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International Statistical Programs of Technical Assistance

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The International Statistical Programs administered by the Economics, Statistics and Cooperative Service (ESCS) employ the most flexible and up-to-date techniques developed in ESCS's domestic programs, including use of satellite imagery as an Area Sampling Frame (ASF) stratification tool.

Current statistics on crops, livestock, fertilizer, labor and income are well within the scope of the technical assistance. Once data requirements are listed by priority by the data users in the participating country, mathematical statisticians select materials and train counterparts in the "art" of ASF construction. Survey statisticians help develop questionnaires and survey procedures, and teach counterparts who will actually train the interviewers. After a pilot survey is conducted in a limited geographic area and evaluated, a data collection strategy for the rest of the country can be developed. By then, the counterparts generally understand the principles of ASF construction and data collection and the consultants understand a little about the country.

Introduction

The Statistics unit of Economics, Statistics and Cooperatives Service (ESCS) is the official data collection agency of the Department of Agriculture. Its function is to collect and publish data on all aspects of the agricultural economy, such as national and state crop and livestock estimates and related statistical data.

These items include:

1. For crops: intentions to plant, area planted, area harvested, yields, potential production, utilization, disposition and values.

2. For livestock: livestock numbers by category of size, hogs on feed, cattle on feed, production of milk, eggs, and meat; reports on breeding intentions, farrowing, hatching, chick placements, and calf and lamb crops.

Other statistics as well are reported: fertilizer, farm numbers and sizes, farm labor and wages, prices received and paid by farmers, grain stocks, hogs, mink, etc.

Although many methods are used to gather data, our most important source of data comes from the June Enumerative Survey, generated from a sample frame of areas of land. A representative sample of small land areas are selected and desired data are collected.

This Area Sampling Frame (ASF) is very useful in the United States and is, sometimes, easily adapted in other countries. We have had many requests from

countries for technical assistance to help them construct an ASF and to develop an agricultural statistics program. The following is our story of how ESCS provides technical assistance in Jamaica - one of about 20 countries that has obtained technical assistance to improve current statistics programs.

Program In Jamaica

A first trip to Jamaica in December 1977, involved meeting USAID representatives and Jamaican counterparts in the Ministry of Agriculture. In this case our counterpart was Mr. Roy Russell, Head of Data Bank and Evaluations Division, Ministry of Agriculture. Mr. Russell obtained a master's degree in statistics from Penn State, and has had considerable work experience. In addition, he is very knowledgeable in the area of Jamaican agriculture.

A project was decided on that would try to estimate some of the basic food crops in Jamaica. Jamaica is divided into thirteen parishes. Three parishes were selected for the pilot study.

Two technicians were sent to Jamaica for a 3 week duration to begin the study. Our objective was to train counterparts and not to do the work ourselves. At first, our team was assigned only one Jamaican. All others were busy with their usual duties.

We actually needed a 4-6 person Jamaican team to construct a frame. The maps, which were selected, were specifically the Jamaican Department of Survey maps. They were the last revised set, dated 1960, and drawn to a scale of 1:50,000. Some crops and topographic features were included on the maps.

Jamaican Department of Survey maps at a scale of 1:12,500 for final stage sample selection were also to be used. After examining the materials, strata were defined and placed in the following categories.

1. Plains - Intensive cropland - 60% or more of land under cultivation. Mostly plains agriculture at altitudes of 250 feet or less was considered. Agriculture producing predominantly sugarcane, coconuts, bananas and rice was included.

2. Uplands - less intensively cultivated - 15-60%, altitudes mostly above 250 feet but including valley basin lands surrounding or adjoining mountainous areas, transition slopes. The crops selected were coffee, vegetables, citrus, cacao and other domestic crops.

3. Pastureland - Scrubland, only small amounts of cultivated land - sparsely wooded hillsides are included at any altitudes.

4. Non-Agricultural: Barren or rocky mountainous land not suitable for crops or livestock. Heavily wooded or swampland areas are included.

