Journal of Philippine Development
Number Thirty, Volume XVII, No. 1, 1990

EVALUATION OF PHILIPPINE CORN STATISTICS

I. P. David, A. Nenette C. Mendoza and David C. Besa[1]

I. INTRODUCTION

In discharging its function as official gatherer of agricultural statistics, the Bureau of Agricultural Statistics (BAS) relies on a system of surveys collectively called lately as the Integrated Agricultural Surveys (IASs).[2] The Rice and Corn Surveys (RCSs) are the centerpiece of the IASs, and these are the sources of practically all data on the country's two principal foodcrops. Because the RCSs draw the lion's share of BAS resources, which undoubtedly is due to the strategic importance of these crops, these surveys are reputedly the best planned and executed among the IASs. The implication is that, of all agricultural statistics, those on rice and corn are the best, i.e., most accurate.

It is widely known in statistical circles that the RCSs and their predecessors have been designed to produce better statistics for rice than for corn. A review of what has been written about the RCSs sampling procedures will readily show that such is the case [see, e.g., (1), (2), (10)]. Indeed, aggregate statistics on rice area and production appear to be accepted generally nowadays to be "in the ballpark." Users, however, will welcome improvements in the accuracy of disaggregated estimates (e.g., by province or by type of cultural management) and in the level of detail with which the statistics are presented particularly those on farm inputs (e.g., fertilizers by kind instead of lumping all kinds together).

Unfortunately, the same cannot be said of statistics on corn. In the first place, hardly anything has been written about how these statistics are produced. Aside from the estimates themselves, most of what is known could be found in the BAS field manuals. Secondly,

1. I. P. David and A.N.C. Mendoza are with the Asian Development Bank. D. C. Besa, formerly with the Bureau of Agricultural Statistics, Department of Agriculture, is now with the National Security Council; his work on the paper was supported by a UNDP-UP Statistical Education Support Project (SESP) grant. The views expressed in the paper are those of the authors and do not necessarily reflect the views and policies of their respective institutions.

2. The BAS was known until 1986 as the Bureau of Agricultural Economics (BAEcon). Also, until 1968 the IASs were called the Crop and Livestock Surveys (CLSs).

there have been repeated public expressions of doubt over the reliability of the official corn statistics. The most recent incident was the official announcement of a bumper corn crop during the first half of 1988, along with pronouncements regarding the possibility of exporting some of it. This was met with disbelief by the country's association of livestock and poultry producers, with public statements to the effect that the government should reexamine more carefully the statistics before it begins talking about an exportable surplus.

The paper aims to lift the veil of public ignorance of the way in which the country's official corn statistics are being produced, making possible a more informed evaluation of their reliability and usefulness. Section II presents the estimation procedures used for area, production and yield. We believe this is the first time that these estimators or formulas are being documented with sufficient detail for general circulation.[3] It turns out that there are two estimators — one that is the source of the officially released estimates, and another that produces what may be called design estimates. These two sets of estimates are compared in Section III. These are compared also in Section IV with estimates from independent sources, such as the agricultural censuses. Highlights of findings and recommendations are given in Section V.

If the quality of corn statistics is second only to that of rice among agricultural statistics, any objective evaluation of the former indirectly provides at least a relative assessment of the quality of the remaining agricultural statistics. Such new knowledge becomes very valuable since there was nothing available before; for until now users have had to accept the official statistics on other crops, livestock and poultry on faith, or more realistically, as there are no real alternatives.

II. SAMPLING STRATEGIES FOR THE RICE AND CORN SURVEYS (RCSs)

A. *Outline of the Sampling Procedures*

The RCSs and their predecessors, the Crop and Livestock Surveys, (CLSs) have always used probability samples. Sampling units were drawn either in three (towns, barrios, households) or two (barrios, households) stages, with the barrios stratified according

3. A recent report which was brought to our attention deals briefly with the same estimation procedure: see reference (10). There are, however, major differences in substance and detail between that report and this paper.

to geographic location and/or cropping pattern. Sample households have always been drawn using simple systematic sampling, while the higher stage units have been chosen using either simple random sampling or with probability proportional to some size measure, e.g., rice or farm area. The provinces have always been treated as domains requiring separate and independent estimates. However, because the resulting provincial estimates were not always of the desired level of precision, there were years when only regional and national estimates were released or published. Data collection has always been through face-to-face interview with the household head or, in his absence, with any member of the household who in the opinion of the interviewer is knowledgeable about the household farm operations.[4] Objective methods of measurement, e.g., crop cutting and the use of measured area segments as sampling units, have only been tried on a pilot or experimental basis.

There are usually four survey rounds in a year. For corn, the statistics for the first semester of the cropyear (July-December 1986) are based on returns from the January 1987 round, and those for the second semester (January-June 1987) are obtained from the July 1987 round. The statistics for cropyear 1987 (July 1986-June 1987) are derived simply by combining the estimates for the two semesters. (The two other rounds are intended mainly for forecasting purposes.)

Brief descriptions of the sampling procedures of all CLSs and RCSs are given in De Guzman (1987). A detailed discussion of the sampling and estimation procedures for the CLSs around the mid-1960s is found in David (1966). Changes in stratification, sampling rates and sampling schemes through the years can be found in various issues of the Bureau of Agricultural Economics' Interviewer's Manual.

Around 1985 a decision was made to begin producing town level statistics all over the country. Hence, the towns were completely enumerated in the RCSs; the barrios (barangays) in each town were stratified according to geographic location and/or cropping pattern and a simple random sample was drawn from each stratum; households in each sample barangay were classified into farm and nonfarm, and samples were drawn independently from each class using simple systematic sampling, with 1/15 and 1/20 rates, respectively. This procedure resulted in over 100,000 sample households nationwide. Such sample cannot possibly be processed in time twice a year. Thus, beginning 1987, the sample was reduced by one-half

4. Note that even if the same household is kept from one survey round to the next, the respondent(s) may be different persons. This could be a major source of response variance.

by listing the towns in increasing order of their rice yields (based on the latest available information) and choosing every other town in the list, thereby reducing the sample by one-half. For more details, the interested reader may see the UPSCRF report (March 1988).

B. *Estimation Procedure*

We now describe the estimation procedure for corn statistics using the 1987 sampling scheme as example. In what follows it is understood that the estimates are for individual semesters, although for simplicity of notation we sometimes use the superscript t to denote semesters or years interchangeably.

In a province, denote by $Y_{hijkl}^{(t/t)}$ the observation (e.g., production, area) from the l^{th} sample household of the k^{th} household type in the j^{th} sample barangay within the i^{th} stratum of the h^{th} sample town; the first superscript $(t/ .)$ pertains to the reference period (viz., first or second semester) and the second $(. /t)$ refers to the time of the interview (in this case at the end of the reference period). The *design estimator*[5] of the provincial total of Y is

$$\begin{aligned} \hat{Y}_D^{(t/t)} &= 2 \sum_h \sum_i (B_{hi}/b_{hi}) \sum_j \sum_k (F_{hijk}/f_{hijk}) \sum_l Y_{hijkl}^{(t/t)} \\ &= \sum_h \sum_i \sum_j \sum_k \sum_l W_{hijk} \; Y_{hijkl}^{(t/t)} \end{aligned} \qquad (1)$$

where h, i, j, k and l run through the sample towns, strata, barangays household type and sample households (farm and nonfarm), respectively, b_{hi}/B_{hi} is the sampling rate of barangays in the hi^{th} stratum, f_{hijk}/F_{hijk} is the sampling rate of households in the hij^{th} sample barangay of the k^{th} household category, and $W_{hijk} = 2B_{hi}F_{hijk}/b_{hi}f_{hijk}$ is the weight attached to the observations in the hij^{th} sample barangay. The factor 2 is to compensate for the 50 percent sampling rate of the towns.

The Bureau of Agricultural Economics stopped the use of design estimators like (1) for computing official statistics sometime in the sixties or late fifties. No one seems to recall now the exact year when a design estimate was last used: let us call that

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5. If $Y_{hijkl}^{(t/t)}$ were the true value of Y (which is, of course, a big IF), then eq. (1) will be unbiased for the total of Y; in this case eq. (1) is said to be ***design-unbiased.***

year $t=0$ and the estimate from (1) $\hat{Y}_D^{(0/0)}$. Using the household responses $\hat{Y}_{hijkl}^{(1/1)}$ in (1) would have given the design estimate

$$\hat{Y}_D^{(1/1)}$$

for the total of Y at time $t=1$. In addition, beginning with time $t=1$, the household responses

$$\hat{Y}_{hijkl}^{(0/1)} = \text{value of } Y \text{ for the corresponding period of the previous year}$$

were also obtained which, when used in (1), would have given

$$\hat{Y}_D^{(0/1)}$$

the design estimate for the total of the previous year's corresponding period (with the interview done during the current year).

