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AGRICULTURAL PLANNING PROJECT  
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## 1. INTRODUCTION

This report summarizes observations, comments and recommendations of a one year consultation programme in statistical survey methods. The programme, conducted during August 27, 1981 through August 26, 1982, was a sub-project of the Agricultural Planning Project in the Jamaican Ministry of Agriculture being sponsored by USAID.

The consultation position, located in the Data Collection and Statistics Branch of the Data Bank and Evaluation Division - MA - , was an integral part of technical assistance being provided within the APP to the Ministry by the firm A. L. Nellum, Associates: Washington, D.C.

The purpose of the survey methods consultation may be seen/understood from the statement -- Scope of Work -- attached as APPENDIX I.

In reference to details and mechanics of actual project conduct, it is noted that the list of activities proposed for attention by the consultant was extensive. It covers all or near all areas of effort and types of operations that are part of a current agricultural statistical service. It is also noted that the Data Collection and Statistics Branch in 1981 had an already established programme of censuses and surveys that it was conducting. The consultant, therefore, became part of an already functioning Ministry of Agriculture statistical office.

Second, the operations of the Statistics Branch are not static nor totally routine; unforeseen requirements for specific statistical information arise because of new or changing policy concerns by the Ministry and/or problems encountered. These requirements must also be attended. In such cases, the consultant may well be requested to undertake preparation of certain material and to participate in survey training, thus, extending the consultation scope further.



Therefore, it was inevitable that the specific topics as listed in the Scope of Work would receive variable degrees of attention depending on their relative priorities and urgencies and that the consultant would function, in a sense, as an integral part of an already operational statistical organization.

The programme was a technical assistance/consultation project. The consultant maintained exchanges with the Chief and selected staff members of the Data Collection and Statistics Branch; to a lesser extent, contact was also maintained with personnel of other Branches in the Data Bank and Evaluation Division and with technical personnel of the Economic Analysis and Planning Unit of the Ministry.

The principal consultation output included direct oral and written communication. The latter included preparation of informal notes and working papers for day-to-day use in the Branch. A number of the principal working papers and documents are attached to this report; selected parts of other documents are included several places in the text below.

In a sense, the working papers, documents and reports that were prepared and used during the project are the project output and accomplishment. Therefore, a further report in one sense would seem unnecessary. In TA/C projects, however, there are cumulative observations by the consultant of the day-to-day statistical operations and the consultant's comments on organizational and technical matters that summarize particular recommendations. This report will include the latter areas of concern. Also, a brief retrospect is included in 2.b. as an introduction to a discussion of the present work, problems that exist and recommendations of steps to



be taken in the future. As the Collection and Statistics Branch was organized in 1976 and has since 1978/79 greatly expanded its roster of personnel and scope of operations, it seems particularly appropriate to review what were the requirements for initiation of a new agricultural statistical service and their status quo at this time.

In a final paragraph in the Introduction, I would like to pay tribute to the personnel of the Statistics Branch. There has been and there is capable technical leadership; and I have found most -- if not quite all -- of the staff dedicated and hard working. The staff in general respond capably to the intense attention to data collection and preparation that is required, even demanded in the present statistical system in the Ministry.

## 2. DATA COLLECTION AND STATISTICS BRANCH

### a. Summary of Present Programme

The Data Collection and Statistics Branch is the statistical reporting service office of the Ministry of Agriculture and, by extension, of Government.

The Branch was established in 1976 at the formation of the Data Bank and Evaluation Division with a nucleus staff of 20 persons. Since 1976 and particularly since 1978/79, the staff and programme of work of the Branch have been expanded in successive phases of development, trail bikes have been acquired for use of data collection personnel and particular studies of the application of census and survey methods have been initiated.



Activities of the Branch at present are both intensive and extensive and cover a wide range of recurring and special surveys and data collection operations. These include:

- quarterly estimates of acreage reaped and of production for 52 domestic crops;
- conduct of a Farmers' Register in 1982 and of periodic livestock and other special censuses and sample surveys;
- collection of farmgate and market prices;
- preparation of livestock slaughter and egg production statistics;
- collection of data regarding the adequacy of the supply of agricultural inputs including fertilizer, small farm tools, and planting materials;
- organization and publication of data from Commodity Boards and producers' associations;
- conduct of experimental crop area and production surveys based on use of area frame sample units.

A comprehensive summary list of Statistics Branch activities is included with this report as APPENDIX II.

In a final point in this paragraph, it is noted that the quarterly estimates of acreage reaped and of production are based on monthly reports for 52 crops submitted by nearly 450 Agricultural Extension Officers.

b. Brief Retrospect

The Data Collection and Statistics Branch - MA-; in its present organizational form was established in 1976; a major development has occurred since 1978/79. Therefore, it is in order at this time to inventory and review the requirements and constraints that were factors in the formation of the new statistical service as they relate to the present status of the organization and to its future development.



Among others, requirements and constraints in 1976 included:

--Limitation of financial, personnel and other resources within which the programme of work of the Branch was to be initiated and developed;

--Definition of goals and objectives and establishment of priorities of programme component parts;

--Need to establish survey methods research as early as possible, to be conducted concurrently with the developing action programmes;

--Urgency to take measures to improve the basic procedure in use everywhere possible in order that immediate improvement in the current statistical series be effected;

--Recognition at the outset that attainment of a near fully objective statistical system would take four to five years minimum, perhaps longer;

--Necessity that staff development include post-graduate training of selected staff in applied statistical survey methods;

--Danger of spreading resources too thin.

The nine points listed above are a minimum list of requirements and constraints that existed in 1976.

In reference to the 5th point, by eventually converting the statistical system of 1976 to a programme based on objective procedures, the Data Collection and Statistics Branch, as a by-product, could become a definite leader in agricultural statistical methods among the Caribbean countries and in other areas also. This will be an achievement, I hope and believe, will materialize.



In reference to goals and objectives of the new statistical service, these may be reviewed and refined at this time.

The Goal of the Statistics Branch is to advance the efficiency and quality of its operations to:

--be increasingly more able to respond to the requirements of Government for agricultural information needed for the day-to-day conduct of its business and as a basis for planning and monitoring government sponsored national regional and specialized local area agriculture and agriculture related development projects;

--more ably respond to agricultural statistical requirements of international planning and development agencies that have economic programme agreements with Jamaica;

--more adequately provide agricultural statistical information services for universities, semi-autonomous agencies, business and industrial enterprises and private research institutions.

The Objective of the Statistical Branch development is formation of an agricultural statistical reporting service to provide timely and accurate agricultural information based on use of scientific methods.

Thus far so good. In reviewing the nine points listed above, it is fair to say that the Data Collection and Statistics Branch record of achievement is notable but far from complete. Statistical development rarely is accomplished rapidly. It is easy to laud objective methods, but they are slow and ponderous to install and nearly always costly to utilize.



In addition, the matter of "objective methods" itself is relative. Rarely is an "objective method" that is found to be practical in application also objective in the complete, absolute and pure sense. For example, it is possible to designate an objective probability sample of farmers for direct interview regarding their agricultural production; or of delineated small units of land for field measure of the crops growing in the sample areas. In both cases, however, obtaining the data is rarely done with complete objectivity. Farmers may not be able to or simply may not wish to report accurately; field measurement exercises may well be done imperfectly. In reference to direct interview of agricultural operators, there are survey statisticians who have little or no confidence in data obtained in this way. Yet, this is a common procedure in use nearly everywhere and which of necessity will continue to be in use.

Regardless, it is important and urgent that the Statistics Branch now accelerate its efforts to establish greater objectivity in the statistical procedures it uses; the Branch has been and very much is aware of the urgency to do so.

It is a matter of phased development; the initial phase including staff and programme expansion and the initiation of experimental objective survey sampling has been completed. A second phase in two sub-phases 1983/84 and 1985/86 will now be devoted to more completely arrive at the Objective stated above.



### 3. STATISTICAL METHODS IN USE

#### a. Preliminary Note

The programme of censuses and surveys conducted by the Data Collection and Statistics Branch is summarized in APPENDIX II.

At present, the methods of data collection include: <sup>1/</sup>

--Monthly quantitative reporting of crop area reaped and production for nearly 450 administrative (Extension) areas;

--Quarterly reporting of average farm gate prices and of the relative adequacy of the supply of selected agricultural inputs at the Extension Area level;

--Periodic conduct of enumerative censuses and surveys, the latter based on personal interview of probability samples of farmers regarding their agricultural operations;

--Experimental field observation and physical measurement of a probability sample of small (1/2 square mile) units of land area to obtain area measurement by type of land use and by individual crops grown.

It may be seen that very different data collection methods are utilized by the Data Collection and Statistics Branch, including, the historical/traditional quantitative reporting for medium sized to large administrative areas at one extreme to the experimental system of area measurement of a probability sample of small area units at the other extreme.

Each approach is utilized to meet specific requirements for statistical information. The methods are briefly reviewed in paragraphs b. through c. below. <sup>2/</sup> In reviewing the Statistics Branch experience with each method,

<sup>1/</sup> In addition but not being considered in this paragraph, the Statistics Branch obtains and publishes data for export crops and other agricultural items that are developed by commodity boards and producers associations, and agricultural information generated by agricultural and agricultural related establishments in the course of administrative and regulatory action including livestock slaughter and egg production.

<sup>2/</sup> An exhaustive review would make this report unduly lengthy



factors in the matter of the workability of the several methods in Jamaica become evident. And as the next phase of methods development in the Statistics Branch will increasingly interrelate all of the types of data collection presently used and new methods to be designed, recommendations regarding methods in use are included in a single paragraph, Section 4.

Quantitative reporting for large and medium-sized administrative areas will be reviewed first. This method is the traditional approach to data collection that has been used by many if not most countries over the world. The method with variations, continues in use -- with efforts having been and being made to improve it -- in a number of countries today simply because it could not be replaced by totally objective methods from a cost -- and to a lesser degree from a cost effectiveness -- standpoint.

b. Quarterly Estimates of Acreage Reaped and Production

The quarterly crop acreage and production report was/is principally based on the subjective-quantitative monthly reporting by Extension Agents of acreage reaped and production for 52 crops classified as domestic crops. Reports are submitted for each of the nearly 450 Extension Areas; and Extension Area averages less than nine square miles in size.

Parish, all Jamaica and quarterly three-month totals are established for publication by summing the Extension Area monthly reports. This is immense detail: 52 crops x 14 Parishes x 4 Quarters.



In practice initially, the system of making monthly quantitative acreage and production reports included several "methods." In part, the reported information was based on personal observation in the field by the Extension Agent in the course of travel within his area of assignment and on inquiry among farmers regarding their agricultural production. In addition, the system on occasion was based on a judgment evaluation of relative change of area reaped -- crop by crop -- from a prior base: relative change from the prior month and/or from the same month in the previous year. Similarly, quarterly data were/are also examined for "reasonableness" Parish by Parish by comparison with a comparable prior base period.

These approaches had the advantage of producing a wide spectrum of crop area and production statistics in great item, area and time space detail. The system is very obviously subject, however, to the vagaries of faulty and incomplete knowledge of precise item totals on the part of the reporter and this weakness in the system was early recognized by the Statistics Branch; identification of practical remedial measures within available resources, however, was/is another matter.

The statistical system in use in the Ministry needed to be evaluated. And the indicated sequence of steps to begin to evaluate the system would have first included a comparison of published data with the results of a recently conducted agricultural census. By making such a comparison, there would have been disclosed, assuming a well done census enumeration, whether the Ministry quarterly programme was producing generally;

- acceptable acreage and production data for the 52 crops;
- acceptable data only for selected crops in selected Parishes;
- not acceptable data for almost all crops in most Parishes.



Thus, the matter of improving the current system would have been clarified and perhaps narrowed in the event the first or second alternative finding would have become evident.

As it occurred, however, the compilation of the 1978 census of agriculture, crop by crop, had not been completed and the results were not available. Therefore, the indicated initial evaluation step could not be carried out.

At the time the 1978 agricultural census results are available, that data will be a welcome source of information for use in conducting an evaluation exercise for the agricultural year 1978 in retrospect.

The Statistics Branch did take several interim measures to attempt to effect some improvement in the basically subjective quarterly crop area and production data being reported and to study relationships in the cycles of crop production and farm gate prices over time. Included there was/is conduct of:

--a detailed regularly scheduled quarterly joint review by Statistics Branch and Extension Agent personnel of the reported information;

--a parallel small scale data gathering operation by Branch Data Collection Officers for selected important crops as a basis for essentially independent check date;

--intensive checking of reported data with data reported for prior base periods by head office statisticians as a mechanism to flag possible erroneous reporting;

--studies of the cycles of crop production and of farm gate prices to note whether significant statistical relationships between the two series exist.



In addition, the Statistics Branch initiated planning and preparation for the conduct of a Farmers' Register as a census level enumeration. The Farmers' Register was field conducted in August/September 1982. The initial results will be available in January 1983.

The beneficial effect of the several interim measures taken is not know. It is a fact that the collective procedures being utilized are sufficiently non-objective, rather non-scientific, in a pure statistical methods technical sense that any "feel" for the matter must await more definitive confirmation.

It is noted, however, that given the item, area and time space detail for which crop area and production estimates are being made and the notably higher costs required to convert the system to a statistically objective procedure, it is not visualized that there can be an early end to the present intercensal system. The consultant, therefore, attaches particular importance to the conduct of an evaluation of the system as described in Section 4.

A copy of the quarterly reporting form is attached to this report as APPENDIX III; a copy of all Jamaica estimates for domestic crop area reaped and of production, 1970 through 1980 as APPENDIX IV.

c. Quarterly Reporting Farm Gate Prices

Average farm gate prices for agricultural commodities as found prevailing in the market place, and as reported by a "cross section" of producers are also reported by Data Collection Officers on the several geographic levels. Averages of farm gate prices for all Jamaica and for Parishes are published and/or available at the Head Office.



As in the case of the quarterly crop area and production reporting, the procedure utilized cannot be described as statistically objective in every sense. In an area limited in size, however, there is generally only modest variation in price range. Therefore, the farm gate price data may be expected to be superior to the crop area and production estimates.

d. Enumerative Censuses and Sample Surveys

(1) Farmers' Register

A Farmers' Register as a census level enumeration was conducted during August/September, 1982.

The field conduct of the Register followed traditional census procedures. A trained enumeration staff completed a listing on a farm listing form and filled out the Farmers' Register questionnaire in a single visit. More than 150,000 farm units were contacted and interviewed regarding their agricultural operations following traditional census enumerative procedures.

It is noted that one of the features of the enumeration process was use of a questionnaire format designed for rapid processing of the data.

Subject to verifications of the census results by a postcensus quality check, I would nevertheless like to commend the Data Collection and Statistics Branch at this time, for the expeditious manner in which the Register was completed.



(2) Other Censuses

The Statistics Branch has conducted, and conducts, special censuses of hog producers, cattle farmers, etc. The procedures follow, as in the case of the Register, traditional census enumerative procedures; the single difference is each special census usually covers only a single specialized subset of the agricultural operations in Jamaica.

(3) Sample Surveys

The Data Collection and Statistics Branch is directed to conduct ad hoc sample surveys on occasion. The procedures followed have generally first established a list of households and/or agricultural operations as a sampling frame followed by the selection of a probability sample of agricultural producing units for personal interview. The Special Banana Farmers' Survey conducted in 1982 in five specially designated areas in Jamaica is an example of this type of survey operation.

e. Area Frame Sample Survey

In 1978, the Data Bank and Evaluation Division initiated use of an Area Frame Sample in a Survey titled Crop Production Survey.

The area frame survey is to be distinguished from the Quarterly Crop Area and Production Estimates which are based on quantitative reporting for administrative (Extension) areas. The Quarterly Estimate Survey is considered briefly in Sections 3.b. and 4. in this report.

Details of the Area Frame Survey design, stratification, preparation of the area sample and results of two of the surveys that have been conducted are given in two documents attached to this report as

APPENDIX V and APPENDIX VI.



These documents are:

-- APPENDIX V

Survey of Crop Production in Jamaica

Roy Russel, Jamaican Ministry of Agriculture and  
Harold F. Huddlesons, U.S. Department of Agriculture

-- APPENDIX VI

Results of First Full Scale Area Sampling Frame Survey in Jamaica

Ashok K. Sahney, Jamaican Ministry of Agriculture and  
William H. Wigton, U.S. Department of Agriculture

The two publications, which are complementary reports, describe in detail the Area Frame sampling experiences in Jamaica thus far; comments included here, therefore, will be limited to selected observations in reference to area frame sampling in agriculture in general.

