

	Page
I. INTRODUCTION	1
II. SCOPE OF THE SURVEY	2
III. MATERIALS	3
IV. DEVELOPMENT OF SURVEY TECHNIQUES	10
V. FIELD WORK	12
A SURVEY OF FOOD GARDENS	
IN THREE COUNTIES OF TRINIDAD	13
(1) Tabulation of data	14
(2) Statistical analysis	20
(3) Results	22
VI. DISCUSSION	27
(1) Food crops	27
(2) Land use	28
(3) Survey work	28
(4) Analysis and results	29
VII. CONCLUSIONS	31
VIII. SUMMARY	32
IX. ACKNOWLEDGEMENTS	33
X. REFERENCES	34
XI. APPENDICES	35
XII. INDEX	36

1957

D.T.A. Report

Submitted as partial fulfilment
of the requirements for the Diploma
of Tropical Agriculture of the Imperial
College of Tropical Agriculture,
Trinidad, B.W.I.

CONTENTS

	Page
I. INTRODUCTION	1
II. SCOPE OF THE SURVEY	5
III. SAMPLING	7
IV. DEVELOPMENT OF SURVEY TECHNIQUES	14
V. FIELD WORK	17
VI. ANALYSIS OF RESULTS	19
(1) Tabulation of data	19
(2) Statistical Analysis	20
(3) Results	22
VII. DISCUSSION	25
(1) The frame	25
(2) Sampling	25
(3) Field work	26
(4) Analysis and results	27
VIII. CONCLUSIONS	31
IX. SUMMARY	32
ACKNOWLEDGEMENTS	33
REFERENCES	34
APPENDICES	35
MAPS	55

I. INTRODUCTION

In most tropical countries the food supply is inadequate. This is to some extent due to the fact that agricultural resources are relatively undeveloped in many parts of the tropics. It is, therefore, the aim of agricultural departments throughout these backward countries to increase agricultural production by the improvement of existing agricultural practises, and by the introduction of new methods wherever this may be practical.

However, the failure of a number of agricultural development schemes (Stamp 1953) has shown that it is necessary to use a certain amount of caution in connection with the introduction of new principles.

Before improvement plans for an area are put into action, in fact, before such plans are completed, some type of agricultural or land utilization survey should be made. The type of survey made will, of course, be largely determined by the information sought. Surveys may be usefully employed to expose problems of agricultural development, among which may be problems involving production potential, population density, drainage and irrigation, pests and diseases, transportation and accessibility, local customs and beliefs, and so forth. The success or failure of an agricultural development programme may depend on recognizing and allowing for such problems. The waste of time and money might often be avoided by a careful examination of the results of an agricultural survey. Therefore, a survey should be one of the first steps in agricultural reorganization or development (Economic Development of Jamaica 1952).

A complete land utilization survey provides information on every unit of the population investigated. Such detailed information may be required. For example, to increase the production of a certain tree crop, a government might

propose to provide fertilizers for every farmer, according to the number of trees he owns. In order to calculate the total amount of fertilizer required for the scheme, a complete survey would be required to determine the exact number of trees grown.

It is not often required that land utilization surveys be so detailed since they are usually employed to investigate an area as a whole.

Sufficiently accurate information on land usage may be provided by a sample survey, which can be carried in a much shorter time, at a much lower cost than a complete survey. Because manpower requirements are also lowered, a sample survey may be undertaken as a convenient project for a student group.

Two land utilization sample surveys have been carried out by post-graduate students of the Imperial College of Tropical Agriculture (see: Castle, Devonald, Hannagan, Humphreys, Mitchell, 1955; Buckler, Furber, Morgan, Murfitt, 1956.)

The 1955 group used a technique of area sampling to survey a large area in the northern plain of Trinidad. The 1956 group surveyed the same area again, but used a line sampling method. With other modifications in surveying technique, they improved upon the accuracy of the results obtained by the preceding group. It is doubtful that the accuracy could be further increased without making a more intensive and detailed survey. This would require more time and a greater number of investigators, and would be largely repetition. To carry out the same type of survey in another part of Trinidad would be impractical for a student group of the Imperial College. Another area of comparable size would be either too remote or too mountainous. If a distant survey area were chosen, too much time and money would be spent in travelling. The same could be said for a mountainous area where farms are inaccessible and widely scattered. The attentions of the 1956-57 team were, therefore, turned in other directions.

Several possible subjects for survey work were examined. Surveys of tree crops, rice growing areas, and fertilizer practises were considered, but were rejected either because of a narrowness of scope for field measurement, or because of the lack of a suitable sampling frame.

In Trinidad political circles there has recently been talk of increasing home food production to help reduce imports. It is apparent, however, that very little is known about food production. In fact, there are no available figures on which to base estimates of either quantity or quality of vegetables and ground provisions produced in Trinidad. It was felt that food gardens would provide ample scope for the development of measurement techniques. A very convenient sampling frame was also available (see Section 3). For these reasons, and because of local interest, it was decided that the present team should carry out a survey of food gardens.

Most of the food crops grown in Trinidad are grown by peasant farmers, and most of the produce is home consumed. Few, if any, peasants keep record of any sales they make. The only records one might find would be those kept by the government in connection with exported produce. With the possible exception of a few bananas, none of the export crops are grown in food gardens.

Peasant farmers in the wet tropics growing a variety of crops, tend to plant them somewhat haphazardly in mixed stands (Shephard 1950). Because of such irregular planting methods, and because of wide variation in the standard of cultivation throughout peasant areas, it is very difficult to estimate food production (Halcrow, 1947; Hunt, 1952). To carry out a survey, it would, therefore, be necessary to devise a method whereby these rather complex food gardens may be measured or sampled to estimate their individual production.

An attempt has, therefore, been made to develop a technique of sample surveying for food gardens, and a survey has been carried out with the following objectives:

1. To determine the numbers of ground provision and vegetable crops grown in an area of Trinidad.
2. To determine what definite crop combinations, if any, are used in planting mixed stands.
3. To estimate the area planted in food crops.
4. To investigate the standard of cultivation and the use of fertilizers in food gardens.
5. To investigate the methods of food crop disposal.

Since this survey was conducted as student project work, it has been subject to certain limitations, some of which have already been pointed out. Because of a shortage of time it has been necessary to limit the area to be surveyed. For the same reason, the extent to which the results were analysed, was also limited. The latter point will be more fully discussed in Section VII.

The present survey team consists of eight post-graduate students of the Imperial College, under the supervision and direction of Dr. A.L. Jolly. Each member of the team was elected to supervise the surveying of a part of the total survey area, and/or to concentrate his attentions on certain parts of the work. For a complete detailed review of this survey, reference should be made to seven other reports. (See: Currie, Gunn, Hill, Mawley, Meredith, Waterworth, Watson.)

In order to get an even wider picture, the county of St. David was admitted into the survey area. The predominant crop is again cocoa, but the gardens in this county are very remote from large markets. In addition to the above diversities, some variation in climate, topography, and soils exists within the survey area (Chenery, 1952).

Thus the survey was planned to cover the three

II. SCOPE OF THE SURVEY

In order to simplify both the design and the interpretation of agricultural surveys, it is convenient to limit them to defined areas. Survey areas are commonly defined by geographical or administrative boundaries. For reasons which will be dealt with in the discussion of the sampling frame, (Section III) it was practical to define the present survey area by administrative boundaries.

Since it is the most intensively cultivated area of Trinidad, it was logical that the county of Caroni (Map 1) should be included in the present survey. However, in Caroni, the population is largely of East Indian origin, the predominant crop is sugar cane, and Port of Spain, the best market for garden produce, is near at hand. All these factors are likely to influence the food gardening practises so that a food garden typical for the county of Caroni could not be said to be typical of another county. Therefore, the results of a food garden survey of Caroni would be of little value in assessing the significance of food gardens in the whole colony.

The county of St. Andrew (Map 1) was, therefore, added to the survey area to include areas of cocoa as well as sugar cane, and areas in which the population were of West Indian origin. The results of a survey of the two counties would have a considerably greater significance than the results of a survey of Caroni county alone.

In order to get an even wider picture, the county of St. David was admitted into the survey area. The predominant crop is again cocoa, but the gardens in this county are very remote from large markets. In addition to the above diversities, some variation in climate, topography, and soils, exists within the survey area (Chenery, 1952). *Why mention it no follow up details.*

Thus the survey was planned to cover the three

/ counties ..

counties of Caroni, St. Andrew, and St. David. The latter two are administrated as one county and, therefore, were treated as one county in this survey.

These counties have a total area of 368,436 acres, almost one third of the total area of Trinidad (1,267,233 acres).

For purposes of this survey, food gardens were originally defined as 'plots in which ground provisions and other vegetables are grown'. However, before field work was started, the question arose, "Should food gardens grown under tree crops be included in the survey?" Before answering this question, several members of the team made a trip to the Caura Valley, which is fairly near to I.C.T.A., to examine food gardens under cocoa. Cocoa is grown in the Caura Valley under conditions comparable to those found in the more distant counties of St. Andrew and St. David.

In general it was observed that where food crops occurred under cocoa, they were too sparsely planted to be called food gardens. It is probable that the food crops were originally planted as shade in establishing young cocoa plants, and subsequently have either been mostly harvested or have died out. It is unlikely that the relatively few remaining plants contribute significantly to food production. Moreover, because of their widely scattered nature, considerable time would be required to measure a small number of plants. For these reasons food gardens grown under tree crops were not included in the survey.

Food gardens which were the property of estates, or of holdings of more than 99 acres were also excluded from the survey by the sampling frame.

III. SAMPLING

The planning and execution of a complete agricultural survey is both laborious and time consuming. Moreover, as was illustrated in the introduction, the results of a complete survey may be much more accurate than is necessary. In most studies concerned with land usage, the estimated results of a sample survey would be as satisfactory as the results of a complete survey. Since time and manpower requirements are reduced by making a sample survey rather than a complete survey, so are costs reduced. Since the amount of data recorded in the field is less for a sample survey than for a complete survey of a given area, the time required for the analysis of results is also reduced. Part of the time saved can be usefully spent in obtaining more detailed information on points of particular interest. Therefore, it may often be advantageous to apply a technique of random sampling to survey work (Moroney, 1953).

