A SAMPLE SURVEY OF SUGARCANE FARMERS SUPPLYING
TRINIDAD SUGAR ESTATES LTD.; ORANGE GROVE
(Vol. 1)


I. McMartin, B.Sc.

1960-1961
D.T.A. Report.

Submitted in part fulfilment of the requirements for the Diploma in Tropical Agriculture of the University College of the West Indies, Faculty of Agriculture, I.C.T.A., Trinidad, W.I.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td><strong>SAMPLING PROCEDURE</strong></td>
<td>3</td>
</tr>
<tr>
<td>1. The Frame and Stratification</td>
<td>3</td>
</tr>
<tr>
<td>2. Sampling Fractions</td>
<td>5</td>
</tr>
<tr>
<td>3. Drawing the Sample</td>
<td>6</td>
</tr>
<tr>
<td>4. Defects of the Frame and Special Cases</td>
<td>6</td>
</tr>
<tr>
<td><strong>ORGANISATION OF ENUMERATION</strong></td>
<td>8</td>
</tr>
<tr>
<td>1. Mapping</td>
<td>8</td>
</tr>
<tr>
<td>2. The Questionnaire</td>
<td>8</td>
</tr>
<tr>
<td>3. The Point Survey</td>
<td>9</td>
</tr>
<tr>
<td>4. Enumerators and Seminar</td>
<td>10</td>
</tr>
<tr>
<td>5. Organisation of Transport</td>
<td>11</td>
</tr>
<tr>
<td>6. Supervision of Enumerators</td>
<td>11</td>
</tr>
<tr>
<td>7. Difficulties in the Field</td>
<td>12</td>
</tr>
<tr>
<td>8. Conclusions</td>
<td>13</td>
</tr>
<tr>
<td><strong>ANALYSIS OF RESULTS</strong></td>
<td>15</td>
</tr>
<tr>
<td>1. Abstraction</td>
<td>15</td>
</tr>
<tr>
<td>2. Aims of Analysis</td>
<td>15</td>
</tr>
<tr>
<td>3. Notation</td>
<td>16</td>
</tr>
<tr>
<td>4. Formulae Used</td>
<td>17</td>
</tr>
<tr>
<td><strong>DISCUSSION OF RESULTS</strong></td>
<td>18</td>
</tr>
<tr>
<td>1. Introduction</td>
<td>18</td>
</tr>
<tr>
<td>2. Land Use</td>
<td>19</td>
</tr>
<tr>
<td>3. Cane Planting</td>
<td>22</td>
</tr>
<tr>
<td>4. Ratoon Cane Cultivations</td>
<td>25</td>
</tr>
<tr>
<td>5. Fertiliser Use</td>
<td>27</td>
</tr>
<tr>
<td>6. Yields</td>
<td>28</td>
</tr>
<tr>
<td>7. Transport</td>
<td>29</td>
</tr>
<tr>
<td>8. Hired Labour</td>
<td>31</td>
</tr>
</tbody>
</table>
9. Conclusions

Agricultural policy is greatly dependent on having past data and facts available. It is only through such knowledge and understanding that the problems facing the industry can be clearly seen, and the correct policy for research and development can be formulated. At present, the number of facts about agriculture, which vary from developed to underdeveloped countries, proves to be extremely limited. In many cases, they may amount to no more than the figures relative to external trade. Little knowledge can be obtained about the state of the industry merely from import and export figures, and no development policy can be based on these alone.

Large scale surveys such as the 1956 World Census of Agriculture are carried out under the auspices of the United Nations Organisation but the amount of information which can be collected from one area is necessarily limited.

There are two main ways of obtaining the necessary information available to Government bodies. The first of these is the complete census and, secondly, there is the sample survey.

In a census the whole population is surveyed. It is obvious that in order to carry this out on a large scale in an underdeveloped country a large number of trained personnel will be required. Even if the personnel are available, the collection of the information is a difficult and lengthy process where the communications are poor and the existing conditions are scattered.

The compilation of the numerous population surveys is a centre is lengthy procedure, and it may be a considerable time before the results of the census can be available. This, of course, means that decisions being arrived at in time and labour, the under crops involved are also very high. Perhaps it will result in being more expensive than the results justify.
Wise Agricultural policy is greatly dependant on having numerous and varied, up to date facts available. It is only through having these facts that the problems facing the industry can be clearly seen, and the correct policy for research and development can be formulated. At present, the number of facts about agriculture which many underdeveloped countries posses are exceedingly limited. In many cases they may amount to no more than the figures relative to external trade. Little knowledge can be obtained about the state of the industry merely from Import and Export figures and no development policy can be based on these alone.

Large scale surveys such as the 1950 World Census of Agriculture are carried out under the auspices of the United Nations Organisation, but the amount of information which can be collected from one area is necessarily limited.

There are two main means of obtaining the necessary information available to Government bodies. The first of these is the complete census and, secondly, there is the sample survey.

In a census the whole population is surveyed. It is obvious that in order to carry this out on a large scale in an underdeveloped country a large number of trained personnel will be required. Even if the personnel are available, the collection of the information is a difficult and lengthy process where the communications are poor and the farming communities are scattered.

The summarisation of the numerous population surveyed in a census is lengthy procedure, and it may be a considerable time before the results of the census can be available. This, of course, means that besides being extravagant in time and labour, the money costs involved are also very high. Perhaps it will result in being more expensive than the results justify.
In a census, there are usually many initial non-responses, and it is often impracticable to make re-visits because of the expense involved. As a result of this the census is in danger of being incomplete.

In a sample survey, only a selected proportion of the population is enumerated and, as a result of this, there is a saving in time, labour and money. Although there is a cash saving, the cost of surveying each unit will be higher than in a census. However, more detailed information can be obtained in a sample survey, because a greater number of questions can be asked per unit interviewed.

Non-responses will also occur in a sample survey, but since the number will be much smaller than in a census, it is more practicable to make re-visits in order that the information obtained is complete.

The speed of the field work and the analysis of results is much quicker where only a sample is taken, and this is of great importance where fairly rapid decisions on policy have to be made.

Thus, sample surveys have many advantages over censuses in finding out facts about agriculture especially in underdeveloped countries. The local organisation of such surveys is often carried out by the Department of Agriculture and this is the reason why Post Graduate students at I.C.T.A., take part in such a survey, in order that they have some knowledge of the techniques used.

The survey of farmers who supply cane to Trinidad Sugar Estates Ltd., was chosen not only for the above reason. Since the time available to organise and complete the sample survey was limited the subject chosen had to have a reasonably good frame as there was insufficient time to construct one. The importance of a good frame will be discussed later.

It was known that Trinidad Sugar Estates Ltd., would have such a frame available, and they had already stated their willingness to co-operate. A relatively minor point in the selection of this
particular sample survey was that there was a lack of detailed knowledge of sugar cane farming in the area.

The team then met Mr Bateson, the cane farmers' supervisor of Trinidad Sugar Estates Ltd., and as a result gained valuable background information about the organisation of the cane estates and the tenant farmers, and also the problems encountered in the area. Access was given to all records which might prove useful. It was from these that the frame used in the survey was chosen.

**SAMPLING PROCEDURE**

1. **The Frame and Stratification**

   It was shown by Auckland *et al* (1959) in their survey of the Banana Industry, that a good frame is essential for the success of any survey of this nature. In this survey, the frame used was a card index of all farmers with contracts to deliver cane to Trinidad Sugar Estates Ltd., and the tonnage of cane delivered in 1960. The cards were arranged according to estates on which the company rented land to farmers and there was a separate file for all the private lands. Within these various groups the individual farmers' names were arranged alphabetically.

   The only alternative frame was the file in which the company kept a record of the acreage rented by farmers. However, the acreages of plots of land held freehold were unknown and with the limited time available it was impossible to obtain them. This immediately ruled out stratification based on acreages which in any case, was found to be unsuitable by Bohun *et al* (1960) in their survey of cane farming in the Caroni area.

