

A SURVEY OF THE FOOD GARDENS
OF THREE COUNTIES OF TRINIDAD

J.V. WATERWORTH, B.Sc.(Notts.)

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1. INTRODUCTION.

Surveys in agriculture are needed before the planning of any large-scale scheme for, say, a marketing organisation or for the intensification of home food production.

A person's general impressions of the agriculture of an area can be misleading. The exact information that only surveys can give is therefore required.

A problem of considerable local interest, and on which exact information is lacking, is that of the composition and production of food gardens in Trinidad and the possibilities of increasing the quantities of food marketed from them, particularly in view of the large imports of flour into the colony (nearly 120 million lbs. in 1954) (Statistical Digest No. 5).

After discussion under the chairmanship of Dr. A.L. Jolly the team (see below) chose to survey the composition and production of food gardens in the counties of Caroni, St. David and St. Andrew. Emphasis was placed on the "staple crops", that is, the ground food provisions *grown in Trinidad*. A necessary part of our project was to devise a satisfactory means of measuring quantitatively the constituent crops of a mixture.

Other subjects were considered and rejected. It was felt that our survey should give us some practice of measuring in the field. For this and other reasons a survey of the use of fertilisers and feeding-stuffs in Trinidad was not undertaken.

We decided not to repeat the Land Utilisation Survey carried out by a group of students (D.T.A. Reports 1956) last year using a map as a frame. They had developed their technique of line sampling to as high a degree of accuracy

as could be achieved with the given resources. The application of this technique to other areas was ruled out by their hilly nature or their distance from the College.

The available resources of labour, money and equipment must be first considered before planning any survey. For the planning, execution and analysis of our survey there was a team of eight post-graduate students who could afford a number of afternoons in the first and second terms for the planning and analysis, and a fortnight between these terms, during the Christmas vacation, for the execution of the field work. Up to six cars were available and money was available for travelling, paper, etc.

With these resources we could not adequately survey food gardens over a large area unless a frame (of lists of food gardeners) was already available. Fortunately this was provided by the Agricultural Survey of 1956 carried out by the Trinidad and Tobago Government Statistics and Agriculture departments. We also had access to maps on which the houses of these growers could be identified.

2. SAMPLING AND THE SAMPLING SCHEME. (Yates, 1953. Chaps. 1-4).

Sampling has many applications in agriculture apart from its use in surveys. Thus, it is imperative to take samples if we wish to assess the percentage viability of seeds for sale to farmers.

The application of sampling to surveys is not imperative on theoretical grounds but is often essential in practice. Given sufficient time and labour a complete survey of food gardens for example could be made. However, a sample survey not only yields quicker results more cheaply, as a rule, but also enables more detailed investigations and exact measurements to be made. The large number of qualified investigators required for a complete yet detailed survey is rarely obtainable. With our limited resources sampling was essential.

The origin of the population from which our sample was drawn was a complete population list. This avoids the introduction of errors of coverage associated with sampling in the absence of a complete enumeration of the population. The main requirement of a sample, however, is that it should not be biased, i.e. that it is truly representative of the population from which it is drawn. To avoid bias samples must be selected objectively and the simplest means of doing this is to take a strictly random sample.

Even when bias in selection is thus largely eliminated it is inevitable that a sample is not fully representative of the whole unless the population sampled is completely uniform. This deficiency constitutes the random sampling error which can be reduced by adjusting the sampling technique to known types of non-uniformity in the population. A population may be classified into strata each more uniform than the whole population and a proportion of the sample taken from each stratum. This eliminates that part of the sampling error due to variation between strata.

Prior to the Agricultural Survey (1956) the population of Trinidad had been divided into "clusters" which were geographical units containing about 150 people over 15 ^{old} years and around 50 - 70 houses each. These were used in the Agricultural Department Survey (1956) as sampling units because field work could thereby be concentrated and thus made easier and cheaper. The sampling of such large units however has the disadvantage that less accuracy is obtained than if the same number of people were sampled directly from the whole population.

It was the approximately 1:10 sample of clusters used in the Agricultural Survey (1956) that we used as the basis for the frame from which our second-stage sample was taken. A contrast can be emphasised here between multi-stage

sampling, which increases the random sampling error of a sample of a given size, and sampling within strata which reduces the sampling error.

The actual frame used was a series of lists of the food gardeners of the clusters within our area and surveyed in the Agricultural Department Survey (1956). In their survey they had stratified holdings into a 1 - 99 acres group and an under 1 acre group, and we retained this division. Most growers who farmed over 1 acre of land had less than 1 acre of food garden - the largest food garden area found in our survey was $5\frac{1}{2}$ acres. Stratification, it may be noted, will only increase the accuracy substantially if there are marked differences between the strata.

From our lists random samples were taken with the proviso that there should be, where possible, at least one operator chosen in each size-group in each cluster. A sampling fraction of $\frac{1}{3}$ was used for the under 1 acre holdings and a fraction of $\frac{1}{2}$ for those over 1 acre. If the total number of operators in a group was not exactly divisible by 3 or 2, as the case may be, the nearest whole number above $\frac{1}{3}$ or $\frac{1}{2}$ of the total was taken as the sample size. The overall sampling fraction was thus approximately 1 in 25 of the estimated number of food gardens (see Appendix 1).

A variable sampling fraction is normally only justifiable when different strata have widely different variability or if we are particularly interested in certain strata. Ideally, sampling fractions would be proportional to the within strata standard deviations of the units. However, a range of fractions somewhere near this ideal size give nearly as accurate results. The relative importance of the over 1 acre holdings may be noted; we found in our survey that they represent in number only about 22% of all food gardens, but cover 63% of the total acreage of food gardens. Furthermore, the over 1 acre gardens are more variable in one respect at least.

A major proportion of the under 1 acre gardens were 0.1 acre or less in size; gardens of operators who had over 1 acre of land showed much more variation in size of food garden.

3. THE SCOPE OF THE SURVEY AND OF THE FRAME USED.

(For a map of the area see Appendix 19).

The counties of Caroni, St. David and St. Andrew include about 29% of the total area of Trinidad, 37% of all cultivated and cultivable land and 16% of the total population (see Statistical Digest No. 5, 1955). It contains 401 out of the 1,578 clusters in Trinidad (excluding the urban zone).

The geographical area of the survey was limited to some extent by our location and resources. Covering whole counties has the advantage that the area is readily defined and the data collected can be related to other data classified on a county basis.

The reason for including St. David and St. Andrew, in spite of their distance from the College and their hilly nature, was that we wished to compare food gardens in the largely Negro-populated, more remote, wetter, cocoa and bush areas of St. David and St. Andrew with those in the largely East Indian-populated, flat, sugar and rice lands of Caroni situated within easy reach of large towns. The fact that food gardens are generally near the house, and houses near the road, led us to believe that we had time to cover those hilly counties as well as Caroni. Furthermore, there were fewer clusters in the remoter, less-populated areas. County St. George was not chosen for two reasons: ^{large} the amount of urban area it includes and the very steep hills which occur over much of the county.

The types of unit to include in the frame had to be defined. The only marginal type we considered was that of food crops grown under trees (usually cocoa). A preliminary reconnaissance showed that the boundaries of such

plots were very poorly defined. Crop stands graded off into stands of weeds only. Difficulties of measuring were therefore different from those of other food gardens. Higher random sampling errors might well be expected and so probably their calculation would have had to be done separately. Furthermore, extracting a frame for them would have been tedious as only the main crops - cocoa, food crops, citrus, etc. were coded and put on the cards of the Agricultural Survey (1956). We would have had to go back to the original forms and study the crops grown on all plots in trees. We concluded that crops under trees could more suitably be dealt with in another survey than in ours.

Our frame of food-garden operators can now be further defined. A farm (or garden) was defined in the Agricultural Survey (1956) as all the land in the day-to-day charge of a farm operator; a farm operator is one who makes the major decisions concerning the cultivation of a farm or garden.

For our over-1 acre lists of operators we took all operators coded as having a food garden, i.e., as having a definite parcel (= plot) or several parcels of land on which one of the following crops was the main crop:- cassava, yams, sweet potatoes, dasheen/eddoes/tannia, corn, pigeon peas, other peas and beans, cabbage, pumpkin/cucumber/water melon, other vegetables, or pineapples. These lists were obtained by machine from the coded cards which gave the operator's house-number, etc.

For our under-1 acre lists we went direct to the original forms as the card sorting machine was busy. We listed the house-numbers of all those operators who had answered "Yes" to the question, "Do you grow food crops". After selecting our sample from these lists, the names and addresses of selected operators were obtained by referring to the house-numbers and going back to the original forms.

Generally, frames consisting of lists of farms or gardens are of more utility^{value} to agricultural surveys than frames of farm-operators since the latter are mobile. However, since our frame of farm operators was up-to-date to last **June**er and was derived from a first-stage frame of clusters of houses, this disadvantage is largely overcome. Indeed, there would be some justification, where new operators had taken over a garden, of measuring the garden and not chasing up the original operator to any new garden he may have.

The origin and the limits of the frame we used have now been considered. It may be added that this frame was the only one available for our purposes. It was not to any great extent out-of-date, and, consisting of lists of named individuals whose houses were mapped, it was not subject to duplication. Further, since all houses within any cluster were to be visited in the Agricultural Survey (1956) there was little chance of any growers being missed. The question of any inaccuracies in the frame - such as the occurrence in it of people who do not in fact possess gardens - will be discussed later.

4. THE DESIGN OF THE SURVEY.

4.1. The Method of Estimation of Garden Composition.

Preliminary to the design of the survey a reconnaissance of a few of the local food gardens was made. One of them was measured and all the plants counted by taking consecutive strips 10' wide, divided into 10' Sections. We counted the plants in each 10' x 10' square.

The complexity of the mixture of crops grown was immediately apparent, as was the general lack of the use of systematic planting distances. Occasional pure stands in regular rows were noticed.

Where gardens were in juxtaposition there was no visible boundary between, but the owners knew exactly where

the boundary was. No difficulty was envisaged in deciding the boundary between food gardens and neighbouring ground crops under cocoa. Food gardens are generally near the house, less frequently in a clearing among trees. Rarely is there an intermediate condition between the food garden and the food grown under a canopy of cocoa. Sugar and rice fields too were clearly delimited from food gardens. In our survey we ignored the few breadfruit, breadnut, pawpaw and plum trees occurring in the gardens.

Our main problem was how to accurately estimate the composition and production of the food gardens with the resources available. Any direct estimation of the total area covered by each crop was impracticable because of the high degree of mixing of crops. Only where pure stands occurred could this be done easily. The area occupied by pure stands is very small, relative to the whole, so a method of estimation suitable for the major part of the gardens had to be devised.

The only alternative to estimating the areas covered was to estimate the plant numbers. From these figures estimate of production might be obtained later. Also, if desired, some estimation of acreages covered by each crop could be obtained from plant counts. Such estimates would be of doubtful accuracy and value when the intensity of mixing of crops is considered.

The time which would be required to count all the plants in the gardens is prohibitive.

Only where plants were spaced regularly (this was rare) could estimates of plant populations be obtained by measuring the total area and the planting distances.

Taking transects through gardens was considered less practicable than the use of a quadrat. Even a belt transect, for example, would introduce more error or bias than a quadrat. If a belt was laid at random it may well be along the rows of a crop or crops and the result would be

unrepresentative of the whole garden. If it was laid in a particular direction chosen as representative of the given garden the question of personal bias would arise.

Point quadrats are impracticable because of the great variation in height and size of the different plants. Also, we require an estimate of total plant numbers, not just the percentage frequency in different gardens.

We are left then with the frame quadrat. It was found in our first attempt at counting the plants of a garden that about 10 ft. was the maximum width over which garden plants could be readily seen and counted without the risk of counting the same plant twice. A 10' x 10' quadrat was chosen as smaller areas would tend to underestimate widely spaced plants.

The time available for measuring a garden was estimated conservatively at 15 - 30 minutes. (430 operators in 14 days means about 4 operators/day/man. Allow in all 1 - 2 hours per operator; i.e. $\frac{1}{2}$ - $\frac{5}{4}$ hour for travelling time within cluster; $\frac{1}{2}$ - $\frac{5}{4}$ hour for questioning and measuring). It was decided that in holdings under 0.1 acre only two samples would be taken. In gardens over 0.1 acre four samples were to be taken.

Time did not permit a pilot survey to determine the minimum number of samples and their optimum size for a satisfactory standard error. A member of the team did try to discover this information from our measurements of one garden, without success.

Personal bias in the placing of sample squares might be serious without a pre-determined system of randomisation. For example, they might be placed where relatively high concentrations of plants occurred; or they may be placed nearer to the house or entrance to a plot. Tannias, for instance, frequently occur at the far end of a garden. The system of randomisation devised is described in the next section.

After placing the squares it was necessary to list and count the individual crop plants. Initially, we had been interested only in ground provisions, but owing to the intimate mixing of crops it was evident that we must include all crop plants present if a complete picture of the food gardens were to be obtained.

Immediately, there arose the problem of how to define a plant. Our main concern when we looked at plants in the field was to find definitions which were as precise and objective as possible so as to eliminate bias in counting. We did not ignore, however, the agricultural units such as the "hills" on which 2 - 3 cucumbers may be grown together virtually as a unit with the separate plants not readily distinguishable.

Many plants such as cabbages and egg-plants could be counted individually; with dasheen, tannia, etc., crowns were the most readily counted unit, and small offsets were ignored. Each stem which emerged from the soil had to be counted with pigeon peas, cassava and sweet potatoes since the (botanical) units of these plants were ill-defined in the field. With okra, however, clumps of stems could readily be distinguished and they formed our units. Yams presented a difficulty; we decided to count the number of sets as being more related to units of agricultural interest. It was sometimes difficult to distinguish yam sets in the field and the number of stems emerging from the soil might have been a more precise unit.

All the bananas present in the garden could be counted in a short time without sampling. We took the stool as our unit. (The term bananas here includes plantains).

Our greatest problem of definition was presented by the pumpkin plant. These, as they spread and root adventitiously, soon lose any relation they had between area covered and the numbers planted. In fact, the number planted cannot be readily

ascertained in practice. We by-passed the problem by proposing to count the number of patches in a garden.

4.2. The Design of the Questionnaire.

A questionnaire was designed to obtain supplementary information of relevance to the purpose of the survey. Such questions had to be few in number because of the time limit. For this reason questions on the numbers of plants grown on a plot were not included, although our measurements would have provided a valuable check on the accuracy of such estimates by growers.

Survey questions should be as simple and precise as possible; but in spite of this and owing to our particular interests, we included a question on the grower's reasons for any particular combination he grew, and also tried to get his estimate of yields. We tried to ascertain too the percentage of crops (a) home consumed, (b) sold casually, or (c) sold in markets.

Additional information sought included questions on the use of artificial and organic manures, and on whether or not the land was cleared at least once a year (and whether cleared by forking or ploughing). Such information, interesting in itself, would reflect too on the general standard of cultivation and might indicate whether improvements could be effected by, say, the use of more artificials.

We questioned whether or not non-food-garden crops had been grown on the land in the last two years to assess change of land use.

Finally, we observed whether the grower was East Indian, West Indian (Negro), or other nationality to find any racial differences in choice of crops, etc.

5. THE PREPARATION FOR THE FIELD WORK.

5.1. The Preliminary Work and Organisation.

Sketch maps of the 41 clusters in our survey were traced off those in the Statistical Department, Port of Spain. The building numbers used in the Agricultural Survey (1956) had been put on to the maps. We obtained lists of those building numbers which were relevant to our survey, as already mentioned. These were sampled at random.

Lists of the names and addresses of our sample of food-garden operators were made under the headings of county and cluster. Building numbers were recorded also as the means of identifying the operator's house on the sketch map. The agricultural zone in which the garden occurred was also noted (Zones 1 and 2 were cocoa zones - North and Central - Zone 4 was the sugar zone).

The number of separate food-gardens controlled by the operators were noted since each would be measured separately. The garden acreage estimates of the Agricultural Survey (1956) were noted also.

