A SURVEY OF FOOD GARDENS

IN

THREE COUNTIES OF TRINIDAD

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I. INTRODUCTION

Agricultural surveys are becoming increasingly important nowadays because any long term agrarian projects demand vital statistics regarding food supply and population increase, availability of land and its agricultural potentialities. Thus it is absolutely fundamental to have some idea of the yields of a produce from a country before its government can go ahead with the plan of erecting, say, a processing plant. Similarly, the government or a company would be very unwise to establish a beef canning plant before they have some knowledge of the number of beef cattle that would be forthcoming to the factory for slaughter.

Surveys in agriculture have been carried out for a number of years in the highly developed countries of Europe and America but they are comparatively new in underdeveloped countries. Their importance lies in the fact that they provide statistics which are necessary before efficient planning of improvements and new developments can take place. They are more difficult to carry out in the latter than in the former because of lack of trained staff, shortage of money, bad communications, lack of maps and perhaps lack of interest and understanding among the village and urban populations of Asia and Africa. Before a survey is carried out, its purpose must be precisely defined and explained to the people quite clearly before they are expected to answer questionnaires. This is not easy when one is dealing with ignorant and illiterate peasants who cannot understand and appreciate the importance of statistics and the part they play in planning say a Land Settlement Scheme. Cases are known in Africa where people have given wrong answers in a population census thinking that

probably the government had in mind the intention of increasing poll tax. Surveys on areal measurements have aroused similar suspicions on taxation. Thus in Africa and Asia agricultural surveys are made more complex by the addition of sociological and political problems. For example it has been authentically reported that in cattle surveys carried out in the Soviet Union "Kulak" farmers never gave the right number of cattle they had because they suspected that the State government would force them to hand in the surplus cattle to the nearest State farm.

Complete surveys sometimes cannot be avoided, e.g. if the government wants to know precisely how many people and farms the country has then members of a survey team will have to visit every household and farm. This kind of survey undoubtedly demands a large number of staff, money and a great deal of travelling, and entails a considerable amount of office work. The follow-ups also present an arduous task. However with some kind of statistical information sample surveys can be used in place of a complete census for which some training is necessary. But these must be planned by experienced men in sample survey techniques and their application in the field. Otherwise results from them may be rendered worthless if they are carried out by inexperienced hands who may use inappropriate sampling design and who may carry out field work in a haphazard fashion.

Advantages of Sample Surveys.

If a sample survey is expected to give useful results then it must be planned and supervised by an experienced person. Assuming that it is, then the advantages derived from it are as follows:-

(1) Less expensive than complete surveys because less field work and office work is needed.

(2) Less staff required.

(3) The results from it are available more quickly and probably more accurate.

(4) Far easier to deal with the follow-up than with complete surveys and hence will be expecting a smaller percentage error.

Bearing this in mind and the fact that rapid developments and economic changes are taking place in the British Colonial territories of Africa and elsewhere it is becoming increasingly evident that some agricultural officers may be called upon in future to conduct such surveys in the territories they are going to serve. For the last two years sample surveys of areas easily accessible from the Imperial College of Tropical Agriculture were undertaken by a team of postgraduate students under the guidance and supervision of Dr. Jolly. This year, 1956/57, a sample survey of food crops was carried out by a team of eight post graduate students. Their project was advised and directed by Dr. Jolly. Mr. R. Meredith, one of the students doing the survey, acted as a supervisor.

The reasons for choosing such a survey were as follows:-

(1) The primary aim was to get training and experience in conducting sample surveys as agricultural officers are likely to be connected with such work when they leave the Imperial College of Tropical Agriculture.

(2) Areal survey similar to the one conducted for the last two years will be merely a repetition of past work.

(3) The Department of Agriculture in Trinidad has no idea of the figures of food crop production in the island. Neither has it any idea of the number of farmers growing food crops. Such statistics undoubtedly are of paramount importance to any country that is importing food.

(4) Will get ample scope for measurements.

Our survey differs from the kind that we may be involved in in other Colonial territories in the following

ways:-

(a) We had to choose an area within easy reach from the College. The areas were the Counties of Caroni, St. David and St. Andrew.

(b) We had to finish all field work by the end of the Christmas vacation and the analysis of results had to be completed by the end of the Easter term.

(c) All the eight members of the team have had University training and perhaps are in a better position to grasp the problems of planning, techniques employed and application methods in the field than the staff one may be asked to supervise who probably had just secondary school training. Thus, field work would be handicapped by lack of trained staff.

(d) The percentage of literacy among the farmers we interviewed in Trinidad is higher than that of the farmers we will contact in other underdeveloped areas.

(e) All the area that we covered during field work had very good roads compared with what we are going to find in other Colonial territories.

(f) We have been fortunate to have fairly accurate maps of the area at our disposal whereas in some parts of the country in Africa maps of the villages and roads do not exist.

(g) Land tenure system in Africa is different from that of Trinidad. In many cases it is not easy to locate farms and farmers in Africa where shifting cultivation is still practised to a considerable extent. In Trinidad we found fairly quickly every household and holding we were interested in because land is either freehold or on lease.

Nevertheless despite the above differences, it would not be very difficult to train staff in Africa or Asia if one is called upon to do a survey of a similar nature and that training we are having in this project will be of inestimable value in future work.

II. THE SURVEY

Our team therefore set out to find out the following:-

(1) What food crops are grown in the area we chose to do the survey.

(2) To get an estimate of the acreage of food crops grown.

(3) To establish whether there is any definite combination of food crops grown in the field.

(4) To get an estimate of yields of crops.

(5) To find out about manurial and cultural practices.

(6) To enquire into domestic consumption and marketing of the food crops grown by peasants.

One fact emerged from the very outset of the field work that it was hopeless to get an estimate of yields because the farmers had not got the faintest idea of the figures we wanted as the harvesting of their food crops was piecemeal.

III. DESCRIPTION OF THE AREA

In choosing the area to be surveyed we had in mind accessibility and contrast. We could not select an area far away from the College because we had limited funds and time at our disposal. The whole project had to be completed within a 9-month period and field enumeration in two weeks.

The Counties picked were:-

(1) St. David } Both hilly and the principal
(2) St. Andrew } perennial crop is cocoa.

(3) Caroni } Flat land, marshy and the main cash crop is sugar cane.

All the three Counties contain food gardens although Caroni differs topographically and pedologically from the other two. For map of survey area see Appendix I (d).

Climate of Trinidad.

It is tropical with two main seasons, wet and dry.

The dry season is between January and May and the wet starts in June and goes on till December. The rainfall distribution is very uneven and the range is 50"- 120" per annum. The considerable variation is due to a topographical position of a particular station. The rainfall tends to be higher as you go from west to east of the island and tends to fall as you get towards the coastal area. Rainfall is very high in the mountainous areas. The maximum precipitation falls on hills near Sangre Grande. The driest area in the island is around Cedros in the South West coastal strip. The temperature range is 70°F. - 90°F. It can go down as low as 66°F. in cool December and may be as high as 93°F. in the hot months of March and April.

Population.

Speaking in general terms for the whole island, there are two main racial groups, Negro and East Indian, and their increase in recent years is remarkable. The latter are concentrated more in the rural areas especially where there are large sugar cane estates, e.g. around Caroni. The Negro population is confined to a very large extent in the urban areas. But in so far as the three Counties mentioned above are concerned the largest East Indian population is concentrated in Caroni and the negroid population in the hilly areas of St. David and St. Andrew.

It is interesting and very encouraging to note that farmers of both racial groups were extremely co-operative on the whole. They were willing to answer our questions at any time and allowed us to measure their holdings whenever we wanted to. Their friendly attitude has considerably facilitated the execution of our task in the field. The other factor which helped the progress of our work was the presence of good roads in the Counties.

IV. ORGANISATION AND PREPARATION OF SURVEY

In the first term meetings were held every Friday under the chairmanship of Dr. Jolly from 2 p.m. to 4 p.m. During these meetings Dr. Jolly outlined briefly the nature of agricultural surveys (land utilisation) which had been conducted by postgraduate students of the past two years. As all the members of the team were new to Trinidad, Dr. Jolly's experience was most valuable as he knew the snags in contacting the people and the kind of agriculture they practised. It was finally decided in these discussions that the best project would be on food crop cultivation. Having all unanimously decided upon it we started making a reconnaissance survey of the holdings around the areas near the College, along the Churchill Roosevelt Highway, and we went as far as the Caura village to see what sort of food crops were commonly grown. This was a very useful way of introducing cultivated food crops to most of the members of the team who were not familiar with tropical conditions. We also asked the cultivators about their crops, their cultural practices, marketing arrangements and general questions pertaining to farming just to see what their reaction would be like if we were to ask them the questionnaire of a properly conducted survey.

During these reconnaissances we came to the conclusion that the growers of market garden crops will have to be excluded because they were specialists in vegetable crops rather than typical general peasants one would be likely to find in the rural areas of the island. Secondly, the area around Caura village (4-5 miles North East of the Imperial College) had to be eliminated because there were very few food growers due perhaps to poor soil conditions and the precipitous nature of the hills around the village.

We also had to come into an agreement as to what crops should be included in the investigation and how to measure their intensity in the field. It was eventually decided to include the

following crops:- Banana, cassava, dasheen, tannia, eddoes, pigeon peas, okra, egg plant, beans, tomatoes, cane (odd stools), corn, cucumber, pumpkin, sweet potatoes, topee tamboo, pineapple, pepper and green vegetables.

Mr. R. Meredith was put in charge of statistical work involved in the Survey and other members of the team were each allocated a certain task, e.g. definitions of crops and how to measure them in the field. Others were asked to prepare questionnaires and instructions to enumerators in the field. What everyone had prepared was discussed during Friday meetings and in most cases amendments followed. Before the final instructions were issued, they had to be agreed upon by all and approved by Dr. Jolly. All these elaborate preparations were necessary because we only had Christmas vacation for all the field work that was entailed.

Before field work started the area was divided into seven sections and each member of the team was put in charge of one of them. Mr. Meredith was not allocated any section because he had a lotto do in the way of preliminary office work. When field work was done in a particular area, the student in charge was responsible for allocation of work to other students and their transport arrangements. At the end of the day they had to report to him on how much work was completed and how much was still to be done. Students worked in pairs and each pair had a car to themselves. Sometimes four students travelled in one car but this was found inconvenient as distances from one farmer to another were in some cases fairly big. This meant that one pair had to do more walking than the other, and hence more time needed to do similar work done by the other pair which had the car at its disposal. The survey was planned in such a way that each pair of students on the average should deal with 16 farmers per day. In all we were supposed (i.e. a team of eight) to have interviewed 430 farmers (more than 1 acre, 137; less than 1 acre, 293).