If a sample survey is to be made, it is important that the correct sampling technique be chosen to suit the requirements. A suitable sampling technique must provide the required estimates to a satisfactory degree of accuracy. It is necessary that the degree of accuracy, or the sampling error, can be determined as a measure of the reliability of the estimate. The total sampling error may be divided into the error due to bias, and the random sampling error.

Error due to bias, caused by the inclusion of samples that are not truly random, can arise in a number of ways in survey work. In attempting to select 'average' sample units, an investigator might be unconsciously biased in favor of units which are slightly larger or slightly smaller than the true average. Other properties of the selection unit, for example quality, might give rise to bias of this kind.

An investigator who desires certain results may allow his desire to influence his selection of sample units, so that the sample will be biased. It is essential, therefore, that a well planned random sampling method is used to select samples for a sample survey.

Even when a sound sampling scheme is used, serious bias may be introduced into survey results by negligence on the part of enumerators. This is especially true in surveys that are based on personal interviews. Enumerators should be trained to recognize false answers. If a reply is suspected of being false, the question should be asked again in another way. ✓

When certain individuals of the selected sample are not available, enumerators may overlook them completely, or substitute other individuals in their place. In either case bias may be introduced. Negligence in enumeration can be detected by those directing the survey, by carrying out spot checks over the area surveyed. If enumerators are informed that checks will be made, their work is likely to be more satisfactory.

For survey work it is, therefore, necessary to use a sound method of random sampling, and in surveys where bias in enumeration is likely, to employ experienced conscientious enumerators who are constantly checked.

Even if a sample is chosen by a proper method of random selection, it cannot be exactly representative of the whole population. This inevitable error arising from the variability between the units of the population is termed the random sampling error. Since this error is approximately inversely proportional to the square root of the number of units in the sample, it can be most easily reduced simply by increasing the number of units in the sample. However, this may not always be practical, and may not be necessary, if

/ other ..

other steps are taken to reduce the effect of the variability between units of the population.

Stratification can be used to advantage in reduction of error, if the population to be sampled can be divided into two or more groups or strata within each of which the units are less variable. If each stratum is sampled proportionately in accordance with its size, it will be represented in the correct proportion in the final sample, and error due to differences between strata will be eliminated from the results. It should be pointed out that it is not always essential to stratify before sampling. Provided that adequate numbers of units in the final sample fall into each stratum, survey results may be adjusted so that each stratum is represented in its correct proportion.

Sampling error can sometimes be reduced by using a variable sampling fraction in different strata, whereby the more variable strata may be more intensively sampled. When this is done, the contribution of each stratum to the total estimate must be weighted proportionately according to the sampling fraction used.

Error can also be reduced by making use of supplementary information that may be available in results of previous investigations in the survey area. It may be known, for example, that the variability between units is greater in a certain part of the population. The population can then be stratified according to variability, and the more variable stratum can be sampled more intensively to give more accurate results.

The efficiency of sampling can be increased by the use of a multiple-stage sampling technique. In this method, the whole population is regarded as a group of first stage sampling units, each made up of second stage sampling units, etc. The sampling is carried out in stages. For example,

 / first ...

first stage units may be villages made up of second stage sampling units which are households. Third stage units could, in this case, be members of the household. This method is used chiefly to reduce work and cost, so that a larger sample can be taken. The samples at each stage must, of course, be randomly selected.

Random sampling demands that the material to be sampled can be divided into sampling units. Sampling units may be individuals, or aggregates of individuals as shown in the above example. Whatever sampling unit is chosen, it must be clearly defined. Definition is achieved by the use of a sampling frame in which every individual of the population is included. Frames commonly used for surveys include maps, lists of names, lists of households, or lists of other aggregates of sampling units.

For the present survey, a list of names of persons growing food crops in Trinidad, was available as a very convenient frame. The frame was provided by the Central Statistical Office of Trinidad, who have recently conducted an agricultural sample survey of the colony.

The rural dwelling areas of Trinidad have been divided into clusters, each of which contains approximately 150 adults. The counties of Caroni, St. Andrew, and St. David are composed of 401 of these clusters. For the agricultural sample survey, approximately ten percent of the clusters throughout the colony were selected in first stage sampling. Thus 41 clusters had been selected from the counties chosen for the present survey. From unpublished results of the agricultural survey, we were able to obtain as a frame, a list of names of all persons growing food crops in the 41 clusters. The list included only those persons having farms of less than 100 acres. These were divided into strata of under one acre and over one acre. Maps of each of the 41 clusters were also available. The present survey team was thus provided with a frame in which the first

2 stage ...

stage sampling was already completed, and the first stage sample was already stratified. By the adoption of this frame, it was possible for the team to take advantage of the ground-work done in preparation for the agricultural survey. Furthermore, the time saved could be well spent in more thorough field investigation.

The list of food growers in the 41 clusters was comprised of 1085 names. The survey was to be carried out during the first two weeks of the 1956 Christmas vacation, by a team of eight. Because of the relatively short time available for field work, it was necessary to carry out a second stage of sampling to reduce the list of operators to a size that could be surveyed by eight men in two weeks. It was estimated that each enumerator could survey at least four operators in one day, or sixty in a fortnight. Eight enumerators could then be expected to survey some 480 operators in the time available.

The list of 1085 operators was divided according to size of farm into strata of under one acre operators, and over one acre operators. Second stage sampling was then carried out. It was suggested that greater variability might exist in the over one acre stratum, so the variable sampling fraction method was applied. Samples of one in three from the under one acre stratum, and one in two from the over one acre stratum were randomly selected from each cluster, using a table of random numbers (Fischer and Yates, 1953). In this way, a sample of 430 food growers was selected, of whom 293 had holdings of under one acre, and 137 had holdings over one acre.

Since the ten percent first stage sample of 41 clusters contained 1085 food growers, the total 410 clusters in the three counties can be roughly estimated to have 10,850 persons growing food crops. Therefore, the final sample of 430 persons included approximately one twenty-fifth or four

4 percent ...

percent of the total number of persons growing food crops in the survey area.

The Central Statistical Office had divided the colony into agricultural zones as follows:

Zone 1	-	Northern Range cocoa	Zone 2
Zone 2	-	Central Range cocoa	Zone 3
Zone 3	-	Southern cocoa	Zone 4
Zone 4	-	Sugar cane	Zone 5
Zone 5	-	Coconuts	Zone 6
Zone 6	-	Urban	

Parts of zones 1, 2, and 4 are included in the present survey area. The 431 operators in the final sample were distributed among these three zones as follows:

Zone 1	-	24 operators
Zone 2	-	79 operators
Zone 4	-	262 operators

For the present survey, the existence of three zones provided a further stratification after sampling. However, this stratification is based on tree crops, and not on food gardens, and, therefore, may be of little value unless tree crops do influence the type of food garden in some way.

Summarizing, the sample represented a two stage scheme, stratified at the first stage by county and crop zone, and at the second stage by size of farm. A summary of the sampling scheme is given in Tables 1 and 2.

Table 1. Summary of Sampling

Sampling Steps	Population Groups		Planned Sampling Fraction	Actual Sampling Fraction	Total
First stage sampling	Clusters in survey area				401
	Clusters in sample area		1/10	1/9.78	41
Stratification	Operators in cluster sample who grow food crops	Over 1 acre Under 1 acre Total	-	-	249 836 1085
	Number of operators selected	Over 1 acre Under 1 acre Total	1/2 1/3	1/1.7 1/2.52	147 293 430
Overall sampling fraction			430/10850 = 1/24.69		

Table 2. Distribution of sample between
zones and counties (Operation).

County 1		County 2	
Zone 2	Zone 4	Zone 1	Zone 2
+ 1 acre - 15	+ 1 acre - 58	+ 1 acre - 14	+ 1 acre - 50
- 1 acre - 13	- 1 acre - 204	- 1 acre - 10	- 1 acre - 66
TOTAL 28	262	24	116
Total No. in cocoa zones - 168			
Total No. in sugar cane zones - 262			

In consideration of this, it was decided that the present survey should be based on recorded measurements made in the field, accompanied by a questionnaire. Some members of the team were elected to prepare a questionnaire while others investigated methods of measuring food gardens.

The questionnaire was planned to provide information concerned with crop disposal, manuring policy, standards of cultivation, yields, and proportions and combinations in which the various crops are grown. The final draught of the questionnaire is shown in Appendix 1. Qualitative questions with respect to crop disposal, manuring, and cultivation were designed so that the operators could give yes or no answers wherever possible. It was felt that by asking questions of this sort, an enumerator could obtain the required information in the shortest time. Thus the operators were to be asked, "Do you, or do you not market your crops, make casual sales, use artificial or organic manures, clear land annually, plough, or fork?" Operators also to be asked whether or not they grew certain crops in definite combinations. If they did, they would be asked to explain why. A column in which to record the operators' estimates of crop yields was included. In addition, space was provided for recording the racial origin of the operator, as well as any other useful information he might volunteer.

IV. DEVELOPMENT OF SURVEY TECHNIQUES

The agricultural sample survey made by the Central Statistical Office of Trinidad, was based entirely on a questionnaire. The accuracy of the results of such a survey could well be doubted, since farmers may be apt to exaggerate somewhat in their replies to questions concerning the quantity and quality of the produce of their labour. On the other hand, in fear of taxation, they might reply that their crops have failed. Therefore, one certainly might question the reliability of the results of a survey based entirely on a questionnaire.

In consideration of this, it was decided that the present survey should be based on recorded measurements made in the field, accompanied by a questionnaire. Some members of the team were elected to prepare a questionnaire while others investigated methods of measuring food gardens.

The questionnaire was planned to provide information concerned with crop disposal, manurial policy, standards of cultivation, yields, and proportions and combinations in which the various crops are grown. The final draught of the questionnaire is shown in Appendix 1. Qualitative questions with respect to crop disposal, manuring, and cultivation were designed so that the operators could give yes or no answers wherever possible. It was felt that by asking questions of this sort, an enumerator could obtain the required information in the shortest time. Thus the operators were to be asked, "Do you, or do you not market your crops, make casual sales, use artificial or organic manures, clear land annually, plough, or fork?" Operators also to be asked whether or not they grew certain crops in definite combinations. If they did, they would be asked to explain why. A column in which to record the operator's estimates of crop yields was included. In addition, space was provided for recording the racial origin of the operator, as well as any other useful information he might volunteer.

