creation, splitting or merging of municipalities and barrios, extreme difficulties were encountered in updating these probabilities from 1948 to 1960. Some rational method must be followed to create, split or merge municipalities or barrios to minimize the difficulties and confusion not only in the development of a sound statistical framework for the province but also in the administration of local affairs.[10] This situation is an important administrative aspect which provncial, municipal and barrio administrators must consider.

Summary and Conclusions

Statistical parameters of population count in the Visayan region are derived by province with the use of results from the 1960 Philippine population census.

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[10] B.T. Oñate, "The Statistical System in Philippine Development," *The Philippine Economic Bulletin*, I:1 (October, 1962), 30.

The use of paper strata definitely will increase statistical efficiency in the estimation of total population count of the province. Equal allocation of sample barrios within strata makes the sampling design as precise as optimum allocation. Equal allocation also has the desired element of administrative simplicity and efficiency in the conduct of the survey. With paper strata, two sample barrios from each stratum will give a coefficient of variation of 2 to 5 per cent for the estimate of a province. Depending on the objectives for which the estimates are to be used, this paper gives alternatives or choices which may be followed by provincial administrators and their assistants. Also, the approaches presented in this paper may serve as models in the use of population census results as sampling frame for the development of efficient multi-stage surveys in the ECAFE (Economic Commission for Asia and Far East) region.

Philippine Fertility and Mortality with Special Reference to the North Mindanao Region: A Critique of Recent Estimates

Part I: The Philippines in General

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The growth of the Filipino population during the past sixteen years is one that has rarely been equaled by any nation of comparable size over an extended period. With its present rate of growth of more than three per cent a year, the "Population Explosion" has indeed come to the Philippines. It is therefore of great interest to discover as precisely as possible what the fertility and mortality rates of the Philippines are, since these are the bases of Filipino population growth in the absence of significant immigration. This paper, by Father Madi-

gan and Rosalia Avanceña, will present an evaluation of recent estimates of fertility and mortality in the Philippines as a whole, while the accompanying paper by Father Madigan alone will evaluate fertility and mortality estimates for the north Mindanao region in particular.

Registration of Vital Events. In the Philippines, birth and death events are tabulated on a place of occurrence basis by the Director of the Bureau of the Census and Statistics who is also Civil Register General. In municipalities and municipal districts, the municipal treasurer is the local civil registrar while in chartered cities the official designated by the particular charter fulfills this task.

At present, adequate coverage of births and deaths is not obtained. Only 76 per cent of the local registrars filed vital statistics reports with the Registrar General in 1956, and by 1960 this had only increased to 88 per cent. In addition, a certainly large but unknown proportion of births and deaths are never reported even in the local registration records. Because the country is rural and mountainous, roads are relatively few and generally poor, and trails from barrios to municipal centers are often arduous and long. Many rural citizens seem to find registration of births and deaths, especially deaths under seven years of age, an unnecessary bother in view of the difficulties, and are accordingly lax in observing this duty.

Adequate correction factors for underregistration for the Philippines as a whole or for different regions in particular have not been estimated thus far. In 1956, the Department of Health surveyed Nueva Ecija, believed to be a province with relatively good registration, where it estimated underregistration of births at approximately 35 per cent and underregistration of deaths at 11 per cent. A later study of death re-

gistration by the same department in 1961, made in nineteen municipalities of Luzon, estimated underregistration of deaths at from sixteen to thirty-three per cent. These should be considered minimum estimates, because the methodology used, which consisted of checking graves and seeking death information of relatives from respondents, gave no guarantee of complete death coverage.

Besides the official registration data series of the Census Bureau, the Department of Health also computes an unofficial series of birth and death rates for its own use. The Department of Health rates are undoubtedly closer to reality than those computed from the Census Bureau data (which reports the number of the events with the estimated appropriate population base); however the compilers of both series acknowledge that their data seriously underestimate the true rates. As an illustration, the Census Bureau data for 1956 compute to a crude birth rate of 24 births per 1,000 persons, and the Department of Health for that year reported a crude rate of 35 births per 1,000, while demographers generally believed that the true rate was close to 50 births per 1,000.

