1.700	1.700	1.700

Table 6. Projected TFRs from 2025-2055 based on three scenarios

C. Mortality

There are two aspects of mortality that have to be projected: the level and the pattern by age and sex. There are several guidelines in projecting mortality using DAPPS. The mortality level is projected forward using the E0_PRJ program. It is strongly recommended to use a fixed slope. Unless the time series of the LE (e0) values is erratic, the last estimated e0 alone should be used. If the time series is erratic, there is a need to select several values to be entered and fitted. E0_PRJ will take an average of these values as its starting point.

The assessment of data inputs by the SWG shows evidence of underregistration in infant and child mortality. There are also inconsistencies in the estimates of infant (1Q0) and child (4Q1) mortality from the NDHS since 2008 to 2022 (Table 7). The NDHS estimates reported high standard errors relative to other indicators (Table 8), and finally, the actual deaths reported and the estimates of deaths based on the 2010 LTs for 2015 and 2020 are not consistent.

Data Inputs

1. Number of deaths by sex and by age group for 2019 to 2022 from the CRVS
2. Population by sex and age group from the 2020 CPH (2021 and 2022 population by sex and age group were estimated using the 2015-2020 PGR)
3. Standard errors for selected indicators from the 2022 NDHS
4. The United Nations Department of Economic and Social Affairs (UNDESA) estimates of LE at birth (e0)
5. United Nations Inter-agency Group for Child Mortality Estimation (IGME) estimates of infant (1Q0) and child (4Q1) mortality

Year	IMR DHS		IMR UN IGME	
Infant Mortality Rate (IMR)	**Male**	**Female**	**Male**	**Female**
2022	.02500	.01200		
2017	.02100	.02100	.02500	.02018
2013	.02300	.02200	.02648	.02141
2008	.02900	.02000	.02806	.02257
Child Mortality Rate (CMR) (1-4)	**Male**	**Female**	**Male**	**Female**
2022	.00500	.00500		
2017	.00700	.00600	.00662	.00565
2013	.00900	.00800	.00719	.00628
2008	.00800	.00900	.00788	.00691

Table 7. Comparison of IMR and CMR from NDHS and UNIGME

2022 NDHS Indicator	Standard Error
Under-5 mortality (last 0–4 years)	2.550
IMR (last 0–4 years)	2.307
CMR (last 0–4 years)	0.885
TFR (last 3 years)	0.049
Mean number of children ever born to women age 15–49	0.020

Table 8. Standard errors of selected indicators from NDHS

Given the observed underregistration of under 5 deaths, there is a need to adjust the IMR and CMR using the 2022 NDHS estimates. In adjusting for IMR and CMR, the SWG conducted the following processes:

1. Generation of 2020-2022 lifetables using updated registered deaths
2. Assessment of IMR and CMR from the generated LTs and comparing these with the 2022 NDHS estimates
3. Estimation of the completeness of death registration, where adjustment factor for 2020, 2021 and 2022 were computed using Mortpak
4. Projecting LEs

Table 9 below shows the comparison between the IMR and CMRs from the 2020-2022 LTs and the 2022 NDHS. The IMRs for both males and females from the 2022 NDHS is higher than the estimated IMRs from the generated lifetables of 2020-2022.

	Qx from LTs			2022 NDHS
	2021	2021	2022	
IMR				
Male	.00892	.00939	.00755	.02500
Female	.00704	.00755	.00787	.01900
CMR				
Male	.00242	.00331	.00303	.00500
Female	.00209	.00276	.00272	.00500

Table 9. IMR and CMR from 2020-2022 LTs and 2022 NDHS

Using the Brass Growth Balance Model to compute the completeness of death registration for ages 5 to 60 years old, results indicate that there is a relatively acceptable level of completeness. There is no need to adjust for these age groups.