As pointed out in the introduction, the common practise of mixed cropping makes garden measurement very difficult. In fact, it is largely for this reason that little information is available on production of mixed crop gardens. It was necessary for the present team to devise some means of measurement in mixed crop plots on which to base estimates of the production or the total crop plant number in the plot. It was desirable that the method be relatively quick and easy to use, and yet as accurate as possible. The possibility of using transect sampling was considered. However, a transect sample of standard length would be too small for large plots and too large for small plots. The use of a transect sample of variable length would make the analysis of results more laborious and more complicated. Moreover, in row crops, a transect sample might fall between rows to give a completely false sample.

Transect sampling was rejected in favor of quadrat sampling, wherein all plants growing within a randomly placed square or rectangle would be included in the sample. Although the ideal shape for crop sampling is said to be rectangular, (Wishart, 1956) it was decided that a square would be more suitable, since it contains a greater area than a rectangle of the same perimeter, and is more easily laid out.

In an attempt to determine the optimum^M size, and number of sample squares to be used per unit area, three members of the team made a complete map of a one-fifth acre plot of mixed crops near the college. From this work it was determined that either very many or very large samples would be required to obtain low standard errors for the estimates of crop totals for the plot. Because the error of sampling within each garden would contribute very little to the overall sampling error, and because of limited time for field measurement, it was decided that a ten foot square would be the largest practical sampling unit that could be used. The area of 100 square feet contained in a ten foot square was estimated to be the greatest area in

∠ which ...

which plants could be counted accurately, without subdivision of the area. It was also decided that at least two samples should be made in plots of less than 0.1 acres and at least four samples in plots larger than 0.1 acres. Pure stands would be treated as separate plots. A method for random location of plot samples was also marked out (Appendix 3). Measurements for location of sample and for total garden area calculations, would be made by careful pacing.

In connection with counting plants within the plot sample areas, it was necessary to define a unit for each crop plant. This was done arbitrarily for each crop that we expected to encounter. The variation in sizes of plants of the same crop was not taken into account.

A measurement recording form was drawn up for recording plant numbers in the field. (Appendix 2) A direction sheet for enumerators was draughted, on which the techniques of field measurement were concisely stated. Standard units for each crop were also listed on this form (Appendix 3).

A map for each cluster was traced from maps made available by the Central Statistical Office of Trinidad, (see Map 2) and log-sheets (Appendix 4) were prepared so that the time and money spent on the survey could be calculated.

V. FIELD WORK

To distribute the work as evenly as possible, the 41 clusters were divided into seven groups. Each member of the team was appointed to supervise the surveying of one group of clusters as shown in Appendix 4. Meredith directed the sampling and was appointed to supervise the analysis of results.

Before the survey work was started, each supervisor made a reconnaissance trip to the group of clusters for which he was responsible, to make certain that maps were accurate, and to generally familiarize himself with the area. Each supervisor was responsible for entering names, addresses, and other information on questionnaires and measurement forms. Random numbers for selection of samples within the gardens (see Appendix 3) were also entered on each measurement form.

Supervisors also prepared daily instructions for enumerators while the field work was in progress. In these instructions a list of clusters to be surveyed was given. Most satisfactory routes to and from the clusters were explained. The order in which clusters should be surveyed was suggested so that a minimum amount of travelling between clusters would be required. Any other helpful information the supervisor might have concerning the area was noted.

It was also the supervisor's job to estimate the number of man-hours required to survey his area, so that enumerators who were not required in one area could proceed to another.

The team worked in pairs in the field. Each pair was equipped with a car, four ten foot rods for laying out samples within gardens, and two clip boards with general instruction sheets glued to the back (Appendix 3). Before leaving the college each morning, each pair were supplied with daily instructions, questionnaires, measurement forms, log sheets, and cluster maps. Cars used were the property of team members.

Because of the small size and irregular shape of many gardens, the use of the random sampling method was often impractical. Gardens are quite commonly planted on four sides of a set of buildings. Therefore, samples located by the prescribed method often fell on the buildings or on adjoining bare compound. In many cases, strips of garden beside houses, too narrow for a ten foot sample were heavily planted. The solution of such problems was left to the discretion of the enumerator. In many small gardens, instead of sampling, enumerators counted crops in full. Apart from the above difficulties, the survey proceeded smoothly. Only one operator refused to allow enumerators to examine his property.

Enumerators were responsible for working out area and crop number estimates for each garden and entering them in the space provided on the measurement forms. The supervisors were responsible for checking calculations on these forms, and for working out details of each log-sheet. It was also the duty of the supervisor to make note of operators not contacted, and to make sure that they were later surveyed in a follow-up. Since relatively few operators were not contacted during the main survey, few follow-ups were necessary.

A total of 451 man-hours or a little more than 56 hours per man were required for the field work including the follow-ups. Operators using artificialia could be separated in the sorting. From these, operators growing bananas could be separated in another sorting (see Appendix 5). Finally the number of bananas entered on each card could be totalled on an adding machine. The whole procedure would hardly take longer than 2 minutes or two. On the other hand, if the information was to be taken directly from recording forms used in the field, it would be necessary to sort through 450 questionnaires to determine which operators used artificialia. It would then be necessary to sort through 450 measurement recording forms, removing those for operators separated in the first sorting. The operators growing

VI. ANALYSIS OF RESULTS

(1) Tabulation of data

When field work, including follow-ups, had been completed, the information on the measurement forms and questionnaires was transferred to Cope-Chat clip-cards (Jolly, 1950; 1953). A brief discussion of the use of clip-cards, together with a diagram of the type of card used, and an outline of the system of coding used for this survey, is given in Appendix 5.

All information recorded in the field was entered on a separate card for each plot of garden. Information concerning plots on holdings of under one acre was entered on pink cards, and information concerning plots on holdings of over one acre was entered on blue cards. Information concerning plots with pure stands of one crop, and plots with definite combinations of crops was entered on separate cards.

Besides offering a compact method for filing information obtained in the field, the clip-card technique provided a means whereby the information could be sorted quickly and easily. The value of clip-cards in the latter connection can best be illustrated by an example. Suppose, that in studying the results of the present survey, one wished to know how many bananas were grown by operators in the sample who used artificial manures. Cards for operators using artificials could be separated in one sorting. From these, operators growing bananas could be separated in another sorting (see Appendix 5). Finally the number of bananas entered on each card could be totalled on an adding machine. The whole procedure would hardly take longer than a minute or two. On the other hand, if the information was to be taken directly from recording forms used in the field, it would be necessary to sort through 430 questionnaires to determine which operators used artificials. It would then be necessary to sort through 430 measurement recording forms, removing those for operators separated in the first sorting. The operators growing

/ bananas ...

bananas could then be sorted from these. The numbers of bananas could then be added as before, but the whole procedure would be both laborious and time consuming.

One might argue that an investigator would summarize his data before seeking the information described above. This is very likely true, but it would not be practical for an investigator to make summaries for all combinations in which the various attributes might occur. The beauty of the clip-card method of tabulating data, lies in the fact that the cards can be sorted quickly and easily for any combination of attributes that may be required.

(2) Statistical analysis

Having tabulated the data on clip-cards, the team was prepared to begin the statistical analysis. The first step in analysis was to summarize the data for each cluster on cluster summary forms (Appendix 6). To do this the clip-cards were sorted into clusters. All data for under one acre operators (pink cards) was transferred to one side of the cluster summary form, and all data for over one acre operators (blue cards) was transferred to the reverse side of the form. Crops were entered on these forms by the same system of coding used on the clip-cards. Most of the remaining data on the cards was transferred to appropriate positions on the summary forms. Numbers of crops and numbers of operators were totalled as shown in Appendix 6. As well as to consolidate the data for each size group in each cluster, these forms were planned to include raised sample totals in the columns provided for them. Totals would be raised by multiplying sample totals by the reciprocal of the fraction of the total estimated population that was contained in the size-cluster group, i.e. the raising factor. However, it was found to be unnecessary to raise totals at this point. Instead, raising factors were incorporated into the analysis at a later stage (see Appendix 8).

For the statistical analysis of crop numbers, the individual crop numbers for each operator were required. These

∠ were ...

were not included on the cluster summary forms so it was necessary to refer back to the clip-cards for this data. For ease and accuracy in computations it was desirable to consolidate these numbers. This was achieved by entering them on paper tapes with printing-type adding machines. Crops were dealt with one at a time as follows. A cluster number was stamped on the tape. Below this the number of the crop in question was stamped for each operator in turn. The total for the cluster was then stamped, followed by the number of the next cluster. Crops on over and under one acre holdings were dealt with separately. The use of the adding machine in this connection is illustrated in Appendix 7.

Numbers of crops up to and including peppers (code No. 311) were entered onto adding machine tape for analysis. Cucumbers (No. 14) and pumpkins (No. 15), recorded in the field only as present or absent, were not included. Because crops with code numbers above 311 were found in relatively few gardens, it was felt that the standard errors for estimates of their total numbers would be too high for calculations to be worth while.

From the figures on the adding machine tapes, estimations of the total numbers of each crop, and the standard errors for these estimates were worked out separately for over one acre, and under one acre operators in each cluster. The calculations were carried out on cluster computation forms. An outline of the method of analysis, with a worked example on a computation form, is given in Appendix 8.

Data concerning area, fertilization and cultivation practises, and methods of crop disposal was taken from cluster summary forms (Appendix 6) for analysis. The analysis was again carried out separately for holdings over and under one acre in each cluster. Computations were carried out on the reverse side of the crop number computation forms (Appendix 8). An outline of the method of analysis with a worked example is

/ given ...

given in Appendix 9.

(3) Results

The results of the analyses were summarized for each crop. A summary for each crop was drawn up to include the estimates of crop numbers, and the estimates of numbers of operators growing each crop (see Appendix 10). The summarized results for the whole survey area are given in Table 3.