Using the reasoning that the ratio

$$\hat{R}^{(0/1)} = \hat{Y}_D^{(1/1)} / \hat{Y}_D^{(0/1)}$$

estimates the change in the total of Y (for the same reference semester) from year 0 to year 1, the pseudo-ratio-type estimate

$$\hat{Y}_R^{(1)} = \hat{Y}_D^{(0/0)} \cdot \hat{R}^{(0/1)}$$

was used as *official* estimate for the first time in year $t=1$. Similarly for year $t=2$, the ratio $\hat{R}^{(1/2)} = \hat{Y}_D^{(2/2)} / \hat{Y}_D^{(1/2)}$ was computed and the value of

$$\hat{Y}_R^{(2)} = \hat{Y}_R^{(1)} \cdot \hat{R}^{(1/2)}$$
$$= \hat{Y}_D^{(0/0)} \left\{ \hat{R}^{(0/1)} \cdot \hat{R}^{(1/2)} \right\}$$

was used as official estimate.

Continuing the process, it can be seen that at time t, the official estimate of the total of Y takes the form

$$\hat{Y}_R^{(t)} = \hat{Y}_D^{(0/0)} \left\{ \hat{R}^{(0/1)} \cdot \hat{R}^{(1/2)} \cdots \hat{R}^{(t-1/t)} \right\} \quad (2)$$

The use of (2), instead of the design estimate $\hat{Y}^{(t/t)}$ in (1), continues as of this writing (1988). As mentioned earlier, (2) is used to compute semestral estimates in each province. Cropyear estimates are obtained by combining the two semestral estimates. Also, regional and country estimates of the total (e.g., production and area) are obtained simply by adding the relevant provincial estimates. Yields are obtained as ratios between total production and total area estimates.

In view of the complexity of (2), no estimates of its sampling variance have been computed or published. It is unlikely that there ever will be since the variance of a product of random variables is already formidable theoretically and computationally [see, e.g., (7)]; moreover, each term in the product inside the brackets is a ratio of random variables the mean square error of which is also numerically tractable only up to the first order of approximation; and then there are the covariances of the ratios to contend with.

The exact reasons for BAEcon's choice of $\hat{Y}_R^{(t)}$ over $\hat{Y}^{(t/t)}$ or some other stimator may never be known. However, such decision would not have been reached if only the computation of sampling errors for the estimates were made an important consideration.

A peculiar property of (2) is that, after so many years, the current estimate $\hat{Y}_R^{(t)}$ is still dependent on the design estimate in the base year, $\hat{Y}_D^{(0/0)}$. The risk here is that $\hat{Y}_R^{(t)}$ swims or sinks with $\hat{Y}_D^{(0/0)}$; if, for example, $t = 0$ was a particularly bad year, the official estimate several years after is still made to suffer the consequences of that bad year. Also, one wonders whether events of this type that are separated by 20 or so years[6] would in fact still be strongly correlated.

6. The 1988 UPSCRF report cited earlier mentions that the base year used in the estimation is 1985. In the case of corn, the base year is in fact definitely earlier than 1971, as the data in section III will show. Also, the report's presentation of the official estimator may be correct for rice but not for corn. To use our notation, the report's simplification of the estimator implies that the expression in brackets in (2) telescopes, i.e., it simplifies into

$$\hat{R}^{(0/1)} \cdot \hat{R}^{(1/2)} \cdot \hat{R}^{(2/3)} \cdots \hat{R}^{(t-1/t)}$$

$$= \frac{\hat{Y}_D^{(1/1)}}{\hat{Y}_D^{(0/1)}} \cdot \frac{\hat{Y}_D^{(2/2)}}{\hat{Y}_D^{(1/2)}} \cdot \frac{\hat{Y}_D^{(3/3)}}{\hat{Y}_D^{(2/3)}} \cdots \frac{\hat{Y}_D^{(t/t)}}{\hat{Y}_D^{(t-1/t)}}$$

$$= \frac{\hat{Y}_D^{(t/t)}}{\hat{Y}_D^{(0/1)}}$$

However, the last equality holds only if $\hat{Y}^{(t-1/t-1)} = \hat{Y}^{(t-1/t)}$ for every t, which is not the case because, although these estimates are for the same period, the responses from which they were computed came from interviews taken one year apart (the samples are not necessarily the same, etc.) (see section III-A).

III. COMPARISON OF OFFICIAL ESTIMATES AND DESIGN ESTIMATES

A. *How and Why May $\hat{Y}_R^{(t)}$ and $\hat{Y}_D^{(t/t)}$ Differ?*

From (2) the ratio between $\hat{Y}_R^{(t)}$ and $\hat{Y}_D^{(t/t)}$ can be expressed as

$$\frac{\hat{Y}_R^{(t)}}{\hat{Y}_D^{(t/t)}} = \frac{\hat{Y}_D^{(0/0)}}{\hat{Y}_D^{(0/1)}} \cdot \frac{\hat{Y}_D^{(1/1)}}{\hat{Y}_D^{(1/2)}} \cdots \frac{\hat{Y}_D^{(t-1/t-1)}}{\hat{Y}_D^{(t-1/t)}} \tag{3}$$

This ratio can differ from 1 for several reasons. The major one is recall bias. Every term on the right hand side of (3) is a ratio of estimates for the same reference period, except that the numerator is based on responses obtained at the end of the period while the denominator is computed from responses obtained one year later. If memory decay leads to more conservative answers or omissions during interview, then the tendency is for every ratio on the r.h.s. of (3) to exceed 1. This will mean that the official estimates $\hat{Y}_R^{(t)}$ will move away continuously from $\hat{Y}_D^{(t/t)}$ and that the former will be increasingly subject to a higher bias as t increases. (Indeed this seems to be the case as will be seen in the succeeding numerical comparisons.)

The ratio (3) will differ from 1 also when there is a change in sampling scheme (say at time t-1), in which case the design estimators $\hat{Y}_D^{(t-2/t-2)}$ and $\hat{Y}_D^{(t-2/t-1)}$ will have different forms; hence, they will give unequal values.

Changes in the sample will likewise cause $\hat{Y}_R^{(t)}$ to differ from $\hat{Y}_D^{(t/t)}$. This happens especially at the household level when a new list (frame) and different samples are drawn from each sample barangay. In fact, respondents can change even in the same sample households. However, since sampling errors associated with design estimates are essentially random, this source of variation should wash out or be negligible with large samples, e.g., with national estimates which are based on about 50,000 sample farm households.

B. *Numerical Comparisons: National Estimates*

The officially released estimates ($\hat{Y}_R^{(t)}$) of corn area and production for the country for 1961-86 and the corresponding design estimates ($\hat{Y}_D^{(t/t)}$) for 1971-86[7] are shown in Table 1. For a more vivid comparison, these are plotted in Figures 1 and 2. It is clear that the official estimates are consistently and inexorably rising further away from the design estimates: the 1986 official estimates of both area and production are 2.6 times higher than the design estimates! This is unnerving to say the least, considering that, aside from response bias of the basic data from which they are computed, the latter estimates should otherwise be design-unbiased.[8]

It is to be noted also that the design estimates of area have remained more or less stable at around 1.4 million hectares; on the other hand, the official estimates had grown at an average annual rate of 3 percent from 1961 to 1986 (also from 1971 to 1986), to 3.5 million hectares in 1986. Similarly, the design estimates of production increased from 20 million sacks in 1971 to 30 million sacks in 1986, or a 3.2 percent annual increase; on the other hand, the official estimates showed a 9 percent annual increase from 24 million sacks in 1961 to 78 million in 1986 (or a 6.3 percent annual increase from 1971 to 1986).

It is easy to see how – but not why – $\hat{Y}_R^{(t)}$ has continued to soar further away from $\hat{Y}_D^{(t/t)}$. The individual ratios on the r.h.s. of Eq. (3) have a tendency to be greater than one; that is $\hat{Y}_D^{(t-1/t)} < \hat{Y}_D^{(t-1/t-1)}$. Using national level estimates we computed the lagged design (LD) estimates $\hat{Y}_D^{(t-1/t)}$ for the years 1971-85 and compared these with the current design (D) estimates $\hat{Y}_D^{(t-1/t-1)}$ (see Table 2).[9] It is seen that during the 15-year period, the average value of the ratio

$$\hat{Y}_D^{(t-1/t-1)} / \hat{Y}_D^{(t-1/t)} = 1.02 \text{ for area}$$

$$= 1.03 \text{ for production.}$$

Thus, t years after continuous use of $\hat{Y}_R^{(t)}$ we could estimate that for production the ratio (3) will be $(1.03)^t$; that is, the official

7. The estimates prior to 1971 can no longer be retrieved or recomputed.

8. Until a few years back eq. (2) was also used to compute the official rice statistics. We have been informed that these have been discontinued recently in favor of design estimates. However, the UPSCRF report (1988) cited earlier mentions that the official estimates being released are still of the pseudo-ratio-type, except that the base year has been moved to 1985.

