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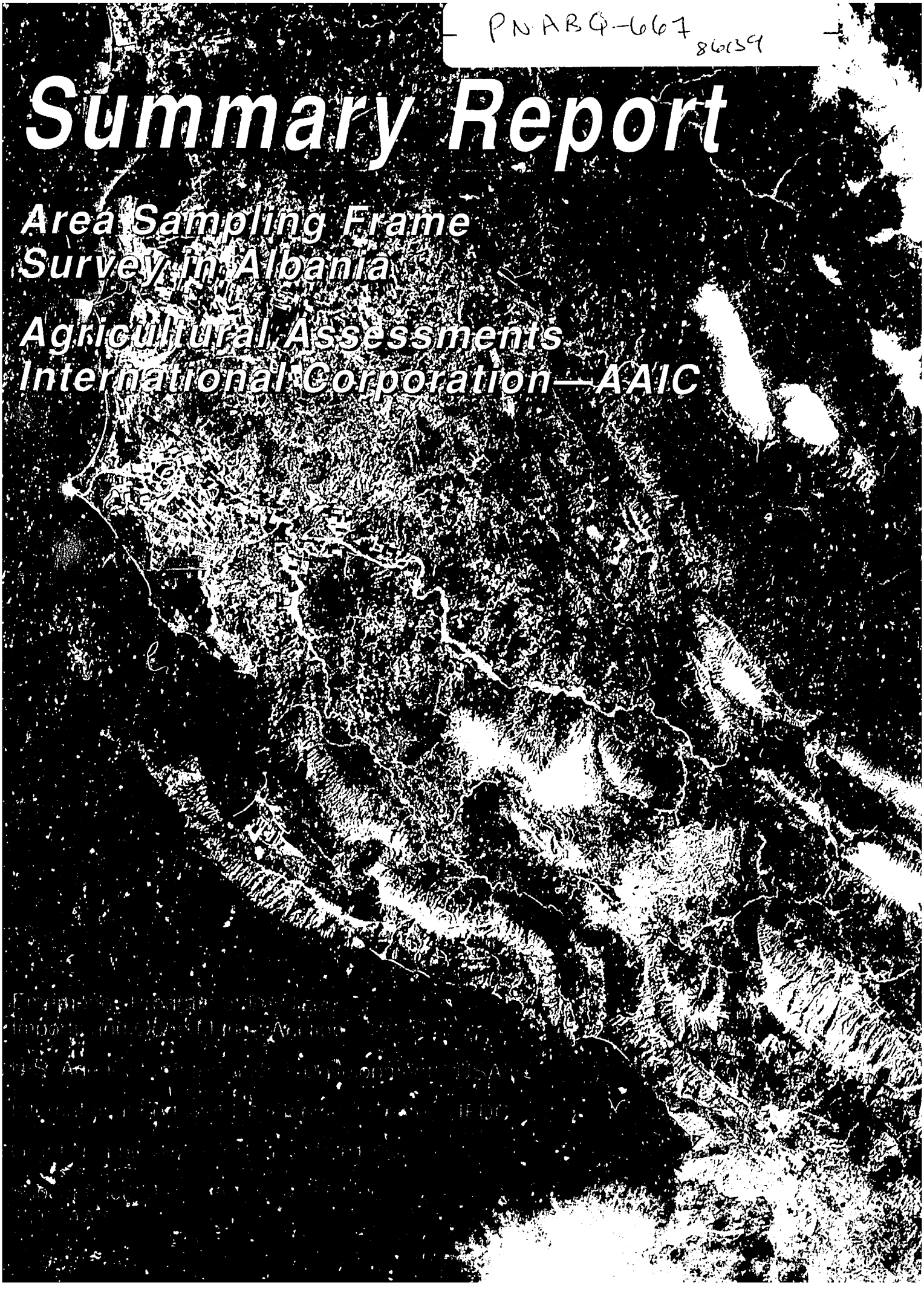
Summary Report

Area Sampling Frame Survey in Albania

Agricultural Assessments International Corporation—AAIC



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Introduction

Emerging Countries

For the United States to continue as a positive influence in the socio-economic and geopolitical achievements of newly emerging countries, we must contribute strongly in developing agricultural policies that affect individual countries.

As these nations take their place in the global market economy, of particular concern is the need to encourage policies that affect food availability—for consumers and for international trade.

The U.S. encourages policies and programs to increase production. A good agricultural statistics system is imperative for monitoring national food and agricultural policy.

Albania

The need to increase agricultural production in Albania through state-of-the-art technology and progressive market management has been given priority in the "Emergency Program of Fertilizer Imports and Open Market Auction."

Initiated by the United States Agency for International Development (USAID), with International Fertilizer Development Center (IFDC), a primary program objective is to aid Albania in developing viable agricultural production.

First ASF Survey

As part of this important program, IFDC subcontracted Agricultural Assessments International Corporation (AAIC) to conduct a crop survey in Albania to obtain estimates of major crop hectares, prospective wheat yields and use of fertilizer.

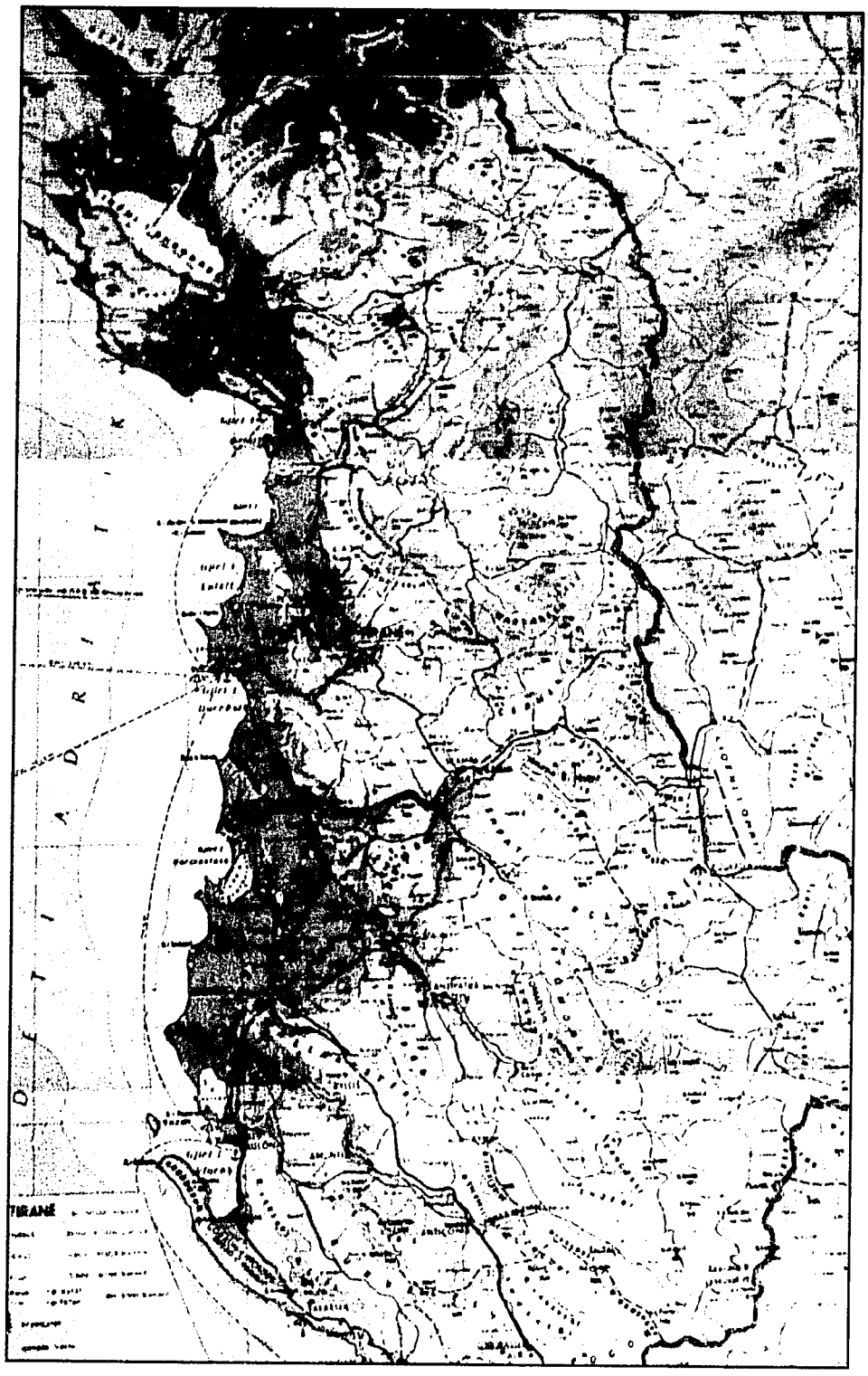
AAIC's challenge was to 1) construct an area sampling frame (ASF), using advanced scientific technology; 2) obtain valid data on pre-harvest crop areas, using local personnel; and, 3) complete the survey in a three month period.

