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THE CENSUS OF AGRICULTURE AND RELATED SURVEYS IN THE
EASTERN CARIBBEAN TERRITORIES

by

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HISTORICAL BACKGROUND

Work on agricultural statistics in the Eastern Caribbean subsequent to the census of Agriculture taken in 1946 started ten years later in 1956, when a Colonial Development and Welfare scheme was approved primarily as a means of developing and testing methods of collecting agricultural statistics in preparation for the census of Agriculture proposed for 1961, through sample surveys, and secondly to provide much needed current data, particularly in respect of food crops and small scale Agriculture in the Leeward and Windward Islands.

The scheme was proposed by the Agricultural Statistics Committee of the British Caribbean Advisory Council on Agriculture, Animal Health, Forestry and Fisheries, which met annually, and on which all the British Caribbean Departments of Agriculture, the Development and Welfare Organisation in the West Indies, the Imperial College of Tropical Agriculture, and others as necessary were represented.

The Agricultural Statistics Committee of this body comprised the Agricultural Economist of British Guiana, the Government Statisticians of Jamaica and Trinidad and Tobago and the Agricultural Economist then attached to the Development and Welfare Organisation. The Agricultural Adviser to the Comptroller for Development and Welfare in the West Indies, or the Assistant Agricultural Adviser usually presided. Early in 1956, the late G. E. Hodnett joined the recently organised Regional Research Centre at I.C.T.A. as Statistician and was very closely associated with census and survey work in the years which followed. In September in the same year I was seconded from Grenada to the Comptroller's staff as Agricultural Survey Officer.

During the next two years surveys were carried out, (with Hodnett's advice) in all the Windward Territories, and also in Nevis and Montserrat, and we improved and refined our techniques as we went along and gained experience. The results of this work were published in "Agricultural Statistics", Series 1, issued by the Federal Government of the West Indies to whom the administration of the scheme had then passed. No. 1 of that series gives a description of the scope and methods of the surveys, Nos. 2 - 7 give the statistical results, and in No. 8 Hodnett made a detailed assessment of the techniques employed and the results obtained. He concluded (at p. 6) that the objectives of the scheme had "proved realistic and the scheme has been amply justified. As a result, the Working Party preparing for the 1961 Census of Agriculture in the Region had decided to employ sampling in that Census."

In 1959-60, repeat surveys were carried out in Montserrat, St. Lucia and St. Vincent, and the results of these were published in Section II of "Agricultural Statistics", Series 2, No. 1. Sample surveys were also done in St. Kitts, Antigua, Dominica and Grenada in 1960. These surveys, however, were carried out principally with the object of building up a body of experience locally in view of the forthcoming Census of Agriculture, and the results, though worked out, were not made public. A survey designed by Hodnett was also carried out by the Government of Barbados early in 1960, but although some tables were prepared by the Barbados Statistical Service for local use, no formal report on the results was issued.

Thus, by the end of 1960, when the Census Working Party met to consider the details of the proposed census, surveys had been conducted in all the Eastern Caribbean Territories, and a great deal of experience had been accumulated both at the local and the central levels, and the 1961 Census of Agriculture could be faced with a certain amount of confidence. When all the detailed preparations had been made, a conference of Territorial Agricultural Census Officers was convened in July 1961, and enumeration started in the field in most of the territories on September 3rd. With the exception of Dominica, the field enumeration was completed by the end of the same year.

During the months immediately preceding the final dissolution of the former Federal Government no full scale programme of work could be planned for processing the census data; however, with the staff then available some progress was made with the Barbados material, which was the first to

arrive in Trinidad, and a pamphlet entitled "Some statistics of small scale agriculture" in Barbados was issued. Arrangements were finally made, at the Common Services Conference in June 1962, for the continuation of the work under the administration of the newly formed Regional Council of Ministers in Barbados, and a new C.D. & W. scheme was prepared towards this end. The scheme was finally approved in June 1963, and after difficulties in securing office accommodation, furniture, etc., and of recruiting subordinate staff had been overcome, a steady programme became possible only in October, more than two years after the nominal date of the Census. A further set-back was the unavailability of punch-card facilities under the new dispensation, with the result that the whole of the processing had to be carried out manually with the help, of course, of calculating machines. That, then, is the history of the Census, and I am glad to say that the final report on the Census is now in the hands of the printer.

PROBLEMS AND PROCEDURE

We should now go back to 1956, and see what the problems were that confronted us. The data to be collected was laid down at an early stage by the Agricultural Statistics Committee - land tenure, land use, area and production of crops, livestock numbers and disappearance. This seemed a very easy task as far as the large estates were concerned, for surely they should be able to supply exact data from their records, or at least give fairly close estimates if the exact figures were not available.

The difficulty lay in arriving at the contributions made by small growers. It was known that in most of the Territories there were large numbers of these, and that usually they kept no records. Such records as were kept would be designed to defeat the best efforts of creditors, produce inspectors and other law enforcement officers. Special purpose surveys carried out by local departments, previously, showed that many small growers resented any attempt to pry into what they considered to be their own business and nobody else's. Physical violence against enumerators was not unknown. Many were likely to see any investigation of the sort proposed as the precursor of new taxation or an increase in the levels of the old, while others would feel sure that their returns would be handed over to the Commissioner of Inland Revenue in spite of assurance that the survey was a confidential one for statistical purposes only, and that the names of persons and properties would appear in the reports. It was known that small holders were traditionally loth to disclose fully their holdings of livestock, and that others

would have very good reasons for not wanting their affairs to be investigated at all closely.

Finally it was feared that many small growers would not know the answers to some of the questions we would have to ask, and could, at best, give us only a well informed guess.

Was it not then possible to obtain our estimates for small scale Agriculture without recourse to the farmer in person? Could we not have local trained observers reporting what they saw and were able to measure? Could we not use maps as a sampling frame? What maps were available at the time? It was considered important that a method should be found which would prove equally workable in all of the Territories. A great deal of thought was given to alternative methods of securing the desired estimates, but it seemed impossible to avoid confronting the small farmer. Only he could answer our questions on land tenure, only he could tell us what area he reaped last year and what his production was, how he disposed of his livestock and how many animals he now had, and what area he had under cultivation in inaccessible mountain gardens. Whether we liked it or not we would have to woo and win the farm operator if we were going to get the estimates we wanted. Thus the "farm" became our unit of Agriculture in the statistical sense, and the farm operator our chief source of information, and perhaps rightly so, our surveys became a study, not of arbitrarily defined sample areas, but a study of individual farms or agricultural business units. We would examine all the large estates, and as the number of small holdings was known to be large we would have to resort to sampling, and accept the implications thereof. We would somehow or other compile a list of all small farms in each territory and sample within this list.