Finally, in projecting LEs, the SWG took note of the evidence of a mortality rebound post-COVID pandemic in 2022. This means, that the level of death registration has been on a decline, thus, the E0_PRJ, a PASEX workbook that extrapolates LEs using a fixed-slope logistic function or an estimated slope, was used to estimate the projected single year LE at birth from 2003 to 2055 using the ultimate LE for 2100 of 82.56 for males and 88.40 for females. The ultimate LE is the summary of low mortality countries modeled by the US Census Bureau. The standard lower asymptote is 25 years. DAPPS assumes a logistic rate of growth for LE at birth projection.

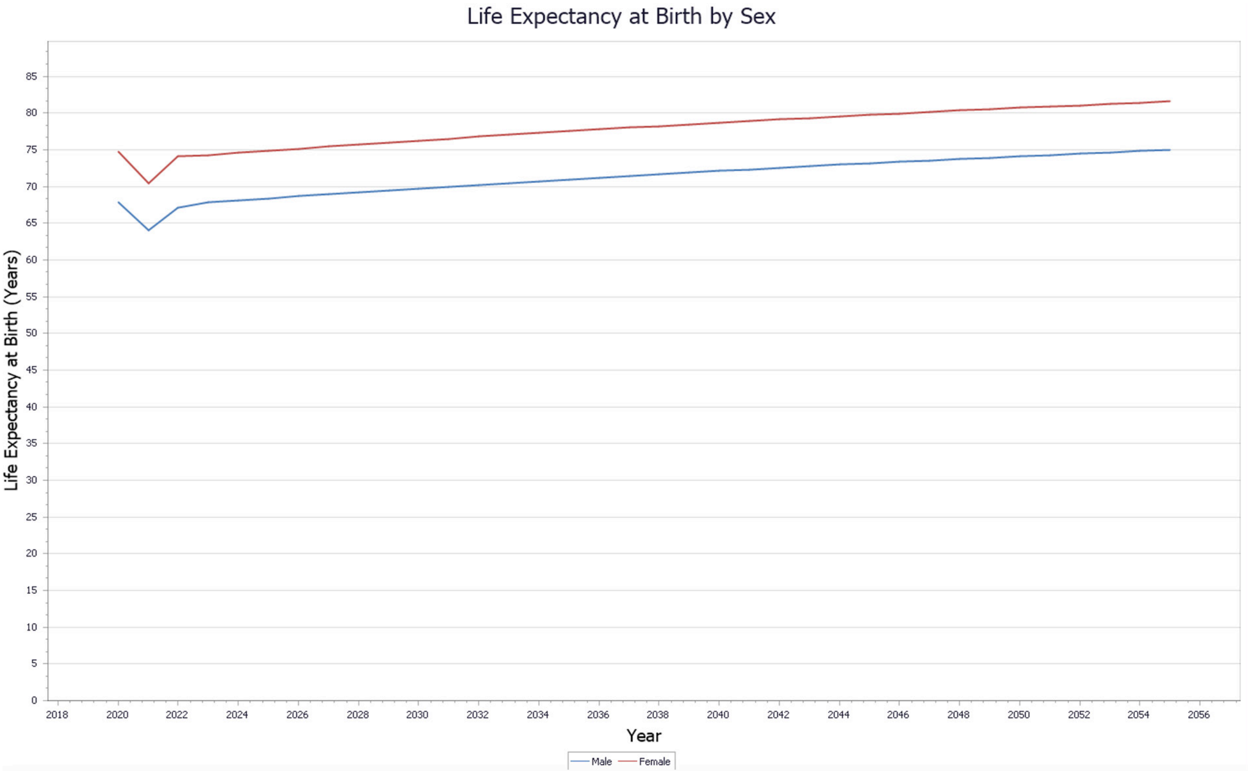

Figure 8. Projected LEs at birth: 2023–2055, by sex

The projected LEs of 75.02 for males and 81.58 for females represent a 7.17 and 6.79 years gained in 35 years, or about a year gain every quinquennial. This is consistent with the average life years gained in the Philippines of about 1.05 from 1960 to 2020.