9. In practice, the official estimates $\hat{Y}_R^{(t)}$, hence, the D and LD estimates also, are computed at the provincial level, and aggregation is subsequently done at the regional and national levels. It is to be expected that provincial level values of eq. (3) will exhibit much wider variation than those in Table 2 (as we shall see later in subsection III-D); in fact the latter figures may be viewed as weighted averages of the provincial ratios, with weights relative to the size of corn area (production) in the province.

Figure 1
OFFICIAL AND DESIGN ESTIMATES
OF CORN PRODUCTION

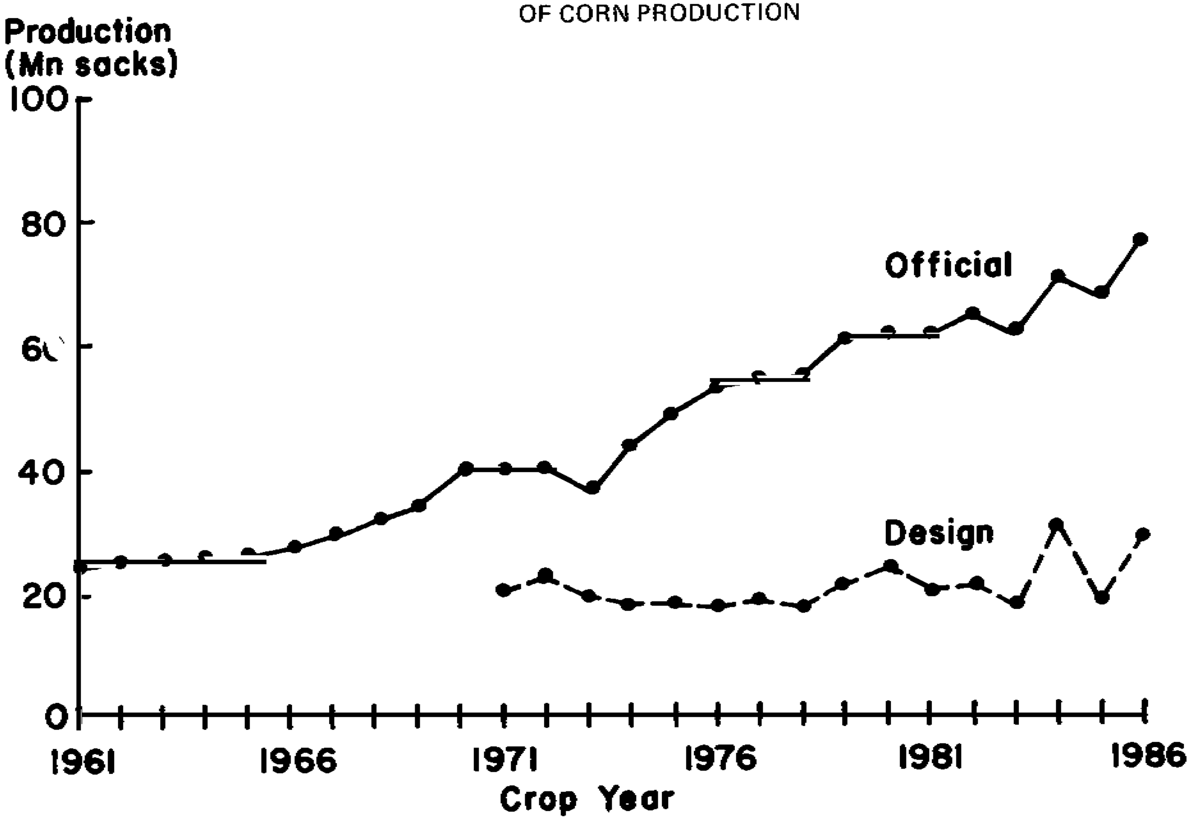


Figure 2
OFFICIAL AND DESIGN ESTIMATES
OF CORN AREA

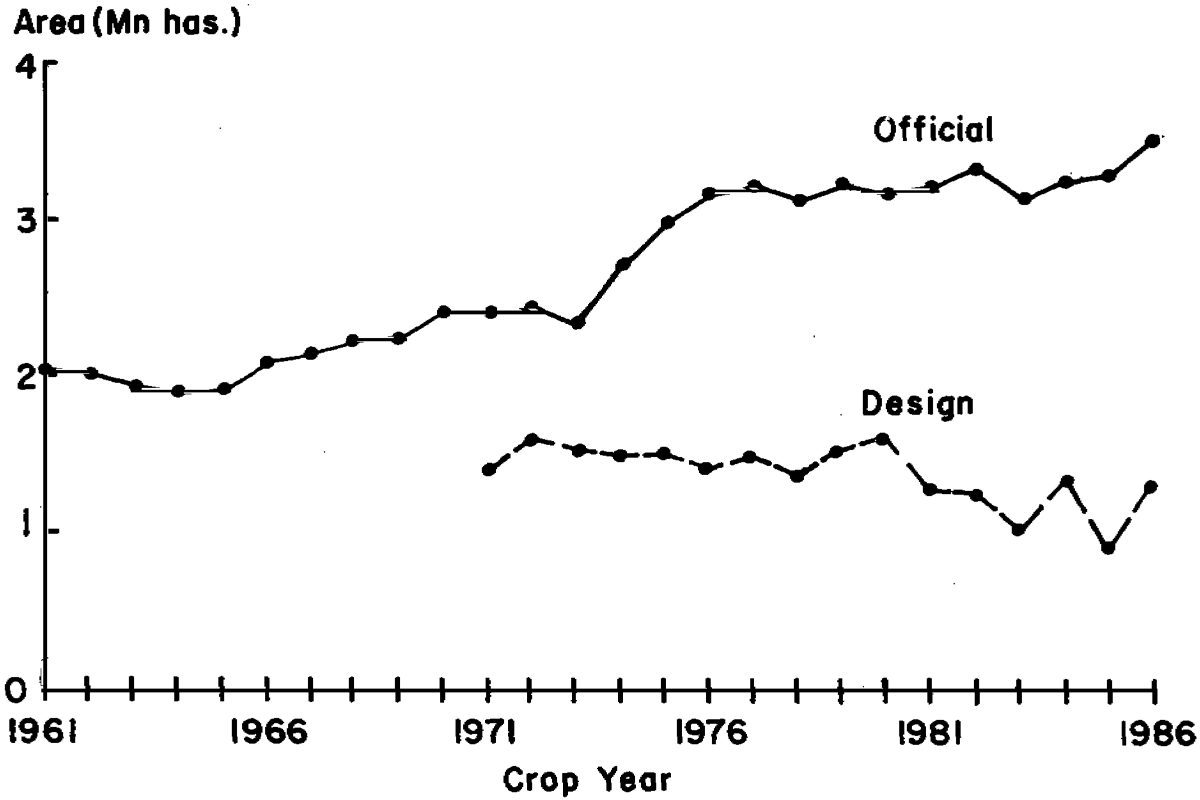


Table 1
RATIO-TYPE ($\hat{Y}_R^{(t)}$) AND DESIGN ($\hat{Y}_D^{(t/t)}$) ESTIMATES
OF CORN AREA AND PRODUCTION, PHILIPPINES

Crop Year	Area ('000 ha)			Production ('000 sacks of 50 kg.)		
	Ratio	Design	Ratio/Design	Ratio	Design	Ratio/Design
1961	2,045	. . .[a]	. . .	24,191	. . .	. . .
1962	2,016	. . .	. . .	25,325	. . .	. . .
1963	1,949	. . .	. . .	25,457	. . .	. . .
1964	1,898	. . .	. . .	25,854	. . .	. . .
1965	1,923	. . .	. . .	26,254	. . .	. . .
1966	2,106	. . .	. . .	27,597	. . .	. . .
1967	2,158	. . .	. . .	29,799	. . .	. . .
1968	2,248	. . .	. . .	32,383	. . .	. . .
1969	2,256	. . .	. . .	34,657	. . .	. . .
1970	2,420	. . .	. . .	40,164	. . .	. . .
1971	2,428	1,388	1.75	40,236	20,398	1.97
1972	2,454	1,615	1.52	40,484	22,877	1.77
1973	2,351	1,553	1.51	36,856	19,887	1.85
1974	2,726	1,513	1.80	45,151	18,693	2.42
1975	3,010	1,522	1.98	50,277	18,951	2.65
1976	3,193	1,437	2.22	54,346	18,187	2.99
1977	3,243	1,517	2.14	55,495	19,630	2.83
1978	3,158	1,383	2.28	55,922	18,396	3.04
1979	3,252	1,553	2.09	61,805	22,274	2.77
1980	3,201	1,646	1.94	62,456	24,895	2.51
1981	3,238	1,298	2.50	62,209	21,370	2.91
1982	3,360	1,284	2.62	65,804	22,007	2.99
1983	3,157	1,038	3.04	62,518	18,471	3.38
1984	3,270	1,377	2.37	71,868	31,772	2.26
1985	3,315	923	3.59	68,775	19,297	3.56
1986	3,545	1,376	2.58	78,440	30,150	2.60

[a]. . . denotes data not available.

estimates move upward away from the design estimates at the rate of 3 percent compounded annually.