This Summary Report presents results of the survey, and concepts and methods used to conduct the first ASF in Albania. Recommendations are presented and conclusions drawn from the AAIC survey.

Collaborative Effort

In-country support from IFDC was primary to the successful completion of this survey.

Map of Albania



Intensive agricultural areas are found along the coast and valleys identified in green on this map of Albania

Dr. Thomas Thompson, IFDC, agreed to use the ASF developed by AAIC for a socio-economic farm level survey. Dr. Thompson selected local enumerators for both the IFDC survey and the AAIC survey.

From AAIC's perspective, the partnership with IFDC was helpful. The existence of an IFDC office in Albania meant that AAIC was not required to deal with on-site operations such as facilities and equipment.

Survey Concepts

Sample Size

Sample surveys are constructed so that a minimum sample representative of the population of interest can be selected. A sample must represent the variability in the original population.

A large sample reduces sampling errors but increases nonsampling errors. The greatest concern is to control nonsampling errors associated with the sampling frame and with data collection in the field. This is accomplished by a survey design which selects a sample that can be managed in the field.

Sample size may also be affected by available funds and the data processing and data analysis systems employed.

Stratification

While there are various methods to reduce variability, stratification is usually used in agricultural surveys. Stratification reduces the required sample size necessary to represent the country.

Stratification allows one to take diverse land and subdivide it into homogeneous subpopulations that can be sampled more efficiently.

Sustainable System

Sample surveys should be conducted over a sufficiently long time period to encourage the development of a system that can be sustained by national entities once outside support ceases. The surveys must be designed to support users' needs for agricultural information over a period of time.

Comparison

Effective economic and resource data must be able to be compared over time with different sectors and different parts of the same country. A viable world market economy requires that data also be compared among countries.

Similar Factors

In order to compare results, data must be of similar quality and content, and from a similar time period. In other words, similar data must be obtained with similar methodology, i.e., collected and summarized at similar points in time.

This survey was designed to be similar to that of countries in the European Economic Community.

The survey designer must balance between sampling errors and nonsampling errors.

Sampling/Nonsampling Errors

In most data collection systems one finds nonsampling errors are the greater errors in magnitude because they tend to grossly degrade the data.

In this survey, nonsampling errors associated with the sampling frame were greatly reduced because of the ASF.

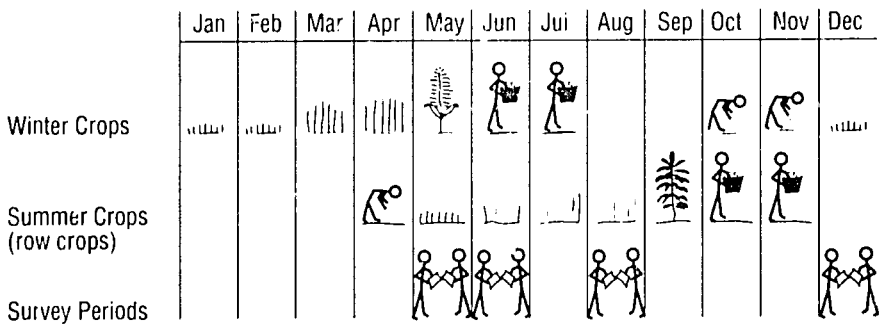
The ASF accounts for nearly all the land of Albania and each area of land has a probability of selection in the sample.

Sampling errors are associated with the specific sample design. The ideal system has nonsampling errors that are controlled and a small sampling error. The survey designer must balance between sampling errors and nonsampling errors.

Timing

Sample surveys are most effective when they correlate to the crop cycle. Ideally there should be 1) post-planting surveys for hectares planted to monitor physiological growth of crops, and 2) post-harvest surveys for evaluating yields and production.

Figure 1. Crop Growing Cycles



Crop Calendar for Albania

Crop	Seeding Dates	Harvest Dates
Wheat	October 15-December 15	June 15-July 31
Maize	March 15-May 15	September 1-November 15
Potato	March 1-April 15	August 15-September 30
Vegetable (GH)	December 15-January 31	March 15-June 15
Vegetable (field)	February 15-May 15	June 15-September 30
Sunflower	February 1-March 31	August 1-August 31
Soybean	April 1-May 15	September 1-October 31
Sugar beet	February 15-March 31	September 1-November 15
Tobacco	March 15-April 30	June 1-September 30
Cotton	March 20-May 10	September 1-November 15
Alfalfa	February 1-March 31	March 15-October 31
Maize fodder	March 15-May 15	August 1-September 30
Olives	—	November 1-February 15
Fruit	—	June 15-October 31
Grapes	—	June 15-October 31

Figure 1. shows the crop growing cycles of summer and winter crops in Albania. Survey periods are indicated in months corresponding to the planting and harvesting periods. They are timed to occur right after planting and harvesting.

*For summer crops planted in **April** and **May**, surveys are indicated in **May** and **June** to obtain an estimate of hectares planted for each crop. Also at this time in the growing season, agricultural inputs such as costs for seed, planting and labor can be obtained.*

*In **August**, a small survey should be completed to obtain yield and production of winter cereal grains. In **December**, a third survey should be conducted to obtain yields and production of the summer crops, planted hectares of winter cereals, and livestock counts. The crop and survey cycles are similar to the cycles in both western Europe and the U.S. The optimum survey cycle begins with a post-planting survey (within one month after planting) and continues with a post-harvest survey (within one month after harvest).*

Results of ASF Survey

Objectives

An ASF was designed by AAIC in order to 1) determine the area of each major crop to be harvested in Albania in 1992, 2) prepare a forecast of winter wheat production in 1992, and 3) determine kinds and amounts of fertilizer applied.