	2020	2055	Gains
Male	67.85	75.02	7.17
Female	74.79	81.58	6.79

Table 10. Validation of estimated LEs

D. Migration

Among the components of the demographic balancing equation, net migration rate (NMR) is the hardest to measure. Compared to fertility and mortality, migration is also the least stable. Labor migration depends on economic and political conditions and these conditions vary. Other drivers of migration, such as war and conflict, and environmental factors can be hard to predict. Reliable and updated migration data are also hard to come by. The SWG on Migration decided to use three types of data sources: 1) Census and surveys, 2) Administrative data, and 3) Model-based data (see Table 11).

Census and Surveys	Administrative-based data	Model-based data
• CPH • POPCEN • Annual Poverty Indicator Survey (APIS) • National Migration Survey (NMS) • Labor Force Survey (LFS) • Survey on Filipino Overseas (SOF)	• Commission on Filipino Overseas (CFO) • Bureau of Immigration (BI)	• UNDESA

Table 11. Data sources for projecting migration

In order to arrive at migration estimates for projection, the following procedures were undertaken by the SWG.

1. Assessment and evaluation of available migration data from various sources
2. Indirect method estimation of net migrants using 2010 CPH, 2015 POPCEN, and 2020 CPH
3. Projection of net number of migrants (NNM) using administrative data from BI and CFO for scenario-building

In 2020, the COVID-19 pandemic necessitated imposition of travel restrictions, which affected census and administrative data on migration. The SWG found an unusually low level of 5-year net migration from 2020 CPH and the resulting age-sex structure of net migrants is atypical, making it not useful for future projection. The 2018 NMS data is pre-pandemic while post-pandemic data are available from the APIS, LFS, and SOF. All survey data on migration have very few cases for international migration needed for national-level population projection. SOF data is limited to OFWs.

On administrative-based data, both the BI and CFO release annual reports of migration registration. Although some levels of under registration in these data sources are noted, the lack of adequate information on the extent of under registration makes data adjustment not possible.

For scenario building, the SWG recommended the use of data from BI and CFO. The NNM can be computed as the difference between the number of in-migrants (number of registered immigrants (foreign nationals), by age and sex from BI and the number of out-migrants (number of registered Filipino emigrants) by age and sex from the CFO. Luckily, the indirect method of estimating the NNM based on the 2010 and 2020 CPH yielded similar results as the annual net migration computed from the BI and CFO. To represent the pre-pandemic age-sex structure of net migrants, the 2019 data of CFO and BI[1] was used in projecting migration (Figure 9).

