FIELD EXPERIENCE IN ESTIMATING POPULATION GROWTH

Patience Lauriat, Demographic Statistics Advisor
to the Government of Thailand (Bangkok),
U.S. Bureau of the Census*

INTRODUCTION

First, let me define the "universe", if you will, to which the following discussion relates. As a primary limitation, it should be pointed out that the surveys described here are designed to estimate growth rates -- not absolute numbers. The validity of attempting the latter by use of sample surveys has long been debated, but today the emphasis appears to have shifted to concern for making reliable estimates of rates of growth which would then, in turn, be used to develop more reliable estimates of total numbers. Obviously, for the countries with well-developed and accurate vital registration systems, the use of surveys to estimate growth rates is hardly necessary. But, in the developing countries, where so much of the recent work has been done, the point of departure for economists and others concerned with developmental planning is the growth of the population relative to growth in investment, national income, GNP, agricultural production, etc. And, generally speaking, reliable estimates of population growth are not available.

There is a long history of the use of sample surveys to obtain estimates of births and deaths, the major components of population growth for most countries under current immigration and emigration restrictions. However, very frequently the results have been rather poor, partly because the surveys were designed to measure several characteristics, of which fertility and mortality were only two, and partly because special precautions were not taken to assure accurate reporting of births and deaths, particularly prone to under-enumeration.

In an effort to avoid some of the pitfalls of previous studies, there is evolving what appears to be a promising technique whereby data on births and deaths are collected by two separate systems and individual events are compared to determine whether 1) the event was recorded in both systems or 2) recorded in only one. The end result of this matching operation is to obtain more reliable data than those obtained by one system alone. I shall not belabor the theoretical considerations behind this approach[1], as the concern here is to discuss field experience. But I should like to confine the following discussion to experience with the growth estimation studies which utilize creation and matching of two independent lists of events. This second limitation of the "universe" to be discussed is not to imply that other recent studies do not have a great deal of merit and have made some interesting methodological contributions to our growing body of knowledge.[2] Rather, it is dictated by the practical exigencies of time and the personal experience of the author.

There are currently three countries engaged in nationwide, continuing, single-purpose surveys designed to provide reliable estimates of growth rates by matching events recorded in a survey with those recorded in a registration system. They are: Pakistan, Thailand, and Turkey.

The alphabetical sequence of these three countries also reflects the historical progression of the surveys. Pakistan initiated its Population Growth Estimation Study (PGE) in 1962, Thailand its Survey of Population Change (SPC) in July 1964, and Turkey its Demographic Survey (TDS) in the spring of 1965. There are various documents relating to these surveys available[3] but, as yet, none has published a printed report. It is the experience of these three studies which the following discussion draws upon -- and most especially that of Thailand, with which the author is most familiar.

EXPERIENCE IN OBTAINING INDEPENDENT LISTS OF VITAL EVENTS

Survey and sample design

The three surveys are markedly similar in their basic design: all are single-purpose; all are continuing; all are nationwide; all use a fixed, area sample. The principal features of the surveys under discussion are set forth in Chart 1.

Sample size varies, of course, dependent on the level of detail to be obtained. The original Pakistan sample, consisting of 24 areas of about 5,000 people each, was designed to provide estimates for East and West Pakistan separately and for the nation as a whole. There is now some feeling that the sample may be sufficient to produce such rates, but is too small and inadequate to provide additional information useful for interpreting the birth and death rates obtained. A second phase of PGE, starting in April 1966, will experiment with different sizes of sample areas but will not attempt to obtain provincial and national estimates of growth rates.[4]

The Turkey survey started out with the largest sample of the three studies, and even after major cut-backs in the number of sample areas, due to methodological improvements, it remains the largest of the three samples. Since the Turkish study is designed 1) to provide annual estimates for five regions and three cities separately and 2) to measure the effects of the recently insituted Turkish Family Planning Program and rural health improvement program, a large sample is indicated. Originally, there were to be 150 urban and 150 rural sampling units in each of five survey regions and 150 urban units in each of the three largest cities. Because the first results indicated unanticipated response errors, the original enumeration, registration, reconciliation, and verification procedures were drastically overhauled and strengthened, at the expense of sample size. Instead of 150 sampling

units in each of the urban and rural parts of the regions and cities, there are to be only 60 in each. Even so, the nationwide sample, when completely enumerated by the spring of 1967, will include about 500,000 population, or about 1.5 percent of the total population.

The Thai survey is not so ambitious. Since, from its inception, one of its secondary aims was to secure a measure of the degree of under-registration of the official system, we decided to select, basically, a two-stage sample of villages, the smallest geographic area identified on the official registration records at the local level. In the first stage, amphurs, or districts, were chosen with probability proportional to population. Within the selected districts, villages were chosen with equal probability, using a constant, over-all sampling rate of 1 in 150. For the municipal areas falling in the sample, blocks were delineated in supplementary field work and were selected using the same sampling ratio as for villages. For practical considerations, Bangkok and environs were excluded from the universe from which the sample was selected but we hope to use official registration records for those areas (where we believe registration is more complete) to adjust our survey data so that it will relate to the whole Kingdom.

The original survey sample in Thailand contained 331 villages and blocks in 60 districts. Nine sample villages in a remote province on the Burmese border had to be abandoned because of inaccessibility. Another three villages were inundated when a dam in the northeast region was completed. At the present time there are about 172,000 people in 29,000 households in the 319 sample areas -- 305 villages in rural areas and 14 blocks in municipal areas.

