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Summary Report

Area Sampling Frame and Crop Yield Surveys in Albania--1993

IFDC International Fertilizer Development Center

In Cooperation With
Ministry of Agriculture and Food, Albania

PN-ABR-538

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Area Sampling Frame and Crop Yield Surveys in Albania–1993

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Preface

Agriculture plays an important role in Albania's economic development and is likely to do so for many decades. Its contribution to the gross domestic product generally exceeds 50%. A large portion of the population is sustained by agriculture. Further, agriculture is an important foreign exchange earner and could also save foreign exchange by producing locally those agricultural products now imported into the country.

Due to the important position agriculture holds in the economic environment of the country, promotion of agriculture is now a key function of the Government. For success in promoting agriculture, planning is essential. No planning is meaningful unless backed by factual information. Thus, statistical data are required for any agricultural planning. Further, statistical data on agriculture are needed for assessing the requirements for food security, estimating the quantities available for exports and imports, and various other purposes.

During the past few years, the agricultural sector's composition in Albania has changed from state and collective farms to private farms. The agricultural land transferred by the Government amounts to about 76% of the total agricultural land. Estimates of agricultural production, agricultural resources, and rapid assessment of these statistics and reports of periodic indicators are now required in Albania. Sampling strategies based on reliable frames and probability sampling schemes will contribute to speeding the process in obtaining reliable estimates. Surveys based on area sample frame methodology represent an appropriate strategy for the establishment of a monitoring system to continuously evaluate agricultural productivity and facilitate policy decisions for projecting future developments of the Albanian agricultural sector.

The present publication contains the results and methodology for area estimation of agricultural land in Albania during the 1993 cropping season. The publication outlines a methodology for survey, data collection, and analysis of land areas and suggests the establishment of a national statistical system for agriculture related purposes. The system is designed to be similar to those currently used throughout Western Europe and the United States.

The area sample frame designed for Albania will enable agricultural officers and survey designers to select representative samples and collect data for a variety of purposes. There is no doubt that aspects of the area frame methodology and th proposed agricultural statistical system need to be refined and implemented in the future. Continued improvements throughout training and repeated surveys are part of the system design. As surveyors and field enumerators become more skilled in data collection and management, and as personnel in the Ministry of Agriculture and Food gain fuller understanding of the methodology and applied concepts behind the system, the proposed system will evolve, being uniquely adapted to Albania's conditions, needs, and resources.

This publication includes the results of hard work performed in 1993 by about 300 Albanian enumerators and interviewers of the Ministry of Agriculture and Food. It also includes many ideas and suggestions taken from preliminary reports from agricultural consultants and Albanian officers. A list of contributors is included in a separate section.

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Acronyms

AAIC	Agricultural Assessments International Corporation
ASF	Area Sampling Frame
DSS	Data Decision Support System
GIS	Geographic Information System
IFDC	International Fertilizer Development Center
MOAF	Ministry of Agriculture and Food
MIS	Management Information Systems
MFS	Multiple Frame Sampling
PSU	Primary Sampling Unit
SU	Secondary Sampling Unit or Segment
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

Summary Report

Area Sampling Frame and Crop Yield Surveys in Albania

Introduction

Since 1991, Albania's agricultural sector has been assisted through "Support to Restructuring Albania Fertilizer Subsector," programs implemented by the International Fertilizer Development Center (IFDC) and funded by the United States Agency for International Development (USAID). One objective of these programs is to help and support Albania's development of stable, viable agricultural production through establishing and institutionalizing agricultural information systems, to be managed by Albania's Ministry of Agriculture and Food (MOAF).

In 1992, IFDC contracted with the Agricultural Assessment International Corporation (AAIC) to construct an area frame for agricultural survey purposes in Albania and conduct the first area crop survey. The objective was to estimate crop areas and determine production of wheat. During 1993, the MOAF in collaboration with IFDC and AAIC undertook a second area survey to estimate agricultural land and fertilizer use, develop techniques to forecast wheat and maize production, and enhance the ASF technology through refinement of previous land stratification and sampling. The main goal was to provide an efficient technique that would improve future surveys and sampling strategies in the country.

The minimum requirement for the application of the area frame survey was maps and satellite imagery for dividing the land area into strata and small area sampling units or segments that have clear physical boundaries and could be accurately identified by an interviewer. The sampling units were randomly allocated to the strata. The area frame and an associated computerized system were designed and implemented in a manner that will allow the sample unit of information to be digitally stored and will facilitate estimation of parameters and sample analysis. The system has been designed to support users' needs for agricultural statistics including cropped land, agricultural resources, and selected socioeconomic indicators. Methods of preparing statistics for agriculture are discussed in Appendix A.

The area sampling frame constructed has unlimited potential uses in Albania. Future surveys of populations associated with land, based on this area frame, can be composed of reporting units. The reporting units are households, persons, farms, crops, livestock, suppliers of agricultural inputs, storage facilities, processors of agricultural products, or any other definable reporting unit that can be uniquely associated with area or spatial data. Adaptability to particular agricultural statistical uses and versatility are strong attributes of the area sampling frame developed.

Construction of the Area Sampling Frame

1. Area Frame Design

The primary objectives of the area frame design in Albania were to provide the basis for periodically estimating cropland areas for major crops, forecast the production of crops, and determine products and amounts of fertilizer applied during the cropping season. A long-term objective is to provide the basis for the establishment of a national agricultural statistical system for monitoring and reporting agricultural development.

For the design and construction of the area frame across the country (Figure 1), maps were needed as well as available reports on topographic features, crop production, crop and fertilizer management, fertilizer use, and intensity of land use in the country. The main source material used consisted of maps with the following characteristics:

- 1:200,000 scale, topographic features of the country.
- 1:250,000 scale, thematic maps of the country.
- 1:50,000 scale, thematic maps of selected areas and regions.
- 1:10,000 to 1:25,000 scales, thematic maps of selected segments.
- Landsat satellite imagery at scale 1:250,000.