Now a small farm cannot easily be identified on the ground and in this manner isolated for study in most cases. A farm may comprise several bids and pieces of land which may be scattered over a wide area with some of its parcels occurring in extremely inaccessible areas. Further, many small holders do not live on their farms, but rather in a nearby village or settlement. The only person who knows of the existence of certain parcels of land and the relationship between these several parcels is the farm operator himself. To find out the number and character of these unknown and highly variable small farms we would have to find their operators using census methods, i.e. we would visit persons where they lived, asking questions to find out whether or not they were farm operators, and if so then we

would extract the required information. We decided to visit every dwelling house in all the Territories we were about to survey, and attempt to draw up a complete list of farms for each.

The "farm" was to be our sampling unit, but though the meaning of the term seems obvious at first sight, it was necessary to define it very closely indeed; for example, how large was to be our smallest farm? How about people who kept livestock on other people's land, having no land of their own? How about squatters? How about share-croppers and communal grazing grounds? How to avoid having the same farm reported more than once by different interested parties? How to ensure that farms were not omitted from the sampling frame?

At this point it became very clear that a given farm must be ascribed to one person and to one person alone. A farm may have several part owners, and owners are not necessarily farmers. Owners might not even be residents. The person with whom the farm is most intimately associated is the person in charge of the day-to-day work on the farm. He is the person best placed to answer our questions, and his identity can usually be established to the exclusion of all others. He, we decided would be the nominal spokesman for the farm, and he was christened the "Farm Operator". As far as the identification of the farm was concerned, all other persons were to be eliminated in order to avoid, as far as possible, duplication of farms in, and omissions from, the lists which together were to be our sampling frames. Great pains were taken to define who was our farm operator in cases where more than one person might claim this distinction. The owners' name would of course be recorded, but only as part of the information supplied by the farm operator, and the operator of a managed farm could, of course, consult the owner if necessary. The exact definitions arrived at are given in the notes circulated. Notice that provision is made for "landless farms" or "holdings without land" so that no important class of livestock holder would be excluded. A more detailed discussion of the definitions used is given in an article by G. E. Hodnett and self published in "Social and Economic Studies", U.C.W.I. 8, 1959.

For the first survey, that of Grenada, we used sampling fractions within size group strata as follows:

for farms less than 1 acre	:	1/100
" " 1 acre & less than 5:		1/15
" " 5 acres & " " 50:		1/15
" " 50 " & over	:	1/1

out in the other Territories these fractions were revised to:

for farms less than 1 acre	:	1/100
" " 1 acre & less than 5:		1/20
" " 5 acres & " " 50:		1/10
" " 50 acres & over	:	1/1

In Grenada listing was done first as a separate exercise, the sample being drawn subsequently. This led to a great deal of paper work in the office and high travelling costs, and in the surveys which followed, listing, sampling and the investigation of the sample farms proceeded concurrently. Sampling was systematic, with separate randomly selected starting points within each enumeration district and size group, and enumerators had no difficulty in this connection.

On the personnel side, it soon became evident that unemployed persons free to undertake whole time duties as enumerators were generally not of the educational standard necessary for the task; further, that very close supervision of the enumerators' work was of paramount importance to ensure that the work was being done faithfully, and to protect the scheme against fraud. After our first experience in Grenada, the rule became: part-time enumerators and full-time supervisors. It was much easier to find the half dozen or so persons who would make good supervisors, and to persuade school teachers, civil servants, agricultural instructors, etc. to take on the enumeration as a part-time activity. This at least was the experience in the small communities in which we worked. Some Departments of Agriculture, loaned officers to assist with the supervision, and this was greatly appreciated.

A great deal of attention had to be paid to the training of personnel, and the Enumerators' Training and Reference Manual grew in size with every new survey as more and more points cropped up to be covered by written instructions. It is remarkable how many mistakes enumerators can make, and it became essential to spell out in painful detail what they were expected to do, and in addition, as far as this could be anticipated, what they were expected not to do. It is necessary to define every expression used, what it means, and what it does mean, what is included and what it

excludes. This is a tedious process, but if it is not done, different enumerators will put different interpretations on the instructions, and when the estimate is finally produced no one will know for sure what the estimate really covers or refers to. Free discussions at training sessions are essential in order to plug as many loopholes as possible. A good example is the section of the census questionnaire dealing with employment in Agriculture: what do we mean when we say "employed in agriculture"? Is the farm operator "employed in agriculture"? Or is he an employer? Enumerators must have a clear-cut decision on a point like this. In our case the enumeration manual implied that he should be regarded as being employed, while the sequence of questions in the questionnaire suggested that he was to be regarded as an employer. This inconsistency came to light at the Conference of Territorial Agricultural Census Officers before the enumeration, and the decision was then taken to treat the farm operator as an employer. As the number of farm operators would be known, both the number "employed" and the number "engaged" in Agriculture could also be arrived at; but the enumerator would almost certainly forget to add the extra one in each case for the farm operator.

Close supervision of enumerators is of particular importance during the first few days in the field so that habitual mistakes can be corrected at an early stage and before any great amount of useless work has been done. In spite of all the detailed instructions, a great deal of editing, checking and querying of enumerators' returns has always been found necessary; inconsistent entries, obvious omissions, shocking arithmetic, incredible yields, ambiguous handwriting can all be expected, and it is the job of the supervisor to have all this tidy before the work is submitted for processing. Supervisors with a flair for such detailed work are often difficult to find, and an appreciable number of such errors and omissions remain in the documents received. A careful editing of the completed questionnaires in the central office before any processing is attempted has been found to be an indispensable exercise.