It is first noted that an area frame sample adequate in every detail to produce estimates of selected agricultural items at required levels of accuracy:

--will have required several or more years to develop;

--once constructed is automatically up-to-date at every point in time;

--should be useful, as long as there are no major shifts in the composition and geographical distribution of agricultural production over the country, for 15 to 25 years minimum;

--will not work well for particular scarcity items such as a product grown by a very limited number of farmers scattered over the country. List sampling likewise does not work well in these cases.



In reference to the actual construction or delineation of an area frame, there are two alternative approaches: whether to delineate defined land use areas and then delineate frame units within the land-use areas; or, whether to delineate frame units without regard to land use and then assemble information about the frame units for sampling purposes.

Each alternative has advantages and disadvantages but both alternatives, to be satisfactory, require substantial amounts of field work in addition to aerial photography and maps.

In reference to Jamaica, area frame consideration must take into account that multiple cropping, mixed cropping and inter-planting, and multiple cycles of planting, growing and reaping within a year are the agricultural modus operandi over much of the country. This would almost certainly dictate making a land use classification first as was done as part of the preparations for the present area frame sample.

In addition at this time, it must also be noted that as part of several agricultural development projects, substantial tracts of land are being designated for concentrated development of specialty crops and that other sections of Jamaica are beginning to undergo changes in the type of agriculture being practiced. These changes will add a dimension of land use classification complexity that will have to be taken into account in future modification of the area frame.

In a brief review of the area frame survey experiences in the Ministry of Agriculture, it is noted:



--the area frame stratification that was applied (within each Parish) has worked well in countries and areas with relatively uncomplicated agriculture and having a limited number, such as two to four or five, principal crops grown;

--the coefficients of variation in the Jamaica survey are satisfactory at the national level for a number of items-characteristics including agricultural labor;

--the coefficients of variation for no crop acreage reaped or crop production items are satisfactory even at the national level;

There would be little doubt but what the area frame beginning in the Ministry is very much on the right track and the Data Bank and Evaluation Division is to be highly commended for the development work done to date. The experiences thus far illustrate, however, that the construction of an adequate -- in the sense of coefficients of variation -- and durable -- in the sense of over time -- area frame may well take several years more to accomplish.

At this time, an initial step might be application and use of multiple frames to estimate all agricultural items. With the completion of the Farmers' Register early in 1983, it will be possible to initiate experimentation with a multiple frame procedure -- large farms and/or specialty items and areas to be sampled from the Farmers' Register as a list frame and all remaining items surveyed via the area frame. There are several variations to this approach also that may be examined.

Second, a series of studies of the present frame may be undertaken using the results of the 1978 Agricultural Census and of the 1982 Farmers' Register.

Third, availability of more recent and more adequate -- for land use stratification and sampling purposes -- aerial photography and/or satellite imagery for use in constructing a new area frame from scratch should be explored.



Additional comments are included in Section 4.

#### 4. STATISTICAL METHODS RECOMMENDATIONS

The work of the Data Collection and Statistics Branch to date has concentrated on conducting the expanding programme of censuses and surveys shown in the list of activities given in Section 2.a. above.

As it has occurred, little time and resources have been available to undertake basic methods research and study to date. Basic methods research and study are extremely important to a statistical service in development.

At this time, vast data resources are becoming available to initiate a study of methods in use and for search of alternative methods and procedures. A series of quality and coverage checks of particular censuses and surveys are proposed in addition to analytical work to be done in the Head Office. It is also proposed that a section within the Branch be established as early as possible to supervise and conduct the methods research and study.

It may not be possible to undertake all proposed studies; variable priorities can of course be assigned different tasks.

The proposed list of tasks takes as given:

- high expectation that the Farmers' Register results will be of major benefit and use to the actual current statistical work and in delineating future improvements;
- continued dependence on the Quarterly Crop Area and Production Survey based on quantitative reporting for administrative areas as a basis for estimates of the 52 domestic crops by Parish;
- continued conduct of special enumerative censuses and surveys using traditional enumerative survey procedures;
- initiation of an evaluation of the Area Frame Sample Survey approach;
- expectation that the detailed results of the 1978 Census of Agriculture will be available to the Data Collection and Statistics Branch in early 1983;
- expectation that the detailed results of the 1982 Farmers' Register will be available in early 1983

The suggestions in Section 4. are given for consideration. A number of these have been part of the Branch thinking in the past; other suggestions have been jointly considered by the consultant together with Branch colleagues; particular suggestions are given for the first time; and others considered unduly impractical at the moment have not been included.

Regardless, each suggestion must be considered in respect to physical and personnel resources and to other resource conditions that exist. Several recommendations may be impractical at the moment; all, however, will be found necessary in order to develop the Data Collection and Statistics Branch as a fully viable agricultural statistical service office of government.

a. Farmers' Register

(1) Quality and Coverage Check Survey

It is taken as given here that the Farmers' Register is/will be the principal information resource to evaluate and to aid in turn the current agricultural statistical work in the immediate future; in addition, it will (be expected to) contribute to an evaluation of the Area Frame Sample.

It is noted that the Register was conducted under time pressure constraints, that the Register was the first such census level enumeration conducted by the Ministry and that undetected problems invariably occur in census operations.



Two additional points are noted:

--The major aid the Register will contribute to the on-going quarterly crop area and production survey will be in the form of accurate base acreage figures for domestic crops by subgroups and for individual export crops, and of inventory numbers for individual kinds of livestock -- for 1982;

--The Farmers' Register results themselves, for selected items, will come under heavy scrutiny by doubting and unconvinced users and via comparisons with other available data.

Therefore, it is extremely important that a measure of the completeness and quality of the Register enumeration be obtained in order to verify the level of its quality and to refute potential claims of "its being inadequate."

Given the above reasons collectively, it is recommended that a rigorous evaluation of the Farmers' Register field enumeration be made.

The following quality and coverage checks are proposed for consideration:

--Conduct of a farm by farm comparison of every item included in the Register's dual enumerations, pilot test in June/July vs. Farmers' Register in August, for the nearly 3,000 agricultural operations with 25 total acres or more;

--Conduct of a post-census enumeration quality and coverage check of a probability sample of areas.

(a) In the First recommendation, the questionnaires for the dual enumerations are with the Head Office. Therefore, the task is to organize a matching of pilot test with Register questionnaires.

Warning. There can be considerable vagary in matching questionnaires from independent enumerations of the same universe. Regardless, as the name of the farm operator, the address of the farm and additional identification information exist on the questionnaires, one would expect that questionable cases of matching should be few. It is proposed that the first principal matching pass be done by computer; questionable cases of matching will require a personal examination.



At the conclusion of the matching operation, the following counts will be known:

- Number of satisfactorily matched cases;
- Number of questionably matched cases;
- Number of cases found in the pretest but not in the Register;
- Number of cases found in the Register but not in the pretest.

If the latter two categories of cases are negligible in number, they may be ignored unless the size of farm, in either case, is very large. After resolution of any "large farm" matching problems, direct comparison of the totals for each Register item should be made at the Parish level. Modest differences of less than five percent may be accepted; differences of five percent or more merit further exploration and study.

If, however, the number of cases in one or other or both of the last two categories is 10 to 15 or more, all such cases should be field verified and particularly of farms found in the pretest but not in the Register. In view of the fact that farms with 25 acres and over account for a large proportion of the total land in farms in Jamaica, the importance of careful examinations of this stratum is obvious. Therefore, matched cases that are divergent in one or more principal crops and/or livestock items beyond ten percent that cannot be explained by difference in time of enumeration periods, or for whatever reason, should also be rechecked in the field in order to explain and understand reasons for the differences. Doing this will aid in a priori reducing such enumeration problems in future surveys and censuses.



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(b) In the second recommendation, it is proposed for consideration that a sample of 40 Farmers' Register Enumeration Areas be selected with probability proportionate to size in terms of the 1982 Register farm counts as a post-census evaluation area sample. In order to delineate a manageable quality and coverage enumeration check, it is recommended that:

- each selected EA be geographically subdivided into eight sub-EA's;
- one sub-EA be selected at random in each sampled EA;
- the sampled sub-EA's be recanvassed thoroughly and all farms listed and reenumerated.

The expected size of sample is approximately 2,000 farms. It is mentioned here that the proposed recheck is not as large as required considering the importance of having a precision measure of the quality of the Register. Nevertheless, if completed thoroughly, it will provide a useful indication of the degree of quality and completeness of the Register field work at the all Jamaica level. It will also provide guidelines for further quality check operations that should be done. Processing of the post-Register canvass and enumeration will involve a search in the Register and the matching of Register reported information and post-Register obtained data. The usual vagaries in matching will exist.

#### ALTERNATIVE

As an alternative to the proposed recheck operation as given above, it is coextensively proposed for consideration that the 438 Area Frame Segments be recanvassed and that all farms having all or a part of their operations within the segments be listed; that all farm operators with "head-quarters" within the segments be reinterviewed--open segment approach--about their entire agricultural operations following procedures used in the Register.



Data processing will involve search in the Registry and matching with the component of vagary in the matching operation as described above.

It would seem that the second alternative is more attractive and practical for immediate attention. The area segments are already defined and delineated on maps; second, the matching of quality check survey questionnaires with Register questionnaires will identify the farms in the Register that are associated -- via headquarters rule -- with the Area Frame Segments, and that the information from the parallel enumerations will be resource information for use in evaluation of the Area Frame.

In reference to headquarters definition, the traditional and simple rule is as follows:

- if the farm operator lives on the land he operates, he is included in the sample if his residence is in the sample area;
- if the farm operator does not live on his land but maintains a hut or other provisional living accomodation on the land, the operator is included in the sample if the hut or provisional residence is located in the sample area;

Additional objective and unique rules for "associating" a farm operation with a sample area can be devised for cases other than those given above.



In summary, the purpose of the quality check survey work and analysis is to determine if the Farmers' Register results are of an accuracy necessary to establish base acreage data by Parish for individual domestic crop subgroups.

If the results are found "satisfactory" for principal selected items, good. If the results, however, find an error in the Register enumeration for one item or more than one item, it may be necessary to formulate a procedure to "adjust" the Register results. The determination of what might best be done regarding establishment of base acreage data --at least at the all Jamaica level -- can only be done with information such as the two post-census evaluation checks proposed above can produce.

(2) Maintaining the Farmers' Register Up-to-Date

At this point the plot somewhat thickens.

The Farmers' Register was conceived as an information resource with multiple uses. It will aid the Ministry to maintain necessary administrative and regulatory action in connection with the Ministry's agricultural development, credit, support, transition, et al., projects -- as one of the Registers' principal functions.



The Register was coextensively conceived as a major source of information to establish acreage base data by Parish and by Extension Area for 52 domestic crops for which quarterly estimates are being made; also, to establish acreage base data for crops classified as export crops and for livestock numbers by kind -- in the same geographical detail.

Third, the Farmers' Register will be very much directly and indirectly involved in the further development and modification of the Area Frame. Apart from contributing to an evaluation of the present Area Frame, the Farmers' Register will -- at a minimum -- be the major resource of crop area information at all geographic levels of Jamaica <sup>3/</sup> until such time as the Area Frame Sample will function as a near fully statistically objective procedure for estimating area planted and reaped by individual crop -- and the latter almost certainly, only at the all Jamaica level.

Given the three points indicated above, namely the cumulative need and use of the Farmers' Register, it would seem there is a strong justification for maintaining the Register up-to-date each year.

In this regard, there are several points to consider:

- which office in the Ministry will be responsible for maintaining the Register up-to-date;
- what are the Ministry requirements of the Register for its administrative and regulatory action;
- what are the needs of the Data Collection and Statistics Branch of the Register for advancing the current agricultural statistical work of the Ministry.

3/ in a census or enumerative survey sense, the quarterly quantitative estimates of crop area and production will, of course, continue to be made.



In reference to the first and second points, if it is the decision of the Ministry to maintain continuous attention to the matter of up-dating the Register, a registry function, similar to population registration in northern European countries, could be established in each Parish. The designated Registrar could be an Agricultural Extension Agent at the Parish level or the Senior Data Collection Officer. In this procedure, as visualized, there would only be the registration of newly established agricultural operations and of operations that have changed in size and/or composition. It would depend on voluntary registration by farm operators which in turn requires a disciplined and cooperative attitude.

Regardless of the decision re: such a registry operation, I would like to propose an alternative for consideration that will adequately attend the needs of the Data Collection and Statistics Branch for up-date Farmers' Register data.

The Statistics Branch is entering its next phase of development which will be accomplished during four to five years. I would like to propose for consideration, therefore, that during each of the next five years a probability sample of 20 percent of the Extension Areas be recanvassed and all farm operations within sample EA's be enumerated.

Given such a sample Farmers' Register operation annually, the Data Collection and Statistics Branch will do/have the following:

--completion of an evaluation of the 1982 Farmers' Register via conduct of the two post-Register quality check surveys and operations proposed in 4.a.(1) above.

--adjustment of the Farmers' Register results, if found necessary, to establish definitive base crop acreage statistics for 1982, for each Parish, and for each crop, or subgroup of crops;



--establishment during five years of 1983, 1984, 1985, 1986, 1987 base crop acreage statistics via ratio estimates utilizing the results of the 20 percent probability sample enumerated each years (a quality and coverage check of each 20 percent sample enumeration is to be automatically part of the annual procedure) and the previous years base acreage as a simple ratio method of estimation. There are additional, more complex, estimation procedures that could and should be examined in the search for a "best" method. The above, however, can be the initial step taken.

It may be noted that given success with the above proposed Farmers' Register activity and steady parallel progress in establishing the geographical level and identification of crops for which an objective Area Frame sample can effectively be utilized, considering cost effectiveness, an increasingly more objective agricultural statistical service operation will be devised. This is 1982; a five-year period to conduct the proposed survey work plus the necessary Area Frame research is not excessive. But who knows, there could be remarkably more advanced aerial photography and satellite imagery available earlier which would speed up and simplify resolution of the Area Frame greatly.

In reference to Register content and questionnaire format for the annual 20 percent sample enumerations, the continued use of a questionnaire format that will permit rapid processing of the data is in order. A question is raised, however, whether domestic crops should better be reported by each individual crop rather than in major subgroups as was done in the 1982 Register. I believe they should be. Completion of the 1982 Register tabulations and study of the results by the domestic crops subgroups used together with comparable data from the 1982 Quarterly Crop Area and Production may aid to clarify this question.



(3) Resource Assessment Project Output

There has been little consideration and exploration of the possible utilization of the Resource Assessment Project output as resource information to aid the work of the Statistics Branch. The Resource Assessment Project data and maps should be examined and studied; there may be a gold mine of assistance for the Statistics Branch in that information.

In fact, the effective development of statistical reporting services nearly everywhere has benefitted from and been a by-product of information produced for other reasons.

b. Quarterly Crop Area and Production Estimates

Suggestions for consideration of steps to be taken in reference to the Quarterly Report of Crop Area and Production Estimates are included later in this paragraph. The suggestions are not innovative; rather they represent a listing of studies and measures that can be taken as the census level, 1978 and 1981 results become available. The studies proposed represent substantial clerical work. Therefore, it is coextensively proposed that ADP equipment be utilized to the maximum.

In reference to the Quarterly Report, given the present schedule of the quarterly publication and release of estimates of crop area and production for 52 domestic crops, it is inconceivable that the system in use can be abandoned in the near future or even modified to a major degree.

The system, quantitative reporting for administrative areas, has been the work horse in the preparation of current statistics of crop area and production in numerous countries and it remains so today in a number of places.

The procedure being followed in Jamaica is briefly described in

Briefly in review, the major problem with the system in Jamaica, as elsewhere, is that there are few or no current qualitative measures of how accurate, or how inaccurate, the estimates are, in fact. Hence, there are claims of reasonable to great accuracy on the one part and accusations of colossal inaccuracy on the other.

The standard procedure nearly everywhere this system has been used, involved directives being issued by government to Agricultural Extension Agents to report the crop and livestock items for his assigned area quantitatively. And thus, he has done so; mostly without transport or other help provided.

As the Extension Agent in the course of his work was supposed to be acquainted with the farmers and the agriculture in his area, he was expected to have detailed knowledge of what -- quantitatively -- was being planted and what was being reaped -- crop by crop. It was rather asking a lot of the Agents in countries where the Extension Area was/is very large covering vast stretches of land. In Jamaica, however, where the Extension Area averages less than nine square miles in size, it would seem the Agent could know his area relatively thoroughly. On the other hand, the tropical agriculture of Jamaica, -- with extensive multiple cropping, mixed and inter-planting and continual cycle of planting, growing and reaping that exists, -- complicates statistical reporting immensely.

What have been some experiences? Actually, this subjective reporting system has been studied in a number of places. The findings are surprising and revealing and in a variety of details conjectural. But the system has survived, in large part of necessity as implementation of alternative objective systems functioned too slowly and they were relatively much more costly.