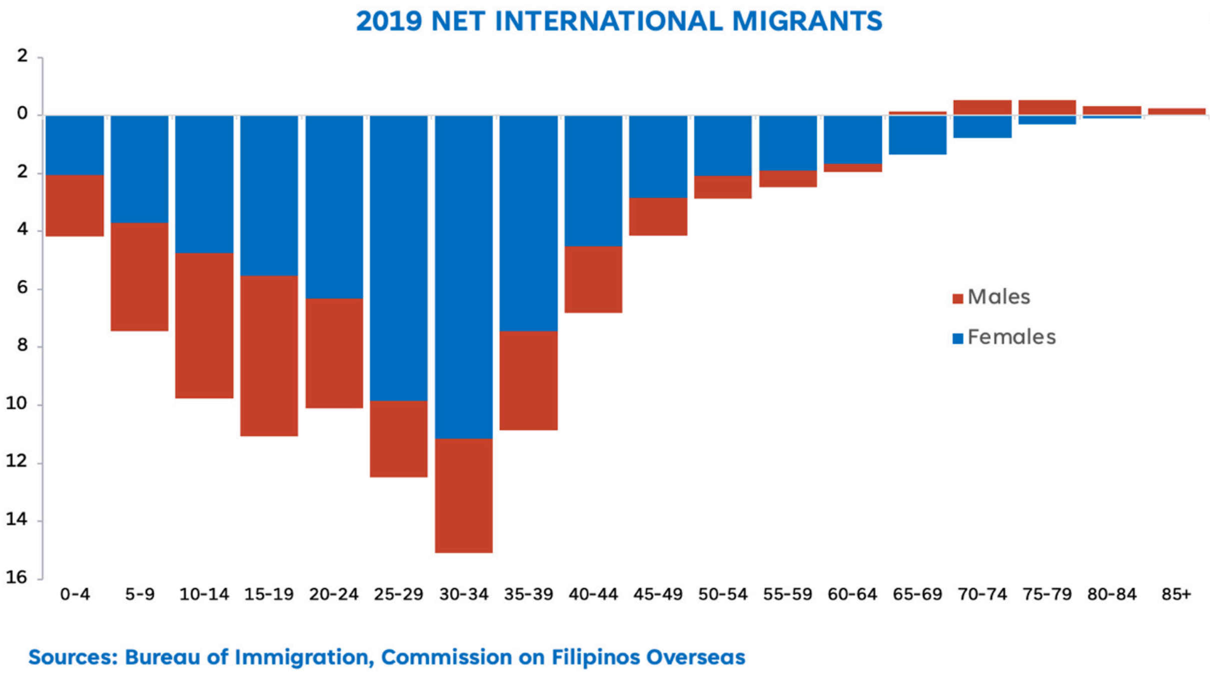

Figure 9. 2019 Age structure of net international migrants

[1] The administrative data were requested from BI and CFO. PSA was provided with the raw and unpublished data in Excel format. The PSA performed data cleaning and processing to obtain emmigration and immigration age structure.

Based on the data from the BI and the CFO, the SWG developed three scenarios on the projected NNM as reflected in Table 12.

Scenario	2020	2021	2025	2030	2035	2040	2045	2050	2055
Constant NNM [2021 NNM-2020 NNM = 6,980] added per year from 2022 to 2025[18,333 + (6,980*4) = 46,253] then **stable from 2030 to 2055**	-11,353	-18,333	-46,253	-46,253	-46,253	-46,253	-46,253	-46,253	-46,253
Constant NNM added per year from 2022 to 2025 then a **10% increase from 2030 to 2055**	-11,353	-18,333	-46,253	-50,878	-55,966	-61,563	-67,719	-74,491	-81,940
2020 NNM computed by adding the difference between the 2019 [57,414] & 2018 [67,005] NNM to the 2019 NNM then **a 10% increase from 2025 to 2055"**	-47,823	N/A	-52,605	-57,866	-63,652	-70,018	-77,019	-84,721	-93,193

Table 12. Scenarios for projecting migration

The SWG recommended the use of Scenario 3 in which the 2020 NNM was computed by adding the difference between the 2019 and 2018 NNM to the 2019 NNM, then assumes that there will be a 10% increase in NNM from 2025 to 2055. As indicated earlier, the travel restrictions that were put in place during the pandemic affected the 2020 BI and CFO data. The low NNM figures do not represent the regular age-sex structure of net migrants and is an irregular pattern in migration trend. The actual computed NNM for 2020 is -11,353. However, to simulate migration had there been no travel restrictions, the NNM for 2020 was computed by imputing from the 2018 and 2019 NNM. Finally, similar to Scenario 2, a 10% increase every 5 years was projected, reflecting the average annual net migration increase from 2015 to 2019.

IV.

Using DAPPS in Population Projection

In estimating population projection, DAPPS requires data inputs from at least 3 components: 1) a base population, by age and sex (usually based on a Census or estimate), 2) mortality structure, by age and sex, and 3) fertility structure, by age mother (births or ASFR). To account for the inflow and outflow of people, a fourth component is optional but recommended: a pattern of net migration (by age and sex of migrant). Population projection can also be completed without a migration component, or to assume that net migration is zero.