Table 3. Summary of crop number analysis

<u>Crop</u>	Estimated Plant Number in Thousands		% S.E.	Estimated No. of Operators Growing Crop		% S.E.
Banana	256	65	25.5	7,162	184	2.6
Cassava	1,962	435	22.2	4,995	256	5.0
Dasheen	1,308	239	23.1	5,641	292	5.2
Tannia	1,052	502	47.7	3,755	292	7.7
Eddoe	364	88	24.9	1,707	205	12.0
Pigeon Pea	950	349	36.7	4,943	269	5.4
Okra	68	17	25.3	2,881	263	9.1
Egg Plant	69	15	22.0	2,389	269	11.3
Beans	2,931	5,510	188.0	1,050	210	20.0
Yams	31	15	50.2	1,616	263	16.3
Tomatoes	285	232	81.4	594	125	21.0
Sugar Cane	68	36	53.4	1,519	192	12.6
Maize	1,452	650	44.7	723	173	23.9
Cucumber				591	156	26.4
Pumpkin				1,381	198	14.3
Sweet Potato	512	169	33.0	1,353	223	16.5
Topee Tamboc	76	26	33.7	1,109	156	14.1
Pineapple	29	15	52.1	658	178	27.1
Peppers	87	82	94.8	1,932	223	11.5

Since the racial origin of operators appeared to have little or no influence on gardens or on practises, the data on this aspect of the survey was not analysed. The distribution of crops between counties, zones, and over and under one acre groups, was not analysed further than estimates of plant numbers.

Summary forms (Appendix 10) were also drawn up for estimates of area, and for numbers of operators who; clear land annually (cutlass), fork, plough, consume all produce at home, make casual sales, market crops, use organic manures, or use artificial manures. The summarized results for the whole survey area are given in Table 4.

Table 4. Summary of analysis of operations, etc.

Operations, etc.	Estimated No. of operators	% S.E.
Cutlass	6,922 $\pm$ 355	5.1
Forking	6,079 $\pm$ 336	5.5
Ploughing	954 $\pm$ 200	21.0
Home consumed only	7,710 $\pm$ 161	2.1
Casual sales	609 $\pm$ 129	21.2
Marketing of crops	643 $\pm$ 110	17.4
Organic manure	3,349 $\pm$ 314	9.4
Artificial manure	1,252 $\pm$ 186	14.9
Estimated area in food gardens 2,161 (12% S.E.)		258 acres

To obtain further information on cultivation and marketing practises, the clip-cards were sorted once again. Information thus obtained is summarized in Table 5.

(see next page)

Table 5. Summary of cultivation and marketing practises (percentage of operators based on sample of 356 operators)

Attribute	+1 acre % operators	-1 acre % operators	Survey area % operators	Main Crops concerned
Pure stand	22.3	9.4	13.5	Sweet potato, Dasheen
Combinations	37.5 20.5	8.2	12.0	Cassava and eddoe with pigeon pea
Artificials	33.0	10.2	17.4	Pigeon pea, bananas, cassava
Organics	38.4	41.8	40.7	Bananas
Casual sales	10.7	6.1	7.6	Bananas, cassava, pigeon pea
Marketed	32.1	0.8	10.9	Bananas, eddoe, pigeon pea

Of the original sample of 431 operators, 74 were not included in the survey. The reasons for rejection, together with the number of operators affected in each case, are given in Table 6.

Table 6. Operators not included in survey results

Reason for exclusion	Under 1 acre	Over 1 acre	Total
No response	3	2	5
Unknown	1	1	2
No garden	37	13	50
Under trees	3	5	8
House condemned	3	-	3
Operator moved	1	-	1
Garden outside cluster	1	4	5
Total	49	25	74

The significance of the exclusion of these operators will be discussed in Section VII.

The results of the time - cost study for the survey are given in Appendix 11.

VII.. DISCUSSION

1. The frame

Of the sample of 430 operators, 74 were not included in the survey for reasons given in Table 6. Of the 74, only eleven were not interviewed. The remainder were excluded because they did not grow food crops under the conditions specified. These persons were not, in fact, part of the population chosen for sampling. The fact that they were included in the sample was a fault of the frame. However, since they were not a part of the true population, their exclusion from the survey does not invalidate the results. Because it covered the population sample and because only eleven operators were actually not accounted for, the frame was satisfactorily accurate, and was suitable for the survey.

Because only 356 of the 430 operators in the original sample grew food gardens under the specified conditions, the estimated number of persons growing food crops in the whole survey area, was reduced from 10850 to 8983. Results have been based on this latter estimate.

2. Sampling

That the sampling method was not entirely satisfactory, can be seen in the high standard errors obtained for estimates of crop numbers. These high errors were observed to be primarily due to a large variance between clusters. It is probable that this variance could be considerably reduced by increasing the number of clusters in the sample.

Because random sampling was carried out at all stages, the selection of the final sample was unbiased. In enumeration, care was taken to avoid bias by omission or substitution, so that only seven of the original sample of 430 were not interviewed. Questioning of operators was done carefully, so as to avoid bias introduced in false replies. It is possible, however, that a small amount of bias was introduced in estimating crop numbers

/ in ...

in individual gardens. As pointed out in Section V, it was not always practical to use the random sampling method in gardens. However, in view of the fact that a large proportion of the gardens were counted in full and in view of the fact that the error in estimation of crop numbers in each garden contributed relatively little to the overall sampling error, it is doubtful that serious bias was introduced at this stage.

On the present survey, the enumerators were assumed to be reasonably conscientious, so spot checks were not carried out. Had it been necessary to employ less reliable enumerators, continual checking to detect bias would have been essential.

3. Field work

When planning and preparations for field work had been completed, a pilot survey, to expose unforeseen difficulties was considered, but because of the relatively straightforward nature of the field work, was felt to be unnecessary. The first day's surveying was carried out in three neighbouring clusters so that the team could meet at lunch time to discuss any difficulties that might arise. However, no major problems were encountered.

The time required for the field work was greatly over-estimated. In determining the number of operators that could be surveyed by the team in the time available, it was assumed that two men could survey at least eight gardens in one day. From the time cost study, it can be calculated that each pair actually surveyed almost twice the estimated number per day. There are a number of reasons why so little time was required for field work.

By following daily instructions issued by area supervisors, enumerators were able to locate clusters easily. With few exceptions, houses within the clusters were also easily located. In this connection, it was observed that persons were often unknown by names appearing on our forms. In many instances, next-door neighbours were known only by nicknames. For this reason, enumerators often had to rely entirely on cluster maps for

/ location ..

location of operators. Nevertheless, the field work was completed in a relatively short time. The value of the cluster maps in the field work for this survey cannot be over emphasized.

With relatively few exceptions, operators or members of their families were contacted during the main survey. In the sugar cane zone, most operators were employed by the estates during harvesting. Fortunately, harvesting had not yet started at the time the survey was carried out, so most operators were at home.

As pointed out in Section V, many gardens were very small, and could be counted in full more quickly and more easily than they could be randomly sampled.

The people whose gardens were surveyed were, on the whole, very helpful and eager to provide enumerators with whatever information they could. However, it was suspected that the enthusiasm of some was not entirely of unselfish origin. A large number of operators were fully convinced that the enumerators were oil prospectors, and welcomed them as potential buyers for their land. Others were certain, regardless of what enumerators said to the contrary, that they were connected with the government, and made requests for financial and other assistance. No promises were made in this respect.

4. The analysis and results

Although the benefits of clip-card recording are numerous, (Jolly, 1950; 1953) the value of using them for tabulating data in the present survey is questionable. Data could easily have been transferred directly from measurement recording forms and questionnaires to the cluster summary forms. If individual crop numbers for each operator had been included on the cluster summary forms, the use of clip-cards could have been avoided. In this case it might have been necessary to sort 430 questionnaires to make a summary of crop combinations and fertilizer practises, (Table 5) but this would have been no more

/ difficult ..

difficult than hand sorting of the cards which was, in fact, carried out for this summary. If the cards had been omitted, the time and labour required for coding and clipping would have been eliminated. Had the analysis been fully planned before the data was tabulated, the cards might well have been considered unnecessary. On the other hand, had a more extensive analysis been carried out, the clip-cards might have proved to be very useful. In either case, either the clip-cards or the cluster summary forms were unnecessary.

Apart from the questionable value of clip-cards in analysing the results of the present survey, it must be borne in mind that their use has provided members of the team with a valuable opportunity of becoming familiar with this useful method of recording.

It was observed in the results entered on the crop summary forms (Appendix 10) that the size of holdings had relatively little influence on the number of the various crops grown. In Table 5 it can be seen that holding size had little effect on cultivations, manuring, or crop disposal. Because most of the food grown in gardens was home consumed (Table 4) the gardens tended to be of a relatively uniform size, (as evidenced by the low S.E. for estimated total area - Table 4) only large enough to supply the needs of one household. For this reason it has been suggested that the over one acre and under one acre stratification could well have been omitted. If this stratification had been rejected, only half the number of analyses would have been required, and the complexity of the analysis would have been considerably reduced.

On unpublished results of the agricultural survey, the Central Statistical Office has estimated that 4160 acres of the present survey area was planted in food crops. From the results of the present survey it has been estimated that only 2161 acres are planted in food crops. As mentioned earlier,

/ the ...

the agricultural survey was based entirely on a questionnaire, whereas the present survey was based on actual measurements. The suggestion that the reliability of the results of the agricultural survey is questionable, seems to be supported.

Before comments are made on the various crops, it should be pointed out that the estimated plant numbers are not necessarily an index to production. The definitions of a plant for each crop was made entirely for the sake of convenience in counting. (Appendix 3) For example, a stool of bananas, having possibly three or four stems, was counted as one plant, whereas in the case of cassava, each stem was counted as one plant. One stool of bananas might easily produce more than 100 pounds of fruit while a half dozen stems of cassava produce only ten or twenty pounds of tubers.

In spite of the limited significance of plant numbers, and the high standard errors of number estimates, the relative popularity of certain crops can be seen in the results in Table 3. From an examination of plant numbers, and numbers of operators growing each crop, it is apparent that banana, cassava, dasheen, and pigeon pea are the most popular crops. This was expected, since it is well known that these crops are widely grown in Trinidad. Yams and sweet potatoes appear to be of relatively less importance, a surprising fact in view of the high yields associated with yams, and the high nutritive value of sweet potatoes. The relative unimportance of the latter crop may be largely accounted for in the fact that the survey was carried out in December. Sweet potatoes are usually sown in June and are harvested by October. (Dept. of Agric., Bull 37) Other crops whose numbers are likely to be higher in other seasons include tomatoes, grown between January and May, and possibly maize, sown in June and harvested in October. Yams, however, are harvested in January.