May I mention here that the field operations were completed according to schedule and the follow-ups were done and finished in the Easter term. The second term was devoted primarily to tabulation of data and the statistical analysis of results. There were fewer Friday meetings compared to last term because everyone was allocated a due share of office work. Everyone was shown how to use the calculating machines and explanations were given regarding methods employed in the analysis of results.

V. SAMPLING AND ITS APPLICATION

It has already been pointed out earlier (page 1) what an important role sample surveys have played in the past and are playing even to a greater extent today in the sociological and agricultural fields. Economic planning is fairly universal nowadays. Before economic developments are carried out, vital statistics of food supply, forecast of cash crop production, rates of change in the economy, internal and external trade must be furnished. Such figures have to be given in a short time and with the minimum of expenditure. Total complete censuses are in many cases out of the question and hence the only alternative left is to conduct sample surveys. These have been found quite practicable in Colonial territories despite the handicaps such as lack of accurate large scale maps, lists of farms and their occupants who are suspicious and ignorant. But providing the consent of the people is obtained and the design of the survey used is a proper one, very useful information can come out of it. (K.E. Hunt. Statistics for Colonial Agriculture).

Yates' (Sampling Methods for Censuses and Surveys - p. 2) remarks, on the place of sampling in Census and Survey work are as follows:-

"(1) Sampling will only be of use in census work if the sampling errors are sufficiently small not to affect the

validity of results for the purpose for which they are required.

(2) The amount of effort and expense required to collect information is always greater per unit for a sample than for a complete census. Sampling results in great economy of effort.

(3) Completeness and accuracy of the returns may be much more easily ensured if the information is collected from only a small proportion of the population.

(4) It is possible to obtain more detailed information in a sample census, and when it is obtained, can be more easily handled, both at the stage of abstraction and coding of the original information and in the analysis of the coded results.

(5) In many types of census the use of sampling makes possible a very considerable increase in speed, both in the execution of the field work and in the analysis of results."

(6) By sampling techniques one can use methods impossible in full censuses, e.g. harvesting and weighing of a sample of a crop.

K.E. Hunt (p. 2) in Statistics for Colonial Agriculture says that sample surveys are practicable in the Colonies for estimating the acreage and production of a few important crops grown in pure stand in a territory where producers freely welcome enumerators to measure their crops.

J.W. Purseglove conducted an outstanding land use survey in areas of Kabale, Kigezi District, Uganda. He found that the area was very highly overpopulated and that the soil fertility had deteriorated tremendously due to over-cultivation. He showed that the best way of relieving the pressure on the land was to move about 20,000 people (approximately 30%) to new areas and build new villages. The survey and the land settlement were possible because of the co-operation of the Department of Agriculture, the Administration and the people themselves.

(i) The Frame.

The basis for sampling is the sampling unit. For instance in a sample survey of the inhabitants of any country the lists of all the households will be the sampling units. On the other hand in a sample survey of areas, the maps showing clearly the selected areas for the survey are necessary. The selected areas on the maps will be the sampling units. The frame in our survey constituted the list of households that grew food crops and the maps of the areas on which we could find the farm operators in whom we were interested.

In developed areas useful information on administrative counties is available which enables the accuracy of first stage sampling to be considerably improved by use of stratification. For example, in our survey the Department of Agriculture of Trinidad sampled the 41 clusters which we investigated out of a total of 401 clusters. This is called first stage sampling and their sampling fraction was 1 in 10.

The frames suitable for the sampling of human populations can be listed as follows:-

(1) Lists of individuals in the population.

(2) Results of a census.

(3) Lists of households in an area.

(4) Town plans.

(5) Maps of rural areas.

(6) Lists of towns, villages, counties, districts.

When using frames it is important to bear in mind that we should deal only with the units specified and contained in the frame. Thus, if we are making a survey of farms in a particular area we should interview only farmers whose holdings occurred in the frame. A departure from such a procedure will make the frame defective. However, no frame is perfect because when even a number of individuals moved from the area to be surveyed the accuracy of the frame is affected. Frames may

be faulty in the following ways:-

(a) May be inaccurate, e.g. when listed units are inaccurately defined.

(b) May be incomplete, e.g. when some units are omitted.

(c) May be subject to duplication.

(d) May be inadequate, e.g. when the frame does not cover all the categories of the material which one wishes to include in the survey.

(e) May be out of date

Our frame on the whole is fairly accurate.

Definitions.

A FARM, for the purpose of the survey, consists of areas of land not exceeding 99 acres in all, occupied by a farm operator and which is used in part or wholly for planting crops and/or the raising of livestock including poultry. A farm may consist of a parcel or of several parcels of land.

A FARM OPERATOR or OPERATOR is the person in charge of a farm. Being in charge means that the person makes all or most of the decisions concerning the day to day operations of the farm. The operator may be the owner, tenant or a manager of the farm so long as he or she makes all or most of the decisions with respect to the farming activities.

A PARCEL OF LAND is a continuous piece of land held under one form of tenure; for example, if two pieces of land are joined to each other and they are both owned, then the whole is to be considered as ONE parcel; if on the other hand, one piece is owned while the other piece is rented, then they are to be regarded as TWO parcels. There may of course be different sections of a single parcel on which different main crops are planted.

A MAIN CROP is the crop which predominates over all others grown on a particular parcel or part of a parcel of land

A parcel may thus contain one or more main crops, but in the case of patches of garden or food crops, there may be no obvious main crop.

A CLUSTER is a group of sampling units, e.g. households, people, farms, etc. In our survey a number of farm operators constituted a cluster.

The frame we used was:-

(1) Maps of Malarial Division of Health Department.

(2) Lists of farmers who had less than one acre and more than one acre plots of food crops.

While travelling up and down the countryside we used the Ordinance Survey Map 1.27" to a mile (1:50,000) which was fairly accurate for the purpose.

(ii) Method of Application.

The first step to be taken in planning a sample survey is to define the aim, the time given for it and the expenses to be incurred, and the staff available and their training must be known. The second step is to get an experienced statistician to draw up an appropriate sampling design. The next step is to make a pilot survey of the area noting its physical features and its problems. The time spent in travelling should be noted and one should also develop and test methods of recording details. The man in charge of the survey should also think of the best way of approaching the farmers and he should test his theory while making the reconnaissance survey. Where they are available, maps, lists of people, statistics of acreage, food crops and cash crops should be collected. One should see that his staff understand the instructions and that they are familiar with recording techniques.

The units that can be used in sample surveys on land utilisation are:-

(1) County.

(2) Village.

(3) Household.

(4) Family - convenient unit for sample surveys in towns and cities.

(5) Cluster.

(6) List of individuals.

(7) Farms.

In rural areas of Africa and Asia villages are clearly defined and probably are unique units. Each contains its fields and their cultivators. Hence the village unit is probably ideal under those circumstances. In the West Indies household units are probably the best because the social set up is not based on tribal units.

While selecting the areas of operation one must always bear in mind ease of accessibility and the ease of contacting the people. In planning our survey these two factors were given the first consideration. Some people or the whole tribe may in some cases be very hostile to a survey and under such conditions one may not get the co-operation which is highly desired for carrying out a satisfactory survey.

(iii) Stratification.

The efficiency of a sample design is increased if we can use available resources such as accurate maps, lists of people and their farms and information from other censuses. A design is said to be more efficient than another if under specified conditions it yields more reliable results per unit of cost.

The idea behind stratifying the sampling units is to get a greater accuracy of the overall population estimates and to ensure that subdivisions of the population in which we are interested are adequately represented. The population in a sample is sorted out into homogenous groups and selection of the units is done at random by the use of random numbers. The sample at this stage is referred to as a stratified sample and the process of dividing such population into various strata

is called Stratification. Stratification of clusters does no harm to sampling and though in many cases it results in greater efficiency and accuracy, in our survey it did not. The higher the degree of homogenity within the stratum the greater is the increase in precision of sample estimates and the greater is the chance of getting a representative sample.

A random sample is one in which each individual sampling unit in the population has an equal chance of being selected at random. It is got either by use of random numbers or shuffled cards. The reason for randomisation is to eliminate bias.

(iv) Cluster-Sampling.

The technique of cluster sampling has been widely used in America with great success, and in the agricultural survey carried out by the Trinidad Department of Agriculture last year the same technique was applied. "If a population is divided into groups and a sample of groups is drawn to represent the population, the groups serve as sampling units and the type of sampling is defined as Cluster-Sampling." (Hansen, Hierwitz, Meadow. Sample Survey Methods and Theory. Vol. I. Methods and Applications). In order to get a better estimate one can stratify the sampled clusters into further homogeneous units. In our survey the clusters were stratified, i.e. every cluster was divided into two units. One unit represented households which had over one acre holdings, and the other unit had households with holdings of less than one acre in size.

(V) Sampling Procedure in the Survey.

The procedure adopted in sampling was briefly as follows:- Our survey was based on the food crops grown in the counties of Caroni, St. David and St. Andrew. The counties were stratified into County 1 denoting Caroni, and County 2 denoting both St. David and St. Andrew. The former depicted a typical flat area growing sugar cane and the latter county (meaning both St. David and St. Andrew) was chosen as a typical

example of mountainous area growing cocoa. The reason for such a choice was to find out whether there is any difference between the types of food crops grown in the two counties. Every county was stratified into two Zones.

Zoning of the surveyed area was done by the Department of Agriculture in their 1956 Survey. The zones were as follows:- (a) Zone 1 - Cocoa in the North of the island. (b) Zone 2 - Cocoa in the centre of the island. (c) Zone 3 - Cocoa in the south of the island. (d) Zone 4 - Sugar cane area. (e) Zone 5 - Coconuts. (f) Zone 6 - Urban. We were concerned with Zones 1, 2 and 4.