Interestingly, $(1.03)^{32} = 2.58$, which was the observed ratio in 1986 (see Table 1). If a status quo in the estimation procedures were to be maintained until the year 2000, the official estimate by then would be 3.90 times the design estimate!

By sheer coincidence, the yields obtained from the official and design estimates which showed wide differences in the 1970s began to converge and were in close agreement by 1986 (see Table

Table 2
COMPARISON OF DESIGN AND LAGGED DESIGN ESTIMATES OF AREA AND PRODUCTION, PHILIPPINES, 1971-85

Year	Area ('000 ha)			Production ('000 sacks)		
	D[a]	LD[b]	D/LD	D	LD	D/LD
1971	1388	1390	0.9982	20398	20327	1.0035
1972	1615	1751	0.9227	22877	27036	0.8462
1973	1553	1376	1.1284	19887	16363	1.2154
1974	1513	1354	1.1174	18693	17228	1.0850
1975	1522	1456	1.0455	18951	18182	1.0423
1976	1437	1423	1.0099	18187	18117	1.0039
1977	1517	1537	0.9868	19630	19220	1.0213
1978	1383	1358	1.0182	18396	16844	1.0921
1979	1553	1579	0.9834	22274	21860	1.0189
1980	1646	1672	0.9846	24895	25828	0.9639
1981	1298	1270	1.0218	21370	20282	1.0537
1982	1284	1386	0.9265	22007	23585	0.9331
1983	1038	995	1.0431	18471	16465	1.1218
1984	1377	1364	1.0092	31772	35898	0.8850
1985	923	849	1.0867	19297	16439	1.1739
		Ave. =	1.0188		Ave. =	1.0307

[a]D = Design estimate $\hat{Y}_D^{(t-1/t)}$.
[b]LD = Lagged Design estimate $\hat{Y}_D^{(t-1/t)}$

3). Both estimates increased by about 2 percent annually to about 22 sacks per hectare in 1986.

C. *Regional Estimates*

The three regions, Southern and Central Mindanao and Central Visayas, accounted for more than half of the corn area in 1986. The first eight regions listed in Table 4 had over 90 percent of the total corn area.[10]

With two exceptions (Northern Mindanao and Western Visayas), the official estimates were likewise much bigger than the design estimates. In fact there were extreme deviations, as in Southern Tagalog where the official estimates were five times higher, and in

10. This information is useful in determining where to concentrate efforts to improve corn statistics; e.g., not in Bicol, Western Visayas, Ilocos and Central Luzon which account for less than 10 percent of corn area.

Table 3
CORN YIELD ESTIMATES, 1961-86
(Sacks of 50 Kg./Ha)

Year	Official or ratio	Design	Ratio/ Design
1961	11.8	...[a]	...
1962	12.5	...	...
1963	13.0	...	...
1964	13.6	...	...
1965	13.6	...	...
1966	13.1	...	...
1967	13.8	...	...
1968	14.4	...	...
1969	15.4	...	...
1970	16.6	...	...
1971	16.6	14.7	1.13
1972	16.5	14.2	1.16
1973	15.7	12.8	1.22
1974	16.6	12.4	1.34
1975	16.7	12.4	1.34
1976	17.0	12.7	1.34
1977	17.1	12.9	1.32
1978	17.7	13.3	1.33
1979	19.0	14.3	1.32
1980	19.5	15.1	1.29
1981	19.2	16.5	1.17
1982	19.6	17.1	1.14
1983	19.8	17.8	1.11
1984	22.0	23.1	0.95
1985	20.8	20.9	0.99
1986	22.1	21.9	1.01

[a] . . . denotes data not available.

Eastern Visayas where the official estimate of production was 12 times higher than the corresponding design estimate! The reasons for these gross differences should be investigated more closely.

D. *Provincial Estimates*

The 20 provinces in Table 5 account for three-fourths of corn area in 1986. Over one-half of the total corn area was concentrated in the seven provinces — Bukidnon, Cebu, Davao del Norte, Isabela, Maguindanao, and North and South Cotabato.

Table 4
COMPARISON OF PSEUDO-RATIO AND DESIGN ESTIMATES
BY REGION, 1986

	Area ('000 ha)			Production ('000 sacks)		
	Ratio	Design	Ratio/ Design	Ratio	Design	Ratio/ Design
S. Mindanao (11)	778	212	3.7	24,066	5,041	4.8
C. Mindanao (12)	570	250	2.3	18,015	8,352	2.1
C. Visayas (7)	520	150	3.5	4,873	1,600	3.0
Cagayan Valley (2)	331	128	2.6	7,497	3,574	2.1
W. Mindanao (9)	290	138	2.1	4,334	2,212	2.0
S. Tagalog (4)	250	49	5.1	4,846	988	4.9
N. Mindanao (10)	238	229	1.0	5,057	4,757	1.1
E. Visayas (8)	215	29	7.4	4,740	394	12.0
Bicol (5)	176	88	2.0	2,680	1,193	2.2
W. Visayas (6)	92	77	1.2	875	1,629	0.5
Ilocos (1)	75	20	3.7	1,291	306	4.2
C. Luzon (3)	10	5	2.0	167	103	1.6
Philippines[a]	3,545	1,376	2.6	78,440	30,150	2.6

[a]Regional totals may not add up to country totals due to rounding.

Along with a few cases of close agreement between official and design estimates, there are provinces in which differences are gross, e.g., Cebu (4.2x), Davao del Norte (6.4x), Isabela (3.9x), and South Cotabato (5.1x). There are also trends that defy simple explanation. For example, in Cebu, Davao del Norte, Isabela and South Cotabato the official estimates increased from 1980 to 1986, while the corresponding design estimates showed a decline; conversely, in Lanao del Sur, the official estimate was cut in half from 1980 to 1986, but the design estimate was almost doubled in magnitude. These discrepancies imply large variations (about 1) in the individual ratios on the right hand side of Eq. (3). To verify this, the ratios

$$\hat{Y}_D^{(t-1/t-1)} / \hat{Y}_D^{(t-1/t)} \quad (4)$$

were computed for each province and each semester during the period 1980 to the first semester of cropyear 1986. The frequency distributions of these ratios for area and production are shown in Table 6.

Table 5
COMPARISON OF AREA ESTIMATES OF TOP 20 CORN PRODUCING PROVINCES, SELECTED YEARS
('000 Hectares)

Province	Ratio estimates 1980	Ratio estimates 1983	Ratio estimates 1986	Design estimates 1980	Design estimates 1983	Design estimates 1986	Ratio/Design 1986
Agusan N.	20	23	19	29	24	20	0.9
Bukidnon	181	123	160	141	107	157	1.0
Cagayan	58	43	39	35	46	38	1.0
Camarines Sur	25	21	29	18	20	27	1.1
Cebu	328	305	349	150	59	83	4.2
Davao N.	151	159	170	40	30	27	6.4
Davao S.	32	28	33	88	53	42	0.8
Iloilo	22	20	25	32	12	20	1.3
Isabela	244	248	267	83	64	69	3.9
Lanao N.	45	36	64	28	8	44	1.5
Lanao S.	200	66	99	26	12	46	2.1
Maguindanao	64	146	153	38	43	59	2.6
Masbate	72	60	67	64	34	45	1.5
Negros Occ.	35	27	51	36	23	46	1.1
Negros Or.	128	124	133	68	40	49	2.7
N. Cotabato	126	201	224	60	51	79	2.8
S. Cotabato	473	473	485	155	96	94	5.1
Sultan Kudarat	2	17	30	19	9	22	1.4
Zamboanga N.	59	72	87	67	36	38	2.3
Zamboanga S.	119	137	139	80	84	76	1.8
Total (A)	2,384	2,329	2,623	1,257	851	1,081	2.4
Philippines (B)	3,201	3,157	3,545	1,646	1,038	1,376	2.6
A/B	0.74	0.74	0.74	0.76	0.82	0.79	–

Recall that, ideally, the above ratio should be 1. However, as Table 6 shows, the range of values is very wide, [0.048 – 51.833] for production and [0.062 – 7.423] for area. The means of these ratios are also substantially greater than 1. The value 1.404 signifies that the interview response to the question on production asked one year after is, on average, 71 percent only (i.e., the reciprocal of 1.404, in percent) of the response to the same question asked one year before; similarly, the lagged response to the question on area is 85 percent only of the response obtained one year earlier.