Until now, the preparatory work had been variously distributed. For the field work itself the survey area was divided into seven areas as geographically compact and as equal in numbers of operators as could be obtained without splitting any clusters. Each of seven members of the team was responsible for the organising and supervising of the survey over his own area. Mr. R.M. Meredith, the remaining member of the team, was to be our statistician and would be responsible for the unenviable task of organising the coding, abstraction and analysis of the data we obtained.

The responsibilities of the supervisor of each area were, to begin with, the transcribing of names and addresses and county, zone, cluster and building numbers to the enumeration and questionnaire forms. The cluster and

county numbers of the Agricultural Survey (1956) were re-coded for our survey to give consecutive numbering for ease of handling the data (see Appendix 1).

Each of us had to obtain from tables the required random numbers for the location of sample squares within the plots and enter these too on the enumeration forms.

With regard to the actual forms used (for examples see Appendices 3 and 4) a few points may be mentioned. Question and enumeration forms were put onto separate sheets. This was partly to allow plenty of room for each and, more essentially, to allow us to work in pairs. One of a pair could put questions while the other measured and sampled unhampered by the attentions of the farm operator. In practice, working in pairs proved most satisfactory for other reasons also. We could consult one another on any difficulties which arose in the field and also an economy in the use of transport was facilitated.

Data such as cluster and building numbers and names and addresses were put on both of the forms to further aid the tabulation of data later on. For the same reason such data were put into clearly demarkated boxes on the head of the forms. Crops were ^{to be} entered in the field. This would give us more room to enter data since not every crop would occur in any one garden.

5.2. The Design of Instruction and Log Sheets.

An Instructions Sheet was composed as an aid to the field measurements (see Appendix 2). It was designed to be comprehensive and so included points which might well be left to the common-sense of post-graduates. Thus team-members (who will be referred to as enumerators) were reminded to test their length of pace under field conditions (if they were using pacing to measure with). Further instructions included the pacing of boundaries, the boundary being the extent of the food

crops, excluding bananas. (We were not primarily interested in bananas and in a few cases pure stands of bananas extended beyond the other food crops.). Enumerators were instructed to pace out areas occupied by buildings or yards when these came within the boundary of the garden. Measurements were to be recorded on a rough plan sketched on the back of the form. Pure stands were then to be measured, and a sample square laid on a representative part of each one.

Plant definitions were included on the sheets, also directions on locating the randomly pre-determined positions of the sample squares. Starting from a randomly determined corner the enumerator was to walk 0 , $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ of the length of the field (according to whether the first random number was 0 , 1 , 2 , 3 respectively) and then (referring to the second random number) he was to walk a distance equivalent to 0 , $\frac{1}{4}$, $\frac{1}{2}$ or $\frac{3}{4}$ of the width of the field. Also to avoid bias sample squares were to be put down to the front and left of the located point (or to the front and right if it would otherwise fall outside the field). The series 0 , $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ was preferred to 0 , $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 since we felt the latter would over-emphasise the field boundary which was likely to be ^auntypical of the rest of the garden. It was not until the field work had started that we realised that in the larger gardens we were still over-sampling round the boundary. Consider the possible ^{paired} combinations of 0 , 1 , 2 , 3 ; 00 , 01 , 02 , 03 , 10 , 11 , 12 , 13 , 20 , 21 , 22 , 23 , 30 , 31 , 32 , 33 . **Seven** out of these 16 contain a 0 , placing the sample somewhere on the boundary. Further, consider that a field of 0.1 acre contains about half its area in a border just within the perimeter $10'$ wide. An acre field contains only about $\frac{1}{4}$ $\frac{1}{5}$ of its area in such a border. Nevertheless, for both field sizes $7/16$ ths of our samples touched the perimeter. *Good point*

It was considered that an Instructions Sheet for use with the questionnaire was not necessary because the

questions themselves appeared straightforward and had been discussed by the team; it was pointed out that entries should be made against all questions, whether replies were positive or negative.

Throughout the survey fairly detailed records were kept of the time spent and of the mileage covered. Such information would always be useful to someone planning a similar survey in the future. For the field work detailed log sheets were prepared (see Appendix 6). These, when completed, would give the man-hours spent in interviewing and measuring, the time taken travelling within clusters, the journey time to and from clusters each day, and the mileage covered and mileage allowance earned. There was a space provided for general observations on the cluster. Instructions for the use of these log sheets were prepared and issued to each enumerator (Appendix 5).

5.3. Reconnaissance.

As a preliminary to organising my own area, visits were made to each cluster in it (excepting one) to check on the accuracy of the maps, enter on them further land-marks, such as milestones, and judge how compact and accessible the clusters and houses were so as to distribute the field work to best advantage. In my own area (see maps, Appendices 16 (a) to (f)) 5 hours and 70 miles of travelling were required for the reconnaissance. My farthest cluster, at Tamana, was not visited and some difficulty in finding it was later incurred through a misnaming of a road on the map. The other maps were accurate but some lacked land-marks.

We decided that, as a rule, we would finish one supervisor's area before passing to the next. We began with a compact one near at hand (Valencia) so that we could all meet at midday on the first day (December 10th) to discuss any problems which had arisen.

The order in which areas were to be taken was decided in advance for the benefit of the supervisors. Generally, the farthest areas were to be taken first.

The only equipment we used was ~~four~~ light wooden 10-foot poles ($\frac{3}{4}$ " square), ⁴~~for~~ for each pair of enumerators, and a metal clip-board, ^{one}~~for~~ for each ~~one~~ of us, to hold forms.

6. EXECUTION OF THE FIELD WORK.

6.1. Measurement in the Field.

One of the problems which arose on the first day of the field work was that of defining the boundaries of gardens which were partly neglected and going back to grass or even bush. It was left to the discretion of enumerators as to how much of such areas were to be excluded in each case. The main criterion adopted was the number of food plants in the neglected part - if there were just a few surviving then the area was excluded. In gardens wholly neglected the same criterion determined whether or not to enter "No garden" on the forms. Rightly or wrongly no ruling was made to give any more strict uniformity of judgement among enumerators. Unfortunately time and travelling expense permitted neither overlapping of the area covered by different enumerators, nor later checks on a random sample of gardens in each area.

Further practical points which arose and may be mentioned include the following:-

For the measuring of gardens some enumerators found it more convenient to use the 10' poles than to pace out the distances. Those who paced had to re-measure their length of stride according to the field conditions - in the hilly areas of Zone 1 for example.

In the laying down of sample squares 2 (or 1) 10' pole(s) were often sufficient especially when only large plants were present.

In very small gardens all the plants were counted,

without any sampling. In other gardens split up by the house for example, one sample was laid in each piece; such samples were treated as samples within one plot for calculation purposes. Only definite areas differing in composition were treated as subplots and kept entirely separate. In the smaller gardens even subplots of similar size containing different crop combinations were treated as one area but sample squares were placed in each subplot and the combinations noted. The result was that these subplots did not appear in the analysis since no definite area could be assigned to them. For this reason the prevalence of definite combinations was underestimated. This did not occur with pure stands which were always measured separately. ✓

Our definitions of plant units were generally adequate. However, with closely spaced bananas, for example, individual stools were not always readily distinguishable. In cases where both enumerators counted the stools no wide discrepancies between the enumerators occurred; the average was taken as the number present.

Pumpkins were recorded present or absent in a garden, according to whether or not it occurred in any of the samples. Tannia presented no difficulty but with dasheen the distinction between main stools and small offsets was not always clear. Eddoes usually occurred singly, not in clearly defined stools with offsets, and it was a moot point as to how small an eddoe should be for it to be ignored. The difficulty of counting yams has already been mentioned. The counting of other plants was relatively straightforward.

6.2. The Questionnaire.

No difficulty at all was experienced in gaining the willing co-operation of operators. We had gone armed with a letter from Dr. Jolly explaining our purpose and harmless nature, but we did not need to use it. We merely said that we

were students of agriculture (not government officials) surveying the food gardens of the area, and we asked to measure their gardens and put a few questions. Everyone (with only one outstanding exception in the whole survey) was very helpful and gave us his time and attention and as much information as he (or she) could. We found, however, that very few indeed could give us any details of yields obtained or of the proportions of the produce sold and home-consumed. Generally it was all home-consumed with the chief exception of bananas when there were about 30 or more stools grown.

Where artificials or organics were used they were generally applied to individual plants or crops, rather than to an area of land so we could easily record on which crops they were used. The quantities used were rarely known exactly. A questionnaire type of survey could not, therefore, ascertain this.

The question of ploughing was straightforward but reasons for any definite combinations of crops were not forthcoming. It is the tradition to mix crops. In general it was claimed that crops were grown in mixtures "because there was not enough room to grow them all separately". Cassava was grown with dasheen because (e.g.) "it does no harm to the dasheen". Some comments were conflicting; thus one grower thought that "eddoes grew better with pigeon peas", while another preferred eddoes in a pure stand because he then got better yields. Cassava was the chief food crop occurring with pigeon peas merely because it is the only one which will compete satisfactorily with it in a close stand. One grower pointed out, in fact, that eddoes could be grown with pigeon peas only until the shade from the latter became too great.

Entries under the heading "General" were confined usually to the nationality of the grower. Occasionally there were remarks such as the preference (e.g.) of East Indians

for eddoes rather than dasheen; or that a grower was a full-time one. Reasons why "No garden" was recorded were given.

No non-food crops had been grown in the previous two years, as a rule, but some operators in the cane area rotated food crops with sugar-cane and a few gardens, notably in the cocoa areas, had recently been in bush.

6.3. An Account of the Area in which the Writer Supervised.

Some details of my own area as examples of the nature of clusters will now be given (see maps, Appendix 16).

Particularly noticeable is the difference between clusters. Within clusters the crops grown and the relative numbers of them were remarkably uniform.

Cluster 01 in Caroni County is in a rice and peasant sugar-cane area. The gardens are on low-lying land, poorly drained. Those north of the main Caroni road were operated by East Indians growing mainly eddoes, with some dasheen and cassava, etc. One had no garden because it was "too wet to grow food crops", but the land was there, unused. Of the six operators to the south of the Caroni road, two (East Indians) had no food crops. The other four (Negroes) grew mostly dasheen and cassava, with some eddoes.

Cluster 08 is in the same rice area, adjacent to peasant sugar-cane lands. All nine operators except one were East Indians. Four had no food-garden. Eddoes was the chief crop by far; some dasheen and a little cassava, etc. were also grown.

Cluster 28 is in a slightly hilly area of bush, with some plots of bananas. The cluster is more thinly spread out than the others; three houses are sited along traces off the metalled road, and two houses occur in Cacandee (28₂ on the map). Again, all except one were East Indians. Cassava was the outstanding crop. Most growers

had pigeon peas and a few bananas. Other crops included corn and dasheen. There were 2 "no gardens".

Cluster 09, County Caroni, was the largest cluster in my area, and situated in the estate cane area. The population is dense and lived alongside a metalled road. Twenty of the twenty-three operators were East Indians. There were no "no garden"s returned by the enumerators but one was included which was doubtful because it merely contained two pumpkin patches, and two other gardens had very few plants in them. Eddoes, pigeon peas, sweet potatoes and cassava were the main crops grown. A few bananas also occurred.

Cluster 09, County of St. Andrew, is in the low hills near Mt. Tamana in a cocoa area. The first attempt to reach it failed due to a flooded road. The second found the main road through it to be wrongly named on the map. Having located the beginning of the cluster by enquiring for people in it we could, however, easily work from house to house in our sample. One exception was the house in Whisky Trace which was not located nor was the house or the person known to local people we asked. It is fair to add that lack of knowledge of neighbours was not unusual; it was partly due to some people being known under different names locally.

This cluster was characterised by the large number in our sample who grew no food crops. Various reasons were given for not working the land - "man very sick, no longer works", "land taken for coffee", two others were under citrus or cocoa, one grew only bananas, others merely grew virtually no crops on their plot of land. Altogether we were left with four operators (out of the 12 in the sample). Three were Negroes (predominant here) but one was East Indian. Cassava and tannia were the main crops, but much dasheen was grown; all had around 40 banana stools, except one who had about 700 (he had three acres of land).

Throughout my area only two, or possibly four, operators could be classified as market gardeners, i.e., as growers who sold most of their produce and gained much of their income from food-garden crops. Elinos Rampersad may be cited as outstanding (County 1, Cluster 08, House 42). He had over $1\frac{1}{2}$ acres of food garden. He was able to give rough figures on his costs and returns. He grew mostly pigeon peas, cucumber, lettuce, okra; also egg plant (and maize). He marketed all his produce and used artificials and organics on all crops. Ramdath Ramdass (County 2, Cluster 09, House 55) was less outstanding. *(i.e. he had a lower income from his garden).* He had over $2\frac{1}{2}$ acres and grew mostly maize, bananas (his chief cash crops), pigeon peas, cassava, tannia and dasheen. All crops were part marketed, part sold casually and part home-consumed. He used artificials on all crops, but organics only on bananas. Both used a plough. Rampersad rotates his food crops with sugar cane; Ramdass had recently recovered some of his land from bush.

The differences in income can be related to the crops grown and this in turn can be related to differences of environment and of distance from markets - nearness to a good market is particularly important for growing a regular supply of perishable vegetables, as opposed to crops like maize which can be harvested at a definite season and stored after harvest, or crops like bananas for which there is an efficient marketing organisation.

The field work over the whole survey area took some 490 man-hours, and 1,850 miles of travelling (including follow-ups). Starting on December 10th the main part of the survey was completed by January 6th (with a break for Christmas). There were 29 follow-ups out of a total of 430 operators in the original sample. The reader is referred to Appendix 7 for a time and cost study for the whole survey.

It may be noted that the time of year (December) was a particularly good one from the point of view of the questionnaire part of the survey because many people were at home then—in the lull before the cane harvest, for example. As regards cropping it was also suitable except that the main crops of ^{and eddoes} maize had been harvested and had the survey been a few months later we may have found a little more egg-plant, tomatoes, cucumber, cabbage and lettuce. However, the virtual absence of cabbage and lettuce was almost certainly not just seasonal.

7. THE PRELIMINARY ORGANISATION OF THE DATA.

7.1. Preliminary Checking and Calculations.

The preliminary calculations, those of the areas of the gardens and of the numbers of plants in them, were the responsibility of the enumerators. It was desirable, although not generally followed, that such calculations be done on the same day as the measurements and the forms passed on by the supervisor for checking. Any ambiguities or omissions might then be reliably corrected from memory.

From the number of plants in 200 or 400 square feet the number in the garden was readily calculated, given the garden area (see Appendix 3). The garden area, if it ^{was} ~~is~~ approximately square, was obtained by measuring two sides only. If of uneven shape, all four sides were measured, a sketch plan drawn and, if necessary, the area was calculated by re-drawing the garden to scale on graph paper. Pure stands were calculated separately.

On checking the questionnaire forms any omissions in any column (disposal, artificials, etc.) following the entry of a crop were queried. Usually the disposal, for instance, was the same as for the other crops, but no indication of this had been made on the form. A supervisor could never be justified in

assuming anything, without questioning the enumerator concerned. Possible anomalies such as the land being ~~for~~ yet not cutlassed were queried also.

Measurement forms were generally not subject to omissions or anomalies. On checking a few of the calculations of each enumerator against his figures I found no arithmetical errors in forms returned to me. Very occasionally, writing or figures were illegible or doubtful and had to be queried. Sometimes a crop was present in the sample but not named on the questionnaire form. Where the opposite occurred it did not matter since only those plants whose numbers we estimated in a garden and which were present in the sample were put onto the clip-cards and included in our calculations.

7.2. Coding the Data and Transference to Cope-Chat Cards.

The next stage was the coding or compaction of the data on the forms which was necessary before its transference to clip-cards. For details of the coding used the reader is referred to Appendix 8.

Coding of the cluster numbers was arranged so that 3 clippings were required for each; this made the clusters mutually exclusive when sorting.

It was found possible to record on the cards nearly all the data we collected. The only exceptions were the following where information was very scanty or lacking: yields, reasons for combinations, other non-food crops grown in the previous two years.