5. Major Cities: The interior portion of major cities that are more than one square mile in size, such as Kingston.

6. Agricultural Urban: Populated areas that are usually listed as A's or B's in the 1970 Census Enumeration E.D. books for each parish. The smallest area broken out was approximately 1/10 of a square mile.

7. Water - Interior lakes, large rivers, etc.

A map mosaic was constructed for each parish at a scale of 1:50,000. The parish was then divided into the seven strata using the definitions above and the notes in the maps. Physical boundaries must be used rather than boundaries such as political or imaginary topographic boundaries.

Figure 1 shows Clarendon Parish with strata.

Primary Sampling Unit Construction

The next intermediate step in the construction of the area frame was to subdivide the strata into primary sampling units (PSU's). These vary in size depending on the stratum and the country. Since in the final step a specific number of sampling units (usually some 6 to 20 sampling units) was assigned to each P.S.U., they were small enough to permit subdivision in a short time. However, they were large enough to be useful for a variety of surveys.

Again, good boundaries were obtained on the map and marked in the color of the stratum. Primary sampling units in non-contiguous parts of the same stratum were grouped together and all PSU's were numbered in a unique way, separately for each stratum. Each primary sampling unit was identified on the map by the stratum number (the first number), its PSU number (the second number). For example, 41-20 means the PSU number is 20 in stratum 41. In numbering the PSU's one can begin in the southeast corner and number in serpentine fashion from east to west so as to guarantee that no PSU is left out. The area can easily be measured using a grid or, more accurately by using a planimeter.

Figure 2 shows a division of stratum blocks into PSU's.

After this is done, all the primary sampling units are listed on a PSU identification sheet. A separate sheet is used for each stratum.