Our original intent in the Thai SPC was to do some experimental work with the relative merits of different types of sampling units.[5] We planned to depend primarily on a fixed sample of areas, enumerating and recording changes occurring to usual residents of those areas. In addition, we had hoped to work with a fixed sample of persons, recording changes regardless of where they maintained their usual residence. We thought such an experimental undertaking feasible because, from the available data, internal migration in Thailand appeared to be low. With a fixed sample of persons we hoped to eliminate biases arising from the association of vital events with change in usual residence. To this end we initially recorded the name and address of a nearby relative or friend who would know the address of destination if a sample household should move. After two intensive, unsuccessful attempts to obtain sufficiently detailed addresses of either individuals or households which had moved, we had to abandon the idea of a fixed sample of persons and limit ourselves to an area sample only. However, our tabulation plans will distinguish between events to full-time and part-time residents in an attempt to provide some information on the nature of the interrelation between change of residence and vital events.

The three surveys have the same basic approach: periodic enumeration of the sample areas coupled with maintenance of registers of births and deaths. In all three studies, the enumeration is conducted by persons with no responsibility for the registration work, in an attempt to preserve some degree of independence. However, the three surveys differ in intervals between enumerations, in recall periods, in overlap to pick up events possibly missed in a previous round, in defining the population within the purvue of the study, and in how the registers are obtained.

In Turkey, under the new design, a complete enumeration is carried out every six months relating to events over the last year and permanent, resident (local) registrars conduct complete monthly canvasses to record all changes in household composition due to births, deaths, and migration. The Pakistan study provides for quarterly enumerations with a reference period of a year and full-time, resident (local) registrars to obtain lists of births and deaths which occur in the same areas on a de facto basis. The PGE registrars obtain these lists through periodic visits to knowledgeable persons, such as midwives and village officials, as well as visits to about every 10th dwelling in their areas.

In Thailand, quarterly enumerations are carried out relating to the period since the last interview (usually about three months) and recording all changes in household composition. Every six months, vital events recorded in the official registration system are copied at the district offices. However, since late registration does not appear to be a major problem -- in other words, if a person registers an event at all, it is usually done within the required 15 days for births and 24 hours for deaths -- and a "special" matching round has successfully taken place for events recorded in Round 7 only, we are seriously considering copying registration records and matching with survey events every three months. Such a procedure has the decided advantage of permitting the field follow-up of registered-but-unsurveyed cases to be carried out more promptly than when copying and matching take place only once every two rounds of enumeration.

One element of the Thai SPC design deserves special note. From the inception of the study, its planners were greatly concerned about the effect of continual, quarterly enumerations on registration in sample areas. In order to get an accurate measure of under-registration, we felt it was vital to obtain some measure of the possible "conditioning effect" which the interview program might have on registration. That is, would the fact that an enumerator came around every three months asking questions about changes in household composition stimulate the sample population to become more aware of such changes and, therefore, incline them to register their births and deaths more often than if the interview program were not undertaken? In order to measure this possible source of bias, we drew a control sample of villages at the same time that we selected the original 331 sample areas to be enumerated quarterly, using the same sample selection factor. No interview work was done in the control sample areas, but our intention was to compare the registration totals for the control sample areas with those for the survey sample

areas. If there were significant differences between the counts of events for the two sets of areas, the estimates of under-registration would have to be adjusted accordingly. Preliminary data from the first such comparison we have made, relating to the first survey year, indicate that no bias has been introduced by the interview program through "conditioning" the survey population to register their vital events more frequently than the population in non-interview areas.

It may also be of interest to mention one other feature of the Thailand SPC before getting into enumeration problems as such. We included questions, to be asked each round, as to whether 1) any woman in the household were known to be pregnant, and, if so, the number of months, and 2) any persons were known to be seriously ill and the nature of their illness. These inquiries were designed to ensure reporting of all births and deaths, a positive answer requiring the enumerator to make appropriate additional checks in subsequent rounds. Only about 70 percent of the births reported in the survey during the first year occurred to women having been previously reported as pregnant, and most of them had been reported pregnant only in the interview immediately preceding birth. The results for deaths during the first survey year were even lower -- only 4 percent of the persons who died had been previously reported as seriously ill. Further information is needed before we can determine that these questions do enable enumerators to report births and deaths they might otherwise have missed.

Enumeration problems

The troublesome areas with which the growth surveys in Pakistan, Thailand, and Turkey have had to contend are not necessarily unique to them. Probably, in large part, the enumeration difficulties and weaknesses are those facing any study carried out in a developing country where physical accessibility, means of communications, organizational structure, and control procedures are lacking.

One of the most basic problems is that of identifying the enumeration units. In Pakistan one of the essential duties of the PGE interviewers is to assign a house number to each dwelling in the sample areas. Such a procedure, in and of itself, is not a startling survey technique, but when you read the enumerator's instruction manual and find that "some 50 spare placards of galvinized iron sheet, black paint, two brushes, hammer and nails" are part of the enumerator's everyday work equipment -- well, one would usually concede, that is a little startling! As in some other eastern countries, there is no house-numbering scheme in Pakistan and so, in order to assure that the correct sample areas were identified and enumerated, the first job was to nail house numbers above the front door.

In Thailand, on the other hand, dwellings are assigned numbers by local administrative officials, but this system has its hazards too. Very frequently there is no particular order to the assigned numbers and quite constant renumbering goes on. Or, one often observes duplicate, and even triplicate, numbers because the remnants of several numbering systems are still in existence and used by the inhabitants.

For all three growth surveys, the basic enumeration schedule is simple and straightforward. After the usual identification items, it consists of a list of household members, with their relationship to the head, sex, age, and marital status. The Turkish Survey includes questions on age at first marriage and education. The PGE instrument has questions on caste and occupation. In the SPC we are asking no questions about characteristics beyond the basic demographic ones.