In the actual clipping, holes to be clipped were marked in pencil first because any clipping error meant that another card would have to be prepared. A group of cards with the same clipping (e.g. cluster number) could be clipped at one time. Any wrongly clipped cards were destroyed.

When there was a "No garden" etc. the cluster, zone and county numbers only were clipped.

It was very important to check clipped cards before putting them into the pool, as errors would be difficult to trace. Cluster and County numbers were checked; the presence of written data inside the card was checked against the clipping made. Finally, as cards were completed, the household number on the list of operators was ticked so that none would be missed out.

The value of clip-cards lay in the ease of sorting and handling material for tabulation. Most categories of information could be selected by use of a sorting needle; clipped cards with the desired information could be shaken free of the rest. Care was required, with the small light cards we used, to ensure that none failed to drop out on shaking. It was necessary to examine the edge of the bunch of cards after each sorting operation.

We found that the use of separate cards for the separate subplots or pure stands (and for separate parcels too) led to difficulties. It would have been easier to tabulate the data if there had been only one card per operator, since the operator was our unit for the calculations. (We had 462 cards for the 430 operators in the original sample).

7.3. The Cluster Summary Sheets.

The data on the cards were summarised and put on the cluster summary sheets (see Appendix 9); one side of the sheet was used for the over 1 acre holdings and the other for those under 1 acre. These summarised all the data for each cluster under the headings of numbers of operators and numbers of plants grown for each crop. Operators were classified according to nationality and totals were calculated. The numbers of operators using artificials, etc. were also given. Also the number of no responses, no garden, etc., but these referred to plots and not necessarily to operators which meant

that we had to go back to the original cards to find the number of operators who had no garden, etc.

These cluster summary sheets provided some excellent checks throughout the analysis and were our source for the qualitative analysis of the number of operators within clusters growing particular crops, etc. Otherwise, they were not used a great deal. Had the analysis itself been designed before the data was tabulated these sheets would have been different and less detailed. Thus a raising factor, R.F., was calculated. This figure was based on the exact fraction of food-garden operators taken in our sample. It approximates to 2.0 for the over 1 acre sample and to 2.8 for the under 1 acre sample. These factors were to be used to raise our operator counts and plant number estimates within our sample to estimates for the whole cluster-size-group. Because of the length of our final calculations we had to use an overall raising factor covering all clusters and applied to county-zone-size-groups - a quicker if less exact procedure.

The total areas of our sample for each cluster-size-group were obtained by summation. We summed both the areas of the holdings as estimated in the Agricultural Survey 1956 (this sum on the sheets = A) and the areas we found ourselves by measurement (this sum on the sheets = B). The area of the whole cluster as given by the Agricultural Survey (1956) was also recorded (C). The ratios B/A and C/A were then calculated. The ratio C/A was also calculated from the figures on the original lists and thus formed a check for the C/A ratio calculated using the A total derived from our cards. Errors in copying were thus shown up unless they cancelled one another out. The B/C ratio could have been used in the calculations as a raising factor if we so desired, but since our sample was one of operators it would have been more logical to use the R.F. which was based on operators. The ratio B/A estimated the accuracy of the Agricultural Survey (1956) acreage estimates compared with our measurements.

Internal cross-checks were given by the vertical and horizontal totalling of operators and crop numbers. Another internal check was the sum of operators under the headings, Marketing, Casual Sales and Home-Consumed. This total should be equal to the total number of food-garden operators we found in our survey in the cluster-size-group. This is explained by the fact that if an operator marketed his produce and also sold some casually he was only entered in the "Marketed" group on the sheet. Similarly, if an operator did not market his produce, but sold some casually and consumed some at home, he was only entered under the heading "Casual Sales".

8. THE ANALYSIS OF THE DATA. (Yates, 1953. Chaps. 7 and 8).

8.1. Quantitative Analysis of Plant Counts.

The data was divided into eight sections (county-zone-size-groups) for the calculations.

TABLE I

County 1.	Zone 2.	Over 1 acre holdings.	(4 clusters).
" "	" "	Under " " "	(" ").
County 1.	Zone 4.	Over " " "	(24 clusters).
" "	" "	Under " " "	(" ").
County 2.	Zone 1.	Over " " "	(4 clusters).
" "	" "	Under " " "	(" ").
County 2.	Zone 2.	Over " " "	(9 clusters).
" "	" "	Under " " "	(" ").

Within these sections the following information was calculated for each crop and for our acreage estimate:- (values are listed in the order in which they were calculated).

($\bar{N}$ = the estimated number of food-garden operators in the section.)
 $\bar{y}$, the estimated mean number of plants per operator in the sample, within the section.

$V\bar{y}$, the variance of the estimate of $\bar{y}$.

S.E. $\bar{y}$, the Standard Error of the estimate of $\bar{y}$ ($= \sqrt{V\bar{y}}$).

% S.E., the Standard Error expressed as a percentage of $\bar{y}$.

VY , the variance of our estimate of the total number of plants in the whole section ($= N^2 \times V\bar{y}$).

$\underline{Y}$, our estimate of the total number of plants in the whole section ($= N \cdot \bar{y} \pm N \cdot \text{S.E.}\bar{y}$).

$A/V(\underline{Y})$ (see below).

To carry out these calculations the following values were required and were calculated beforehand:-

N , defined above.

α , a complex factor applied to the M.S. of the between clusters variation in our calculations.

β , a complex factor applied to the M.S. of the within clusters variation in our calculations.

For an outline of the theory of the analysis, and for a definition of α and β in algebraic terms the reader is referred to Appendix 10.

For a worked example of the calculation, see Appendix 11.

The calculated values of $\underline{Y}$, S.E. $(\underline{Y})$, % S.E., $V(Y)$ and $\frac{\alpha A \times 100}{V_y} \%$ were entered on "master"-sheets, one for each crop (see Appendix 11, and the discussion, page 32; for an example, see Appendix 14).

Estimated totals and their variances etc. were calculated by summation of county-zone-size group totals and the corresponding variances.

8.2. Qualitative Analysis of Operator Numbers. (The analysis of the numbers of operators growing a particular crop or using artificials, etc.).

The data was divided into the same eight sections as for the Quantitative analysis.

Within each section the following information was calculated (in the order given).

- p , the estimated proportion of operators growing a particular crop in a given cluster.
- q , the reciprocal of the p values.
- p_o , the estimated proportion of operators growing a particular crop in a given section.
- q_o , the reciprocal of p_o .
- V_p , the variance of the estimate of p .
- $V(U)$, the variance of our estimate of the total number of operators growing the particular crop in the whole section. ($= N^2 \times V p$ where N has the same value as in the quantitative analysis).
- S.E.(U), the Standard Error of the estimate of U ($= \sqrt{V(U)}$).
- U , the estimated number of operators growing the particular crop in the whole section. ($= N \times p_o$).
- % S.E. = $\frac{S.E.(U) \times 100}{U}$
- $\alpha C/V_p \times 100\%$ (see worked example, Appendix 13, and the discussion, page 32).
- N , α , β , have the same values as before. They are again used in the calculations.

See Appendix 12 for an outline of the method of analysis and Appendix 13 for a worked example.

The values of U , S.E.(U), % S.E., VU and $\alpha C/V(p)$ were entered on the "master-sheets" and estimated totals and their errors for zones and counties were obtained by summation of the section totals and the corresponding variances.

8.3. Further Analyses of the Sample Data.

Further analyses on the unraised sample figures were done to find the percentage distribution of the use of artificials, marketing, etc. (Appendix 18), also the (percentage) differences in crops grown, use of artificials, etc. between

East Indians and West Indians (Negroes) (Appendix 17). For these calculations the cluster summary sheets were used as a source of data and various percentages were calculated. These are slightly biased by the higher sampling fraction we used for the over-1-acre holdings.

A table of the numbers of "no gardens", etc. was drawn up also, by reference to the cards (see page 44). Operators, not plots, were taken as the units.

Finally the writer has tabulated some of the information given by the "master"-sheets showing differences between the strata used, and relevant percentages were calculated (Appendix 17).

8.4. Checks.

A few comments may be made on the question of the checks of our calculations.

In the qualitative analysis there was a unique check in that two separate calculations should give the same answer (i.e. $(\bar{p} - \bar{p}_0^2)n'' + n''\bar{p}\bar{q} = (S'n'')\bar{p}_0\bar{q}_0$) (see worked example, Appendix 13).

In the quantitative analysis there was only one internal check - The difference between the sum of the cluster values of $S''(y)^2/n''$ and of $S'S''(y)^2$ should equal the sum of all the differences between these values for each cluster. (For worked example, see Appendix 11).

Had time permitted all calculations should have been checked through, particularly the later ones on the "master"-sheets for example; an error in the final stages of calculation could have been particularly serious.

Percentage Standard Errors and other simple calculations can be checked by inspection. Anomalous or unusual values can also be noted by inspection and investigated. Thus the reason for a very high percentage Standard Error would be looked into.

The numbers of operators in our final estimates were, for each crop, expressed as a percentage of the total estimated number of operators in the survey area. These percentages were then checked against the corresponding percentages obtained for the sample population only. Because of the variable sampling fraction and the approximate raising factors involved in our calculations the two percentages would not be identical but gross errors could be detected.

9. RESULTS AND DISCUSSION.

9.1. The Precision of the Results.

The consideration of the results of any survey falls into three main sections: the information which was obtained; the accuracy and precision of that information; and the utility of the information - particularly with reference to the purposes of the survey.

Of major importance is the accuracy of our results. Unless this is known the results themselves are valueless - hence our complex calculations, the whole purpose of which was to find the variance of our data. Only simple calculations would have been required just to raise the figures we obtained up to single values relevant to the whole area from which we sampled.

Inspection of the percentage Standard Errors of the results (Appendix 17) shows that in general the percentage Standard Errors for our estimates of crop numbers are of the order of 20-25% or more. Our Standard Errors for the estimation of operator numbers are of the order of 15-20%.

These Standard Errors measuring as they do the precision of the estimates (except for inaccuracies due to bias) indicate that many of our plant number estimates are of very doubtful value, but nearly all of the operator number estimates are precise. Half of the latter have percentage Standard Errors around 3-12%, only 6 out of 27 are above 20% S.E.

However, even errors around 20-25% S.E. do not render estimates such as ours completely valueless. Therefore, our crop number estimates for bananas, cassava, dasheen eddoes, okra and egg-plant are of value.

What is the reason for the more exceptionally high errors? Take beans, peppers, tomatoes and tannia as examples. They have percentage Standard Errors of 188%, 95%, 81% and 48% respectively. Inspection of the "master" sheets shows immediately which section contributes most to the variance. Referring back, then to the relevant cluster sheets, it is found that with beans the very high error is caused by one person in the county 1, zone 4, over 1 acre section, who had the most exceptional number of 167,000 plants! Again, with peppers one man had 4,000 plants; with tomatoes one had 11,000 plants; with tannia one grower had 18,000 plants - most had only 200-300.

(It may be pointed out here that where a section has a very large Standard Error but a small total number of plants it does not greatly affect the overall Standard Error.)

These examples show clearly the meaning of our high Standard Errors; they mean simply that the average variation from one garden to another in our sample became excessively great when one person grew an exceptionally large number of plants. Pigeon peas would have had an even higher percentage Standard Error had there been only one extreme count, instead of the three or four which actually occurred.

Even dasheen, having one of the lowest ^{overall} percentage Standard Errors showed ~~great variation of~~ percentage Standard Errors from one section to another; in fact most of the overall Standard Error was contributed by four growers who grew 98% of the dasheen in the County 1, Zone 2, over 1 acre section.

We cannot leave out extreme values, for while stthat would reduce our Standard Errors considerably it would be a most biased procedure. There is no way of telling that just as one man in our sample grew many more plants than anyone else so there may be a proportionate number of such people in the whole survey area.

The values of $aA \times 100/v_y \%$ were about 90% for most of the calculations. When we made some calculations to separate the first stage (between-cluster) variance from the total variance (see Yates 8. 10, 8. 11) we found, for example, that in one typical case (i.e. $aA \times 100/v_y \%$ over 90%) the within-cluster variance was greater than that between clusters.

In another typical case (i.e. $aA \times 100/v_y \%$ over 90%) the between-cluster variance was the greatest. No doubt where this occurred the varying pattern of crops over the survey area was a very important factor. In such cases a sample of a given size taken from the whole population would probably have a lower variance than that obtained by multistage sampling. In fact the greater the proportion of the total variance that occurs in the between cluster fraction the more ^{will have been} total variance ~~is~~ swollen by our multistage sampling method.

In the qualitative analysis errors were highest (i.e. over 12%) only when very few growers had the crop (i.e., less than 20%). Generally, errors were low because any one grower can only affect the total error by a small amount.

Owing to the low values of βB this part of the analysis could have been left out with little detriment to the results and a consequent saving of time. (Similarly, βD could have been left out.). (See Yates 7. 17 for the adjustments then required).

9.2. The Survey Crop Numbers and Prevalence Estimates.

The actual estimates we obtained for crop counts must be considered in the light not only of their precision but also of the definitions of the units we used. Thus the number of cassava "plants" must be greatly reduced if they are to be considered in the normal sense of botanical units.

9.2.1. Estimates for the Whole Survey Area

Taking mainly those crops with the lower percentage Standard Errors it may be seen (Appendix 17) that Dasheen, Tannia and Cassava are by far the commonest starchy roots; fewer Eddoes and Sweet Potatoes are grown and very few Yams. Of the other crops, Pigeon Peas and Maize may be mentioned as being numerous, even allowing for the higher Standard Errors.

The mostly widely grown crops are the following:-

Table II

Crops	% of Operators who grow it	(The estimated total number of food garden operators in the survey area was 8983 - see Appendix 14)
Banana	80	
Dasheen	63	
Cassava	56	
Pigeon Peas	55	
Tannia	42	
Okra	33	
Egg-plant	27	
Peppers	22	
Eddoes	19	

Crops such as tomatoes and cucumbers are grown by very few people (e. 7% grow these crops). (See Appendix 17 for further figures).

Thus the commonest crops are those which require least attention and have no critical harvesting season (most growers are part-time only). Yams, for example, require a relatively high input of labour and costs (poles) to be grown properly.

It may be of interest to mention here the approximate mean number of plants per operator (for those crops with the lower Standard Errors).

(The data in Table III were from County 1 and County 2 are from County 3)

Table III

Crops in order of prevalence	Mean Plants for all operators	Mean Plants for those who grow the crop	% S.E. for original plant number estimates
Banana	30	40	25
Dasheen	150	230	23
Cassava	220	390	22
(Pigeon Peas)	10	20	37
Okra	8	25	25
Egg-plant	8	30	22
Eddoes	40	200	26
(Sweet Potatoes)*	60	380	33

*(Grown by 15% of all operators)

Finally it should be interesting to compare our results with those of the Agricultural Survey (1956) (unpublished data). If allowance was made for the different time of year (June-July) that that survey was carried out, an assessment could be made of the value of a questionnaire survey as a means of obtaining information on numbers of plants being grown.

9.2.2. Differences between the Cocoa Zones and the Cane Zone.

It may be noted that the cane-zone is pre-eminently suited to sugar cane because of the marked dry season which enables harvesting to be facilitated; also cane can grow on the heavy soils there, and the flatness aids cultivation. The moister, hilly regions of Zone 1 are generally suited to cocoa - especially the better structured soils.

(The differences between County 1 and County 2 are very similar as would be expected from looking at the map. (See map, Appendix 19)).

Some differences between these zones may be noted. Direct comparisons are readily made because about half the acreage of food gardens falls into each zone. (See Appendix 15, Table (b) for the exact figures).

The following table shows the outstanding differences (among crops with Standard Errors low enough to be outweighed by the differences);-

Table IV

Crop	% of Total Plants		% S.E. of relevant Estimates	
	Cocoa Zones	Cane Zone	Cocoa Zones	Cane Zone
Banana	70	30	35	19
Cassava	74	26	36	36
Dasheen	74	26	24	23
Eddoes	11	89	34	28
Okra	18	82	35	20
Egg-plant	22	78	60	23

These differences are further illustrated by comparing the relative numbers of those operators in the

zones who grow the particular crops, together with the mean number of plants (per operator who grows the crop).