   Several means of stratification were discussed and all but one were discarded due to lack of information or because they were likely to be ineffective.
It was impossible to stratify on the basis of land tenure as many of the farmers who held land freehold also rented land, thus giving no clear cut division between the two. With the information available it would have been possible to stratify according to the estates on which land is rented. However, this was not likely to be effective as these estates are very similar topographically, and the cultural techniques would be similar in all areas. It was also known that the majority of the farmers live in urban areas and their homes are completely divorced from their cane plots, and thus it was suspected that there would be very little difference between the type of farming on different estates.

It seemed that the only basis of stratification which would yield profitable results was the tonnage of cane which was delivered in 1960 and this was the basis used.

The strata chosen for the survey were:

I. Farmers who produced between 0 & 10 tons of cane in 1960

II. " " " 1.1 & 20.0 " " " " "

III. " " " 20.1 & 100.0 " " " " "

IV. " " " more than 100.1 " " " " "

It was thought that farmers who produced more than 100 tons of cane might find it possible to make a full time living as farmers, whereas those who produced less than 100 tons would find this difficult and would probably have to find alternative employment for part of the year. Farmers who produced less than 20 tons of cane per annum would be liable to find some difficulty in replanting their cane. There would be a great temptation to cut more than the usual number of ratoons as replanting often means that there is no income from the cane for one year, and the cost of replanting is relatively high to the small farmers. The farmer who produces less than 20 tons of cane per annum is more likely to find difficulty in transporting his cane as it will not pay him to keep his own animal.
The 0 to 1.0 tons stratum was included because it was seen that many of the contract holders delivered no cane in 1960, and it was thought desirable to find out why this was so.

It was thought that considerable differences in farming techniques would be brought to light with such a stratification.

There were on the companies records, five contracts which delivered more than 300 tons of cane in 1960. One of these was held by a person who rented land to farmers on a private estate. This however, was only on a temporary basis since the land was scheduled for housing purposes. The estate owner refused to co-operate in the survey and since these farmers were soon to lose their land they were excluded from the survey. Of the remaining four, two were teaching establishments, one was an experimental station, and, in the other case, cane was a temporary intercrop in the establishment of a citrus grove. Since all of these did not represent normal commercial cane production, it was decided to omit them from the survey.

2. **Sampling Fractions**

It was decided to use a variable sampling fraction in the different strata in order to increase the efficiency of the survey. To obtain more accurate information about these farmers who contributed most to the cane production in the area, a larger proportion of them were to be included in the sample.

The overall sampling fraction for the population was determined by the number of enumerators who would be available, and the amount of work they could complete per day. It was assumed that 15 post graduate students would be available, and that they would be able to do 10 enumerations in three days. This did not seem unreasonable as the farmers' homes are in a fairly compact area and not much travelling was necessary. Thus it was estimated that 120 farms could be enumerated with the resources available.
When the sample was being drawn, a reserve sample of 31 was also drawn. This reserve sample could be used in a pilot survey or could be included in the survey if a higher sampling intensity was required and if the resources available for enumeration were adequate. It was finally decided that such resources would be available and the reserve sample was included in the overall sample. It was thought that this would increase the accuracy of the survey.

With the removal of certain special cases from the sample, the final sample was 148, which represented 1/8th of the total population. The following table shows the final sampling fractions.

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>Final Population</th>
<th>Final Sample</th>
<th>Final Sampling Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1.0</td>
<td>316</td>
<td>6</td>
<td>1/53</td>
</tr>
<tr>
<td>1.1 - 20.0</td>
<td>520</td>
<td>24</td>
<td>1/22</td>
</tr>
<tr>
<td>20.1 - 100.0</td>
<td>319</td>
<td>97</td>
<td>1/3</td>
</tr>
<tr>
<td>Over 100.1</td>
<td>35</td>
<td>21</td>
<td>2/3</td>
</tr>
<tr>
<td>Total</td>
<td>1190</td>
<td>148</td>
<td>1/8</td>
</tr>
</tbody>
</table>

3. Drawing the Sample

The contract holders were first classified into their production groups, and then every q'th farmer was selected, where 1/q was the sampling fraction. The first unit in each stratum was selected by choosing a random number between one and q. This system of systematic sampling is almost as good as random sampling provided that certain types of individuals do not appear periodically on the list, (Yates, 1953). There was no evidence of the list not being random, nor was there any evidence of periodicity.

4. Defects of the Frame and Special Cases

The frame is the basis of a sample survey and its nature and accuracy will affect the form of the survey and the accuracy of the
results obtained from it.

The frame used was a good one, being complete and up to date since it was a record of all cane deliveries made to Orange Grove Factory in 1960. However, it was not completely accurate as it was subject to some duplication. In cases where an individual farmed more than one plot of land, it was possible that he could hold more than one contract and thus have more than one card in the file. This is known to the company, who are gradually eliminating this fault. However, this resulted in farmers being wrongly stratified.

This inaccuracy could not have been corrected by putting the units into their correct strata after their total deliveries had been found, for, if this had been done, the sample would then have borne an unknown relationship to the whole population.

Restratification of the population was impracticable, as it would have taken too long to sift through the records to find the cases in which the cards are duplicated.

The total number of special cases discovered in the sample was six or approximately 4%.

It was found that one card in the file used as the frame was one which referred to a block of land which had been taken from a farmer and was being farmed by the estate. This was the only case of its type and it was removed from both the sample and the original population.

Three of the special cases were farmers who had no land. One farmer was in hospital and could not be interviewed and one farmer could not be located at all. These special cases did not alter the original population total. By using the appropriate raising factors, an estimate of the numbers of farmers who had no land in the various strata was obtained.

It is difficult to explain why some farmers have no land yet were paid for cane produced in 1960. The only explanations are that the land has been taken over for building purposes or has
been taken over by the estate since the 1960 crop.

Full figures of sampling fractions and special cases can be found in Appendix I.

ORGANISATION OF ENUMERATION

1. Mapping

It was necessary to find out where the farmers in the sample lived, and to map their houses so that the enumerators could go straight to them to interview the farmers. The farmers’ homes were located by the team with the help of a workman provided by Trinidad Sugar Estates Ltd., who was said to know most of the contract holders. As each home was located, its position was marked on a sketch map in relation to main roads, milestones and telegraph poles. In many cases a short description was given.

If the farmer was at home, the purpose of the visit was explained and an approximate enumeration date was given. In this was most of the farmers had some idea of what was happening.

At a later date, the sketch maps were transferred to the front page of the questionnaire along with written directions as to the location of the house.

2. The Questionnaire

The questionnaire was based on that used by Bohun et al in a sample survey of farmers supplying cane to Caroni Ltd. On the whole this questionnaire had worked satisfactorily in 1960, and it was the team’s intention to strengthen the weaker parts of it and to modify it in certain parts to make it more applicable to the area under survey.

In 1960, it was found that a great proportion of the farmers employed labour to the value of $50 per annum, and that most of them earned more than this amount in outside employment. This year it
was decided to find out more exactly the labour costs and the income from alternative employment.

Trinidad Sugar Estates Ltd., set aside a field of cane from which farmers can have planting material. The variety is one which has proved its value on the soils in that area. Since this system is unique in Trinidad, the extent to which the farmers make use of it was to be investigated.

The questionnaire consisted of a top sheet giving all that was known about the holding, and two other pages which contained three groups of questions which were as follows:

i. Questions relating to all plots of land farmed by the farmer.

ii. Questions relating to cane cultivation techniques.

iii. Questions relating to the farm as a whole and other sources of income.

A set of instructions was issued separately to each enumerator and a copy of this and the questionnaire can be found in Appendix II.