The survey was conducted May 15-June 9, 1992 on pre-harvested crops shown in Table 1.

Two strata were identified for survey: Stratum 1. intensive agriculture (along the coast and valleys), and Stratum 2. less intensive agriculture (primarily hill country). Cities and urban areas were not surveyed, nor were lakes and open water considered in total land mass.

The National Level data expressed in Table 1. are computed by adding data shown in Stratum 1. and Stratum 2.

ASF Data vs MOA Data

The ASF survey determined total land at 2,768,600 hectares. Ministry of Agriculture (MOA) data indicate total land at 2,874,800 hectares.

If we assume the MOA figure to be correct, the ASF accounts for 96.3 percent of the land; or has not accounted for 3.7 percent (106,200 hectares).

This 3.7 percent difference could be 1) attributed to the fact that area under water was not measured in the ASF, or 2) an accumulation of measuring errors in Stratum 1.

Crop and Idle Land

We have chosen not to discuss arable land *per se* because there can be definition problems. For example, the AAIC survey identified some tree crops on land not arable for crops, and other tree crops on excellent arable land. Therefore, Table 1. displays cropland data which include both types of tree crops, vineyards, and row and cereal crops totaling 588,500 hectares of crop and idle land.

Idle land seems to be high compared to other years. Factors which may contribute to the increase of idle land in 1992 are 1) farmers reported that some land was not planted because boundaries were not clear, 2) land was not distributed in time to plant, and 3) land was still to be distributed.

Additionally, some farmers reported that seed was not available, or they did not know how to proceed.

Idle Land Identification

During the review process, after interview, it was noted that in some mountainous areas land was identified as idle land which should have been classified as wasteland.

It is necessary, for future surveys, to provide further training in how to interpret definitions such as idle land. We recommend clarification of terms be done during training of enumerators and supervisors. Additional time is recommended for field training to practice identification following stricter definitions of survey procedures.

Winter Wheat and Maize

Winter wheat is the most important crop in Albania; maize is the second most important crop.

Table 1. shows a National Level for wheat of 132,200 hectares; 62,200 in Stratum 1. and 70,000 in Stratum 2. and a National Level for maize of 76,900 hectares; 21,100 in Stratum 1. and 55,800 in Stratum 2.

Data have been calculated using a standard application of ASF methods. Hence, data in Table 1. are not influenced by the fact that a portion of wheat and maize are grown on state farms.

Since a significant amount of wheat and maize are grown on state farms in Stratum 1., we have applied another estimating technique which combines ASF data and MOA data. The method could be considered multiple frame estimation. However, in a strict statistical sense this estimator is not a true multiple frame estimator, rather a variation of that technique.

A list (if reliable) is a very effective sampling frame for state farms. The list is reliable only if the state farms report accurately. It is not an efficient sampling frame for private farms in Albania because there are too many private farmers to allow for proper list maintenance. Also, enumeration of a large sample increases nonsampling errors.

For purposes of this survey, we assume MOA data are more reliable for the two major state farm crops of wheat and maize for the following reasons: 1) MOA obtains a complete list of state farms, 2) a total enumeration of all state farms is performed, and 3) records are summarized for all state farms rather than data collected from selected samples.

Because a significant amount of wheat and maize are grown on state farms contained in Stratum 1., we can estimate each crop separately for the state farms and omit the state farm data from the ASF.

Table 1—Cropland Area by Land Use and Strata
Albania June 1992

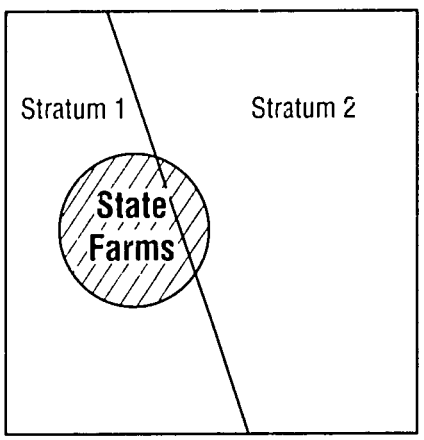
Land Use	National Level Hectares	Stratum 1 Hectares	Stratum 2 Hectares
Winter Wheat Planted	132,200	62,200	70,000
Maize Planted	76,900	21,100	55,800
Alfalfa	47,000	24,400	22,600
Vegetables and Melon	35,700	21,500	14,200
Tree Fruits	25,800	9,700	16,100
Olives	19,600	1,700	17,900
Dry Beans	15,600	8,700	6,900
Tobacco	14,600	4,000	10,600
Vineyards	8,200	6,000	2,200
Sunflower	8,000	8,000	0
Fodder	5,100	2,500	2,600
Potatoes	4,700	1,400	3,300
Cotton	2,200	2,200	0
Soybeans	1,800	0	1,800
Barley	1,500	800	700
Sugar Beets	1,300	900	400
Oats	700	300	400
Total Cropland	400,900	175,400	225,500
Idle Cropland	187,600	48,100	139,500
Total Crop and Idle	588,500	223,500	365,000
Pasture, forest wasteland, and nonagricultural	2,180,100	29,600	2,150,500
Total Land Albania	2,768,600	253,100	2,515,500

Method

State farm data are obtained from MOA administrative records. The ASF data contain estimates from selected samples of both private farms and state farms.

To eliminate duplication, ASF data identified as state farms are deleted, leaving estimates for private farms. These data are then combined with MOA data, providing an estimate of wheat (or maize) grown in Stratum 1. A visual representation is shown in Figure 2.

Figure 2. Venn Diagram Total Land of Albania



Note the majority of state farms are contained in Stratum 1.

Data in Table 1. represent Stratum 1. without consideration of the type of farm, i.e., the estimate is derived from selected samples which may or may not include state farms. Therefore, the estimate might be less accurate than data obtained from all state farms as in the MOA data.

Table 2. and Table 3. contrast data derived using ASF data only (Table 1.) and data derived using ASF data combined with MOA records for state farms in Stratum 1. Comparison of estimates from these sources is shown.

The same methods were used to derive data for maize (Table 3.) as for wheat (Table 2.) Using ASF only, we report maize at 76,900 hectares. When we substitute state farm data collected from MOA for state farm data collected from the ASF, we refine that estimate to 81,900 hectares.

Table 3. also presents a breakout of usage by hectares for grain and fodder.

Again it is assumed that MOA data are more accurate since they reflect a complete enumeration of state farms. However, there often could be bias in data collected from the MOA and one must be cautioned in accepting these data as accurate.

Table 2—Winter Wheat Area for Harvest and Prospective Production
Albania June 1992

Method I. Using Area Frame Survey Data Only

	Hectares for Harvest	Yield Qt/Hect	Product Quintels
Stratum 1. W/O State Farms	46,600	25.0	1,165,000
State Farm Data	15,600	34.0	530,400
Total	62,200	27.3	1,695,400
Stratum 2.	70,000	23.0	1,610,000
Total Albania	132,200	25.0	3,305,400

Method II. Using Area Frame Survey Data combined with State Farm Data from Ministry of Agriculture

	Hectares for Harvest	Yield Qt/Hect	Product Quintels
Stratum 1. W/O State Farms	46,600	25.0	1,165,000
State Farm Data	22,000	34.0	748,000
Total	68,600	27.9	1,913,000
Stratum 2.	70,000	23.0	1,610,000
Total Albania	138,600	25.4	3,523,000

Yield and Production

The first ASF survey (May 1992) was conducted in time to forecast yield and production for wheat estimates since wheat was planted in November 1991 and harvested in July and August 1992.