Table 6
FREQUENCY DISTRIBUTION OF PROVINCE-LEVEL RATIOS OF CURRENT TO LAGGED DESIGN ESTIMATES $\hat{Y}_D^{(t-1/t-1)}/\hat{Y}_D^{(t-1/t)}$, OF PRODUCTION AND AREA, 1980-86

Production		Area	
Interval	Frequency	Interval	Frequency
< 0.4524	37	< 0.2605	5
0.4525 – 0.8604	167	0.2606 – 0.4585	10
0.8605 – 1.2684	467	0.4586 – 0.6565	49
1.2685 – 1.6764	144	0.6566 – 0.8545	102
1.6765 – 2.0844	38	0.8546 – 1.0525	344
2.0845 – 2.4924	15	1.0526 – 1.2505	241
2.4925 – 2.9004	11	1.2506 – 1.4485	70
2.9005 – 3.3084	5	1.4486 – 1.6465	31
3.3085 – 3.7164	3	1.6466 – 1.8445	15
3.7165 – 4.1244	2	1.8446 – 2.0425	8
4.1245 – 4.5324	2	2.0426 – 2.2405	8
4.5325 – 4.9404	3	2.2406 – 2.4385	1
4.9405 – 5.3484	4	2.4386 – 2.6365	2
5.3485 – 5.7564	1	2.6366 – 2.8345	5
5.7565 – 6.1644	3	2.8346 – 3.0325	7
> 6.1644	1	> 3.0325	6
Total	914		914

Summary Statistics:

	Production	Area
Arith. Mean	– 1.404	– 1.170
Minimum	– 0.048	– 0.062
Maximum	– 51.833	– 11.167
Std. Dev.	– 2.568	– 0.890
Skewness	– 13.104	– 7.423

In turn, these findings imply that the ratio

$$\hat{R}^{(t-1/t)} = \hat{Y}_D^{(t/t)} \; / \; \hat{Y}_D^{(t-1/t)} \tag{5}$$

when used to measure the rate of increase in the total of Y from period $(t\text{-}1)$ to t, can lead to estimates that are significantly biased upwards. For obscure reasons, the magnitude of the bias varies widely across provinces. The bias is compounded further by the use of the product of these ratios in the official estimate $\hat{Y}_R^{(t)}$. This is what accounts for the large and still expanding differences between the official and design estimates shown in Table 5.

In retrospect, it is surprising that an investigation of the properties of the ratio (4), and hence of (5) as a measure of change, had not been done earlier. Such a study could have shown early in the game that the official estimates $\hat{Y}_R^{(t)}$ will inevitably lead to highly and positively biased estimates.

IV. WHICH ESTIMATES ARE CLOSER TO THE TRUTH?

A. *Introduction*

The question of which estimates are closer to the truth begs to be answered in view of the great discrepancy between the two sets of estimates. As in most real-world problems, the parameters will never be known. However, we can continuously strive to get closer to the truth, or at least take little steps towards it. What we propose to do here is to consider for purposes of comparison data which are independent of the RCSs, but which also contain information about the unknown parameters. Foremost among these are the agricultural censuses.

B. *Comparison With the Agriculture Censuses*[11] *Data*

1. *Country Estimates*

Table 7 presents the official, design and census estimates of corn area and production for the country and regions in 1971 and 1980. Consider the country figures:

	1971			1980		
	Official	**Design**	**Census**	**Official**	**Design**	**Census**
Area ('000 ha.)	2427.8	1387.6	2353.1	3119.0	1608.1	2466.9
Rel. Difference (%)	3	-41	0	30	-35	0
Prod. ('000 Sacks)	40236	20398	38528	61021	22706	56789
Rel. Difference (%)	4	-47	0	8	-60	0

11. These are sample censuses. All farm households with seven hectares or over were completely enumerated and a 20 percent sampling rate was used for those under seven hectares in the 1971 Agriculture Census. The cut-off area for the complete enumeration group was reduced to five hectares in the 1980 Census; however, only a 5 percent sample was taken from the small farm households group.

Table 7
COMPARISON OF RCS AND AGRICULTURE CENSUS DATA, 1971 AND 1980

Region	Area ('000 ha) Official (1)	Design (2)	Census (3)	(1) – (3)x100 / (3)	Production ('000 sacks) Official (5)	Design (6)	Census (7)	(5) – (7)x100 / (7)
				Year = 1971[a]				
I	47.5	54.8	20.8	129	430	417	332	30
II	240.3	74.2	123.5	94	4493	1230	2003	124
III	8.5	10.5	5.4	57	116	118	94	23
IV	172.4	43.9	71.2	14[e]	3290	609	1009	226[e]
V	99.4	101.8	131.7	–24	1414	604	1422	–1
VI	71.0	39.0	86.6	–18	909	356	986	–8
VII	354.8	208.9	270.8	31	3927	1715	3079	28
VIII	96.8	53.1	86.4	12	1667	799	1480	13
IX	190.0	120.7	224.9	–15	2756	1134	2582	7
X	337.5	253.2	345.0	–2	3780	6232	5438	–30
XI	388.8	213.6	484.0	–20	9234	2934	8774	5
XII	420.7	213.9	422.8	–1	8219	4250	11328	–27
NCR	0.0[c]	0.0	80.0	[e]	0	0	1	[e]
Total[d]	2427.8	1387.6	2353.1	3	40236	20398	38528	4
				Year = 1980[b]				
I	55.1	23.7	37.7	46	816	325	824	–1
II	283.1	103.1	134.1	112	3888	1278	2895	34
III	8.5	8.7	9.7	–12	112	82	283	–60

Table 7 (Continued)

Region	Area ('000 ha) Official (1)	Design (2)	Census (3)	(1) – (3)x100 / (3)	Production ('000 sacks) Official (5)	Design (6)	Census (7)	(5) – (7)x100 / (7)
IV	224.7	54.3	90.1	149[e]	5263	1094	1813	190[e]
V	179.3	89.5	113.8	58	2317	1251	1690	37
VI	71.4	60.3	95.2	–25	709	565	1303	–46
VII	473.3	204.6	369.6	28	4541	1560	6660	–32
VIII	187.0	24.0	64.4	190	3445	388	1273	171
IX	251.8	165.4	234.6	7	3439	2018	3998	–14
X	285.4	254.9	414.1	–31	4866	4369	9368	–48
XI	738.1	251.8	497.5	48	20172	4871	13466	50
XII	441.2	156.5	400.7	10	11451	3896	13006	–12
NCR	0.0	0.0	5.3	e	0	0	210	e
Total[d]	3199.0	1396.8	2466.9	30	61021	21696	56789	8

[a]Cropyear 1 July 1970 – 30 June 1971.
[b]Calendar year 1 January 1980 – 31 December 1980.
[c]0.0 denotes less than half of unit used, i.e., less than 500 hectares or sacks.
[d]Regional totals may not add up to national totals due to rounding.
[e]For computation of relative differences, the census data for the National Capital Region are added to the data for Region IV, where most of the former crops were expected to be physically located. This is just for completeness' sake, since the small magnitude of the NCR figures will only have marginal effects.

Sources: Bureau of Agricultural Economics and National Census and Statistics Office, Census of Agriculture 1971 and 1980.

The census figures are in-between the two estimates. They are much closer to the official estimates than to the design estimates. The 3 percent and 4 percent differences between the official and census estimates in 1971 are within reasonable random sampling error rates (assuming, say, a 2 percent coefficient of variation levels for both estimates). However, because of the tendency of the former to increase at a compounded rate, the observed differences in 1980 had climbed to 29 percent and 8 percent for area and production, respectively. These are no longer within acceptable levels. In all likelihood, the differences will increase further in 1990 if the same methods of data collection and estimation are used.

The situation is worse with the design estimates where, even at the national levels, the estimates of production were 47 percent and 60 percent lower than the census estimates in 1971 and 1980, respectively.

The method of data collection is the same for the censuses and RCSs, namely, by interview of a "knowledgeable" person in the household. The census reference period is one year and the RCSs' six months but with a recall period of one year also (in the case of the lagged estimates). Thus, one is tempted to assume that the basic data from both sources would be subject to more or less the same magnitude of measurement or response error; or to put it another way, the difference in the response errors is not enough to account for the gross discrepancy in the census and design estimates. Also, the Bureau of Agricultural Economics must have been strongly suspicious of the quality of the design estimates; otherwise it would not have replaced them with the pseudo-ratio estimates.

In the face of all this it appears certain that the design estimates are seriously biased downwards. Why? We suspect that the reason lies in the RCSs' sampling frames and the formulas used. Is it possible, for example, that the weights used in $\hat{Y}_D^{(t/t)}$ are negatively biased on account of deficient frames? This should be a subject of future investigations.

On the other hand, the (official) pseudo-ratio estimates may have been alright before, but it appears equally certain that the more current ones are seriously biased upwards. The main reason here is clearly that the estimator $\hat{Y}_R^{(t)}$ has a built-in propensity to increase at a compounded annual rate.