When the design of the questionnaire had been decided, members of the survey team did a pilot enumeration of some farms to find out if any alterations were necessary. No alterations were necessary.

In the pilot enumerations it was found that some farmers were more intent on telling the ideal way of running their holding and only very good framing of the questions resulted in the answers required. This experience was very valuable in formulating the instructions to the enumerators.

3. The Point Survey

In the 1960 survey the enumerators had to visit at least one plot of land farmed by each farmer in the sample. This was necessary as it was the only way in which an estimation of froghopper (Aeneolamia varia, var. saccharina,) damage and the condition of field drains could be found.

In the Caroni area most of the farmers lived close to their
land but in cases where the land was a considerable distance from the home difficulties were found in getting to the plot and completing the survey and in many cases it was not done at all. Most of the farmers who deliver cane to Trinidad Sugar Estates Ltd., live in the urban area along Eastern Main Road and their homes are completely divorced from their land, thus the same difficulties found in 1960 were foreseen in the 1961 survey. Since valuable information could only be obtained by visiting plots of land, some other form of field survey had to be devised. It was finally decided that this should be based on a point survey.

In a point survey, the whole area is mapped and points are selected at random within the area. Observations are then made at these points. In this survey ward maps of the scale 12 chains to 1 inch were obtained with the help of Trinidad Sugar Estates Ltd., and all the areas of farmers cane were marked. The optimum number of cane plots which could be visited with the enumerators available was about 50. A 2" x 2" grid was put over the ward maps and this gave about 50 points falling on farmers' cane. Using this method the cane plots selected are randomly distributed.

It was the duty of the enumerator to trace out the points allocated to him in relation to roads and landmarks and to go to the plot on which the point fell and to measure it and make observations on it. The definition of a plot was given in the set of instructions. The measurement of the area was made in paces and, at a later date, the pace of each enumerator was calibrated and the measurements were then converted into feet, and then to acres.

A copy of the point survey sheet which was to be completed can be found in Appendix II.

4. Enumerators and Seminar

The enumerators used in the survey were post graduate students of I.C.T.A., who were available for this work before Christmas.
About one week before the enumeration was due to commence, a seminar was held under the chairmanship of Mr. G.E. Hodnett. The purpose of this was to give the enumerators a background to the survey, and to elaborate on the questions and the instructions given in the questionnaire and instruction sheets. On the same day, eye estimates of yield and froghopper damage were calibrated.

5. **Organisation of Transport**

In view of the restricted mileage allowance, it was necessary to restrict the number of cars to be used in the enumeration. One full car load of enumerators was to go to each area, each enumerator was to be dropped close to his first holding, and then he was to proceed on foot to the others. It was up to the driver of the car and the occupants to decide where and when they were to be picked up and taken home. However, difficulties were soon encountered and this system did not work too satisfactorily. These difficulties will be discussed later.

6. **Supervision of Enumerators**

The enumerators knew beforehand when they would be required to work. On the first morning each enumerator was given all his questionnaires and a set of instructions and was allocated to a car. The car drivers were given the set down points and were responsible for fixing the pick up points and times.

There was no supervision of the enumerators in the field. There were several reasons for this, the first of which was that it was considered unnecessary after the team's experience in the pilot enumerations. This had been completed without difficulty, and the team had confidence in the enumerators being able to do the work after having attended the seminar. There were not as many enumerators available as had been expected when the survey was being planned. This resulted in the team having to do much of the enumerating, and
little time was left for supervision. Had the time been available, it would have been very difficult to supervise in the field as it would be impossible to say at which holding an enumerator would be at a specific time.

On completion, the questionnaires were collected by members of the survey team and were checked as soon as possible. The car drivers were required to state the mileage done each day and approved claims for mileage allowances were made by the individual drivers.

Transport arrangements were similar for the point survey and again there was no supervision in the field for the above reasons.

7. Difficulties in the Field

There was very little resistance on the part of the farmer when asked questions, and this was no doubt due to the good advertising of the purpose of the survey when the mapping was being done.

During the first day of the enumeration, it was found that it was difficult to find the farmer at home during the morning. The main reasons for this were that the farmers worked in their plots during the morning and the plot is usually a considerable distance from the home, or else the farmer had alternative employment during this slack time of year, i.e. before harvest. This was not foreseen in the pilot enumerations as they were carried out in the evening. The decision had to be made whether to discontinue morning work, or to carry on as before in the hope of finding farmers at home during the morning. In most cases when the enumerators had found that the farmers were not at home, they had fixed a suitable time to hold the interview. Some were arranged for the mornings and others for the afternoons and evenings. Thus it was impossible to completely discontinue morning work. This however, completely disrupted the transport arrangements.
In some cases, it was so difficult to find the farmers at home that several visits had to be made before the questionnaires could be completed. This greatly increased the cost of the survey.

In a few cases, farmer's homes were wrongly mapped, mainly due to similarities in names. These errors had to be rectified. This was often done by the enumerators who enquired as to the whereabouts of the correct address. At times however, this did not work and members of the team had to go to Trinidad Sugar Estates Ltd., where there was usually someone who knew the correct address.

There was little difficulty in finding the plots in which the points fell in the point survey. The main difficulties were in the measurement of plots with irregular shapes and indistinct boundaries. Sketch maps of the irregularly shaped plots along with the length in paces of all the sides were made. The areas were then worked out at a later date. In cases where boundaries were indistinct there was usually a peasant working reasonably close at hand who was willing to point out the correct boundaries.

8. Conclusions

The success of a sample survey is greatly dependant on the initial organisation. In this survey, some parts were well organised but others were very badly done.

The mapping was, on the whole, well done as most of the enumerators were able to find the farmers' homes without difficulty. When the enumerators were able to find the farmers at home, and the interviews were being conducted, it was shown that the list of instructions and the advice given in the seminar proved very useful, as very little difficulty was found in getting the farmers to answer the questions.

The enumerators used in the survey had no training period, and only some advice and instructions were given. More time should
have been spent on demonstrating the limits of the visual observations to be made in the field. Visual measurement is difficult at any time but the very short period of demonstration made the work much more difficult.

In the point survey, the soil type of the plots visited had to be put into one of three classes. These soil classes were not demonstrated at all. It is human nature to judge one thing relative to another; thus it could be the case that if an enumerator went firstly to a plot with very heavy soil, and then proceeded to a lighter one, the former would be classed as heavy and the latter classed as light. However, in another district a few miles away, this "light" soil may be relatively heavy and would be classed differently. This makes the results of the investigation of very doubtful value, and shows the need of laying down rigid standards of classification.

There was little organisation of transport carried out other than allocating enumerators to cars and cars to districts. When it was realised that the pilot enumerations had failed to show that few farmers were at home during the mornings, transport became completely dis-organised. By this time it was too late to work out a satisfactory solution for reasons discussed earlier and, as a result, the costs of the survey were greatly increased. This shows the great need for good preliminary investigations and good transport arrangements, so that there is no excessive expenditure of time, labour or money.

When the level of sampling was being arranged, it was assumed that about 15 enumerators would be available but when the enumeration was due to commence only 9 enumerators could participate. The main reason for this being that at this time of year the other students had either too much work to do on their own projects, or else they were going on holiday. As a result of this, more than 60% of the enumeration had to be done by the survey team. This left very
little time for supervision of the work by other enumerators.

Little supervision was however required, and the only stage at which it would have been more helpful was in the checking of completed questionnaires as soon as they were brought into the office.

Despite all the difficulties encountered, the field work was completed in a reasonably short time. This was, however, mainly due to the efforts of the team.

**ANALYSIS OF RESULTS**

1. **Abstraction**

   When the enumeration was completed, it was necessary to check and code the questionnaires, and then all of the information required from the questionnaires had to be abstracted. Transfer of data from one sheet to another is very laborious and involves the risk of copying errors and cross checks had to be made fairly frequently on the abstraction sheets.