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It is also noted, however, that over the years statistical reporting services have taken measure to convert the subjective reporting to at least a partially objective system by the use of small probability samples of farm operators for interview and/or area units for observation.

Regardless, it is proposed in the preceding section in this report that the Statistics Branch conduct quality check surveys and studies of the results of the Farmers' Register in order to establish 1982 base crop area figures by sub-groups of domestic crops. This is a specific measure to inventory the quarterly data produced and to make adjustments and revisions in the area and production estimates if found necessary.

Therefore, in reference to the Quarterly Crop Area and Production Survey, the following measures are proposed for consideration.

--Conduct of detailed comparisons and tests of the 1978 quarterly survey estimates with the results of the 1978 Census of Agriculture (the data must be for comparable periods of time);

--Conduct of detailed comparisons and tests of the 1982 quarterly survey results with the results of the 1982 Farmers' Register -- with revised Register results based on the post-Register quality checks, if possible;

--Revision of the 1982 quarterly survey estimates per the Register results to establish revised 1982 base figures;

--Study of the possibility to revise the quarterly survey estimates for the years 1978 through 1981 based on an inter-period interpolation of the 1978 census and 1982 Register results;

--Continuation of the intensive quarterly review of reported data presently being conducted;

--Initiate use of small probability samples of 15 to 20 farm operators per Extension Area for interview re: their agricultural operations plus direct interview of all farm operations classed as large in the area.



As indicated above, the proposed programme of work will require extensive data processing and clerical operations. Nevertheless, if the indicated steps can be accomplished, the matter of "putting the quarterly estimate of crop acreage in order" should materialize.

c. Other Enumerative Censuses and Surveys

The Data Collection and Statistics Branch has conducted a number of enumerative censuses and surveys; traditional survey methods including probability sampling of agricultural operations have been utilized. In the observation of the consultant, the Statistics Branch is to be highly commended for its planning and conduct of these surveys.

There would be a point in reference to questionnaire format that will be made here although it relates to the conduct of all survey approaches utilized by the Statistics Branch.

In census and sample survey enumeration, there are basic principals in reference to questionnaire format and the conduct of interview that are taken for granted. Obviously adaptation and modification of these principals are required on occasion in order to be practical.

The goal in statistical census/survey work is uniformity of published information. And to obtain uniformity of published information, there are prerequisites which will be listed in reverse order as follows:

Goal: Uniformity of published statistical information.

Prerequisites: Uniformity of

-- respondent understanding of the statistical information being requested;

-- enumerator presentation of the information to be requested;



-- enumerator acquisition of understanding during training of the information to be requested;

-- trainer (training) presentation of what information is to be requested;

--survey reference manual language re: the information to be requested;

--survey questionnaire wording.

The above sequence summarized the common and well known chain sequence of events in the "business" of statistical survey conduct.

Given the above sequence, the most indicated questionnaire format, in general, will include preprinted brief pertinent instructions for the constant attention of the enumerator and preprinted questions to be put to the respondent by the enumerator; in wording, hopefully, that most accurately defines and describes the information wanted.

And, thus, begins the circle: Given survey question wording will invariably be understood at variance from respondent to respondent and, for that matter, from enumerator to enumerator in spite of careful training. Therefore, a new dimension -- probing -- enters the interview process. The necessity of probing in turn reinforces the urgency for standard questionnaire wording to permit that probing have a common standard to which all survey interpretation during interview relate.

It may be worth noting that the number of points through which "purpose of survey" and "information wanted" is passed on is never less than five and may on occasion be as many as ten. Therefore, it has to be remarkable if the intention of the survey at its inception survives through the data collection process intact.



Accepting the importance of standardized questionnaire wording for use by enumerators, the preferred solution is preprinted question wording as part of the questionnaire format. The questionnaire used in the Special Banana Farmers' Survey and questionnaires used by the Evaluation Branch of the Data Bank Division and by the Marketing Division are example of such questionnaires.

There are cases, however, when survey questions may be lengthy and involved such that they would occupy a large part of the questionnaire. In such cases, the standardized wording is equally, even more, important and a special enumerators' reference manual should be prepared. The special enumerators' reference manual for the Food and Beverage Consumption Survey is an example of this approach.

In summary, it is suggested that the Statistics Branch, as part of its increasingly diversified development, also adopt reporting forms that include brief pertinent instructions to the enumerator and preprinted question wording on the questionnaires -- except in repetitive, routine surveys that are conducted frequently.

Further, it is also noted that questionnaire pretest operations may benefit the survey by including the testing of alternative wording of survey inquires in order to identify a wording that most satisfactorily obtains the required information.



d. Area Frame Survey

The Area Frame Survey in Jamaica was briefly reviewed in Section 3.e. above.

It was noted in that paragraph that the coefficients of variation found in the last Crop Production Area Survey conducted by the Statistics Branch are satisfactory at the All Jamaica level for a limited number of characteristics including agricultural labour. It was also noted that coefficients of variation for individual crop acreage items are not really satisfactory -- for any purpose -- even at the All Jamaica level.

Nevertheless, the experiences in Jamaica thus far are positive and additional effort should be expended in order to identify measures that when in effect will establish a viable Area Frame Survey system. A viable system can always be devised; its cost and the cost of its utilization as an established system, however, can be a deterrent to adoption.

It is first proposed that the goal of the Area Frame development in four years should be coefficients of variation of principal crop acreage and of livestock inventory items at the All Jamaica level of 0.03 to 0.05; that maybe, of course, overly ambitious.

Briefly, the Area Frame Survey approach has much "going-for-it." In relatively stable agricultural production configurations over time and where there are few principal crops, an Area Frame once established can remain in use -- given the goals re: coefficients of variation for principal items -- for 15-20, even more, years.

In addition, as an Area Frame sample is always automatically up-to-date, the tedious and almost always imperfectly done chore of maintaining a list frame of agricultural operators up-dated -- the principal alternative approach to area sampling -- can be eliminated. List frame update may well be require annually.

It must be recognized that preparation of an Area Frame and selection of an area sample at the beginning is time consuming and requires a major investment if it is to be well done. The expenditure of these vast resources, however, if successful, can be amortized during the 15-20, even 25, years the Frame continues in use.

A discussion of Area Frame preparation may be found in a number of publications, e.g., Area Frame Sampling in Agriculture by Earl E. Houseman; Publication SRS No. 20 of the Statistical Reporting Service, U.S. Department of Agriculture.

In reference to the most recent Area Frame experiences of the Statistics Branch in the interest of delineating a programme of Area Frame review, it may be conjectured that:

- Land in farms, All Jamaica level, will be satisfactorily estimated;
- Individual crop area items included in the survey are not highly correlated with total land in farms, hence, the high CV's found;
- The land use classification/stratification as originally done was not adequately correct, detailed or fine for crop acreage items;
- The sample size of 438 area segments is too small given the land classifications adopted;
- Utilization of multiple, list and area, frames can probably effect a marked reduction in CV's for particular crops concentrated in a limited number of areas and/or grown by a limited number of agricultural operators;
- Utilization of multiple frames will likely effect only a modest reduction in CV's for other crops;
- A slight modification in the present sample by subdividing the area segments into two near equal halves and increasing the sample size to nearly 1,000 area units could reduce the CV's by a factor of approximately the  $\sqrt{2}$  -- assuming no major change in the between segment variation.
- The high crop acreage CV's may be due principally to the complexity of agriculture in Jamaica, as mentioned several places above.

--It may be found necessary to obtain more recent aerial photography and/or more adequate -- for stratification and sampling purposes -- satellite imagery and simply do a new land use classification.

Regardless of all of the above, the good news is that at this time, it is becoming possible to delineate definitive studies of the Area Frame experiences. These studies could include in part -- and to the extent found practical to do within existing Branch resources:

- Search for and identification of farms in the 1978 Census of Agriculture that are "associated" with the Area Frame Segments by both the open and closed segment definitions 1/;
- Calculation of simple unbiased estimates for principal of items of census totals from the census data for farms "associated" with the sample areas using reciprocals of the area segments probabilities of selection as raising factors;
- Calculation of ratio-raising factors from the census totals --for principal items -- and the "census sample data" to determine whether such ratio estimating factors could be used to improve the simple unbiased estimates -- from the Area Frame sample data for intercensal years;
- Attempt to directly match 1978 Census of Agriculture reports with reported data for the same farms from the October 1979 Area Frame Enumeration 2/;
- Search for and identification of agricultural operations in the 1982 Farmers' Register that are "associated" -- open and closed segment definitions, as in the first task listed above,--and calculation of the estimate and the raising factor described in the second and third points 3/ (A by-product of the two exercises suggested above will be at least a partial review of the adequacy of the land use classification as originally done for survey stratification.)

1/ There may be that matters of confidentiality of the 1978 Census of Agriculture returns would prevent such an operation from being done. As the 1978 Census enumeration is more than five years old, it would seem such a restriction should be reviewed in order to determine whether a waiver of the restriction could be granted in the interests of the Area Frame study. It will also depend on present availability and physical condition of the census returns

2/ This could be a useful exercise even if not all farm operations can be found to match.

3/ This search and match operation was proposed in connection with the Farmers' Register post-census evaluation survey.

- Experiment with multiple-list and area-frames utilizing the development work for this approach already done by the U.S. Department of Agriculture;
- Conduct a new Area Frame canvass with a larger and slightly modified sample of approximately 1,000 sample area segments of 1/4 square mile average size;
- Explore the availability of more recent and more adequate aerial photography and/or satellite imagery for use in making a new land use classification.

Frankly, the several studies suggested above are pure drugery but such is the life of methods study; and it may not be possible to do the proposed exercise in connection with the 1978 Census of Agriculture in any case. The conduct of that exercise, however, should be done, if possible, as together with the results of a comparable exercise done in connection with the 1982 Farmers' Register, an opportunity will exist to verify whether consistency, partial consistency or total inconsistency of the two census level enumerations in relation to the Area Frame Survey results exists.

If a high degree of consistency is found to exist in the two cases, use of a calculated "ratio type of estimating factor," mentioned in the third and fifth points above, to improve the Area Frame simple unbiased estimates should be studied further for possible use in connection with the Area Frame in intercensal years.

Regardless of what may materialize in connection with the 1978 Census, it is important that the proposed "search and match" exercise of the 1982 Farmers' Register agricultural operations "associated with the area segments be done:

- For use in the post census study of the quality and completeness of the Farmers' Register;
- For use in the study of the Area Frame.

Experimentation with the use of multiple frames will be possible with the completion of the Farmers' Register and should assuredly be done.

In reference to the proposed Area Frame canvass for a modified sample of 1,000 area segments of 1/4 square mile average size, it is noted that the total land area in the sample will remain about the same. Hence, with the new area sample once designated, the field canvass operation will require only a relatively slight increase in enumerator man hours to complete; and there is the chance to reduce the CU's by a factor of approximately the  $\sqrt{2}$ .

And after nearly all is done and said, it could materialize that making a new land use classification -- utilizing recent aerial photography, information from the Resource Assessment Project and a more thorough on-the-ground land use verification than was done for the present Area Frame -- will be found to be the most indicated solution and necessary, later if not sooner.

Therefore, regardless of the conduct of the various studies suggested above, I believe the Data Collection and Statistics Branch should proceed coextensively with those studies to complete a new land use classification in the two Parishes considered to be the most important agriculturally.

In reference to area detail for which Area Frame estimates may be made, the initial goal with a new area sample should be estimates of principal items at the All Jamaica geographic level. Additional detail will be a matter of costs and cost effectiveness compared with surveys based on sampling from the Farmers' Register as a list frame.



## 5. ORGANIZATION

### a. Review

In reference to the establishment of the new statistical reporting service in the Ministry, the Data Collection and Statistics Branch, organization separation of functions within the service were initially not easily possible. The existing few personnel had to undertake everything. As the organization increased staff, expanded its programme of work and was given new responsibilities, it became necessary to create some specialization of the work in order that the service function increasingly more efficiently.

Thus, stated as such or not, the Statistics Branch organization basically already includes:

- Central Direction and Management;
- Central programme and development staff;
- Central operations staff;
- Cartography and Mapping;
- Data Collection Officers and personnel;
- Data processing and publication staff;
- Analysis, methods and operations research.

And it can be said that the above separation of functions has been gradually emerging in the Statistics Branch.

In further review in the matter of organization, it is also noted that in addition to the statistical operations conducted by the Statistics Branch, statistical surveys are also prepared and conducted by the Evaluation Branch of the Data Bank Division, by several sections in the Marketing Division, by the Economic Policy and Planning Division, etc.



Therefore, attention is drawn here to the fact that the Statistics Branch has several units that are in fact common service units in any statistical office. These include: Cartography and Mapping; Data Collection; Data Processing; Methods and Operations Research.

b. Inter-Ministerial Coordination

There is no formal Inter-Ministerial coordination of the Ministry's various statistical operations; there is, of course, a "degree" of informal "coordination" and cooperation among the personnel of the several branches and united conducting surveys.

c. Recommendations

Two recommendations are given for consideration:

- The Data Collection and Statistics Branch should further accentuate its division of functions in order to establish increasingly more specialized personnel for its various operations and should plan to establish, at the earliest, a Statistical Methods and Standards Section to do methods research and studies;
- The Data Bank and Evaluation Division should develop a plan for the creation of a formal coordination of all statistical operations in the Ministry.

It is proposed that the Data Bank and Evaluation Division be designated as the Coordinator. Given this development, the Data Bank Division and the Statistics Branch can gradually standardize the statistical work of the Ministry and increase the efficient use of the common service units such as data collection and statistical methods and standards.



## 6. DATA PROCESSING (Methods Research)

It is urgently proposed for consideration that expansion and updating of the physical facilities, equipment and personnel of the Data Processing Branch of the Data Bank Division include provision for greatly increased methods research and studies by the Statistics Branch.

The need for data processing for methods research can be seen from the proposals given in Section 4. above. And as the initiation of specific research makes evident the need for additional studies, the need for ADP support is even greater than that indicated in this report.

It is necessary for the Statistics Branch to carefully identify and quantify its need for ADP services for its upcoming research programmes in addition to the need for normal regularly scheduled and survey data processing.

## 7. TRAINING

The initiation of new statistical programmes has implications of personnel training and job orientation. New skills have to be acquired by employees working at different levels and in different jobs. Training programmes, refresher courses and job orientation will need to be established accordingly. The need for basic training is not limited to new programmes. Existing and on-going programmes being modernized and extended for greater utility also require basic training and refresher courses to improve employee skills and to effect a continuing improvement in the quality of the



work being accomplished. Training requirements include administrative and executive training at different levels, advanced technical training in mathematics and statistical methods, special training in routine office operations, training in field supervisions and enumeration techniques, in data edit and preparation and in many other aspects of the work.

In several areas of training, the Data Collection and Statistics Branch has excellent active programmes:

--Data collection personnel and staff are trained in the details of each enumerative census and survey conducted; periodic, regularly scheduled refresher courses for all staff concerned with the Quarterly Crop Area and Production Survey based on quantitative reporting are held;

--Selected personnel from the Head Office and from the data collection staff have attended specialized courses at the University of the West Indies.

Comments and suggestions for consideration are given below separately for data collection and for academic training.

## RECOMMENDATIONS

### a. Data Collection Training

To date, training of field staff has been conducted only by a very limited number of senior staff of the Statistics Branch; and, it has been of high quality -- as far as it could be done.



Preparation for and the organization of the actual training, however, could benefit from some modification.

Several training deficiencies are noted:

- The size of individual groups of Statistics Branch data collection personnel and of temporary staff employed for census and special survey enumerations are far too large for a trainer to be able to do effective training;
- Materials including reference manuals, questionnaires, other survey forms and maps are taken to the training site in bulk and distributed in a less than orderly fashion;
- A number of one-day training sessions in fact required at least a second day to be done well.

In reference to the first and third points, the following comments and suggestions below are offered for consideration:

It is taken as given that budget constraints will continue to dictate single day training sessions. The problem, however, can be overcome in part by establishing training groups of maximum 20 persons for all except census level training programmes. A group of 10 to 20 trainees is relatively manageable as compared to groups of 40 - 90 persons.

Therefore, it is recommended for consideration that the Statistics Branch prepare more of its Head Office and Senior Data Collection Staff to serve as trainers. In addition, the Statistics Branch should request the participation of selected staff of the Evaluation Branch to aid in conducting training. For example, the Head of the Evaluation Branch in the Data Bank is an excellent training person.



Through increase in the number of trainer personnel, the groups being trained can be reduced in size which in turn will permit higher quality of training being done.

In reference to the second point, the manner in which the materials are distributed at Training Centers consumes greater quantities of materials than necessary and almost always sets of an air of mixed confusion and levity.