I have already given a verbal caricature of the farm operator. It was the duty of the enumerator to establish rapport with him, win his confidence, and secure his co-operation. A great deal was done to make his task lighter by giving wide publicity to the surveys and stressing their confidential nature through the press, radio, broadcaster vans, posters, hand bills and the pulpit, the last being particularly effective. But this does not mean that the enumerator's job was either easy or enviable. In the final

analysis, the success or otherwise of the field work depends in no small measure on the enumerator, for no amount of processing will yield good estimates if the original data supplied is of poor quality. No pains there should be spared to secure the services of the best men (or women) possible for that task. The list of attributes required in an enumerator is a very long one, but in addition to the more obvious ones, I would emphasise honesty, determination, patience and tact. He should be interested in his work for he will often have to interpret the questions to the farm operator and assist him in finding the best possible answer. In one of our earlier surveys, the enumerator was allowed to record as a possible answer the letters n.k., standing for "not known", but this section of Manual was hastily revised when the consequences of this concession became apparent.

It should not be assumed that persons who have the personality qualifications looked for are necessarily in possession of the mental equipment required for carrying out detailed instructions, and it is very desirable to test candidates before training. A good plan is to circulate copies of the Manual about a week before training is due to start, and to set a qualifying exam based on knowledge of the Manual and arithmetic. In this way inadequate candidates can be weeded out from the outset. Often, however, there is not much choice in a small island, and those best equipped to serve as enumerators are apt to place a very high value indeed on their spare time.

What has been said, then, gives some indication of the kind of problem we encountered and the conditions under which we laboured, and it must be emphasised that agricultural survey work, though simple enough in theory, presents a host of practical difficulties. As regards field procedure, we used three main forms, now known as:

- (a) The Visitation Record: in which all heads of households were listed as well as other persons in the households who were farm operators.
- (b) The Small Farm Register: in which all farm operators were recorded, and their farms, by size groups.
- (c) The Farm Schedule: i.e. the main questionnaire or schedule of questions.

Enumerators' pay was determined from the Visitation Record and the number of farm schedules completed. The Visitation Record also enables supervisors to check and see that the district assigned had been completely covered. Enumerators were required to make sketch maps of their districts to show the approximate location of the houses visited, but this proved beyond the capabilities of many. When a farm operator was found by means of this house-to-house search, he was questioned about his holdings and enough information elicited to place his farm or farms in one or other of the size group strata. The farms were then entered in the Small Register, separate sheets being kept for the separate strata. Each farm was given a line, and lines were numbered serially within strata. Certain line numbers were selected in advance, and the farms falling on these lines gave us the sample which we required. Sampling at first was systematic, the first number of each series being selected at random; later, for the census, it was entirely systematic.

An important lesson learnt from the first survey was that the Visitation Record and Small Farm Register are far better handled as loose leaves, rather than in booklet form, for loose leaves can be handed in for scrutiny as soon as each has been completed thus facilitating supervision and the early detection of errors.

The method of processing the data was that described by Frank Yates in his book entitled "Sampling Methods for Censuses and Surveys", the relevant formulae being those numbered (i) to (iv) on the sheets distributed. In effect the estimate is obtained by multiplying the average per farm as calculated from the sample by the total number of farms as determined from the house to house visitations. This is done for each stratum separately and the results added together. Similarly, the strata variances are worked out and added together. The square root of this sum gives the standard error, which is then expressed as a percentage of the estimate.

One of the things which must be faced squarely is that having approved sampling as the only practical way of obtaining the estimates we want, sampling standard errors must also be accepted as part of the bargain. They are the price we have to pay, and this should be freely acknowledged and the price paid as cheerfully as possible, for the standard error says something important about the estimate, and it is as much a part of the results as the estimate itself. This seems to be a very bitter pill to some, and very few seem to thank you for working them out, though this is what takes up most of the time. Many would prefer not to be told about them,

or else regard them as some sort of apology for the estimates. Yet the standard is a necessary commentary on the estimate.

In any sample survey in which there is a large number of variates under investigation there will inevitably be circumstances in which both very low, and very high, sampling errors are to be expected due to the high variability of the population itself. Further the same sample will not be equally efficient for all the variates. In our case, the whole of the sampling variation came from farms less than 50 acres. This was implicit in the design. For an enterprise, therefore, in which most if not all the farms larger than this take part, and small growers to a lesser extent, the standard errors when expressed as a percentage of the estimate for all farms are pleasingly small (less than 1½% for sugarcane in Barbados). However, it should not come as a shock to hear the percentage standard error for non-bearing cocoa trees in Antigua was as high as 80%. The estimate was only 88 such trees in the whole Territory. The high standard error does not mean that the estimate is worthless. What this result says is that there was probably less than the equivalent of half an acre of non-bearing cocoa trees in Antigua at the time of the census - a very small quantity indeed. This, of course, is an extreme case, but the result is nevertheless meaningful. Low sampling errors, however, do not mean that the levels of the estimates are in accordance with the truth, but when they are not, the weakness usually lies elsewhere. Finally, we must not forget that we accept 95% probability as next door to certainty, but that the odd 5% of cases are expected to crop up with roughly that frequency. Such are the implications of sampling.

In commenting on the precision of the estimates produced by the 1956-58 surveys, Hodnett had this to say: for the more widely grown crops, the sampling standard errors were less than 10% of the estimates in most cases. This precision was considered very reasonable for the purposes for which the estimates were required. The standard errors were as low as 1 - 2% for items, such as the area of crop land which were particularly uniform within the strata, whereas they were relatively large for the crops grown on a small scale, in particular, for arable crops. Part of the latter variation is probably due to the inability of farm operators to give accurate information on these crops. In fact in some instances they were unable to provide any information at all."