For the 2020 Philippine Census-based national population projection, there are 3 fertility scenarios: Scenario 1, the TFR for years 2021 and 2022 is estimated to be at 1.946 children based on the 2022 NDHS and assumed to rebound to a TFR of 2.100 children from 2025 until 2055. Scenario 2, a slow decline from 2.099 children in 2020 to 1.946 children in 2021 and 2022, and a further decline to 1.900 children from 2025 until 2055 is expected. Finally, Scenario 3 assumes a continuous decline such that by 2055, the TFR is at 1.700 children. Table 13 presents the projected TFR in the three fertility scenarios, from 2025 to 2055. Figures for 2020-2022 are based on actual data. In each of these scenarios, a fixed mortality schedule and migration scenario will be inputted in DAPPS to generate the population projection for the next 35 years.

Year	Scenario 1	Scenario 2	Scenario 3
2020 (Baseline)	2.099	2.099	2.099
2021	1.946	1.946	1.946
2022	1.946	1.946	1.946
2025	2.100	1.913	1.744
2030	2.100	1.901	1.706
2035	2.100	1.900	1.701
2040	2.100	1.900	1.700
2045	2.100	1.900	1.700
2050	2.100	1.900	1.700
2055	2.100	1.900	1.700

Table 13. Projected TFRs for three fertility scenarios: 2025-2055

For mortality inputs, nMx values (from 0 to 85 years and above) were used to generate the LT for males and females using MORTPAK. MORTPAK is a software package for mortality measurement in developing countries.

In DAPPS, a new portfolio should be created when starting the projection. The DAPPS Portfolio is a directory that contains subdirectories and all the files that will be needed by DAPPS for data storing and generating projections. Each component, base population, fertility, mortality and migration will each have a separate portfolio folder. The data for each component can come from a spreadsheet program, like Excel, Mortpak or RUP input file.

The DAPPS Projection outputs include the following:

- Single-year, 5-year and irregular age groups for population, migration and deaths
- Single-year and 5-year ASFR
- Abridged and unabridged LT
- Summary measurements

Outputs are given in both tabular and chart forms.

The results of the national population projection for 2055 according to the three fertility scenarios are reflected in Figure 10 and Table 14.

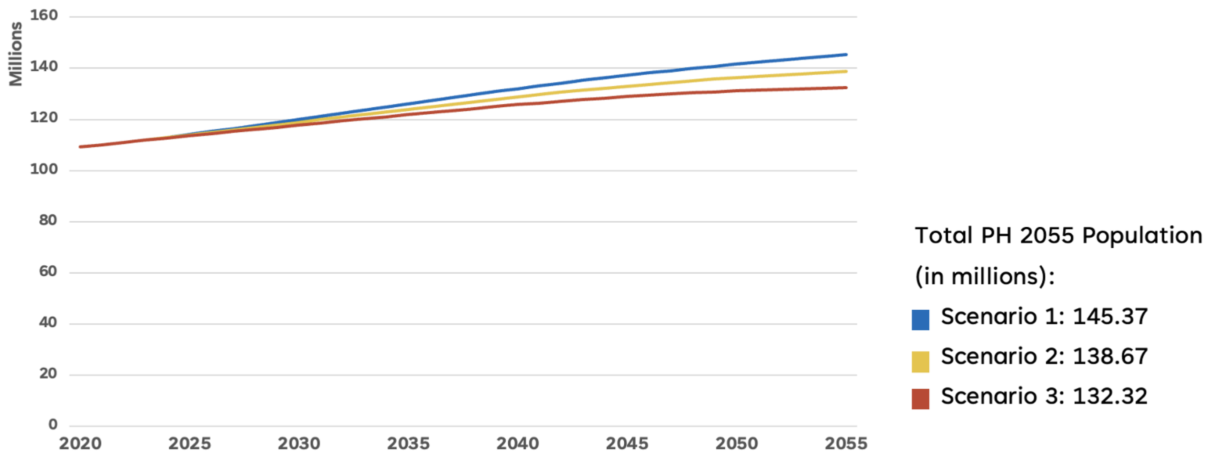

Figure 10: Projected national population: 2025-2055, according to 3 fertility scenarios