Such data could not be obtained for maize since it is planted in May and June and harvested in September and October—far too early for farmers to project yield and production estimates.

It should be noted that farmer projections for yield and production are subjective in nature. In many countries farmers will provide fairly good data based on past knowledge of crop varieties and soil fertility. We do not know how these data for Albania will hold up over time. These data need to be calibrated either by objective yield surveys or post-harvest farmer recall surveys.

Yield Survey Methods

One common method to ascertain yield data is crop cutting. This involves going to the field at harvest or near harvest, selecting sample plots and doing actual crop harvests. This method is exacting, requiring intensive training, precise instruction manuals and can be expensive in terms of man-hours.

A second method is to conduct a post-harvest follow-up survey, asking farmers to recall what they obtained.

The post-harvest survey is based on subjective factors influenced by economics and politics.

Of the two methods, crop cutting is more accurate if done properly since it is based on biological yields. However, pre-harvest and post-harvest loss must be taken into account. In any case, accurate survey data are required to calibrate the target yields.

Production Forecasts

Production forecasts for wheat were obtained by multiplying the number of hectares planted to wheat by the expected yield.

Cropland Breakout

Table 4. shows the breakout of cropland into two strata. The first three numeric columns contain MOA data. The distribution of cropland into strata by district was provided by Mr. Pandi Zdruli, Institute of Soil Studies, and by Mr. Arian Turka, Geodetic-Geology Enterprise, Tirana, Albania.

An important statistic in Table 4. is 364,998 hectares, which is the total cropland in Stratum 2. This value (rounded to 365,000) was used to extrapolate data from the sample segments in Stratum 2.

Table 3—Maize: Area Planted and Prospective Utilization
Albania June 1992

Method I. Using Area Frame Survey Data Only

	Total Area Planted Hectares	For Grain Hectares	For Silage and/or Fodder Hectares
Stratum 1. w/o State Farms	19,400	10,900	8,500
State Farms	1,700	900	800
Total Stratum 1.	21,100	11,800	9,300
Stratum 2.	55,800	48,500	7,300
Total Albania	76,900	60,300	16,600

Method II. Using Area Frame Survey Data combined with State Farm Data from Ministry of Agriculture

	Total Area Planted Hectares	For Grain Hectares	For Silage and/or Fodder Hectares
Stratum 1. w/o State Farms	19,400	10,900	8,500
State Farms	6,700	6,700	0
Total Stratum 1.	26,100	17,600	8,500
Stratum 2.	55,800	48,500	7,300
Total Albania	81,900	66,100	15,800

Unexpanded Sample Data

Data in Table 5. are unexpanded from the sample. These data are used to calculate estimates presented in Table 1. for Stratum 1. and Stratum 2. Data in Stratum 1. are segment averages for 60 segments, i.e., there are 7.782 hectares of wheat in the average of 60 segments.

Data in Stratum 2. are not segment averages since Stratum 2. was expanded using ratio techniques. These data are ratios but one could think of them as percentages. For example, in Stratum 2., 19.1 percent of the land in the samples that were in cropland was planted to wheat. Thus these data in this column are multiplied by the number of cropland hectares in Stratum 2. to obtain estimates.

In both cases, crops that have small averages or low ratios in Stratum 1. or Stratum 2. will have relatively higher sampling errors. Crops that have high averages, such as wheat and maize, have lower sampling errors. The same is true for Stratum 2. The higher the percent or ratio, the lower the sampling errors.

Table 4—Cropland by District and Strata (in Hectares)

District	Total Land	Agricultural Land	Crop Land	Stratum 1	Stratum 2
Berati	102,315	41,167	29,958	11,430	18,528
Diber	156,824	28,490	23,415		23,415
Durres	84,766	51,627	43,582	20,779	22,803
Elbasan	148,097	47,744	38,768	5,390	33,378
Fier	117,830	71,213	58,455	25,660	32,795
Gramsh	69,463	10,451	9,105		9,105
Gjirokaster	113,734	17,693	14,968	4,714	10,254
Kolonje	80,463	11,289	10,131	4,520	5,611
Korce	218,068	63,110	56,555	22,014	34,541
Kruje	60,587	25,489	21,390	19,277	2,113
Kukes	133,050	17,918	15,692		15,692
Lezhe	47,867	18,509	16,882	14,682	2,200
Librazhd	101,302	14,489	12,684		12,684
Lushnje	71,239	51,139	46,390	38,550	7,840
Mat	102,847	14,157	12,585		12,585
Mirdite	86,710	6,319	5,498		5,498
Permet	92,958	14,765	12,216		12,216
Pogradec	72,501	17,506	14,474	2,334	12,140
Puke	103,369	5,165	4,412		4,412
Skrapar	77,495	12,180	10,088		10,088
Sarande	109,683	25,837	17,037	3,837	13,200
Shkoder	252,830	45,620	38,929	26,423	12,506
Tepelene	81,734	13,063	10,893		10,893
Tirane	123,849	33,145	23,359	8,312	15,047
Tropoje	104,298	7,390	5,428		5,428
Vlore	160,921	37,839	25,927	5,901	20,026
ALBANIA	2,874,800	703,314	578,921	213,823	364,998

Fertilizer Usage

One component of the subcontract between IFDC and AAIC was to estimate the amount of fertilizer usage. Consequently, the questionnaire contained a set of questions to elicit information as to whether fertilizer was applied and if so, what kind and in what quantity.

The data indicate that very little fertilizer was being applied at the time of the survey in May and June. The IFDC/USAID fertilizer auctions were in progress at the time of the survey. Thus, our fertilizer usage information was obtained before the USAID program had significant impact.

- Of the 60 segments in Stratum 1., 18 received some type of fertilizer application.
- Of the 20 state farms surveyed, 3 applied urea; 1 applied superphosphate; and, 4 applied organic fertilizer on fields inside the segment boundaries. (These state farms were not interviewed as a farm. Rather, segments of 25 hectares were selected and data collected for those fields inside the segment boundaries.)
- Of the 1,820 fields in Stratum 1., 40 fields had organic fertilizer applied; 77 fields had urea applied; and, 15 had nitrates applied.
- Of the 40 segments in Stratum 2., 11 segments had farmers who had applied some type of fertilizer usage.
- Of the 1,145 fields in Stratum 2., 23 fields had organic fertilizer applied; 66 had urea applied; and, 60 had nitrates applied.

These data are too low a percentage to expand in order to calculate reliable estimates of fertilizers applied. The survey timing did not allow collection of fertilizer uasage for summer crops being planted at the time of the survey. Nor had the IFDC fertilizer import program had impact on the winter small grains because of the late start of the program.

ASF Methodology

ASF Construction

Two methods of ASF construction were used in the survey design for Albania. First, land was stratified into homogeneous land use strata.