Table V

Crop	Number of Operators				Approx. Mean plants/operator	
	Cocoa Zones	(Total 3279)	Cane Zone	(Total 5704)	Cocoa Zones	Cane Zone
Banana	2850	<u>87</u>	4312	<u>76</u>	<u>60</u>	20
Cassava	2073	<u>63</u>	2922	<u>51</u>	<u>700</u>	170
Dasheen	2392	<u>73</u>	3249	<u>57</u>	<u>400</u>	110
Eddoes	323	<u>10</u>	<u>1384</u>	<u>24</u>	90	<u>230</u>
(Pigeon Peas)	1484	<u>45</u>	<u>3459</u>	<u>61</u>	220	(180)*
Okra	552	<u>17</u>	<u>2329</u>	<u>41</u>	20	20
Egg-plant	243	<u>7</u>	<u>2146</u>	<u>38</u>	60	30
(Sweet Potatoes)	430	13	<u>923</u>	16	230	(450)*
(Tomatoes)	115	4	477	8	-	-
(Cucumbers)	34	1	55	10	-	-

*(Relevant % Standard Errors rather high)

(Further figures, including the % Standard Errors, are given in Appendix 17).

Some of these differences (i.e. those of eddoes, okra and egg-plant) may be partly caused by East Indian and "West Indian" (Negro) preferences, within the cane zone, for different crops, together with the fact that only 72 (or 47%) of the Negroes in our sample lived in the cane zone, compared with 155 (or 78%) of the East Indians. This point is illustrated by the following table which is based on the numbers within our sample:-

Table VI

Crop	CANE ZONE				COCOA ZONES	
	Negroes (Total = 72)		East Indians (Total = 155)		Negroes + East Indians (Total = 124)*	
	%	No.	%	No.	%	No.
Banana	76	55	74	115	87	108
Cassava	60	43	<u>48</u>	74	62	77
Dasheen	74	53	<u>52</u>	81	70	87
Eddoes	18	13	<u>30</u>	47	9	11
Okra	26	19	<u>47</u>	72	16	20
Egg-plant	21	15	<u>43</u>	67	6	8

*There are no marked differences between East Indians and Negroes within the cocoa zones; ^(within the sample) they contain 44 East Indians and 80 Negroes. Thus in all there are 199 East Indians and 152 Negroes. Overall, about 63% of operators occur in the cane zone (on 46% of the land). (See Appendix 15).

In conclusion it may be said that more bananas, cassava and dasheen are grown in the cocoa zones mainly because those who grow them grow many more, per head. More okra and egg-plants are grown in the cane zone mainly because a higher proportion of people there grow them, particularly East Indians. With eddoes both more people grow them, and these people grow more plants per head, in the cane zone.

These differences can be related to many interacting factors such as rainfall, soil, markets, history. (An "effective rainfall" map is given in Appendix 19). Thus Bananas (and Tannia too) 'prefer' moist conditions and a calcareous soil. Dasheen can tolerate very wet conditions; eddoes cannot. Okra and egg-plants are preferred, to some extent, by the East Indians in the cane zone, whence they can, if desired, be more cheaply marketed than from the cocoa zone (which is further from the main markets). Further, heavy clays are not suitable for cassava.

9.2.3. Differences between the Over- and Under-1 Acre Holdings.

Errors for the over- and under-1 acre holdings themselves were not calculated but by inspection of the distribution of the different crop plants, and of the numbers who grew them, very few possibly significant differences were found after considering the overall errors. Certainly the cropping differences did not warrant their separate treatment throughout the survey, although, as will be seen later, marked differences occurred in the prevalence of ploughing, use of artificials and marketing.

The main difference is shown by maize; 96% of the maize is grown on "+ 1" or Over-1 acre holdings. About 340 or 17% of the over-1 acre operators grew maize compared with about 380 or 5% of the "- 1" or under-1 acre operators.

Other differences which may be noted are shown in the table below. It should be borne in mind that the over-1 acre holdings include 63% of the food garden acreage of the survey area (see Appendix 15).

Table VII

Crop	+ 1		- 1		+ 1	- 1
	% of Total Acreage				% of All Operators	
	63%		37%		22%	78%
	No. & % of Plants				% of Operators	
	' 000	%	' 000	%	%	%
Eddoes	230	67	114	33	<u>27</u>	17
Okra	27	40	40	<u>60</u>	25	27
Egg-plant	23	33	47	<u>67</u>	16	<u>30</u>
Maize	1387	<u>96</u>	65	4	<u>17</u>	5
Sweet Potatoes	160	31	352	<u>69</u>	17	15

The plant percentage differences in okra, egg-plant and sweet potatoes **might** be accounted for (in part, at least) by the preponderance of these crops in the cane zone together with the preponderance of under-1 acre holdings in that zone as shown by the following table:-

Table VIII

Distribution of + 1 and -1 acre Holdings

	+ 1	- 1
Cocoa Zones	51%	32%
Cane Zone	49%	<u>68%</u>

(It may be the case, of course, that more of these crops appear in the cane zone because more of them are grown on under-1 acre holdings).

Similar figures might, at first sight, have been expected of eddoes since 89% of all eddoes are grown in the cane zone and a higher percentage of operators in that zone grow eddoes (24% as against 10% in the cocoa zones). However, nearly all (488 out of 535) of the over-1 acre holdings growing eddoes occur in the cane zone.

Thus it appears that most of the maize is grown on the over-1 acre holdings; also, a higher percentage of all over-1 acre growers have maize and a higher percentage have eddoes ^{than do the under-1-acre growers.} It may be mentioned that maize gives one of the quickest returns of all crops, maturing in three months. Also that okra and egg-plant being easier to steal than root crops might be grown on smaller holdings partly for that reason—the larger holdings were more commonly away from the house.

Finally, the degree of fragmentation may be noted:- nearly all the under-1 acre holdings were of one plot only; the over-1 acre group contained 112 operators and 138 main plots.

9.3. Operations, Marketing and Fertilisers Analyses, etc.

The results of these analyses are tabulated in Appendix 17 and the results of the further collection of data from the unraised figures of the sample are given in Appendix 18.

9.3.1. Operations.

A question concerning the use of a cutlass to clear land was not included on the questionnaire form; there the question "Do you clear the land annually" was meant merely to lead up to the two corollary questions which referred to clearing the land by forking or by ploughing. However, it was found that some people merely cleared the land by cutlassing and the meaning of the question became altered.

We estimated in our analysis that 77% of operators cleared the land by cutlassing, 68% by forking and 11% by ploughing. There is no indication in these figures of how many people cutlassed only, nor of how many people did not clear the land annually at all.

Reference to the clip-cards gives this information and it is tabulated below:-

Table IX

	Under-1 acre Holdings		ALL PLOTS		Over-1 acre Holdings	
	No. of Plots (= No. of Operators) (Total = 244)		(Total = 382)		No. of Main Plots* (Total = 138) ¹³⁷	
	No.	%	No.	%	No.	%
Land not cleared annually	244 45 ^{3%}	18	53	14	137 8	6
Cutlassed only	28	12	58	15	30	22
Forked ⁽¹⁾	157	64	223	58	66	48
Ploughed	14 ⁽²⁾	6	47	12	33 ⁽³⁾	24

(1) Nearly all cutlass also.

(2) All cutlass, 5 also fork.

(3) 3 plough only.

22 cutlass and plough.

8 cutlass, fork and plough.

*For ease in obtaining the figures main plots or "parcels" (totalling 138) are used instead of operators; the percentages will be little affected by this. Thus the overall figure for ploughing (12%) is nearly the same as that of appendix 17 (11%)

It is evident that a much larger proportion of the over-1 acre holdings are ploughed and a lower proportion not cleared annually compared with the under-1 acre holdings. On the other hand the proportions of both size groups who fork or plough (or both) are about the same (c. 70%).

The figures in Appendix 17 show that considerably more forking and ploughing is done in County 1 (and in the cane zone) than in County 2 (and in the cocoa zones). The incidence of ploughing differs most and this may be due to the greater number of ploughs available in the cane zone where they are used in the cane (and rice) fields. Within the cane zone itself our figures suggest that there may be a significantly higher percentage of East Indians who plough compared with the Negroes there; if this is so it might be linked with the relative amounts of sugar cane (and rice) grown by the East Indians and Negroes. In our sample only clusters 09, 13 and 22 (in County Caroni) had more than 3 people who ploughed and they, in all, have 23/43 (or 53%) of all operators who plough. It may be significant that all these clusters are near the main rice areas.

9.3.2. Disposal of the Produce.

Here the categories we used are exclusive; thus, over the whole survey 86% of growers sell none of their produce, about 7% sell casually but do not send to market and about 7% sell in a market (they may also sell casually). Almost all growers consume some of their produce.

Virtually all the produce marketed is from the over-1 acre holdings (see Appendix 18).

Another strata difference is that between zones; 5% of all operators in the cane zone send to market compared with 11% in the cocoa zones. This can be accounted for by the higher overall prevalence of the marketing of bananas and the relative paucity of bananas in the cane zone. The banana is the only ^{garden} crop for which there is an efficient and widespread marketing system.

By reference to Appendix 18 the main crops in the various strata which are marketed can be studied together with the total numbers and percentages of operators concerned.

It can be seen that, over the whole survey, bananas is the chief cash crop in both marketed and casual sales categories. ✓

However, in zone 4 (and county 1) the main crops marketed are pigeon peas and eddoes, in that order, with the result that over the whole survey area the number who market pigeon peas approaches the number marketing bananas.

Within zone 2 (and county 2) cassava is second only to bananas.

Casual sales show a slightly different pattern - thus cassava is sold widely in county 1 (equally with pigeon peas) as well as in county 2 where it is only exceeded by bananas. Over the whole area, therefore, cassava approaches bananas in the number of operators who sell it and well outcedes the number who sell pigeon peas (casually).

9.3.3. Use of Organics and Artificials.

Organics and artificials are used by approximately 37% and 14% of operators respectively (Appendix 17).

The most marked between-strata difference is that between the cane and cocoa zones; 17% of operators use artificial ^{in the cane zone} in the cane zone and only 9% in the cocoa zones. This can be largely explained by the proximity of cane salt%. A similar difference occurs with organic manures; 45% of operators use them in the cane zone compared with 24% in the cocoa zones. This may be explained by the relative prevalence of manure in the cane area (for example, that from the draft animals used in the cane fields). It would have been interesting to include definite questions in a survey of the area about the

type and source of the artificials and organic matter used. Entries such as "pen-manure", "pig manure" and "cane salt" were made on a few of our forms. There is no doubt that organic manure is valued - to judge by the common economy of placing a little in each hole at planting time.

The crops to which artificials are applied (see Appendix 18) are correlated with those which are sold - i.e., the main cash crops receive the best treatment. Thus in zone 4 the number who apply artificials to the legume, pigeon peas, on the over-1 acre holdings, ^{not almost exceed} far outcedes the number who apply it to bananas; surprisingly, in the under-1 acre holdings pigeon peas are fourth in the list of "preference" and far fewer people apply artificials to them than to bananas.

In county 2, cassava is second only to bananas and comes third over the whole survey area, with bananas second.

Over the whole survey area pigeon peas are first, bananas second, and cassava third.

The pattern changes in relation to organics; bananas lead the field; pigeon peas are low in the list. Egg-plant, being widely sold in zone 4 from the under-1 acre holdings, assumes second place overall, followed by cassava. In county 2, dasheen is second, after bananas. It may be that pigeon peas has less need of it.

9.3.4. Combinations of Crops, and Pure Stands.

(See Appendix 18).

The main combination in both counties is that of pigeon peas with cassava. This is followed, in zone 4, by pigeon peas with eddoes. The only other combination worthy of note is that of cassava and corn prevalent in the over-1 acre holdings in zone 4.

Perhaps the main reason why pigeon peas is so common a constituent of combinations is that little else can compete with it. Therefore any mixture with it, if there is

one, is a simple one and likely to be recorded in the field as a definite combination.

Pure stands of dasheen far out-number those of any other crop. Dasheen is often grown alone in drains because it alone tolerates the wet conditions there.

In the cane zone, where dasheen is less common than in the cocoa zone, pure stands of sweet potatoes are far more numerous. Pure stands of corn are also more numerous there than those of dasheen. Sweet potato is usually grown in a pure stand as it is grown on banks.

9.4. No Responses, etc.

True no responses were rare (5 in number out of the 430 operators in the sample). Another five operators were not interviewed because they had food gardens "outside the cluster area". These add to the small bias introduced by the true no response. These and the remaining 64 operators not interviewed are classified below.

Table X

	Over-1 acre	Under-1 acre	Total
No Response	2	3	5
Unknown	1	1	2
No Garden	13	37	50
Under Trees	5	3	8
House Condemned	-	3	3
Operator Moved	-	1	1
Food Gardens outside cluster area	4	1	5
Total	25	49	74

(There would be a bias introduced by new garden operators if they had come into the area since the Agricultural Survey (1956); any such bias is probably very small, to judge

by the very small number of new gardens owned by operators within the sample and the general rarity of new houses).

The remaining 64 operators referred to (chiefly with "no garden") do not bias our results because they fall outside the frame, as we defined it; i.e., the frame we used was faulty. It was slightly out of date, hence the three condemned houses and the one operator who had moved. Its main fault lay in the inclusion of so many plots which were not true gardens. This "fault" may in many cases be due to a difference between our definition of a food garden and that used in the Agricultural Survey (1956). Often the land was there but was virtually unused; it was only a potential garden. The inclusion of a few plots, which were under trees is more likely to be a definite error. It is doubtful, although possible, that a food garden crop might be considered as the main crop of a plot even if it was under trees. It is not known whether the instructions to the enumerators in the Agricultural Survey permitted this - for example, when the tree crop was neglected. In our survey we did not include any gardens under trees (excepting when a few breadfruit, breadnut or pawpaw trees were present).

The question of the detailed definition of the frame has therefore to be carefully considered when using someone else's frame for a survey.

9.5. Time and Cost Study.

Little will be said about the time and cost involved in the survey; the reader is referred to Appendix 7 for a breakdown of the total man-hours under separate headings.

The costs recorded are those of travelling only; normally in a survey there would be high labour costs also.

An important point to notice is that the actual office work and calculations took more time (587 man-hours) than the field-work (491 man-hours). In addition to the

office work there were 235 man-hours of discussion. This was mostly prior to the field-work and was concerned with the choice and detailed definition of the survey; the problems of estimating the number of plants within gardens; the construction of the questionnaire forms; the other problems. Here one may mention the value of a statistician in the initial stages of a survey as well as in the analysis of the data.

10. CONCLUSIONS.

A few main conclusions emerge from the survey.

The high errors associated with our crop number estimates rendered many of them of questionable value; in general only the estimates for Bananas, Cassava, Dasheen, Eddoes, Okra and Egg-plant were reasonably precise (i.e. with Standard Errors not over 25% of the estimated figures).

On the other hand we obtained low Standard Errors for the estimates of the numbers of operators growing particular crops, or doing certain operations, or marketing their produce, or using manures.

Therefore, in an agricultural survey such as ours (i.e., with the size of sample and the sampling procedure we adopted) much more precise information can be obtained concerning the prevalence of crops among growers than about the actual amounts being grown.

We found with fair precision what were the main constituents of the food gardens we surveyed and how these varied from one strata to another. We also obtained precise supplementary information on the prevalence of ploughing, marketing and other subjects. In this respect the survey was successful.

We did not succeed in estimating the production of the food gardens in the survey area. To find this a

larger sample would have to be taken. In particular, a higher sample than 1 in 10 of the clusters would be required. This would necessitate a complete census of the additional clusters selected in order to construct a frame of the food gardens in them. Even then, there would remain the difficulty of converting plant counts to yield estimates. This could be done, very approximately, by using supplementary information on the level of yields of the peasant holdings of the area. If existing information was not sufficient, or was not considered sufficiently precise, random samples in gardens would have to be taken at times of the year appropriate to the different crops.