THE CENSUS OF AGRICULTURE, 1961

The Census of Agriculture was planned to take place in 1961, the year after the Census of Population, and the population census questionnaire included a single question on Agriculture designed to locate the farm operators. It was expected at the time that this would supply a satisfactory sampling frame for use in the Census of Agriculture. However, the agricultural surveys of 1959 and 1960, when it was sought to re-examine the sample of small farms selected in 1957 and 1958, showed that sampling frames in which the farm was the sampling unit fell out of date very rapidly indeed, and to keep such frames up to date would be tantamount to repeating the house-to-house enumeration annually at considerable cost. It was therefore decided that the Agriculture census should be redesigned to take this finding into account. For the purposes of the population census, each Territory had been sub-divided into small enumeration districts, and the boundaries had been permanently described and recorded in the Government Gazettes. The number of such enumeration districts ran from 113 in the case of St. Kitts-Nevis-Anguilla to 340 in the case of Barbados, each enumeration district containing 100 - 300 households. Here now was a ready made sampling frame in which the sampling unit would be the enumeration district - a sampling frame, moreover which would not vary, disconcertingly, from year to year. We would sample these primary sampling units (or "clusters", if you will), and within these we would carry out house-to-house visitations to track down the farm operators, and sample their farms as before. To take account of the difference in size between the enumeration districts, we would use the number of households, as revealed by the population census, as additional information in calculating the estimates. This two-stage design was accepted by the agricultural census Working Party. To control variation between farms and enhance the precision of the estimates, the enumeration districts were stratified by "Agricultural Zones" within which the general pattern of small scale was roughly uniform, and withinstrata, farms were further stratified before selection into three size groups. After selection the under 5 acre group was split to show the contributions of the holdings without land and size groups 0- and 1- and the 5 -50 group to give the size groups 5-, 10- and 25- for purposes of processing and reporting. Depending on available funds, sampling fractions at the first stage were one in three or one in four, and at the second stage, sampling fractions for farms were 1 in 5 for farms less than 5 acres; 1 in 1 for farms over 5 acres.

The detailed scope and content of the questionnaire was laid down by the Census Working Party, and followed broadly the lines suggested by the Food and Agriculture Organisation of the United Nations. A list of questions common to all the Territories was first drawn up, and then individual Territories were invited to suggest other questions of particular local interest. The questionnaire form, which was designed for processing by the pag-bar method, comprised 18 pages, printed front and back on 9 sheets, and by suitably clipping the corners and folding the form, it was possible to process all the data on the 18 pages without removing the schedules from the pag-bar once they had been mounted.

A comprehensive Enumeration Manual was prepared, together with booklets entitled:

Training Manual (for Census Officers and Supervisors)
 Training Work Book
 Instructions to Supervisors, and
 Notes for Agricultural Census Officers.

A Conference of Territorial Agricultural Census Officers was called in July, 1961, and these officers were trained first as if they were enumerators, next as supervisors, and finally they were instructed as to their own personal duties in connection with the Census.

After the necessary regulations under the federal Census and Statistics Act had been promulgated, and formally consented to by the Territorial Governments, all census personnel were duly sworn in, and enumeration commenced on or about 3rd September, 1961.

Some difficulty was reported by Census Officers in locating the exact boundaries of enumeration districts on the ground from the word descriptions, but these were soon overcome with the help of personnel who participated in the population census, but apart from the expected quota of difficult respondents, the census field work went as closely according to plan as anyone could reasonably expect, except in the case of Dominica, where the field work was not completed until November 1962. In all other Territories, this work was completed by the end of December, 1961.

Processing the data: For clarity and ease of reference, the calculation of the estimates and their standard errors was organised and described as a series of separate processes: Processes 1 - 6 gave two self checking estimates of each Territorial Total, while Processes 7 - 11 were concerned with the sampling standard errors. The processes

described visually by means of a large diagram or chart which showed the notation to be used, and also how the schedules, on which the results of each process were entered, were in contrasting colours in order to avoid confusion and to facilitate identification. Operators completed a given process for all the questions in his batch of schedules before going on to a new batch or process, and so were required to concentrate on only one or at most two types of calculation at any given time, and this plan made for greater speed and accuracy.

The formulae used for deriving the estimates and their sampling errors are equations (v) - (ix), on the sheets distributed. The calculation of the standard errors was rather complex, but a simplification was possible because certain constants were common to all the computations within strata, and these could be calculated beforehand, and expressed as a single factor, M . It was then only necessary to calculate $sq.^2$, which, however, required six other separate calculations, including sums of squares and sums of products, for each variate.

Editing: In spite of the detailed instructions given for the checking of the schedules in the Territories, a great deal of editing was necessary in the central office before processing proper could begin. This was particularly so in the case of the Windward Islands where there is a much greater diversification of crops on individual holdings than in the Leewards and Barbados. The main types of defect in the completed schedules were failure to state the acreage in compact stands for tree crops corresponding with the number of trees, and failure to state harvested production. At first the number of these omissions were simply noted and brought forward through the processing stages with a view to adjusting the final estimates by awarding strata averages after a study of the total extent to which such non-response had occurred. This method however, proved rather cumbersome, and was soon abandoned in favour of supplying such missing data on all farm schedules before starting the accumulations. The data supplied were based on the averages as calculated from the other farms in the same batch - averages per farm if one of the possible answers was zero or per acre in the case of arable crops.

Another function of the editing was to make sure that ratios, such as production per tree and per acre, trees per acre, etc. fell within reasonable limits. This is not particularly easy to do for very low yields or no yield at

all though it may be regarded as reasonable in some cases. For example, young fruit trees may have been in bearing for the first time at the date of the census, but had produced no crop during the previous 12-month period. A further consideration was that the census recorded "harvested production", and it was clear that particularly in the Windwards, that a great deal of the produce from minor tree crops and even coconuts is not harvested at all, at least not by the farm operator. In many cases it was stated in the returns that estate owners allowed labourers to collect produce at will for their own use, and in others that most of the produce was stolen. In practice it was seldom possible to alter what appeared at first sight to be an extremely low yield. On the other hand, a very high yield could only be revised if it fell completely outside the possible range for the crop. For some crops like mangoes the possible range is very wide indeed for individual trees and small groups of trees, and amendment of very high yields were usually necessary when it was obvious that the enumerator's arithmetic was at fault, when an extra zero had somehow found its way into the calculation. When unlikely, but not impossible yields were encountered, therefore, the farm operators word was taken.

Arithmetical inconsistencies were found from time to time, and these are not always easy to deal with, for it is not always clear whether the total or one of its parts is in error. In these cases, the editor must ask himself which of the figure is more likely to be correct, and then act accordingly. For example, the farm operator, on the question of land use, is likely to know, within fairly narrow limits the acreage under crops, while he would be vague about forest and woodland, which he would arrive at by subtraction from the total farm acreage which is usually known.