Four strata were identified:

1) intensive agriculture—along the coast and valleys; 2) less intensive agriculture—mostly hill country; 3) cities and urban areas; and, 4) lakes and open water.

Traditional ASF

A traditional ASF was constructed for Stratum 1., intensive agriculture. A grid-type ASF was constructed for Stratum 2., less intensive agriculture. Strata 3. and 4. were not sampled.

We refer to the method used in Stratum 1. as the traditional method because it has been used in the U.S. since the early 1940s even though there have been extensive modifications over the years. The second method applied to Stratum 2. was developed by the French and is used in Europe.

Steps in ASF Design

1) divide the total land to be surveyed into homogeneous land use strata,

2) subdivide the strata to be sampled into sampling units,

3) select sample of the units that are representative of the strata,

4) collect valid data from the sample,

5) expand the sample data to the population totals using the appropriate expansion factors.

"The simplicity of the idea is in striking contrast to the complexity of successful application of the concepts." Houseman, E.E."Area Frame Sampling in Agriculture," SRS No. 20 (1975).

Construction of the ASF begins with allocation of land into strata. Modifications in the traditional method applied to Stratum 1. have evolved over the years which take advantage of advances in scientific technology.

Satellite Data

The use of satellite data for estimating and forecasting crop production is an exciting and effective technology. Although not replacing traditional data collection methods, remote sensing promotes efficient ground sampling and serves as a powerful supplement to traditional on-the-ground techniques.

Table 5—Average Hectares per Segment by Crop in Stratum 1 Ratio to Cropland in Stratum 2

June 1992

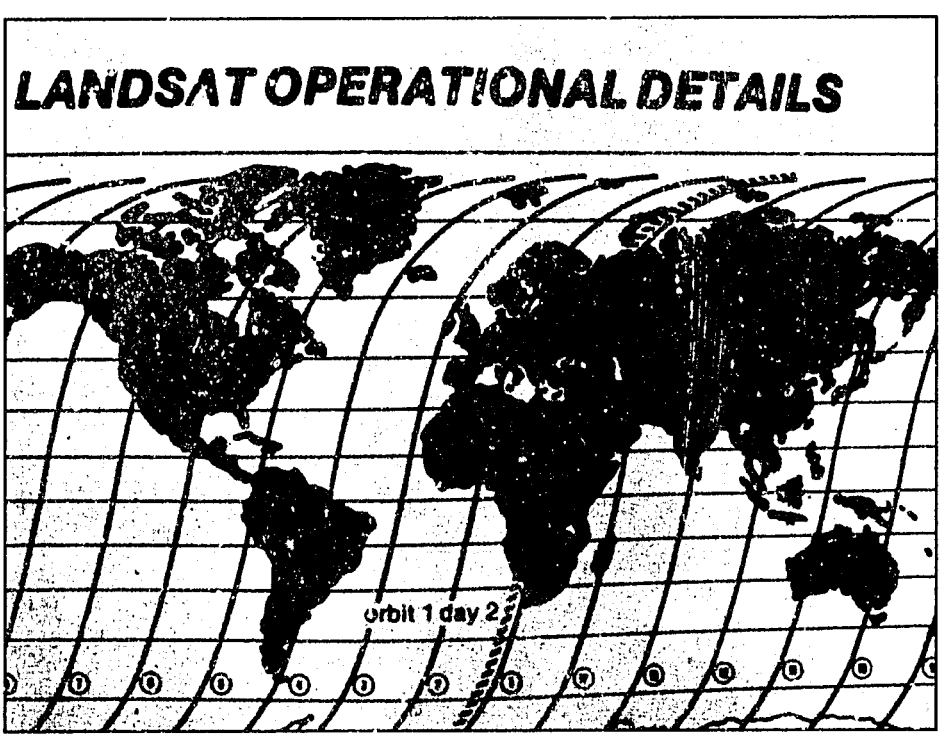
Land Use	Stratum 1*	Stratum 2
Idle Cropland	6.020	0.383
Winter Wheat Planted	7.782	0.191
Maize Planted	2.637	0.153
Alfalfa	3.058	0.062
Vegetables and Melons	2.690	0.039
Tree Fruits	1.218	0.044
Olives	0.217	0.049
Dry Beans	1.083	0.019
Tobacco	0.501	0.029
Vineyards	0.750	0.006
Sunflower	1.001	0.000
Fodder	0.310	0.007
Potatoes	0.178	0.009
Cotton	0.276	0.000
Soybeans	0.003	0.005
Barley	0.095	0.002
Sugar Beets	0.117	0.001
Oats	0.038	0.001

*pasture and wasteland not shown

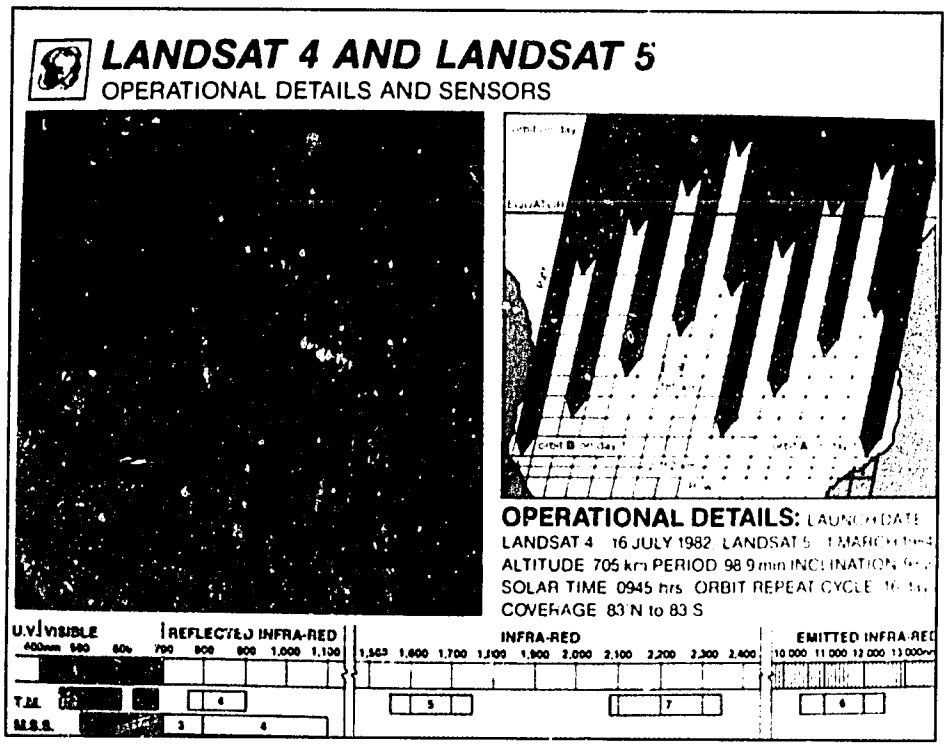
Building an area sampling frame using conventional aerial photography can be a major investment. Space imagery such as SPOT and Landsat TM has proven useful for stratification to identify different agricultural lands at reasonable costs.

Space imagery also is useful in the construction of the sampling units from which segments are selected for data collection.