Estimates by Population Analysts. Because of the fog which beclouds the data from the registration system, population analysts prefer to estimate fertility and mortality patterns in the Philippines by methods other than the simple combination of registration data and appropriate population bases. These methodologies may be grouped roughly under seven general headings, although in the concrete they are often found in combinations. These are:

a.) Survival and reverse survival ratio methods applied to census or survey populations,

b.) Drawing conclusions from studying the age-structure of the popu-

lation revealed in census or survey enumerations;

c.) Graphic or statistical analysis of children born to women of various age characteristics, as these data are available in census or survey publications;

d.) Correction of registration data by application of various assumptions;

e.) Combining intercensal geometric increases with assumed or estimated birth or death rates to conclude to estimates of correlative birth or death rates;

f.) Life table construction based upon census data with or without correlative registration data; and

g.) Sample survey methods.

A critical consideration of representative findings from these studies will dispel some of the fog surrounding Filipino fertility and mortality characteristics.

Survival and Reverse Survival Ratio Methods. Edith Adams and her associated United Nations' demographers (1960; pp. 3-4, 38-42) estimated a series of age-adjusted birth rates by survival ratio methods for the Philippines for five year periods from 1894-1939, and for the ten year period 1947-1957. They also computed crude death rates for the period 1939-1947 and for the period 1948-1957. They based their survival and reverse survival computations upon the 1948 Census and the 1956-1957 Philippine Statistical Survey of Households sex-age distributions. The rate they found were as follows, per 1,000 persons of the population:

	1899-1939	1939-1947	1948-1957
Birth Rates	52.7[a]		45.6 — 52.7
Death Rates		31.7	25 — 31

[a] The present writers computed this mean by omitting the 1894-1899 rate, which seemed unreasonably low, and averaging the others without weighting.

Several points are noteworthy. First, they found no solid evidence of declining fertility. Secondly, the range of births per 1,000 persons for the 1948-1957 period averages to 49.2, which is probably better than either the low or high estimate, since children less than five years of age were probably under-enumerated and those 5-9 years of age in the 1956-57 surveys were probably overcounted due to misstatement of age. Finally, they felt that the death rate for the period 1948-57 was probably nearer 20 per 1,000, at least for the latter part of the period, than the rate they computed by survival techniques, namely, between 25 and 31 deaths per 1,000.

Elvira Mendoza-Pascual (1962: pp. 174-77) also used survival rates based on the 1960 Census sex-age distribution of the population to compute a crude Philippine birth rate of 50 per 1,000 for the 1950-55 period. Although the present writers agree that the resulting birth rate is about right, they feel that the survival ratios she utilized were based on a too-high expectation of life at birth (47.5 years) for the Philippines at that time. Mendoza-Pascual also computed a crude death rate of 18 deaths per 1,000, by subtracting the estimated intercensal increase, based on preliminary Census reports, of 3.2 per cent per annum for the years 1948-1960, from her estimated birth rate of 50 births per 1,000. However, she lowered this figure to 16 deaths per 1,000 because she assumed that registration of deaths should be five per cent more complete than registration of births. The present writers believe that 16 deaths per 1,000 is an

underestimate of Philippine mortality for 1950-55.

Analysis of Births of Children by Age of Women. The United Nations' demographers (1960: p. 3) found 7.1 children were reported for each ever-married woman above 45 years of age, in the May, 1956 PSSH socio-economic survey. This result supports their own and Mendoza-Pascual's estimate of the birth rate, because it is consistent with a crude birth rate of 50 births per 1,000. However, the October, 1956 survey indicated a birth rate of only 46 births per 1,000, a result which may have been due to underreporting of children.

Irene B. Taeuber (1960: pp. 106-110) discovered evidence in the 1939 Census, by utilizing this children-women methodology, of fertility differentials between provinces whose populations were largely Christian in religion and provinces which were *predominantly* Muslim by religion, and also between these largely "Christian" provinces and provinces containing *appreciable proportions* of Muslim or "native" (tribal) peoples. She also found limited but pervasive fertility differentials between provinces by socio-economic characteristics. However, Dr. Taeuber cautiously qualified her findings by pointing to possible inaccuracies in the Census enumerations. It is of especial interest here that she found 6,576 children ever born for each thousand women of ages 45-54, a finding which is consistent with a high Philippine birth rate, although not as high as that found in the May, 1956, PSSH survey data. From this same May, 1956 survey data (1957: pp. 14, 19), Father Madigan for this paper computed that there were 771 children under five years of age per 1,000 women 15-44 years of age, and 1,261 children under five per thousand ever-married women 15-44 years old. This showed no evidence of fertility decline since the 1939 Census, from which Dr. Taeuber had found 745 and 1,132 children for the same categories.

Correction of Registration Data. Although the attempts made to correct the registration data have been ingenious, such attempts are forced to make assumptions which generally force differing provincial registration situations into the same mold, whether or not the fit is good.