Similarly, when the number of trees does not seem to be consistent with the acreage, it is usually the case that one has been calculated from the other at the enumeration stage, assuming so many trees to the acre - the enumerators line of thought can sometimes be seen from the boldness with which items have been written in - a small farm operator can usually give an estimate of the number of trees, but is vague about the acreage, while the opposite would be expected to be the case for a large estate. I should, however, give a word of warning about being too quick to edit what appears to be a most unlikely answer, for the unlikely result has proved time and time again to be no more than the truth; due to some local peculiarity unknown to the editor, and important results may be obscured by over-zealous editing. Editing,

then, must be approached with some caution lest we get results which simply reflect the subjective views of the editor who would normally tend toward some pre-conceived average, and the farm operator and the enumerator must always be given the benefit of any doubt, for in large scale census work it is not possible to refer back to the Territory concerned and but for most massive of discrepancies, the solution of which would deeply affect the estimate under consideration.

Control of numerical accuracy: This is one of the greatest importance at all stages. Many of the tabulations were self checking at the end of the calculations, and a great deal of time can be wasted hunting for mistakes in cases results which should agree, don't. Numerical accuracy is best achieved by making provision for two-way checks in the form of miniature two-way tables all along the line, so that a mistake once made will be spotted almost immediately and corrected. Thus wherever possible spaces for totals and sub-totals should be provided in the body of the questionnaire form so that these totals can themselves be accumulated across the schedules in the batch, and verified with the sum of the components on the process schedule. For example the total for both sexes should be shown on each questionnaire in addition to the number of males and the number of females. In the case where no such two-way check is available, as with production data, each calculation must be done twice, or more often if necessary, until the correct answer is established. Errors can arise from omissions, failure to bring forward a result from one process to the next or from making the same mistake twice. The work of each operator must therefore be checked by another operator using a different machine. For checking, it is very desirable that a calculator which prints the items and results on tape be used so that it can be verified that the repeat calculations have indeed been carried out.

Compiling the final tables: The labour required to compile the final tables of a comprehensive census from the working schedules can very easily be lost sight of or at least grossly estimated until one is faced with the actual task. I speak feelingly. The transcriptions to the draft tables must be checked not merely by calling back, but by actual summation across the lines and up the columns, and the two-way checks applied. The results of these checks, recorded on the tape of the adding machine, are then attached to the draft for scrutiny of a senior officer before being sent for typing. The detailed design of the final tables calls for a great deal of personal attention for printing costs can soar

out of hand if each page is not used as economically as circumstances will permit. The aim should be the maximum number of cells consistent with an easily grasped lay-out and good legibility.

The subsidiary analyses: The filing and labelling system adopted for the schedules paid offhandsomely when it became clear that the tabulations which were to have been done with punched cards would now have to be carried out by manual methods. The schedules had already been sorted, permanently, by size groups and enumeration districts, and further sorting within these groups for such characteristics as form of tenure, age and status of operator, occupation of holder, etc., proved a very easy manual task. Further, it was a simple matter to regroup the files containing the estimates for enumeration districts to work out estimates for the major population census divisions. The intermediate results of these subsidiary tabulations were carried on specially designed working schedules which could themselves be further processed by the peg-bar method.

The analysis by major divisions provided a rough check on the results obtained from the main analysis by agricultural zones, and in this a satisfyingly small number of errors in the latter were brought to light. In the Territories where agricultural zone boundaries cut across the major census division or parish boundaries, the Territorial estimates obtained by the two methods of analysis would not be expected to agree at all exactly, for particular values would have different raising factors for the two occasions. Large differences were investigated for the possibility of numerical errors, but in the absence of these, the estimate as derived from the analysis by agricultural zones was taken as the more precise of the two due to the greater homogeneity within agricultural zones, and the estimates for the major census divisions were adjusted, proportionately, to agree. A hypothetical example is given.

In Territories where agricultural zones comprised groups of major divisions, closer agreement between the corresponding territorial estimates was to be expected due to the greater similarity between major divisions in the same zone.

In deciding on the amount of detail which should be included in the tables of the final report it was necessary to be highly selective if the size of the report was to be kept within reasonable proportions and consistent with our budget. Nevertheless there was still some 20,000 estimates in the final tables for Barbados alone, as compared with about

5,000 in the 1946 census. It is possible at this stage to comment only in very broad terms on the accuracy or otherwise of the census results. As far as the sampling precision of the results were concerned, the standard errors were roughly what were expected, and those for the more important estimates are given on one of the sheets distributed. Standard errors for components of these estimates, e.g. males and females in the case of livestock, would be higher in many cases, but not all. The data on the sheet is summarised on the reverse side. It will be seen that the lowest standard errors were obtained in Barbados, where conditions are more uniform than elsewhere, and where 80 enumeration districts were examined. In the other Territories the number of ED's in the sample varied from 38 in the case of St. Kitts-Nevis-Anguilla to 47 in the case of Grenada. Sampling errors were highest in Antigua, St. Kitts and St. Vincent, with Dominica and Grenada occupying intermediate positions. Sampling errors for data on livestock are generally higher than those for crops, indicative of the fact that most of the livestock in the islands are kept by small holders, and that the stratification of the sample by size of holding would not, in the case of livestock add much to the precision of the estimates.

Regarding the magnitudes of the estimates themselves, it is not possible at the moment to enter into any full discussion, for this would require a detailed comparison of the census results with other sources of information. In making such comparisons, great care should be taken in the matter of definitions, for data from different sources are seldom based on the same formulae, and in many cases a great deal of local knowledge has been found necessary to interpret the results. Nevertheless, on the whole one would expect the census results to be too low rather than too high, for omissions and understatements are more often to be expected than exaggerations, and such comparisons as have been made up to the present time have shown that this may indeed be the case, at least with small farms. On the other hand there have been a large number of cases in which the estimates are considerably in excess of the expected values.

In making comparisons with other sources of information it is also important to compare the coverage claimed for the various data, e.g. whether a given series for say Antigua includes Barbuda, or in the Windwards whether the Grenadines were included. A further source of incomparability between sets of data stems from seasonal fluctuations throughout the year. Hence the date on which the census or survey was taken may have an important bearing on the estimate that will be arrived at. In the case of livestock it was expected that the census and survey results would under-

estimate the true numbers due to the suspicions of farm operators, and this in fact is believed to have been the case. But an examination of the results over the years, as compared with other sources and the comments of users, would seem to indicate that the seasonal factor may be of considerable importance in interpreting data on livestock found on farms at particular times of the year, for seemingly low results are obtained from surveys carried out in the early months of the year, while surveys conducted in the middle months appear to yield results more closely approaching the expected. An example, based on three years' data, of the seasonal pattern of slaughterings is given on one of the sheets circulated.

THE CURRENT SURVEYS, 1964 - 1965.