Although no analysis was carried out to determine differences between counties and between zones, it was observed

on the crop summary forms that greater numbers of dasheen and cassava were found in the cocoa zones (County 2) while bananas and pigeon peas appeared to be grown uniformly over the whole survey area.

The results in Table 4 show clearly that cultivations are largely confined to cutlassing and forking. The limited use of the plough is not surprising in view of the fact that the average garden size is approximately one quarter acre. (2161 acres for 8983 operators) The number of operators selling their produce is relatively small. Because the number represents such a small proportion of the total number of operators, no attempt was made to determine the differences between counties with regard to crop sales.

Organic manures appear to be used to a considerably greater extent than artificials, but approximately half of the gardens receive no fertilizer of any kind. Over ninety percent of the organic manure was applied to bananas.

A noticeably greater percentage of over one acre operators grow crops in pure stands or definite combinations than do under one acre operators. The reason for this was not determined. However, it may be due to the fact that operators with more than one acre are likely to be true farmers rather than casual gardeners, and, therefore, have a better sense of organization in planting crops.

Artificial manures are not widely used and almost all organics are applied to bananas, so the larger part of the gardens receive no fertilizers.

The bulk of the food produced in gardens is home consumed. Bananas, cassava, pigeon peas, and eddoes are sold to a small extent.

VIII. CONCLUSIONS

An estimated area of 2,161 acres is planted in food gardens in the Counties of Caroni, St. Andrew, and St. David.

The numbers of the more important food crops grown in the above area have been estimated. However, as mentioned earlier, these numbers are of limited value in themselves, since numbers of plants are not uniformly related to crop yields. In order to estimate the quantity of food produced in the survey area, rather extensive investigations of crop yields would have to be carried out. In such investigation it would be necessary to give consideration to the effects of soil productivity, standards of cultivation, and mixed cropping, on crop yields. The information obtained from such work could be combined with the results of this survey to provide estimates of food production.

The crop numbers ^{HAVE BEEN} estimated to show the relative popularity of a number of crops. Among these are banana, cassava, dasheen, and pigeon pea.

Crops in most gardens in the survey area are planted in unorganized mixed stands. Where they do occur, pure stands are most frequently of sweet potatoes or dasheen, and definite combinations are usually of cassava or eddoes with pigeon peas.

Food garden cultivation is generally of a low standard. The plough is used relatively little, tillage being done with a fork. Artificial manures are not widely used and almost all organics are applied to bananas, so the larger part of the gardens receive no fertilizers.

The bulk of the food produced in gardens is home consumed. Bananas, cassava, pigeon peas, and eddoes are sold to a small extent.

IX. SUMMARY

An account is given of a survey of food gardens in three counties of Trinidad.

The objects of the survey were to determine the numbers and combinations in which various crops were grown, and to investigate standards of cultivations and extent of crop sales.

A list of persons growing food crops in the survey area provided a sampling frame. A randomly selected sample of approximately one food gardener in every twenty-five was interviewed, and gardens were examined and measured.

Numbers of crops and numbers of operators growing them were estimated, and standard errors for these estimates were calculated. Relatively high standard errors were obtained for estimates of crop numbers, but the popularity of certain crops was clearly shown.

Information obtained concerning cultivation, manuring, and crop disposal has been summarized. The findings of the survey have been discussed.

REFERENCES

1. Chenuary, R.W. (1952) "The Soils of Central Trinidad". Gov't Printing Office, Trinidad, B.W.I.
2. "The Economic Development of Jamaica" (1952) Report by a mission of the International Bank for reconstruction and development, John Hopkins, Baltimore.
3. Fischer, R.A. and F. Yates (1953) "Statistical Tables for Biological, Agricultural, and Medical Research." Oliver and Boyd.
4. Halcrow, M. and J.H. Cave (1947) "Peasant agriculture in Barbados". Bull. 11 Dept. of Science and Agriculture, Barbados, B.W.I.
5. Kent, K.M. (1952) "Statistics for Colonial Agriculture." H.M. Stationary Office for the Colonial Office, London.
6. Jolly, A.L. (1950) "The Use of Clip-Cards in Agricultural Research". Tropical Agriculture 27: 108-122.
7. Jolly, A.L. (1953) "Clip-Card Accounting on the Farm." Imperial College of Tropical Agriculture, Trinidad, B.W.I.

ACKNOWLEDGMENTS

8. Horowitz, M.J. (1953) "Facts from Figures". Penguin Books.
9. "The Windward Islands." I.C.T.A. Report.
10. Stamp, D.L. (1953) "Africa, a Study in Tropical Development". John Wiley and Sons, New York.
11. Trinidad and Tobago Department of Agriculture (1954) Bulletin 37, "Notes on Vegetable growing in Trinidad and Tobago".
12. Wishart, J. and H.G. Sanders, "Principles and Practice of Field Experimentation". W. Hoffer & Sons, Cambridge.
13. Yates, F. (1951) "Sampling Methods for Censuses and Surveys". Charles Griffin, London.

REFERENCES

1. Chenery, E.M. (1952) "The Soils of Central Trinidad". Gov't Printing Office, Trinidad, B.W.I.
2. "The Economic Development of Jamaica" (1952) Report by a mission of the International Bank for reconstruction and development, John Hopkins, Baltimore.
3. Fischer, R.A. and F. Yates (1953) "Statistical Tables for Biological, Agricultural, and Medical Research." Oliver and Boyd.
4. Halcrow, M. and J.M. Cave (1947) "Peasant Agriculture in Barbados". Bull. 11 Dept. of Science and Agriculture, Barbados, B.W.I.
5. Hunt, K.E. (1952) "Statistics for Colonial Agriculture." H.M. Stationery Office for the Colonial Office, London.
6. Jolly, A.L. (1950) "The Use of Clip-Cards in Agricultural Research". Tropical Agriculture 27: 108-122.
7. Jolly, A.L. (1953) "Clip-Card Accounting on the Farm." Imperial College of Tropical Agriculture, Trinidad, B.W.I.
8. Moroney, M.J. (1953) "Facts from Figures". Penguin Books Ltd., Harmondsworth, Middlesex.
9. Shephard, C.Y., "Peasant Agriculture in the Leeward and Windward Islands." I.C.T.A. Report.
10. Stamp, D.L. (1953) "Africa, a Study in Tropical Development". John Wiley and Sons, New York.
11. Trinidad and Tobago Department of Agriculture (1954) Bulletin 37, "Notes on Vegetable growing in Trinidad and Tobago".
12. Wishart, J. and H.G. Sanders, "Principles and Practise of Field Experimentation". W. Heffer & Sons, Cambridge.
13. Yates, F. (1953) "Sampling Methods for Censuses and Surveys". Charles Griffin, London.

APPENDIX 1.

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME
DATE	INTERVIEWER	ACREAGE	PLOT	ADDRESS	

	CROP	DISPOSAL %			MANURES		YIELD	REMARKS
		HC	CS	M	ART	ORG		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

CULTIVATION (i) Land cleared annually _____ (a) Forked _____
 (b) Ploughed _____
 (ii) Non food crops grown in last 2 years _____

COMBINATIONS (e.g. 1 & 2)

REASONS FOR COMBINATIONS:

GENERAL:

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME

DATE	INTERVIEWER	ACREAGE (measured)	ACREAGE	PLOT	ADDRESS

RANDOM NUMBERS		A					
		B					
CROP		SPL 1	SPL 2	SPL 3	SPL 4	PURESTAND AREA	TOTAL
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

COMBINATIONS:

FIELD INSTRUCTIONS (MEASUREMENTS)

1. Record LENGTH OF PACE under field conditions (e.g. 20 = 16 yds.)
N.B. On a given holding one person must do all pacing.
2. PAGE out field dimensions, the BOUNDARY being the extent of the operators FOOD CROPS (excluding bananas).
(ii) If the house etc. comes WITHIN the food garden, pace out extent of house + courtyard + flower garden (to be excluded from calculation of plot area).
N.B. Record figures on a rough sketch plan.
3. (i) Pace out PURE STANDS.
(ii) SAMPLE THESE (One sample per pure stand). Place the 10ft square on a REPRESENTATIVE part and count food plants.
4. Record number of BANANA STOOLS and number of SEPARATE PATCHES OF PUMPKIN OR WATER-MELON.
5. SELECTION OF SAMPLE AREAS IN PLOT:-
N.B. Take 2 samples if GIVEN ACREAGE is 0.1 and 4 samples if over 0.1
(i) Number of NEAREST CORNER of field is 1, and other corners 2,3,4 in a CLOCKWISE direction.
STARTING CORNER for the 2 (or 4) samples is given by RANDOM No. (A).
(ii) LOCATE SAMPLING POINT according to random Nos. (B)
N.B. (a) EXCLUDE pure stands, flower garden, etc.
(b) CALCULATE No. OF PACES required by the fraction given by the sampling No., ($0 = 0$, $1 = \frac{1}{4}$, $2 = \frac{1}{2}$, $3 = \frac{3}{4}$ of a plot side)
(iii) Lay down SAMPLE SQUARE parallel to sides of field and to FRONT and LEFT of LOCATED POINT.
N.B. WHEN sample would fall OUTSIDE field, place to FRONT and RIGHT.
6. COUNTING OF PLANTS IN SAMPLE AREAS:-
Count Nos. of each food plant present in the 10ft x 10ft square ACCORDING TO THE FOLLOWING DEFINITIONS:-
GROUND PROVISIONS:-
(i) CASSAVA. Count EACH STEM emerging from soil.
(ii) DASHEEN, EDDOES, TANNIA. Count EACH CROWN; IGNORE small offsets.
(iii) SWEET POTATOES. Count or Cal- } (1) Record (a) STEMS (OR SETS) in 10ft
 } or 10 square ft.
(iv) YAMS. Count or calculate } and (b) TOTAL ROW, LENGTH OR AREA
 } COVERED WITHIN SAMPLE
 } (uwrite e.g. 16 X 56ft or 18 x 33 sq.ft)
 } OR (2) COUNT ALL STEMS (OR SETS) IN SAMPLE.
 } (WRITE E.G. 25)
- OTHERS:-
(i) CORN. Count EACH MAIN STEM. (ii) OKRA. Count EACH CLUMP OF stems.
(iii) PIGEON PEAS. Count EACH STEM emerging.
(iv) OF FOLLOWING COUNT STEMS EMERGING (or "Calculate by" Method used with Sweet Potatoes)
 BEANS - POLE TYPE.
 BODI BEANS.
 SPINACH - CLIMBING TYPE.
(v) OF FOLLOWING COUNT EACH BUSH OR PLANT:-
 BEANS (BUSH OR DWARF), BEET, CABBAGE, CHRISTOPHINE, CAULIFLOWER, EGG-PLANT,
 LETTUCE, PEPPER, PINEAPPLE, SPINACH (BUSH TYPE), TOMATO.
(vi) MISCELLANEOUS:-
 CARROTS. Count No. of FEET OF ROW. 4" = 1 PLANT. WRITE E.G. 20(ft) x 3
 CUCUMBER. Count No. of "HILLS"
 LEEK. Count No. of "HILLS"
 MUSTARD. Count No. of SQUARE FEET.
 ARROWROOT, ONION, SHALLOTS, TOPEE TAMBOO. Count No. OF SETS
 (BANANA and PUMPKIN - See Section (4) above)

APPENDIX 4.SAMPLE SURVEY UNITInstructions to supervisors re the Log Sheet.