   Originally about 300 sheets had to be handled but this was reduced to five during the abstraction process. This meant that the information was readily available without loss of time in looking for the appropriate sheet.

   During the abstraction, all figures relating to acreages were corrected to two decimal places as were the raised strata totals. The raising factors were taken to one decimal place.

2. **Aims of Analysis**

   The aims of the analysis of information collected in the survey are listed as below.

   1. With quantitative variates such as the acreage under cane cultivations.

      (a) Estimation of the stratum population totals, means and proportions.
The stratum population being the total numbers of contract holders in that stratum.

(b) Estimations of Standard Errors for the individual strata populations and for the total population.

2. With qualitative variates such as the number of farmers who intercrop their plant cane.

(a) Estimation of stratum population totals and proportions.

(b) Estimation of Standard Errors for the individual strata populations and for the total population.

3. (a) Estimations of totals and proportions from the point survey results.

(b) Estimations of Standard Errors for the totals from the point survey results.

3. Notation

The notation used is that used by Yates (1953). A super-bar denotes a mean value, a single sub-bar denotes an estimated value and a double sub-bar denotes a true value.

\[ \begin{align*}
  f &= \text{sampling fraction} \\
  g &= \text{raising factor} \\
  i \, (\text{suffix}), &= \text{denotes values belonging to a particular stratum i.} \\
  n &= \text{number of units in the sample} \\
  N, \hat{N} &= \text{number of units in the population and its estimate} \\
  p &= \text{proportion of units in the population possessing a given attribute} \\
  q &= 1 - p \\
  s^2 &= \text{estimate of variance of any given variate} \\
  S &= \text{summation of units} \\
  S, S &= \text{sums of squares} \\
  S. E &= \text{estimated standard error} \\
  U &= \text{number of units in the population with a given attribute} \\
  U, U/ &= \text{not applicable} 
\end{align*} \]
\( U, u \) = Number of units in the population with a given attribute and its estimate

\( V \) = estimated variance of any variate

\( \overline{X} \) = estimated mean of a quantitative variate

\( \hat{Y} \) = estimate of population value for a quantitative variate

4. Formulæ Used

I. Formulæ for quantitative variates

(a) Stratum totals and means

\[
N = \sum n
\]

\[
\overline{X} = \frac{\sum (y) n}{n}
\]

\[
\hat{Y} = N \overline{X}
\]

(b) Standard errors of totals

\[
V(\hat{Y}) = n s^2 \frac{g(g-1)}{n}
\]

II. Formulæ for qualitative variates

In these formulæ \( y = 1 \) if the sampling unit has the given attribute and \( y = 0 \) if the attribute is absent.

Therefore \( \overline{Y} = \frac{u}{n} = p \)

(a) Standard errors

\[
V(\overline{X}) = \frac{1}{n} \left( S(y^2) - \frac{(S(y))^2}{n} \right) \left( 1 - f \right)
\]

\[
V(p) = \frac{p(1-p)}{n-1} \left( 1 - f \right)
\]

\[
U = g \hat{u}
\]

\[
V(U) = g(g-1) \frac{u(n-u)}{n-1}
\]
DISCUSSION OF RESULTS

1. Introduction

According to Yates (1953), sample surveys will only be of use if the sampling errors are sufficiently small not to affect the validity of results for the purposes for which they are required.

In this survey a fairly narrow range of standard errors were found. Standard errors were calculated only for the main quantitative and qualitative statistics. The main quantitative estimates were, the whole farm acreage, the total cane acreage, the acreage planted in 1960 and the acreage on which fertiliser was applied. The standard errors for these were reasonably low, varying from 8 to 14%. In the individual strata the standard errors varied from 5 to 44%.

The qualitative estimates for which standard errors were calculated were, the numbers of farmers who drained plant cane land, the numbers who intercrop, the numbers who cultivate by machine and the numbers who control froghopper by chemical means. In these the standard errors ranged from 11 to 27% and in general were reasonably low. The standard errors for the individual strata ranged from 3 to 62%. The high standard errors for individual strata was partly due to low sampling fractions and partly due to the high degree of variability in some strata.

The high percentage standard errors in individual strata were not important as the purpose of the survey was not primarily to compare individual strata, but to obtain a general picture of cane production in the area.

In the 0 to 1·0 tons stratum, a sample of six was taken to find out why those contract holders did not deliver cane in 1960. Of this sample, one was dead, two no longer had any land, one was replanting all of his cane and two were wrongly stratified. This high degree of variability led to very high percentage standard
errors in statistics pertaining to this stratum. In the discussion of results, this stratum will not be mentioned as it has very little bearing on the agriculture in the area.

On the whole, the survey proved to be sufficiently accurate for the purpose required, and it was the opinion of the team that this accuracy would not have been greatly impaired if the sampling intensity had been less, particularly in the 20·1 to 100·0 tons stratum.

In the discussion of results which follows, for the sake of simplicity the various strata will be designated as follows:—

the 0 - 1·0 tons stratum will be referred to as Stratum I
the 1·1 - 20·0 tons stratum will be referred to as Stratum II
the 20·1 - 100·0 tons stratum will be referred to as Stratum III
the over 100·1 tons stratum will be referred to as Stratum IV.

Full details of the information gained in this survey are to be found in Volume 2 of the survey report. In this text of the report, acreage figures will be given to the nearest 0·01 acres and other figures have been taken to the nearest whole number, as greater accuracy cannot be claimed. The tables given in this report are abstractions from the complete tables found in Volume 2.

2. Land Use

The total population surveyed was 1190 farmers and it was estimated that they farmed 2620·5 acres, giving an average farm size of 2·2 acres. The full figures of total acreage, cane acreage and numbers of farmers within the stratification groupings can be seen in the following table:
From the above figures, it can be seen that the majority of the land is farmed by those producing less than 100 tons of cane, whereas those producing more than this figure farm only about 8% of the land area. When the 1960 cane survey was being organised, the Cane Farmers Association stated that farms of less than five acres were uneconomic units. In the Caroni area about 3/4 of the farms could be considered uneconomic but in this area only 3% could be considered economic.

Despite the fact that the farm sizes are very small, most of them are subdivided into several blocks. Blocks of land were defined as being distinct units geographically or as regards tenure. The table below shows the subdivision of the land in this area.

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>Average Farm Acreage</th>
<th>Average Number of Blocks per Farm</th>
<th>Average Block size (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 0 - 1.0</td>
<td>1.00</td>
<td>1.17</td>
<td>0.85</td>
</tr>
<tr>
<td>II 1.1 - 20.0</td>
<td>1.62</td>
<td>1.47</td>
<td>0.97</td>
</tr>
<tr>
<td>III 20.1 - 100.0</td>
<td>3.05</td>
<td>2.34</td>
<td>1.30</td>
</tr>
<tr>
<td>IV over 100.1</td>
<td>5.75</td>
<td>3.57</td>
<td>1.64</td>
</tr>
<tr>
<td>Total</td>
<td>2.20</td>
<td>1.77</td>
<td>1.24</td>
</tr>
</tbody>
</table>

Such subdivision of farms will undoubtedly lead to many management problems, and it is possible that those blocks nearest to the farmer's home will receive more attention, while those further away may tend to be neglected.
The small farm sizes and the subdivision of the farms is mainly due to the high percentage of unemployment in the urban areas of Trinidad. Most of the farmers in this area have their homes in urban areas and lack of other employment leads to pressure on the agricultural land nearest to these areas.

Very little of the land in this area was held freehold, but of what there was, stratum IV had the highest percentage of it. This may be an indication that those farmers are prepared to invest money in land in order to make a living from farming alone. Almost half of the land in the Caroni area is held freehold, and there is no apparent reason for the very low proportion in this area.