Maps and satellite imagery such as Landsat thematic mapper have proven useful for estimating land areas as well as for land stratification. They were used to stratify the country, identify agricultural resources in low and mountainous areas, locate permanent physical boundaries, and for preliminary assessing of land areas. The use of satellite data promoted efficient ground sampling and served as a powerful supplement to traditional on-the-ground techniques. Most of the

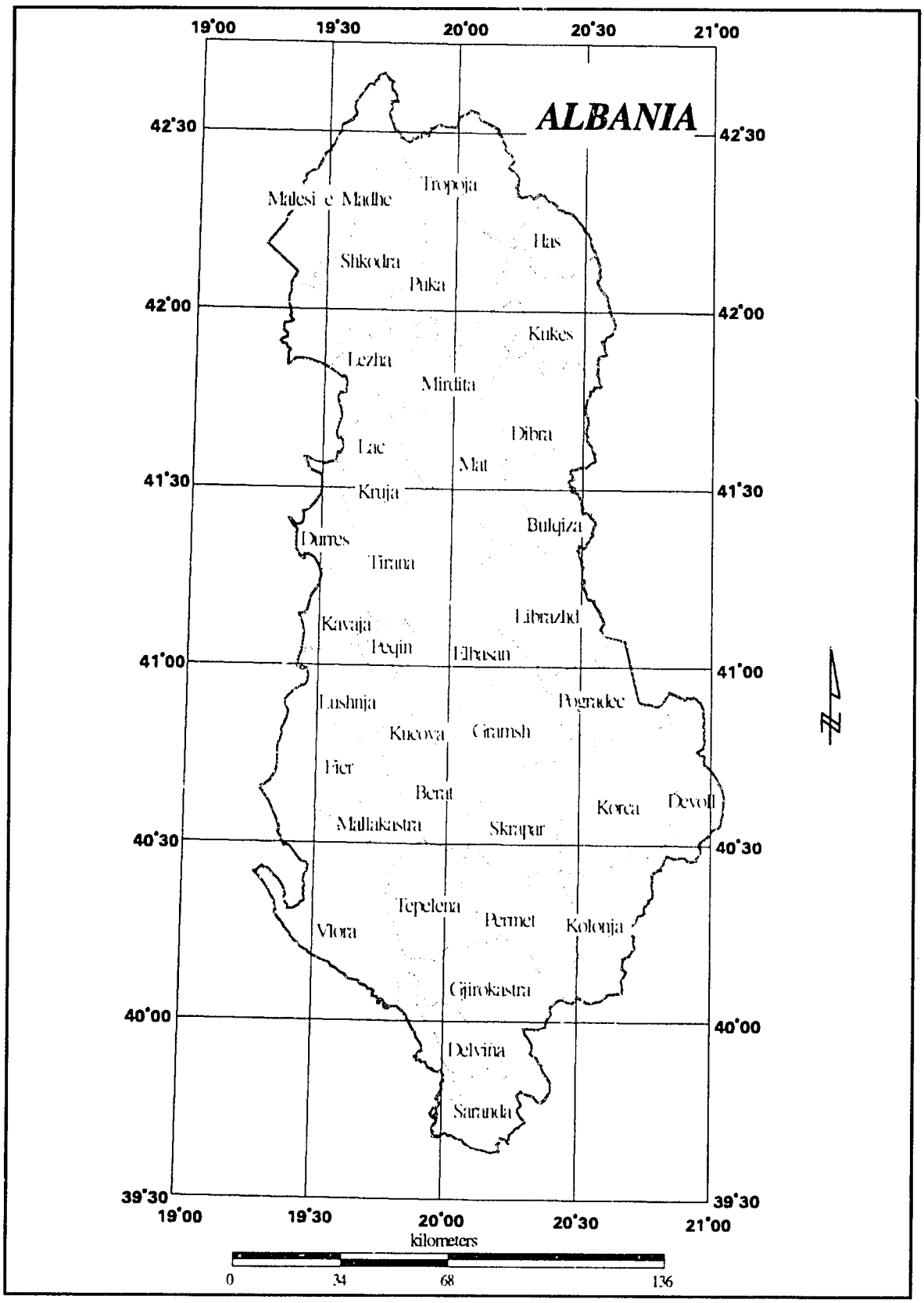

Figure 1. Administrative Districts in Albania.

maps used in the surveys were found in the country. The satellite images required were obtained abroad at very reasonable costs.

Using the map resources, personnel from MOAF's Soil Research Institute in Albania, IFDC, and AAIC identified and allocated land into eight different strata. This stratification was done to increase the reliability and precision of the area estimates and to reduce the required sample size necessary to represent the country. The strata were then transferred to maps with minor changes so that the boundaries would correspond to the features clearly identifiable on the ground. The following strata were identified (Figure 2):

1. Coastal, low, and level land with intensive agriculture.
2. River valleys and foothills with intensive agriculture.
3. Upland hills with diversified agriculture.

4A. Low mountain areas with limited agriculture.

4B. High mountain areas with little or no agriculture.

5. Water ponds, rivers, lakes.
6. Military areas.
7. Populated places or major cities.

The strata 1, 2, 3, 4A, and 4B were the main strata defined and surveyed. These strata characterize agricultural land in Albania. The objective was to create a permanent frame, useful and efficient for current and future agricultural statistical monitoring in the country. Strata 5, 6, and 7 were not surveyed. Those strata were determined to permit strict control of the number of sampling units assigned to the agricultural land strata.

Once strata were delineated, the land area in each stratum from 1 to 4B was divided into identifiable smaller adjoining areas or units for sampling or subsampling purposes. The sampling units of an area frame consist of units of land that in the aggregate comprise the total area of a geographic area or region. The following sampling units were identified:

- Primary sampling units (PSUs).
- Secondary sampling units (SUs) or segments.
- Tracts or fields owned or managed by farmers.

The PSUs (Figure 3) are area aggregates with imaginary boundaries used as first-stage of sampling. The PSUs were numbered, listed, and measured several times to accurately determine their size. Sampling of PSUs was then performed using probability sampling procedures. The selected PSUs are presented in Figure 4. Two secondary sampling units or segments were assigned at random to each of the selected PSUs. The selected segments, such as the ones presented in Figures 5 and 6, were referred to as pieces of land with clear natural boundaries that could be located on the ground, measured, and clearly drawn on a photo or delineated on a map. The selected segments were initially marked on satellite enlargements and maps at scales varying from 1:10,000 to 1:50,000.