Therefore, it is proposed that Enumerator Kits be prepared in the Head Office in advance and distributed at the training site as the first item on the training schedule. Such kits should consist of an envelope with the Enumerator's Name and identification of enumeration area of assignment entered on the outside and contain the following:

- Identification Card (if required);
- Enumerators' Reference Manual;
- Copies of questionnaires and/or other reporting forms;
- Copies of administrative and other required forms;
- Copies of maps;
- Pencils and other materials.

In reference to training conduct, some modification in the approach is also in order. Trainees should actively participate more completely in the sessions and line practice interviews should also include the enumeration of practicing farmers. If the size of the training groups can be reduced, total trainee participation will be more nearly possible.

As indicated initially, the principal senior staff that have done much of the training have done an excellent job.



b. Academic Training

The following points in connection are noted:

- Academic training at the University of the West Indies should be continued;
- Overseas training of selected staff via the Agriculture Planning Project should be utilized;
- Technical Assistance/Consultation training via the part time assignment of selected staff to work directly with the Consultant should be arranged.

In reference to the second point, the Branch has not taken advantage of overseas training available through the APP. There are excellent courses available at the U.S. Bureau of the Census (USBC) and through the U.S. Department of Agriculture. The advantages of utilizing this type of training are:

- Exposure of the trainee to well organized courses given by training personnel who conduct courses of training every day;

8. DATA ANALYSIS: ECONOMIC INTERPRETION

During the period the Consultant was attached to the Data Collection and Statistics Branch, there was a certain agitation several places in the Ministry and in Government that greater analysis and interpretation of the results of the several censuses and surveys be made by the Statistics Branch.

The Statistics Branch has an obligation to interpret the results of its statistical series in terms of sampling errors, explanation of biases, reporting physical conditions -- such as lack of rainfall to explain a low yield, etc.



It is not the responsibility of the Statistics Branch, however, to make economic/sociological interpretations of statistical data that involve action and reaction of national and/or international agencies to national and/or international happenings. Such interpretations necessitate the construction of simple or complicated economic models that would assuredly include numerous factors far beyond the knowledge of the Statistics Branch personnel.

In fact, such economic/sociological interpretations of statistical data are almost always conjectural in one aspect or other or from one economic faith or other. A statistical office should not be in the "economic/sociological interpretation game."

Therefore, it is strongly recommended that either a parallel Economic/Sociological Interpretation Branch be established in the Data Bank and Evaluation Division or -- perhaps better yet -- elsewhere in the Ministry.

#### 9. OTHER TOPICS

The Consultant was very heavily engaged in the original thinking, design, planning and preparation of the proposed Food and Beverage Consumption Survey.

Because of the immense detail involved, a separate report solely on that survey is being prepared.



10. APPENDICES

APPENDIX I	Scope of Work
APPENDIX II	Activities of the Data Collection and Statistics Branch
APPENDIX III	Quarterly Crop Area and Production Report
APPENDIX IV	All Jamaica Estimates of Domestic Crop Production- 1970-1980
APPENDIX V	Survey of Crop Production in Jamaica
APPENDIX VI	Results of First Full Scale Area Sampling Frame Survey in Jamaica



SURVEY METHODS SPECIALISTScope of Work

This Advisor will be required for a total of 1 year. He/she will report to the project manager designated by the Ministry of Agriculture and will work closely with a counterpart personnel in the Data Bank and Evaluation Division.

He/she will:

- a. Provide on-the-job training and in-country courses to local counterparts on all aspects of survey methodology including planning field excursion, office procedures, quality control, data processing and data analysis of sample surveys.
- b. Assist in the evaluation of sampling frame.
- c. Assist in developing questionnaires, control forms, etc.
- d. Assist in developing plans for efficient execution of sample surveys.
- e. Assist in developing analytical plans for various surveys.
- f. Assist in the design of various types of sample.
- g. Assist in developing systems for efficient survey management and operation.
- h. Assist in the statistical, sociological and economic analyses of sample surveys data.
- i. Assist in identifying ST technical assistance for specialized areas of survey needs.
- j. Coordinate the evaluation of existing surveys.
- k. The advisor should be able to provide management assistance in the implementation of field surveys, from sampling selection and surveys designed through data processing, to data summarization, and finally, to publication of the results.
- l. Improvement and evaluation of forecasting accuracy and procedures.
- m. Any other areas of statistical consultation which may arise from time to time.

Qualification:

This advisor should possess a minimum of a Master's Degree or equivalent experience in Math Statistics or Statistics, with extensive experience in sample survey methodology in developing countries. Particular experience is highly desirable in the applications of sampling techniques to agricul-

contd./

ture such as;

- i) Remote Sensing
- ii) Objective yield measurement
- iii) Area Frame Sampling
- iv) Livestock Surveys
- v) Crop Production Surveys
- vi) Nutrition studies

1. As I initiate technical consultation for the A. L. NELLUM ASSOCIATES, Inc project - USAID - with the JAMAICA Ministry of Agriculture, the precise scope of work and mechanics of consultation operations will become more obvious.

ACTIVITIESDATA COLLECTION AND STATISTICS BRANCHDATA BANK AND EVALUATION DIVISIONMINISTRY OF AGRICULTUREA. TYPE OF DATA COLLECTED AND PUBLISHED

- (1) DOMESTIC CROPS
  - ACREAGE \*
  - PRODUCTION \*
  - YIELD
  - MARKET PRICES
  - FARM GATE PRICES
  - MONTHLY AND THREE MONTHLY CROP FORECAST
  - INDICES OF PRODUCTION
- (2) EXPORT CROPS
  - PRODUCTION
  - EXPORTS
  - VALUE OF EXPORTS
- (3) SLAUGHTER DATA AND EGG PRODUCTION
  - CATTLE
  - PIGS
  - GOAT AND SHEEP
  - CHICKEN AND EGG PRODUCTION
- (4) FARM INPUTS IMPORTED QUANTITY AND VALUE OF
  - FERTILIZERS
  - CHEMICALS
  - SMALL FARM TOOLS
  - FARM EQUIPMENT
  - FOOD
  - PLANTING MATERIAL
- (5) a. SURVEYS (REGULAR)
  - (i) QUARTERLY CROP PRODUCTION SURVEY
  - (ii) ANNUAL PIG CENSUS
- b. SURVEYS (AD-HOC)
  - (i) SURVEY OF POULTRY FARMERS
  - (ii) FAMILY PLANNING SURVEY
  - (iii) AGRO-SOCIO-ECONOMIC SURVEY-PINDARS RIVER/TWO MEETING AREAS
  - (iv) RABBIT SURVEY
  - (v) NUTRITION SURVEY
  - (vi) FLORICULTURE SURVEY
  - (vii) SURVEY OF THE FISHING INDUSTRY
  - (viii) AGRO-INDUSTRY SURVEY
  - (ix) LOGWOOD SURVEY
  - (x) SURVEY OF WHOLESALERS etc.

## B. RELIABILITY OF DATA

DATA COLLECTED BY EXTENSION STAFF HAS ITS LIMITATIONS:

- OVERBURDEN
- SUBJECTIVITY
- BIAS
- NO DIRECT CONTROL

BUT THIS METHOD STILL BEING USED BY MOST OF THE DEVELOPING COUNTRIES DUE TO LACK OF RESOURCES AND EXPERTISE. IN EACH LAND AUTHORITY QUARTERLY CROP REVISION MEETINGS ARE HELD TO EDIT AND SCRUTINIZE THE CROP ESTIMATES. INPUTS FROM DIVISIONAL OFFICERS AND EAO'S ENSURE THAT THE DATA IS REASONABLE.

ESTIMATES OF CROP PRODUCTION FORECASTS ARE ALSO COMPARED WITH PRICES AND PREVIOUS YEARS EXPERIENCE BEFORE BEING PUBLISHED. HOWEVER, DATA MAY BE BIASED IN TERMS OF ABSOLUTE VALUES BUT PROVES USEFUL IN SHOWING TRENDS.

ONLY DATA ON DOMESTIC CROP PRODUCTION IS COLLECTED BY THE EXTENSION STAFF. OTHER DATA IS COLLECTED BY THE DATA COLLECTING OFFICERS OF THIS DIVISION.

DUE TO LIMITATIONS, OBJECTIVE AND SCIENTIFIC METHOD OF COLLECTING DATA - CROP PRODUCTION SURVEY WAS DEvised.

## C. CROP PRODUCTION SURVEY

### a. METHODOLOGY

WITHIN EACH PARISH:

1. TOTAL AREA IS DIVIDED INTO AGRICULTURAL AND NON-AGRICULTURAL LAND USING AERIAL PHOTOGRAPHS.
2. AGRICULTURAL LAND IN EACH PARISH IS THEN DIVIDED INTO SEGMENTS OF SIZE 1/2 SQUARE MILE.
3. A SCIENTIFIC SAMPLE OF THESE SEGMENTS IS SELECTED WITHIN EACH PARISH.
4. DATA COLLECTING OFFICERS ARE SENT TO ENUMERATE THE SELECTED SEGMENTS USING QUESTIONNAIRES.
5. COMPLETED QUESTIONNAIRES ARE SENT TO THE HEAD OFFICE WHERE THEY ARE EDITED AND CODED.
6. DATA IS THEN TRANSFERRED TO THE COMPUTER FOR PROCESSING.
7. PROCESSED DATA IN TABULAR FORMS IS ANALYZED AND PUBLISHED IN A REPORT CALLED CROP PRODUCTION SURVEY.

b. TYPE OF INFORMATION COLLECTED

1. LAND UTILIZATION
2. USE OF FERTILIZER AND CHEMICALS
3. ACREAGE AND PRODUCTION OF CROPS
4. FARMER'S INTENTIONS
5. IRRIGATION
6. NUMBER OF GOATS
7. LABOUR
8. FARMER'S PROBLEMS

b. FUTURE DEVELOPMENTS - CROP PRODUCTION SURVEY

- INCLUSION OF OTHER ASPECTS OF AGRICULTURE SUCH AS:
- SOCIO-ECONOMIC INDICATORS TO EVALUATE THE COMPREHENSIVE RURAL DEVELOPMENT PROGRAMME
  - MARKET INFORMATION
  - POST HARVEST LOSSES ON FARM
  - FARM INPUTS AND COST
  - LIVESTOCK INVENTORY
  - FARM WAGES
  - FARM INCOME

D. OTHER PROJECTS

- SURVEY OF THE FISHING INDUSTRY
- CROP CALENDAR
- INDICES OF EXPORT CROPS
- BIBLIOGRAPHY OF AGRICULTURAL INFORMATION
- NEW CROP FORECASTING SYSTEM

E. FUTURE SURVEYS

- CATTLE SURVEY
- FARMER'S REGISTER
- OBJECTIVE MEASUREMENT OF YIELD
- DEMAND ANALYSIS
- GOAT AND SHEEP SURVEY
- SURVEYS TO EVALUATE PROJECTS
- SURVEYS REQUESTED BY OTHER DEPARTMENTS AND DIVISION
- AGRICULTURAL OUTLOOK
- MARKET SITUATION OUTLOOK
- MODEL BUILDING FOR FORECASTING

QUARTERLY CROP AREA AND PRODUCTION REPORT  
PROVISIONAL ESTIMATE OF NATIONAL PRODUCTION

APPENDIX III

EXTENSION AREA: ..... FARMING CATEGORY:.....  
 DIVISION:..... TOTAL RAINFALL:.....  
 PARISH:..... NO. OF RAINY DAYS:.....  
 AREA OFFICER:..... WEATHER CONDITIONS:.....  
 MONTH ENDING:.....

CROPS	Target	ACREAGE		ACREAGE REAPED		Yield per ac. Unit/Tons	Acres Currently Growing	Acreage to be reaped month after next
		Planted		This Month	Total			
		This Month	Total					
<u>PULSES</u>								
Broad Bean								
Sugar Bean								
Lima Bean								
Cow Peas								
Gungo Peas								
Red Peas								
Peanut								
Other Pulses								
<u>VEGETABLES</u>								
Beetroot								
Cabbage								
Calsico								
Carrot								
Cauliflower								
Celery								
Cho-Cho								
Cucumber								
Egg Plant								
Lettuce								
Okra								
Pumpkin								
String Bean								
Tomato								
Turnip								
Other Vegetables								
<u>CONDIMENTS</u>								
Escallion								
Ginger								
Onion								
Hot Pepper								
Sweet Pepper								
Thyme								
<u>FRUITS</u>								
Paw-Paw								
Pineapple								
Watermelon								
<u>CEREAL</u>								
Hybrid Corn								
Ordinary Corn								

CROPS	ACREAGE PLANTED			ACREAGE REAPED		Yield per ac. Unit	Acr. Currently Growing	Acreage to be reaped month after next
	Target	This Month	Total	This Month	Total			
Rice								
Horse Plantain								
Other Plantain								
<u>GROUND PROVISIONS</u>								
Irish Potato								
Sweet Potato								
Lucea Yam								
Negro Yam								
Renta Yam								
St. Vincent Yam								
Yampie								
Tau Yam								
Yellow Yam								
White Yam								
Bitter Cassava								
Sweet Cassava								
Coco								
Dasheen								
Sorrel								
<u>PERMANENT CROPS</u>								
Coffee								
Cocoa								
Citrus								
Coconut								
Pimento								
Others								

(1) This Report is to be completed monthly and during the first week of each month.