Then we proceeded to make use of 41 clusters randomly sampled and which were surveyed previously by the Department of Agriculture of Trinidad. The Department had at its disposal 401 clusters. Their sampling fraction was 0.100 (1/10) but their exact sampling fraction worked out at 0.102. The next stage was to stratify each of the 41 clusters into two units, one unit had households of less than one acre holdings and the other had more than one acre holdings. Later a list of the names of households was prepared under each of the two groups. Sampling was randomised. Among the over one acre households the sampling fraction was 0.5, i.e. we took every alternate household in the list; and among the under one acre households every third person in the list was selected, i.e. the sampling fraction was 0.3. The sampling fraction was higher in the former because it was thought we could get a better estimate of food crops grown in large plots than in the small gardens located behind the houses. Therefore the bigger the proportion of over one acre sample we took the better the estimate of food crops would be. For over one acre farms the overall sampling fraction was 1/20, and for under one acre farms the overall sampling fraction was 1/30. In all we dealt with 430 farmers of whom 137 came under the category of over one acre, and 293 under the category of under one acre. The primary aim of stratification was to help us to select a representative sample.

The accuracy of the survey would have been very much increased if the sampling fraction was bigger but the costs would have been higher and a longer time would be required to complete the survey.

Briefly what was done was a multi-stage sampling, i.e. we carried out a sampling process at different stages. The first stage was done by the Trinidad Department of Agriculture which sampled 41 clusters out of 401. The second stage was done by Mr. Meredith who stratified every cluster into two units, i.e. over one acre and under one acre farms, and operators were randomly sampled from each stratum.

VI. FIELD WORK PREPARATION .

This took place during the first term. Individual students were asked to find the best way of measuring crops in the field. Others were given the work of preparing questionnaires, and some spent time in the Statistical Department in Port of Spain sorting out names of operators and their addresses. While we were in the Statistical Department the man in charge, Mr. de Souza, gave us full access to the cluster maps and we traced the ones that we needed. This job took quite a bit of our time.

While doing the reconnaissances we were aware from the very beginning of the difficulties to be encountered if we were to do a survey of crop cultivation. For instance, we observed that a typical small garden behind the hut contained a very complex mixture of crops, and that if we were to get an estimate of the food grown we had to agree to include many crops in the survey. The other factor that also came to light was that the peasants did not practise any systematic spacing of their crops and this fact would add to the difficulty of counting the plants in the field. We also found that a good many of the food gardens were too small to come into the category of a food garden as we understood it by our definition. Added

to that there were not in some cases any defined boundaries separating one garden (e.g. among over one acre size) from the other.

In view of the above observation it was quite evident that a quick and practical method of estimating the extent of food crop cultivation had to be devised because individual counting of all plants in the whole garden would undoubtedly be too laborious. We therefore had to count plants in the sampled squares only (10' x 10') as this was found to be the quickest method under the circumstances. We could probably have got a better estimate of the yield of crops if we harvested the plants that fell in the sample units. But this would have taken a much longer time and perhaps the farmers would not have allowed us to interfere with their gardens to such an extent. Despite the fact that counting was easy we still found it very hard to count plants of pumpkin, cucumbers, beans, water melon and "topee tamboo". Due to the spreading nature of pumpkin we just recorded it to be present if the sample squares fell on it, and with regard to dasheen and bananas we decided to count the main stems and ignored the offsetts.

Sampling in the field was taken at random. Two measurements were taken in a garden of less than 1/10 acre and four measurements in the case of a garden of more than 1/10 acre. But where there were patches of pure stand of a crop, e.g. pigeon peas, we decided to take an additional separate sample on that crop, i.e. if there was one patch of pure stand of pigeon peas in under 1/10 acre garden we took 3 samples instead of 2.

The area covered by the two counties (representing one-third of Trinidad) was divided into seven sections and every student (except Mr. Meredith) was in charge of one of them. In every section there was a certain number of clusters in which there was a number of operators. The allocation of work was such that if a man had a lot to do with preliminary work

then he was given fewer clusters to deal with than a man who did not do very much in the way of preparation of instructions for the whole team. When doing field work it was therefore best to work in pairs. Each pair was expected to interview on the average 16 farmers per day. For the allocation of areas see Appendix I (c).

The man in charge of his area was responsible for allocation of field work to the other three pairs and for their transport. The team had more cars at their disposal than they needed. In most cases four cars were sent out every day.

Time was another important factor of investigation in this sort of survey work and hence log sheets were prepared and distributed to everyone and proper instructions given on the recording of mileage, time of travelling from the Imperial College of Tropical Agriculture to the clusters, time of travelling between clusters, lunch time, and time taken to interview and measure the garden of every individual household.

VII. EXECUTION OF FIELD WORK

As it has already been mentioned (page 8) every man was put in charge of a certain area and it was his duty to make a reconnaissance of his clusters in order to get an idea of their location. This gave him a chance to find out whether the clusters were as easily accessible as shown on the maps and he was also in a position to plan the allocation of the clusters to other members of the team in the best possible way with regard to efficiency and economy of transport. This reconnaissance was of tremendous value because it was found necessary at times to indicate on the map the places where one may easily miss some of the roads leading to clusters. For a few of the so called roads were merely tracks without any sign posts at the junctions. Every supervisor was supplied with all the maps of his clusters in his area. A specimen copy of one of the cluster maps is shown in Appendix I(e).

A. FIELD INSTRUCTIONS.

Before the actual field work of the survey started every supervisor was supplied with the following:-

(i) Survey Sheets.

(ii) Questionnaire Sheets.

(iii) Log Sheets.

(iv) Instructions referring to supervisors and enumerators respectively (re the Log Sheets).

(v) Field Instruction measurements.

(vi) Writing board.

(vii) Four rods each 10 ft. long per pair of students.

Everyone was expected to understand these instructions fully before field work started. This is fundamental in survey work and any difficulties arising were explained during Friday meetings.

Survey and Questionnaire Sheets.

It was the duty of every supervisor to enter the relevant information on these sheets before giving them out to other members of the team. He had to write on them all the names and addresses of the operators in his area from the lists in the Master Sheets. He also recorded how many parcels of land the operator had in order to provide a separate set of sheets for every one of the parcels. Thus, if Mr. X was cultivating two plots of land, then the information was entered on two Survey sheets. Sheet No. 1 would refer to plot 1 with appropriate acreage, and sheet No. 2 would refer to plot 2 with the relevant acreage of the plot. There would also be two questionnaire sheets each one of which will have a corresponding survey sheet. Information about the county, zone, cluster, building number, date, interviewer, measured and given acreage was put on both sheets.

On the survey sheets (Appendix III) were columns for random numbers, crops, purestand area, the sample units and total. The sample units were randomised by use of random

numbers (see Experimental Designs by Cochran & Cox, p. 422). The random numbers were entered in appropriate columns in the survey sheets otherwise it would have been a clumsy job to do it in the field. The details to be filled in the questionnaire and survey sheets are clearly shown in Appendix III.

Log Sheets.

The idea of keeping log sheets is to get an estimate of the time taken to do the whole survey. We had to record the names of enumerators, times of departure and arrival at the clusters and mileometer reading of the car used during the day. Usually about one hour was allowed for lunch. The time of return journey was also noted. The number of the area, the cluster and the date were all noted down in the log sheet. The number of miles covered during the day provided an estimate of the cost of travelling because travelling allowance at 15¢ per mile was paid to the owners of a car of 10 H.P. or more and an allowance of 10¢ per mile to a person who used a car of less than 10 H.P. In Appendix X details of the cost of the survey will be found.

A specimen sample of log sheet and instructions pertaining to it will be found in Appendix I (a) and (b).

Field Instruction Measurements.

The details of these will be found in the Appendix II. Briefly, enumerators were instructed to standardise their pacing. In most cases it was 10 paces = 10 yards. On a given holding one man had to do all the pacing. If the area occupied by the house and the compound came within the plot it was measured separately and was subtracted from the whole garden. Areas which had crops in pure stand were paced separately and were subtracted from the area of the whole garden, but they were included when calculating the measured acreage of the whole plot. These pure stand areas were sampled in the

same way as the rest of the garden. One representative sample was taken from every patch of pure stand. Banana stools were individually counted but pumpkins, water melons and cucumbers were only recorded as present if they happened to fall in the sample units because they were found very difficult to count in the field.

B. THE INTERVIEW.

This was started on 10th December 1956 in the Sangre Grande area. All eight members of the team split into four pairs worked in that area. Each pair had cluster maps, survey and questionnaire sheets, writing boards and four rods (10 ft. long each). On arrival at the household we showed a letter of introduction from Dr. A.L. Jolly to say that we were students of the Imperial College of Tropical Agriculture and that we were engaged in a study of food gardens. In order to avoid suspicion on the part of farmers it was made quite clear from the letter that we were not government officials collecting taxes. Having got permission to measure the garden, one member in the pair did the sampling in the field and entered the details in the sample sheets provided. The other member had a questionnaire sheet referring to the same plot of land which his partner was measuring. He asked the farmer what crops he grew and to which of them he applied farm yard manure or artificial fertiliser. He also asked him what crops he consumed at home and how much of them were for sale. He tried to find from him an approximate yield of those crops. He also asked him whether he cutlassed, forked and ploughed his land. Reasons were asked for any combination of crops which he observed in the garden. In most cases the answer was "I don't know, it is just so". The man who was asking the questions counted the banana stools and his partner recorded the number in the survey sheet. The pair recorded whether the operator of the holding was a West Indian or an East Indian.

During some of these interviews no sample measurements were taken because the garden was very small and it was realised that the simplest thing to do was to count every crop plant in it. Some interviews were very short indeed, e.g. they lasted 10 minutes. But others took as much as two hours because the operators had their plots very far out in the forests and it took quite a while to get there.

On the whole the work proceeded at a much quicker rate than we had anticipated because there was no difficulty in finding the operators, some of whom were very quick to understand what we wanted to find out. A number of them had no gardens at all, others had patches of food crops grown in small cocoa estates in which case we did not take any measurements because the plots did not comply with our definition of a garden. However, we sometimes came across farmers who had 3 or 4 plots of food crops although in our list they were supposed to have only one parcel. Another factor which slightly delayed our work was that in a few cases we came across individuals whose names in our list did not agree with the names they were known by in the village. It was not very easy to find such operators.

Our experience with these farmers showed that most of them were extremely co-operative. Occasionally we were mistaken for tax collectors or government officials allocating more land to farmers. At Biche, farmers asked whether the survey had anything to do with the installation of electricity in the area.

At the end of the day's work, the supervisor collected the sheets of his area from the other three pairs of students and checked the information entered. Information of no responses was recorded and a list of farmers to be followed up was carefully noted. Quite a number of operators were wage earners at the Public Works Department or at the big estates, and hence they were not at home when we got to their holdings.