Although no estimate was obtained in this survey, it seemed that most of the farmers were tenants of Trinidad Sugar Estates Ltd., who give written tenancy agreements but at the same time exercise strict control over land use. This has the effect of eliminating the very poor farmer and the land if usually re-allocated to the better farmer, although in some cases, the land is taken over and farmed by the estate. This is no doubt the reason why most of the area is under cane cultivations and relatively little is uncultivated or under food crops. As a result of the enumeration, it was estimated that 89.1% of the 2620.5 acres total area was under cane and in the point survey the results were 81.0% out of 2419.2 acres. The standard errors being 8.2% and 7.4% respectively.

All land rented by the estate must be used for cane production only and the growing of other crops if confined to freehold land or land rented from other landlords. This, however, does not include the intercropping of plant cane, a practice which is very widespread and in which it was estimated that more than 60% of the farmers participate. The proportion was highest in stratum IV and the reason for this could be that while striving to be full-time farmers they are trying to get the highest possible returns from the land available as it is difficult to increase the farm size. In the other
strata, the demands of alternative employment possibly limit the amount of intercropping which can be carried out.

The estate does its best to disencourage the intercropping of plant cane, the reason being that some of the food crops grown seriously reduce the cane yields. However, there is no definite experimental evidence that food crops are detrimental to the growth of plant cane. One school of thought considers tall intercrops, such as corn, pigeon peas and cassava, to be the only detrimental ones as they shade the cane considerably whereas others say that intercrops such as sweet potatoes and tomatoes also have a great effect on plant cane growth as they are serious competitors for water and nutrients.

At present, the estate will not allow tall intercrops to be grown and violation of this rule can lead to the loss of rented land. At the same time, they are trying to discourage all types of intercropping. This is, however, very difficult as vegetables find a ready market in the urban areas.

3. Cane Planting

From the questionnaires, it was estimated that almost 600 acres of cane were planted in the area in 1960. This represented about 1/4 of the total area under cane. The results of the point survey did not agree with this as it estimated that only about 12% of the cane was plant cane. This difference may have been partly due to difficulty in the recognition of six month old plant cane. From the enumeration results, it would seem that either two or three ratoons are cut depending on whether the plant cane is cut at the 12 or 18 months stage. Most of the cane in the area is planted in the period July to September and as a result little will be cut at the 12 months stage. Thus it would seem that 18 months plant cane and two ratoons are cut to make up the four yearly planting cycle.

It has been suggested that part of the blame for the low yields of peasant cane rests on infrequent planting. This does not
seem to be so in this area as the regularity of replanting is comparable to estate practice. When stratification was being discussed, it was thought that those who produced low tonnages of cane would have difficulty in replanting. Results showed that the proportion of cane planted in 1960 was much higher in strata II and III and was as low as 13% in stratum IV. The reason for this may be that with lack of attention some cane would deteriorate much faster than cane which is well looked after. This will necessitate more frequent replanting.

Most of the cane varieties grown in the area are modern ones. The main reason for this is that the estate provides planting material and almost 60% of the farmers take advantage of this. The material provided by the estates are modern varieties which have proved their worth under estate conditions. About 25% of the farmers in the area provided their own planting material in 1960 but the majority of this was taken from plants which at one time had come from the estate.

It is well known that different types of canes have different milling requirements and providing such a service ensures that the majority of the canes entering the factory are of the same type.

The commonest period for cane planting is July to September, although there is some planting at all times of the year. The cane farmer no doubt wishes to replant his cane as soon as possible after harvest and this is possibly the earliest time since replanting involves much preliminary land cultivation. It is interesting to note that the farmers in stratum IV plant the majority of their cane in the period October to December. This may be because each farmer has more land to be cultivated and it is likely that those who produce more cane are later to finishing the harvesting of it.

Most of the land preparations are performed mechanically, some is done by hand and relatively little done using animal power. The
reason for this is that cane in this area is grown on cambered beds and it is exceedingly difficult to form these beds with anything other than mechanical power. The cost of mechanical cultivation does not seem to be very limiting in any of the strata as the proportion of land prepared in this fashion is as high as 71% in stratum II and rises to 90% in stratum IV. The cost of mechanical cultivation is high since operating costs are greatly increased as only very small areas are to be cultivated.

It is very interesting to note that the figures pertaining to the drainage of plant cane land are very similar to those of mechanical cultivation, the reason being that the main type of drainage used in the area is that associated with cambered beds.

In this area where there is not much natural drainage, the fact that only 63.3% of the plant cane land is drained could have some serious effects on yields. Cane growth is seriously affected on badly drained land and bad drainage in one plot of land can lead to adverse growth on an adjacent plot. The point survey showed that 85.3% of the total cane area was drained, however, just less than 40% of the drains inspected were in a neglected condition.

It would seem that in this area drains are constructed where the land is cultivated mechanically. However, keeping drains in good condition requires much labour and since many of the farmers do not realise the advantages of good drainage the drains tend to be neglected until the replanting of the cane is necessary.

After the initial cultivations, the large lumps of earth are often broken up with a cutlass or a pick and the land is ready for planting.

The peasant farmer plants his cane by hand and the tool most commonly used is a pick. A fork or a crowbar being much less common. This result is to be expected when it is realised that 2/3 of the land is planted with short sets and a pick is very suitable for planting such material. Long sets are rarely used
as it is too expensive in material. Soldier setts accounted for about 1/4 of the area planted in 1960. These soldier setts (cane tops) are set upright in the soil. A crow bar is the most suitable implement for this operation.

About 40% of the land under cane receives pen manure and most of this is applied to plant cane land some time after planting. However, the benefit to the cane is doubtful as the more quickly growing intercrops will take most of the readily available nutrients, and probably the cane will only receive the long term benefit of the pen manure.

It was not ascertained in this survey whether there was any difference between the fertilising of plant cane and ratoon cane. However, little difference is expected and fertiliser use can be taken to be similar on both.

Since no distinction in the rates of application of pen manure and fertiliser were made between plant cane and ratoon cane both will be discussed later.

The only after cultivation necessary in plant cane is weeding. In general most cane receives two or three weedings per annum, although in some cases weeding may be continuous. It was noticed that some chemical weed control is being used by farmers in stratum IV. Although it is negligible at present, this labour saving practice may spread rapidly in the not too distant future.

4. Ratoon Cane Cultivations

Compared with plant cane, there are very few cultivations required in ratoon cane. Regular weedings are carried out and again this is done either two or three times annually or else continuously until the cane is high enough to smother out the weeds, and reduce the competition for nutrients and water.

Froggopper is considered to be the major pest of sugar cane in Trinidad and it has been estimated (Caribbean Commission Crop
Inquiry Series No. 6, 1947) that severe cases of damage by this pest can reduce the yield of cane by as much as nine tons per acre.

By means of the point survey it was estimated that 96.7% of the cane in the area had suffered some damage from the pest. This damage was in varying degrees and only an estimated 3.3% had died as a result. Nevertheless such damage much cause considerable losses which cannot be apparent to the peasant farmers for it was reported that no form of control was used on 83% of the cane area. In the individual strata there was great variation ranging from over 90% in stratum II down to 48% in stratum IV.

The main means of controlling froghopper is by the use of an insecticidal dust which was used on 12% of the cane area. 41% of the land farmed by those in stratum IV was dusted but the proportion was much lower in the other strata.

It is said that some measure of control can be had by removing the trash from the cane at regular intervals. Very little of this is done and its value is very doubtful.

There are several possible reasons why there is so little effort on the part of the peasant to control this pest. During the enumeration, when questions were asked about control, many farmers said that it was not necessary since there was little sign of froghopper damage. This may mean that many of the farmers cannot recognise the signs of this pest until the cane is actually dying. Another reason for lack of pest control may be that the cost of the dust is limiting to the very small farmer and it is only the larger farmer who can afford to control froghopper.