All three surveys maintain simultaneous sets of records in the field, for use in continuing interview and registration systems, and in the central processing office, to provide input for periodic hand and machine tabulations. All survey materials are generated manually up to the punch cards used as tabulation input. Obviously, as soon as a survey becomes dependent on several manual operations, sources of error are increased at each level. In the Thai SPC, for example, by 100 percent verification of all clerical operations and various checks and controls built into the survey operations, we feel we keep such manual errors down to a minimum. Even if an error goes undetected in verification, the system is circular enough that we will probably detect it in a subsequent processing step.

The most impressive feature of the three growth surveys underway is the elaborate system of controls which each has had to develop and without which none would enjoy whatever success it does. We all must admit that searching for a birth -- let alone a death -- in any population, regardless of size, has many elements of looking for a needle in a hay-stack! To ensure that all events are found and that found events are true occurrences taxes the leadership and imagination of all the technicians involved in the current growth studies. Shortly after we initiated our Thai SPC, we attended a seminar in Karachi to exchange experiences with PGE technicians firsthand. All of us from Thailand were very impressed with the elaborate procedures which had been developed there to ensure reliable data -- and promptly returned to Bangkok to establish our own!

When we started the SPC in July 1964, we hired nine temporary supervisors (graduates, usually in the liberal arts, of one of the local universities in Bangkok) and 60 part-time, temporary enumerators (usually 8th grade graduates referred by local government officials). Because of the lure of permanent appointments in other government agencies and because of the hardships involved in being in travel status outside Bangkok for extended periods, the turn-over rate of the supervisors became a very serious problem. By the end of the first year, only one of the original nine was still working on the SPC and we had had to hire an additional nine to keep the positions filled. The turn-over rate among the enumerators was also high -- about two-thirds were replaced during the first year.

An official administrative reorganization of the National Statistical Office of Thailand was put into effect coincidental to the 7th round of SPC enumeration (January through March 1966).

Provision was made for the establishment of 69 Provincial Statistical Offices, within the framework of the already-extant 12 Regional Offices. Each of the Provincial Offices is staffed by three or four full-time, permanent government employees (one or two supervisors and two or three enumerators) and is responsible for all the survey and census field work undertaken by the National Statistical Office in the province. The SPC supervisors and enumerators whom we wished to retain were given permanent positions in the Provincial Offices. The net effect on the SPC field staff of this organizational realignment was to increase the number of supervisors to 41 (the number of provinces in which the sample districts are located) and retain 59 enumerators, one for each district. Although these permanent supervisors and enumerators now work on more than just the SPC, this does not decrease the total time devoted to SPC field work because previously it was carried out every twelve weeks for six weeks of full-time work.

Apart from the enhanced prestige attendant on permanent civil service appointments for enumerators, morale was further increased by establishment of a far more realistic pay structure. Up until that time, enumerators had received a basic wage of $1.00 per day, including costs of transportation, lodging, and meals. Under the reorganization their basic wage was supplemented with per diem and transportation costs, bringing the total to $1.75 or $2.00 per day. Similar provisions were made for reimbursing supervisors for costs connected with carrying out official business.

The impact of these two reforms -- 1) a greatly increased ratio of supervisors to enumerators (from 9 to 59 to 41 to 59) and 2) sufficient remuneration so that our survey workers were not "out of pocket" in order to do their jobs properly -- was immediate and dramatic. Table 1 presents the number of events reported in each quarterly canvass for the first seven rounds of enumeration. It should be noted that whereas there were about 1,500 births and 400 deaths reported in each round for the second through the fifth, the numbers of events increased to 1,670 births and 511 deaths in Round 6 and, for births, increased even more sharply in Round 7 -- to 2,078. The Round 6 increases may be partially explained by the fact that for that round, we were able to employ an additional six supervisors, thus increasing the original 9 to 15, since it had become apparent within the first year of the survey that we had seriously overestimated the number of enumerators that could be effectively handled by one supervisor. After many discussions with supervisors and enumerators alike, we have concluded that the high numbers of events in Round 7 are the direct result of tightened supervisory controls and adequate payment for services rendered. Where previously the enumerator did not re-canvass every village in every round, and there was not sufficient time for our short-handed supervisors to visit every enumerator sometime in the course of each enumeration round, we now have an adequate number of supervisors to assure that the enumerators do go to all sample villages and, once there, do find more events, as well as increased numbers of in- and out-migrants. If the momentum seemingly set in motion in Round 7 continues to yield higher levels of events than were recorded in the first six rounds, careful analysis of the data obtained in the first rounds will have to be undertaken before any firm conclusions can be drawn regarding growth rates.

As a last point in this discussion of enumeration problems, mention should be made of one of the basic concerns of a demographer -- the de jure vs. de facto approach. In the three surveys under discussion, only the Pakistan PGE has taken the de facto approach; the Thailand SPC and the Turkish TDS utilize the de jure approach. Each has its own particular problems. Mauldin, in discussing the Pakistan PGE, outlined the salient difficulties and concluded that it is quite feasible to obtain vital events on both a de facto and a de jure basis.[6] This is the approach which, with modification, has been taken in the Thai SPC. However, it too has its pitfalls.

The de jure approach assumes that the concept of "usual residence" has a functional meaning to the respondent. In Thailand, this may or may not be a realistic assumption. The law provides for the maintenance of a Household Register and all population movement between households theoretically is to be reported to the proper local authorities. Furthermore, there is a system of individual Identification Cards, based on proper recordation in the Household Register. But there appears to be a good deal of shifting from one village to another that does not necessarily get recorded in the Household Registers and which, to the mover, is not necessarily a permanent, real "move".