1970 - 1980 ALL ISLAND ESTIMATE OF CROP PRODUCTION

UNIT: - SHORT TONS

CROPS	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
<b>LEGUMES</b>											
Broad Bean	204	137	244	115	130	126	150	202	200	267	133
Sugar Bean	158	176	224	200	201	203	215	162	206	200	104
Cow Pea	516	547	561	477	571	773	600	956	1,619	970	803
Green Pea	2,200	2,093	3,199	1,340	1,892	2,362	1,510	1,144	2,277	2,515	2,501
Red Pea	2,150	2,833	2,983	2,027	2,374	2,257	2,375	3,706	5,694	6,957	6,233
Peanut	720	1,273	1,083	1,192	1,266	1,171	1,500	2,033	3,000	2,770	2,512
SUB TOTAL	5,964	7,049	8,294	5,951	6,543	6,892	5,160	8,103	13,130	11,558	10,466
<b>VEGETABLES</b>											
Beetroot	749	888	1,049	695	598	657	1,265	653	1,213	670	670
Cabbage	7,910	12,144	10,518	7,700	13,554	8,912	16,955	2,785	12,390	15,107	15,784
Calaloo	-	-	-	-	-	-	-	10,779	11,373	12,461	15,571
Garrot	5,337	7,114	3,920	3,207	3,269	6,011	10,620	2,511	11,373	12,235	11,361
Cauliflower	145	158	161	116	97	63	75	46	47	60	42
Celery	77	80	20	39	33	149	85	97	90	77	57
Cho-Cho	1,986	3,514	4,077	3,576	3,969	4,419	4,985	5,126	3,100	2,700	4,313
Cucumber	5,754	3,440	3,304	3,744	3,500	4,340	5,100	3,012	2,765	3,000	4,070
Edo Plant	198	128	142	53	70	77	80	44	77	74	55
Eschour Lettuce	1,164	4,372	3,510	3,147	2,168	2,556	3,235	245	271	1,007	723
Straw Lettuce	1,204	743	709	737	414	518	470	320	468	464	454
Okra	470	711	1,131	1,231	1,034	1,258	1,100	1,172	1,101	1,108	1,233
Pumokin	14,502	22,170	119,910	20,401	21,601	25,055	23,400	29,936	37,428	25,245	27,070
String Bean	423	503	701	538	511	364	965	368	880	626	711
Tomato	7,224	10,085	9,072	9,720	9,457	9,369	14,165	26,677	25,793	22,926	25,500
Turnip	1,380	1,394	2,370	2,154	1,392	1,535	2,070	1,553	2,402	3,317	1,277
SUB TOTAL	43,341	68,114	67,216	53,533	67,115	67,432	96,189	105,444	128,193	104,402	112,620
<b>CONDIMENTS</b>											
Escallion	838	1,180	1,416	1,127	1,138	940	1,560	2,729	3,941	4,188	3,843
Ginger	416	456	657	749	857	949	995	423	697	580	440
Onion	32	285	197	523	1,511	2,307	3,540	4,744	9,073	2,377	2,441
Hot Pepper	492	1,075	953	912	1,011	1,045	990	1,432	1,366	2,104	926
Sweet Pepper	195	209	220	235	243	378	460	415	494	603	1,059
Thyme	65	148	212	105	193	2,330	145	148	105	203	206
SUB TOTAL	2,028	3,353	3,664	3,731	4,953	6,037	7,600	9,806	15,745	9,245	9,076
<b>FRUITS</b>											
Pawpaw	805	914	1,656	2,128	1,746	2,174	2,500	2,795	2,256	1,631	1,376
Pineapple	1,125	1,137	2,244	5,910	4,485	5,095	4,057	5,357	3,376	2,670	3,205
Watermelon	4,526	3,356	2,403	2,451	2,387	2,245	3,750	2,083	5,308	2,920	3,171
SUB TOTAL	6,456	6,407	6,463	10,529	9,588	9,614	10,307	10,236	10,939	7,221	7,752
<b>CEREALS</b>											
Hybrid Corn	-	-	1,260	1,405	1,025	10,745	10,670	8,641	5,315	5,232	2,503
Ordinary Corn	4,351	5,717	3,460	2,000	1,322	1,495	1,510	1,522	1,054	7,107	2,339
Sweet Corn	28	41	33	13	36	20	-	5	-	-	-
Rice	-	-	-	-	-	-	-	-	-	-	-
SUB TOTAL	4,379	5,758	4,753	3,418	2,383	12,260	12,180	10,166	6,369	12,339	4,842
<b>PLANTAIN</b>											
Horse Plantain	8,152	15,470	10,274	20,153	17,712	13,849	11,210	15,397	22,110	24,391	19,694
Other Plantain	4,977	10,415	10,364	7,075	3,010	5,720	5,515	3,971	10,557	2,041	8,716
SUB TOTAL	13,129	25,885	20,638	27,228	20,722	19,569	16,725	19,368	32,667	26,432	28,410
<b>POTATOES</b>											
Irish Potato	9,304	14,528	17,702	9,956	14,528	14,913	8,425	9,283	12,360	13,378	8,100
Sweet Potato	13,576	21,285	21,908	17,775	22,721	16,825	18,020	31,259	162,045	201,450	29,300
SUB TOTAL	22,880	35,813	39,610	27,731	37,249	31,738	26,445	40,542	174,405	214,828	37,400
<b>YAMS</b>											
Luca's Yam	6,090	14,329	12,930	12,260	13,441	14,330	13,025	14,277	15,933	17,649	14,349
Yema Yam	23,540	30,160	21,004	28,970	33,387	28,197	15,265	26,556	35,878	34,157	27,202
Renta Yam	43,090	18,552	22,584	23,712	22,061	25,704	25,085	25,941	28,234	27,092	24,442
St. Vincent Yam	6,444	6,625	7,620	7,857	7,054	11,037	11,555	11,554	12,843	14,538	12,133
Sweet Yam	3,375	3,002	4,556	3,317	5,176	5,435	4,500	7,073	7,780	9,374	7,144
Igu Yam	5,652	13,115	12,599	11,539	9,689	2,352	10,150	8,705	14,259	13,570	8,005
Yellow Yam	29,526	14,100	12,450	11,503	15,160	14,107	14,416	11,124	14,206	15,468	16,714
Other Yam	3,508	15,324	15,536	15,455	15,017	5,551	4,105	5,402	7,470	11,005	4,716
SUB TOTAL	90,579	117,007	112,532	123,277	144,724	138,340	131,310	151,532	160,533	173,050	164,630
<b>OTHER TUBERS</b>											
Bitter Cassava	16,000	12,750	16,074	11,406	11,201	15,430	16,570	23,270	27,245	19,444	16,426
Sweet Cassava	4,121	7,116	7,350	5,730	5,164	5,140	5,200	6,500	6,500	41,100	41,100
Joco	12,551	11,535	12,122	12,507	15,154	12,150	11,655	15,978	22,550	10,450	14,350
Patience	10,132	18,125	20,324	19,229	25,330	21,505	22,465	32,131	27,451	10,534	12,036
SUB TOTAL	42,804	49,426	55,860	49,124	49,311	54,225	59,965	78,224	74,246	81,528	88,162
TOTAL	112,251	186,560	160,474	207,208	252,002	244,274	352,374	432,377	532,215	468,114	470,266

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## APPENDIX V

### SURVEYS OF CROP PRODUCTION IN JAMAICA

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#### 1. INTRODUCTION

The Crop Production Survey was initiated within the Ministry of Agriculture in 1978 because of the need to provide more precise and more objective estimates of the main agricultural parameters (crop production, irrigation use, land utilization, fertilizers, etc.) and to provide a more reliable base for forecasting agricultural production.

It was recognized from the outset that an area sample was more appropriate for this purpose than a list sample, largely because a list sampling frame gets outdated rather quickly. In this regard, attempts were made to utilize LANDSAT imagery for stratifying the country into homogeneous areas for sampling purposes. Examination of a number of LANDSAT frames showed that this was unsuitable for Jamaica because of the following reasons:

- (a) the high incidence of cloud cover, and
- (b) the relatively poor spatial resolution without the use of expensive electronic equipment.

As a consequence of the above, use was made of recent aerial photographs, taken at an average height of 25,000 ft. above sea level and at a scale of approximately 1:50,000.

The area frame was constructed with the aid of topographic maps and ground truth in the fall of 1978 and reconstructed in the light of subsequent experience in the winter of 1979. The aerial photographs referred to earlier were used during the reconstruction phase, along with topographic maps and ground truth.

A description of the area frame was contained in a paper<sup>1</sup> presented at the Thirteenth International Symposium on Remote Sensing of Environment. The first survey using this frame was made in early October 1979. The main purpose of the survey was to provide estimates of crop acreages and variances for determining the final sample size at the country and parish levels.

In addition, the survey was expected to provide the staff with insight and experience with the concepts needed to implement a crop survey using maps, photographs, and questionnaires.

## 2. SURVEY DESIGN

The area sample frame was stratified by parish and within parish by intensity of cultivated land as well as some consideration of land elevation. The strata within parish were designated by numbers and briefly described as follows:

- Stratum 10: Extensively cultivated lowlands
- Stratum 20: Foothills, valleys intensively cultivated but primarily above 750 feet elevation
- Stratum 30: Less intensively cultivated area and pasture land
- Stratum 41: Marginal agricultural land primarily devoted to subsistence farming
- Stratum 50: Nonagricultural areas other than populated places
- Stratum 60: Populated places
- Stratum 70: Water (ponds, rivers, swamps, lakes, reservoirs)

The initial sample was selected in only strata 10, 20, 30, and 41. The sample allocation was based primarily on the relative historical importance of agriculture in the parishes since variances were not available for determining an optimum allocation. A replicated systematic sample was selected within each stratum. A systematic sample was selected to give a geographic dispersion within each stratum. The replicates were used to provide a valid and unbiased estimate of the sampling error using systematic sampling. An average segment size of  $\frac{1}{2}$  square mile was used.

The sample for the first survey was selected from each of the 113 parishes in Jamaica. The sample allocation is given in Table 1 and was designed to provide results from a large number of crops, both acreage and production data and other farm-related data primarily at the country level but also estimates for major crops at the parish level. The variances from the first survey by strata were expected to be used to modify the design before increasing the sample size for the country. Pooled variances within strata for several parishes are to be used as a basis for setting sample size for major crops at the parish level. The sample size of 228 segments was considered adequate for this task. However, the sample size was constrained by the limited resources and personnel available in 1979. The strata, frame count units, and sample segments selected for Clarendon Parish are shown in Figures 1, 2, and 3. However, for the first survey only one-half of the segments shown in Figure 3 were used due to limited resources.

### 3. ACREAGE AND PRODUCTION FORECASTS FOR SELECTED CROPS

Tables 2, 3, and 4 give estimates at the country level which show the estimates and sampling errors for planted acres as of the survey date in absolute and percentage units (coefficient of variation). Tables 5, 6, and 7 show similar results for the parish of Clarendon, which is a major agricultural parish in the south-central part of the country.

Sampling errors in Tables 2 and 3 with coefficients of variation in the 5-15 range were considered satisfactory and probably would require no special design modification. This group includes the land use items: total farm land, pure crop stands, and grasslands. The uses designated ruinate and the catch-all category of woods, waste and roads would probably not receive any special consideration in the design. Among the crops in Table 3, only sugarcane falls within the 5-15 percent range. A number of crops with errors less than 30 percent hold the most hope of improvement through future design modification. This group includes: red peas, peanuts, pumpkin, corn, plantain, sweet potatoes, the yams and, among the permanent crops, bananas, coconuts and coffee.

For the parish of Clarendon the land use items (Table 5) are estimated with more consistency than at the country level even though the errors are larger. The largest error corresponds to a coefficient of variation of 35 percent. Among the crops, only sugarcane is estimated with acceptable accuracy at the parish level. The next level of errors for crops is in the 40 percent range. These are tomatoes, sweet potatoes, other yams, cassava, and coffee. At the parish level, a group of five or six major crops is about the maximum number for which the error level can be lowered to near 15-20 percent with the resources which can be expected in the near future. It is proposed to evaluate each of the 13 parishes to identify the major crops which can be expected to have acceptable errors at the parish level of 15-20 percent and be consistent with the country objective of having errors of 5-10 percent for major crops and land use categories. It is expected that a more attainable goal will be to have sampling errors of 5-10 percent for major crops at the country level and errors at 15-20 percent level for the major crops for five or six of the most important agricultural parishes. The remaining parishes would be combined into two regional groups for estimation and design considerations.

Many problems were encountered in the field due to lack of transportation. The enumerators did not have personal transportation and had to rely on public transportation in rural areas. This resulted in many inefficiencies in completing segment work and the scheduling of appointments or call-backs to growers. The forwarding of completed segments to Kingston had to be accomplished by the field supervisors arranging to pick up finished segments directly from the enumerators. The lack of personal transportation also limited the quality control efforts of supervisor to resolve inconsistencies in the questionnaires.

#### 4. SUMMARIZATION PROCEDURES

The survey data was summarized by a Horizon II microcomputer system<sup>2</sup> with questionnaire data being entered on diskettes through two-user terminals. The data were entered on a farm-tract basis and each section of the questionnaire was screened. That is, consistency checks are made by the computer software for reasonableness. A message is immediately sent via the terminal to the person entering the questionnaire data of any discrepancies. The discrepancies must then be corrected or the operator can indicate that the value(s) is acceptable and wishes to continue with the next section of the questionnaire.

There are 34 tests for consistency of the questionnaire data made during data entry for each tract. The following are examples of the consistency checks made for a tract:

- (a) Land use items for tract must sum to the total acreage in tract. If not, an error message is printed on the operator's terminal.
- (b) For an individual crop, acres to be harvested plus acres to be planted must be less than the land available as pure stands, mixed stands, in grass or in fallow. If not, an error message is printed on the operator's terminal.
- (c) For an individual crop, the areas to be harvested or planted as pure stands plus mixed stands must be equal to the total area to be harvested or planted. If not, an error message is printed on the operator's terminal.

In each situation where an error message is printed, the operator has several options:

- (1) change one or more of the data values entered;
- (2) accept the values already entered; or
- (3) quit processing the tract and ask the supervisor to review questionnaire.

In addition to the consistency checks: (a) yield per acre and prices are examined to see if they fall within acceptable ranges and (b) production is also converted to pounds (using standard conversion factors) for most crops if reported in other units. For corn the values used were:

Crop Code	Yields		Prices		Stan- dard Unit	Conversion Factor to Standard Unit				
	Upper Limit	Lower Limit	Upper Limit	Lower Limit		Lbs	Hund/ Wt	Tons	Qt to Lbs	Other to Lbs
501	2400	500	.27	.09	lbs	1	100	2000	2	0

After all the tract questionnaires for an area segment are entered, a segment software program adds the individual farm tracts to the segment level. If some tracts are missing, the segment program permits adjusting the reported tract data for missing tracts based on either the number of tracts missing or the acres in the tracts missing. When all segments for a parish are entered, an ANALYSIS program makes the estimates and computes the sampling errors. For the country there were 228 segments in the pilot survey and data were entered for a total of 1,750 tract questionnaires in approximately 15 working days. However, there were several days in which data could not be entered because of waiting for questionnaires to be forwarded to Kingston from the field. No information for plots of land not used for agriculture (nonfarm plots) was summarized.

The formula used in making the estimates by strata within parish is as follows:

$$\hat{Y}_h = \frac{N_h}{n_h} \sum_{i=1}^{n_h} X_i = \frac{N_h}{n_h} \sum_{i=1}^{m_h} \sum_{j=1}^{k_h} X_{ij} = N_h \bar{X}_h$$

where  $\hat{Y}_h$  = estimated acres for the crop or land use category.

The variance<sup>3</sup> of the estimate is calculated based on either simple random sampling or replicated systematic sampling within a stratum. The operator must indicate which type of sampling has been employed.

$$V(\hat{Y}_h) = \frac{N_h - n_h}{N_h} \frac{N_h^2}{n_h} \sum_{i=1}^{n_h} (X_i - \bar{X}_h)^2 \div (n_h - 1) \text{ for SRS}$$

and 
$$V(\hat{Y}_h) = \frac{N_h - n_h}{N_h} \frac{N_h^2}{m_h} \sum_{r=1}^{m_h} (\bar{X}_{rh} - \bar{X}_h)^2 \div (m_h - 1) \text{ for replicated samples}$$

(this formula is alternative version of that shown in reference (3) which was based on expanded replicate totals rather than means)

where  $X_i$  = segment value for  $i^{\text{th}}$  segment in stratum of an item under SRS,

$X_{ij}$  = segment value of  $j^{\text{th}}$  segment in  $i^{\text{th}}$  replicate in stratum for an item under replicated systematic sampling,

and  $\bar{X}_{rh}$  = segment mean for an individual replicate in stratum for an item.

$$\bar{X}_h = \frac{\sum_{i=1}^{n_h} X_i}{n_h} ,$$

and  $N_h, n_h$  refer to segments in frame and in sample for strata,  
 $M_h, m_h$  refer to replicates in frame and in sample for strata,

$$k_h = \frac{N_h}{M_h} \quad \text{also} \quad n_h = m_h k_h$$

For the parish the estimate and variance of an item are:

$$\text{Estimate for Parish} = E_p = \sum_{h=1}^L \hat{Y}_h$$

$$\text{and Variance for Parish} = V_p = \sum_{h=1}^L V(\hat{Y}_h)$$

For the country the estimate and variance of an item are:

$$\text{Estimate for Country} = E = \sum_{p=1}^{13} E_p$$

$$\text{and Variance for Country} = V = \sum_{p=1}^{13} V_p$$

## 5. FUTURE MODIFICATIONS

The first survey indicated that the sample design and allocation will need to be revised for the specific crops for which it is considered necessary to control the sampling errors. This will probably mean that sampling errors for the other crops will be larger than desired in most cases. However, the larger the number of crops contained in the group for which their errors are controlled, the larger the sample size will become unless some improvements in the stratification can be made. For example, stratum 41 contains a significant acreage of oranges and other crops which indicates that restratification is needed. Some sample segments are clearly in the wrong strata based on an inspection of the aerial photographs. Reallocation of the sample may be expected to be effective for improving the efficiency of the ground provision group. The other crops will need to be handled on an individual basis.

The prospects for an improvement based on a new allocation which will lower the sampling errors to acceptable levels for all parishes are very unlikely. Error levels for five or six parishes can be reduced while trying to satisfy the crops most important for the country through a re-allocation of the present sample. The distribution of the additional segments will be done after a careful evaluation of the October 1979 survey and a review of the frame strata.

The survey field staff will shortly be increased from 29 (26 enumerators and 3 supervisors) to 67 (52 enumerators, 13 parish supervisors and 2 regional supervisors). As a result, the sample will be increased from 228 segments to approximately 500.

Also, objective measurement of yields will be started on a continuous basis for at least three crops during 1980 (sugarcane, bananas, and yams) if resources permit. The yield surveys will be used to improve the estimates of production, and forecasts of the crops mentioned.

#### 6. REFERENCES

1. Huddleston, Harold F. and Russell, Roy, "Agricultural and Resource Assessment in Jamaica Using an Area Sampling Frame," Thirteenth International Symposium on Remote Sensing of Environment, Ann Arbor, Michigan, April 1979.
2. Luebbe, Raymond C., "Jamaica Microcomputer Data System for Crop Production Surveys," U.S. Department of Agriculture, Washington, D.C., December 1979.
3. Huddleston, Harold F., "A Training Course in Sampling Concepts for Agricultural Surveys," SRS No. 21, U.S. Department of Agriculture, Statistical Reporting Service, Washington, D.C., April 1976.