Frank S. Morrison attempted to show gradual improvement in registration coverage for the years 1954 to 1956 by grouping cities and provinces reporting birth and death rates above the national average for the particular year, and computing their average rates. By these average birth and death rates, he then corrected the births and deaths of provinces and cities which had reported vital rates below the national average. For the years 1954, 1955, and 1956, his corrected birth rates per 1,000 persons were, respectively, 41.4, 43.5, and 44.8, his corrected crude death rates were 11.9, 11.2, and 11.5, and his corrected infant mortality rates were 90.9, 78.9, and 79.3. Morrison realized that these "corrected" rates were below the true rates, but offered them as evidence of improving registration. However, the present writers are not sure that the results of the death and infant mortality computations really prove that registration of these events is improving. If the true rates are higher, why does not improved registration manifest itself in the computation of higher, rather than lower, death rates?

Basilio B. Aromin corrected the Philippine death rates from 1903 to 1960 by two methods. Both assume a constant birth rate over time of about 49 births per 1,000, and the first method besides assumes that for any particular

year completeness of birth registration equals completeness of death registration. Thus after he had estimated the per cent of birth completeness by dividing the registered by the assumed constant birth rate of 49 births per 1,000, by assumption this also gave him his estimate of the death completeness percentage. He secured his estimates of the true death rates by multiplying the registered death rate by the reciprocal of this percentage.

In his second method, he assumed that the completeness of death registration remained constant during each intercensal period. Subtraction of the average inter-censal increase gave him an average crude intercensal death rate, which he divided into the average registered death rate for the same period. With the resulting correction factors (one for each intercensal period), he estimated the true death rates by multiplying each year's registered death rate by the proper correction factor. Aromin felt in general that his second method gave truer estimates. It is notable that the first method gave higher estimates for years before World War II and lower estimates after the war than the second method. For three representative postwar years, in terms of deaths per 1,000 persons, Aromin's rates are:

	1950	1955	1960
Method A	17.3	14.2	12.9
Method B	19.3	15.5	13.3

Sample Surveys. The 1960 Census gathered number of children by age of mother on a ten per cent sample household basis and also birth as well as infant mortality data for the November 1, 1959 to January 31, 1960 period. It intended using the last-mentioned data to check upon completeness of registration. However, the results of these questions have not yet been released. The PSSH sample survey rounds have

already been mentioned. The thirteenth round results (for October, 1962) have already been published.

Sample surveys by other agencies are regional, provincial, or local. Dr. Amos H. Hawley (1954: pp. 32-33; 1955: p. 23) surveyed 301 households in a middle-class Quezon City housing development in 1952, and analyzed data (1955) from the Rivera-McMillan survey of approximately 2,700 households of rural central Luzon of 1952 (1954). Father Madigan (1962a, 1962b, and 1963) and Antonio J. A. Pido (1961) surveyed the rural area of Cagayan de Oro City in 1959 and the urban area of Cagayan de Oro in 1958, respectively. The results of these last two surveys will be treated in the following paper by Father Madigan.

Hawley's analysis of fertility in nine barrios of central Luzon checks with the United Nations' and Mendoza-Pascual's estimates of a birth rate near 50 per 1,000 for women 35 years of age and above, but would seem to indicate an abrupt reduction in fertility for women under 35 for the years 1942-1952. Probably this was due to the Hukbalahap dissidence, which seriously disturbed the provinces of the nine barrios, rather than to any lasting decrease in the fertility of rural women of central Luzon.

However, in this connection a study of Dr. Enrique P. Virata and associates should be mentioned (1959: pp. 3, 65-70). From data upon six barrios of rural Luzon (in Batangas, Bulacan, Ilocos Sur, Laguna, and Tarlac Provinces), one computes 6,198 children ever born for each thousand ever-married women 45-54 years of age, and 4,112.5 children per 1,000 ever-married women 15-44 years of age. Since Taeuber's 1939 data for ever-married women 45-54 years of age average to 6,870.6 children per

1,000 when provincial means· for these same. five provinces are averaged (without weighting), the Virata study may indicate some decline in rural Luzon fertility. It seems to the present writers however in view of the Census data of

1948 and 1960 that the lower· fertility of these six barrios might be explained on other grounds, such as sampling fluctuations or an unusual sample.