As a consequence, SPC established an elaborate series of conditions to determine who was a usual resident of a sample household vs. those persons remaining there only temporarily. The latter were defined as visitors but, if found to be still there after six months, were redefined as usual residents. In the reverse case, persons reported as usual residents who were not present at the time of subsequent interviews were, after three rounds, deleted from the resident population if they had been absent for more than six months and working elsewhere, even if reported as intending to return. (Absent residents reported as studying elsewhere were retained as household members, regardless of length of absence.)

We have not attempted to compare our lists of household members with the Household Registers for our sample households. Nor have we conducted any intensive interviews to test the real meaning of "usual resident" and determine whether or not a respondent tends to answer in terms of persons registered as residing in the household or in terms of persons actually living there. It might be instructive if we did, but the comparisons we have made between SPC counts of households and counts reported by village headmen indicate that probably the net effect on the population-at-risk of an event would be neglibible. In a tropical country where living arrangements are fairly casual, basic food, shelter and clothing needs minimal, the extended-family system prevalent, and a very distinct seasonal work-pattern established by the major agricultural crop (rice),

"usual residence" may be an academic nicety that does not adequately reflect reality.

The number of events reported as occurring to visitors is very small, and we are not planning to include them in our calculations of rates. Similarly, although we record the comings and goings of visitors in and out of the sample villages, they are excluded from our tabulations of the population-at-risk. Rather, our main concerns are coverage of events to residents, which may occur away from the place of usual residence or in households which move out before the next interview.

Registration problems

The second major piece of field work which the three population growth estimation studies under consideration carry out involves development of independent lists of events reported by a registration system. The Pakistan and Turkey study designs include the establishment of carefully controlled and executed registration systems for the sample areas covered by the studies. In Thailand, official registration records are utilized.

Regardless of the source of the registration records, the key issue here is the independence of the registration system from the enumeration phase. Hashmi has outlined the procedures incorporated into the Pakistan PGE to assure that collusion between enumerator and registrar was avoided or kept to a minimum:

> "Attempts were made to maintain the independence of the two systems in the experiment. Registrars were not allowed to keep the records of births and deaths for more than a couple of months. On the other hand, enumerators were collecting births and deaths which had occurred during the past twelve months. This minimized the scope of copying. The primary focus of the cross-sectional survey was to collect data on population size, household composition, age, marital status, occupation, caste and pregnancy. Obtaining information on births and deaths was at the tail-end of the schedule used and was a small part of the total survey. Since enumerators had to visit each dwelling to obtain most of the information, they would not turn to the registrars to copy a small bit of information on births and deaths. On the basis of our matching experience, and on-the-spot checks, we feel that there was little collaboration between registrars and enumerators."[7]

Seltzer and Hashmi, in evaluating the PGE mortality data, upon which Provincial Pakistan life tables for 1962 were based, raise the really critical issue of bias introduced because enumerated events will more likely be registered, and vice versa:

> ". . . Lack of independence can arise either because the enumerator and registrar overtly collaborated in the preparation of their reports or because the same types of deaths are likely to be omitted by both systems. Because of the possibility of overt collaboration, steps were taken from the very beginning of PGE to ensure that the work of the registrar and enumerator was as dissimilar as possible. . . .Lack of independence of the two systems due to other (non-intentional) sources remains to be properly evaluated."[8]

The Turkish experience in obtaining registration lists may be of particular interest. Whereas the original study design called for continuous registration in only a fifth of the sample areas and a comparison of distributions based on enumeration and sub-sample registration results, the revised procedure includes monthly enumerations in all sample areas by permanent, resident registrars and a case-by-case comparison with events recorded in the semi-annual, census-survey conducted by independent enumerators. Fisek, et al., include a recital of the findings which prompted them to make this radical change in their survey design:

> ". . . Shortly after the initial enumerations were begun, it became apparent that the number of enumerated vital events was short of expectations. For example, in one of the first series of rural enumerations, the Crude Birth Rate was reported as 45 per 1000 persons. The Crude Death Rate was 11 per 1000 and the Infant Mortality Rate was 122 per 1000 live births. Because of the questionable magnitude of these rates, particularly the mortality experience, a small enumeration was held in several sampling units in the same region in which vital registrars were previously established. When the registrars' records and the enumerators' reports were subsequently reconciled and verified, it was found that the Crude Birth Rate was nearer 46 per 1000, the Crude Death Rate 18 per 1000 and the Infant Mortality Rate 140 per 1000."[9]

While Pakistan and Turkey face the problems of assuring complete coverage within their specially-designed registration systems, Thailand's SPC takes a somewhat different approach. Since one of the secondary aims of the study is to measure the extent of under-registration of births and deaths in the official system, it was decided to use official registration records as the independent registration list, to be matched to events reported in the quarterly surveys. This approach was partly dictated by the difficulties of maintaining adequate controls over resident registrars in 319 areas spread throughout the Kingdom and by the fact that a direct measure of under-registration was needed before serious consideration could be given to improving the established registration system.[10]

This procedure of using official vital registration records is probably the greatest weakness of the Thai SPC, now that enumeration has been significantly improved. The clerks sent to the local district administrative offices have experienced great difficulties in finding the registration books for the communes in which the sample villages are located. In all district offices, maintenance of vital registration records

is only one of many functions, and is often relegated to the end of the priority list of tasks to be accomplished by an inadequate staff, and may even be put on a "voluntary over-time" basis. Receipt of the registration books from the communes, where the registration actually takes place, is usually sporadic and there are no controls over the receipt (i.e., by date and/or certificate number, etc.) nor any attempt made, in most district offices, for proper filing of books received and awaiting posting in the combined volume for the district.