C. AREA V.

This is the area of which I was in charge. It consisted of 8 clusters very widely distributed with 70 farmers in them. The nearest cluster from the College was situated at Valencia (14 miles from the Imperial College) and others were scattered along Toco Main Road. The most distant cluster was at Paria Main Road (52 miles from the Imperial College) and the least accessible one was situated at Biche about 36 miles away from the College, but it was the most compact. The Manzanilla cluster presented no problem at all.

Physical Features.

The island is topographically subdivided by three mountain ranges separated by undulating land, plains and swamps. The ranges decrease in altitude from North to South. The Northern Range fringes the Caribbean Sea, the Central Range bisects the island obliquely, and the Southern Range, 15-20 miles south of the Central Range, forms the southern rim of the land. (Suter. The General and Economic Geology of Trinidad, page 2.)

Six of my clusters fell in the Northern Range and two in the Central Range. The most outstanding features of these mountainous areas is that they are all covered with forests on high altitudes and contain cocoa estates in the valleys. Both ranges are supplied with a network of small rivers. The main rivers are: the Caroni River (in Caroni) and the Oropouche (North) River which drains the Northern and Central Ranges to the west and to the east respectively.

The Northern Range consists mainly of sandy soils. Around Toco the beds are mostly of calcareous shells and geologically, Cretaceous in age (70-120 million years). The majority of the beds in the rest of the range are made of phyllites and schists of Jurassic age (140-150 million years).

The Central Range is younger than the Northern one having developed during the Pleistocene age (about 1 million years).

The southern side has hills made up of Tertiary (15-50 million years) reef limestones forming prominent scarps at Guaracara and Biche. Erosion by landslides and flash floods is very active in this area. The road is very bad between Manzanilla and Biche and it is quite risky to travel on it during the heavy rainy season.

Quarries of limestone and building sand were seen in both mountain ranges and these contribute slightly to the economy of the area.

The People.

The people in this area were predominantly West Indian for out of 70 operators only 15 were of East Indian descent. The rest were West Indians. At Valencia there were 4 East Indians out of 12 operators, one of whom was a first class market gardener. At Biche there were 7 East Indians out of 18 operators. The majority of operators in this cluster worked for the Newlands Cocoa Estate and their gardens were on the whole very badly looked after. Out of 70 operators there were only 2 really good farmers among East Indians and a similar number among West Indians.

Biche Cluster.

This cluster presented some difficulties because the file for it was lost by the Statistical Department in Port of Spain. We had the map of the area showing house holdings but we lacked the list of farmers in the area. My partner (Mr. J. Waterworth) and I went around Biche and asked everyone of 85 people in the area shown on the map as to whether they grew food crops or not in their gardens. We also asked them to give an estimate of the acreage of their holdings. The persons interviewed were asked whether they had more than one plot of land. If the estimated acreage of the garden was more than 1/10 of an acre then it came in the category of more than one acre size group. The plots which varied from less than

0.1 acre up to 0.1 acre were put in the group of less than one acre. This work took half a day.

Then Mr. R. Meredith, who was put in charge of statistical work, sampled at random all the food holdings of the under one acre size group using a sampling fraction of 1/3. The figures for the over one acre size were available from the Statistical Department in Port of Spain. Thus the over one acre size farmers were not resampled. Out of 85 persons we interviewed, 19 had no food gardens. It took half a day (on 6/1/57) to complete all the field work at Biche because the cluster was compact and 4 students worked on it on the same day. The total number of operators we had to deal with in this cluster was 18.

VIII. COMPILATION OF DATA

Instructions (see Appendix IV) and general notes on the tabulation of data were issued. The compilation was done in four stages:-

(1) Calculating the area of the food garden.

(2) Calculation of totals of various crops in a food garden.

(3) Coding of the crops.

(4) Transfer of crop totals onto cards.

(5) Transfer of crop totals in cluster sheets.

The Area of the Mixed Garden.

This was obtained by subtracting the area occupied by the house, court yard, flower garden and areas of pure stand crops from the whole garden. The final figure represented the area of mixed crops. But when calculating the measured acreage of the garden the pure stand areas were included.

Calculation of Crop Totals.

This was done by a student who did sampling measurements in the field. If for instance two samples were taken on

a 200 sq. yd. field, and if in Sample 1 were found 10 cassava stems, 2 dasheen and 5 pigeon pea plants, and in Sample 2 were found 5 of the former, 10 of the latter and 3 dasheens, then totals will be 15 cassava plants and a similar number for pigeon peas and 5 dasheens on 200 sq. ft. Therefore the total cassava plants on the 200 sq. yd. of garden:

$$= \frac{15 \times 200 \times 9}{200} = 135 \text{ cassava plants.}$$

and Ditto for pigeon peas = 135 pigeon pea plants.

$$\text{Dasheen totals} = \frac{5 \times 200 \times 9}{200} = 45 \text{ dasheen plants.}$$

A specimen pair of questionnaire and sample sheets have been inserted in Appendix III but the details on them do not refer to the example above.

Crop Coding.

The first step undertaken in connection with coding was to check whether there were any major disagreements between crops recorded in the questionnaire sheets and those recorded in the sample sheets. It was important for crops in the questionnaires to agree with those in the sample sheets but not vice versa. Where there were wide differences checking in the field by the enumerators was recommended.

The second stage of the aspect of this work was concerned with coding the crops on the sample sheets, e.g. 00 = Banana, 01 = Cassava, etc. After that, appropriate holes were punched on the cards to indicate the crops grown and their corresponding total numbers were entered at the back of the card. If there was an area of pure stand in the garden the total of the crop was recorded in a separate card and a hole for sub-plot was punched. A similar procedure was followed if there was a patch of a definite combination of say cassava and pigeon peas, in the field, i.e. a separate card for combination was kept. Details of this work will be found in Appendix IV. In these cards appropriate holes were punched for information on manures,

cultivation practices, racial group, zones, cluster and county. The clip-cards were used because of the ease in handling the data. Blue cards were used for gardens of over one acre size group and yellow cards for gardens of less than one acre group size. (See Appendix IV (a).

Cluster Summary Sheets.

These sheets show totals of various crops grown by operators in a zone within a cluster size group. A specimen sample of one of them will be seen in Appendix V. Briefly they have columns for crop codes and racial groups, i.e. East Indian and West Indian. Each sheet referred to a cluster consisting of farms of over one acre size on one side and the other side referred to the same cluster with farms of less than one acre group. Totals of each crop (in a code form) were entered into an appropriate column. Thus if cluster cards showed a total of 200 banana stools grown by West Indians then we had to enter the figure 200 in the West Indian column.

We also entered the number of operators who cutlassed, forked and ploughed their land. Similarly, information on the number of operators who used artificial fertilisers, organic manures and the number of those who sold their crops to the market was put in the appropriate columns.

A record was also made of the number of plots in the cluster which came under the category of no response, no garden and food garden under trees. The total given acreage of the whole cluster was entered under column A and the measured cluster acreage was recorded under column B. The proportion B/A was calculated although this figure was not used in the final analysis. It was done as a matter of interest. The figures for A and B were obtained by adding the corresponding acreages recorded in the cluster cards referring to the size group. C represented total food acreage of the cluster within the frame.

Mr. R. Meredith calculated the Sampling fraction (S.F.) and the Raising factor (R.F.) for each cluster group within the zone. The S.F. and R.F. are shown on top of the sheet.

IX. ANALYSIS

The analysis was a fairly complex one because of elaborate stratification. There were two counties each of which had two zones. Every zone contained a number of clusters, i.e. first stage sampling units. Each cluster was stratified into two size groups, i.e. the over one acre group and the under one acre size group. Thus we ended up with eight groups of analysis, i.e. 8 strata analysis. The computations were based on these eight strata.

Briefly the set up was as follows:

County	Zone	Group*	No. of clusters	No. of operators per cluster with gardens	No. of operators per cluster
1	2	+	4	14	15
		-	4	8	13
Zone 2			4	22	28
1	4	+	24	56	58
		-	24	174	204
Zone 4			24	230	262
County 1			28	252	290
2	1	+	4	12	14
		-	4	8	10
Zone 1			4	20	24
2	2	+	9	30	50
		-	9	54	66
Zone 2			9	84	116
County II			13	104	140
TOTAL SURVEY			41	356	430

* Over one acre (+)
Under one acre (-)

24 Clusters were in the Sugar Zone
17 " " " " Cocoa " .

Zone 1 represents cocoa areas north of the island.
" 2 " " " centre " " "
" 4 " sugar cane areas.

Two methods of analysis were required for every one of the eight strata analyis. The two methods are as follows:-

(1) Quantitative analysis is based on crop totals and it attempts to measure variation of crops between and within clusters.

(2) Qualitative analysis is based purely on numbers of operators.

Quantitative Analysis.

Instructions were issued (see Appendix VI) on how to do the analysis on the computation sheets which were provided to every student in the team. Every one of us was allocated one of the eight strata and was required to calculate statistics for all observations enumerated. I worked on 4 clusters of over one acre size group in Zone 1 (i.e. Cocoa area north of the island) of County 2.

The following is an example to illustrate how the above analysis on a crop of cassava (coded 01) was done:
The first step taken was to get the totals of cassava plants grown in each cluster in the size group. This was obtained by sorting out the details from all the cards in the cluster and entering the cassava plant totals of the growers in the cluster. Facilities were extended for use of adding machines when doing this work. The figures referring to the four clusters in my stratum are shown below:

Cluster	Total No. of Operators	Total No. of Cassava growers	Total No. of cassava plant count	
01	1	0	0	
04	2	2	312 774	1086
07	4	2	4842 2666	7508
10	7	5	2017 1303 53 292 1161	4826

Cluster 01 had one operator who when interviewed was found to have no garden. This cluster was rejected in the analysis because it had no operator in the sense we understood it. For a similar reason one of the operators in Cluster 07 was also rejected.

Having got these details sorted out the Quantitative Analysis was done on the Computation Sheet as follows:-

where n' = number of clusters in the sample.

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

n"- 1 = Degrees of freedom (within clusters).

y = The Crop count for each operator.

Y = The total crop count for the Zone = S'S"(y)

S"(y) = Crop totals in each cluster.

$\underline{N}$ stands for the estimated total number of operators in the zone. Calculations of α, β and $\underline{N}$ are shown in Appendix VI and the figures for each size group in the zone were done and given to us. For over 1 acre group in County 2, Zone 1,

α = 0.0888

β = 0.0092

$\underline{N}$ = 113

Notes on the Analysis of Variance.

A gives variation between clusters.

B " " within clusters.