While work on the census data was in progress, a series of surveys designed to keep the census up to date and to provide current estimates in the Eastern Caribbean Territories was approved in 1964. The scheme allowed for two complementary surveys per year in each Territory, and funds were provided for the central planning of the surveys, the processing of the results and for the payment of enumerators. However, the implementation of the programme in the Territories and the supervision of the enumerators in the field was to be the responsibility of the Territorial Governments who appointed liaison officers for this purpose and through whom the central organisation could work. To obtain the estimates, a sub-sample of the enumeration districts used in the census was drawn for each Territory, and within these new frames of farm operators were to be drawn up each year in October and immediately sampled, the sample of farms thus obtained being revisited the following April to secure remaining information for the agricultural year, which was taken as running from April to March. As the Territories expressed their wish to participate in this programme, but in fact, many have found it impossible to do so due to lack of staff and/or funds to supervise the work properly, while other departments of agriculture have complained bitterly of the extra work load which the surveys have placed on their already hard pressed establishments. Absences of the liaison officers trained for the work due to leave, transfers, etc. have also limited the work which could be attempted in some of the Territories. For these and other reasons little or no work was possible in the Leewards or in Dominica. Of the four surveys possible in each Territory

two were carried out in St. Vincent, and three in St. Lucia. Barbados and Grenada were able to make full use of the facilities offered by the Scheme. Due to our pre-occupation with the census, the processing of this data has been delayed, though one report, on Barbados, has been issued and two others completed. Work on the rest continues.

It is hoped that funds will be forthcoming to continue this work on current estimates, and in the new scheme submitted, an item of expenditure was included to assist needy Territories financially in supervising the field work. It has also been recommended strongly that each Territory should provide, with C. D. & W. assistance if necessary, an officer whose first duty should be to see to the proper conduct of these surveys in the field at the Territorial level. It has already been demonstrated that the control office has the means to cope with the proposed programme now that we are free from the census, and it should be possible in future to produce the results of the surveys two to three months after the completed documents have been received from the Territories. On the planning side, it has been suggested that the Department of Agricultural Economics and Farm Management and the Institute of Social and Economic Research who have a special interest in this work should be co-opted to form part of an advisory committee to assist in determining in which avenues our energies could best be expended, having in mind the needs of the area as a whole, and the peculiar requirements of particular Territories, to fill the need which has so often been felt for expert consultation and discussion, and also to enhance the status of the work in the eyes of the Territories. If these hopes are realised conditions will then exist under which the scheme can be expected to function with satisfaction to all, and given the full co-operation of Territorial Governments and the keen interest of local departments. I feel there is no good reason why our objective should not, in practice, be achieved. Some modifications in our existing methods may be necessary - some, in fact, have already suggested themselves - but these are largely matters of detail, for one of the difficulties which may be expected to arise in the future is the growing resistance on the part of the large estates to the frequency of our visitations and those of other workers in this field. Unlike the small farmer who may be in the sample this year but out the next, the large farms get two rather lengthy investigations every year without respite, sometimes when he can ill afford the time to receive the enumerator. It is possible that he might prefer to have the investigation more or less evenly distributed over the year in the form of short questionnaires mailed to him at the appropriate times of the

year when the data requested are still fresh in his memory. Experience in other countries, however, has shown that the rate of non-response to mail questionnaires may be very high indeed, and a great deal of follow-up work will undoubtedly prove necessary if hundred percent coverage is aimed at for the large farms. But it is of vital importance that every effort should be made to retain the co-operation of this important section of the farming fraternity to which the small grower looks for example and guidance and on whom we rely on so heavily for our agricultural statistics.

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DEFINITIONS

FARM (or Holding)

One or more parcels of land used wholly or in part for agricultural purposes and operated by one person (the farm operator) alone or with the assistance of others as a single business unit without regard to title, size or location. The term "farm" does not include any part of such parcel or parcels let or rented out to other persons, but it does cover livestock kept for agricultural purposes without agricultural land.

For a holding to be considered as being used for agricultural purposes it must have had associated with it during the past twelve months at least one head of cattle, or two head of sheep, goats or pigs, (or one head of any two), or a flock of at least twelve chickens (fowls), or ten or more bearing trees of any tree crop, bananas or plantains, or one eighth of an acre of any vegetables, ground provisions, food or cash crop.

FARM OPERATOR

The person directing the day-to-day operations on the farm. He may be the owner, tenant or lessee of the farm, or he may be a manager appointed by the owner, tenant or lessee or by an association of persons to be responsible for the day-to-day operations on the farm.

FARMER (Holder, Entrepreneur)

The person or association of persons bearing the ultimate financial risks attaching to and enjoying the ultimate financial benefits accruing from the farm. He may be the owner, tenant or lessee, but he cannot be a manager, agent or attorney, though he may appoint one of these to represent him from time to time.

LANDLESS FARM (Holding without land)

A farm which is operated by a person who keeps livestock, whether his own or those of another (i.e. he is in charge of the day-to-day tending of the animals, feeding, watering, grooming, housing, milking etc.) though he does not hold any land on which to keep them. It may be regarded as a farm of a nominal or very small acreage.

FORMULAENOTATION (after Yates)

f,	exact sampling fraction ($=n/N$)
g,	exact raising factor ($=N/n$)
N,	number of units in the population
n,	" " " " " sample
p,	proportion of units in the sample possessing a given attribute
q,	proportion of units in the sample ^{not} possessing a given attribute
\bar{r} ,	the ratio Y/X , or its estimate
S^2 ,	summation over the units of the sample
s^2 ,	sum of squares of deviations from the mean
u,	number of units in the sample possessing a given attribute
U,	the estimated number of units in the population possessing the given attribute
x,	supplementary quantitative variate, such as size of unit, (number of households)
X,	total of x for the population
y,	quantitative variate under investigation
Y,	estimate of y for the population
$V(Y)$,	variance of Y
$V(U)$,	" " U

IN THE 1956-60 SURVEYS -- single stage design

Within strata:

$$\begin{aligned}
 \text{(i)} \quad Y &= g.S(y) \\
 \text{(ii)} \quad U &= g.u \\
 \text{(iii)} \quad V(Y) &= g^2.ns^2(1-f) \\
 &= ns^2.g(g-1) \\
 \text{(iv)} \quad V(U) &= g^2.npq(1-f) \\
 &= g(g-1). \quad u(n-u)/n \\
 \text{or more precisely} &= g(g-1). \quad u(n-u)/(n-1)
 \end{aligned}$$