Earlier this year (April to May), we conducted a special study in one-half of the sample villages regarding knowledge about, attitudes toward, and practice of (a "KAP" study) birth and death registration. The events covered were those occurring during calendar year 1965. Without indicating to the special study enumerator whether or not the office records showed an event to be registered, a direct question was asked of the respondent as to whether or not the event had been registered. If the respondent indicated that it had been, the enumerator asked to see the certificate and, in cases where it was available, recorded the number and date of registration. It came as something of a shock to find, from a special hand tally of cases we had originally classified as unregistered, that only 12 percent of the births and 7 percent of the deaths were admitted by respondents to be unregistered! And, for those reported as registered, 61 percent of the respondents produced birth certificates and 26 percent produced death certificates. In examining the reasons given by respondents who said the death had been registered but who did not have a certificate available, many indicated they had had to give it to the temple where the body is buried before its final cremation. Therefore, the proportion of deaths actually registered among those reporting them as registered is, in all probability, higher than the 26 percent indicated above.

As a consequence of this unexpected finding of our special "KAP" study of registration, we are instituting several measures, as of the current round of copying, in order to obtain more complete registration records. We are soliciting the cooperation of the Ministry of Interior, which has the direct responsibility for vital registration, to ask the appropriate officials in the 59 districts covered by the sample to keep the records for the communes which contain our sample villages separate and in good order. We are instructing the copying clerks to check serial numbers and dates from the end of one book to the beginning of the next for a commune. These and other measures, which we are still in process of developing, should, we hope, go far to strengthen what has now appeared as a bisic weakness in our survey procedures.

Matching experience

It would hardly be fair to leave a discussion of the experience of these population growth estimation studies without at least a brief discussion of there experience with matching the two independent lists of events so arduously and painstakingly obtained. And, since the nonmatches require some form of field reconciliation, such discussion seems within the purview of this paper.

To paraphrase Stein's immortal words -- "A match is a match is a match"! Were the problem so easy of definition, a great many of the headaches inherent in the current growth estimation studies would be eliminated. Mauldin has succinctly stated the basic considerations which any matching scheme must take into account:

> "Problems of matching are very difficult. There is no adequately developed theory for determining what is a 'match', and procedures developed to date in matching studies are not fully objective. If the matching criteria are too rigid (exacting), an event which has been picked up by both the registrar and by the survey will sometimes be counted as two events because the entries about this event differ slightly. If, however, matching criteria are too loose, different events may be considered as the same event. In general, if matching criteria are too rigid, one gets an inflated estimate of the total number of events, and if the criteria for matching are too loose, one gets an underestimate of the number of events."[11]

Since the Turkish TDS has only recently been redesigned, details of its matching definition and operations were not available to the author at the time of this writing. So the following discussion is necessarily limited to the Pakistan and Thailand experience.

The Pakistan PGE faces a rather unique problem in that new-born babies are not given names until they are some months old. Ergo, a simple name match for births is impossible. Rather, an elaborate codification of parents' names, as well as infants' where available, is done manually; cards with coded names and other requisite information punched; and machine listings of events arranged in sequence by name of mother, name of father, name of infant, date of birth, place of birth, and sex of the child obtained. All "apparent matches" (from three different sequential listings) are verified manually. All "possible matches" are divided, on the basis of manual inspection, into three types: 1) matches, 2) doubtful matches, and 3) nonmatches. Doubtful matches are referred to the field for additional follow-up by "third-party" enumerators.

As Seltzer and Hashmi have stated:

> ". . . While the matching procedure is subject to rigorous controls, including a reinvestigation in the field of many of the non-matching reports, errors do, of course, occur. They may be broadly classified into two types: false matches and false nonmatches. . . . No information is available to measure the relative frequency or the absolute effect of either type of matching error."[12]

In the Thailand SPC, the basis for matching is rather more straight-forward because it is, essentially, a manual match based on name of birth or death, names of parents and age of mother in the case of births, sex of birth or death, place

of occurrence of the event, and place of residence of the parents or the deceased. Using the address given in the lists of registered events for each sample area, the clerks search the list of household members for the specified house number. If the house number cannot be found in the survey records, other households with heads having the same last name are identified from the house-listing sheets and residents of those households searched. If the name of the event, the names of the parents, or the registration address cannot be found, the case is classified as "non-surveyed - (preliminary)" and remanded to the field for follow-up. After all events on the registration lists have been processed, the sample area is searched for events reported in the survey but not included on the registration lists. On the assumption that all cases found in the quarterly surveys represent "true" cases, no field follow-up of surveyed-but-unregistered cases has been undertaken to date. In light of some of the enumeration and registration problems discussed above, we are planning to follow-up at least a sub-sample of some of these cases to determine that they are, in fact, cases within the defined scope of the survey.

Table 2 presents data available from the Pakistan, Thailand, and Turkish studies. Detailed comparisons between the three studies may not be indicated because of incomparabilities between the data, but some salient points should be noted:

1) In all three studies, the match rate for deaths is significantly less than for births, although the differences in the rates for births and deaths for both wings of Pakistan are much smaller than those for Thailand or Turkey. A lower match rate for deaths is probably indicative of the same factors that make reliable measurements of mortality difficult -- that death is a disruptive factor in the "life" of a household or reporting unit and is an unpleasant event which respondents may be reluctant to report. Also, in areas of high infant mortality, where deaths under one year of age account for large proportions of all deaths, non-reporting of infant deaths may be more frequent than in areas of low mortality.