Each surveyor received then a map at scale 1:25,000 detailing the location and the boundaries of the sampled segment. Examples of selected segments and some details of physical boundaries are presented in Figure 6. The surveyor located the segment, identified and measured the tracts or fields, and interviewed all the farmers in the tracts.

The tract was the smallest portion or subdivision of a selected segment used for reporting or interviewing. It was defined as the area of land operated by one person (or under the control of one entity such as a partnership, cooperative, state farm, etc.). It was either an entire farm, part(s) of a farm, or a nonfarm area or piece of land. The tract was differentiated in the segment by the crop grown, the current land management, and the boundaries of the segment. A segment was generally composed of one or more tracts and/or farms. In locating segments, interviewing, and measuring tracts, the surveyor used the following methods or instruments: (1) passing, (2) tapes and chains, (3) optical distance measures/rangematic instruments, and (4) questionnaires. Details on questionnaires used are presented in Appendix B.

Table 1 contains the main sampling characteristics of the land area surveyed. Stratum 3 accounted for about 42% of the total land area in Albania, which is considerably larger than any other stratum. The first two strata, which represent areas with intensive agriculture when combined, accounted for one-fourth of the total land area of the country. Together, the five delineated strata accounted for approximately 96% of Albania's total land area. The remaining 4% includes nonagricultural areas such as lakes and other water areas, military complexes, and large cities, which were not sampled or surveyed. The total number of PSUs was 1,551 of which 678 or about 44% were in the strata with intensive agriculture. The total number of segments was 53,424 of which 46% were in the strata with intensive agriculture. The total sample size was 210 segments which is about .4% of the total number of segments and 14% of the total number of PSUs composing the ASF in the country.

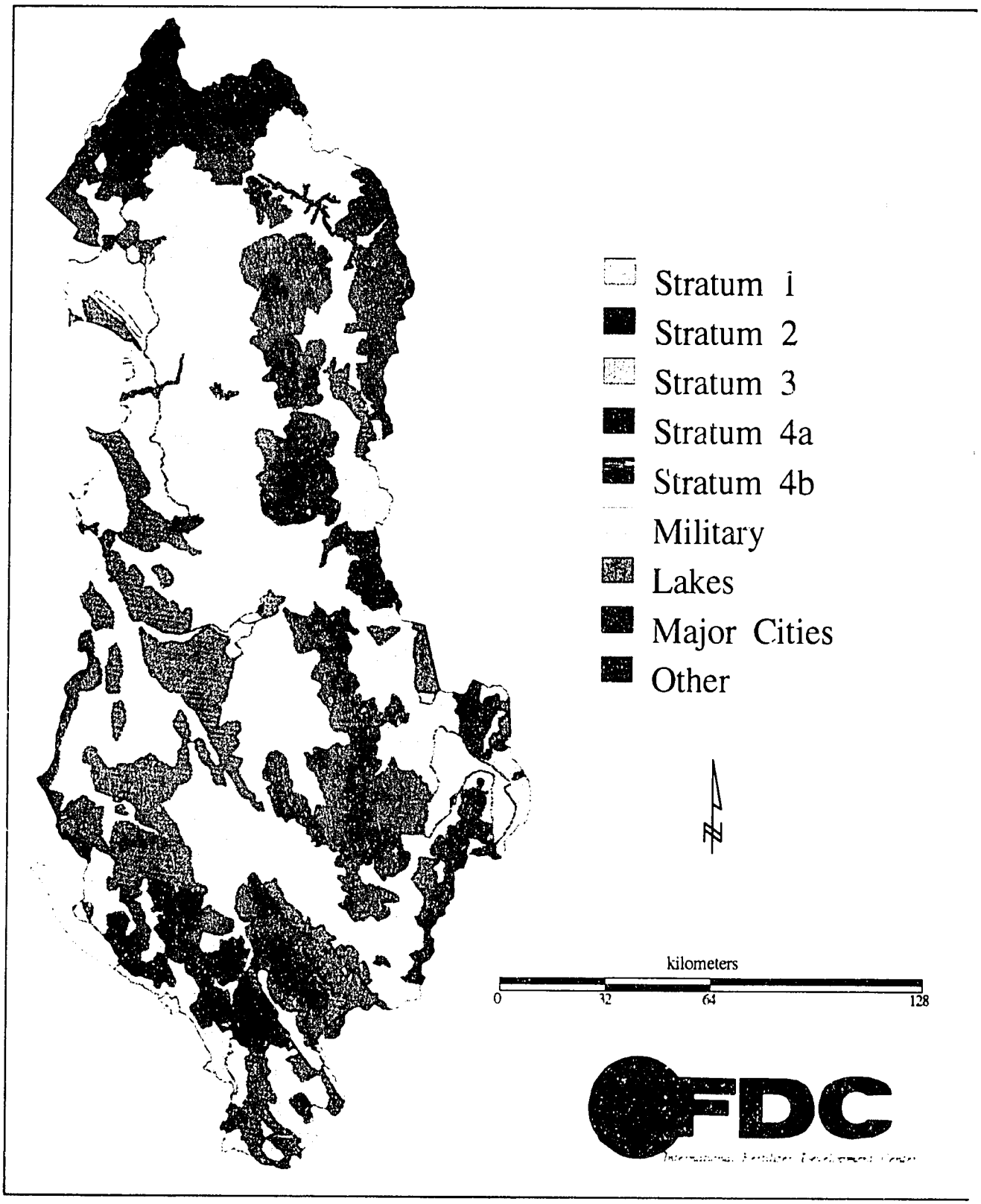

Figure 2. Albania Land Area Stratification.