The rates per 1,000 married women found by Hawley are as follows:

	under ·25	25-29	30-34	35-39	40-44
Rural Luzon	407	341	269	230	98
Quezon City					
1951-1952	286	418	352	213	145
1951	263	353	378	316	160
1952	320	485	325	137	135

The Quezon City data may indicate a downward trend in the fertility of middle-class women of the Manila area since the crude birth rate for the sample averaged only 35.8 births per 1,000 persons. This hypothesis may at first sight seem supported by K. M. Jupp's findings for Manila· fertility in 1956 (1960) vis-a-vis the rural areas and by Mercedes B. Concepcion's data based on 1956 and 1958 PSSH survey rounds (1963: pp. 62-76, 111-12), both of which found clear indications of a considerably lower fertility for Manila women. But as Concepcion· explicitly states, these may reflect longstanding differentials rather· than an incipient decline in Manila fertility. It seems better to await further data on this point before coming to any conclusion.

Other Methodologies. Most of the other techniques used by demographers to estimate Philippine rates were used only in auxiliary fashion. Only two of these are of interest here.

The United Nations' demographers analyzed the age structure of the 1956-1957 PSSH rounds and found evidence in this age structure of a birth rate in excess of 45 births per 1,000 (1960: p. 3).

The Census Bureau used registration data and the 1948 Census enumeration

data to construct life tables by sex for 1948. Attempts were made on theoretical bases to correct the birth and death registration data, and the completed tables give the 1948 expectation of life at birth for males as 48.8 years and for females as 53.4 years. The present writers believe these figures were considerably too favorable for expectation of life in the Philippines at that time.

Madigan-Avanceña Research. After this analysis, the general picture of the birth rates in the Philippines seemed to the writers one of about 50 births per 1,000 persons. However, a check upon this estimate, based on the 1960 Census, seemed desirable. Secondly, the death rate haze needed clarification. The rates of Aromin and Mendoza-Pascual seemed less than the true rates while the United Nations demographers' range of rates for 1948-57, namely 25-31 deaths per 1,000, seemed unduly high.

The present writers therefore applied survival ratios to the 1948 and 1960 Census sex-age distributions to obtain their own estimates of these rates.[1] Three trials with the United Nations' model life tables at aging the sex-age distributions of the 1948 Census up to 1960 indicated the pair of tables with life expectation at birth of 42.5 years (for

both sexes together) as the most appropriate for the October 1, 1948 to June 8, 1954 period, and the pair of tables with life expectation at birth of 45.5 years for the June 8, 1954 to February 15, 1960 period. Survival ratios for the latter tables were computed for each sex by interpolation from the ratios of the two immediately adjacent tables. The following rates were thus computed:

Period	Age-Adjusted Birth Rates	Crude Death Rates	Life Table Death Rates	Estimated Expectation of Life at Birth
1948-1954	54.0	21.6	23.5	42.5
1954-1960	44.2	18.5	22.0	45.5

The low level of the rate of birth for the 1954-1960 period is probably due to underenumeration of children 0-4 years old in the 1960 Census. Correlatively, the totals of the children stated as 5-9 years old may be swelled by children whose age has been misstated. Thus the average of the two periods, 49.1 births per 1,000, is the rate which the present writers estimate for the period 1948-1960. This rate checks well with and supports the rates of the United Nations' demographers (45.6-52.7, mean 49.2) and of Mendoza-Pascual (50).

The death rates seem more realistic than those mentioned in the previous discussion. In the absence of important net immigration, the estimates of the death rate when added to the natural increase per 1,000 persons per year should come close to 50 births per 1,000, a birth rate which most demographers familiar with Philippine data accept as the approximate rate. The Madigan-Avanceña estimates are closer to the level which yields a birth rate of about 50 per 1,000 than the others, as one sees in the table following.

	United Nations		Aromin, Method I			Aromin, Method II		
	1939-48	1948-57	ca. 1957	1950	1955	1960	1950	1955	1960
Death Rate	31.7	25 — 31	20	17.3	14.2	12.9	19.3	15.5	13.3
Nat.. Increase	19.1	30.6 — 30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6
Resultant Est. of Birth Rate	50.8	55.6 — 61.6	50.6	47.9	44.8	43.5	49.9	46.1	43.9

	Madigan-Avanceña		Mendoza-Pascual
	1948-54	1954-60	1950-1955
Death Rate	21.6	18.5	16
Nat. Increase	30.6	30.6	30.6
Resultant Est. of Birth Rate	52.2	49.1	46.6

Conclusion and Evaluation. The foregoing discussion indicates from a number of independent research sources that the current birth rate of the Philippines is about 50 births per 1,000. Although because of limited space the constancy of this rate during the present century was not directly examined, general agreement exists that the rate has been fairly constant at 50 births per 1,000, and that no clear signs are present of a current decline from that high level.