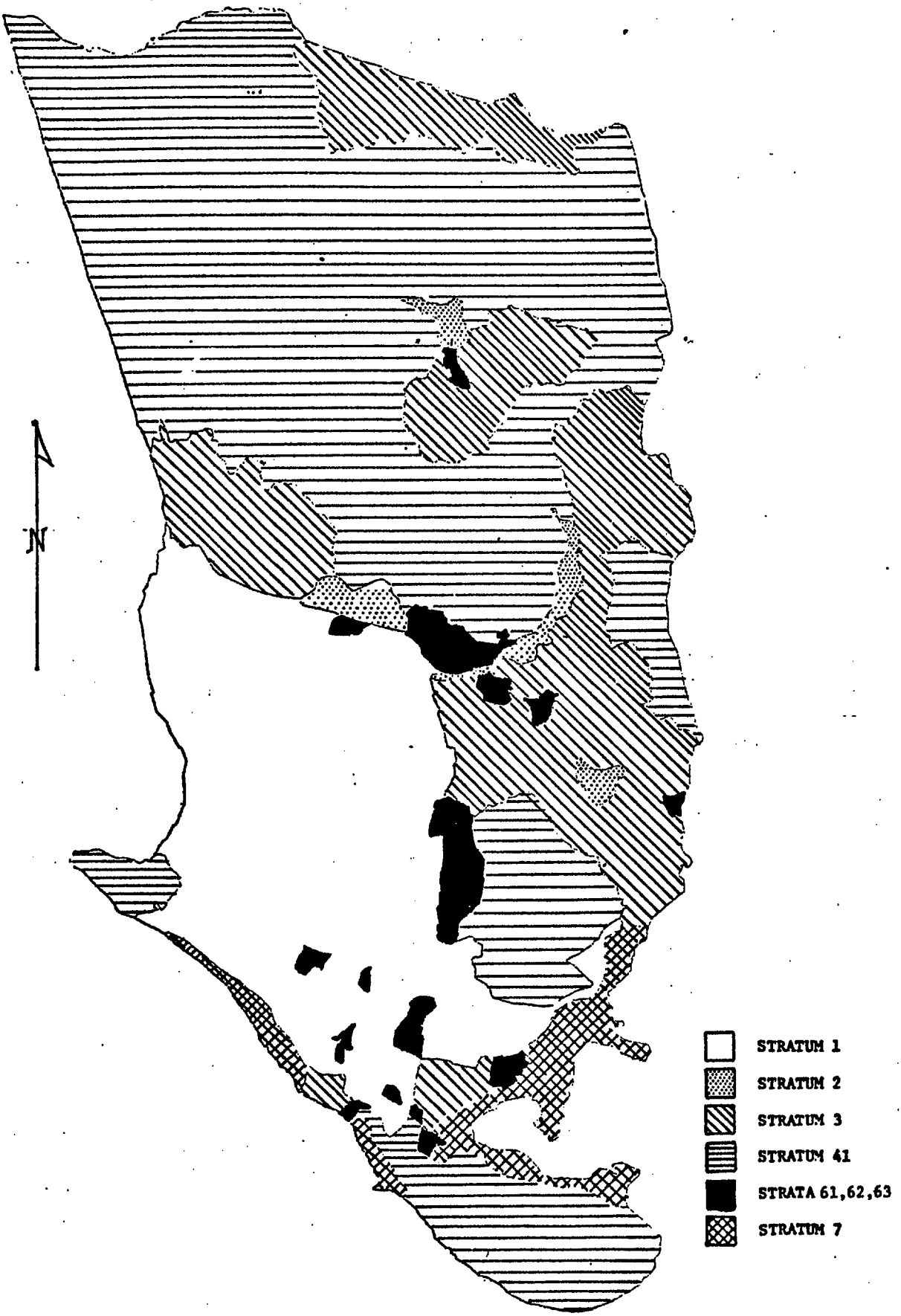


FIGURE 1. STRATA BLOCKS - CLARENDON PARISH, JAMAICA

Sampling Unit Construction and Segment Selection

In order to save time, not all the PSU's were actually broken down into sampling units; rather, a certain number of sampling units were assigned to all of them. Only a few PSU's were then randomly selected for further subdivision into sampling units (SU's). The probability that a given PSU was selected was proportional to the number of assigned sampling units in it. The most suitable number of PSU's to be selected (equal to the number of segments to be enumerated) depends on many considerations.

The number of sampling units assigned to a PSU is dependent on its size. The optimum SU size varies with the land use conditions in the survey area, the survey priorities and resources and the length of the questionaire.

It normally differs in different strata. As an example, the optimum SU size is given for all strata for Jamaica in Table 1.

The actual number of SU's assigned to each PSU is determined by dividing the area of the PSU by the optimum SU size, then by rounding the quotient down to the nearest whole number. The number of assigned sampling units in each PSU was then listed on the PSU identification sheet for PSU selection. Once a PSU was selected, it was divided into the assigned number of sample units (SU) and one was selected at random.

Since only one SU is selected within each selected PSU, the sample selection procedure may be thought of as a two step single stage rather than a two stage cluster sampling design.