However, the main reason we sought information on the production of food gardens was in order to weigh the possibility of increasing that production. This we can do, to some extent, with the information we obtained. We found that the average size of the holdings was very small. (Of the "over-1 acre" holdings the mean was 0.68 acre; of the "under-1 acre holdings it was 0.11 acre). Over 50% of all the gardens were under 0.1 acre; many were thus comparable to the size of an English allotment garden. We found also that the amount of investment of any kind was very small; for example, artificials are only used by 14% of the growers. It is doubtful if it would be economic to invest much money in such small gardens in any case (even if growers were willing to) and certainly not for the production of "staple foods" such (a. ground provisions).

Furthermore, the number of growers who sell their produce is very small (14%, if casual sales are included). There is, therefore, no existing marketing organisation which could absorb an immediate increase of production of staple foods (or, for that matter, any foods except exported ones) - even supposing that there exists a flexible demand for them.

The Statistical Digest (1955) for Trinidad and Tobago shows (page 146) that much more flour, rice and Irish potatoes are imported than any other starchy foods. There were, however, about 7 million lbs. of sweet potatoes imported, which is about 25% of the total supply. Also, about 10% of Trinidad's estimated supply of fresh vegetables (excluding tomatoes, onions and garlic) is imported (1954). Most tomatoes consumed are produced in Trinidad.

There already appears to be, therefore, a potential market for an increased home production of sweet potatoes and fresh vegetables if they can be produced at competitive prices and with competitive quality. However, production of sweet potatoes is rather seasonal in Trinidad and they don't store well.

Given a rise in the general standard of living in Trinidad there would almost certainly follow an increase in the local demand for the more expensive vegetables. The future scope for increased home production may well be in this direction and not in the increased production of local ground provisions, which, to judge by the import figures, are already not so popular as Irish potatoes and rice and would not be likely to replace any of the flour at present imported.

At present tomatoes, cucumbers, lettuce and cabbage (to take 4 examples) are grown by very few people in the area surveyed (c. 7%, 7%, 6/356 and 1/356% respectively - but note the time of year of the survey). The distance of much of the area from the larger markets may be a contributing cause of this. It must be borne in mind that our survey area did not cover market garden areas such as that at Aranguez. It is worth noting in this connection that Egg-plant is the only crop widely grown in the survey area which is also one of the main cash crops in Aranguez Estate.

We observed that nearly all the growers in our survey area were part-time only and were not very interested in growing things. They were, therefore, inefficient.

The final conclusion drawn is that, except on some of the "over-1 acre" holdings (only about 20% of them are over 1 acre and most of those are under 2 acres), there is very little possibility of extending the present production from the food gardens existing in the counties of Caroni, St. David and St. Andrew. In our estimation (Appendix 15, Table (e)) all the food gardens ^(of the area) included about 1.6% of the cultivated and cultivable land of the three counties (as given in the Government Statistical Digest, No. 5, 1955). They are likely to remain as a rather inefficient supplement to the food consumption of the area.

11. SUMMARY OF THE CONTENTS.

The selection of the survey subject and the resources available to carry it out are outlined in the "Introduction" (page 1).

"Sampling" (page 2) is next considered, and the extraction of our sample is described. Reference is made to the frame we used and this is further considered in the section on "The Scope of the Survey and of the Frame used" (page 5).

A section on the "Design of the Survey" (page 7) follows. In this the nature of food gardens is outlined and the problems of sampling within gardens and of defining plant units are considered. The construction of the questionnaire forms is also described.

In the section "Preparation for the Field Work" is an outline of the work involved prior to commencing the field work and details of our instructions sheets for use in the field are given.

Under the heading "Execution of the Field Work" (page 16) the problems which arose in the field are described and a brief discussion of the area in which the writer supervised the field work concludes this section.

The Checking, Coding and Tabulation of the data (page 22) is then described and discussed followed by a section on the Analysis (page 26) itself in which is listed and defined the values we calculated. Mention is made of the further analyses and tabulations we carried out using the unraised sample figures themselves, followed by a brief discussion of the Checking of the calculations.

There is a detailed account of the Results (page 30), and the differences we found between the zones and those between the other strata we used are discussed. At the end of the section is a consideration of the "No Responses" and "No Gardens", bias, and the time and costs involved in the survey.

Finally, some main Conclusions are drawn (page 46) and our results are discussed in relation to supplementary information and to the purpose of our survey.

REFERENCES.

D.T.A. Reports (1956). I.C.T.A. Messrs. B. Buckler, J. Furber, H.E.G.Morgan, R.F.A. Murfitt.

Yates, F. (1953). Sampling Methods for Censuses and Surveys. 2nd Edition. Charles Griffin & Co., Ltd. London.

(Annual) Statistical Digest of the Government of Trinidad and Tobago. No. 5, 1955. (1956). Government Printing Office, Port of Spain, Trinidad.

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LIST OF APPENDICES.

1. List of Clusters, with zones and numbers of operators. Overall sampling fraction.
2. Field Instructions Sheet (Measurements).
3. A completed Measurements Form.
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6. A completed Log Sheet.
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8. Instructions for Coding for the Cope-Chat Cards. The Master Card.
9. A completed Cluster Summary Sheet.
10. Outline of the Quantitative Analysis.
11. An example of the Quantitative Analysis.
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15. The Distribution of the Estimated Acreage between Strata.
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18. Pure Stands, Combinations, Artificials, Marketing, etc.; the main crops involved.
19. Map of the Survey Area showing the Clusters and Zones.

List of the Clusters in our Survey showing the corresponding Cluster numbers used in the Agricultural Survey (1956). The agricultural zones in which the clusters come are given as is the number of operators in our sample in each cluster under the headings +1 and -1 acre.

Agricultural Survey 1956	I.C.T.A. Survey	Zone	Operators in Sample			Operators with gardens					
			+1 acre	-1 acre	Total	+1 acre	-1 acre	Total			
County 4 Cluster (Caroni)	County 1	01	4	2	7	9	2	4	6		
		03	4	0*	4	4	-	4	4		
		05	4	0*	8	8	-	6	6		
		07	4	0*	3	3	-	2	2		
		09	4	1	8	9	1	7	8		
		11	4	3	13	16	3	10	13		
		13	2	3	3	6	3	2	5		
		15	4	3	6	9	3	3	6		
		16	4	13	10	23	13	10	23		
		17	4	1	3	4	1	3	4		
		18	4	5	9	14	5	8	13		
		19	4	6	4	10	5	4	9		
		20	4	6	6	12	6	4	10		
		21	4	0*	8	8	-	6	6		
		22	4	1	11	12	1	10	11		
		23	4	3	6	9	3	4	7		
		24	4	0*	9	9	-	8	8		
		25	4	1	12	13	1	10	11		
		26	2	6	2	8	5	1	6		
		27	2	3	(1)	4	3	0	3		
		28	4	2	11	13	2	10	12		
		29	4	6	5	11	6	5	11		
		30	4	2	8	10	2	8	10		
		31	4	0*	16	16	-	13	13		
		32	4	0*	11	11	-	10	10		
		33	4	2	17	19	2	17	19		
		34	4	(1)	9	10	0	8	8		
		35	2	3	7	10	3	5	8		
		County 6 (St. David and St. Andrew)	County 2	01	1	(1)	6	7	0	5	5
				03	2	1	5	6	1	3	4
				05	2	9	1	10	4	1	5
				07	1	2	2	4	2	2	4
				08	2	12	11	23	11	9	20
				09	2	1	9	10	1	7	8
				10	1	4	2	6	3	1	4
11	2			5	13	18	2	11	13		
12	2			8	4	12	4	1	5		
13	1			7	0*	7	7	-	7		
14	2			1	14	15	1	14	15		
15	2			5	5	10	3	4	7		
16	2			8	4	12	3	4	7		
TOTALS		41		137	293	430	112	244	356		

The sample 137 was from a population of 249 food gardeners + 1 acre
The " 293 " " " " " " 836 " " " - 1 acre
249 + 836 gives a total of 1085 food gardeners in the first stage sample of 41 clusters.

In Caroni, St. David and St. Andrew there are 401 clusters.
Thus the overall sampling fraction is approximately 1 in 25.

This is only approximate because of:-

- (a) varying number of operators per cluster.
- (b) different sampling fraction for over and under 1 acre holdings.

Because of (b) it is more accurate to express the overall sampling fraction as below:-

For over 1 acre holdings the sampling fraction is about 1 in 18.
For under 1 acre " " " " " " " 1 in 33.

* (0's occur where there was no operator (in the frame) in the particular size group in the cluster).

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
culate No. of STEMS emerging } or 10 square ft.
(iv) YAMS. Count or calculate } and (b) TOTAL ROW-LENGTH OR AREA
No. of SETS. } COVERED WITHIN SAMPLE
} (write e.g. 16X 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 3.

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME
2	2	09	55	(4 ² found)	Ramdath Ramlass

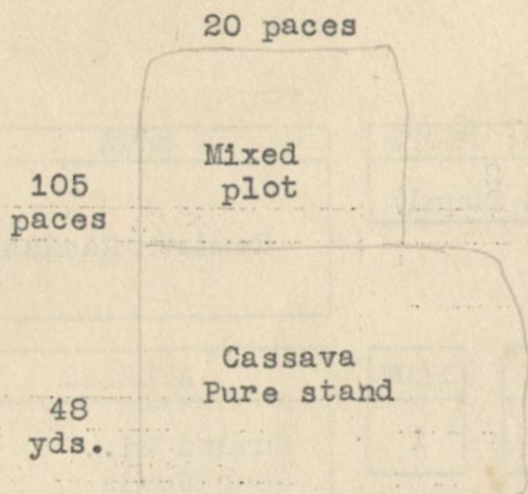
DATE	INTERVIEWER	ACREAGE (measured)	ACREAGE	PLOT	ADDRESS
17/12	S. Mawly	4213	1.1	1	Cumuto Rd., Four Roads Tamana.

RANDOM NUMBERS		A	3				
		B	13	21	22	32	
CROP	Code No.	SPL 1	SPL 2	SPL 3	SPL 4	FOREST AND AREA	TOTAL
1 Cassava	01	2	-	-	2		172
2 Pigeon Peas	05	-	-	-	2		86
3 Tannia	03	-	3	3	-		258
4 Dasheen	02	6	4	3	-		558
5 Maize	13	4	10	2	-		688
6 Cucumber		-	Present	-	-		
7 Banana	00						100 stools
8 Cassava	01			16 in	10'x 10'	48 yds x 48 yds	3312
9							
10							
11							
12							
13							

COMBINATIONS: x

For calculations, P.T.O.

Calculations.



(1) Area of pure stand of Cassava

$$= 48 \times 48 = 2304 \text{ sq. yds.}$$

Total number of cassava stems

$$= \frac{2304 \times 9}{100} \times 16$$

$$= \underline{3,312}$$

48 yds. (paced by J.W. 1 pace = 1 yd.)

(2) Area of mixed plot = $105 \times 20 \times \frac{10}{11}$ sq. yds. (Pace = $\frac{10}{11}$ yds.)
= 1909 sq yds.

Plant Totals:

Cassava = $\frac{1909 \times 4 \times 9}{400} = \underline{172}$

P. Peas = $\frac{1909 \times 2 \times 9}{400} = \underline{86}$

Tannia = $\frac{1909 \times 6 \times 9}{400} = \underline{258}$

Dasheen = $\frac{1909 \times 13 \times 9}{400} = \underline{558}$

Maize = $\frac{1909 \times 16 \times 9}{400} = \underline{688}$

APPENDIX 4.

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME
2	2	09	55	2 (4 found)	Ramdath Ramdass
DATE	INTERVIEWER	ACREAGE	PLOT	ADDRESS	
	J. Waterworth	1.1	1	Cumuto Road, Four Roads Tamana.	

CROP	DISPOSAL %			MANURES		YIELD	REMARKS
	HC	CS	M	ART	ORG		
1 Cassava	✓	✓	✓	✓	x	*	More HC than sold
2 Figs (has 500)	✓	✓	✓	✓	✓	Has sold \$75 worth, 4¢/lb.	1875 lbs.
3 Pigeon Peas	✓	✓	✓	✓	x	From all his land	
4 Corn	✓	✓	✓	✓	x	Has sold \$75 worth, 8¢/lb.	938 lbs.
5 Tannia	✓	✓	✓	✓	x	From 1½ acres	
6 Dasheen	✓	✓	✓	x	x		
7							The pure stand of
8							cassava is rather
9							neglected.
10							*The figs on this plot are mostly very young plants, not bearing.

CULTIVATION (i) Land cleared annually ✓ (a) Forked ✓
(b) Ploughed x

(ii) Non food crops grown in last 2 years Cleared from Bush
August 1955

COMBINATIONS (e.g. 1 & 2) Cassava, Pure Stand.
Rest (+ cassava) all mixed.

REASONS FOR COMBINATIONS:

X

GENERAL: East Indian. This grower is a full-time one apparently.
He sells about \$150 (+) worth of produce per year, mostly
Figs (Bananas) and Corn (Maize).
He feeds himself, a wife and two children.
Garden is better than the average, kept well (most of it), and
the crops doing well.

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 mileometer 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.

Supervisor: J. Waterworth.

APPENDIX 6.

SAMPLE SURVEY UNIT

LOG SHEET

Area IV Clusters 09 County 1

Date 13th December

Enumerators M. Watson, J. Law

Vehicle No: P.B. 895

Departure: Time 12.30 p.m. Mileometer reading 0000

From Cluster 21

Return: 3.35 p.m.

0069

To Cluster 09

Journey Time: Out 40 mins. In 30 mins.

Interview	Bldg.No.	Time (Man-hours)
1	71	10 mins.
2	62	15 "
3	61	10 "
4	58	10 "
5	56	15 "
<u>Lunch</u>		
6	44	15 "
7	42	10 "
8	41	10 "
9	40	15 "
10	50	20 "

* VIII-2 hrs.20 IX-2hrs.10 X-1 hr. 40 8/10- \$10.35

Enumerators Report.

Left cluster at 3.05 p.m. Cluster very compact.

People mainly Indian and very inquisitive and helpful.

[*Note: VIII is the no. of man-hours spent travelling to and from the task.
IX is the intervening time in man-hours.

X is the travelling time within the cluster.

8/10 is the cost of transport, allowing (here) 15 cents per mile.

For the Instructions to supervisors and enumerators re the Log Sheet, see Appendix 5.]

TIME AND COST STUDY

	TIME (Man-hours)	COST* \$	Approx. Mileage
<u>PRELIMINARY WORK.</u>			
Obtaining and selection of the sample	45	8	50
Preliminary surveying of the area	71	70	470
Preliminary statistical analysis (an attempt to determine optimum sample within gardens)	45	-	-
Preparation of Maps	26	9	60
Design of forms	34	-	-
<u>TOTAL</u>	<u>221</u>	<u>87</u>	<u>580</u>
<u>FIELD WORK.</u>			
Supervisory work (filling in forms, headings, etc.)	40	-	-
Travelling to and from tasks	116	235	1570
Travelling within clusters	132	-	-
Interviewing time	185	-	-
<u>TOTAL</u>	<u>453</u>	<u>235</u>	<u>1570</u>
<u>FOLLOW-UP (29 follow-ups).</u>			
Total travelling	25	42	280
Interviewing time	13	-	-
<u>TOTAL</u>	<u>38</u>	<u>42</u>	<u>280</u>
<u>ANALYSIS.</u>			
Preparation for and supervision (includes coding, clipping of cards)	134	-	-
Computation and supervision (includes tabulation onto cluster summary sheets)	232	-	-
<u>TOTAL</u>	<u>366</u>	<u>-</u>	<u>-</u>
<u>GENERAL DISCUSSION</u>	235		
<u>COST OF BOARDS AND RODS</u>		10	
<u>COST OF PAPER</u>		18	
<u>SURVEY TOTAL</u>	<u>1313</u>	<u>392</u>	<u>2430</u>

* Travelling only (at 15¢ per mile in nearly all cases).

There are no charges for labour.

INSTRUCTIONS FOR CODING FOR THE COPE-CHAT CARDS (by R.M. Meredith)

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.

Example: (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. (all entries should be made legibly, in ink).
 5. Area of land (in square yards) relating to this card along line ending Cr. (The area figure entered should refer purely to crops punched on the card.)
 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 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 4 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 "OO".