$\bar{y}$ = Mean = $\frac{\text{Crop totals in the stratum}}{\text{Number of operators in the stratum}}$

$V(\bar{y})$ = the variance of the mean number per operator

= A + B.

$SE(\bar{y})$ = Standard error of the mean = $\sqrt{V(\bar{y})}$

$\underline{Y}$ = Estimated cassava crop totals in the Zone and Size group.

$V(\underline{Y})$ = the Variance of estimated total = $N^2 \times V(\bar{y})$

Example of Quantitative Analysis: -

Computation Sheet

County ...2.... Zone ...1.... ~~+ 1 acre~~ ~~- 1 acre~~ Crop ..01...

Cluster	S"(y)	n"	n" - 1	$(S"(y))^2/n"$	Difference	$S'S"(y)^2$
01	0	0	0	-	-	-
04	1086	2	1	589,698	106,722	696,420 i.e. $312^2 + 774^2$
07	7508	3	2	18,789,551	11,762,969	30,552,520 i.e. $4842^2 + 2666^2$
10	4826	7	6	3,327,182	3,874,910	7,202,092 i.e. $2017^2 + 1303^2 + 53^2 + 292^2 + 1161^2$
TOTAL	13420	12	9	22,706,431	15,744,601	38,451,032
C.F.				15,008,003		15,008,003
S.S.				7,698,398	15,744,601	23,442,999
d/f				2	9	11
M.S.			A	= 3,849,199	B = 1,749,400	
				= 0.0888	= 0.0092	
V(ȳ)			$\alpha A + \beta B$	= 357,903.35		
$N = 113$	$\bar{Y} = \frac{13420}{14} = 1118.33$			SE$\bar{Y}$ = $V(\bar{y})$ =		598.25
				% S.E. = 53.49		
$V(Y) = N^2 \times V(\bar{y})$					$Y = N \times \bar{Y} \pm$	$N \times SE(\bar{y})$
$= 113^2 \times V(\bar{y})$					= 126,371	
$= 4570.06 \times 10^6$					± 67,602	

Qualitative Analysis.

The method of analysing and determining the standard error of number of operators growing a given crop was explained to the survey team and instructions on it will be found in Appendix VII.

The following is an example taken from the group of analyses I did on a number of operators growing cassava:-

where p_- = estimated proportion of operators growing cassava, in a given cluster, $p_- = \frac{u}{n''}$ and $q = 1-p$.

p_o = overall proportion of operators growing cassava in the zone. $p_o = \frac{S'u}{S'n''}$ and $q_o = 1-p_o$

$\underline{U}$ = estimated number of operators growing cassava in the zone = $\underline{N} \times p_o$.

$\underline{N}$ = estimated number of operators in the zone.

Example of Qualitative Analysis.

County 2. Zone 1. + 1 acre. Crop 01 (Cassava).

Cluster	04	07	10	Overall
$\frac{u}{n''}$	$\frac{2}{2}$	$\frac{1}{3}$	$\frac{5}{7}$	$\frac{8}{12}$
p_-	1.0000	0.3333	0.7143	$p_o = 0.6667$
q_-	0	0.6667	0.2857	$q_o = 0.3333$

				Total	D.F.	M.S.
$(p_- - p_o)^2 n''$	0.2222	0.3336	0.0159	0.5717	2	0.2859 = C
$n'' p_- q_-$	0	0.6666	1.4285	2.0951	9	0.2327 = D
$(S'n'')p_o q_o$	12 x 0.667 x 0.3333			2.6668	11	

$$V(\underline{U}) = N^2(\alpha C + \beta D)$$
$$= 113\ (0.0888 \times 0.2859 + 0.0092 \times 0.2327)$$
$$= 351.5147$$
$$S.E.(\underline{U}) = \sqrt{V(\underline{U})} = 18.74$$
$$\underline{U} = N(p_o) = 113 \times 0.6667 = 75.3$$
$$\% \text{ S.E. } \underline{U} = 24.9\%$$

X. SUMMARY OF RESULTS

From the Summary Computation Sheets a final summary of results of the food crop survey was prepared. It gives details of estimated plant counts of 17 crops with their corresonding number of operators. The standard errors and their percentages referring to every one of the crops and operators have been calculated. It will be observed from the summary (see Appendix XI) that there are no figures for the estimates of cucumber and pumpkin because their plants were found difficult to count in the field with a reasonable degree of accuracy. The details referring to cultural, manurial and marketing of these crops have also been worked out (Appendix XI).

Mr. A. Gunn prepared a summary of analysis on pure stand, combinations, artificials, organics, casual sales and marketing of the crops. For details see Appendix IX (b).

The results indicate that the majority of the farmers do not plough their land but are just contented to cutlass and fork it. Artificial fertilisers are unheard of by the majority. However, just over a third of the farmers apply organic manures especially on bananas. It has also been found that the largest percentage of the crops produced in a garden is home consumed. This is particularly true of farmers who have 1/10 of an acre or less behind their houses. The farmers of bigger holdings (1/10 acre or more) sell a small percentage of their garden produce. The crops which are most commonly offered for sale are bananas, pigeon peas and cassava.

The most striking result is the popularity of bananas among the peasants, e.g. 80% of them grow this crop. Other crops in order of popularity are dasheen, cassava, pigeon peas and tannia. About 1/5 of the operators grow

peppers and about 1/3 grow okra. Crops like pineapples, cucumber, maize and tomatoes are grown by only a small percentage of operators.

The other outstanding feature of the gardens is the tremendous diversity of cropping. Quite often one comes across gardens with a few plants of many crops unevenly spaced. Occasionally however one sees patches of pure stands of pigeon peas, sweet potatoes and cassava. In the large holdings a combination of cassava and pigeon peas was quite noticeable.

XI. CONCLUSION AND RECOMMENDATIONS

Although the results of the survey as shown in Appendix XI are inconclusive, yet on careful scrutiny they do furnish some interesting and valuable information. It is undoubtedly true that even at the end of the survey we are still in the dark in so far as the yields of the various crops are concerned. But it is equally true that we have a far better idea of food crop cultivation in the three administrative counties (i.e. Caroni, St. Andrew and St. David) by the end of the survey than at the beginning.

At the start we knew nothing about it but towards the end we knew something about it. For example, now we know that the banana is the most popularly cultivated crop in the three counties (which represent one-third of Trinidad). The other bulky and starchy crops which are also extensively grown are dasheen, cassava, tannia and pigeon peas. Their preference may perhaps be accounted for the fact that they are easy to cultivate and that they suit the small farmer who always harvests them piecemeal. Wherever there are little channels with running water in the plot almost invariably one finds tannia and dasheen have been planted because both crops do well on wet soil. Banana is found on almost every small plot and responds tremendously to the

application of kitchen refuse.

The Quantitative and Qualitative Analyses show high percentage standard errors. This is not due to the wrong method applied in the analyses. It is due to the low sampling fraction and a high variability in the sample. The extraordinarily high S.E.% (188) in the case of bean crop is attributed to the fact that while one or two farmers grew large quantities of bean the majority grew very little of it. The range is between 22% - 188%. But in the case of Qualitative analysis which was based on the number of operators the range of Standard Error variation was not very wide, e.g. 2.6% - 26.4%. From this we conclude that the estimate of the number of food growers is more reliable than the estimate of plant totals in the three counties. Therefore future surveys of this kind will render more useful information if one sets out to find the number of people who grow food rather than the yields of the various crops.

The survey has undoubtedly achieved three main objects. Firstly, it has furnished information, on the estimate of people growing foodstuffs, which the Trinidad Department of Agriculture lacks. Such information is vital to any country which is endeavouring to stimulate more food production. Secondly, the experience gained in planning and conducting such a survey is in my opinion extremely useful. Any one of the eight postgraduate students who participated in the survey should be able to carry out an agricultural survey of this kind provided the advice and help of an experienced statistician is available in the territory one is going to serve. Thirdly, it has provided information which will enable future surveys of this kind to be more efficiently planned and conducted.

Recommendations.

Assuming that such a survey will be repeated next year I can offer recommendations only on the technical aspects.

We found during the analysis that there was greater variation between clusters than within clusters, It will be an improvement in sampling design if more clusters are taken in future and less number of operators than those dealt with this year. The higher the sampling fraction of the clusters the lower is the sampling error and hence the greater is the accuracy. But it must be remembered that costs increase as the number of sampling units increases. The results have also revealed that stratification of clusters into groups of farms has not been found advantageous. Hence in future, computations of results will not be so complex if cluster stratification is dispensed with.

If the whole survey was just limited to one county, e.g. Caroni, the overall effort of eight members of the team would probably have produced better results. I would therefore prefer to see in future surveys of this kind concentrated intensely on a single county considering that the time devoted for practical field work is only two weeks. Perhaps we will get more information from the farmers if we have more time to spend with them during the interview.

XII. SUMMARY OF THE SURVEY

(1) A survey of food gardens in three administrative counties of Trinidad (i.e. Caroni, St. David and St. Andrew) was undertaken by eight postgraduate students. The project was completed at scheduled time.

(2) Stratification was applied at three stages. The three administrative counties were stratified into two counties, i.e. County 1 (Caroni) and County 2 (St. David and St. Andrew). Each county was stratified into two zones. In all there were four zones, three of which were cocoa zones and one was a sugar zone. Every cluster in the zone was stratified into two sampling units, i.e. a group of food gardens of over one acre size and the other group represented

food gardens of less than one acre size. The clusters represented the first stage sampling units and the two strata in each cluster represented the second stage sampling units. Of the 41 clusters we worked on, 17 were in the cocoa zones and 24 were in the sugar zone.

(3) The frame we used consisted of a list of operators with food gardens and maps of the clusters. Of the 430 farmers we interviewed only 356 had food gardens. The other 74 farmers were rejected in the analysis (for reasons see Appendix IX (a)).

(4) Although the results do not give any idea of the yields of various crops yet they do indicate the popularity of crops like bananas, dasheen, cassava and pigeon peas among farmers. They also show that the majority of the crops produced are consumed at home and not for sale.

(5) It will be observed that the percentage standard errors of crop counts are extremely high. This is not due to the wrong method employed in the analysis. But it is attributed to the low sampling fraction we took and to the large variation in the sample. On the other hand, the standard errors in the qualitative analysis are not so widely varied as in the quantitative. This means that the estimated numbers of operators growing the various crops were fairly accurate.

(6) The survey has thrown some light into the amount of work involved in planning, execution and analysis of even a modest survey like the one we conducted. The experience gained in this respect is to my mind of inestimable value.