FORMULAE (continued)

IN THE CENSUS -- Two-stage design, with additional information,

Where:

y' is the quantitative variate at the second stage,
 $Y' = y$ " " " " " for the primary
 sampling units,
 u', U', u are the corresponding numbers of units
 possessing a given attribute,
 g' is the exact second stage raising factor,
 and
 f " " " " " sampling fraction:

$$\begin{aligned} \text{(v)} \quad Y' &= g' \cdot S(y') = y \\ \text{(vi)} \quad U' &= g' \cdot u' = u \end{aligned}$$

and within strata:

$$\begin{aligned} \text{(vii)} \quad Y &= X/S(x) \cdot S(y) \\ \text{(viii)} \quad U &= X/S(x) \cdot u \end{aligned}$$

$$V(Y) = \frac{x^2}{\{S(x)\}^2} \cdot (1-f)n \cdot s_q^2$$

where:

$$s_q^2 = Q/(n-1)$$

and where:

$$Q = S(y^2) - 2 \bar{r} \cdot S(xy) + \bar{r}^2 \cdot S(x^2)$$

or, if $M = n(1-f) \cdot x^2/(S(x))^2$, constant within strata,

$$\text{(ix)} \quad V(Y) = M \cdot s_q^2$$

Variances for U are obtained in the same way, substituting u for y .

HYPOTHETICAL EXAMPLE -- Analysis of Enumeration District Data
by Agricultural Zones and by Major
Census Divisions.

Sample of 20 ED's from population of 100.

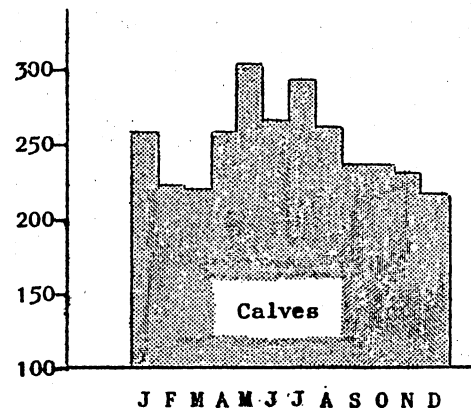
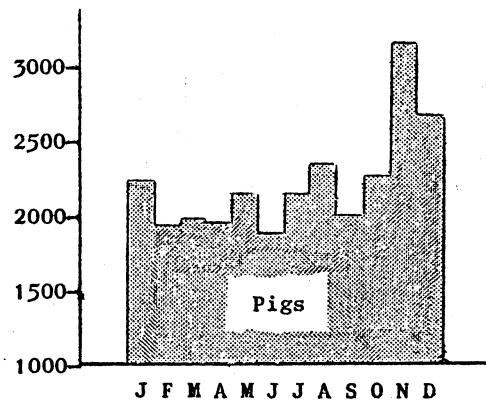
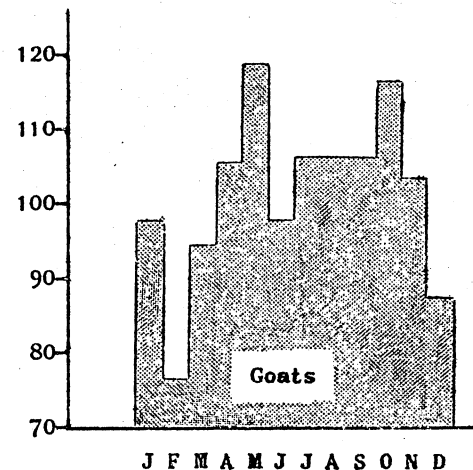
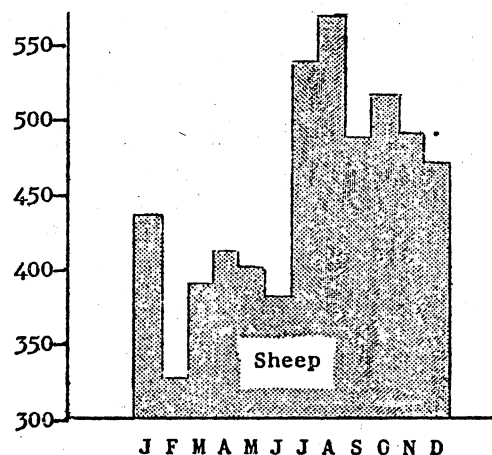
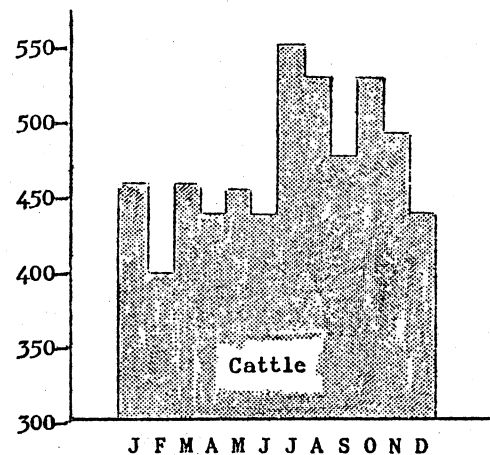
Sample ED's	Values of y	Zone or Major Division	n	N	g	S(y)	Y= g.S(y)	Corrected Y
<u>By Agricultural Zones</u>								
3 8 13 18	15 17 23 11	I	4	22	5.50	66	308	308
23 28 33	37 28 41	II	3	14	4.67	106	495	495
38 43 48 53	15 -- 12 4	III	4	19	4.75	31	147	147
58 63 68 73 78	53 48 60 54 23	IV	5	26	5.20	238	1,238	1,238
83 88 93 98	5 10 9 7	V	4	19	4.75	31	147	147
Total	-	-	20	100	-	472	2,335	2,335

Sample ED'S	Values of y	Zone or Major Division	n	N	g	S(y)	Y= g.S(y)	Corrected Y
<u>By Major Census Divisions</u>								
3 8 13	15 17 23	1	3	16	5.33	55	293	287
18 23	11 37	2	2	9	4.50	48	216	211
28 33 38	28 41 15	3	3	15	5.00	84	420	411
43 48	-- 12	4	2	10	5.00	12	60	59
53 58 63	4 53 48	5	3	14	4.67	105	490	479
68 73	60 54	6	2	11	5.50	114	627	613
78 83	23 5	7	2	12	6.00	28	168	164
88 93 98	10 9 7	8	3	13	4.33	26	113	111
Total	-	-	20	100	-	472	2,387	2,335

Correction Factor = $2,335/2,387 = 0.987$

* Slaughtering of Livestock at Cheapside Market, Bridgetown, Barbados,

for the 3-year period 1958 - 1960 inclusive, by months.