A. Before distribution to enumerators, fill in:-

1. Area number.
2. Cluster number.
3. Names of enumerators.
4. Vehicle number enumerators are to use.

B. On return of the log sheets fill in the time in the following categories.

VIII. Number of hours travelling to and from the task, i.e. the journey time in plus the journey time out multiplied by the number of enumerators.

IX. Interviewing time, i.e. the sum of the column headed "Time (man-hours)" less that entered for the lunch-break.

X. Travelling within the clusters, i.e. the total time from departure to return multiplied by 2, less VIII, less IX, less the time entered for the lunch break.

8/10. Cost of transport, i.e. the total mileage covered by the vehicle (if any entered) multiplied by the rate per mile applicable to the vehicle.

Instructions to enumerators re the Log Sheet.

Enter the following details:-

1. Date.
2. If you are driving a car enter the milometer reading at the start of the day.
3. Enter time of departure.
4. The time taken to get to the first cluster in hours under "Journey out". Also enter here the time taken to travel between clusters.
5. For each interview and subsequent measuring of the holding enter the building number and the total time in man-hours required to complete the two questionnaire sheets.
6. Opposite the word lunch enter the time spent over lunch.
7. On return enter (a) the time.
(b) the time taken over the return journey.
(c) mileometer reading if 2 was filled in.
8. A general report.

The log sheet should be returned to the supervisor each night.

SAMPLE SURVEY UNITLOG SHEET

Area _____ Clusters _____ Date _____

Enumerators _____ Vehicle No: _____

Departure: Time _____ Mileometer reading _____

Return: _____

Journey Time: Out _____ In _____

Interview Bldg.No. Time (Man-hours)

1

2

3

4

5

Lunch

6

7

8

9

10

VIII-

IX-

X-

8/10-

Enumerators Report.

APPENDIX 5.Distribution of clusters for supervision
of field work.

Supervisor's Name	Cluster No. and Location	No. of Operators in Cluster	
Currie County 1	13 Chase Village	12	
	04 Buttler Village	3	
	14 Waterloo	8	
	18 Esperanza	13	
	27 Esperanza	10	
	16 Freeport Rd.	9	
	05 Freeport Village	9	64 ✓
Gunn County 1	06 Claxton Bay	16	
	21 Freeport Mission Rd.	13	
	26 Gran Couva Rd.	19	
	07 Brasso Tamana Rd.	6	
	20 Brasso Village	4	58 ✓
Hill County 2	03 Guaico	10	
	05 Sangre Grande	23	
	06 Sangre Grande	10	
	11 Sangre Grande	15	58 ✓
Mawley County 2	01 Paria Main Rd.	7	
	04 Balandra	4	
	07 Toco Main Rd.	6	
	13 Valencia	12	
	12 Manzanilla	10	
	02 Manzanilla South	6	
	08 Biche	18	
	10 Allendale Settlement	7	70 ✓

Supervisor's Name	Cluster No. and Location	No. of Operators in Cluster	
Law	03 Jermingham Junction	8	
County 1	12 Jermingham Junction	10	
	22 Charlieville	11	
	11 Longdenville	14	
	23 Longdenville	10	
	19 Ravine Sable Rd.	8	61
Waterworth	01 Madras Settlement Rd.	9	
County 1	08 Kelly village	29	
	09 Caroni Savannah Rd.	23	
	28 Las Lomas Rd.	8	
	09 Cumut's Tamana Rd.	12	613
Watson	02 Chaguanas	4	
County 1	24 Perseverance	16	
	15 Exchange	12	
	25 Couva	11	
	17 California	9	
	28 Cacandee	2	
	10 Chaguanas	4	58

APPENDIX 6.

The use of clip-cards in tabulation of survey results.

Data collected in agricultural research can often be most conveniently recorded on clip-cards (Jolly) ¹⁹⁵⁰ In this method, perforations around the perimeter of cards are coded to represent information to be recorded. Data is entered by cutting a V shaped slot with a pair of hand clippers over the applicable perforation. For the present survey, one card was used for each plot of garden. Crops or practises were entered by clipping or not clipping. A needle is used to sort a pack of cards on which information has been recorded in this way. The needle is inserted through a perforation and the pack is lifted with the needle. All cards which have been clipped at that perforation fall out of the pack.

Crop numbers were entered in ink on the reverse side of the card next to the appropriate clipping. Crops concerned with manuring and sales were entered by code number on the front of the cards in the space provided. Ten perforations were used to identify clusters by using a factorial method of punching. This is more fully explained in the following directions for clipping.

The advantage of the card system is that the observations entered on the cards can be quickly and easily sorted in any possible way that may be desired.

The cards used for tabulation were designed for accounting (Jolly) ¹⁹⁵³ but were adapted for use in the present work.

Directions for use of Cope-Chat. Cards.

The master card is appended and these notes are explanatory to that card:

Section A. Identification

1. Use blue cards for gardens on holdings over 1 acre and pink cards for those on holdings of less than 1 acre.
2. County. Punch out appropriate hole, e.g. County 1 hole 0.
3. Cluster No. Punch out one of holes 2,3, or 4 according to the tens of the number and punch two of holes 5,6,7,8 and 9 for the units of the number with the proviso that holes valued 4 and 7 = 0.

Examples: (County No./Cluster No.)

1/01	Punch holes	0,2,5,6.
1/15	" "	0,3,6,8.
2/10	" "	1,3,8,9.
2/09	" "	1,2,7,9.

This punching may be done in batches for each cluster.

N.B. Check

Each card should have 4 holes punched out of the side 10.

4. Enter building No. along line commencing Dr.
5. Area of land relating to this card along line ending Cr.
6. On one card for each parcel, enter at space marked "A" the estimated area of the garden as given on the questionnaire. For holdings of over 1 acre this should refer to the food parcel and for holdings of less than 1 acre the size of the holding should be entered. At "B" enter the total size of the food area as measured.

Section B.

Top line - Holes L to M

7. Manures. If any artificial or organic manures are used punch out the appropriate hole. Also enter in the body of the card the crop codes, using line 3 for those to which organics are applied and line 4 for those to which artificials are applied.
8. Cultivation. Clip appropriate holes.
9. Nationality. Clip appropriate hole. If "other" write nationality along left hand side of card.
10. Zone. Clip appropriate hole.
11. If this card refers to a pure stand area clip out "pure stand". If the card refers to an area with a definite combination clip out "00". If the card refers to an area that is only a part of a parcel clip out "M".

12. If there are no sales at all, clip out the dollar sign on the left hand margin of the card.
If any crops are sold enter appropriate crop code in the body of the card. Line 1 for casual sales and line 2 for those crops that are regularly marketed.

Section C. Crops

Clip out appropriate holes when crops occur in a garden.

Code of crops.

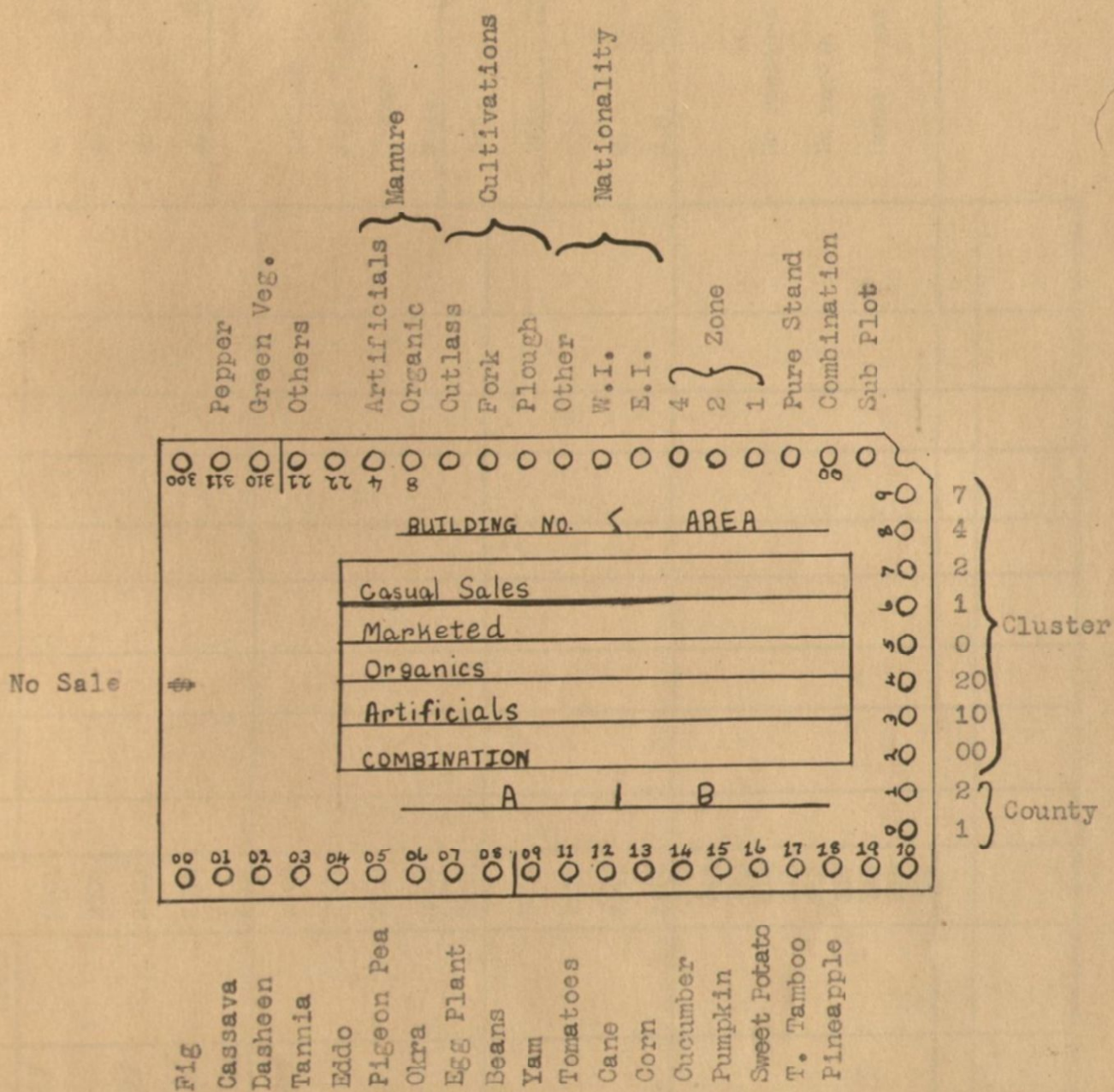
00 Fig	16 Sweet Potatoes
01 Cassava	17 Topee tamboo
02 Dasheen	18 Pineapple
03 Tannia	19
04 Eddo	10
05 Pigeon Pea	300
06 Okra	311 Pepper
07 Egg Plant	310 Green Vegetable crops
08 Beans	21 Others
09 Yam	22
11 Tomatoes	310 will be sub-coded as follows:
12 Cane	312 Cabbage
13 Corn	313 Lettuce
14 Cucumber	314 Mustard
15 Pumpkin	315 Patchoi