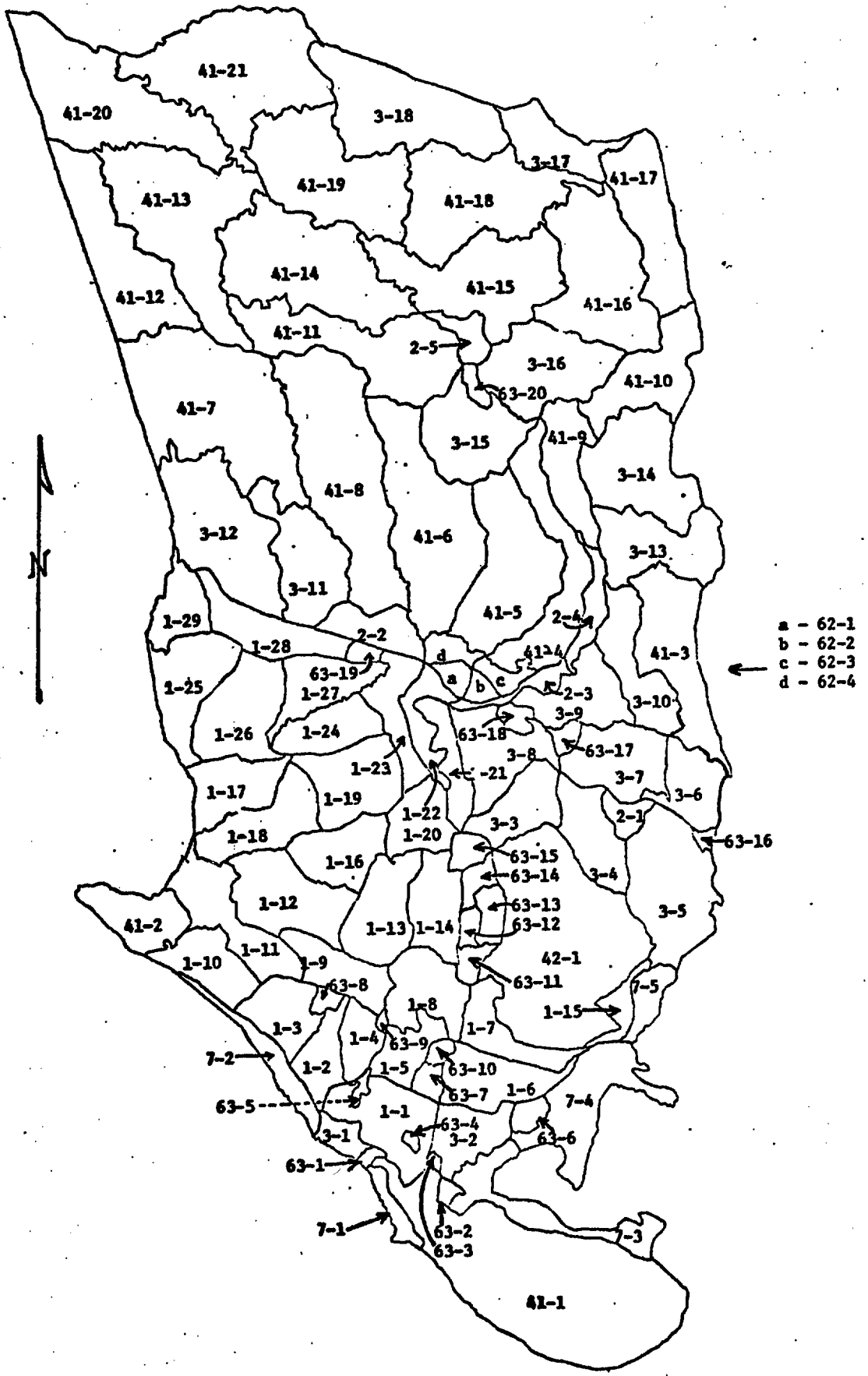
Figure 3 shows segments selected in Claredon Parish.

Questionnaires were designed to obtain the desired information. Next, interviewers were trained since ASF questionnaires must be tied to parcels of land, interviewing techniques are quite different. Usually interviewing manuals are written and three days to a week training school is necessary with two days being devoted to supervised field interviews.

Following training, interviewers were busy collecting data in the field. As soon as data came in, it was edited, key punched and summarized.

After the first survey was completed, a team went back to Jamaica to evaluate the results and recommend how the area frame could be improved.(1) The team congratulated the Jamaican Ministry of Agriculture for completing an area frame and running a survey in about 5 months. The original Survey Questionnaire had some poor questions in it since many questionnaires were incomplete. It was decided to collect acreage data on standing crops - yield data for those acres would be collected at the following quarter survey, after the crops had been harvested. A hand edit and summary had been completed for one parish, Saint James Parish. The results of the first survey are shown in Table 2.

(1) Unpublished trip report - May 17-25, 1978 Harold Huddleston, Wayne Gardner, USDA/ESCS and Beverley Carlson, US Census Bureau



Primary Sampling Units

FIGURE 2. - CLARENDON PARISH, JAMAICA

TABLE 1

Optimum and tolerance PSU sizes by Stratum

Stratum	Optimum size	Range of Tolerance
1. Intensive cropland	2	1 - 8
2. Uplands	2	1 - 8
3. Pasture, scrubs	4	2 - 10
4. Non-Agriculture	8	4 - 20
5. Major Cities	1/4	1/20 - 1
6. Agricultural Urban	1/4	1/10 - 1
7. Water	1/2 and up	1/2 and up

Almost as soon as the results were in, Jamaicans and USDA consultants knew that the ASF could be improved with better stratification and better boundaries. However, it was also obvious that better materials would be needed.