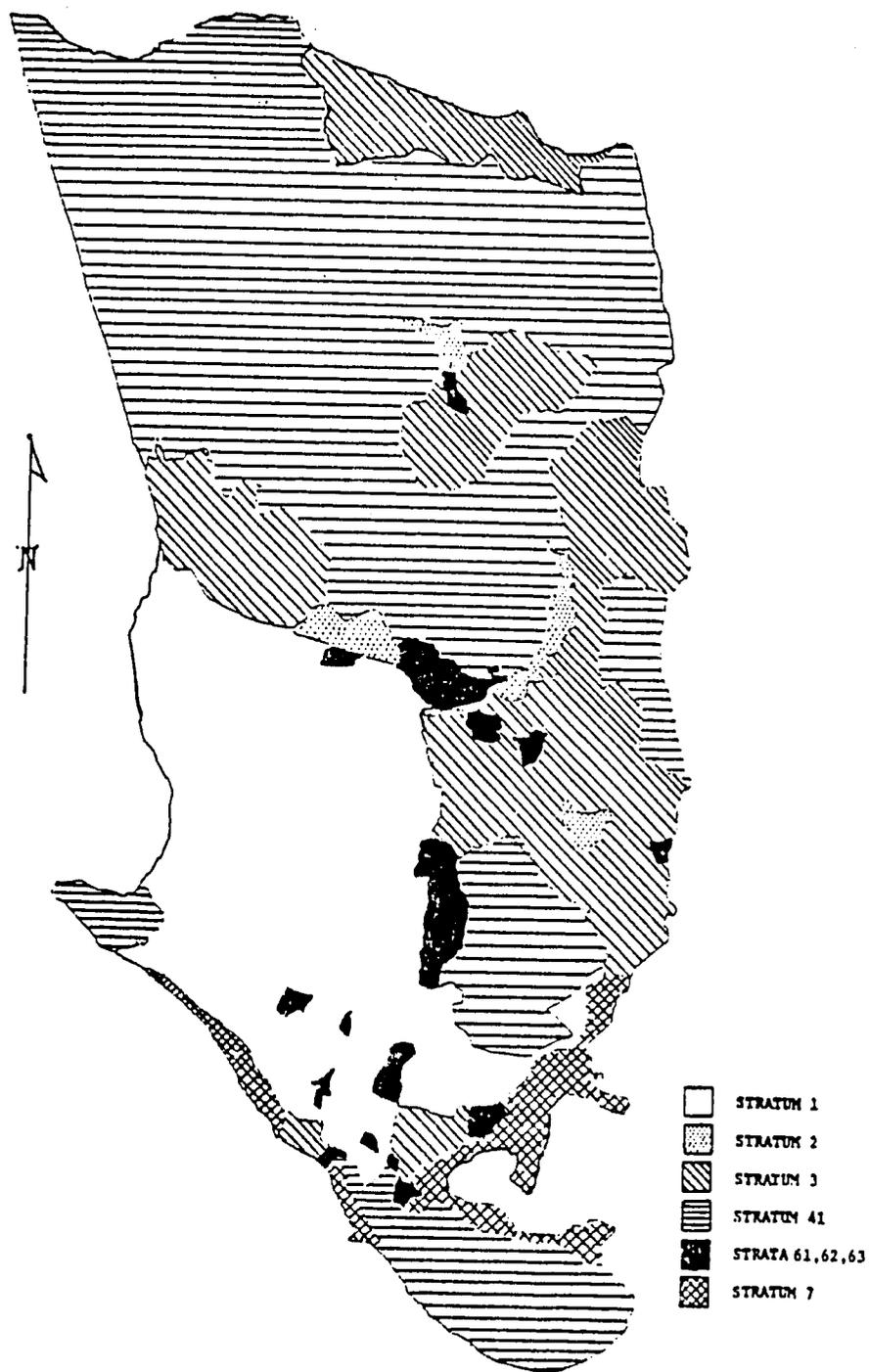


FIGURE 1. STRATA BLOCKS - CLARENDON PARISH, JAMAICA

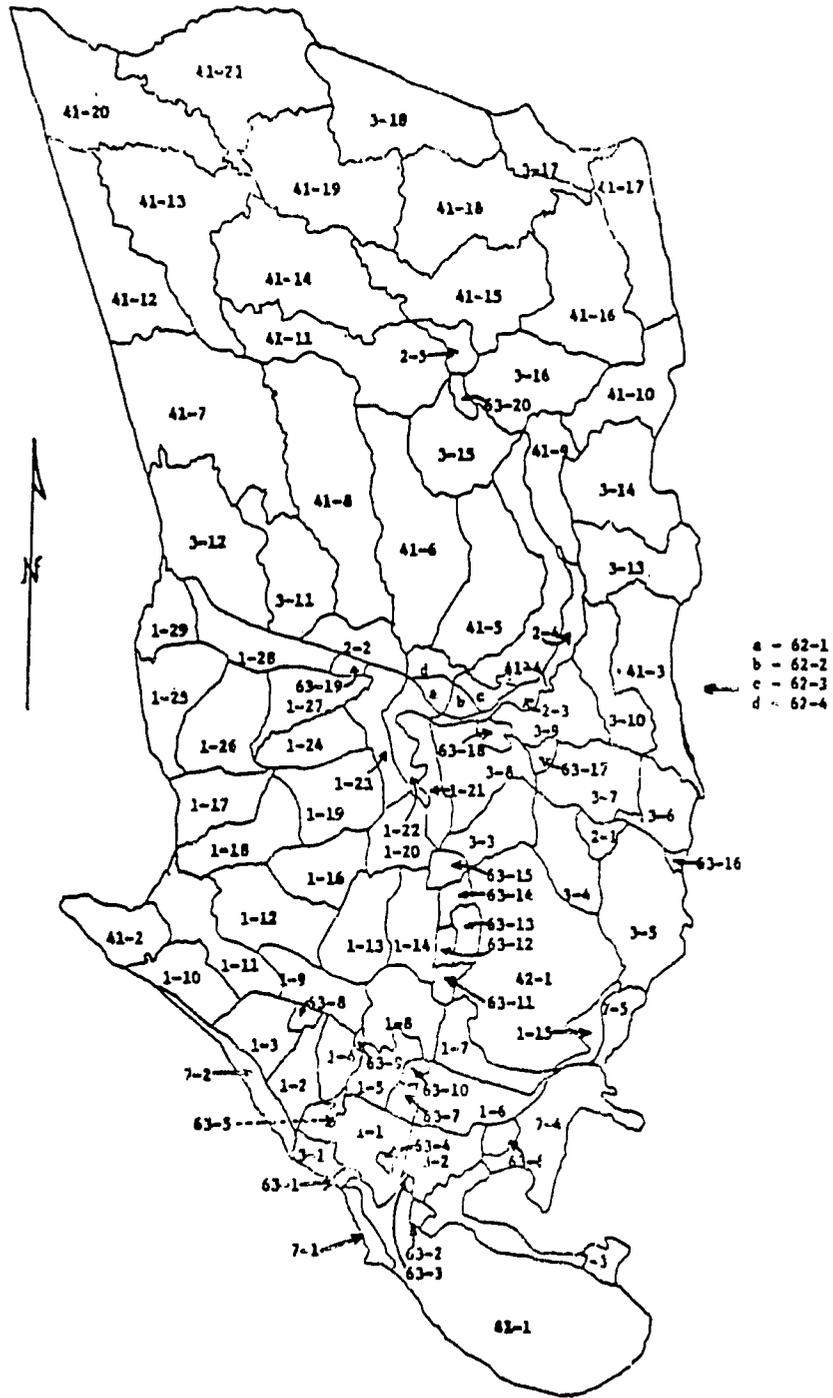


FIGURE 2. COUNT UNITS - CLARENDON PARISH, JAMAICA

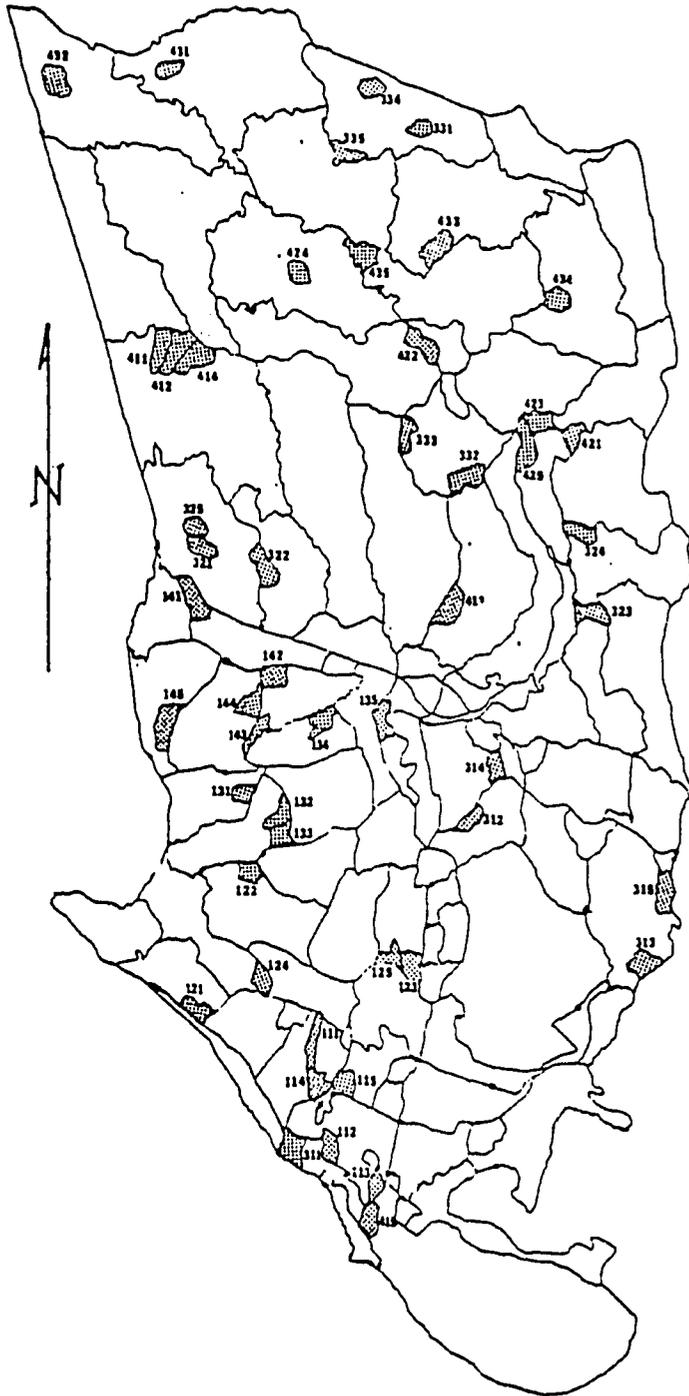


FIGURE 3. SELECTED SEGMENTS - CLARENDON PARISH, JAMAICA

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Table 1. Segment Allocation by Parish and Strata

Parish	Strata				Total
	10	20	30	41	
St. Andrews	0	0	0	12	12
St. Thomas	2	4	2	4	12
Portland	2	0	6	8	16
St. Mary	0	6	6	4	16
St. Ann	1	0	8	12	21
Trelawny	2	0	9	2	13
St. James	2	0	2	6	10
Hanover	4	0	6	2	12
Westmoreland	6	0	6	6	18
St. Elizabeth	4	0	16	6	26
Manchester	0	0	12	9	21
Clarendon	12	0	9	6	27
St. Catherine	8	2	6	8	24
Country	43	12	88	85	228

Table 2. Use of Farm Land, 4th Quarter 1979 - Jamaica

Farm Land Uses:	Estimated Acres (1)	Error in Estimate (2)	Relative Error (%) (2) ÷ (1) (3)
Total Farm Land in Current Use	1,189,940	64,200	5.3
In Pure Crop Stands	349,689	28,790	8.2
In Mixed Crop Stands	100,188	23,240	23.2
In Grasslands	294,095	28,240	9.6
In Fallow.	44,757	28,650	64.0
In Ruinate	241,566	39,430	16.3
In Building Sites	51,833	25,933	50.0
In Wood, Waste, Roads, etc.	109,234	18,544	17.0
Number Farm Tracts in Samples	1,724		
Number Farm Tracts Not Interviewed	146		

Table 3. Estimated Acres Planted or To Be Planted for Principal Crops <sup>1/</sup>  
4th Quarter 1979 and 1st Quarter 1980 - Jamaica

Crop Group	Crop	Standing on Oct. 1			To Be Planted		Total Area <sup>2/</sup> Available for Harvest Between 10/1/79&7/1/80
		Estimated Acres	Standard Error		Oct.-Dec.	Jan.-Mar.	
			Acres	Acres	Pct	Estimated Acres	Estimated Acres
Pulses	Red Peas	1,405	276	19.6	3,782	3,607	8,794
	Gungo Peas	8,143	2,562	31.4	1,390	2,188	11,721
	Cow Peas	815	389	47.7	312	525	1,652
	Peanuts	1,545	429	27.8	2,240	3,326	7,111
Vegetables	Cabbage	1,419	1,039	73.2	1,209	649	3,277
	Tomato	664	240	36.1	1,002	405	2,071
	Pumpkin	1,014	226	22.3	711	593	2,318
Cereals	Corn	7,296	2,012	27.6	2,835	5,052	15,183
Plantain	Horse	11,819	1,906	16.1	388	947	13,154
Ground Prov.	S. Potato	7,332	2,142	29.2	4,065	1,446	12,843
	Yellow Yams	8,247	1,714	20.8	855	2,964	12,066
	Negro Yams	3,561	1,023	28.7	526	1,722	5,809
	Other Yams	10,346	2,465	23.8	343	5,204	15,893
	Cassava	6,151	2,074	33.7	2,016	2,700	10,867
Permanent Crops	Banana	83,665	20,857	24.9	1,676	5,271	83,665 <sup>3/</sup>
	Sugarcane	192,129	21,839	11.4	1,142	23,765	192,129 <sup>3/</sup>
	Coconut	51,813	11,918	23.0	1,325	399	51,813 <sup>3/</sup>
	Coffee	21,422	5,714	26.7	442	452	21,422 <sup>3/</sup>
	Oranges	32,413	18,910	58.3	104	350	32,413 <sup>3/</sup>

<sup>1/</sup> Includes only crops with 1,500 acres or more planted or to be planted.

<sup>2/</sup> Acres standing plus acres to be planted by 4/1/80.

<sup>3/</sup> New plantings of permanent crops will not be harvested because of long-growing periods required for these crops.

Table 4. Estimated Acres and Production To Be Harvested for Principal Short-Season Crops 1/ During 4th Quarter 1979 and 1st Quarter 1980 - Jamaica

Crop	Area Standing Oct. 1, 1979 (acres)	Expected To Be Harvested		Historical <u>2/</u> Yield (short tons)	Expected Production <u>3/</u>	
		4th Q/79 (acres)	1st Q/80 (acres)		4th Q/79 (short tons)	1st Q/80 (short tons)
	(1)	(2)	(3)	(4)	(5)	(6)
Red Peas	1,405	1,123	269	.48	539	129
Gungo Peas	8,143 <sup>4/</sup>	2,094	6,563	.30	628	1,969
Cow Peas	815	633	182	.34	215	62
Peanuts	1,545	1,138	315	.35	398	110
Cabbage	1,419	585	491	2.50	1,463	1,228
Tomato	664	460	193	3.00	1,389	579
Pumpkin	1,014	465	436	2.50	1,163	1,090
Corn	7,296	3,260	3,762	.44	1,434	1,655
Horse Plantain	11,819	4,490	4,738	2.50	11,225	11,845
Sweet Potato	7,332	2,148	4,186	2.44	5,241	10,214
Yellow Yam	8,247	3,304	4,344	2.43	8,029	10,556
Negro Yam	3,561	2,137	701	2.45	5,236	1,717
Other Yam	10,346	3,069	5,461	2.24	6,875	12,233
Cassava	6,151	1,455	1,200	2.20	3,201	2,640

1/ Individual crop listed in Table 2 excluding permanent crops.

2/ Based on previous survey reports by growers.

3/ Columns 2 and 3 multiplied by column 4.

4/ Multiple harvesting of acres is a common practice.