If the card refers to an area that is only a part of a parcel clip out "M".

(The aim is to use one card for a pure stand or a definite combination within a garden. Thus where a garden has definite areas of maize and pigeon peas with cassava and the remainder of the crops are all mixed up in the rest of the garden, 3 cards should be used.

The card referring to the maize area would have "pure stand" and "sub plot" punched. That referring to pigeon pea and cassava would have "combination" and "sub plot" holes punched. The card for the rest of the garden would just have "sub plot" punched out.)

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	

Code of Crops (continued)

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.

Crop Code Supplement

Code 21

2101	Arrowroot	2105	Carrots
2102	Groundnuts	2106	Water Melon
2103	Seim Bean	2107	Christophene
2104	Saffron	2108	Ginger

Code 310

316	Coreille
-----	----------

Combinations.

Where a definite combination occurs, clip "00" and put the crop codes occurring in the combination on the 5th line of the table.

MASTER CARD

No Sale

BUILDING NO. 5 AREA		Cluster	
Casual Sales	7	0	7
Marketed	6	1	4
Organics	5	0	2
Artificials	4	20	1
COMBINATION	3	10	0
	2	00	0
	1	2	0
	0	1	0

County

Products: Pepper, Green Veg., Others, Artificial, Organic, Cutlass, Fork, Plough, Other, W.I., E.I., Zone, Pure Stand, Combination, Sub Plot

Regions: A, I, B

Products List: Cassava, Dasheen, Tannia, Eddo, Pigeon Pea, Okra, Egg Plant, Beans, Yam, Tomatoes, Cane, Corn, Cucumber, Pumpkin, Sweet Potato, T. Tamboo, Pineapple

No. Operators, less "No garden" etc. - 2

No. Operators...5.... No. cards...7..... S.F..... R R.F. 2,000 Zone...2..... County...2..... Cluster...08..... +1 acre..

C	W.I.		E.I.		Others		Total		Raised Total		W.I.		E.I.		Others		Total		Raised Total	-1-acre		
	O	N	O	N	O	N	O	N			O	N	O	N	O	N	O	N		Sq. yds.	acres	
00	2	121					2	121		2101									A	34,364	7.1	
01	2	828					2	828		2102									B	2,501	0.517	
02	2	492					2	492		2103									C		11.7	
03	0						0			2104									B/A	0.0728	C/A	1.648
04	0						0			2105												
05	2						2	312		2106									Number of Operators			
06	0						0			2107									Cutlass	W.I. (2)	E.I. (0)	2
07	0						0			2108									Fork	2		2
08	0						0			2109									Plough	2		2
09	1	72					1	72		2110									None	0		0
11	0						0			2111									Art.	0		0
12	1						1	180		2112									Org.	0		0
13	0						0			2113									C.S.	0		
14	0						0			2114									M.	2		2 (CHECK)
15	0						0			312									H.C.	0		
16	2						2	244		313									Plots A Sq.yds			
17										314									No response	0		
18										315									No garden	4	27,588	5-4=1 but 1 opera tor had 2 "No Garden" plots.
19										316									Under trees	0		
										317												
										318												
										319												
										320												
311																						
Check Total																						

No. Operators, less "No garden" etc. - 1

No. Operators...13... No. cards...15... S.F..... R.R.F.3-0000 Zone.2... County...2... Cluster...08... ±=±±±±±

C	W.I.		E.I.		Others		Total		Raised Total		W.I.		E.I.		Others		Total		Raised Total
	0	N	0	N	0	N	0	N			0	N	0	N	0	N	0	N	
00	6	95	5	137			11	232		2101									
01	3	311	5	2364			8	2675		2102									
02	6	1481	5	972			11	2453		2103									
03	4	176	4	106			8	282		2104									
04	1	7	0				1	7		2105									
05	2	102	3	54			5	156		2106									
06	2	101	2	57			4	158		2107									
07	0		0				0			2108									
08	2	2	1	1			3	3		2109									
09	0		0				0			2110									
11							0			2111									
12	2	4					2	4		2112									
13							0			2113									
14							0			2114									
15	1	1(P)	2	2(P)			3	3		312									
16			3	643			3	643		313									
17			2	24			2	24		314									
18	1	3					1	3		315									
19										316									
										317									
										318									
										319									
										320									
311	2	6	1	10			3	16											
Check Total	32	2289	33	4370			65	6659											

-1 acre

Sq. yds. acres
A 10,164 2.1

B 6,156 1.272

C 6.2

B/A 0.606 C/A 2.952 (CHECK)

Number of Operators
W.I. (6) E.I. (5)

Cutlass 6 5 11 Not

Fork 5 3 8 711

Plough 1 1 2 (CHECK)

None 0 0

Art. 0 0

Org. 0 0

C.S. 0 1

M. 1 0

H.C. 5 4

11 (CHECK)

Plots A Sq.yds.

No response 0

No garden 2 1,452

Under trees 0

13-2=11

(Must check here that the 2 plots belong to operators who do not have other garden plots and thus may appear above.)

QUANTITATIVE ANALYSIS - (as outlined by Mr. Meredith)Method of Analysis and Determination of Standard Error of Crop Counts.

S' refers to sum of first stage units (i.e. clusters).

S'' refers to sum of second stage units (i.e. operators).

n' = number of clusters in the sample.

n'' = number of operators per cluster in the sample.

y = the crop count for each operator.

Y = the total crop count for the zone = $S'S''(y)$.

f' = sampling fraction of clusters in the section.

f'' = sampling fraction of operators in a cluster.

s' is the mean square of the between clusters variation.

s'' is the mean square of the within clusters variation.

Estimation of population mean and total.

Mean per operator

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

Estimated number of operators in zone

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

where $\bar{g}$ = average raising factor = $\frac{1}{f'f''}$

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

(n'' is introduced into value A to express it in terms of the second stage sampling units).

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

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

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

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

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

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

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

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

$$V(\bar{y}) = \frac{1-f'}{n'} \cdot \frac{A}{n_O''} + f' \cdot \frac{1-\bar{f}''}{n'\bar{n}_O''} \cdot B \quad \dots (c)$$

$$\text{If } \alpha = \frac{1-f'}{n'n_O''}$$

$$\text{and } \beta = f' \cdot \frac{1-\bar{f}''}{n'n_O''}$$

this formula becomes

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

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 $1/10$)

$$\text{also, } \underline{N} = \frac{14}{4/51 \cdot 15/29} = 345$$

(It should be noted that in determining $\bar{n}_O''$ 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 a crop will be

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

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

An Example of the Quantitative Analyses
Computation Sheet

County ...²... Zone ...²... ~~+ 1 acre~~ - 1 acre Crop ...¹²...

Cluster	$S''(y)$	n''	$n'' - 1$	$(S''(y))^2/n''$	Difference	$S'S''(y)^2$
13	22	4	3	121	363	484
12	18	4	3	81	89	170
11	22	14	13	35	103	138
9	0	1	0	-	-	-
8	4	11	10	1	9	10
6	24	7	6	82	82	164
5	162	9	8	2,916	10,466	13,382
3	3	1	0	9	-	9
2	4	3	2	5	11	16
TOTAL	259	54	45	3,250	11,123	14,373
Correction Factor = $\frac{(TOTAL)^2}{n''}$				1,242		1,242
S.S.				2,008		13,131
d.f.				8	45	53
M.S.				A = 251	B = 247	
α, β				$\alpha = 0.0173$	$\beta = 0.0011$	
$\alpha A, \beta B$				4.3423	0.2717	
$V_{\bar{y}}$ ($= \alpha A + \beta B$)					<u>4.61</u>	
$\frac{A \times 100}{V_{\bar{y}}}$					94 %	

$$\underline{N} = 1719, \quad \underline{N}^2 = 2,954,961 \quad \bar{y} = \frac{\sum S''(y)}{\sum n''} = 4.80, \quad S.E.\bar{y} = \sqrt{V_{\bar{y}}} = 2.15$$

$$\% S.E. = \frac{S.E. \times 100}{\bar{y}} = 44.8$$

$$V_Y = N^2 \times V_{\bar{y}} \\ = 13.622 \times 10^6$$

$$\underline{Y} = \underline{N} \cdot \bar{y} \pm \underline{N} \cdot S.E.\bar{y} = 8251 \pm 3696$$

QUALITATIVE ANALYSIS (as outlined by Mr. Meredith)The Method of Analysis and Determination of Standard Error of Number of Operators growing a given Crop.(a) Estimation of Population proportions and totals (in a given county-zone-size-group).

Estimated proportion of operators growing a given crop in a given cluster:-

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

(where u = the number of operators growing a particular crop in a given cluster

and n'' = total number of operators in sample in the given cluster.

Estimated overall proportion of operators growing a given crop in a given county-zone-size-group:-

$$\underline{p}_o = \frac{\sum u}{\sum n''}, \quad \underline{q}_o = 1-\underline{p}_o \quad \dots\dots\dots (2)$$

Estimated number of operators growing a given crop in a given county-zone-size-group:-

$$\underline{U} = \underline{N} \underline{p}_o \quad \dots\dots\dots (3)$$

(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	$n' - 1$	$\sum (n'' (\underline{p} - \underline{p}_o)^2)$	$n'' s'^2 = C$
Within first stage units and between second stage units	$\sum (n'' - 1)$	$\sum (n'' \underline{p} \underline{q})$	$s''^2 = D$
Total	$\sum (n'') - 1$	$(\sum n'') \underline{p}_o \underline{q}_o$	

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

$$V(\underline{p}) = \alpha C + \beta D$$

$$V(\underline{U}) = \underline{N}^2 \cdot V(\underline{p})$$

$$S.E.(\underline{U}) = \underline{N} \cdot S.E.(\underline{p})$$

($\underline{N}$, α , β , have the same values as in the quantitative analysis, see Appendix 10).

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

AN EXAMPLE OF THE QUALITATIVE ANALYSIS

APPENDIX 13.

Cluster	13	12	11	9	8	6	5	3	2	Overall	CROP 12 County 2 Zone 2 - 1 acre	
u/n''	1/4	2/4	5/14	0/1	2/11	5/7	3/9	1/1	1/3	20/54		
p	0.2500	0.5000	0.3571	-	0.1818	0.7143	0.3333	1.0000	0.3333	p_b 0.3704		
q	0.7500	0.5000	0.6429	1.0000	0.8182	0.2857	0.6667	-	0.6667	q_o 0.6296		
										TOTAL	D.F.	M.S.
$(p - p_b)^2 n''$	0.0580	0.0672	0.0025	0.1372	0.3913	0.8279	0.0124	0.3964	0.0041	1.8970	8	C = 0.2371
$n'' p q$	0.7500	1.0000	3.2141	0	1.6362	1.4285	1.9999	0	0.6666	10.6953	45	D = 0.2377
$(S' n'') p q_o$									12.5930 (Check)	12.5923	53	

$$\begin{aligned}
 V(\underline{U}) &= \underline{N}^2 \times V_p = 2,954,961 \times aC + \beta D \\
 &= 12,893.3813 \\
 S.E.(\underline{U}) &= \sqrt{V(\underline{U})} = \pm 113.55 \\
 \underline{U} &= \underline{N} \times p_o = 1719 \times 0.3704 \\
 &= 636.72 \\
 \% S.E. &= \frac{S.E.(\underline{U}) \times 100}{\underline{U}} = 17.83\% \\
 &= \frac{aC \times 100}{V_p (= aC + \beta D)} = 94\%
 \end{aligned}$$

aC	0.00410
βD	0.00026
$\epsilon_{\beta D}^{aC}$	0.00436
a	0.0173
β	0.0011
N	1719
N^2	2,954,961

(N values:-)
used.

					Crop Count					Number of Operators				
County	Zone	Group	n'	S'(n'')	<u>Y</u>	S.E. (<u>Y</u>)	%S.E.	$V(\underline{Y}) \times \frac{aA}{10^3}$	$\frac{aA}{V(\underline{Y})}$	<u>U</u>	S.E. (<u>U</u>)	%S.E.	$V(\underline{U}) \times \frac{aC}{10^3}$	$\frac{aC}{V(\underline{U})}$
1	2	+	4	14	2,118	2,346	110.0	5496	98%	49	53	110.0	2,815	99%
		-	4	8	583	386	61.2	127.119	91%	106	58	54	3,334	88%
Zone 2			4	22	2,701	2,371	87.8	5623	-	155	78	50.6	6,149	-
1	4	+	24	56	628	434	69.1	188	98%	105	63	60.2	3,966	88%
		-	24	174	49,302	35,452	71.9	1256,979	95%	435	106	24.4	11,268	93%
Zone 4			24	230	49,930	35,455	71.0	1257,167	-	540	123	22.9	15,234	-
County 1			28	252	52,631	35,535	67.5	1262,790	-	695	146	21.0	21,383	-
2	1	+	4	12	1,526	2,103	137.9	4,426	98%	28.3	28.3	100.0	801	99%
		-	4	8	258	193	75.1	0.37	61%	27	18	65.0	313	80%
Zone 1			4	20	1,784	2,104	117.9	4,426.4	-	55	33	60.0	1,114	-
2	2	+	9	30	4,933	4,472	90.6	19,956	97%	132	38	28.8	1,464	93%
		-	9	54	8,251	3,696	44.8	13,622	94%	637	114	17.8	12,893	94%
Zone 2			9	84	13,184	5,795	44.0	33,578	-	769	119	15.5	14,357	-
County 2			13	104	968	6,165	41.2	38,004	-	824	124	15.0	15,471	-
Zones 2			13	106	5,885	6,261	39.4	39,201	-	924	143	15.5	20,506	-
Cocoa Zones			17	126	17,669	6,605	37.4	43,627	-	979	147	15.0	21,620	-
Survey			41	356	67,599	36,065	53.4	1,300,694	-	1,519	192	12.6	36,854	-

-1-

DISTRIBUTION OF ACRES AND HOLDINGS

$\left\{ \begin{array}{l} + 1 \text{ acre v. } - 1 \text{ acre} \\ \text{cocoa zones v. cane zone} \\ < .1 \text{ acre and } > 1 \text{ acre} \end{array} \right.$

Table (a) Numbers of Operators and % Distribution.

	+ 1 acre holdings		- 1 acre holdings		Total	
	No.	%	No.	%	No.	%
Operators in cocoa zones	1027	51	2252	32	3279	37
Operators in cane zone	977	49	4727	68	5704	63
Total	2004	22	6979	78	8983	100

Table (b) Numbers of Acres and % Distribution.

	+ 1 acre holdings		- 1 acre holdings		Total		% S.E.
	acres	%	acres	%	acres	%	
Acres in cocoa zones	923.5	68	248.8	31	1172.3	54	19
Acres in cane zone	440.3	32	548.7	69	989.0	46	13
Total	1363.8	63	797.5	37	2161.3	100	12

Table (c) Mean Acres per Operator.

	+ 1 acre holdings	- 1 acre holdings	Overall Mean
Mean acres cocoa zones	0.90	0.11	0.36
Mean acres cane zone	0.45	0.12	0.17
Overall Mean	0.68	0.11	0.24

Table (d) Garden Plots over and under .1 acre and Whole
Gardens over 1 acre within the Sample.

	+1 acre holdings		-1 acre holdings		Total		Estimated % for Whole Survey
	Plots	%	Plots	%	Plots	%	
Under 0.1 acre	28	19	165	67	193	49*	53
Over 0.1 acre	118	81	81	33	199	51*	47
Holdings with over 1 acre of food garden	22/112	20	2/244	0.8			

*(N.B. Proportion of + 1 acre holdings swollen
by larger sampling fraction).