USDA purchased some recent high altitude color infrared photographs of the island. These photographs were flown by NASA in 1971 and they were available for purchase.

Mosaics had to be constructed but there was no doubt that the entire job could be done better with this new material. The entire process of ASF construction was started again in Sept. 1978. This time, Malcolm Caines, the principal Jamaican involved in the ASF construction, came to Washington D.C. and spent three weeks working in the ASF office for U.S. frames. He completed three parishes in Washington D.C. and returned to Jamaica.

After Mr. Caines returned to Jamaica, we assisted his group to some degree with the ASF construction, by sending a person to Jamaica. However, the main thrust was to be on their completion of the work themselves.

When the frame was complete and the segments were selected, we ordered the enlargements and sent them to Jamaica to be identified and marked. These aerial photographs are used in the quarterly surveys as an aid to the interviewing phase. Data must be collected on each field.

This is the frame that is presently being used. There are 606 items being asked and variances are computed for the sum for all strata.

N in Jamaica is 6,830. The sample size is 228 (n=228) with an average of eight questionnaires per segment. There are approximately 2000 questionnaires being summarized quarterly. This sample size is about half the size they require; so hopefully, next year there will be 4000 questionnaires.

Initially, we had used a computer in Jamaica that seemed to be busy most of the time. Our work had been hampered by this bottleneck. Therefore, we purchased a $16,000.00 Horizon II microcomputer and related entry devices with floppy disks. Software was programmed to store and edit data entered from questionnaires. Once a clean data set is available, another program is run