On the reverse side of the card record the number of plants against the appropriate punched hole.

For crops coded 21 and 310 enter the number of plants in the centre of the card e.g. (312) 200 (212) 850
(313) 415

When entering the numbers of plants, always have the clipped corner to the bottom left-hand corner of the card.

DIAGRAM OF CLIP-CARD USED WITH CODING
METHOD SHOWN



No. Operators...2... No. cards...2... S.F..... R R.F. 2.000 Zone...4... County.....1... Cluster...61... +1 acre..

C	W.I.		E.I.		Others		Total		Raised Total		W.I.		E.I.		Others		Total		Raised Total
	O	N	O	N	O	N	O	N			O	N	O	N	O	N	O	N	
00			1	27			1	27		2101									
01										2102									
02			1	328			1	328		2103									
03			1	255			1	255		2104									
04			2	2376			2	2376		2105									
05			1	214			1	214		2106									
06										2107									
07										2108									
08										2109									
09										2110									
11										2111									
12										2112									
13										2113									
14										2114									
15			1				1			312									
16										313									
17										314									
18										315									
19										316									
										317									
										318									
										319									
										320									
311			1	1			1	1											
Check Total			8	3201			8	3201											

	- 1 acre	
	Sq. yds.	acres
A	2420	0.5
B	2394	0.202
C		0.8
B/A	0.989	4A 1.600
	Number of Operators	
	WI	EI
Cutlass		1
Fork		-
Plough		1
None		-
Art.		1
Org.		1
C.S.		-
M.		1
H.C.		1

	Plots	A
No response		-
No garden		-
Under trees		-

CLUSTER SUMMARY FORM

No. Operators.....4		No. cards.....4		S.F.....		R.R.F.....		Zone.....4		County.....		Cluster.....					
C	W.I.		E.I.		Others		Total	Raised Total	2101	W.I.		E.I.		Others		Total	Raised Total
	O	N	O	N	O	N				O	N	O	N	O	N		
00	3	24					3	24									
01	3	704					3	704									
02	3	1201					3	1201									
03	1	105					1	105									
04	3	290					3	290									
05	3	321					3	321									
06	2	6					2	6									
07																	
08																	
09	1	63					1	63									
11																	
12																	
13																	
14																	
15	1						1										
16	3	999					3	999									
17																	
18																	
19																	
311	1	3					1	3									
Check Total	24	3128					24	3128									

-1 acre		Sq. yds.		acres	
A		8712		1.8	
B		2557		1.4	
C					
B/A	0.29	9A	4.111		
Number of Operators					
Cutlass	4				
Fork	4				
Plough	-				
None	-				
Art.	2				
Ork.	1				
C.S.	1				
M.	-				
H.C.	3				
Plots A					
No response					
No garden	3				
Under trees					
					6292

APPENDIX 8.EXAMPLE OF ADDING MACHINE TAPES.

COUNTY 1
 ZONE 4
 BANANAS (00)

5.	□	_____	Cluster number
16.	}	_____	Crop number for each operator
104.			
24.			
2.			
36.			
15.			
197. 0.0	□	_____	Cluster total
13.	□	_____	Cluster number
20.			
8.			
4.			
32. 0.0	□	_____	

APPENDIX 9.

Sample Survey Unit.Method of analysis and determination of Standard Error of crop counts.

- n' = no. of clusters in the sample.
 n'' = no. of operators per cluster in the sample.
 y = the crop count for each operator.
 Y = the total crop count for the zone = $S' S'' (y)$

Estimation of population mean and total.

Mean per operator

$$\bar{y} = \frac{S' S''(y)}{S' (n'')}$$

Estimated number of operators in zone

$$\underline{N} = \bar{g} S' (n'')$$

where $\bar{g}$ = average raising factor = $\frac{1}{f' f''}$
 (For $\bar{f}''$, see below)

Then $\underline{Y} = \underline{N} \bar{y}$ Estimation of sampling error.

For a given crop in a given zone and a given size group, the analysis of variance table takes the following form. (Yates 8.11)

Variance	d.f.	S.S.	M.S.
Between first stage units (i.e. clusters)	$n' - 1$	$(S''(y))^2/n'' - Y^2/S'(n'')$	$A = n'' s'^2$
Within first stage unit and between second stage units (i.e. operators).	difference	difference	$B = s''^2$
Total		$\sum g'(n'') - 1 S' S''(y^2) - Y^2/S'(n'')$	

The Variance of the mean $\bar{y}$ may be calculated thus

$$V(\bar{y}) = \frac{1 - f'}{n'} s'^2 + f' \frac{1 - f''}{n' n''} s''^2 \quad \text{---(Y.7.17)---(a)}$$

However all the above presupposes that n'' is constant, which is not true in this analysis. Hence one must replace n'' by $\bar{n}''$ where

$$\bar{n}'' = \{S'(n'') - S'(n''^2)/S'(n'')\} / (n' - 1) \quad \text{---(Y.8.11d)---}$$

Further f'' is not constant and $\bar{f}''$ must be determined. For example in county 1, Zone 2 (+ 1 acre) there were 29 operators growing food crops out of which 15 were interviewed, hence

$$\bar{f}'' = \frac{S'(n'')}{S'(\bar{N}'')} = \frac{15}{29} \quad \text{---(b)}$$

This approximates to $\frac{1}{2}$, which was the working sampling fraction.

With these modifications and substituting for s'^2 and s''^2 from the analysis of variance, we may rewrite (a) as:

$$V(\bar{y}) = \frac{1 - f'}{n'} \cdot \frac{A}{n_0''} + f' \cdot \frac{1 - f''}{n' \bar{n}_0''} \cdot B \quad \text{-----}(c)$$

If $\alpha = \frac{1 - f'}{n' \bar{n}_0''} = 0.0052$

and $\beta = f' \cdot \frac{1 - f''}{n' \bar{n}_0''} = 0.0004$

this formula becomes

$$V(\bar{y}) = \alpha A + \beta B. \quad \text{-----}(d)$$

which is the form used for computation.

For example in County 1 Zone 2 (+ 1 acre), there were 4 clusters in the sample out of a total of 51 so that

$$f' = \frac{n'}{N'} = \frac{4}{51}$$

(Due to stratification by zones after selection, this differs from 1/10)

$$\text{Also, } \bar{f}'' = \frac{14}{4/51 \cdot 15/29} = 3451$$

(It should be noted that in determining $\bar{n}_0''$ and $\bar{g}$, allowance has been made for those operators whose food crops were under tree crops or who had no garden at all.

No allowance for the above operators has been made in determining $\bar{f}''$, since if it is assumed that the sampling is uniform over the whole cluster, there would be no alteration of f'' when these were rejected.)

Thus the estimated standard error of the total plant population of acrop will be,

$$N. S. E. (\bar{y}).$$

$$S. E. (\bar{y}) = \sqrt{V(\bar{y})}$$

Computation Sheet.

County ...1... Zone ...2... $\frac{+ 1 \text{ acre}}{- 1 \text{ acre}}$ Crop ...50...

Cluster	$S''(y)$	n''	$n''-1$	$(S''(y))^2/n''$	Difference	$S'S''(y)^2$
07	669	3	2	149,187	286,494	435,681
19	65	5	4	485	628	1,473
20	1967	3	2	1,289,696	744,000	2,033,697
28	134	3	2	5,985	5,170	11,156
Total.	$\sum Y = 2835$	14	10	1,445,713	1,036,292	2,482,007 Check.
C.F.				574,087		574,087
S.S.				871,626	1,036,292	1,907,919
d.f.				3	10	13
M.S.				A=290,542	B=103,629	
α, β				$\alpha = 0.0672$	$\beta = 0.0028$	
$V(\bar{y})$				19809.70		

$\underline{N} = 3451$ $\bar{y} = 202.50$ $S.E.(\bar{y}) = 140.75$ $S.E. = 69.5\%$

$V(\underline{y}) = 235,922 \times 10^6$ $\underline{y} = 698827 \pm 485728$

APPENDIX 10.Sample Survey TeamMethod of analysis and determination of Standard Error
of number of operators growing a given crop.(a) Estimation population proportions and totals (in a given size group).