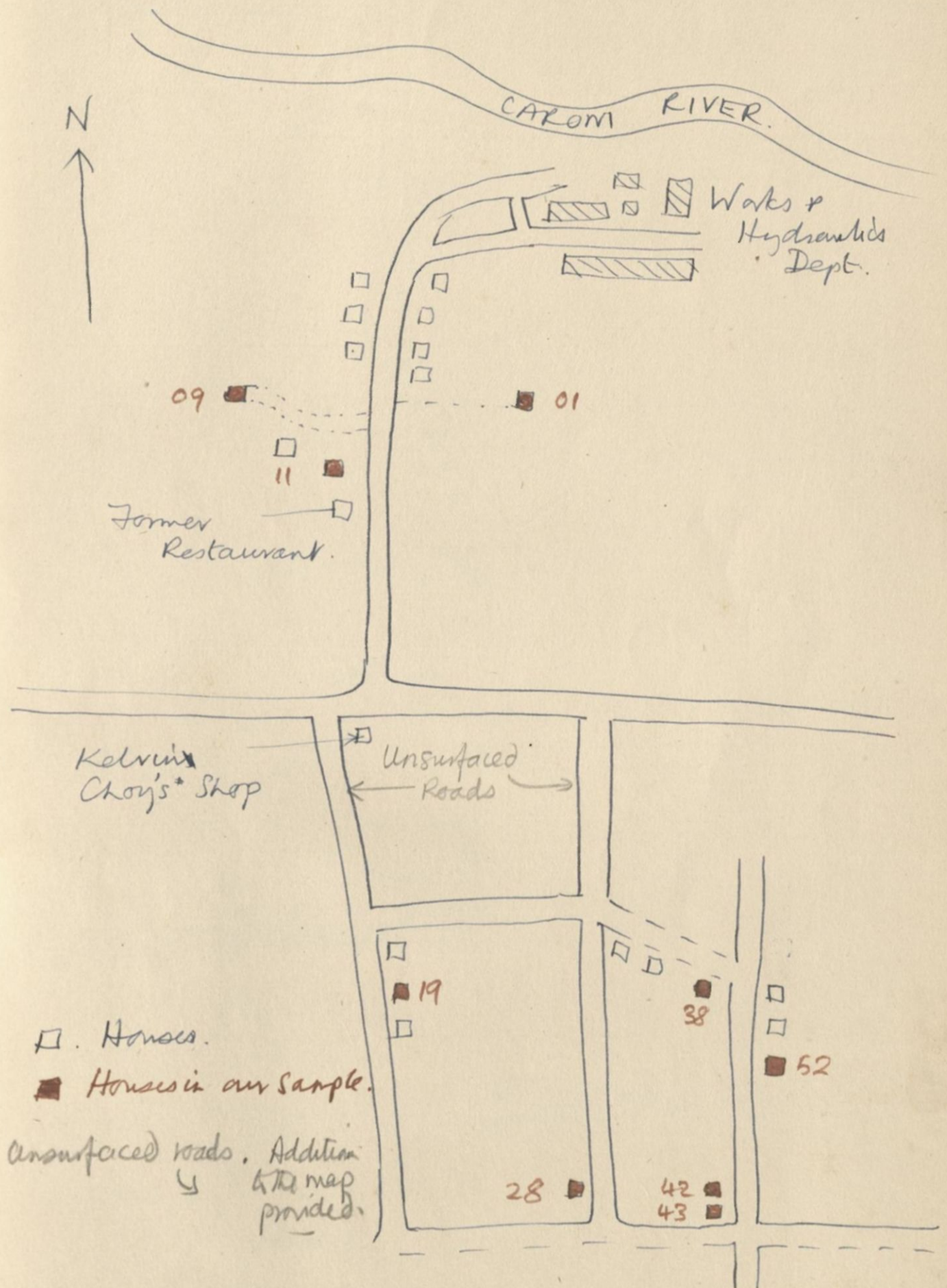
Table (e)

	acres	%
Acreage of Trinidad, cultivated and cultivable land only	354,101	100
Acreage of Survey Area, cultivated and cultivable land only	132,463	37
Area of Survey Area Food gardens (our estimate)	2,161.3	
Food gardens in Survey Area as % of Cultivated and Cultivable land in Survey Area		1.6

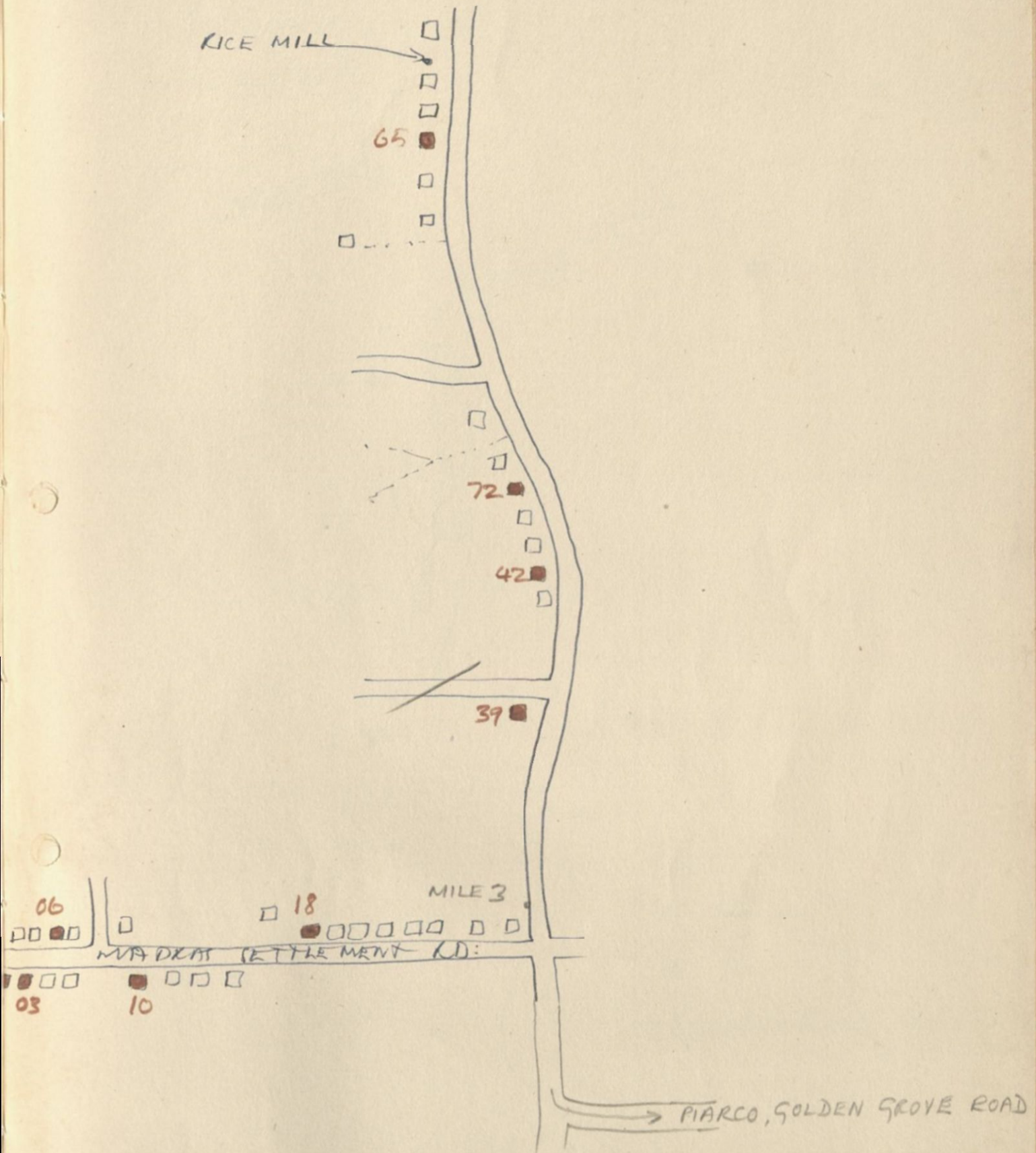
CLUSTER 01

County 1.

(9 operators in sample)



Cluster 08 County 1. (9 operators in sample)



Legend:-

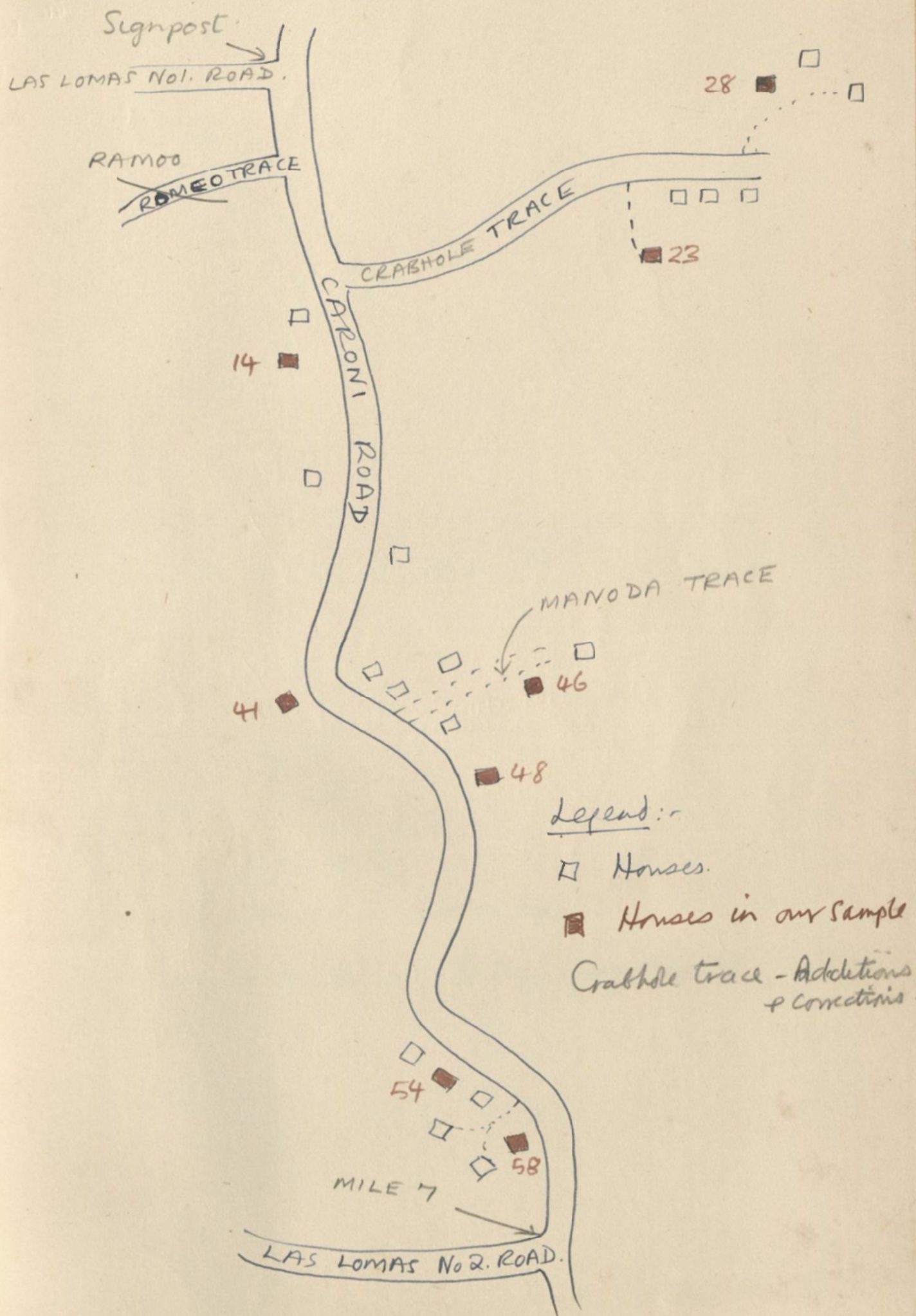
□ Houses.

■ Houses in our sample.

||/ Additions to map provided.

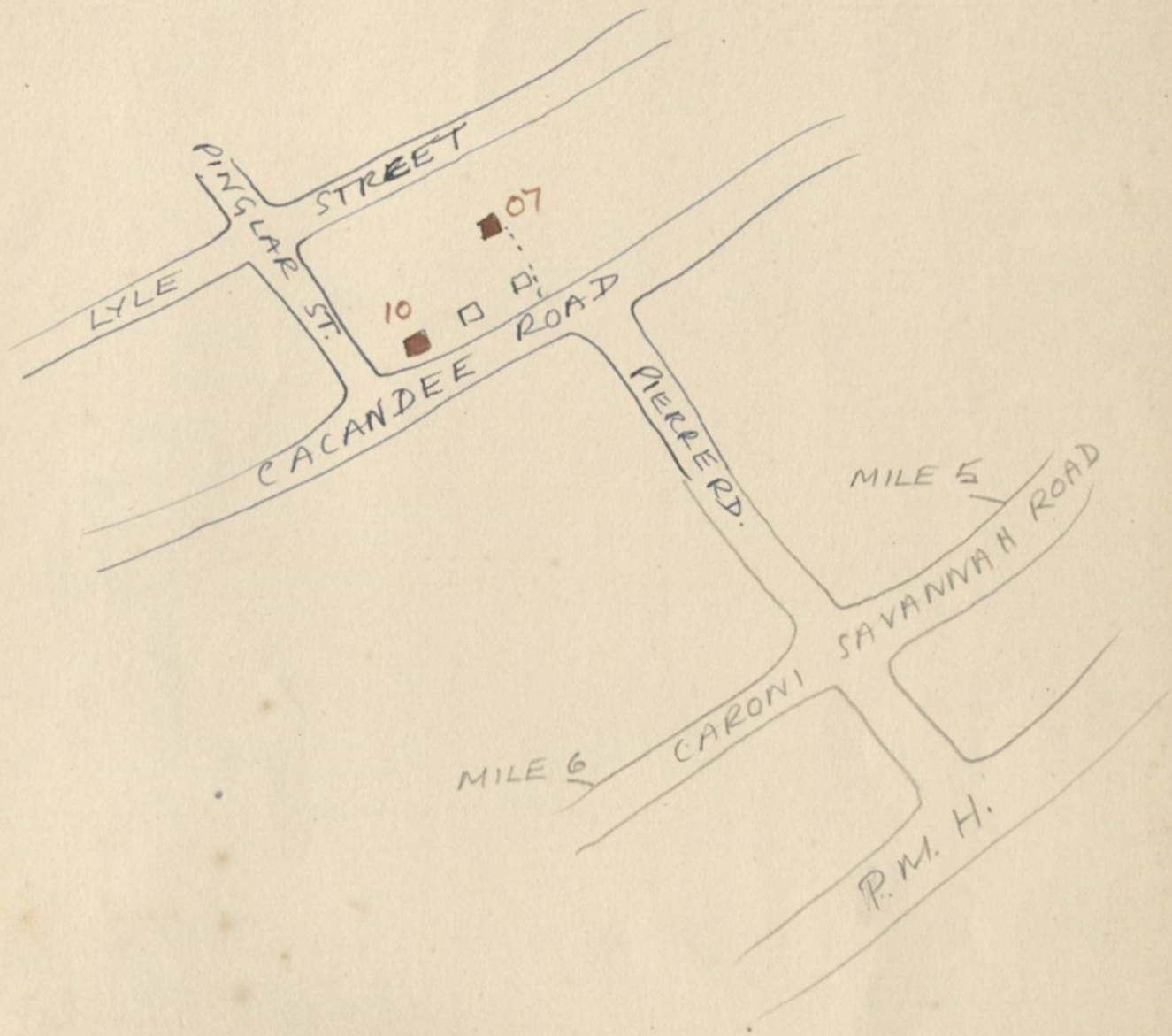
CLUSTER 28,
COUNTY 1.

8 operators in sample.



CLUSTER 282
COUNTY 1.