(7) It was also realised at the very outset that if the survey was to produce useful results, then the help of a qualified and experienced statistician is indispensable.

XIII. ACKNOWLEDGEMENTS

I wish to thank Dr. A.L. Jolly, my supervisor of studies, for his helpful suggestions and comments in the course of writing this dissertation. I am also grateful to Mr. G. Hodnett for his valuable assistance in statistics. To Mr. R. Meredith the whole team extends our sincere thanks for the amount of work he has put in supervising the survey.

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APPENDIX I (a)

SAMPLE SURVEY UNIT

Instructions 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.

Instructors to enumerators re the Log Sheet.

A. Before:

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.

On return:

7. 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.

APPENDIX I (b)

SAMPLE SURVEY UNIT

LOG SHEET

Area V Clusters 10 & 01 Date 12/12/56

Enumerators J. Waterworth & S.H. Mawly Vehicle No: P. 8261

Departure: Time 7.20 a.m. Mileometer reading 1959

Return: 16.20 (11 hrs. 5 mins) 2073

Journey Time: Out 2 hrs. 10 min. In 2 hrs. 5 min.

Interview	Bldg.No.	Time (Man-hours)
1	23	Absent
2	24	40 man-minutes
3	27	60 " "
4	58	40 " "
5	49	Absent
Lunch		12.45 p.m. - 1.45 p.m.
6 *	50	Absent
7	54	Land abandoned
8	63	30 man-minutes
9	64	30 " "
10	71	30 " "

VIII- IX- X- 8/10-

Enumerators Report.

Interview	Bldg. No.	Time (Man-hours)
11	73	Land outside cluster area.
12	65	30 man-minutes
*	50	30 " "

APPENDIX I (c)

AREA NO. I. — A. Gunn in charge.

County 1.

Cluster No.		No. of operators
11	Claxton Bay	16
28	Freeport Mission Rd.	13
33	Gran Couva Rd.	19
13	Brasso Tamana Rd.	6
27	Brasso Village	4
Total 5		58

AREA NO. II. — M. Watson in charge.

County 1.

Cluster No.		No. of operators
03	Chaguanas	4
31	Perseverance	16
22	Exchange	12
32	Couva	11
24	California	9
17	Chaguanas	4
Total 6		56

AREA NO. III. — J. Currie in charge.

County 1.

Cluster No.		No. of operators
20	Chase Village	12
07	Buttler Village	3
21	Waterloo	8
25	Esperanza	13
34	Esperanza	10
23	Freeport Rd.	9
09	Freeport Village	9
Total 7		64

APPENDIX I (c) (continued)

AREA NO. IV. J. Waterworth in charge.

	Cluster No.		No. of operators
County 1.	01	Madras Settlement Rd.	9
	15	Kelly Village	9
	16	Caroni Savannah Rd.	23
	35	Las Lomas Rd.	8
County 2.	12	Cumuto Tamana Rd.	12
Total	5		61

AREA NO. V. S.H. Mawly in charge

	Cluster No.		No. of operators
County 2.	01	Paria Main Rd.	7
	04	Balandra	4
	07	Toco Main Rd.	6
	13	Valencia	12
	12	Manzanilla	10
	02	South Manzanilla	6
	11	Biche	18
	10	Alandale Settlement	7
Total	8		70

AREA VI. D. Mc Hill in charge.

	Cluster No.		No. of operators
County 2.	05	Guaico	10
	08	Sangre Grande	23
	09	Sangre Grande	10
	14	Sangre Grande	15
Total	4		58

APPENDIX I (c) (continued)

AREA NO. VII. J. Law in charge.

County 1.

	Cluster No.		No. of operators
	05	Jerningham Junction	8
	19	Jerningham Junction	10
	29	Charlieville	11
	18	Longdenville	14
	30	Longdenville	10
	26	Ravine Sable Rd.	8
Total	6		61

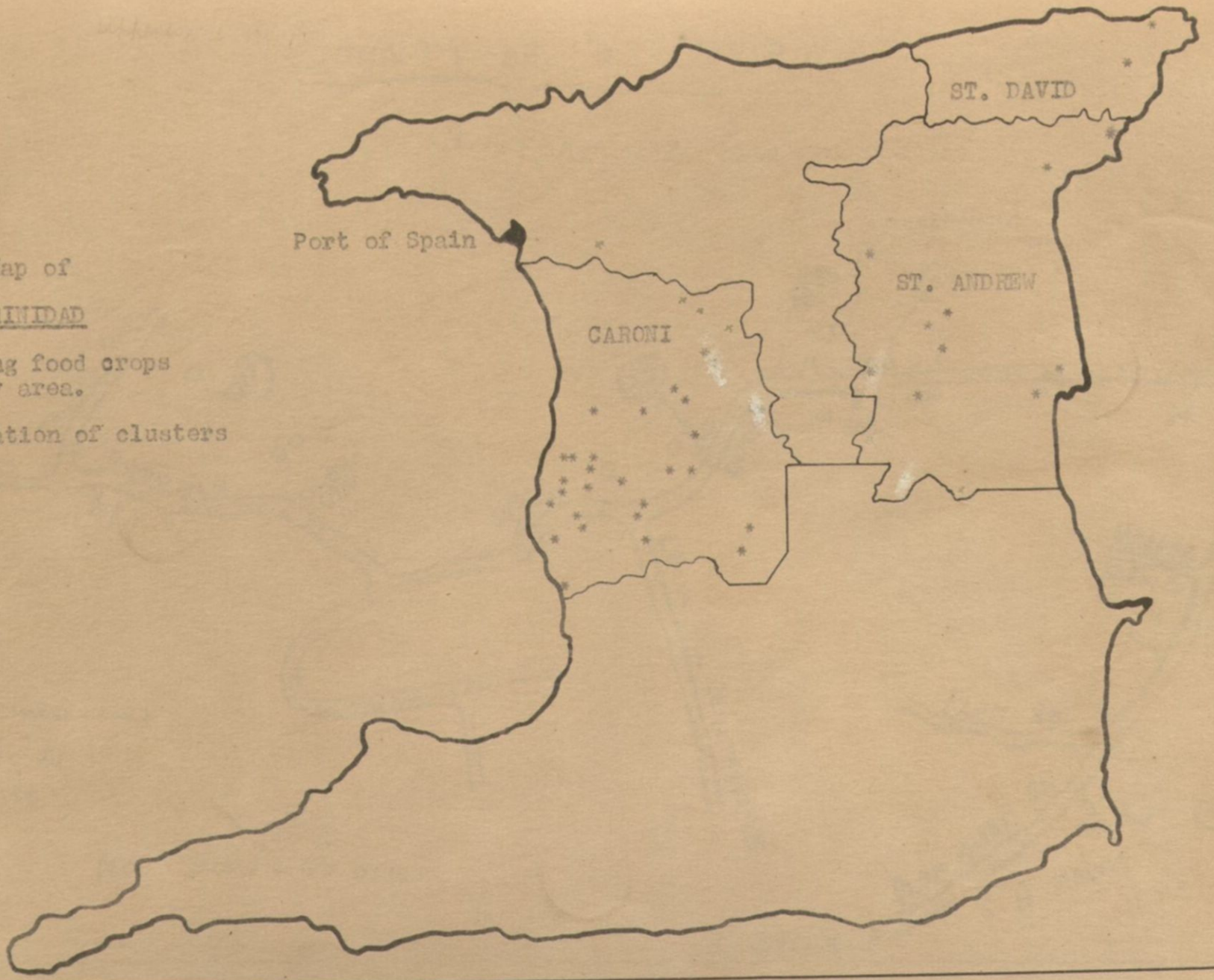
APPENDIX I (d)

Map of

TRINIDAD

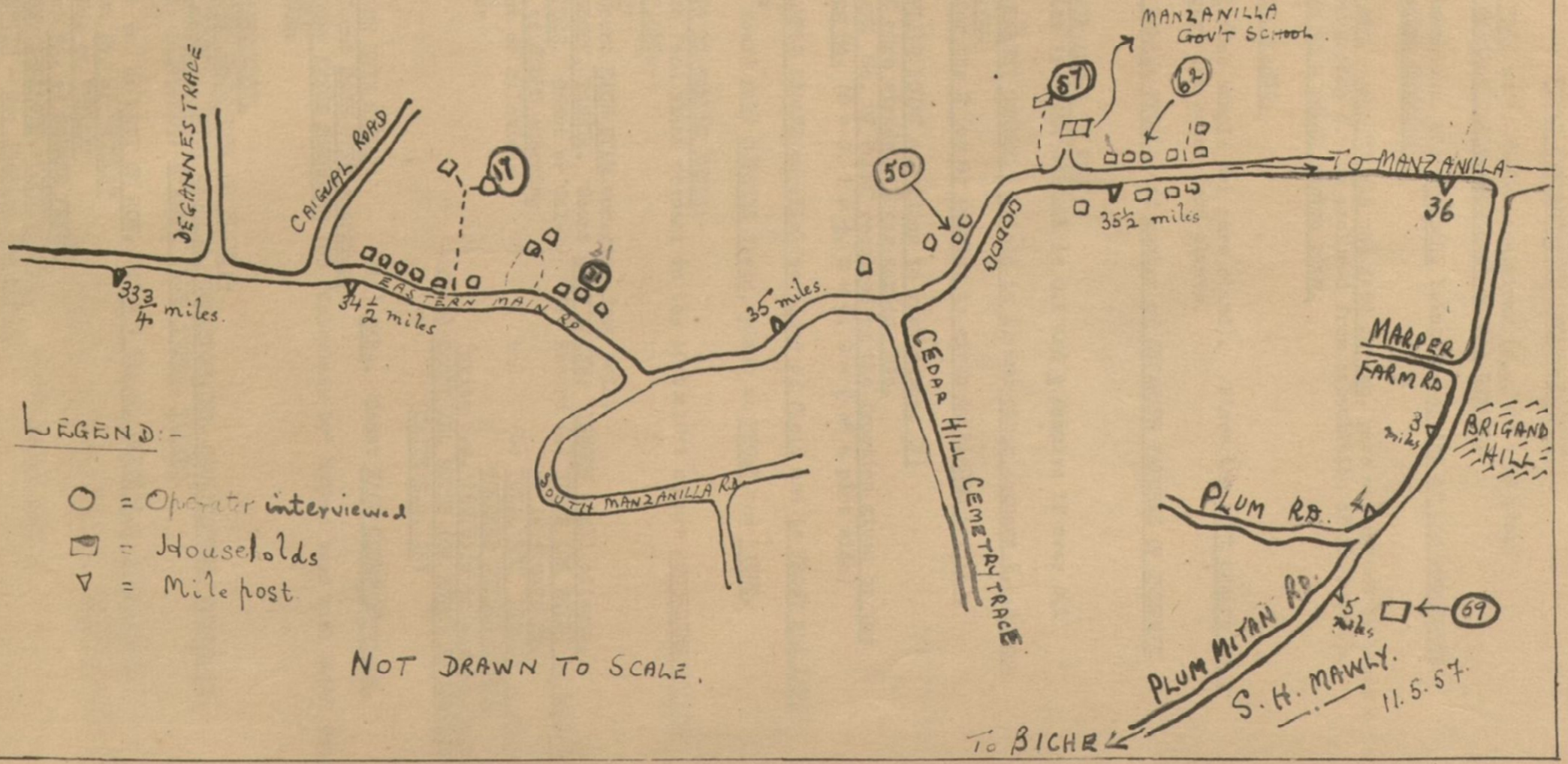
Showing food crops survey area.