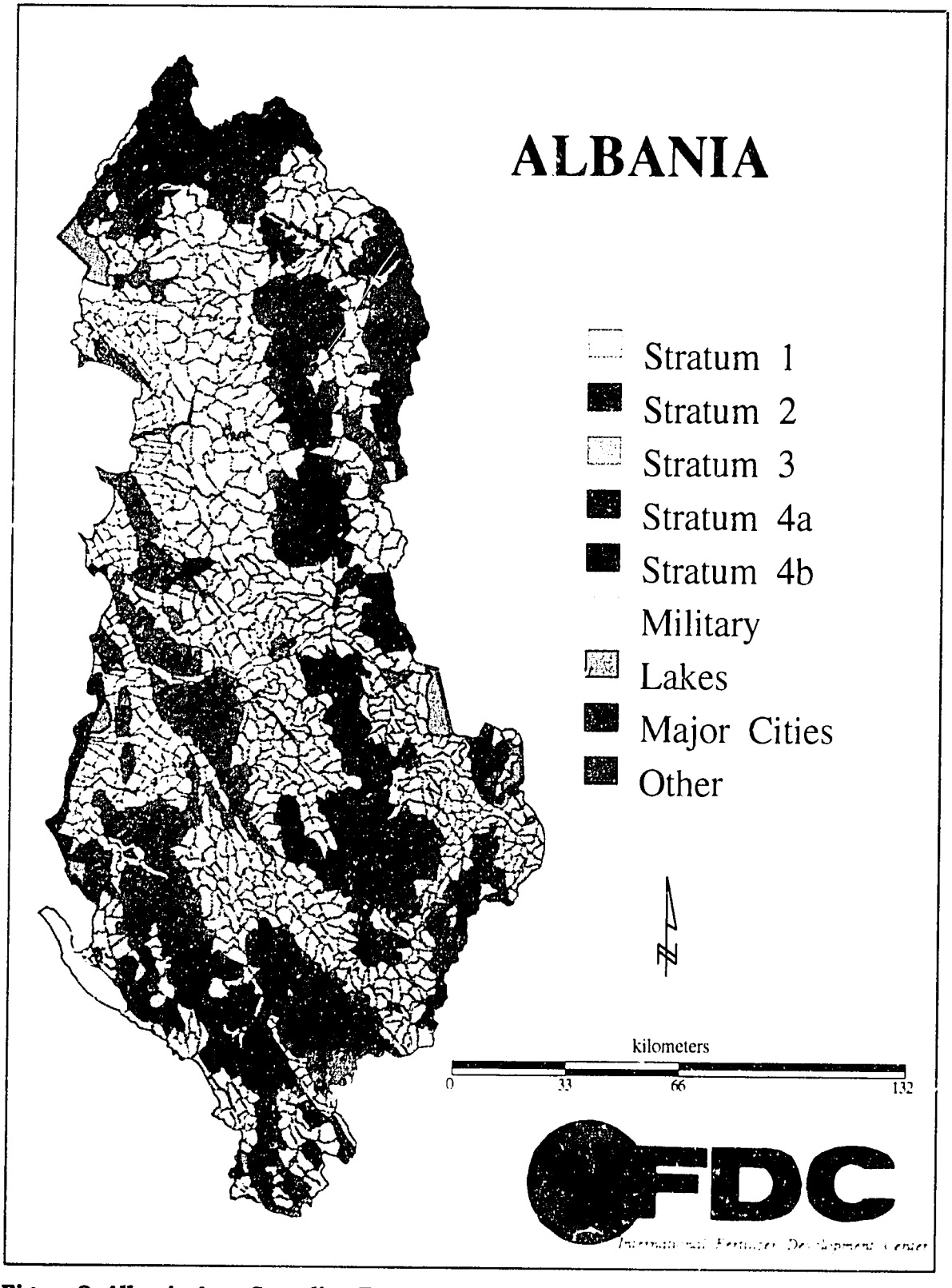

Figure 3. Albania Area Sampling Frame—Primary Sampling Units (PSUs).