Orbital details determine satellite characteristics. Resource satellites are in near earth polar orbit. The first three Landsat satellites had an orbit path which allowed the entire earth to be imaged in an 18-day cycle. The Landsat 4 and 5, currently in use, have orbits at 705 Km. This slightly lower orbit provides a cycle of 16 days in which the earth is imaged before the cycle repeats.



Orbital characteristics for the first Landsat satellites 1, 2, and 3. These satellites were in near earth polar orbit. The entire earth was imaged with a repeat cycle of 18-days.

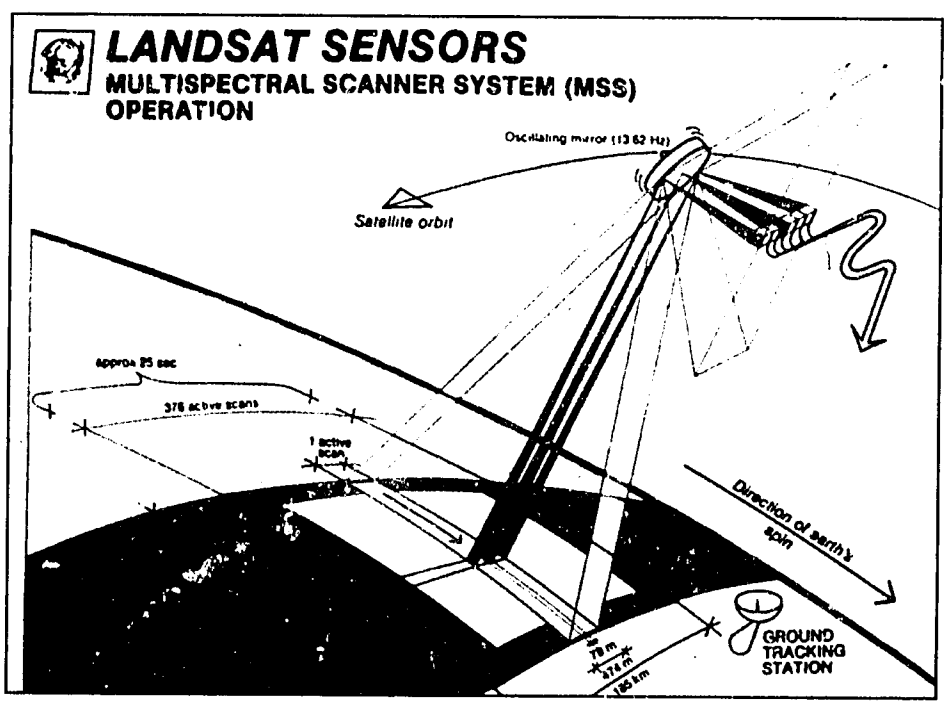


Sensors measure narrow energy bands which correspond to colors in the visual and near infrared range

On board Landsat 4 and Landsat 5 are two sensors: the multispectral scanner (MSS) and the thematic mapper (TM). Ground resolution of the TM is 28 to 30 meters. Ground resolution of the MSS is 80 meters. TM imagery is most useful when fields are small in area.

Sensors measure narrow spectral bands which correspond to colors in the visual range and are extended into the infrared zone of the electromagnetic spectrum.

Both the MSS and TM operate essentially on the same principle. The forward motion of the satellite from the North Pole to the South Pole allows the satellite to take strips of the earth from the north to the south directly under the satellite. A mirror on board mounted to oscillate allows energy to be collected in a 185 Km. strip. The rotation of the earth on its axis allows different land to be imaged every orbit of 98.9 minutes.



The rotation of the earth on its axis allows different land to be imaged every oribital revolution of 98.9 minutes.

Satellite Images and Maps

When dividing the land to be surveyed into homogeneous land use strata, satellite imagery was used for Stratum 1. The first step was to identify and separate the intensive lowland agriculture.

This stratum was identified by its large fields that had comprised cooperative and state farms. Identification could be made using topographic maps, but the land becomes much clearer using satellite images. Maps are quite useful later on in the construction process.

The second step is to subdivide the land into Primary Sampling Units (PSUs) between one and 10 square kilometers, using physical boundaries. The PSUs are numbered in a serpentine fashion and measured. To select PSUs, a random start is determined and then every I^{th} PSU is selected where I is a constant.

Physical Boundaries

In the traditional ASF construction, physical boundaries are those which can be identified on the ground and in maps and satellite images. Physical boundaries were used for all subdivisions including the stratum boundaries. Physical boundaries include roads, railroads, rivers, power lines and any other physical features that can be readily identified.

Assigning Probabilities

Once land has been identified and subdivided into PSUs ranging from one to 10 square kilometers, each PSU is assigned a probability. Large PSUs have a larger probability than smaller PSUs.

Step three is to select samples that are representative of the strata to be surveyed. The PSUs are selected with Probabilities Proportional to Size (PPS). Next the PSUs selected are broken down into Sampling Units (SUs) of 50 hectares each.

Sampling Units

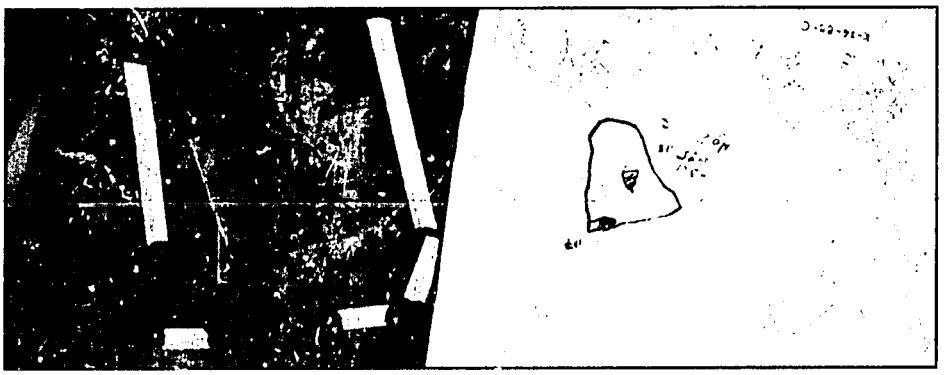
The number of SUs assigned depends on the size of the PSU. In Stratum 1, thirty PSUs were selected to be subdivided into SUs.

Two SUs are selected for survey from each selected PSU. The selected SUs, termed sample segments, are marked on satellite enlargements and maps at a scale of 1:50,000.

Size of Segment

The original design called for sample segments of 50 hectares each. The concept is to have the segment large enough to have variability but not so large to have significant duplication. Also, it is desirable to have segments small enough to be surveyed as rapidly as possible.

Factors influencing sample size include 1) travel within the segment, 2) the number of interviews in the average segment, 3) the length of the questionnaire, 4) the difficulty of the questionnaire, and 5) the number of interviewers who are working together.



A PSU in Stratum 1. is marked on the satellite image and map with two survey segments identified.

Albanian personnel transferring located segments from satellite images to photocopied maps.

The hills had tremendous diversity, including tree crops. In the high mountains we found forest nonagricultural land which could not be separated with MSS imagery.

The ASF was constructed by overlaying a grid onto Stratum 2. that was equivalent to a one kilometer square grid on the ground. There were over 25,000 grid cells. The grid was developed by using a Geographic Information System (GIS), called ARCINFO, to digitize out the lakes and Stratum 1. land.