The need for better corn statistics cannot be exaggerated.[12] The

12. By inference the same applies to the other agricultural statistics, with the possible exception of those on rice. However, it is difficult to imagine – without further empirical studies on the current methods used and the quality of the data being put out for the other agricultural commodities – how anyone could come up with better strategies for producing more reliable statistics.

present data are simply not good enough either for short-term decision-making (e.g., import/export and pricing policies) or for medium- or long-term planning, not even at the national level. For example, consider the yield estimates (sacks per hectare):

Estimate	1971	1980	Annual Geometric Growth Rate
Official	16.6	19.2	1.6%
Design	14.7	14.1	–0.5%
Census	16.4	23.0	3.8%

It is clear that the design estimates have a problem: they are much smaller than the census values and they show a yield decline from 1971 to 1980 which is contrary to the commonly-held belief that technology change results in increased yields, which is certainly supported by both the official and census estimates. Likewise, the two other estimates could lead to different conclusions or policy implications. Starting at almost equal levels in 1971, the census figure was 20 percent higher than the official estimate in 1980. Thus, one could point to the 3.8 percent annual increase in the census yields to support the idea that past programs to improve corn yields had a positive significant impact, while others could cite the 1.6 percent growth rate exhibited by the official estimates to advance a different conclusion – namely that the same programs had a modest impact, if at all.

2. *Regional Estimates*

As early as 1971, there were already large differences between the official and census estimates (see Table 7). The differences (relative to the census) ranged from –24 percent to 129 percent for area and from –30 percent to 226 percent for production. The comparisons became worse in 1980. Moreover, the discrepancies were large even among the major corn producing regions, and more particularly in Regions II (Cagayan Valley), IV (Southern Tagalog) and VIII (Eastern Visayas).

Comparisons of official and census yields can be seen in Table 8. Again the discrepancies are significant. The estimates of annual growth rates between the census years are so different in many cases, making policy or plan formulation on their basis risky business. The yield growth rate in the largest corn producing area (Region XI – Southern Mindanao), for instance, was 1.4 according to the official estimates, and 4.6 based on the census values. The corresponding estimates in Region VII (Central Visayas) were –1.2 percent and 5.2 percent.

Table 8
OFFICIAL AND CENSUS YIELDS, 1971 AND 1980
(Sacks of 50 Kg. per Hectare)

Region	1971		1980		Annual growth rates (%)	
	Official	Census	Official	Census	Official	Census
I	9.1	16.0	14.1	21.8	5.0	3.5
II	18.7	16.2	20.4	21.6	1.0	3.2
III	13.6	17.4	16.7	29.1	2.3	5.9
IV	19.1	14.2	25.7	20.1	3.4	3.9
V	14.2	10.8	13.7	14.8	–0.4	3.6
VI	12.8	11.4	12.9	13.7	0.1	2.1
VII	11.1	11.4	10.0	18.0	–1.2	5.2
VIII	17.2	17.1	18.2	19.8	0.6	1.6
IX	14.5	11.5	15.0	17.0	0.4	4.4
X	11.2	15.8	13.6	22.6	2.2	4.1
XI	23.8	18.1	27.0	27.1	1.4	4.6
XII	19.5	26.8	21.7	32.5	1.2	2.2
NCR	...	...	...	...	...	...
Total	16.6	16.4	19.2	23.0	1.6	3.8

3. *Provincial Estimates*

The top 20 corn producing provinces are listed in Table 9 sequentially from the highest to lowest 1980 official estimates of corn production, along with comparisons of the official and census estimates of production, area and yield. The discrepancies look worse than those observed at the regional and national levels, as expected. In general, the relative differences are large and have no discernible pattern, e.g., there are positives and negatives. The latter predominate, but the magnitude of the former tends to be larger (in absolute values). It is particularly daunting to note that in the two top producing provinces, South and North Cotabato, the official estimates of production are 150+ percent higher than the 1980 census estimates[13]; also, the recent estimates have continued to

13. This debunks the idea that one possible explanation for the large errors in corn statistics is the fact that corn farms are more scarcely and unevenly distributed (compared to rice for example), and sampling distributions from such types of populations exhibit more variation. However, corn farms in these two provinces can hardly be considered scarce. Besides, all things considered, it is the sampling error of estimates, not nonsampling error or bias, that is affected when sampling rare and spatially distributed events.

Table 9
OFFICIAL AND CENSUS ESTIMATES OF CORN PRODUCTION, AREA, AND YIELD OF THE TOP 20 CORN PRODUCING PROVINCES, 1980 CALENDAR YEAR

Province	Production ('000 sacks)			Area ('000 ha)			Yield (sacks/ha)		
	Official	Census	Relative difference a/ (%)	Official	Census	Relative difference a/ (%)	Official	Census	Relative difference a/ (%)
South Cotabato (11)	15040	6006	150	464	207	124	32	29	12
North Cotabato (12)	6603	2583	156	152	104	46	44	25	75
Bukidnon (10)	3347	6289	–47	191	245	–22	18	26	–32
Davao del Norte (11)	3214	2304	40	164	95	72	20	24	–19
Cebu (7)	2714	3675	–26	319	199	61	9	18	–54
Isabela (2)	2600	1307	99	215	66	226	12	20	–39
Lanao del Sur (12)	2541	2035	25	173	65	165	15	31	–53
Zamboanga del Sur (9)	1953	2587	–25	136	157	–13	14	16	–13
Maguindanao (12)	1513	5002	–70	73	114	–35	21	44	–53
Negros Oriental (7)	1349	2527	–47	126	138	–9	11	18	–42
Zamboanga del Norte (9)	1107	1321	–16	63	73	–14	18	18	–3
Masbate (5)	943	860	10	83	69	20	11	13	–9
Cagayan (2)	873	906	–4	46	42	10	19	22	–13
Lanao del Norte (12)	712	1775	–60	41	73	–44	17	24	–28
Davao del Sur (11)	416	4068	–90	31	138	–78	13	29	–55
Negros Occidental (6)	400	806	–50	35	51	–31	12	16	–27
Camarines Sur (5)	269	433	–38	26	23	13	10	19	–45
Agusan del Norte (10)	244	332	–26	18	19	–5	14	17	–21
Iloilo (6)	177	275	–36	25	26	–4	7	11	–34
Sultan Kudarat (12)	83	1611	–95	2	45	–96	35	36	–2

[a](Official-Census)/Census x 100%.

climb, e.g., from 15.0 million and 6.6 million sacks in 1980 to 18.5 million and 8.5 million sacks in 1986 for South and North Cotabato, respectively.

Differences are particularly large in some other provinces, e.g., Isabela, Lanao del Sur, etc. There are also inconsistencies, as in Cebu where the official estimate of production is 26 percent lower and the estimate of area is 61 percent higher than the census estimates.

Figure 3 provides a visual display of the same data, in Table 9. If this were a simple linear regression problem, we could say that "the strength of the relationship is modest, with the abscissa accounting for no more than half of the variation in the ordinate." Compare this with the reality: both coordinates measure the same thing, and, aside from sampling variation, should have perfect correlation.

C. *Are the Sampling Frames Major Sources of Error?*

In the previous subsection we expressed the suspicion that the answer to the above question could be yes. Here we present some partial results in support of the contention, with the caveat, however, that a final answer will require a much more thorough investigation.

The top graph on Figure 4 compares the estimated number of farms from the 1971 and 1980 censuses, on the one hand, and from the RCSs, on the other hand. The latter are design estimates.[14] The census estimates are higher and appear to be increasing faster than the RCSs estimates. At least 0.5 million farms separated the two estimates around 1979-80, giving rise to a 15 percent difference. Further, the implied (geometric) annual growth rates from the census and RCSs figures were 4.3 percent and 2.7 percent, respectively.

The data shown in the bottom half of Figure 4 are not exactly comparable; the census data are estimates of farm area while the BAEcon estimates refer to cultivated area; hence, the former should really be higher. The reason for showing the data here is to raise the possibility that significant errors may not be limited to corn statistics, but that the problem may be in the RCSs frame and estimation procedures (and hence in all estimates obtained from the RCSs). How could it be possible for the number of farms and farm area to increase, but for cultivated area to decrease or be stagnant?

Part of the answer may be because the frames from which the weights [W_{hijk} in Eq. (1)]are obtained may be in error or are rendered

14. BAECON did not produce estimates of the number of farms on a regular basis. The estimates presented in Figure 4 are the only ones that seem to be most recently available.