It would be impossible for a farmer to eliminate this pest from his small area of land unless his neighbours also tried to do it, since their plots act as natural reservoirs for reinfection following dusting of the crop.
5. Fertiliser Use

The most commonly used fertiliser on cane lands is a nitrogenous one, and very few farmers use phosphatic, potassic or compound mixtures of fertilisers.

In this survey the quantity of fertiliser used on the whole farm was determined but, since there are few crops besides cane grown in the area, the figures can be said to apply to the cane lands.

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>% Number of Farmers using N.</th>
<th>Mean Application of N. (cwts. per acre)</th>
<th>% Number of Farmers using P.M.</th>
<th>Mean Application of P.M. (Loads per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 0 - 1.0</td>
<td>50.03 1.03</td>
<td>16.88 2.33</td>
<td>2.33</td>
<td></td>
</tr>
<tr>
<td>II 1.1 - 20.0</td>
<td>83.46 2.09</td>
<td>70.94 6.50</td>
<td>7.84</td>
<td></td>
</tr>
<tr>
<td>III 20.1 - 100.0</td>
<td>95.17 2.55</td>
<td>78.62 5.84</td>
<td>4.37</td>
<td></td>
</tr>
<tr>
<td>IV over 100.1</td>
<td>100.00 3.47</td>
<td>87.43 4.37</td>
<td>5.50</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>78.19 2.71</td>
<td>59.07 5.50</td>
<td>5.50</td>
<td></td>
</tr>
</tbody>
</table>

Most farmers producing more than 20 tons of cane per annum use a nitrogenous fertiliser. However, the rates of application vary greatly between the strata; farmers in stratum IV used on average 3.5 cwts. per acre and those in stratum II used 2.1 cwts. per acre. The overall average for the area surveyed being 2.7 cwts. per acre.

Such rates of application are very low compared with estate practice where six cwts. per acre of a nitrogenous fertiliser is the usual application. Phosphate and potash are applied at two cwts. per acre and the land also receives twenty tons of pen manure and fifteen tons of compressed mud every three years. This may be one of the main reasons for the low yields of cane under peasant agriculture. Fertiliser is usually bought from the estate who give credit until cane payments are made. More recently the Cane Farmers Association have started to sell fertilisers to their members at a reduced price. Thus it cannot be said that it is the lack of immediate capital which limits the manuring of sugar.
cane. The true reason may be found in the Soulbury Commission Report which stated that the small scale farmer thought of his cane as money-bank in which he invests a little labour and no capital.

Just less than half of the area surveyed received pen manure, and it was suspected that much of this was applied to plant cane land. The rates of application by the different strata were a complete reversal of those for nitrogenous fertilisers. The reasons for this are that it was the smaller farmers who replanted most cane in 1960 and it is unlikely that the larger farmers will be able to produce sufficient pen manure to give high applications to their greater acreage.

The value of pen manure as a fertiliser for cane is doubtful and in any case its application is possibly uneconomic because of the high costs of transporting, and applying it to the land.

6. Yields

It was estimated that 24,087·4 tons of cane were produced in the area in 1960. The following table shows the production in the different strata.

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>Total Production (1960)</th>
<th>Cane Acres cut (1960)</th>
<th>Yield per acre</th>
<th>Total Cane Acres</th>
<th>Total Yield per acre from Total Cane Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 0 - 1·0</td>
<td>0·0</td>
<td>13·8</td>
<td>0·0</td>
<td>316·20</td>
<td>0·0</td>
</tr>
<tr>
<td>II 1·1 - 20·0</td>
<td>6,379·8</td>
<td>479·4</td>
<td>13·3</td>
<td>842·61</td>
<td>7·6</td>
</tr>
<tr>
<td>III 20·1 - 100·0</td>
<td>13,092·8</td>
<td>726·1</td>
<td>18·1</td>
<td>974·16</td>
<td>13·4</td>
</tr>
<tr>
<td>IV over 100·1</td>
<td>4,614·8</td>
<td>148·3</td>
<td>31·1</td>
<td>201·45</td>
<td>22·9</td>
</tr>
<tr>
<td>Total</td>
<td>24,087·4</td>
<td>1,485·6</td>
<td>16·21</td>
<td>2,334·42</td>
<td>10·3</td>
</tr>
</tbody>
</table>

From this it can be seen that those farmers who produce between 20·1 and 100 tons per annum contribute most to the cane production in the area.

Various estimates of the average cane yields per acre on peasant farms in Trinidad have been made in the past. The Soulbury Commission (1948) estimated it to be 9·6 tons per acre and the
B.W.I. Sugar Association Handbook (1958) gave it as being 15.24 tons per acre. If from this survey the average yield per acre is calculated from the total average cut in 1960 and the estimated total production, it is 16.2 tons per acre, just slightly higher than the figure quoted in 1958. However, it may be more realistic to calculate the yield per acre from the total area under cane, to get a more accurate figure for the efficiency of production by the peasant farmer. By using this method the average yield per acre is only 10.3 tons per acre which is very close to the figure given in 1948.

The yields obtained under peasant systems of agriculture are far below those obtained under estate conditions. This is even so on the best peasant farms. Estate yields are achieved by better cultivations, much higher applications of fertilisers, superior pest control, and better management all round.

Extension work could help the peasant farmer to improve his yields by making him realise the benefits to be obtained from heavier fertiliser applications and better pest control.

7. Transport

The main form of transport in the area is animal drawn carts. It was estimated that just over half of the farmers owned their own animals and many hired them at harvest times. About 2/3 of the farmers hire a tractor during the year but this is mainly for cultivation purposes and rarely for transport.

When a farmer goes to work in his cane he usually takes his animal drawn cart. By taking the speed of such transport to be about the same as that of walking i.e. about 4 m.p.h. it was estimated that more than 1/3 of the land is greater than two miles from the farmers' homes. In a few cases the land may be six miles distant.

If a farmer has two blocks of land, as most of them do, it is quite conceivable that there is some degree of unwillingness
to cultivate the more distant with the same degree of care as the nearer one will receive. The block of land nearest to the home will receive the bulk of the fertilisers and the pen manure applied. It will probably be weeded more often and it is more liable to be intercropped with high value vegetables. No such vegetables are grown on distant plots since petty larceny is very prevalent.

With animal transport, the carting of cane to the scales is very slow and with the long distances the cane has to be taken it is rare for a farmer to deliver more than one cartload per day. This results in the harvest period for the individual farmer taking a relatively long time.

Thus it can be said that the distances which have to be travelled and the methods of transport used seriously affect the efficiency of peasant cane farming.

Ownership of Transport

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>Tractor</th>
<th>Large Animal</th>
<th>Small Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 0 - 1.0</td>
<td>0.00</td>
<td>16.68</td>
<td>16.68</td>
</tr>
<tr>
<td>II 1.1 - 20.0</td>
<td>0.00</td>
<td>33.38</td>
<td>8.35</td>
</tr>
<tr>
<td>III 20.1 - 100.0</td>
<td>1.03</td>
<td>57.93</td>
<td>21.72</td>
</tr>
<tr>
<td>IV over 100.1</td>
<td>4.86</td>
<td>87.42</td>
<td>14.57</td>
</tr>
<tr>
<td>Total</td>
<td>0.04</td>
<td>37.12</td>
<td>14.33</td>
</tr>
</tbody>
</table>

The seasonal demand for labour in sugar cane farming varies. In some parts of the Lower Stratum many of the farmers were farmers in some only as they held full-time jobs outside agriculture and possibly only looked upon their land as a form of security. A very noticeable fact was that less than 10% of the farmers in stratum IV had outside employment. This merely indicates that they have almost achieved the state of being full-time farmers.
Hiring of Transport

% Numbers of Farmers Hiring:-

<table>
<thead>
<tr>
<th>Stratum (tons)</th>
<th>Tractor</th>
<th>Large Animal</th>
<th>Small Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 0 - 1.0</td>
<td>33.25</td>
<td>33.35</td>
<td>0.00</td>
</tr>
<tr>
<td>II 1.1 - 20.0</td>
<td>70.94</td>
<td>41.73</td>
<td>12.52</td>
</tr>
<tr>
<td>III 20.1 - 100.0</td>
<td>76.55</td>
<td>40.34</td>
<td>3.10</td>
</tr>
<tr>
<td>IV over 100.1</td>
<td>92.29</td>
<td>9.71</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>63.09</td>
<td>38.19</td>
<td>6.30</td>
</tr>
</tbody>
</table>

8. Hired Labour

With a crop such as sugar cane there are times of the year when there is much work to be done whereas at other times the farmer may be idle. At the busy times of the year many of the farmers have to hire labour and during the slack periods many find alternative employment.