Year	Scenario 1	Scenario 2	Scenario 3
2025	114,123,597	113,863,084	113,627,648
2026	115,286,635	114,849,420	114,452,841
2027	116,463,340	115,845,614	115,281,539
2028	117,652,003	116,849,590	116,111,293
2029	118,850,838	117,859,582	116,940,298
2030	120,057,985	118,873,785	117,766,754
2031	121,271,464	119,891,411	118,592,116
2032	122,489,074	120,911,482	119,417,684
2033	123,708,233	121,931,588	120,241,200
2034	124,926,675	122,949,704	121,060,868
2035	126,141,735	123,963,515	121,874,707
2036	127,347,368	124,968,044	122,679,010
2037	128,537,824	125,958,526	123,470,193
2038	129,711,236	126,932,989	124,246,292
2039	130,866,524	127,889,682	125,005,226
2040	132,001,977	128,826,046	125,744,044
2041	133,110,726	129,735,055	126,456,012
2042	134,185,992	130,610,172	127,135,048
2043	135,227,238	131,450,353	127,779,708
2044	136,235,592	132,255,310	128,388,606
2045	137,212,405	133,024,506	128,959,748
2046	138,157,956	133,756,334	129,489,956
2047	139,072,027	134,449,512	129,976,972
2048	139,955,012	135,104,119	130,420,481
2049	140,807,588	135,720,389	130,820,106
2050	141,630,861	136,298,854	131,175,583
2051	142,427,395	136,841,303	131,487,744
2052	143,199,513	137,349,534	131,757,763
2053	143,947,383	137,823,773	131,985,820
2054	144,671,105	138,264,469	132,172,501
2055	145,371,322	138,672,745	132,319,148

Table 14. Projected national population: 2025-2055, according to 3 fertility scenarios

V.

Summary and Recommendations

The process of projecting the national population based on the 2020 CPH involved the assessment of various data sources and analysis of existing demographic data. The Philippines was one of the few countries that pushed through with the conduct of a decennial Census in 2020, marked by a once in lifetime public health crisis the world experienced – the COVID-19 pandemic.

There were observed discrepancies in the available data, for instance, the results of the 2020 CPH are not consistent with the indirect estimates derived from various sources between 2010 and 2020.

The pandemic effect on demographic events was evident and considered in the projection. In fertility data inputs, the CRVS data on births saw fluctuating trends, particularly at the peak of the pandemic, and a slight recovery in the number, thereafter. It is for this reason that the average TFR (2018-2020) was used as baseline. For mortality pattern, CRVS records showed highest level of deaths in 2021, but a decline has since been observed in 2022. The unusually low number of migrants registered at the BI and CFO led to the decision to use the 2019 age-sex structure of migrants.

What could explain the discrepancies observed particularly in the 2020 CPH data?

It is crucial to assess the methodologies employed during the 2020 CPH and understand the challenges encountered by the PSA and its field workers in conducting the census amid the pandemic. Questions arise regarding potential adjustments made to the census enumeration design, the impact of an extended implementation period compared to previous censuses on the results, and whether movements and travel restrictions during the pandemic might have led to instances of double counting. Exploring these aspects is essential to gain insights into the observed data discrepancies.

As next steps, PSA and its partner agencies may consider the following recommendations:

01 Review and update of population projections after the mid-decade census (2025) to validate assumptions given the disturbance or noise of the baseline data brought about by COVID-19.

02 Make available, if any, the Post-Enumeration Survey (PES) results to inform the IAWGPP in this task of projecting populations.

03 Add a question on "number of children who died" in the Census Questionnaire to provide more source of information on infant deaths.

04 Conduct more research on available data, for example, computing mortality indicators using survival analysis and indirect techniques based on CEB and surviving children from the CPH data, or study the completeness of birth and death registration.

05 There should be a regular computation of indicators like LTs.

- Annually, based on reported death statistics and compare with projected ASDRs.
- Estimation of LTs by education can be done if education variable is included in the death registration. This will allow further analysis such as computation of education dividend.

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