Systematic Sample

A systematic sample of 40 grid cells (100 hectares each) was selected by determining a sampling interval and a random start. After the random start, each 625th cell (25,000/40) was selected.

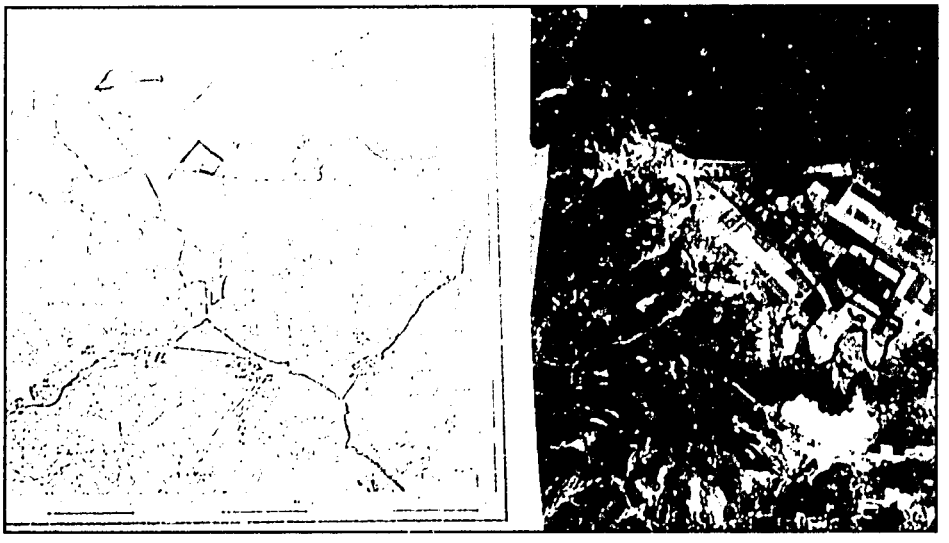
In the case of Albania, it was decided the optimum target number was 20 farm interviews per segment. Segments should be about 25 hectares.

Thus all the segments were divided into two equal (or nearly equal) parts using physical boundaries; one was selected at random as the final segment. Stratum 1. had 60 segments.

French ASF

In order to divide Stratum 2. we applied a method of ASF construction developed by the French, and widely used in Europe.

Ideally, 28 meter TM Landsat satellite imagery should be used. Time constraints required that we use 79 by 59 meter ground resolution MSS Landsat imagery.



Once segments are selected, a satellite enlargement is obtained for use in the field. The panchromatic image of a SPOT scene has 10 meters resolution.

Global Positioning System

The selected segments were transferred to 1:50,000 scale topographic maps. Grids were correlated to longitude and latitude in order to locate selected areas in the field using Global Positioning System (GPS) equipment.

Each selected cell was divided into two equal parts. Thus the locations were determined by physical boundaries and by longitude and latitude using GPS.

Inaccessible Segments

The majority of Stratum 2. segments were identified with little or no difficulty. However, some segments selected were found to be areas where there were no roads and/or no inhabitants.

Albanians familiar with these remote rural areas identified segments which were inaccessible. For these areas the crop survey questions were assigned a zero value on the assumption that there were no inhabitants, no crops, and no fertilizer.

Data Collection

Step four in ASF construction is to collect data. Interviewers were provided enlarged satellite images and corresponding maps with selected segments for survey. They were required to 1) drive to the segment, 2) identify the boundaries, 3) locate the appropriate farmer, and 4) collect data for all land within each segment.

During data collection a sketch of the land is made as well as interviewing the farmer

Reliability Check

In Stratum 1., a 10 percent subsample was checked by either AAIC personnel or Albanian supervisors for interview accuracy. On this basis, the interviewers collected data correctly.

However, boundary identification was difficult. The satellite images did not reflect the possible redistribution of land due to breakup of cooperative farms. Prior to redistribution many fields equaled 50 hectares. The land which has been partitioned into smaller parcels is, for the most part, between one and four hectares. Some difficulty was found in identifying segment boundaries unless physical boundaries were available.

Survey Tools

The materials used in Albania to identify segments, especially the boundaries and fields, need to be improved.

Satellite images that are enlarged to 1:50,000 scale become blurry. At 1:50,000 scale, 50 hectares become 1 centimeter by 1 centimeter.

In countries where aerial photos are used, the scale is at least 1:10,000 and a 50 hectare segment is 25 times larger for the 1:10,000 scale.

Data Entry

Data were entered into a 486 type computer with a 120 megabyte hard disk using a dBASE III PLUS program. The program was written so that the questionnaire appeared on the screen one page at a time. Computer operators took data off the questionnaires, entering data one page at a time and one segment at a time.

Part of our data analysis design contained a plan for continual review during data collection and data entry. When data entry was completed, a computer edit was performed to obtain "clean" data sets.

Data Summary

Selection of data expansion, step five, depends on which method provides the estimates that are the closest to the target values. There are several ways to expand the data.

Data may be expanded by direct expansion, ratio estimation (there are several of these) and probability proportional to size expansion. The latter method is not discussed here because it was not appropriate in the sample design for Albania. Direct expansion was applied to Stratum 1.; ratio estimation was applied to Stratum 2.

Direct Expansion

Direct expansion is easily understood if we consider the following:

- If 100 out of 10,000 sampling units are selected, then 100 represents the total 10,000.
- Data are multiplied by the proper expansion factor, N/n or the total number of sampling units in the population divided by the total number of sampling units in the sample.
- The direct expansion method is excellent if proper control of nonsampling errors has been taken during data collection.

Locations in the field are checked using the road as a starting point in identifying segments on satellite image and photocopied map

Ratio Estimator

Ratio Estimation is easily understood if we consider the following:

- If 50 segments in a stratum are selected and 12% of the land in the segment is wheat, then one can say 12% of the land in that stratum is wheat since the segments were selected to represent the stratum.
- The ratio estimator can be the more accurate of the two when there are minor errors in the data collection.
- Ratio estimators reduce the effect of collecting too little or too much data for segments.
- If segment boundaries are difficult to identify, ratio expansion should be applied.

Stratum 2. in Albania was refined by making two domains: 1) nonagricultural, 2) cropland.

Sampling Errors

Sampling errors are controlled by stratification, by survey design and by the sample size.

The simplest way to calculate the sampling errors is to calculate the sample variance—assuming a stratified or a simple random sample (SRS) is selected.

The formula applied is the well-known formula for the variance. In the case of systematic sampling the formula is not applied, because we have a sample of one random number.

Systematic sampling is used because it forces variation into the sample that would not be there if the sample were selected at random. The SRS variance formula overestimates the variance, in some cases quite extensively.

There are two types of errors that are present in all surveys—sampling and nonsampling. The ASF was developed to reduce such errors. Nonsampling errors associated with the sampling frame are vastly reduced because each parcel of land has a known probability of selection. In addition, the sample is clearly defined with aerial photos or enlarged satellite imagery so that data collection is understood and precisely defined.

Sampling errors are reduced due to stratification using satellite imagery. Land uses can be identified and used in the stratification process. Moreover, a systematic sample can be selected to reduce the true sampling errors even further. Use of ASF has tremendous advantages in controlling both types of survey errors.