* Location of clusters



COUNTY OF ST. DAVID.

CLUSTER 02 (South Manzanilla)



LEGEND:-

○ = Operator interviewed
□ = Households
▽ = Mile post

NOT DRAWN TO SCALE.

APPENDIX I (e)

APPENDIX II

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. PACE 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 Calculate No. of STEMS emerging
(iv) YAMS. Count or calculate No. of SETS.
(1) Record (a) STEMS (OR SETS) in 10ft or 10 square ft.
and (b) TOTAL ROW, LENGTH OR AREA 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 III - QUESTIONNAIRE SHEET

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME
2	1	07	60	1	Lloyd Gibbs

DATE	INTERVIEWER	ACREAGE	PLOT	ADDRESS
11/12/56	S.H. Mawly	0.1	1	Toco Main Rd., Langosta.

	CROP	DISPOSAL %			MANURES		YIELD	REMARKS
		HC	CS	M	ART	ORG		
1	Banana (00)	x	-	-	-	-		
2	Dasheen (02)	x	-	-	-	-		
3	Pigeon Peas (05)	x	-	-	-	-		
4								
5								
6								
7								
8								
9								
10								

CULTIVATION (i) Land cleared annually x (a) Forked -

(b) Ploughed -

(ii) Non food crops grown in last 2 years _____

COMBINATIONS (e.g. 1 & 2) 1 & 2

REASONS FOR COMBINATIONS: No reason given

GENERAL: Banana main crop.

Wife answered questions - husband away.

W.I.

APPENDIX III - SAMPLE SHEET

COUNTY	ZONE	CLUSTER	BUILDINGS	No: PLOTS	NAME
2	1	07	60	1	Lloyd Gibbs

DATE	INTERVIEWER	ACREAGE (measured)	ACREAGE	PLOT	ADDRESS
11/12/56	J. Waterworth	222 sq. yds.	0.1	1	Toco Main Rd., Langosta.

RANDOM NUMBERS	A	2			
	B	00	22		

	CROP	SPL 1	SPL 2	SPL 3	SPL 4	PURESTAND AREA	TOTAL
1	Pigeon Peas 05					(9 x 8) sq. yd.	6
2	Banana 00					= 72 sq.yd.	35
3	Dasheen 02	6	4				68
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

COMBINATIONS:

APPENDIX IV

SAMPLE SURVEY UNIT

Coding of Cope-Chat Cards.

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

Section A. Identification.

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

   Examples: (County No. / Cluster No.)

   1/01 Punch holes 0,2,5,6.

   1/15 " " 0,3,6,8.

   2/10 " " 1,3,8,9.

   2/09 " " 1,2,7,9.

   This punching may be done in batches for each cluster.

N.B. Check

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

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

Section B.

Top line - Holes 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 "00". If the card refers to an area that is only a part of a parcel clip out "M".

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

Section C. Crops.

Clip out appropriate holes when crops occur in a garden.

Code of Crops.

00	Fig	310	Green Vegetable crops
01	Cassava	310 will be sub-coded as follows:	
02	Dasheen	311	Pepper
03	Tannia	312	Cabbage
04	Eddo	313	Lettuce
05	Pigeon Pea	314	Mustard
06	Okra	315	Patchoi
07	Egg Plant	316	Coreille
08	Beans	2100 will be sub-coded as follows:	
09	Yam	2101	Arrowroot
11	Tomatoes	2102	Groundnuts
12	Cane	2103	Seim Bean
13	Corn	2104	Saffron
14	Cucumber	2105	Carrots
15	Pumpkin	2106	Water Melon
16	Sweet Potatoes	2107	Christophene
17	Topee Tamboo	2108	Ginger
18	Pineapple		
21	Others		

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

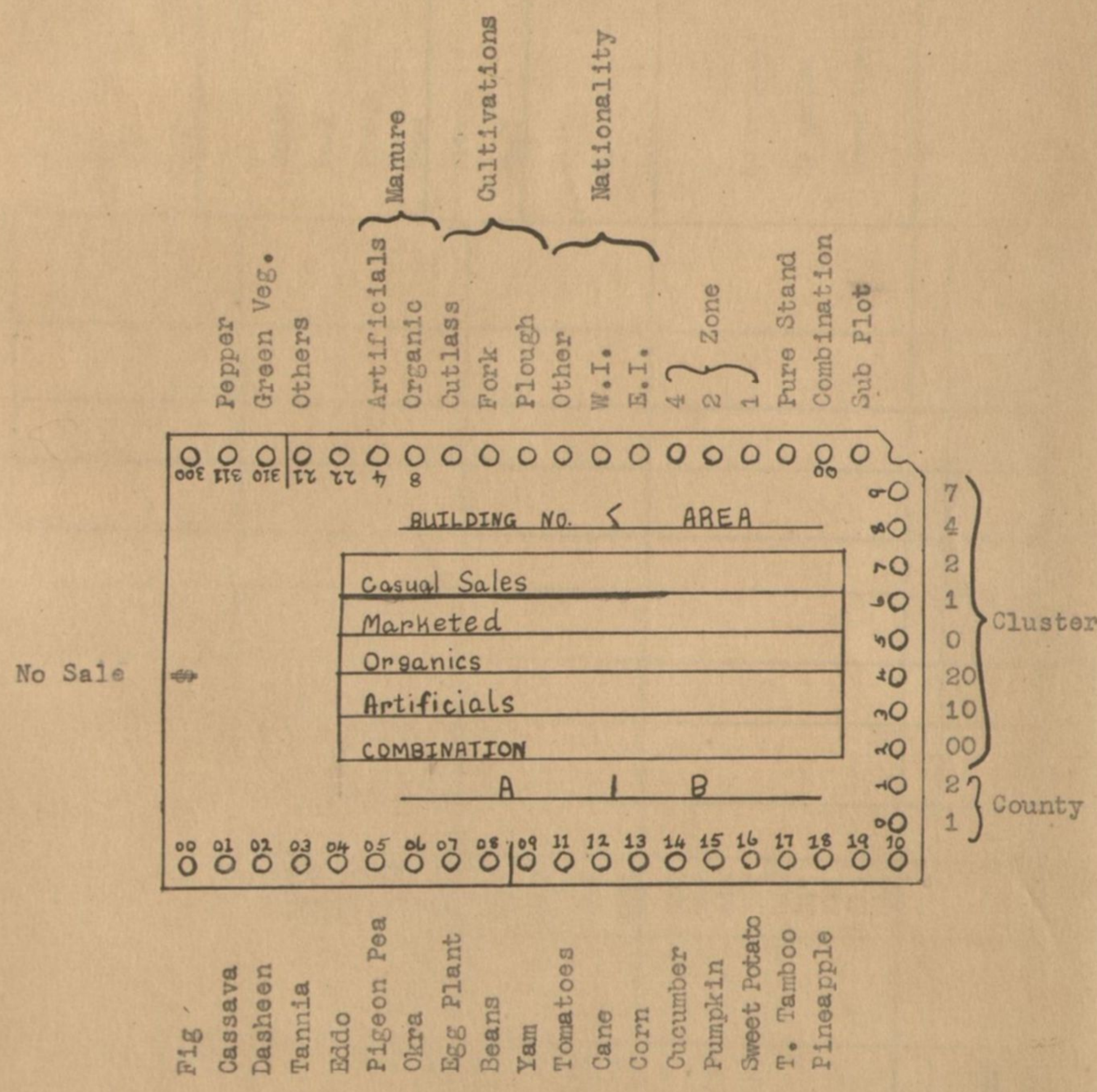
For crops coded 21 and 310 enter the number of plants in the centre of the card e.g. (312) 200 (212) 850
(313) 415

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

Combinations.

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

APPENDIX IV (a)



o. Operators.....13..... No. cards.....13..... S.F.....R R.F.2.937. Zone...4..... County....1..... Cluster.....24... ~~+1 acre~~.

	W.I.		E.I.		Others		Total		Raised Total
	O	N	O	N	O	N	O	N	
0	3	412	6	262			9	674	
1	2	403	2	279			4	682	
2	3	1337	7	1134			10	2471	
3	3	1328	7	843			10	2171	
4	-	-	1	23			1	23	
5	2	221	4	271			6	492	
6	-	-	3	85			3	85	
7	1	25	2	380			3	405	
8	-	-	1	41			1	41	
9	1	33	-	-			1	33	
1	-	-	2	952			2	952	
2	-	-	1	27			1	27	
3	-	-	1	324			1	324	
4	-	-	1	72				72	
5	-	-	-	-			-	-	
6	-	-	1	394			1	394	
7	1	440	2	443			3	883	
8	1	6	-	-			1	6	
9	-	-	-	-			-	-	
	2	92	-	-			2		
ck al	19	4297	41	5530				9827	

	W.I.		E.I.		Others		Total		Raised Total
	O	N	O	N	O	N	O	N	
2101									
2102									
2103									
2104									
2105									
2106									
2107									
2108									
2109									
2110									
2111									
2112									
2113									
2114									
312									
313									
314									
315									
316									
317									
318									
319									
320									

-1 acre

	Sq. yds.	acres
A	8228	1.7
B	5717	1.2
C		7.0
B/A	0.69	C/A 4.118

	Number of Operators W.I.	E.I.
Cutlass	8	2
Fork	8	3
Plough	-	-
None		
Art.	4	-
Org.	4	-
C.S.	-	-
M.	-	-
H.C.	9	4

	Plots	A
No response	-	
No garden	3	1936 sq.yd.
Under trees	-	

APPENDIX V

No. Operators..... No. cards..... S.F.....R R.F..... Zone..... County..... Cluster..... +1 acre..