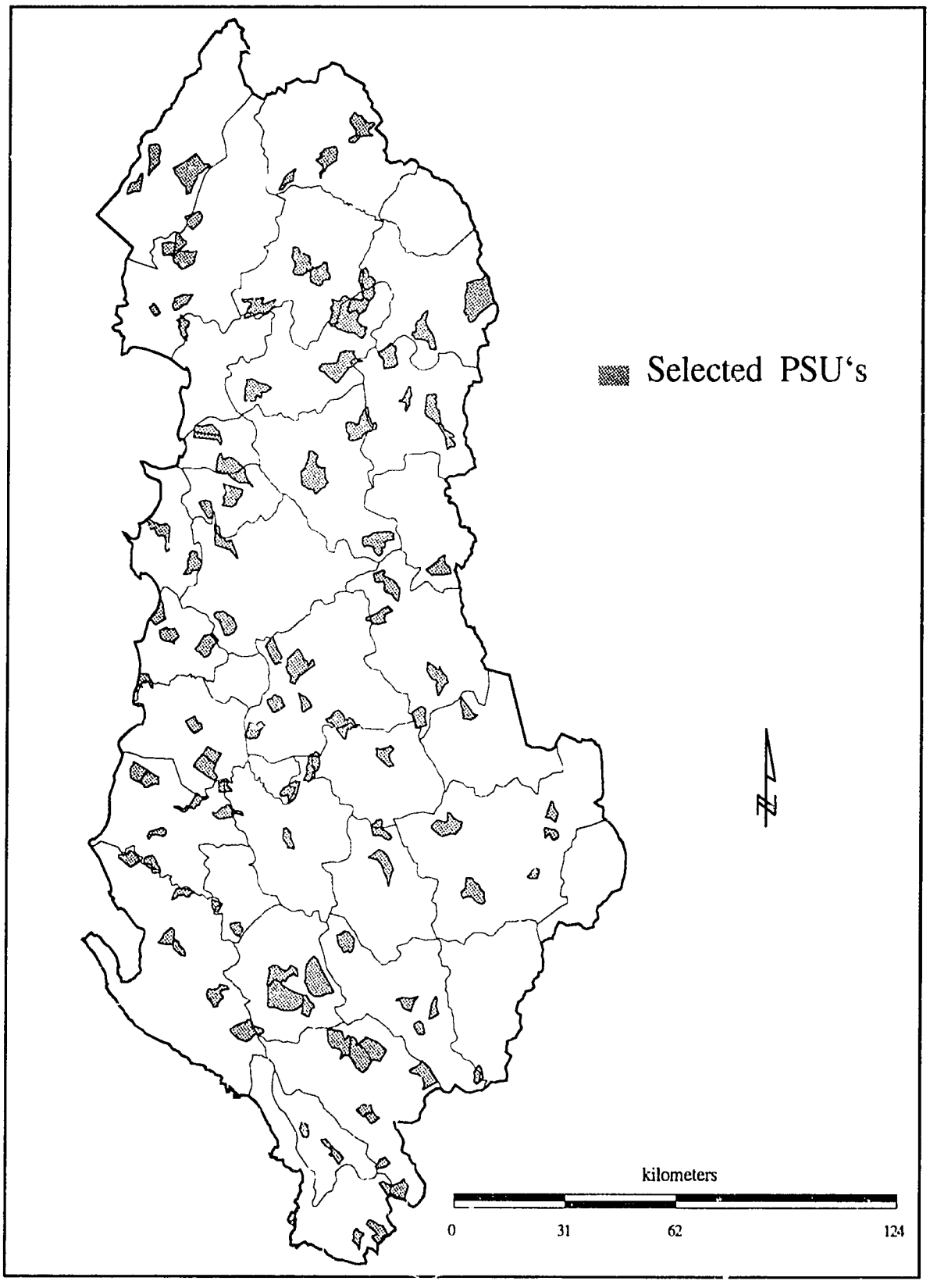

Figure 4. Selected PSUs for Total Area Estimations.

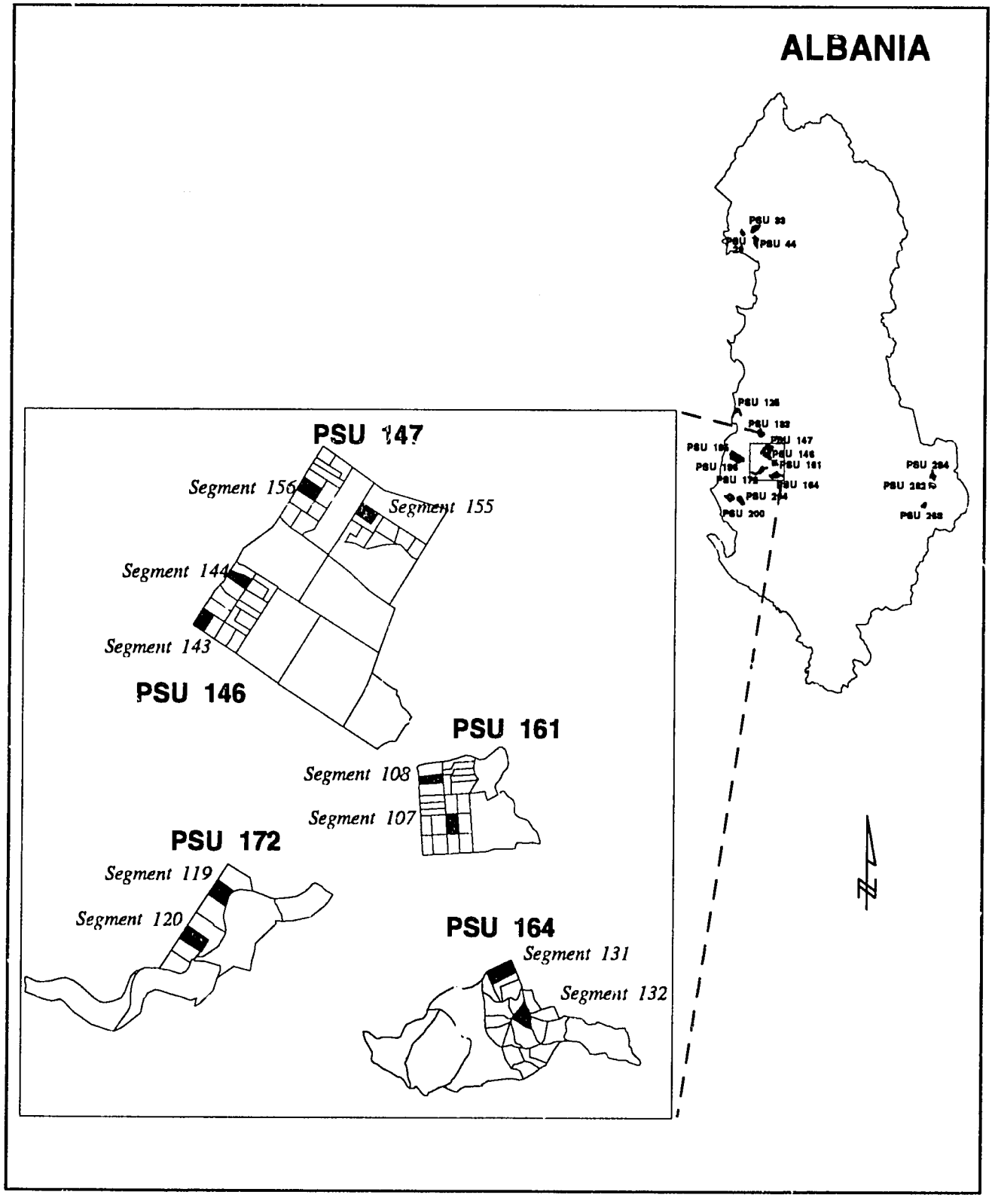

Figure 5. Selected Segments Within PSUs.