Figure 3
COMPARISON OF PROVINCIAL OFFICIAL
AND CENSUS ESTIMATES, 1980

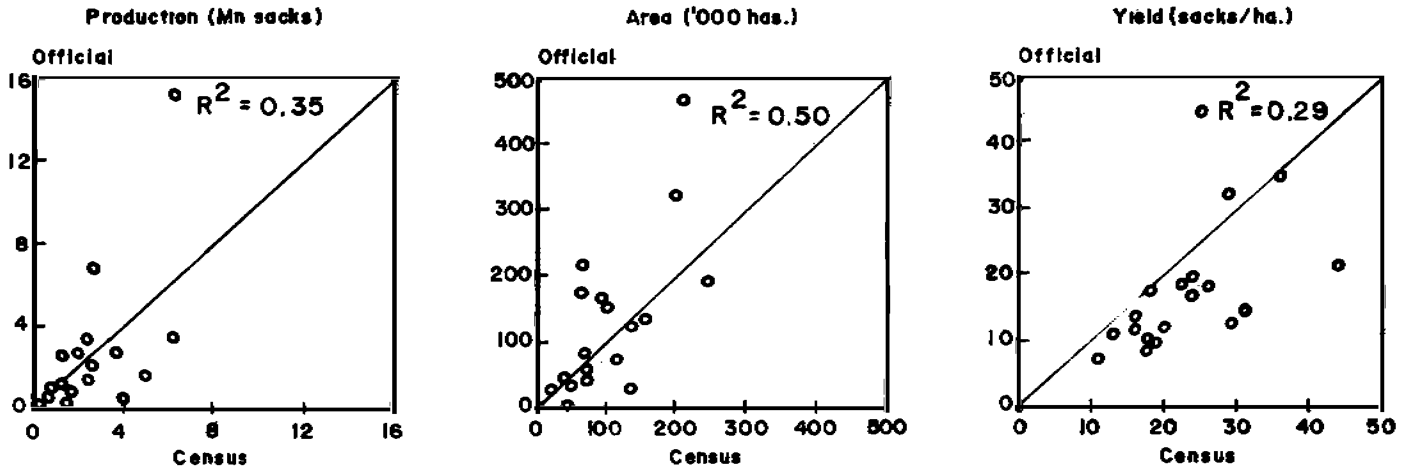
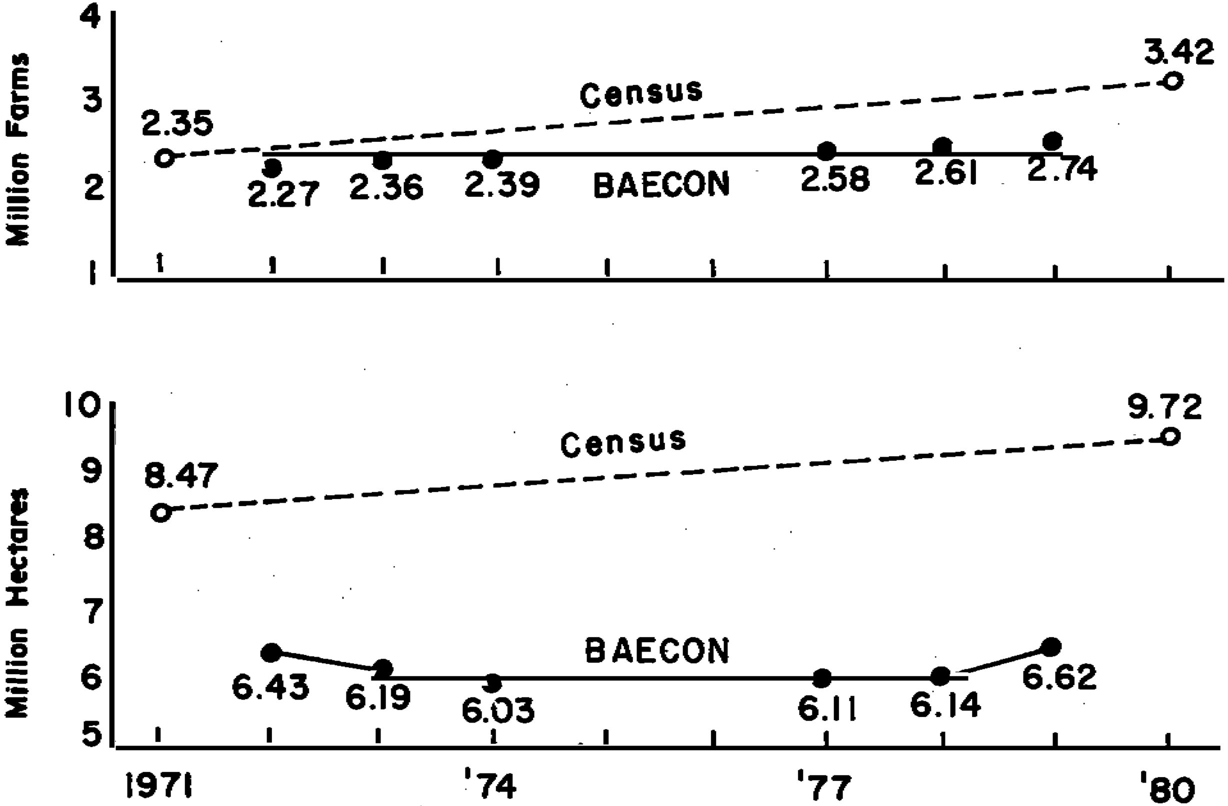


Figure 4
COMPARISON OF BAEcon AND CENSUS ESTIMATES
OF NUMBER OF FARMS AND CULTIVATED AREA, PHILIPPINES



obsolete by infrequent updating. During the 1970s the frame data for the barangays — number of households, livestock and poultry, farm area and crop areas — were obtained from the Barangay Screening Surveys (BSSs) done in 1971, 1974, 1976 and 1979. The respondents in these surveys were all the barangay captains; the weights W_{hijk} used in the estimation were based on their responses, specifically number of (farm) households. Occasionally, a *complete* listing of households in the RCSs *sample* barangays was done also, wherein the same data asked from the barangay captains were gathered from the individual households. These operations were called Household Screening Surveys (HSSs).

In an attempt to assess the barangay captains as sources of statistical information, the data from the BSSs and the HSSs may be compared by matching the totals of the barangays common to the two surveys. This was done in the 1976 data for some provinces in two regions; see David (1978). A table from that earlier paper showing the relative differences between the two sources is reproduced here as Table 10. Note that in Region I the BSSs data were all lower than the HSSs data for all households (farm + nonfarm), nonfarm households and farm households (excepting two instances in La Union Province and Pangasinan). This was not the case in Region III, where in some provinces the BSSs data were higher than the HSS data. It may be said that the differences between the sources, viz., barangay captains and households, can be very large; hence, the W_{hijk} can be seriously flawed and, at least in Region III, would tend to be underestimates.[15]

For its surveys in the 1980s, BAEcon decided to stop the use of BSSs and to replace these with HSSs nationwide. It took close to five years from 1980 to 1984 to complete the HSSs for all barangays, which means that their ages or reference dates differ among the provinces. The same data are still being used today; thus, in exchange for more reliable information, there is now the issue of obsolescence.

To see the effect of outdated frames, assume for simplicity a one-stage simple systematic sampling of the households. At time $t+k$, let the correct number of farm households in a province be $F_{t+k} = (1+c)^k F_t$ if F increases at a constant annual rate equal to c (see Figure 4). Simple systematic sampling will automatically result in the correct sample size f_{t+k} and sampling rate f_{t+k}/F_{t+k}. Suppose

15. In the case of stratification variables, e.g., rice and corn area, errors in the frame data will affect the efficiency of the stratification but not necessarily the (un) biasedness of the estimates. Here the more relevant gauge is not the absolute error in the data but the strength of the correlation between the frame data and the actual values; see David (1978).

Table 10

RELATIVE DIFFERENCES IN PERCENT: 100 x (BSS-HSS)/HSS, 1976

Variable	Region I: Province a/							Region III: Province		
	1	2	3	4	5	6	7	1	2	5
Rice + Corn Area	30	46	40	43	23	0	198	95	91	53
Other crops area	–4	154	33	1152	138	1199	420	164	243	430
All households	–17	–19	–41	–7	–18	–5	–5	–5	29	10
Non-farm households	–4	–45	–12	–3	–37	–2	–23	25	46	15
Farm households	–1	38	–26	–4	–3	12	8	–7	124	8
Carabaos	5	–11	65	24	22	5	39	–5	88	42
Cattle	42	30	110	3	–2	45	60	75	250	53
Hogs	23	–36	56	4	–13	4	43	7	30	16
Chicken	–20	–30	–6	7	–22	0	–16	–13	–90	–23
Ducks	16	170	40	104	549	234	7	97	–13	37

[a]Region I is Ilocos with provinces 1. Abra (n=58); 2. Benguet (n=32); 3. Mt. Province (n=53); 4. Ilocos Norte (n=60); 5. Ilocos Sur (n=143); 6. La Union (n=90); 7. Pangasinan (n=248); Region III is Central Luzon with provinces 1. Bataan (n=49); 2. Bulacan (n=63); 5. Tarlac (n=98).

the latest available value of F is F_t. Without adjustment, the estimate which will be used for the total is

$$\hat{Y}_D^{(t+k)} = (F_t / f_{t+k}) \sum_s y$$
$$= F_t \cdot \bar{y}$$

which is biased. The design-unbiased formula is[16]

$$\hat{Y}_{Du}^{(t+k)} = (F_{t+k}/f_{t+k}) \sum_s y$$
$$= F_{t+k} \cdot \bar{y} = (1 + C)^k F_t \cdot \bar{y}$$
$$= (1 + C)^k \hat{Y}_D^{(t+k)}$$

which shows that $\hat{Y}_D^{(t+k)}$ needs an adjustment by a factor of $(1+c)^k$, assuming c is known. Without such adjustment or updating of the frame, the bias gets compounded.