Table 5. Use of Farm Land, 4th Quarter 1979 - Clarendon Parish

Farm Land Uses:	Total Acres (1)	Error in Estimate (2)	Relative Error (%) (2) ÷ (1) (3)
Total Farm Land in Current Use	93,445	20,188	21.6
In Pure Crop Stands	60,085	16,206	27.0
In Mixed Crop Stands	2,457	208	8.5
In Grasslands	11,819	2,511	21.2
In Fallow	4,185	648	15.5
In Ruinate	1,441	330	22.9
In Building Sites	1,121	371	33.1
In Wood, Waste, Roads, etc.	12,337	4,299	34.8
Number Farm Tracts in Samples	168		
Number Farm Tracts Not Interviewed	10		

Table 6. Estimated Acres Planted or To Be Planted for Principal Crops 1/  
4th Quarter 1979 and 1st Quarter 1980 - Clarendon Parish

Crop Group	Crop	Standing on Oct. 1			To Be Planted		Total Area <u>2/</u> Available for Harvest Between 10/1/79 & 7/1/80
		Estimated Acres	Standard Error		Oct.-Dec.	Jan.-Mar.	Estimated Acres
			Acres	Pct	Estimated Acres	Estimated Acres	
		(1)			(2)	(3)	(4)
Pulses	Gungo Peas	1,336	735	55.0	53	632	2,021
	Cow Peas	314	311	99.0	60	278	652
	Peanuts	321	242	75.4	1,013	1,269	2,603
Vegetables	Tomatoes	108	52	48.1	329	168	605
Cereals	Corn	610	358	58.7	139	315	1,064
Ground Prov.	Sweet Potatoes	462	178	38.5	444	372	1,278
	Yellow Yams	625	472	75.5	36	69	730
	Negro Yams	658	567	86.2	95	582	1,335
	Other Yams	572	245	42.8	33	11	616
	Cassava	250	111	44.4	174	168	592
Permanent Crops	Banana	4,439	3,063	69.0	69	0	4,439 <u>3/</u>
	Sugarcane	32,154	4,558	14.2	0	0	32,154 <u>3/</u>
	Coffee	1,818	832	45.8	211	21	1,818 <u>3/</u>
	Oranges	18,939	17,741	94.5	104	0	18,939 <u>3/</u>

1/ Includes only crops with 500 acres or more planted or to be planted.

2/ Acres standing plus acres to be planted by 4/1/80.

3/ New plantings of permanent crops will not be harvested because of longer growing periods required for these crops.

Table 7. Estimated Acres and Production To Be Harvested for Principal Short-Season Crops 1/ During 4th Quarter 1979 and 1st Quarter 1980 - Clarendon Parish

Crop	Area Standing Oct. 1, 1979 (acres)	Expected To Be Harvested		Historical <u>2/</u> Yield (short tons)	Expected Production <u>3/</u>	
		4th Q/79 (acres)	1st Q/80 (acres)		4th Q/79 (short tons)	1st Q/80 (short tons)
	(1)	(2)	(3)	(4)	(5)	(6)
Gungo Peas	1,336 <sup>4/</sup>	226	1,068	.30	68	320
Cow Peas	314	306	8	.34	104	3
Peanuts	321	164	157	.35	57	55
Tomatoes	108	92	16	3.00	276	48
Corn	610	230	230	.44	101	101
Sweet Potatoes	462	231	170	2.44	564	415
Yellow Yams	625	259	322	2.43	629	782
Negro Yams	658	305	154	2.45	747	377
Other Yams	572	258	86	2.24	578	197
Cassava	250	26	179	2.20	57	394

1/ Individual crop listed in Table 2 excluding permanent crops.

2/ Based on previous survey reports by growers.

3/ Columns 2 and 3 multiplied by column 4.

4/ Multiple harvesting of acres is a common practice.

RESULTS OF FIRST FULL SCALE AREA SAMPLING  
FRAME SURVEY IN JAMAICA

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## Introduction

The Crop Production Survey was initiated by the Data Bank and Evaluation Division, Ministry of Agriculture, with technical assistance from the Remote Sensing Branch, Statistical Reporting Service of the U.S. Department of Agriculture (USDA). The need to provide more objective, accurate and timely information on key agricultural parameters such as land utilization, crop production, crop forecast, use of fertilizers and chemicals, irrigation, etc., stimulated this Division to start this kind of Survey. A quarterly monitor on these parameters was considered desirable to increase the capability of the Ministry of Agriculture in furthering its performance.

It was recognized on the outset that an Area Frame Sample Survey would be the best choice. Hence, in 1978, the use of aerial photographs taken at an average height of 25,000 feet above sea level and a scale of approximately 1:50,000 along with the topographic maps of Jamaica was made to construct an Aerial Frame. A description of this Area Frame and subsequent improvements in the frame are contained in Section B of this paper.

With the given resources and experience it was recognized that this survey will provide reasonable estimates primarily at county level but also at parish level for items such as land utilization and crops with large acreage in cultivation. A number of experimental surveys were conducted during 1978, 1979 to obtain information which was used to improve on the sample design and calculate optimum sample size. For the first time, the optimum sample size was used in the April-May, 1980 Crop Production Survey.

The purpose of this paper is to present the results and relevant information gathered from this survey.

B

## GENERAL DESCRIPTION OF THE SURVEY

### 1. Objectives

The main objectives of the survey are as follows:

- (1) to provide more precise and more objective estimates of the main

agricultural parameters such as crop production, labor, irrigation, land utilization, etc.

(ii) To provide information on the main agricultural parameters which will assist planners and policy makers in the orderly development of the agricultural sector.

(iii) To provide information which will assist potential investors in the industry to make rational decisions based on sound statistical data.

## 2. Sample Designs

This sample design which is referred to as an Area Sample Design is obtained from an Area Sampling Frame. This Area Frame may be described as follows:

(i) The country is stratified into parishes.

(ii) Each parish is further stratified into homogenous ecological areas or strata. Seven strata have been identified - these are described below:

STRATUM 10: Intensively cultivated lowlands

STRATUM 20: Foot hills, valleys, intensively cultivated but primarily above 750 feet elevation.

STRATUM 30: Less intensively cultivated areas and pasture land.

STRATUM 40: Marginal agricultural land primarily devoted to subsistence farming and natural forest.

STRATUM 50: Non-agricultural areas other than populated places.

STRATUM 60: Populated areas - cities, towns, housing developments, etc.

STRATUM 70: Water, ponds, rivers, swamps, lakes, reservoirs, etc.

Each of the first four stratum was next subdivided into a number of segments.

The size of each segment was function of (a) the stratum, and hence the extent to which the land was used for agricultural purposes, and (b) the availability of suitable landmarks which could be used as boundaries for the segments.

The sample allocation was based primarily on the relative historic importance of agriculture in the parishes and variances available for determining an optimum

allocation. A replicated systematic sample was selected within each strata. A systematic sample was selected to give a geographic dispersion with each stratum. The replicates were used to provide a valid and unbiased estimate of the sampling error using systematic sampling. An average segment size of 1/2 square mile was used.

A sample of 438 segments was selected from 13 parishes. The sample allocation is given in the following table and was designed to provide results for a large number of crops, both acreage and production data and other farm-related data primarily at the country level, but also estimates for major crops at the parish level.

SEGMENT ALLOCATION BY PARISH AND STRATA (No. of Segments)

PARISH	STRATUM NUMBER				TOTAL
	10	20	30	41	
Kingston & St. Andrew	-	-	-	20	20
St. Thomas	4	8	4	8	24
Portland	4	-	12	16	32
St. Mary	-	12	10	10	32
St. Ann	2	-	16	24	42
Trelawny	3	-	15	6	24
St. James	4	-	4	12	20
Hanover	6	-	12	6	24
Westmoreland	12	-	9	12	33
St. Elizabeth	6	-	32	12	50
Manchester	-	-	24	18	42
Clarendon	20	2	20	8	50
St. Catherine	16	4	9	16	45
All Island	77	26	167	168	438

### 3. Nature of Information Collected

The information that was collected included the following:

- (i) Land Utilization
- (ii) Use of fertilizers, insecticides, fungicides, and weedicides;
- (iii) Acreage planted or to be planted, acreage harvested or to be harvested, production and farm-gate prices of several crops;
- (iv) Acreage under irrigation
- (v) Number of goats
- (vi) Farm labor

### 4. Method of Collecting Data

The data that is contained in this report was collected by the field staff of the Data Collection and Statistics Branch of this Division. The field staff consists of 52 Data Collecting Officers (DCO) ranging from 2 to 6 per parish depending upon the intensity of agriculture in each parish. In each parish, the work of DCO's is supervised by a Senior DCO and there are two Chief DCO's stationed in Western and Eastern Region to coordinate and supervise these officers.

The DCO's interviewed the farmers in the selected segments using the Crop Production Survey questionnaires.

### 5. Date and Duration

The field work started on July 1, 1980, and was completed within a period of five weeks.

### 6. Data Processing

The completed questionnaires were submitted to the SDCO's who after checking them for errors and omissions, forwarded them to Head Office. The questionnaires were then edited and coded manually by the trained editing and coding staff of the Statistics and Data Collection Branch. On completion of the editing and coding phase, the data was then summarized on a Horizon II

microcomputer system.

7. Estimation Procedure

The formula used in making the estimates by strata within parish is as follows:

$$Y_n = \frac{N_h}{n_h} \sum_{i=1}^{n_h} X_i = N_h \sum_{i=1}^{m_h} k_h X_{ij} = N_h \bar{X}_h$$

Where  $Y_h$  = estimates acres for the crop or land use Category.

The variances of the estimate is calculated based on either simple random sampling or replicated systematic sampling within a stratum.

$$V(y)_h = \frac{N_h - n_h}{N_h} \frac{N_h^2}{n_h} \sum_{i=1}^{n_h} (X_i - \bar{X}_h)^2 - (n_h - 1) \text{ for SRS and}$$

$$V(Y_h) = \frac{N_h - n_h}{N_h} \frac{N_h^2}{m_h} \sum_{r=1}^{m_h} (\bar{X}_{rh} - \bar{X}_h)^2 \quad m_h - \text{ for replicates samples}$$

where  $X_i$  = segment value for  $i$ th segment in  $i$ th replicate in stratum for item under

replicated systematic sampling, and  $\bar{X}_{rh}$  = segment mean for an individual replicate

in stratum for an item.  $\bar{X}_h = \frac{\sum_{i=1}^{n_h} X_i}{n_h}$

$i = 1$  and  $N_h, n_h$  refer to segment in frame and in

sample for strata  $M_h, m_h$  refer to replicates in frame and in sample for strata,

$K_h = N_h$  also  $n_h = m_h k_h$  for the parish the estimate, variance and coefficient of

variation for an item are:

$$\text{Estimate for Parish} = E_p = L \sum_{h=1}^H \hat{Y}_h$$

$$\text{Variance for Parish} = V_p = \frac{L}{h-1} \sum_{h=1}^L V(Y_h)$$

and coefficient of variation for parish =  $+\frac{V_p}{E_p}$

For the country the estimate variance and coefficient of variation

$$\text{Estimate for Country} = E = \frac{1}{p-1} \sum_{p=1}^p E_p$$

$$\text{Variance for Country} = V = \frac{1}{p-1} \sum_{p=1}^p V_p$$

and coefficient of variation for country =  $+\frac{V}{E}$

C. Estimates and Their Accuracy

Tables 1 to 7 in the appendix show the estimates along with coefficients of variation of items covered in the survey.

1. Estimates at Country Level:

The estimates for most items at the country level appear to be quite satisfactory. It can be seen from the following table that most of the items were estimated with a coefficient of variation of less than .10.

TABLE (i): Estimates and Coefficient of Variation of Major Items at Country Level

ITEM	UNIT	ESTIMATE	COEFFICIENT OF VARIATION
(i) Land in Farms	Acres	1,180,203	.029
(ii) Production	Short		
(a) Sugar Cane	Ton	1,158,103	.14
(b) Bananas	Short		
(iii) Fertilizer Used	Ton	39,069	.179
(iv) <u>Tracks Using:</u>			
(a) Insecticides	No.	12,829	.073
(b) Fungicides	No.	9,948	.089
(c) Weedicides	No.	3,885	.092
(v) Irrigated Land	Acres	71,858	.08
(vi) Goats	No.	282,513	.069
(vii) Labor			
(a) Workers	No.	235,537	.05
(b) Mandays	No.	509,329	.07

However, estimates for other major crops such as peas, tomatoes, pumpkin, potatoes, yams, citrus, coconuts, etc., would need further improvement.

2. Estimates at Parish Level:

Tables 1 to 7 show that the estimates at parish level for land utilization and labor are at acceptable levels. But for other items such as major crops, use of fertilizer and chemicals, irrigation and number of goats the coefficients of variations are quite high.

In order to improve the estimates at the parish level data from the census of Agriculture (1978) and experience gained in previous surveys will be used.

Comparison with Independent Sources of Information

Table (ii): Land in Farms

PARISH	CENSUS 1978	SURVEY APRIL-JUNE 1980	PERCENTAGE DIFFERENCE
St. Andrew	27,013	10,203	-62
St. Thomas	91,784	69,055	-25
Portland	59,851	58,879	- 2
St. Mary	91,230	88,053	- 3
St. Ann	145,365	63,762	-56
Trelawny	90,666	94,529	+ 4
St. James	69,411	64,630	- 7
Hanover	57,443	77,900	+36
Westmoreland	120,794	145,042	+20
St. Elizabeth	185,632	161,680	-13
Manchester	89,927	86,476	- 4
Clarendon	185,412	142,327	-23
St. Catherine	164,938	177,471	+ 8
All Island	1,379,466	1,180,203	-14

The differences between the two sources could be a combination of the following factors:

(i) The census was taken in the year 1978 whereas Survey period refers to April-June, 1980. The historical data obtained from various census shows that the land in farms is decreasing over time.

(ii). The Crop Production Survey includes only those farms which have an acreage of half an acre and over whereas census includes all farms. It is estimated that the total acreage under half acre farms does not exceed 15,000 acres.

(2) Quantity of Sugar Cane Harvested

Almost all of sugar cane produced in Jamaica is sold to the sugar factories

for processing. The data on amount of sugar cane bought was collected from the Sugar Industry Board. The following table shows that the comparative estimates are very close from the two sources.

Table (iii): Data on Sugar from Survey and Sugar Industry

SUGAR (short ton)	SUGAR INDUSTRY 26th MARCH-25th JUNE/80	SURVEY APRIL-JUNE 1980	PERCENTAGE DIFFERENCE
		1,117,631	1,158,103

The small difference in the two sources could be explained by:

- (i) difference in reference period.
- (ii) a small amount of sugar cane harvested would be consumed locally and wastage on farm and in transportation from farmers to factories.
- (iii) sampling variation.

(3) Quantity of Fertilizer

Table (iv): Data on Fertilizer from Survey and Various Importers

FERTILIZER	IMPORTERS	SURVEY
Total	13,743	39,069
Sulphate of Ammonia	9,986	8,681
Murate of Potash	368	660
Calcium of Superphosphate	198	571
Mixed Fertilizers	4,699	16,727
Other	15	12,430

It can be seen from the above table that the survey estimates are reasonable except for the mixed and other fertilizers. The survey results over estimated the mixed and other fertilizers used. In the case of the other fertilizers, the survey includes organic fertilizer from livestock waste.

(ii) It is noted that whereas sulphate of ammonia is used by large farmers mainly for sugar cane, mixed fertilizers are used by small farmers for domestic crops. The survey was able to estimate the sugar cane harvested and amount of fertilizers used for sugar cane but failed to estimate successfully the quantity

of domestic crops harvested as well as fertilizer used.

#### Future Modifications

We hope to evaluate the sample frame in the near future in order to estimate major crops at the country as well as at parish level. It might be necessary to modify the sample design in order to estimate specific crops by utilizing the ground truth on major producing areas. It is contemplated that in the near future, use of multiple frame will be made. Information on other areas such as livestock, marketing, cost of production and socioeconomic indicators will also be collected.