On the other hand, on the basis of the evidence presented, it appears that the

death rate has fallen to slightly less than 20 deaths per 1,000 from a high level of from perhaps 35 to 45 deaths per 1,000 at the start of the century. Although the decline of the death rate will probably be slower during the next decade because of massive rural health

problems of personnel, medicines, facilities, and lack of roads, still even the current birth and mortality levels indicate a current annual increase of more than three per cent a year, an increase which the Philippine economy will find hard to absorb.

[1] The survival ratios were applied to the 1948 Census, utilizing the smooth and adjusted age-sex totals worked out by the United Nations' demographers (1960: pp. 41-42), but with a small correction to adjust to the 1948 Census totals. The populations were worked through two five-year periods, October 1, 1948-October 1, 1953, and October 1, 1953-October 1, 1958. In each trial, the geometric increase in population, which would be obtained by applying the survival ratios together with an age-adjusted birth rate of 53.0 per 1,000, was computed. This geometric increase was then applied to the October 1, 1958, totals obtained in each trial to project that population to February 15, 1960. The age-adjusted birth rate found by the United Nations' demographers, 1899-1939, was 52.7; and in the absence of evidence of declining fertility, it seemed wise to use this at the level of 53.0 for both parts of the projection process, 1948-1958.

Investigation revealed that net immigration had been negligible between 1948 and 1960. Therefore, natural increase would be equivalent to population growth for the period.

The first trial was made with the two United Nations' model life tables averaging (by combining the sex tables) 40.0 years of expectation of life at birth (1956: p. 80) for 1948-1953 and 42.5 years of expectation for 1953-1958. Following the techniques described above, the resulting population for February 15, 1960 (the 1960 Census date) was 2.58 per cent less than the 1960 Census total.

The second trial used the tables with expectations at birth of 45.0 and 47.5 for the same two periods, and the result was a Census date population 1.94 per cent larger than that enumerated in the actual Census. The third trial took the tables with rates of 42.5 and 47.5, and the ensuing estimated population was 0.92 per cent too large. Since 47.5 years of life seemed too high for the period June 8, 1954, to February 15, 1960, this was the table whose expectation was reduced. Thus the final survival ratios used were those from the table with expectation of life of 42.5 years at birth for the 1948-1953 period (equivalent in our technique to October 1, 1948-June 8, 1954) and those from a table with 45.5 years of life expectation at birth for

the 1953-1958 period (equivalent to June 8, 1954-February 15, 1960). The second set of survival ratios was found by interpolation from the two adjacent tables with life expectation of 45.0 and 47.5 years at birth, respectively.

The 1960 Census population was not smoothed for theoretical reasons. Births were estimated from the 0—4 ages by applying the survival ratios (in reverse) from the table with expectation at birth of 45.5 years. Births thus secured represented the period February 15, 1955 to February 15, 1960. The population for the mid-point of this period, namely, August 15, 1957, was computed by averaging the populations for February 15, 1955 and for February 15, 1960. The February 15, 1955, population was found by geometric retrogression from the 1960 Census total at the rate of 3.126 per cent per year (the increase yielded by the 45.5 expectation of life table's survival ratios with the assumed birth rate of 53.0 per 1,000), which was 3/10 of one per cent larger than the geometric progression from the 1948 Census totals at 2.988 per cent (the increase yielded by the table with 42.5 years expectation of life). The base for the August 15, 1952, population was found by averaging the February 15, 1950 population (found by geometric progression from the 1948 population at 2.988 per cent a year) and the February 15, 1955 population. The birth rates found therefore refer directly to the periods February 15, 1950-February 15, 1955, and February 15, 1955-February 15, 1960, but have been extended to the periods October 1, 1948-June 8, 1954 and June 8, 1954 to February 15, 1960, for two reasons: (1) the rates should refer to the whole period covered, 1948-1960, because of the techniques used, and (2) there is no indication of declining fertility.

The death rates were found similarly by projection of the 1948 population forwards by the same survival rates through the periods October 1, 1948 to October 1, 1953, and October 1, 1953 to October 1, 1958, with the assumption of an age-adjusted birth rate of 53 per 1,000. Similarly the same rates were extended to cover the periods October 1, 1948 to June 8, 1954 and June 8, 1954 to February 15, 1960.