It was estimated that about 40% of the farmers employed labour costing more than $100 per annum. In stratum IV almost 90% of the farmers paid more than this sum for hired labour. In some cases the cost of labour rose above $1,000 per annum and in one case a farmer paid more for labour than he could ever hope to get from his crop. However, it is felt that some of the very high costs given were slightly exaggerated.

To counteract the cost of hired labour about 40% of the population earned more than $400 per annum in outside employment. In some of the lower strata many of the farmers were farmers in name only as they held full-time jobs outside agriculture and possibly only looked upon their land as a form of security. A very noticeable fact was that less than 30% of the farmers in stratum IV had outside employment. This surely indicates that they have almost achieved the state of being full-time farmers.

The seasonal demands for labour in sugar cane farming makes it
difficult to manage a holding with such a monocrop. This coupled with the very small acreages makes it very difficult for a farmer to make a living entirely from his holding and forces him to take alternative employment which is often detrimental to the farm.

9. Conclusions

From this survey it would seem that there are very few, if any, farmers in the population who have holdings of economic size and who make a living solely from their farms.

Despite their size, most of the holdings are fragmented and the blocks of land are often very far from the farmers' homes. This results in management difficulties, and comparative neglect of some pieces of land.

The yields of cane are very low, even although modern varieties are grown. However, under peasant conditions they are never allowed to reach their potential as under estate conditions, the limiting factors being:-

1. The fertiliser applications are totally inadequate. Remedying this alone could possibly increase yields greatly.

2. There are very few attempts to control destructive pests such as froghopper in spite of its very high incidence.

3. In many cases the cultivations and land preparation are inadequate. Hand, animal and light tractor cultivations do not go deep enough for sugar cane and drainage is inadequate in more than a few cases.

4. Intercropping may reduce the yields of plant cane but more experimental evidence is required.

5. There seems to be a lack of extension work to make the farmers realise the implications of the above four facts.

Due to the seasonal demand for labour it is necessary for the farmer to hire labour and to find employment off the farm. Lack of land in the area, makes it impossible for other crops to be
grown during the slack periods of the year.

Many farmers use their land as a form of security against loss of full-time employment outside agriculture.
REFERENCES

A Sample Survey in Bananas in Trinidad.

A Sample Survey of Cane Farmers Supplying Cane to Caroni Ltd.

B.W.I. Sugar Association Handbook (1958)
Yuille's Printerie, Port of Spain, Trinidad, W.I.

Caribbean Commission Crop Inquiry Series No.6. (1947)

Soulbury Commission Report (1948)
Government Printer, Trinidad, W.I.

Yates, F. (1953)
Sampling Methods for Censuses and Surveys.
I would like to express my thanks to the following for help given during the Survey:

Dr. A.L. Jolly, Economics Department, I.C.T.A. Supervisor.
Mr. G.E. Hodnett, Regional Research Centre Statistician.
Mr. Bateson, and other members of the staff, Trinidad Sugar Estates Ltd.
The student enumerators.
The other members of the survey team.
### APPENDIX I

**SAMPLING FRACTIONS AND THE EFFECT OF SPECIAL CASES ON THE SIZE OF SAMPLE**

<table>
<thead>
<tr>
<th>STRATUM (TONS)</th>
<th>ORIGINAL POPULATION</th>
<th>ORIGINAL SAMPLE</th>
<th>ORIGINAL 'g'</th>
<th>SPECIAL CASES</th>
<th>SPECIAL POPULATION CASES</th>
<th>ADJUSTED SAMPLE</th>
<th>ADJUSTED POPULATION</th>
<th>FINAL 'I'</th>
<th>FINAL 'g'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1.0</td>
<td>316</td>
<td>6</td>
<td>52.7</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>316</td>
<td>1/53</td>
<td>52.7</td>
</tr>
<tr>
<td>1.1 - 20.0</td>
<td>520</td>
<td>24</td>
<td>21.7</td>
<td>2</td>
<td>0</td>
<td>24</td>
<td>520</td>
<td>1/22</td>
<td>21.7</td>
</tr>
<tr>
<td>20.1 - 100.0</td>
<td>320</td>
<td>100</td>
<td>3.2</td>
<td>4</td>
<td>1</td>
<td>97</td>
<td>319</td>
<td>1/3</td>
<td>3.3</td>
</tr>
<tr>
<td>Over 100.0</td>
<td>35</td>
<td>21</td>
<td>1.7</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>35</td>
<td>2/3</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1191</strong></td>
<td><strong>151</strong></td>
<td><strong>6</strong></td>
<td><strong>1</strong></td>
<td><strong>148</strong></td>
<td><strong>1190</strong></td>
<td><strong>1/8</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SUGAR CANE SURVEY QUESTIONNAIRE

A. (1) Serial No. 163
(2) Name (I or 0). Seepersad
(3) Address. Pasea
(4) Amount of cane delivered to Orange Grove factory from 1960 harvest. i.e. last harvest. 56.7 tons
(5) Directions to reach holding.

Trace next to T.P.8 - second house after the second T.P. after the bend in the trace - Modern house on short stilts.

Probably be at home after 5 p.m.
### B. Number of blocks and crops growing on them

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acreage (acres)</td>
<td>1</td>
<td>½</td>
<td>½</td>
<td>1</td>
<td>½</td>
</tr>
<tr>
<td>2. Ownership (T &amp; F)</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
<td>T</td>
</tr>
<tr>
<td>3. Time taken from:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Homestead to block</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>(b) Block to scale</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>(Exclude waiting time at scale)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### II PLOT

<table>
<thead>
<tr>
<th></th>
<th>A1</th>
<th>A2</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tonnage delivered 1960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Crops C,R,F,O,U</td>
<td>C</td>
<td>R</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>3. Acreage of Plot</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>½</td>
<td>1</td>
<td>½</td>
</tr>
<tr>
<td>4. Year and month of planting</td>
<td>6/59</td>
<td>6/58</td>
<td>8/60</td>
<td>6/60</td>
<td>6/60</td>
<td>6/60</td>
</tr>
<tr>
<td>5. Variety (X,M,O)</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>6. Fertilizer applied (O,N,P,K,M,C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) in 1960</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>(b) to plant cane in 1959</td>
<td>N.M.</td>
<td>N.M.</td>
<td>N.M.</td>
<td>N.M.</td>
<td>N.M.</td>
<td>N.M.</td>
</tr>
<tr>
<td>7. Froghopper Control (O,D,C)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. Farmer's estimate of production 1961 crop</td>
<td>36</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### C. Last planted cane plots

<table>
<thead>
<tr>
<th></th>
<th>C,D,E.</th>
<th>C,D,E.</th>
<th>C,D,E.</th>
<th>C,D,E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initial cultivations (H,A,M)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Drainage (Yes/No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Planting (F,P,C,P1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Planting material</td>
<td>L</td>
<td>Sh</td>
<td>Sr</td>
<td></td>
</tr>
<tr>
<td>(b) Where obtained (E,O,N)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Intercropping (Yes/No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Weeding (a) Number or whether continuous (C)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Method (H or S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*H,M.*