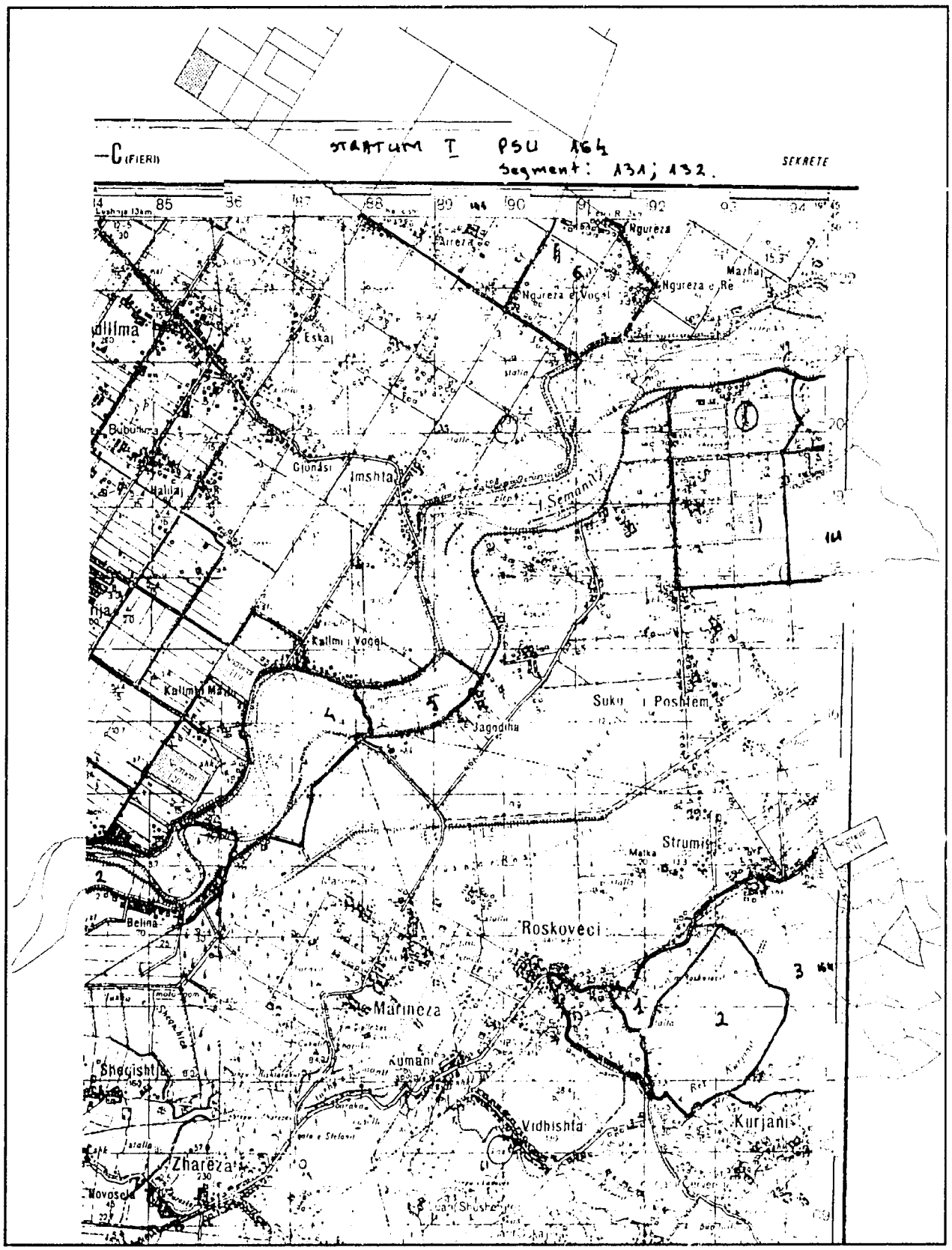

Figure 6. Albania Section Map With Example of Segment and Tracts.

Table 1. Frame Construction and Sampling Elements, ASF 1993

Stratum	Land Area (% of Total)	Number of Primary Sampling Units (PSUs)	Number of Secondary Sample Units (SUs)	Target Sample Unit Size (ha)	Number of Sample Units (Segments) Selected
1	11	293	10,902	25	60
2	13	385	13,684	25	40
3	42	601	21,539	50	70
4A	10	87	2,474	100	20
4B	19	185	4,825	100	20
Total	96	1,551	53,424		210

2. Size of Sampling Units

Factors to consider when defining the number and size of the sampling units in ASF include: sampling variability, costs, problems associated with identifiable permanent boundaries, the size and number of farms, and topographic details of the areas. Cost considerations have often given rise to strong intuitive impressions that favor SUs that are larger than they should be. This comes from the fact that, for a given cost, more farms can be included in the sample when the SUs are large.

An optimum size of sampling units is difficult to define and determine in practice, especially when estimates are calculated for many crops and for several domains as well as for the whole country. The size of the sampling units in Albania's ASF depended mainly on the intensity of cropping, the farm size, the number of farms and the topographic details differentiating segments. The main criteria used to assess the size of sampling units for strata with intensive agriculture was to have segments containing from 10 to 15 farms—assuming a farm size ranging from 1.0 to 1.5 ha. Since agriculture is sparse in the hills and mountain regions, the criteria for strata 3 to 4B was to select segments containing at least 10 farms. In general, the objective was to have a segment large enough to have variability but not so large that it had significant duplication. Although it was desirable to have segments small enough to be surveyed as rapidly as possible, it was noticed that, as the size of the segment decreased, the topographic features suitable for use as segment boundaries became less prevalent.

Depending on the number and size of the segments, the size of the PSUs varied from 400 to 1,000 ha across the strata. The average size of the PSUs was approximately 700 ha. The target size of the segments varied across the strata. In strata 1 and 2, the segment target size was 25 ha. In stratum 3, the segment target size was 50 ha. In strata 4A and 4B, the segment target size was 100 ha (Table 1). Because the sample units must have identifiable permanent boundaries, actual segment sizes can vary a little from the target sizes.

To increase the precision of estimates in the sample and to improve the efficiency of surveys for future land area evaluations or crop acreage monitoring, the number of segments or the size of the segments per stratum may need to increase or change. To determine if those changes are necessary, estimation of the mean square errors in areas for segments and tracts within segments will be required. The mean square error is a combination of the sampling variance and a bias generally associated with segment boundary determination.

An analysis was made to determine whether the number of segments or the size of the segment for each stratum needed to be changed in future surveys in the country. The analysis was done by comparing the mean square error in land areas among segments for each stratum with the mean square error of the tracts or fields within the segment. The comparisons were expressed in terms of variance ratios. A high variance ratio means more variability between segments than within segments; thus, the number of segments may need to increase. A very low value of the ratio means more variability within the segment than between segments; thus, the number of tracts/farms or the size of the segments may need to increase.