Estimated proportion of operators growing a given crop in a given cluster.

$$\underline{P} = \frac{u}{n''} \quad q = 1 - P \quad \dots\dots\dots (1)$$

Estimated overall proportion of operators growing a given crop in a given zone.

$$\underline{P}_0 = \frac{S'u}{S'n''}, \quad q_0 = 1 - P_0 \quad \dots\dots\dots (2)$$

Estimated number of operators growing a given crop in a given zone.

$$\underline{U} = \underline{N} \underline{P}_0 \quad \dots\dots\dots (3)$$

(b) Estimation of Standard Errors.

For a given crop in a given zone and a given size group, the analysis of variance table takes the following form.

Variance	d.f.	S.S.	M.S.
Between first stage units i.e. clusters	$n' - 1$	$\Sigma (n'' (\underline{P} - \underline{P}_0)^2)$	$n'' s'^2 = C$
With first stage units and between second stage units.	$S'(n'' - 1)$	$\Sigma (n'' \underline{P} \underline{q})$	$s''^2 = D$
Total	$S'(n'') - 1$	$(S'n'') \underline{P}_0 \underline{q}$	

By substituting n'' by $\bar{n}_0''$ and following the same arguments as in the quantitative analysis, one may derive the variance of $\underline{P}$ as

$$V(\underline{P}) = \alpha C + \beta D. \quad \dots\dots\dots (4)$$

$$V(\underline{U}) = \underline{N}^2 V(\underline{P}) \quad \dots\dots\dots (5)$$

$$S. E.(\underline{U}) = \underline{N} S. E. (\underline{P}) \quad \dots\dots\dots (6)$$

(c) Estimated totals and their errors for zones and counties are obtained by summation from zone-size group totals and the corresponding variances.

Computation Sheet (2)

County ...1.	Zone ...2.		+ 1 acre		Crop ...3..	
Cluster	07	19	20	28	Overall	
u/n''	1/3	2/5	2/3	2/3	7/14	
$\underline{p}$	0.3333	0.4000	0.6667	0.6667	$\underline{p}_o = 0.5000$	
$\underline{q}$	0.6667	0.6000	0.3333	0.3333	$\underline{q}_o = 0.5000$	
$(\underline{p}-\underline{p}_o)^2 n''$	0.0834	0.0500	0.0834	0.0834	Total	D.F. M.S.
					0.3002	3 0.1001 = C
$n'' \underline{p} \underline{q}$	0.6666	1.2000	0.6666	0.6666	3.1998	10 0.3200 = D
$(S'n'')\underline{p}_o\underline{q}_o$	14 x 0.5000 x 0.5000			3.5000	13	
				Check		

$$V(\underline{U}) = 345^2 (0.0672 \times 0.1001 + 0.0028 \times 0.3200)$$

$$= 907.2942$$

$$S.E.(\underline{U}) = \pm 30.12$$

$$\underline{U} = 345 \times 0.5$$

$$= 172.5$$

$$\% S.E. = \underline{17.5\%}$$

OWI LIBRARY ST. AUG.

					Crop Count					Number of Operators				
County	Zone	Group	n'	S'(n')	$\bar{Y}$	S.E. ($\bar{Y}$)	%S.E.	$V(\bar{Y}) \times 10^6$	$\frac{sA}{V(\bar{Y})}$	$\bar{U}$	S.E. ($\bar{U}$)	%S.E.	$V(\bar{U}) \times$	$\frac{sC}{V(\bar{p})}$
1	2	+	4	14	225,333	104,394	46.3	10,898	97%	246	45	18.3	2001	96%
		-	4	12	75,366	47,064	62.3	2,177	89	371	75	20.2	5639	97
Zone 2			4	26	300,699	114,000	38.0	13,076	-	617	87	14.1	7640	-
1	4	+	24	56	244,543	168,239	68.8	28,291	100	558	91	16.3	8328	97
		-	24	174	264,544	46,295	17.6	2,145	88	2364	176	7.45	30848	93
Zone 4			24	230	509,078	174,000	36.1	30,436	-	2922	198	6.8	39,176	-
County 1			28	256	809,786	209,000	25.8	43,512	-	3539	216	6.1	46,816	-
2	1	+	4	12	126,371	67,602	53.5	4,570	95	75	19	24.9	352	92
		-	4	8	5,000	5,987	119.7	35,856	24	41	251	61.49	632	91
Zone 1			4	20	131,371	68,000	51.9	4,606	-	116	31	26.7	984	-
2	2	+	9	30	835,861	363,568	46.3	132,182	96	417	46	11.2	2181	100
		-	9	56	185,325	98,121	52.9	9,628	98	923	125	13.6	15602	95
Zone 2			9	86	1,021,186	376,578	27.1	141,810	-	1340	133	9.9	17,783	-
County 2			13	106	1,152,557	382,644	30.1	146,416	-	1456	137	9.4	18,767	-
Zone 2			13	112	1,321,885	393,555	33.6	154,886	-	1956	160	8.2	25,423	-
Cocoa Zones			17	132	1,453,256	399,365	36.4	159,492	-	2093	163	7.9	26,407	-
Survey			41	362	1,962,343	435,809	22.2	189,928	-	4995	256	5.1	65,583	-

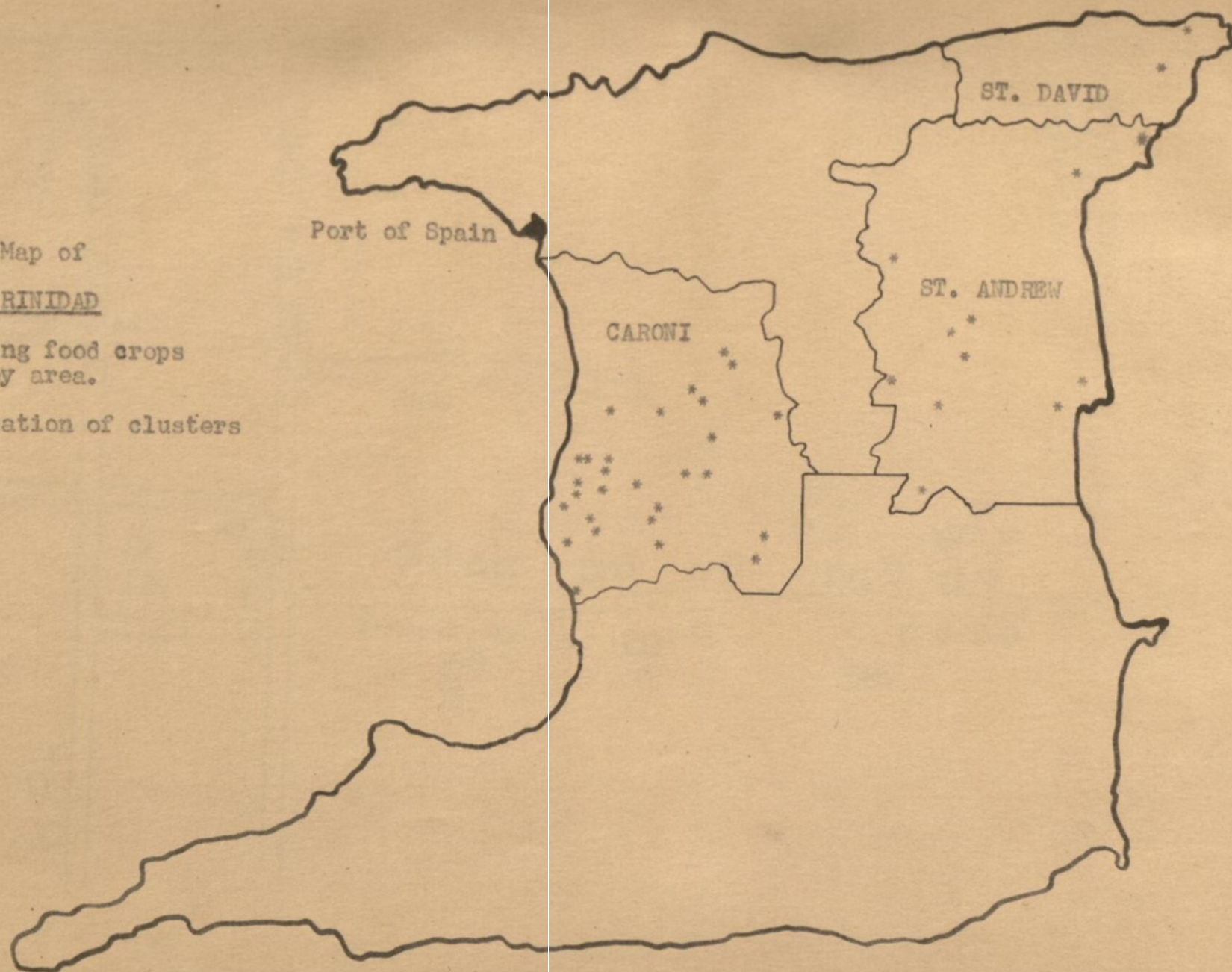
APPENDIX 12.Time and Cost Study.

	<u>Time Man hrs.</u>	<u>Cost in \$ Travelling only</u>
1. <u>Preliminary work.</u>		
Obtaining and selection of sample	45	8
Preliminary surveying of area	71	70
Preliminary statistical analysis	45	
Preparation of maps	26	9
Preparation of field recording forms	<u>34</u>	—
Total	<u>221</u>	<u>87</u>
2. <u>Field work.</u>		
Supervisory work	40	
Travelling to and from tasks	116	235
Travelling within clusters	132	
Interviewing time	<u>185</u>	—
Total	<u>453</u>	<u>235</u>
<u>Follow-up</u>		
Total travelling time	25	42
Interviewing time	<u>13</u>	—
Total	<u>38</u>	<u>42</u>
3. <u>Analysis</u>		
Preparation and supervision	134	
Computation & supervision	<u>232</u>	
Total	<u>366</u>	
General discussion	235	
Costs of clip boards & measuring rods		10
Cost of paper	—	<u>18</u>
Grand total	<u>1313</u> <u>man hours</u>	<u>\$392</u>

Map of
TRINIDAD

Showing food crops
survey area.

* Location of clusters



TYPICAL CLUSTER MAP

COUNTY CARONI.
CLUSTER 23.
LONGDENVILLE