2) As one might expect on methodological grounds, the original Thai SPC survey events are a consistently higher proportion of total events than the registered events. However, when the original numbers of unregistered events shown in Table 2 are adjusted to reflect the proportions of respondents in the special study who had registration certificates (60 and 30 percent, respectively, of the "unregistered" births and deaths investigated), the birth coverage of the survey is only slightly better than that of the official registration.

For deaths, on the other hand, based on either the original or adjusted figures, the survey includes a consistently higher proportion of events than registration -- up to 91 percent for the period July to December 1965. In Pakistan, on the other hand, the registration system appears to yield higher proportions of events than the survey. Apart from the fact that the Thai SPC is tied-in to the official registration records, it should also be remembered that the Pakistan survey, although conducted quarterly, has a recall period of one year, and only the fourth quarter survey results for 1962 were used to obtain the matching data shown in Table 2. The SPC conducts quarterly surveys, but the reference period is "since the last interview" (an average of about three months).[13]

3) The Turkish data shown in Table 2 are included to illustrate the kinds of "growing pains" to which all these current population growth estimation studies are subject. It was exactly on the basis of the figures in Table 2 that the major changes described above were made in the Turkish TDS design:

> "The results of this matching study /in 15 sampling units/, demonstrate that both the enumerators and registrars were individually missing vital events. Over 90% of enumerator errors were caused by under-reporting on the part of the respondents. Registrar errors were largely due to the mistaken conviction, on the part of the registrar, that they were thoroughly familiar with all the events that occurred in their village. . . . In addition /to a monthly canvass by registrars in all sampling units/, a semi-annual census-survey, with an overlapping recall period, will be conducted by central staff supervisors. Reconciliation and field verification of vital events reported on each form will be performed by an independent set of supervisors."[14]

As a final note on the actual field experience which we have been accumulating with these population growth estimation studies, I would like to draw your attention to Table 3. Lacking comparable data from the other studies, it presents only Thailand SPC data on the results of the field checks which were made of all registered-but-unsurveyed cases identified in the first three rounds of matching operations, covering events occurring between October 1964 and December 1965. In the case of Matching Round 1, the field follow-up was done between 3 and 9 months after occurrence of the event; for Matching Rounds 2 and 3, each of which covered six months of events, field follow-up was carried out 3 to 12 months after occurrence.

The improvement in the basic survey enumeration is indicated by the fact that only 52 percent of the births checked in Matching Round 3 should have been recorded by the survey and only 47 percent of the deaths in the same round. Although some may feel these proportions to be too high, they represent a distinct improvement over the proportions missed in Matching Round 2, when the enumeration (Rounds 3 and 4) obviously deteriorated -- 60 percent of the births and 56 percent of the deaths sent out for reconciliation in the field had not been properly recorded in the survey enumeration.

It is interesting to note the source of these errors. In the case of births, the major cause of missed events was due to enumerator failure to record the event itself -- 65 percent of the error in Matching Round 1, 77 percent and 83 percent in Matching Round 2 and 3, respectively. For deaths, on the other hand, although missed

events were a major source of error, comprising 43 percent, 68 percent, and 65 percent, respectively, in the three Matching Rounds under discussion, the comparative contribution of events occurring to missed population was somewhat greater than amongst the births investigated.

CONCLUSION

This paper has attempted to describe some aspects of implementing the population growth estimation studies now being carried out in Pakistan, Thailand, and Turkey. The fact that the fore-going discussion is largely discursive, and not predominantly a detailed and sophisticated demographic and/or statistical analysis, is perhaps indicative of the state of development of these growth studies. They are currently in the position of "becoming". We are still improvising and revising procedures designed to refine and improve the results we are getting. The preliminary results are under constant scrutiny in an effort to identify and correct yet other weaknesses in procedures and methodology. Intensive analysis of the final results, now conspicuously absent, will be required to assure ourselves that the answers we obtain are valid and reliable.

The application of sample survey techniques to measure population growth is the extension of tested procedures to a new subject area. It has its own particular set of hazards. But, because the work under discussion here is being carried out in yet-to-be-developed countries, these growth studies must also contend with problems and issues, such as communications and trained personnel, that do not occur to as great an extent in developed countries. The burden of proving these studies to be reliable lies heavy and taxes all the resources and intelligence being devoted to them. The challenge is there and, with time, it appears that it will be met.

That we are on solid methodological ground is borne out by the three studies discussed above. We are demonstrating that sampling techniques can be applied to obtain accurate estimates of growth rates, that two independently derived lists of vital events do provide more reliable data than one system alone, that these techniques can be successfully applied in countries where vital registration is grossly inaccurate, or nonexistent. That the implementation process poses difficulties has been the burden of this discussion.

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*The opinions expressed in this paper are those of the author and do not necessarily represent those of the organization of which she is an employee, nor of the National Statistical Office of Thailand, with which she has been closely associated for over two years. The author is indebted to several of her Thai and American colleagues for their cooperation in providing information presented here and for their helpful criticisms of this presentation. However, she accepts full responsibility for the data and interpretations expressed herein.

[1] See Chandrasekaran, C. and Deming, W.E., "On a Method for Estimating Birth and Death Rates and the Extent of Registration," Journal of the American Statistical Association, Vol. 44, No. 245, March 1949, pp. 101-115 and Coale, A.J., "The Design of an Experimental Procedure for Obtaining Accurate Vital Statistics," Proceedings of the International Population Conference, New York, 1961, Vol. II, pp. 372-375.