*No*

*P*

*Sh.*

*E.O.*

*Yes*
D. Whole Farm

1. Total fertiliser used

<table>
<thead>
<tr>
<th>Compound bags</th>
<th>PM bags</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>25</td>
</tr>
</tbody>
</table>

2. Transport

<table>
<thead>
<tr>
<th>TRACTOR</th>
<th>TRUCK</th>
<th>LARGE ANIMAL</th>
<th>TONKEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired Out</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Work off the farm in excess of in 1960

<table>
<thead>
<tr>
<th>Cane Estate</th>
<th>Other Cane farmers</th>
<th>Other crop farmers</th>
<th>Non agricultural work</th>
</tr>
</thead>
</table>

4. Cost of Hired Labour in 1960

<table>
<thead>
<tr>
<th>(i) Cultivation and Planting</th>
<th>(ii) Cultivation of Ratoon Cane</th>
<th>(iii) Harvest and Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>Rate of Pay</td>
<td>Amount $</td>
</tr>
<tr>
<td>Man Days</td>
<td>$50</td>
<td>$50</td>
</tr>
</tbody>
</table>

Signed:-
Date:-
A. (2) Definition of East Indian farmers (I) or others (0)

B. I

Blocks of land to be distinct units either geographically or as regard tenure in Private Lands. Each block should be denoted by a letter progressing in alphabetical order. Start with one block and on completing Section I move straight on to Section II, breaking the block into its component parts before proceeding to the second block.

A plot of land is any area with a distinct crop on it or with cane of a distinct age. Plots should be denoted by the relevant block letters followed by a suffix number A₁, A₂ ... etc.

I (1)

Acreage cultivated by the farmer as given by him. At the end ask the total acreage and then check that this agrees with the total of individual plots. Exclude land owned by him but let out to others.

(2) Ownership as stated by the farmer. Indicate tenant farmer by T and freehold by F.

(3) Distance from homestead to block and block to scale to be expressed in time in minutes taking the usual method of transport.

Note which method used. Automobile (A), walking (W) or cart(C).

II(1)

Tonnage of cane delivered in 1960 harvest from each plot. Check that these total up to the figure in A (4)

(2) Crop. Whether cane (C), food crops (F), rice (R), other crops (0) or uncultivated land (U). Where a block is in more than one crop each separate plot should be recorded in a separate column.

Definition of Other Crops (0) - include cucumbers, tomatoes, lettuce or anything known as "Pine vegetables".

Food Crops (F) - Maize, sweet potatoes, cassava, yams, etc.

(3) Acreage of plot - The farmer's estimate of acreage should be recorded. Check the total of individual plots against the total of block acreages in B.I (1).

Should the area of the plot be given as a length x breadth measurement in feet, yards or rods, a separate sheet is supplied to work out areas in these units. Then consult conversion table to obtain acreage.

(4) Year and Month of planting. This and the following questions apply only to sugar cane. Leave columns referring to other crops blank.

(5) Variety. Distinguish between modern (M) with identification numbers of more than four digits e.g. B 37161 and old (0) and unknown (X).

(6) Fertilizer applied. If none, insert '0' otherwise N,P,K or combinations, pen manure (M), or compound (C).

(a) 1960 - fertilizer application on individual plots

(b) 1959 - this to be restricted to plant cane only.
III(7) Froghopper Control. Determine method of control. Do not ask whether a particular practice was adopted. Indicate whether, no control (0), dusted (D), cultivation (C) or both.

(8) Farmers estimate of production for 1961. Check this against date of planting. If estimate appears high then the plot should be 18 month plant cane. Katoon cane will probably show a decrease in yield from the 1960 figure for yield c.f. E.II (1). Tonnage delivered 1960.

Questions in this section are to be confined to all plots planted in 1960. If none planted in 1960 then the most recently planted plot should be used. If two or more plots occur in a year other than 1960 only the most recent should be recorded e.g. if May and July 1959, record July 1959 only. The date of planting is shown in Section B. Part II, question Z.4. With the 1960 plant crop enter the earliest planted in the first columns and that planted on successive dates in following columns in chronological order.

1. Initial cultivation. Whether using hand (H), animal (A) or mechanical (M) draught power.

2. Drainage. Whether drains actually constructed or not.

3. Planting done using fork (F), pick or hoe (P), crowbar (C), or plough (Pl).
   (a) Planting material - Long setts (L), Short setts (Sh) or Soldier cane (Sr).
   (b) Where obtained. Estate (E), Own (O), Neighbours (N).

4. Intercropping. Yes or no.

5. Weeding. Distinguish between separate weedicings and a single weeding spread over a period of time interrupted at intervals.
   (a) Note number of weedicings or whether continuous (C).
   (b) Method used. Hand (H) or Chemical (S).

D. 1. Record number of bags of fertilisers or cartload (pen manure). Where less than one bag used record the pounds weight and take one truck of pen manure to three cartloads.

2. Transport. Large animal include waterbuffalo, oxen, mules and horses.

3. Work off the farm in excess of $ 0
   100
   200
   400
   600
   800

Tick appropriate figure. This is confined to the year 1960. Please tick against category of work off farm and in appropriate column i.e. Mostly, Occasionally or Rarely.

Cultivations and Planting\]

Cultivation of ratoon cane

Harvest and transport

Specify the amount which has been paid out in each category.
**POINT SURVEY**

**Identification number of plots**

**Observations:**

1. **Estimated tonnage**
   - Less than 10 tons per acre
     - 10 - 25 " "
     - 25 - 40 " "
     - More than 40 " "

2. **Froghopper damage**
   - No scarring of leaf tissue
   - Scarring of leaves
   - Dead cane, dead terminal leaves

3. **Soils**
   - Light
   - Medium
   - Heavy

4. **Drainage**
   - Yes
   - No
   - If yes, observe state of drains
     - well kept
     - neglected

5. **Size of plot.**
   - Length in feet: 70, 105, 60, 80, 70
   - Width in feet: 25, 25, 50, 30, 25
   - Area in square feet
CONVERSION TABLE

1 acre = 160 sq. rods = 4,840 sq. yds = 43,560 sq. ft.
1 rod = 5\(\frac{1}{2}\) yds

<table>
<thead>
<tr>
<th>Acres</th>
<th>Sq. Rods</th>
<th>Sq. Yds</th>
<th>Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 acre</td>
<td>20 sq. rods</td>
<td>605 sq. yds</td>
<td>5,445 sq. ft.</td>
</tr>
<tr>
<td>1/4</td>
<td>40 &quot; &quot;</td>
<td>1,210 &quot; &quot;</td>
<td>10,890 &quot; &quot;</td>
</tr>
<tr>
<td>3/8</td>
<td>60 &quot; &quot;</td>
<td>1,815 &quot; &quot;</td>
<td>16,335 &quot; &quot;</td>
</tr>
<tr>
<td>1/2</td>
<td>80 &quot; &quot;</td>
<td>2,420 &quot; &quot;</td>
<td>21,780 &quot; &quot;</td>
</tr>
<tr>
<td>5/8</td>
<td>100 &quot; &quot;</td>
<td>3,025 &quot; &quot;</td>
<td>27,225 &quot; &quot;</td>
</tr>
<tr>
<td>3/4</td>
<td>120 &quot; &quot;</td>
<td>3,630 &quot; &quot;</td>
<td>32,670 &quot; &quot;</td>
</tr>
<tr>
<td>7/8</td>
<td>140 &quot; &quot;</td>
<td>4,235 &quot; &quot;</td>
<td>38,115 &quot; &quot;</td>
</tr>
<tr>
<td>1</td>
<td>160 &quot; &quot;</td>
<td>4,840 &quot; &quot;</td>
<td>43,560 &quot; &quot;</td>
</tr>
</tbody>
</table>