(2 operators in sample)

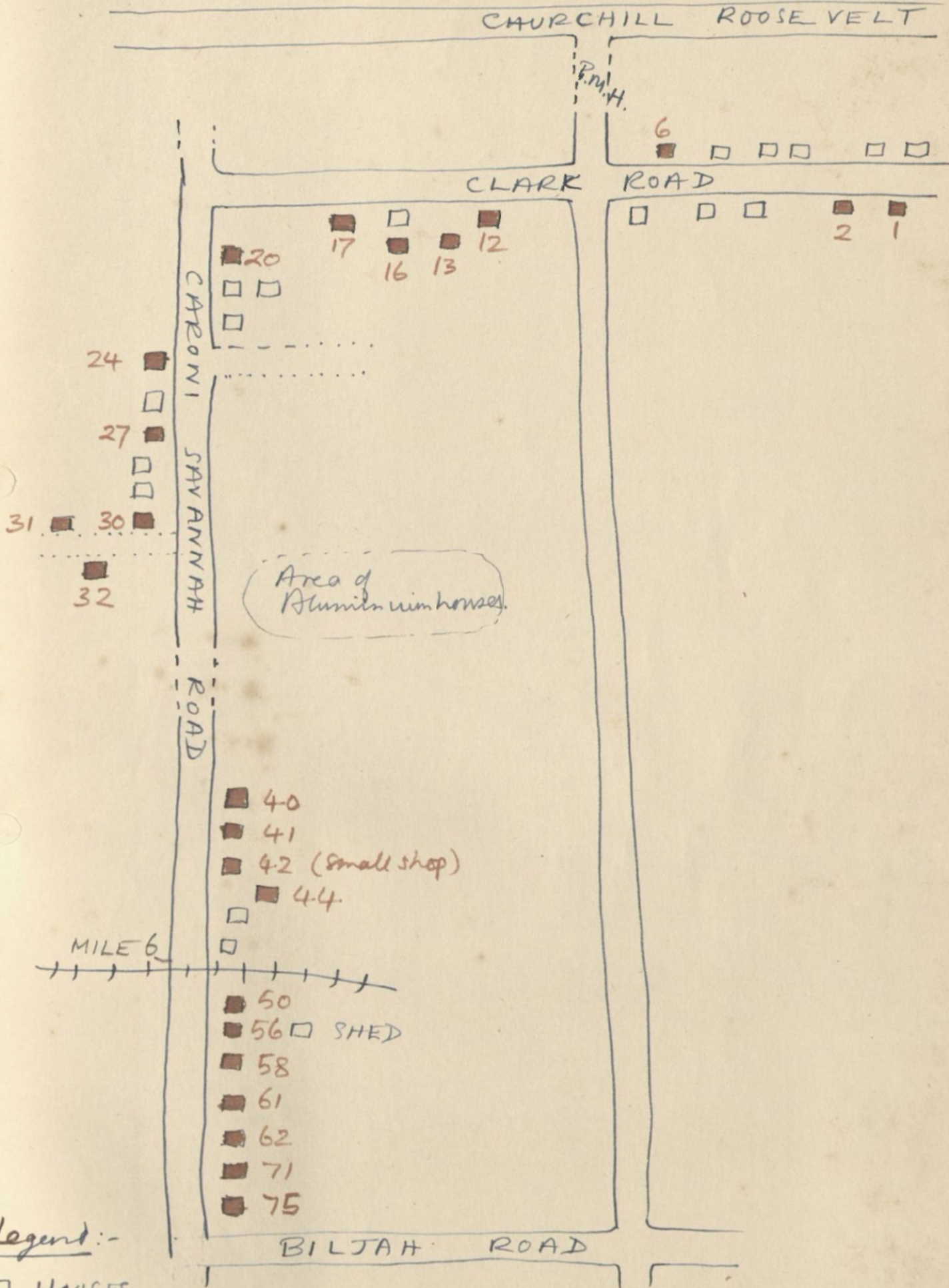


Legend:-

□ Houses.

■ Houses in our sample.

Y Additions to the map provided.

CLUSTER 09 County 1:(23 operators in the sample).

Cluster 09 County 2. (12 operators in sample)



» Additions and corrections.

ANALYSIS RESULTS OF A SURVEY OF THE FOOD GARDENS OF THE COUNTIES
OF CARONI, ST. DAVID AND ST. ANDREW

(FURTHER RESULTS ARE IN THE TEXT AND APPENDICES 15 & 18)

CROPS	CODE	ESTD. PLANTS		ESTD. OPERATORS		% WHO GROW ETC.	NO. OF OPERATORS WHO GROW ETC.				% WHO GROW ETC.		% WHO GROW ETC.		NO. OF OPERATORS WHO GROW ETC.		% WHO GROW ETC.		% WHO GROW ETC. WITHIN SAMPLE				
		No. (000)	% S.E.	No.	% S.E.		Cocoa Zones	% S.E.	Cane Zone	% S.E.	Cocoa Zones	Cane Zone	County 1 (Caroni)	County 2 St. David & St. Andrew	Holdings Over 1 Acre	Holdings Under 1 Acre	Over 1 Acre	Under 1 Acre	NEGROES		EAST INDIANS		
																			In Total Sample	In * Cane Zone	In Total Sample	In * Cane Zone	
Banana	00	256	25	7162	3	80	2850	3	4312	4	87	76	75	91	1536	5627	77	81	84	76	76	74	
Cassava	01	1962	22	4995	5	56	2073	8	2922	5	63	51	55	58	1296	3699	65	53	61	60	51	48	
Dasheen	02	1308	23	5641	5	63	2392	6	3249	8	73	57	56	81	1233	4418	62	63	70	74	57	52	
Tannia	03	(1052)	48	3755	8	42	1477	12	2278	10	45	40	42	41	738	3017	37	43	41	-	40	-	
Eddoes	04	(344)	26	1707	12	19	323	24	1384	14	10	24	22	11	535	1172	27	17	(14)	18	(25)	30	
Pigeon Pea	05	(950)	37	4943	5	55	1484	10	3459	7	45	61	61	38	1251	3692	62	53	52	-	60	-	
Okra	06	68	25	2881	9	33	552	25	2329	10	17	41	37	(20)	504	1877	25	27	(22)	26	(39)	47	
Egg Plant	07	69	22	2389	11	27	(243)	41	2146	12	(7)	38	35	(4)	(317)	(2072)	(16)	30	(13)	21	(36)	43	
Beans	08	(2931)	188	1050	20	12	(437)	38	613	21	(13)	11	(11)	13	(146)	(904)	(7)	(13)	(11)	-	(11)	-	
Yams	09	(31)	50	1616	16	18	(570)	29	1046	19	(17)	18	19	(15)	(354)	(1262)	(18)	(18)	(20)	-	(15)	-	
Tomatoes	11	(285)	81	594	21	7	(117)	50	477	23	(4)	8	8	(4)	(141)	(453)	(7)	(7)	(4)	-	(10)	-	
Sugar Cane	12	(68)	53	1519	13	17	979	15	540	23	30	9	11	33	314	1205	16	17	24	10	11	9	
Maize	13	(1452)	45	723	24	8	(288)	48	435	23	(9)	8	10	(4)	(341)	(382)	(17)	(5)	(9)	-	(9)	-	
Sweet Potatoes	16	(512)	33	1353	17	15	(430)	35	923	18	(13)	16	16	(12)	(345)	(1008)	(17)	(15)	(15)	-	(15)	-	
Topee Tamboo	17	(76)	34	1109	14	12	(236)	30	873	16	(7)	15	15	(5)	(226)	(883)	(11)	13	(5)	10	(17)	17	
Pineapple	18	(29)	52	(658)	27	7	(253)	52	(405)	30	(8)	(7)	8	(6)	(186)	(472)	(9)	(7)	(10)	-	(7)	-	
Peppers	311	(87)	95	1932	12	22	346	24	1586	13	11	28	(25)	12	(351)	(1581)	(18)	23	(16)	22	(27)	30	
Cucumbers	14	-	-	(591)	26	7	(34)	85	(557)	28	(1)	(10)	(9)	(0.4)	(156)	(435)	(8)	(6)	(7)	-	(8)	-	
Pumpkin	15	-	-	1390	14	16	(359)	28	1031	17	(11)	18	18	(9)	(297)	(1093)	(15)	(16)	(11)	-	(20)	-	
OPERATIONS:-																							
Cutlassing	-	-	-	6922	5	77	2293	12	4629	5	70	81	81	66	1786	5136	89	74	74	-	85	-	
Forking	-	-	-	6079	6	68	1653	17	4426	4	51	78	76	45	1150	4929	57	71	58	-	69	-	
Ploughing	-	-	-	954	21	11	(229)	43	725	24	(7)	13	13	(5)	(510)	(444)	(25)	(6)	(8)	(11)	(16)	(18)	
Home Consumed	-	-	-	7710	2	86	2588	5	5122	2	79	90	89	79	1192	6518	59	94	79	-	84	-	
Casual Sales	-	-	-	609	21	7	307	24	(302)	35	9	(5)	(6)	(8)	(207)	(402)	(10)	(6)	(10)	-	(6)	-	
Marketing	-	-	-	643	17	7	(364)	26	279	22	(11)	5	5	(13)	(612)	(31)	(30)	(0.4)	(11)	-	(11)	-	
Organics	-	-	-	3349	9	37	779	24	2570	10	24	45	44	(21)	775	2574	39	37	32	47	46	51	
Artificials	-	-	-	1252	15	14	(282)	28	970	17	(9)	17	17	(6)	(651)	(601)	(32)	(9)	(12)	17	(22)	23	
TOTAL OPERATORS				8983		100%	3279		5704		27%	63%	No., 6473 72%	No., 2510 28%	2004	6979	22%	78%	No., 152	No., 72 47% of all N.	No., 199	No., 155 78% of all E.I.	

N.B. The least precise values are bracketed ()
(e.g. those with % S. Errors over 25% where these are known).

*Some figures only are given.

USE OF ARTIFICIALS, MARKETING, ETC.:— NUMBER AND PERCENTAGE OF OPERATORS, AND MAIN CROPS INVOLVED
AS JUDGED BY THE NUMBERS OF OPERATORS CONCERNED UNDER EACH HEADING, IN EACH STRATA, WITHIN OUR SAMPLE.

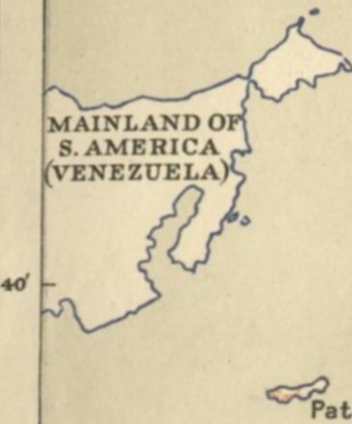
S T R A T A			(a) No. of clusters (b) No. of operators (a) (b)		PURE STANDS		COMBINATIONS		ARTIFICIALS		ORGANIGS		CASUAL SALES		MARKETED	
Co.	Zone	Size Group			No. of operators	%	No. of operators	%	No. of operators	%	No. of operators	%	No. of operators	%	No. of operators	%
					Crops involved		Crops involved		Crops involved		Crops involved		Crops involved		Crops involved	
1	2	+	4	14	3	21	1	7	3	21	4	29	2	14	2	14
					02, 05, 13		07 & 11		00		00, 01, 07, 11		00, 01, 05		00, 05	
		-	4	8	-	-	2	25	1	13	8	100	2	25	-	-
					-		05+02, 00+01+13		00		00 >> 01, 02 >> 07, 15		01, 13		-	
Zone 2, Co. 1			4	22	3	14	3	14	4	18	12	55	4	18	2	9
					02, 05, 13		-		00		00 > 01 > 02, 07		01 > 00, 05		00, 05	
1	4	+	24	56	14	25	14	25	26	47	29	52	8	14	16	29
					13, 16		01+13, 04+05, 01+04+05		05 > 04 > 06 > 03, 07		00 > 05, 04 > 07 > 06		05, 01 > 00, 04		05 > 04 >> 06	
		-	24	174	15	9	17	10	22	13	83	48	6	3	1	1
					16 >> 01, 02		01 + 05		00 >> 01, 07 > 05		00 >> 07 > 02 > 01		00, 05 > 01, 16 > 02		04	
Zone 4			24	230	29	13	31	14	48	21	112	49	14	6	17	7
					16 >> 13 > 01, 02		05+01 >> 04+05		05 >> 00, 07 > 04 > 01		00 >> 07 > 05 > 01 > 03		05 > 01 > 00		04, 05	
County 1			28	252	32	13	34	14	52	21	124	49	18	7	19	8
					16 >> 13 > 01, 02		05+01 >> 04+05		05 > 00 > 07 > 04 > 01		00 >> 07 > 01 > 05		05, 01 > 00		05 > 04 >> 00	
2	1	+	4	12	6	50	1	25	3	25	2	17	2	17	7	58
					02		01+13, 13+16		00 >> 01		00, 03		00, 01		00 >> 01, 02	
		-	4	8	4	50	-	-	-	-	-	-	3	38	-	-
					02, 05		-		-		-		00		-	
Zone 1			4	20	10	50	1	5	3	15	2	10	5	25	7	35
					02		-		00 >> 01 -		00, 03		00 >> 01		00 >> 01, 02	
2	2	+	9	30	2	7	7	23	5	17	8	27	-	-	11	37
					01, 05		01 + 05		00, 01, 05		00 >> 02		-		00 >> 01 > 02, 05	
		-	9	54	4	7	1	2	2	4	11	20	4	7	1	2
					02		01 + 02		00, 04		00 > 02 >> 05		00 > 01 >> 16		00	
Zone 2, Co. 2			9	84	6	7	8	10	7	8	19	23	4	5	12	14
					02 >> 01, 05		05 + 01		00 > 01, 05 > 04		00 >> 02		00 > 01		00 >> 01 > 02, 05	
County 2			13	104	16	15	9	9	10	10	21	20	9	9	19	18
					02 >> 01, 05		05 + 01		00 > 01 > 05 > 04		00 >> 02 >> 03		00 >> 01		00 >> 01 > 02 >> 05	
TOTAL			+ 1	41	25	22	23	21	37	33	43	38	12	11	36	32
					16, 13 > 02, 05 > 01		05+01 >> Any other		05 >> 00 > 04 > 06		00 >> 05 > 04 > 07		01 > 00 > 05 > 04		00, 05 > 04 > 01 > 02	
		- 1	41	244	23	9	20	8	25	10	102	42	15	6	2	1
					16 >> 02 >> 01 >> 05		05+01 >> Any other		00 >> 01, 07 > 05		00 >> 07 > 02 > 01, 05		00 >> 01 > 16 > 05		00, 04	
WHOLE SURVEY			41	356	48	14	42	12	62	17	145	41	27	8	38	11
					16 > 02 > 13		05+01 >> 05+04		05 > 00 > 01 > 04, 07		00 >> 07 > 01 > 05 03		00 > 01 > 05		00 > 05 >> 04	

KEY:-

- 00 Banana
01 Cassava
02 Dasheen
04 Eddoes
05 Pigeon Pea
06 Okra
07 Egg Plant
11 Tomatoes
13 Corn
16 Sweet Potatoes
- > = "more operators than"
>> = "over 1/2 more operators than"
, = "same number as"

MAP OF TRINIDAD

SHOWING MOTOR ROADS AND OTHER MEANS OF COMMUNICATION



Scale 1:250,000
Miles 5 0 5 10 15

- Reference**
- Motor Roads
 - Beach Roads (Passable at Low Tide) and Projected Motor Roads
 - Important Private Motor Roads
 - Trinidad Government Railway
 - Gulf Launch Route
 - U. S. Leased Areas

Note: Important Private Motor Roads are shown for the convenience of Permit Holders, but the general public is not permitted to traverse Private Roads unless in possession of a Permit previously obtained.

LEGEND ; (I.C.T.A. AGRIC SURVEY OF FOOD GARDENS)

COUNTY & SURVEY-AREA BOUNDARIES

03 CLUSTERS IN SURVEY **01** Clusters surveyed under writer's Supervision; see appendix for detailed maps.

4 ZONE 4 (CANE ZONE) Approx. extent in survey area.

1 ZONE 1 (COCOA, NORTH) Approx.

2 ZONE 2 (COCOA, CENTRAL) Approx.

G U L F

FOREST SWAMP

RICE

COCONUTS, COASTAL

LAND FORM

EFFECTIVE RAINFALL (Mohr)

INS. 150 120 100 90 70 60 40

CONTINUOUSLY WET (no dry months)
CONTINUOUSLY MOIST (no dry months)
WEAK DRY SEASON (1 dry month)
MARKED DRY SEASON (2-3 dry months)
INTENSE DRY SEASON (4-6 dry months)