D. *Comparison with "Objective" Results*

There is only one case in recent memory in which somewhat different sampling strategies were tried on corn. This was a 1979-80 BAEcon pilot experiment in one province, Pangasinan, to construct an area sampling frame using satellite images, aerial photos and ground truth surveys (for details, see Besa 1980). A master sample was drawn from this frame in such a manner that the resulting weights for estimating totals are based on measured areas rather than household counts. However, the ultimate sampling unit was still a farm household in a sample segment, and the sample farm area and production were obtained by interview. Hence, the procedure cannot really be described as objective. A summary of the results is shown in Table 11. The experiment did not resolve anything, except that establishing an area sampling frame required more highly skilled manpower and money than the usual way of conducting the RCSs. For inexplicable reasons, the area sampling estimates of corn area and production were still very much lower than the design estimates, even though the latter themselves were already less than half the official estimates. The coefficients of variation of the area sampling estimates were also very high.

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16. That is, assuming away biases due to measurement errors and the fact that F_{t+k} may not be an exact multiple of $ft+k$.

Table 11
COMPARISON OF DESIGN (D), PSEUDO-RATIO (R) AND AREA SAMPLING (AS) ESTIMATES, PANGASINAN PROVINCE, 1980[a]

Item	July-Dec. 1979			Jan.-June 1980			Cropyear 1980		
	D	R	AS	D	R	AS	D	R	AS
Area ('000 ha.)	4.4	4.4	0.4	7.9	27.2	4.4	12.3	31.6	4.8
CV (%)	36.0	...[b]	20.0	22.0	...	71.0	...	...	...
Prod. ('000 sacks)	40.0	53.1	3.6	97.4	410.4	54.6	137.4	463.5	58.2
CV (%)	27.0	...	34.0	22.0	...	68.0	...	...	...

[a]Source: David C. Besa, "Remote Sensing for Agriculture in the Philippines," BAEcon, 1980.
[b]. . . denotes data not available.

V. MAJOR FINDINGS AND RECOMMENDATIONS

The Philippines' official estimates of corn area and production are upward adjustments of design estimates obtained from the Rice and Corn Surveys. The same adjustment formula, a chain-ratio-type estimator, has been in use since the 1960s. The adjustment may have been a good idea up to the early 1970s, since the design estimates were seriously biased downwards. However, the chain-ratio-type estimator has a built-in bias to continuously produce higher estimates, so much so that recent estimates are seriously biased upwards. By 1986, the 3.5 million-hectare official estimate of corn area was already 2.6 times higher than the 1.4 million-hectare design estimate; and the official estimate of production of 78 million sacks was also 2.6 times higher than the design estimate of 30 million sacks. The truth is most likely somewhere in-between. In 1971 the census estimates were closer to the official estimates than were the design estimates. However, by 1980 the official estimates had increased much further away from the census estimates.

Although the design estimates are biased, their growth rates may be indicative of the real trends; thus, corn area remained stable at around 1.4 million hectares while production grew at a 3.2 percent annual rate from 1971 to 1986. On the other hand, the official estimates showed annual growth rates of 3.1 percent and 6.3 percent, respectively, during the same period. By arithmetical accident both series ended up with the same yield of about 22 sacks per hectare in 1986.

The comparisons at the regional and provincial levels showed worse results as expected, thus casting serious doubt on the usefulness of official estimates.

The study answered a few questions, but in the process it raised many more.

Why are the design estimates so badly biased? We conjectured here that one reason is the defective or obsolete frames which gave rise to erroneous weights in the estimator. One of the easiest things to do is criticize; however, one cannot lay the blame on BAEcon if, in the first place, it was not given the wherewithal to construct and maintain up-to-date frames. In this particular case, the fault lies in the "system." One raison d'être for censuses is to have frames. In the 1970s BAEcon had to resort to Barangay Screening Surveys (BSSs) because the basic data from the 1971 Census of Agriculture and Fisheries (which was done by the then National Census and Statistics Office) were not made available to it. Similarly, BAEcon had to do the Household Screening Surveys (HSSs) in 1980-84 at considerable taxpayers' expense, in spite of the 1980 CAF which, of course, was funded by the same taxpaying public. Hopefully, the story would be different with the 1991 CAF.

Another possible reason for the bias in the design estimates is interview response errors. There is very little empirical evidence to support or refute this hypothesis. Within the government statistical system there has not been any support for sustained research on data quality; development, testing and comparison of alternative data collection methods; and the like. This kind of work was not only intellectually more demanding; it also required people to deal with real situations, including the handling of basic data and occasional field work. Beyond the obvious need for field operations to collect basic data, we think it would be fair to say that in the allocation of resources the system gave more priority to desk activities and problems that can be resolved by committees, such as the preparation of statistical frameworks, plans and programs.

Of course, outside the system, which is mainly in the universities, survey sampling research was meager and more academically oriented.

Consequently, in the absence of new knowledge, we find — at least in agricultural surveys — that data collection is still being done in the same way it was done 25-30 years ago. Through all these years changes have been by way of changing the names of surveys, tinkering with the sampling design, and mostly increasing the sample sizes — in the case of the RCSs to a stupendous 100,000 households! While countries around us have continued experimenting with and eventually used on a large scale more objective methods of data collection such as crop-cutting, the system gave up after a few small-scale trials and has relied exclusively on the interview method. It is not because we have found the latter better or more cost-effective. The truth is we know very little more now than we did one generation ago.

There is an urgent need for research to look into the quality of basic data obtained from face-to-face interview and into the reasons why such method seems to evince underestimates (at least in the case of corn area and production). Likewise, there is a pressing need for action-cum-research toward developing alternative survey sampling strategies for agricultural statistics.

Why has the use of the adjusted official estimates continued for such a long time? BAEcon already suspected at least as early as 10 years ago that the estimates it was releasing were overestimates and were becoming even more so. Its problems were what to substitute for the flawed estimation method; how to break to the public the news that they were being fed inaccurate statistics; and the uncertainties about the aftermath of such an admission, including the ripple effects of drastically revised corn statistics series on the rest of the data system, as well as their implications on some government projects, e.g., *Masaganang Maisan.*

It appears, however, that the rest of the statistical system has not been aware that there is a problem with the corn series. If this were so, then the mechanisms for coordination and monitoring of the system which relied heavily on inter-agency committees (IACs) and technical committees (TCs) were inadequate.[17] In retrospect, this was to be expected, for what was required was not coordination and monitoring, but critical evaluation of the actual output of the system. This type of work needs to be backstopped by research. Committees which meet only at certain intervals are not suited for the task.

The present system still depends fairly heavily on the IACs and TCs. Upon scanning the Report of the Special Committee to Review the Philippine Statistical System (1986) and Executive Order 121 that arose from it, we find no specific reference to mechanisms for evaluating the outputs of the different bodies of the system. We recommend that this oversight be rectified.

How may the system proceed to replace the present method of estimating corn area, production and yield with a new, more credible procedure? How, if need be, may the series be revised,

17. In this particular case, those involved were the IAC on Agriculture, Fishery and Forestry Statistics and the TC on Survey Designs.

starting from the 1960s or 1970s? We do not see any easy quick fix. Still, the pseudo-ratio-type of estimation procedure has to go at the soonest possible time. One may start by examining closely the actual weights used in the design estimates and exploring a way to adjust them towards current, more realistic values. To reiterate, a research agenda for investigating the quality of data collection and of the various measurement problems inherent in agriculture should be prepared, and the statistical system should try its very best to find funding for it. For example, in Luzon where much of the corn is harvested green, why does the system insist on measuring production and yield in sacks of 50 kg. of grains at 14 percent moisture instead of reporting two separate estimates, one for green and another for mature corn? In farms where corn is one of several choices for a second crop, it is not planted on a predetermined parcel; instead, the decision whether or not to plant corn and how much depends on a number of factors such as what and how much seed(s) is available, and what proportion of the farm (after the rice crop) has become dry enough for corn. In these situations, what kind of area data does one get from the interview when the enumerator is instructed not to leave any blank space on the questionnaire? When were conversion factors from local units to standard units of measure last revised? The list of research topics can go on and on.

The revision of the series from the 1960s or even the 1970s is made difficult by the possibility that the basic data may no longer be available. This is not surprising considering that all these years BAEcon or BAS never had a home, but had to make do with with cramped, rented space. Its data base management capability and archiving, through no fault of its own, are also antiquated.

Our classroom training on statistical errors does not prepare us adequately for an encounter with the magnitudes of errors such as those we have seen here. The experience drove home the enormity of the gap between statistical theory and statistical practice in the Philippines. Moreover, since corn data are considered second best (after rice), the results of this study do not speak well of the quality of the other agricultural statistics. Indeed, there could be more jolting surprises. We recommend, therefore, as a first step in a program to improve agricultural statistics, that similar evaluations be conducted on the series for the other agricultural commodities, perhaps including fishery and forestry. The task can be made more comprehensive by including relevant data from all likely sources, e.g., nutrition surveys, controlled experiments, satellite images and aerial photogrammetries, and experiences in neighboring countries.

We repeat that this is a job that cannot be entrusted to a committee.

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