* Data kindly supplied by Barbados Statistical Service.

SAMPLING STANDARD ERRORS FOR MAIN ESTIMATES

Census of Agriculture, 1961

ITEM		.Ant. B'da	B'dos	D'ca	G'da	.St.K. N.- Ang.	St. Vin.
		%S.E.	%S.E.	%S.E.	%S.E.	%S.E.	%S.E.
Holdings, number	no	4.7	4.5	6.0	4.8	12.1	11.9
" area	acres	1.9	1.0	3.2	2.4	3.4	3.6
Parcels, number	no	5.2	6.6	7.6	4.9	15.1	8.2
Holdings fertilizing	no	10.4	6.1	8.2	6.6	27.6	7.2
Land Use:							
Arable land	acres	2.6	1.2	4.1	5.3	2.8	6.2
Grassland, cultivated	"	2.3	1.9	21.3	5.7	2.9	6.1
" uncultivated	"	3.6	1.4	7.5	5.5	11.1	8.8
Land under tree crops	"	*	*	4.2	3.1	4.1	6.2
Maize: area reaped	acres	9.3	5.8	*	11.6	6.7	12.5
production	lb.	8.0	2.9	*	8.9	6.6	10.5
Peas & beans:							
area reaped	acres	13.6	9.9	*	*	*	11.2
production	lb.	5.6	3.6	*	*	*	13.1
Sweet potatoes:							
area reaped	acres	11.1	1.9	*	20.8	9.0	14.3
production	lb.	11.0	1.3	*	9.1	9.0	16.9
Yams:							
area reaped	acres	20.2	1.8	26.7	24.1	18.8	24.0
production	lb.	17.8	0.8	11.6	9.3	10.6	9.8
Sugar cane:							
area reaped	acres	15.2	1.2	13.1	10.2	1.8	7.6
production	tons	2.3	0.1	18.0	9.2	1.3	3.4
Oranges:							
bearing trees	trees	*	*	14.9	7.1	*	12.6
production	fruit	*	*	1.6	6.4	*	15.2
Grapefruit:							
bearing trees	trees	*	*	2.4	10.7	*	15.2
production	fruit	*	*	1.2	10.7	*	29.6*
Limes:							
bearing trees	trees	*	*	12.0	5.4	*	14.4
production	tins	*	*	5.5	10.5	*	13.4
Bananas: for export							
bearing stools		-	-	6.6	4.7	-	8.4
production	stems	-	-	6.2	6.0	-	8.3
Coconuts:							
bearing trees	trees	13.2	9.0	6.7	5.3	3.3	1.7
production	nuts	17.6	12.5	2.5	3.0	4.9	1.5
Cocoa:							
bearing trees	trees	*	*	5.2	3.8	*	15.3
production lb.	dry	*	*	4.8	4.0	*	10.6

Sampling Standard Errors for Main Estimates
Census of Agriculture, 1961 (cont'd)

ITEM		.Ant. B'da	B'dos	D'ca	G'da	.St.K.. N- Ang.	St. Vin.
		%S.E.	%S.E.	%S.E.	%S.E.	%S.E.	%S.E.
Nutmegs:							
bearing trees	trees	-	-	*	7.7	-	*
Arrowroot:							
area reaped		*	-	-	-	-	9.0
production, rhizomes		*	-	-	-	-	7.4
Cotton:							
area reaped	acres	13.8	*	-	...	17.5	26.9
production	lb.	13.8	*	-	...	15.3	14.4
Cattle:							
	number	7.5	4.9	12.2	6.9	7.6	7.9
disappearance	"	10.5	20.7	24.4	16.2	11.2	11.7
Sheep:							
	number	7.4	7.4	19.2	13.6	27.1	13.9
disappearance	"	6.0	13.8	37.8	16.5	16.5	25.3
Goats:							
	number	10.8	7.3	20.7	9.8	20.5	10.3
disappearance	"	15.4	24.3	36.5	20.6	16.1	25.6
Chickens (fowls)	number	14.2	4.2	9.1	6.4	18.5	10.1
Employment	number	5.4	5.7	6.6	6.1	6.6	9.1
Farm population	"	5.4	4.9	7.0	6.0	13.9	5.4
Tractors	number	18.2	0.0	0.0	14.7	2.7	13.6
Ploughs	"	41.2	2.7	0.0	0.0	4.5	25.5
Farm water supplies	"	9.1	5.1	8.3	19.1	8.3	10.1
Pigs							
	number	27.3	6.5	8.4	8.0	12.1	10.5
disappearance	"	19.6	15.1	9.3	17.0	21.3	17.8

*Small quantities only - : nil or negligible --- not available

Frequent Distribution of Sampling Standard Errors for Main Items.

CLASS	.All Isl	.Ant. B'da	B'dos	D'ca	G'da	numbers	
						.St. N.-A.	K. Vin.
Less than 5%	58	7	18	10	9	10	4
5 - less than 10%	76	9	10	15	20	7	15
10 - less than 15%	49	10	2	5	8	6	18
15 - " " 20%	24	6	1	2	3	7	5
20% and over	24	3	2	6	3	4	6
Total	231	35	33	38	43	34	48

Cumulative Totals

									numbers
CLASS			.All Isl.	.Ant. B'da	B'dos	D'ca	G'da	.St.K.. N.-A.	.St.. Vin.
Less than	5%		58	7	18	10	9	10	4
" "	10%		134	16	8	25	29	17	19
" "	15%		183	26	30	30	37	23	37
" "	20%		207	32	31	32	40	30	42
Total			231	35	33	38	43	34	48

Frequency per cent

									per cent
Less than	5%		25	20	55	26	21	29	8
" "	10%		58	46	85	66	67	50	40
" "	15%		79	74	91	79	86	68	77
" "	20%		90	91	94	84	93	88	88
Total			100	100	100	100	100	100	100