C	W.I.		E.I.		Others		Total		Raised
	O	N	O	N	O	N	O	N	Total
00									
01									
02									
03									
04									
05									
06									
07									
08									
09									
11									
12									
13									
14									
15									
16									
17									
18									
19									
311									
Check Total									

	W.I.		E.I.		Others		Total		Raised
	O	N	O	N	O	N	O	N	Total
2101									
2102									
2103									
2104									
2105									
2106									
2107									
2108									
2109									
2110									
2111									
2112									
2113									
2114									
312									
313									
314									
315									
316									
317									
318									
319									
320									

-1 acre

Sq. yds. acres

A

B

C

B/A

Number of Operators

Cutlass

Fork

Plough

None

Art.

Org.

C.S.

M.

H.C.

Plots A

No response

No garden

Under trees

APPENDIX VI

Sample Survey Unit

Method of Analysis and determination of Standard Error of Crop Counts.

n' = no. of clusters in the sample.

n'' = no. of operators per cluster in the sample.

y = the crop count for each operator.

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

Estimation of population mean and total.

Mean per operator

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

Estimated number of operators in zone

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

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

Then $Y = N \bar{y}$

Estimation of sampling error.

For a given crop in a given zone and a given size group, the analysis of variance table takes the following form. (Yates 8. 11).

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

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

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

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

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

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

$$\bar{f}'' = \frac{S'(n'')}{S'(\underline{N}'')} = \frac{15}{29} \qquad \ldots\ldots(b)$$

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

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

$$V(\bar{\underline{y}}) = \frac{1-f'}{n'} \cdot \frac{A}{n_o''} + f' \cdot \frac{1 - f''}{n'\bar{n}_o''} .B \qquad \ldots\ldots(c)$$

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

and $\beta = f' \cdot \frac{1 - \bar{f}''}{n' \, n_d''}$

this formula becomes

$$V(\bar{\underline{y}}) = \alpha A + \beta B \qquad \ldots\ldots(d)$$

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

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

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

$$\text{Also, } \underline{N} = \frac{14}{4/51 \,.\, 15/29} = 345.1$$

(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 itis 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

$$\underline{N} \,.\, S.\, E.\, (\bar{\underline{y}}). \qquad S.\, E.\, (\bar{y}) = \sqrt{V(\bar{\underline{y}})}$$

APPENDIX VI (continued)

Computation Sheet

County 1 Zone 2 $\frac{+ 1 \text{ acre}}{- 1 \text{ acre}}$ Crop 00

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

$\underline{N}$ = 345.1 y = 202.50 S.E.($\bar{y}$) = 140.75 %S.E. = 69.5%

$V(\underline{Y}) = 235,922 \times 10^6$ $\underline{Y} = 69882.7 \pm 48572.8$

APPENDIX VII

SAMPLE SURVEY TEAM

Method of Analysis and Determination of Standard Error of number of Operators growing a given crop.

(a) Estimation population proportions and totals (in a given size group)

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

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

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

$$\underline{p}_o = \frac{S'u}{S'n''} \qquad q_o = 1 - p_o \qquad \ldots\ldots\ldots (2)$$

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

$$\underline{U} = N\underline{p}_o \qquad \ldots\ldots\ldots (3)$$

(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	$\sum(n'') - 1$	$(S'n'')\underline{p}_o\,\underline{q}_o$	

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

$$V(\underline{p}) = \alpha C + \beta D \qquad \ldots\ldots\ldots (4)$$

$$V(\underline{U}) = N^2 V(\underline{p}) \qquad \ldots\ldots\ldots (5)$$

$$S.E.(\underline{U}) = N\ S.E.(\underline{p}) \qquad \ldots\ldots\ldots (6)$$

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

APPENDIX VII (continued)

Computation Sheet (2) (Qualitative Analysis)

County 1. Zone 2. + 1 acre Crop 03 (Tannia)

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

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

$$= 907.2942$$

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

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

$$= 172.5$$

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

SUMMARY OF COMPUTATIONS

Crop ..Tannia (03).....

County	Zone	Group	n'	S'(n")	Crop Count					Number of Operators				
					$\underline{Y}$	S.E.($\underline{Y}$)	%S.E.	$V(\underline{Y})x\ 10^6$	$\frac{aA}{V(\underline{Y})}$	$\underline{U}$	S.E.($\underline{U}$)	%S.E.	$V(\underline{U})x$	$\frac{aC}{V(\underline{p})}$
1	2	+	4	14	465,743	48,706	104.7	237,763	97	172	30	17.5	907	88
		-	4	8	7,155	5,512	77.7	309,214	99	265	101	38.2	10,245	96
Zone 2			4	22	472,898	487,641	103.1	237,794		437	106	24.3	11,152	
1	4	+	24	56	29,134	12,085	41.5	146	93	349	64	18.2	4,040	95
		-	24	174	333,490	39,659	34.1	1,576	96	1929	228	11.8	51,866	96
Zone 4			24	230	362,624	41,497	11.4	1,722		2278	236	10.35	55,906	
County 1			28	252	835,522	489,404	58.6	239,516		2715	259	9.53	67,058	
2	1	+	4	12	27,798	10,057	36.2	101.205	94	47	21	43.9	427	93
		-	4	8	1,272		74.2	0.891773	62	27	18	65	314	98
Zone 1			4	20	29,070	10,099	34.7	102		74	27	36.5	741	
2	2	+	9	30	156,515	108,713	69.5	118,174	98	170	43	25.3	1,857	93
		-	9	54	31,355	11,999	38.3	144	91	796	127	15.8	15,778	96
Zone 2			9	84	187,870	109,367	58.2	11,961		966	133	13.8	17,635	
County 2			13	104	216,940	109,832	50.6	12,063		1040	136	13.1	18,376	
Zones 2			13	106	660,769	499,758	75.6	249,755		1403	170	12.1	28,787	
Cocoa Zones			17	126	689,838	499,860	72.5	249,857		1477	172	11.6	29,528	
Survey			41	356	1,052,462	501,577	47.7	251,579		3755	292	7.7	85,434	

APPENDIX IX (a)

THE FRAME

Size Group	TOTAL	No Response	Unknown	No Garden	Under Trees	House Condemned	Operator moved	Food Plot Outside Cluster Area
Over One Acre	25	2	1	13	5	-	-	4
Under One Acre	49	3	1	37	3	3	1	1
TOTAL	74	5	2	50	8	3	1	5

APPENDIX IX (b)

SUMMARY OF ANALYSIS ON:- PURE STAND, COMBINATIONS, ARTIFICIALS, ORGANICS, CASUAL SALES AND MARKETED.

Attribute	+1 Acre %	-1 Acre %	Survey %	Crops
Pure Stand	22.3	9.4	13.5	1. Sweet Potatoes 2. Cassava
Combinations	21	8.2	17.4	1. Cassava 2. Pigeon Peas
Artificials	33	10.2	17.4	1. Pigeon Peas 2. Bananas
Organics	38.4	41.8	40.7	1. Bananas
Casual Sales	10.7	6.1	7.6	1. Bananas 2. Cassava
Marketed	32.1	0.8	10.7	1. Bananas 2. Pigeon Peas

Calculations were based on 356 operators.

112 were in over 1 acre size group.

244 " " under 1 acre " " .

APPENDIX X

TIME AND COST STUDY.

	Time (man-hours)	Cost $ (Travelling only)
Preliminary Work.		
Obtaining and selection of the sample	45	8.00
Preliminary surveying of the area	71	70.00
Preliminary statistical analysis	45	
Preparation of maps	26	9.00
Preparation of field papers	34	
Total	221	87.00
Field Work.		
Supervisory work	40	
Travelling to and from tasks	116	235.00
Travelling within clusters	132	
Interviewing time	185	
Total	453	235.00
Follow-up.		
Total travelling time	25	42.00
Interviewing time	13	
Total	38	42.00
Analysis.		
Preparation for and supervision	134	
Computation and supervision	232	
Total	366	
General Discussion	235	
Cost of Boards and Rods		10.00
Cost of Paper		18.00
SURVEY TOTAL	1313	$392.00

APPENDIX XI

SUMMARY OF FOOD CROP SURVEY

Crop	Est. Plant Count (000)	% S.E.	Est. No. of Operators	% S.E.	% Growers
Banana	256 ± 65	25.5	7,162 ± 184	2.6	80
Cassava	1,962 ± 435	22.2	4,995 ± 256	5.1	56
Dasheen	1,308 ± 239	23.1	5,641 ± 292	5.2	63
Tannia	1,052 ± 502	47.7	3,755 ± 292	7.7	42
Eddo	354 ± 88	24.9	1,707 ± 205	12.0	19
Pigeon Pea	950 ± 349	36.7	4,943 ± 269	5.4	55
Okra	68 ± 17	25.3	2,881 ± 263	9.1	33
Egg Plant	69 ± 15	22,0	2,389 ± 269	11.3	27
Beans	2,931 ± 5,510	188.0	1,050 ± 210	20.0	12
Yams	31 ± 15	50.2	1,616 ± 263	16.3	18
Tomatoes	285 ± 232	81.4	594 ± 125	21.0	7
Sugar Cane	68 ± 36	53.4	1,519 ± 192	12.6	17
Maize	1,452 ± 650	44.7	723 ± 173	23.9	8
Cucumber			591 ± 156	26.4	7
Pumpkin			1,381 ± 198	14.3	16
Sweet Potato	512 ± 169	33.0	1,353 ± 223	16.5	15
Topee Tamboo	76 ± 26	33.7	1,109 ± 156	14.1	12
Pineapple	29 ± 15	52.1	658 ± 178	27.1	7
Peppers	87 ± 82	94.8	1,932 ± 223	11.5	22
Operations,etc.					
Cutlass			6,922 ± 355	5.1	77
Forking			6,079 ± 336	5.5	68
Ploughing			954 ± 200	21.0	11
Home Consumed			7,710 ± 161	2.1	86
Casual Sales			609 ± 129	21.2	7
Marketing of Crops			634 ± 110	17.4	7
Organic Manure			3,349 ± 314	9.4	37
Artificial Manure			1,252 ± 186	14.9	14
Area	2,161 ± 258 acres	12.0			

N.B. The figures for the number of operators and their percentages were based on an estimated total of 8,983 operators in the whole survey area. 8,983 was calculated from N valuesss