Results in Table 2 show the variance ratios for three important crops in the country: wheat, maize, and vegetable crops. The variance ratios for wheat range from 4.2 for stratum 1 to 1.5 for stratum 4B. Ratios for maize changed from 3.1 in stratum 1 to 0.7 in stratum 3. The ratios for vegetable crops changed from 5.5 in stratum 1 to 1.7 in strata 4A and 4B. These results suggest that, for future land area surveys, the size of the segments in the strata will not have to be changed but the number of segments or the sample size should be increased, principally in strata 1 and 2. The approximate number of segments required for future surveys will depend on the above

Table 2. Segment and Tract Area Variability for Main Crops, ASF 1993

Variance	Stratum 1	2	3	4A	4B
Wheat:					
Segment Variance	0.96	1.11	0.57	0.38	0.030
Tract Variance	0.23	0.31	0.15	0.11	0.020
Variance Ratio	4.17	3.58	3.80	3.38	1.500
Mean Tract Area (ha)	0.10	0.08	0.06	0.03	0.001
Maize:					
Segment Variance	0.66	0.31	0.91	0.23	0.170
Tract Variance	0.21	0.14	1.35	0.15	0.150
Variance Ratio	3.14	2.21	0.70	1.53	1.130
Mean Tract Area (ha)	0.05	0.05	0.06	0.06	0.050
Vegetables:					
Segment Variance	0.11	0.11	0.04	0.05	0.050
Tract Variance	0.02	0.06	0.02	0.03	0.030
Variance Ratio	5.50	1.83	2.00	1.70	1.700
Mean Tract Area (ha)	0.01	0.01	0.06	0.01	0.012

Note:
The variance ratio is the value that results from dividing the variance of the segments of a specific stratum and crop by the variance of the tracts or fields within the segments.

The tracts are different fields with the same crop operated by the same or different farmer.

The tract mean is the average value of the area operated by farmers in one segment.

variance ratios, the required precision of estimates, costs, problems associated with the boundaries and identification of segments, the type of survey, and the domain of variables included in the survey.

3. Coverage of the ASF

Conceptually, the area sampling frame is always current and complete with regard to any definition of the reporting unit. For example, the area sample of segments is a sample of segments as they are clearly defined and exist at the time of the survey. The sample then can be expanded to estimate the total area. The estimate of total area based on the sample of segments is defined as:

$$X = (N/n)*\Sigma x$$

where X = The estimated total for a measured area.

N = The total number of segments per stratum.

n = The number of sampled segments per stratum.

Σx = The total area for all reporting units (tracts) associated with the sample of n segments.

This estimate is considered as an unbiased estimate of the total area for the stratum or crop regardless of how the reporting unit is defined.

In practice, however, the major problem for estimating total area is the bias associated with the coverage of the area sampling frame. If a selection of an area sample is made and (N/n) or (N) are expansion factors, the fieldwork in locating the segment and identifying, measuring, and associating reporting units (farms, fields, or tracts) with each segment in the sample must be performed with great care. If the identification of farms, fields, or tracts is incomplete or is not done correctly, the actual sampling fraction with regard to the number of farms in the sample in relation to the population of farms will not be (n/N). Therefore, $(N/n)*\Sigma x$ will not be an unbiased estimate of the population total or total area.

Unbiased estimation of total areas in ASF is then conditioned to clear definition of segments and proper localization of segment boundaries in the stratum. It also requires proper identification and careful measuring of the reporting units or tracts in the segment. The area frame constructed in Albania and the area survey performed complied with the above conditions and, thus, minimized the coverage error. A lot of work was

involved in estimating the segment size, in sampling, and in locating PSUs and segments on maps. Training activities were carried out in different areas of the country to prepare surveyors in proper identification of reporting units as well as in using measure methods to correctly specify crop areas or land use areas within the segments.

It is assumed, therefore, that the country has a reliable instrument that can be used to provide efficient and unbiased estimates of total acreage for major crops, and that it can be used in the future for sampling other agricultural resources associated with segment areas such as livestock, provided that the reporting units are clearly identified and measured. It could also be used in social, economic, and environmental studies since most of the data collected are within a spatial context. ASF approach could be efficiently used for supporting estimations, analyses, and information in socioeconomic surveys, marketing strategies, and forest resources; for monitoring crop production; and for assessing environmental changes.

4. Upgrade of the ASF

The area frame does not become out-of-date in terms of coverage of a population, unless the population extends into areas not covered by the frame. Changes or upgrades in land use, or number and location of sampling units, have a bearing on sampling variability but do not introduce bias. Some boundaries of sampling units will lose identity as time passes. This will increase the potential for bias as a result of ambiguity of boundary locations.

There are some possible reasons for upgrading the area frame already constructed in Albania: (1) The number of segments can be increased over time to reduce variability and increase the precision in the estimates of selected agricultural surveys or other sampling activities and (2) new or updated maps could be available in the country and could be used to achieve better boundaries of the sampling units in the frame.

Upgrades of the area frame should be done as needed. The MOAF in Albania should take full responsibility for these activities. Upgrading will be required to maintain the coverage of the frame, associate the frame with the current cadastral systems, and, overall, support the future implementation of a national agricultural statistical system.

Results of Total Agricultural Area Survey Using ASF

1. Agricultural Land Area

Based on the area frame constructed and probability sampling selection of segments, a survey was conducted from May 20 to July 17 of 1993. The survey dates coincided with the harvesting dates for winter crops and with the seeding dates for summer crops. Questionnaires for the survey were developed, tested, and used to estimate crop areas and fertilizer use for the total agricultural land of the country. A summary of the interviewer's guide and the questionnaires is presented in Appendix B. MOAF economists, statisticians, and agronomists, located in the vicinity of the selected segments, were trained in survey data collection methods. Evaluation of data indicated that the MOAF specialists collected quality data.

The data of the survey were recorded, edited, and processed. A computerized system was developed to manage and analyze the data. The system consists of attribute and geographic databases on land use areas, cropping cycles, and fertilizer product use. The following databases were constructed:

TRACT: Database system for tract identification

FIELD: Database system for land areas, crop production, and fertilizer resource use

ASF: Geographic database (GIS) including PSUs, SUs, tracts, districts, and other coverage for the country.

The database systems have relational structures and can be upgraded to include more attributes or coverage. They will be helpful for sampling design in future MOAF surveys and for supporting future management information and data decision support systems in the country.