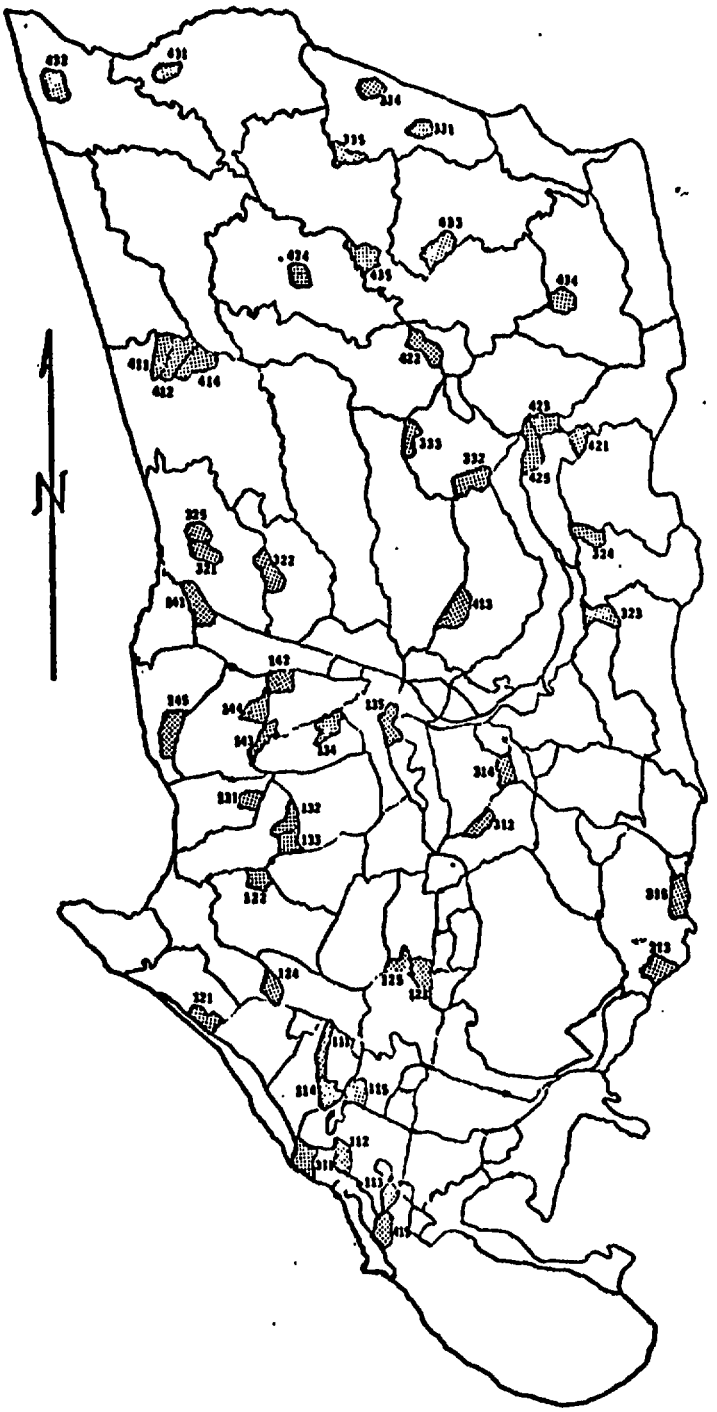


FIGURE 3. SELECTED SEGMENTS - CLARENDON PARISH, JAMAICA

Table 2. Saint James Parish select crops planted during Survey Quarter.

TABLE 2

Crop name	Estimated total acres planted	Coefficient of variation of estimated
	this quarter	total
	Acres	Percent
Red peas	211	45
Tomatoes	78	99
Onions	51	48
Corn	233	37
Yellow yams	864	49
Other yams	271	39
Bananas	10,709	42
Total tracts enumerated	450	

that aggregates the questionnaires to segment totals and produces estimates with associated Coefficients of Variations (C.V.). Approximately, 71 questionnaires are entered per personday, and it takes 28 persondays for data entry. We are upgrading the system to handle three users at the same time. We are hopeful that in about two weeks from the time that data collection has been completed, the edit can be started. Edit, aggregation, and summarization programs only entail two days to run.

Table 3 shows the results of the fourth quarterly survey run in 1979. These items are at the county level.

The Jamaicans are self-sufficient in ASF construction and microcomputer programming and operation. In these two areas, we see need for very little technical assistance.

Future Program in Jamaica

There are several directions that USDA technical assistance may go in Jamaica. It is obvious from looking at the C.V.'S on Table 3 that more work needs to be done to improve stratification. Actually, the Jamaicans are trying to estimate very rare items. A few strata are contributing to the main problem. Some work will be done to see if additional strata will help. Perhaps, lists will be assembled and multiple frame estimators used. This will depend on the source of names of these rare items.

TABLE 3

Land Utilization	Acres	Coefficient of variation %
Pure stand	348,943	8.2
Mixed stand	99,438	23.6
Pastureland	301,168	9.0
Fallow	40,785	19.9
Ruinate	241,024	16.5
Other	160,858	
Total land in farms	1,192,216	5.1
Sugar Cane		
Acres Harvested	27,527	
Quantity (short tons)	645,639	25
Yield/acre (short tons)	23.45	
Bananas		
Acres Harvested	30,212	
Quantity (short tons)	2,293	37
Yield/acre (short tons)	1.43	
Coffee		
Acres Harvested	10,045	
Quantity (short ton)	2009	42
Yield (short tons)	.20	
Orange Acres		
	12,676	
	94,600	62
	7.46	
Red peas		
Acres Harvested	1331	
Quantity	268	46
Yield	.20	
Plantan		
Acres Harvested	2051	
Quantity	2257	32
Yield	1.1	
Labor		
Agricultural Labor	124,799	9.1
Goats	187,579	9.2

Another technical assistance activity will involve objective yield estimates. Now, yield information is collected after harvest using the recall method. We will begin some crop cutting experiments to develop better yield forecast methods. Eventually, agromet yield models may be developed.

Another technical assistance activity will be digital processing of LANDSAT type data. The ground support system is in place with the ASF. As soon as the next generation satellite (Thematic Mapper) is in orbit, digital satellite data will be available which will improve acreage estimates of data since both spectral and spatial resolution will be good enough to improve estimates in Jamaica. At present, LANDSAT MSS data resolution is not good enough. This

assumes that the computer technology will keep pace with the satellite technology as it has in the past.

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