Table 1: ACREAGE CLASSIFIED BY PARISH AND LAND UTILIZATION  
OF VARIATION OF ACREAGE BY PARISH AND LAND UTILIZATION

PARISH	LAND UTILIZATION							TOTAL
	Pure Stand	Mixed Stand	Grass Land	Fallow	Ruinata	Occupied by Buildings	Wood, Waste, Roads, Ditches	
Andrew	1,402 (.297)	3,422 (.117)	875 (.606)	1,206 (.255)	2,187 (.024)	579 (.024)	690 (.488)	10,203 (.153)
Thomas	27,437 (.263)	7,799 (.264)	8,029 (.471)	3,252 (.379)	9,823 (.240)	760 (.221)	11,956 (.588)	69,055 (.130)
land	11,596 (.384)	15,734 (.167)	9,527 (.284)	5,663 (.577)	12,307 (.233)	370 (.155)	3,700 (.302)	58,879 (.105)
Mary	22,963 (.150)	24,998 (.180)	15,486 (.178)	2,103 (.248)	16,885 (.217)	2,705 (.285)	2,913 (.302)	88,053 (.076)
Ann	9,321 (.311)	5,653 (.482)	30,410 (.155)	1,132 (.271)	13,393 (.500)	995 (.698)	2,858 (.372)	63,762 (.113)
awny	18,498 (.120)	5,896 (.470)	30,400 (.299)	3,320 (.437)	9,034 (.368)	1,606 (.372)	25,777 (.258)	94,529 (.107)
James	18,008 (.221)	2,257 (.306)	15,026 (.397)	481 (.291)	22,738 (.257)	539 (.372)	5,580 (.651)	64,630 (.207)
ver	10,572 (.145)	10,906 (.415)	37,394 (.158)	2,110 (.265)	16,298 (.361)	519 (.146)	232 (.437)	77,900 (.112)
moreland	31,327 (.097)	8,621 (.318)	45,829 (.078)	9,097 (.125)	25,127 (.124)	2,708 (.153)	22,333 (.344)	145,042 (.021)
Elizabeth	26,630 (.139)	15,415 (.134)	46,021 (.123)	5,755 (.339)	43,029 (.168)	3,835 (.274)	20,995 (.325)	161,680 (.059)
hester	18,548 (.207)	4,845 (.208)	21,539 (.272)	4,156 (.162)	22,255 (.158)	1,206 (.128)	13,927 (.326)	86,476 (.100)
endon	63,434 (.080)	22,050 (.215)	9,507 (.296)	5,014 (.201)	24,599 (.239)	4,150 (.191)	13,573 (.198)	142,327 (.082)
Catherine	48,033 (.088)	15,106 (.256)	8,326 (.289)	2,880 (.260)	28,515 (.338)	2,378 (.246)	12,235 (.150)	177,471 (.137)
	307,767 (.047)	142,723 (.076)	278,371 (.062)	46,169 (.102)	246,189 (.076)	22,348 (.087)	136,758 (.115)	1,180,203 (.029)

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OF STAND FOR SELECTED COMMODITIES 2nd QUARTER - 1980

OP	TYPE OF STAND	ACRES HARVESTED	QUANTITY HARVESTED (short tons)	YIELD/ACRE (short tons)	AVERAGE FARMGATE Price/lb/box	COEFFICIENT OF VARIATION FROM QUANTITY HARVESTED
Peas y-shelled)	<u>Total</u>	<u>3808</u>	<u>1232</u>	<u>.324</u>	<u>2.12</u>	<u>.31</u>
	Pure	2979	1061	1356	-	.31
	Mixed	828	171	.206	-	.35
go Peas y-shelled)	<u>Total</u>	<u>1055</u>	<u>356</u>	<u>.337</u>	<u>1.50</u>	<u>.65</u>
	Pure	324	91	.281	-	.40
	Mixed	731	264	.362	-	.86
r Peas y-shelled)	<u>Total</u>	<u>208</u>	<u>53</u>	<u>.256</u>	<u>1.73</u>	<u>.42</u>
	Pure	152	37	.241	-	.52
	Mixed	56	17	.295	-	.38
nut shelled)	<u>Total</u>	<u>1440</u>	<u>784</u>	<u>.544</u>	<u>1.40</u>	<u>.51</u>
	Pure	1267	731	.577	-	.52
	Mixed	173	53	.307	-	.59
baga	<u>Total</u>	<u>203</u>	<u>374</u>	<u>1.843</u>	<u>.65</u>	<u>.41</u>
	Pure	190	369	1.942	-	.41
	Mixed	13	5	.416	-	.56
Tot	<u>Total</u>	<u>304</u>	<u>403</u>	<u>1.324</u>	<u>.75</u>	<u>.65</u>
	Pure	244	359	1.469	-	.71
	Mixed	60	44	.731	-	.49

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(Continued)

Table 2: ACREAGE HARVESTED, PRODUCTION, YIELD, FARMGATE PRICES AND COEFFICIENT OF VARIATION BY TYPE OF STAND FOR SELECTED COMMODITIES 2nd QUARTER - 1980

TYPE OF STAND	ACRES HARVESTED	QUANTITY HARVESTED (short tons)	YIELD/ACRE (short tons)	AVERAGE FARMGATE Price/lb/box	COEFFICIENT OF VARIATION FROM QUANTITY HARVESTED	
ate	<u>Total</u>	<u>548</u>	<u>1126</u>	<u>2.056</u>	<u>.59</u>	<u>.30</u>
	Pure	512	1094	2.138	-	.30
	Mixed	36	33	.902	-	.55
umber	<u>Total</u>	<u>176</u>	<u>187</u>	<u>1.062</u>	<u>.22</u>	<u>.37</u>
	Pure	126	172	1.363	-	.40
	Mixed	49	14	.292	-	.45
ttuce	<u>Total</u>	<u>33</u>	<u>15</u>	<u>.435</u>	<u>.49</u>	<u>.52</u>
	Pure	18	3	.155	-	.63
	Mixed	15	12	.764	-	.63
mpkin	<u>Total</u>	<u>1587</u>	<u>956</u>	<u>.603</u>	<u>.37</u>	<u>.25</u>
	Pure	853	624	.732	-	.36
	Mixed	734	332	.452	-	.22
aion	<u>Total</u>	<u>191</u>	<u>187</u>	<u>.980</u>	<u><del>1.17</del></u>	<u>.50</u>
	Pure	191	187	.980	-	.50
	Mixed	-	-	-	-	-
eet pper	<u>Total</u>	<u>73</u>	<u>74</u>	<u>1.009</u>	<u>.49</u>	<u>.39</u>
	Pure	59	63	1.071	-	.44
						.92

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TABLE 2: ACREAGE HARVESTED, PRODUCTION, YIELD, FARMGATE PRICES AND COEFFICIENT OF VARIATION BY TYPE OF STAND FOR SELECTED COMMODITIES 2nd QUARTER - 1988

CROP	TYPE OF STAND	ACRES HARVESTED	QUANTITY HARVESTED (short tons)	YIELD/ACRE (short tons)	AVERAGE FARMGATE Price/lb/box	COEFFICIENT OF VARIATION FROM QUANTITY HARVESTED
Watermelon	<u>Total</u>	<u>120</u>	<u>251</u>	<u>2.088</u>	<u>.27</u>	<u>.57</u>
	Pure	116	244	1.930	-	.53
	Mixed	4	27	6.667	-	1.07
Corn	<u>Total</u>	<u>3064</u>	<u>1650</u>	<u>.539</u>	<u>.33</u>	<u>.34</u>
	Pure	803	754	.939	-	.48
	Mixed	2261	896	.393	-	.47
Horse Plantain	<u>Total</u>	<u>3230</u>	<u>3549</u>	<u>1.099</u>	<u>.16</u>	<u>.20</u>
	Pure	603	755	1.252	-	.29
	Mixed	2627	2794	1.064	-	.26
Irish Potato	<u>Total</u>	<u>459</u>	<u>599</u>	<u>1.307</u>	<u>.72</u>	<u>.64</u>
	Pure	418	564	1.307	-	.68
	Mixed	41	35	.863	-	.56
Sweet Potato	<u>Total</u>	<u>1608</u>	<u>2401</u>	<u>1.494</u>	<u>.32</u>	<u>.47</u>
	Pure	1066	2037	1.910	-	.55
	Mixed	541	364	.673	-	.27
Yellow Yam	<u>Total</u>	<u>1938</u>	<u>3717</u>	<u>1.918</u>	<u>.49</u>	<u>.25</u>
	Pure	1801	2721	2.091	-	.32

(Continued)

TABLE 2: ACREAGE HARVESTED, PRODUCTION, YIELD, FARMGATE PRICES AND COEFFICIENT OF VARIATION BY TYPE OF STAND FOR SELECTED COMMODITIES 2nd QUARTER - 1980

CROP	TYPE OF STAND	ACRES HARVESTED	QUANTITY HARVESTED (short tons)	YIELD/ACRE (short tons)	AVERAGE FARMGATE Price/lb/box	COEFFICIENT OF VARIATION FROM QUANTITY HARVESTED
Negro Yam	<u>Total</u>	<u>472</u>	<u>299</u>	<u>.633</u>	<u>.50</u>	<u>.33</u>
	Pure	165	164	.993	-	.47
	Mixed	307	135	.440	-	.44
Other Yam	<u>Total</u>	<u>1901</u>	<u>2687</u>	<u>1.413</u>	<u>.40</u>	<u>.43</u>
	Pure	140	228	1.623	-	.51
	Mixed	1761	2459	1.396	-	.47
Cassava	<u>Total</u>	<u>685</u>	<u>1006</u>	<u>1.469</u>	<u>.15</u>	<u>.50</u>
	Pure	334	679	2.033	-	.70
	Mixed	350	326	.932	-	.42
Banana	<u>Total</u>	<u>54,801</u>	<u>49,041</u>	<u>.895</u>	<u>.11</u>	<u>.18</u>
	Pure	25,083	22,867	.912	-	.23
	Mixed	29,718	26,174	.881	-	.27
Sugar Cane	<u>Total</u>	<u>52,243</u>	<u>1,158,103</u>	<u>22.168</u>	<u>.01</u>	<u>.14</u>
	Pure	51,227	1,145,911	22.369	-	.14
	Mixed	1,016	12,192	12.000	-	.36
Coconut	<u>Total</u>	<u>26,724</u>	<u>32,380,000</u>	<u>1212</u>	<u>.14</u>	<u>.43</u>
	Pure	14,995	23,941,448	1601	-	.50
	Mixed	11,769	8,438,553	717	-	.40

TABLE 2: ACREAGE HARVESTED, PRODUCTION, YIELD, FARMGATE PRICES AND COEFFICIENT OF VARIATION BY TYPE OF STAND FOR SELECTED COMMODITIES 2nd QUARTER - 1980

P	TYPE OF STAND	ACRES HARVESTED	QUANTITY HARVESTED (short tons)	YIELD/ACRE (short tons)	AVERAGE FARMGATE Price/lb/box	COEFFICIENT OF VARIATION FROM QUANTITY HARVESTED
ee	<u>Total</u>	<u>1267</u>	<u>346</u>	<u>.273</u>	<u>.40</u>	<u>.36</u>
	Pure	255	91	.358	-	.62
	Mixed	1012	255	.252	-	.38
e/Citrus	<u>Total</u>	<u>10,022</u>	<u>964,085</u>	<u>96</u>	<u>4.64</u>	<u>.62</u>
	Pure	8,591	935,697	108	-	.64
	Mixed	1,331	28,389	21	-	.44

**TABLE 3: QUANTITY (Short Ton) OF FERTILIZER USED AND (Coefficient by Variation) BY TRACT OPERATORS, BY TYPE OF FERTILIZER AND PARISH**

Parish	TYPE OF FERTILIZER					
	Total	Sulphate of Ammonia	Murate of Potash	Calcium Superphosphate	Mixed Fertilizers	Other
Total	39068.8 (.179)	8681.0 (.165)	660.1 (.275)	571.3 (.558)	16726.8 (.189)	12429.6 (.489)
St. Andrew	16.1 (.32)	7.2 (.430)	0 (0)	1.5 (1.00)	4.8 (.772)	2.4 (1.00)
St. Thomas	1428.4 (.36)	998.2 (.431)	0.20 (.928)	0 (0)	427.1 (.642)	2.8 (.951)
Portland	643.2 (.33)	291.6 (.600)	18.2 (.933)	0 (0)	331.8 (.300)	1.6 (.672)
St. Mary	1109.8 (.34)	573.2 (.531)	0 (0)	0 (0)	526.4 (.438)	10.1 (.662)
St. Ann	4152.6 (.44)	740.8 (.413)	0 (0)	0 (0)	3396.8 (.530)	15.0 (.505)
Trelawny	2542 (.425)	1655.2 (.638)	477.0 (.356)	181.4 (.549)	201.2 (.445)	17.0 (.964)
St. James	636.7 (.322)	47.3 (.578)	16.8 (.978)	20.9 (.367)	551.4 (.367)	0 (0)
Hanover	218.5 (.409)	8.1 (.731)	0 (0)	0 (0)	202 (.440)	8.1 (.965)
Westmoreland	2455.0 (.146)	293.9 (.382)	95.4 (.450)	5.5 (.693)	2041.0 (.167)	19.0 (.568)
St. Elizabeth	3136.1 (.149)	73.9 (.441)	4.9 (.181)	8.5 (.732)	2920.6 (.158)	127.9 (.443)
Manchester	11083.8 (.541)	66.3 (.800)	0 (0)	29.5 (.073)	1807.5 (.261)	9180.4 (.652)
Clarendon	3839.7 (.143)	2418.0 (.162)	43.2 (.942)	98.0 (.797)	425.6 (.281)	844.6 (.421)
St. Catherine	7826.3 (.346)	1506.6 (.403)	4.0 (1.00)	225.6 (1.00)	3889.8 (.628)	2200.1 (.445)

TABLE 4: NUMBER OF TRACT OPERATORS WHO USED INSECTICIDES, FUNGICIDES AND WEEDICIDES AND (Coefficient of Variations) BY PARISH

Parish	Number of Farmers		
	Insecticides	Fungicides	Weedicides
Total	12,829 (.073)	9,948 (.089)	3,885 (.092)
St. Andrew	347 (.339)	83 (.673)	14 (1.00)
St. Thomas	345 (.430)	231 (.404)	89 (.525)
Portland	243 (.280)	379 (.275)	292 (.287)
St. Mary	616 (.249)	462 (.366)	603 (.241)
St. Ann	444 (.295)	225 (.402)	78 (.335)
Irelaway	828 (.359)	340 (.316)	277 (.233)
St. James	91 (.531)	57 (.494)	79 (.423)
Essex	15 (.965)	15 (.965)	116 (.399)
Westmoreland	366 (.353)	274 (.301)	786 (.253)
St. Elizabeth	3,304 (.114)	2,776 (.132)	625 (.226)
Manchester	2,924 (.182)	3,014 (.196)	311 (.409)
Clarendon	2,115 (.205)	1,265 (.310)	353 (.219)
St. Catherine	1,189 (.246)	828 (.311)	262 (.226)

**TABLE 5: ACREAGE CURRENTLY IRRIGATED AND COEFFICIENT OF VARIATION  
FOR THIS ACREAGE, BY PARISH**

Parish	Acreage Currently Irrigated	Coefficient of Variation for Acreage Currently Irrigated
Total	71,858	.076
St. Andrew	34	.538
St. Thomas	3,218	.675
Portland	214	.493
St. Mary	761	.549
St. Ann	6,179	.420
Trelawny	2,894	.590
St. James	0	.000
Hanover	0	.000
Westmoreland	611	.689
St. Elizabeth	6,757	.185
Manchester	98	1.070
Clarendon	25,047	.076
St. Catherine	26,046	.120

TABLE 6: NUMBER OF GOATS AND (Coefficient of Variation)  
BY PARISH AND SEX

Parish	Total	Male	Female
Total Contry	282,513 (.069)	71,184 (.070)	211,329 (.073)
St. Andrew	3,382 (.280)	803 (.325)	2,589 (.275)
St. Thomas	23,873 (.277)	6,161 (.280)	17,711 (.278)
Portland	11,161 (.350)	2,035 (.226)	9,126 (.394)
St. Mary	12,048 (.174)	2,233 (.167)	9,816 (.190)
St. Ann	7,936 (.856)	2,179 (.891)	5,757 (.842)
Delawny	13,421 (.128)	2,737 (.119)	10,684 (.158)
St. James	17,017 (.268)	4,400 (.250)	12,617 (.276)
Manchester	12,438 (.253)	2,908 (.306)	9,530 (.243)
Westmoreland	34,715 (.163)	10,397 (.163)	24,318 (.166)
St. Elizabeth	50,274 (.175)	12,943 (.158)	37,331 (.186)
Manchester	23,997 (.138)	9,060 (.228)	14,937 (.133)
Warendon	59,654 (.179)	12,297 (.155)	47,356 (.193)
St. Catherine	12,589 (.152)	3,032 (.189)	9,557 (.147)

TABLE 7: PEAK NUMBER OF WORKERS DURING SURVEY QUARTER AND TOTAL NUMBER OF MAN-DAYS AND (Coefficient of Variation) DURING LAST 7 DAYS IN JUNE BY PARISH

Parish	Number of Workers	Number of Man-Days
<u>Total Country</u>	<u>235,537</u> (.052)	<u>509,329</u> (.074)
St. Andrew	3,820 (.177)	3,355 (.267)
St. Thomas	14,467 (.158)	36,655 (.253)
Portland	9,487 (.195)	33,508 (.264)
St. Mary	19,433 (.157)	58,624 (.189)
St. Ann	9,352 (.250)	22,618 (.244)
Trelawny	15,431 (.181)	5,888 (.307)
St. James	9,218 (.235)	25,491 (.395)
Hanover	8,290 (.127)	19,724 (.199)
Westmoreland	19,723 (.130)	27,312 (.146)
St. Elizabeth	39,594 (.108)	107,741 (.068)
Manchester	21,493 (.182)	21,485 (.199)
Clarendon	41,862 (.138)	110,347 (.229)
St. Catherine	23,368 (.274)	36,580 (.423)