[2] See Cantrelle, P., "Repeated Demographic Observation in a Rural Area in Senegal: Method and First Results," paper presented to the World Population Conference, Belgrade, 1965, Doc. No. B.6/V/F/207; Majumdar, M., "Estimation of Vital Rates in the Indian National Sample Survey," paper presented to the World Population Conference, Belgrade, 1965, Doc. No. B.6/I/E/312; Sabagh, G. and Scott, C., "An Evaluation of the Use of Retrospective Questionnaires for Obtaining Vital Data: The Experience of the Moroccan Multi-Purpose Sample Survey of 1961-63," paper presented to the World Population Conference, Belgrade, 1965, Doc. No. B.6/V/E/56; United Nations, Guanabara: Demographic Pilot Survey (Population Studies No. 35), New York, 1964; -----, The Mysore Population Study (Population Studies No. 34), New York, 1961; and Vukovich, G., "The U. A. R. Project for Measuring Vital Rates in Rural Areas," paper presented to the World Population Conference, Belgrade, 1965, Doc. No. B.6/I/E/68.

[3] Pakistan: Ahmed, N. and Krotki, K.J., "Simultaneous Estimations of Population Growth: The Pakistan Experiment," The Pakistan Development Review, Vol. III, No. 1, Spring 1963, pp. 37-65; -----, "Second Report on the Population Growth Estimation Experiment," paper presented to the Asian Population Conference, New Delhi, 1963; Hashmi, S.S., "Estimating Vital Rates in Developing Countries with Special Reference to Pakistan," paper prepared for the Regional Cooperative Development Seminar on Family Planning, Karchi, 1966.

Thailand: Lauriat, P. and Chintakananda, A., "Technique to Measure Population Growth: Survey of Population Change in Thailand," paper presented to the World Population Conference, Belgrade, 1965, Doc. No. B.6/V/E/507; National Statistical Office, Office of the Prime Minister, Government of Thailand, "Survey of Population Change: Study Outline," July 1964 (mimeographed).

Turkey: Fisek, N.H., Heperkan, Y. and Rumford, J., "The Role of the Turkish Demographic Survey in the Family Planning and Rural Health Programs," July 1965 (offset); -----, "The Evolution of the Turkish Demographic Survey," (unpublished manuscript).

[4] Hashmi, op cit., pp. 15-16.

[5] National Statistical Office, op cit., pp. 7-8.

[6] Mauldin, W.P., "Estimating Rates of Population Growth," paper presented to the International Conference on Family Planning Programs, Geneva, 1965, p. 15.

[7] Hashmi, op cit., p. 14.

[8] Seltzer, W. and Hashmi, S.S., "A Note on the Limitations of Population Growth Estimation Data Used for Life Table Construction," (Appendix A in Aslam, N. and Hashmi, S.S., "Abridged Life Tables of Pakistan and Provinces by Sex, 1962," Research Report No. 48), Pakistan Institute of Development Economics), March 1966 (mimeographed), pp. 30-31.

[9] Fisek, et al., The Evolution . . ., p. 2.

[10]*Lauriat and Chintakananda, op cit., p. 4.*

[11]*Mauldin, op cit., p. 14.*

[12]*Seltzer and Hashmi, op cit., p. 30.*

[13]*Discussion of estimating the numbers of events missed by both systems was deliberately excluded here on the basis that this presentation is confined to actual field experiences with growth estimation studies. The exclusion is not meant to imply that such an estimate is not an important element in any of these studies. On the contrary, it is an area of vital concern and it is to be hoped that final data from the studies under discussion here will yield new insights into methods of reliable estimation (see Chandrasekaran and Deming, op cit.).*

[14]*Rumford, J., "Progress Report, Month of October 1965," (Memorandum to M.J. Lieberman), November 3, 1965 (typed), pp. 1-2.*

Chart I - Principal Features of Surveys to Measure Population Growth in Pakistan, Thailand and Turkey

Item	Country		
	Pakistan	Thailand	Turkey
1. Name of survey.....	Population Growth Estimation Experiment (PGE).	Survey of Population Change (SPC).	Turkish Demographic Survey (TDS).
2. Start of enumeration.....	January 1962.	July 1964.	September 1965.[1]
3. Separate estimates for--.....	East and West Pakistan.	Whole Kingdom only.	Urban and rural for 5 regions, 3 largest cities.
4. Approximate sample size (number of persons).....	120,000	170,000	450,000
5. Sample design.....	24 compact sample areas, averaging 5,000 population.	60 districts, subsample averaging 5 to 6 whole villages per district.	30 districts, 2 whole villages per district in rural part of each region; 60 blocks in urban part of each region; 120 blocks in total for 3 largest cities.
6. Type of registration system used.....	Local survey registrars make "rounds" continuously to identify and record vital events.	Official birth and death registration.	Local survey "registrars" visit all households monthly.
7. Frequency and reference period of survey enumeration..	Quarterly, covers all events in preceding 12 months (overlap).	Quarterly, covers all events since previous enumeration.	Semi-annual, covers all events in preceding 12 months.[2]
8. In-scope events.....	Events occurring in sample areas.	Events for residents of sample areas.	Events for residents of sample areas.
9. Frequency of matching and reconciliation.....	Annual	Semi-annual[3]	Semi-annual

[1]Start of enumeration in Regions I and II. Other regions and cities are being introduced on a staggered schedule. Full coverage of Turkey scheduled for May 1967.

[2]First semi-annual enumeration in Regions I and II covered only the preceding 6 months.

[3]First and fourth matching rounds covered events for a single quarter.