Advantages of ASF

Data can be collected on many different types of items using area sampling frame technology. The survey design can be constructed to gather agricultural, socioeconomic and environmental data simultaneously.

In many cases, questionnaires and training manuals already exist which can be adapted with little modification.

Data Reliability

A statistic is only as reliable as its source. One might consider AAIC's first survey in Albania to be a pilot survey in the sense that Albanian farmers had not been surveyed by interview prior to this 1992 survey.

Under Communist control for nearly 50 years, Albanian crops were raised on land operated as state farms or cooperative farms. During this period crop production information was based on data from reports sent to the capital. These data were summarized as by-products from administrative records. No sampling was involved.

A point for consideration is were the responses of farmers interviewed affected by the economic and political climate. Were their estimates of yields influenced by past experience where it was politically expedient to overestimate?

AAIC has confidence in the level of performance of Albanian enumerators and supervisors selected to gather data. As a young, bright group who speak English, they had no difficulty acquiring skills presented in an intensive 3-day training session (2-day classroom; 1-day field trial).

Crop production education of small farmers is essential to bring Albania into a free market society

Conclusions/ Recommendations

The AAIC survey demonstrates that scientific technology can be applied using local personnel to gather data. Use of local personnel is desirable, both economically and in terms of "national buy-in."

1) The survey should be institutionalized in the Ministry of Agriculture and Food (MOAF) or other appropriate institutions responsible for statistical reports.

It is possible to conduct a (satisfactory) ASF within a short time frame (3 months in this case) providing technical expertise is sufficiently high to overcome inevitable challenges/barriers.

2) However, future surveys require that Stratum 2. be further stratified into at least two strata. The sample size should be doubled in Stratum 1. and quadrupled in Stratum 2.

A continuous survey cycle allows time series analysis to be performed. A one time survey has little value for planning strategies as it can not be compared to similar data.

National agricultural statistics increase in value when a data series can be obtained and compared to previous years within the survey country. Added value can be obtained by comparison of similar data from other countries.

3) Surveys should be conducted in May, June, August and December. These ASF data need to be linked with market news data, providing current supply and demand information to farmers and traders.

There has been environmental damage in Albania. The ASF with modifications could appropriatedly handle environmental monitoring.

4) Environmental monitoring should be instituted to include forested areas, soils, water quality, air quality and agricultural productivity.

Summary

We began this report by stating the need for U.S. involvement in developing agricultural policies that affect individual countries.

As a nation, Albania is now beginning to function in a free market society, i.e., in a post-communist environment. Western European countries and the United States use ASF methods to estimate crop production. It is desirable to develop ASF methods so data can be compared across years, among countries and across regions within Albania.

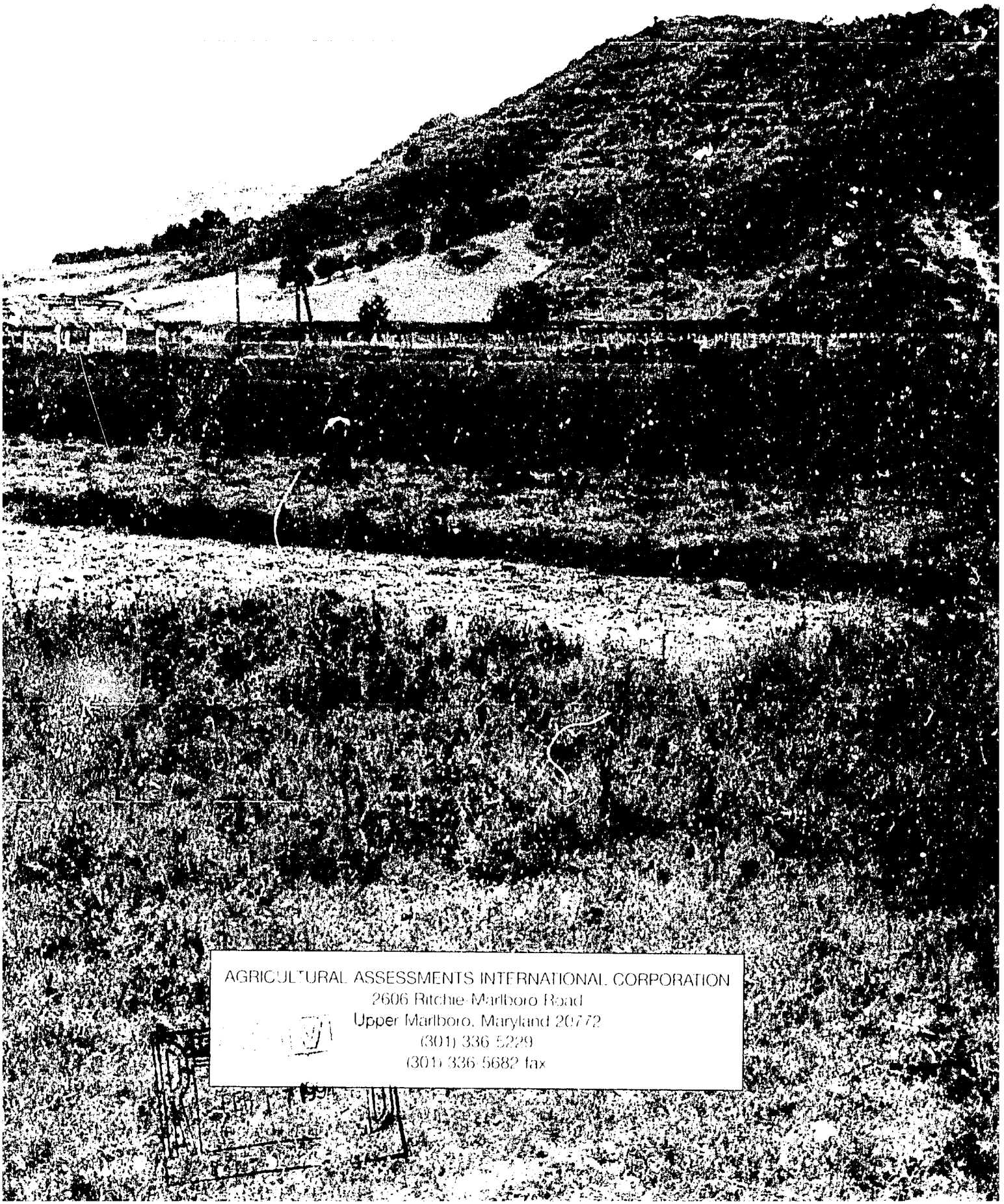
As Albania shifts to open market structures, improved agriculture production information (timeliness and accuracy) and access to this vital information becomes critical to the success of all involved—the agricultural community, governments and the consuming public.

Sample surveys are completely foreign to persons living with a centrally planned government. Statistics in Albania were gathered by a simple administrative by-product. State and cooperative farms were requested to send information to directing Ministries and the results were summarized.

Consequently, sample survey methods are completely foreign to them. Although many are well educated, they need training in sample survey methods.

If technology transfer is a long-term goal, then a rather long-term investment will be required. Emerging nations must be trained to develop and conduct surveys that can be sustained by national entities once outside support ceases.

The United States and other world powers must lead the way in aiding these nations in becoming more productive forces in a global market society.



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