TABLE 1 -- Sample Counts, Survey of Population Change (Thailand): Enumeration Rounds 1 to 7[1]

Item	Round 1 (July-Sept. 1964)	Round 2 (Oct.-Dec. 1964)	Round 3 (Jan.-Mar. 1965)	Round 4 (Apr.-June 1965)	Round 5 (July-Sept. 1965)	Round 6 (Oct.-Dec. 1965)	Round 7 (Jan.-Mar. 1966)
Beginning population.....	-	169,458	171,460	172,036	171,148	172,219	173,789
Changes:							
Births.....		1,460	1,579	1,539	1,487	1,670	2,078
In-migrants.....		3,072	2,382	3,692	2,775	2,896	5,546
Deaths.....		423	360	367	398	511	524
Out-migrants.....		2,107	3,025	[3]5,752	3,244	3,253	5,513
Other[2].....					+451	+768	+1,814
Ending population.....	169,458	171,460	172,036	171,148	172,219	173,789	177,190

[1]Usual residents only.

[2]Other includes persons missed in previous rounds as well as a small number of visitors reclassified as usual residents when they remained in the sample household for more than six months.

[3]Includes all persons in three villages inundated by a new dam.

Source: SPC Office Records.

TABLE 2 -- Events by match status: Pakistan, Thailand, and Turkish Growth Estimation Studies

Class of Event	Pakistan - 1962[1]		Thailand - Specified rounds[2]						Turkey - Pretests, 1965[3]	
	East	West	Oct.-Dec. 1964		Jan.-June 1965		July-Dec. 1965		10 villages 3 blocks	2 villages
			Original	Adjusted	Original	Adjusted	Original	Adjusted		
BIRTHS										
Total	2,469	2,140	1,732	1,732	3,704	3,704	3,385	3,385	316	42
Matched	1,678	1,306	1,045	1,307	2,330	2,901	2,111	2,743	232	22
Not Surveyed	394	521	220	220	406	406	198	198	29	16
Not Registered	397	313	437	175	951	380	1,053	421	55	4
Undetermined	-	-	30	30	17	17	23	23	-	-
Total Registered	2,072	1,827	1,265	1,527	2,736	3,307	2,309	2,941	261	38
Total Surveyed	2,075	1,619	1,482	1,482	3,281	3,281	3,164	3,164	287	26
Match rate	68%	61%	60%	75%	63%	78%	62%	81%	73%	52%
% reg. events of total	84%	85%	73%	88%	74%	89%	68%	87%	83%	90%
% surv. events of total	84%	76%	86%	86%	89%	89%	93%	95%	91%	62%
DEATHS										
Total	813	787	490	490	833	833	960	960	114	21
Matched	498	434	209	370	350	455	363	515	65	7
Not surveyed	206	267	63	63	117	117	88	88	23	10
Not registered	109	86	202	141	351	246	506	354	26	4
Undetermined	-	-	16	16	15	15	3	3	-	-
Total registered	704	701	272	333	467	572	451	603	88	17
Total surveyed	607	520	411	411	701	701	869	869	91	11
Match rate	61%	55%	43%	55%	42%	55%	38%	54%	57%	33%
% reg. events of total	87%	89%	56%	68%	56%	69%	47%	63%	77%	81%
% surv. events of total	75%	66%	84%	84%	84%	84%	90%	91%	80%	52%

[1]Figures relate to 8 areas in each wing where both registration and enumeration were carried out. For purposes of comparability with the Thai and Turkish figures, estimates of events missed by both registration and enumeration are not shown here. Source: "PGE Interim Report No. 5," Pakistan Institute of Development Economics, August 11, 1964, pp. 8-10.

[2]The undetermined cases shown here are those which occurred outside the SPC sample areas to residents of the sample areas but for which no special search of registration records could be made. The adjusted data assume that 60 percent of the unregistered births and 30 percent of similar deaths were, in fact, registered,(see discussion regarding "KAP Study" of registration). Source: SPC Office Records.

[3]Data in the first column are for 13 sampling units where a vital registration system had been in operation for 8 months prior to October 1965 when the matching pretest was carried out. Data for the second column are for two villages in the Kazan Health District where midwives' records for one year were used as registration lists. Source: Memorandum Rumford to Lieberman, "Progress Report, Month of October, 1965," dated November 3, 1965, Appendix Table.

TABLE 3 -- Results of field follow-up of events registered but unsurveyed, Survey of Population Change (Thailand): Matching Rounds 1 to 3

Item	Matching Round[1]		
	1	2	3
BIRTHS			
Total sent to field	561	1,233	936
Found to be outside sample areas[2]	272	495	448
Total missed by survey[3]	289	738	488
In missed households	66	74	45
Population to whom event occurred not enumerated	33	98	29
Event not enumerated	190	566	414
Percent of total missed by survey	52%	60%	52%
DEATHS			
Total sent to field	141	314	276
Found to be outside sample areas[2]	66	137	145
Total missed by survey[3]	75	177	131
In missed households	9	15	7
Population to whom event occurred not enumerated	34	40	39
Event not enumerated	32	122	85
Percent of total missed by survey	53%	56%	47%

[1]Matching Round 1 covers events occurring in Enumeration Round 2 (October-December 1964) and followed up in April-June 1965; Matching Round 2 covers events occurring in Enumeration Rounds 3 and 4 (January-June 1965) and followed up in October-December 1965; Matching Round 3 covers events occurring in Enumeration Rounds 5 and 6 (July-December 1965) and followed up in April-June 1966.

[2]Includes small number of events found to be out of scope and events for which a followup interview could not be conducted.

[3]These figures are higher than "Not surveyed" as shown in Table 2 because they include "late survey" and "late registration" events form previous rounds as well as events found in missed households.

Source: SPC Office Records.

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