The results of analysis of data from the area survey were summarized in tables. Tables 3 to 7 include the breakout of cropland into the strata and statistics of areas for each stratum and land use. The tables include the total and the average area of the sampling units or segments, total area of crops and other agricultural resources in the stratum, and the total land area. The total land area includes agricultural land resources, pastures, land in forest, and unproductive land. Arable land, composed principally of row and cereal crops, and tree crops composed of vineyards, fruits, and olives were considered as the

major agricultural land resources. Arable land and tree crops are also expressed in the tables as percentage of agricultural land. The tables are useful for future sampling designs and for comparisons with other area surveys using the same frame.

The tables indicate arable land occupying between 60% and 90% of the total agricultural land. Some areas surveyed as arable crops were termed "idle" because they were not used by farmers during the cropping season covered by the survey. Other areas with arable crops such as rice were not properly identified, and/or some crops were mixed or intercropped, making it difficult to estimate the crop areas. This arable land, termed "Other crops," should be more clearly identified and measured in future surveys. Some important statistics from the tables are as follows:

- The agricultural land in stratum 1, which includes the coast, low, and level land areas of the country, is mostly occupied by grain crops (Table 3). Winter wheat and maize are being cropped in 118,683 ha, about 45% of the agricultural land in the stratum. Dry beans and vegetables are other important crops in this stratum, using 9% of the agricultural land.

Table 3. Estimates of Agricultural Land Areas in Stratum 1, Area Survey 1993

Land Use	Total of Segments (ha)	Average of Segments (ha)	Total of Stratum (ha)	Percentage of Agricultural Land
Agricultural Land	1,449.4	24.16	263,355	100.0
Arable Land	1,306.0	21.77	237,297	90.1
Winter Wheat Harvested	422.8	7.05	76,815	29.2
Maize Planted	230.4	3.84	41,867	15.9
Alfalfa	153.5	2.56	27,887	10.6
Fodder	57.0	0.95	10,359	3.9
Oats	7.1	0.12	1,296	0.5
Barley	7.6	0.13	1,372	0.5
Dry Beans	53.1	0.88	9,645	3.7
Soybeans	0.3	0.01	55	0.0
Sunflower	1.7	0.03	303	0.1
Sugar Beets	9.0	0.15	1,633	0.6
Potatoes	11.2	0.19	2,042	0.8
Tobacco	25.2	0.42	4,582	1.7
Cotton	8.6	0.14	1,554	0.6
Vegetables	74.4	1.24	13,511	5.1
Other Crops	7.4	0.12	1,339	0.5
Idle	236.9	3.95	43,036	16.3
Tree Crops	143.4	2.39	26,058	9.9
Vineyards	53.2	0.89	9,665	3.7
Fruits	82.1	1.37	14,918	5.7
Olives	8.1	0.14	1,475	0.6
Pasture	75.7	1.26	13,758	
Total Land			318,929	

Note:
Number of segments sampled = 60
Total number of segments in stratum = 10,902

Alfalfa and fodder are cropped in 15% of the land, and tobacco was found in 1.7% of the agricultural land. The total agricultural land area in this stratum potentially available for intensive agriculture, including tree crops, is 263,354 ha. This is 83% of the total land area in this stratum. About 4% of the total land area in this stratum is used in pastures, and 13% is land not used and considered idle or abandoned land.

- Winter wheat and maize are also predominant crops in stratum 2 (Table 4). These two crops occupy 63,935 ha which cover 35% of the agricultural land in this stratum, characterized by fertile soils located on river valleys and foothills of the country. Alfalfa and fodder occupy about 8% of the agricultural land in this stratum. Dry beans and vegetables are cropped in 5% of the agricultural land. Tobacco is an important crop in this area and is cropped in 3% of the agricultural land. Tree crops are one of the main resources in the farming systems in this stratum and occupy about 32% of the agricultural land. The total land area in this stratum potentially available for intensive agriculture, including tree crops, is 177,334 ha. This is 46% of the total land area in the stratum.

Table 4. Estimates of Agricultural Land Areas in Stratum 2, Area Survey 1993

Land Use	Total of Segments (ha)	Average of Segments (ha)	Total of Stratum (ha)	Percentage of Agricultural Land
Agricultural Land	518.37	12.959	177,334	100.0
Arable Land	355.00	8.867	121,336	68.4
Winter Wheat Harvested	111.50	2.788	38,144	21.5
Maize Planted	75.39	1.885	25,791	14.5
Alfalfa	16.88	0.422	5,775	3.3
Fodder	22.40	0.560	7,663	4.3
Oats	3.89	0.097	1,331	0.8
Barley	0.20	0.005	68	0.0
Dry Beans	8.68	0.217	2,969	1.7
Soybeans	0.02	0.001	7	0.0
Sunflower	1.34	0.034	458	0.3
Sugar Beets	0.10	0.003	34	0.0
Potatoes	5.18	0.130	1,772	1.0
Tobacco	15.26	0.382	5,220	2.9
Cotton	0.00	0.000	0	0.0
Vegetables	16.00	0.389	5,316	3.0
Other Crops	5.20	0.130	1,779	1.0
Idle	73.10	1.828	25,008	14.1
Tree Crops	163.69	4.092	55,998	31.6
Vineyards	14.34	0.359	4,906	2.8
Fruits	35.65	0.891	12,196	6.9
Olives	113.70	2.843	38,897	21.9
Pasture	277.19	6.930	94,827	
Total Land			381,862	

Note:
Number of segments sampled = 40
Total number of segments in stratum = 13,684

About 15% of the land area in the stratum is used in pastures and 7% is land not used and considered idle or abandoned land.

- Statistics for stratum 3 are presented in Table 5. This stratum includes agricultural systems located in upland hills with diversified agriculture and intensive livestock production. Maize and winter wheat are cropped in 73,469 ha or 43% of the agricultural area. Dry beans and vegetables occupy about 10%, and tobacco is cropped in 1%. Alfalfa and fodder occupy about 11% of the land predominantly used for livestock. Potatoes appear to be another important resource in the agricultural systems of this stratum and are cropped in 4% of the agricultural land. Fruit trees are another important resource in this stratum. The land used by tree crops is about 12% of the agricultural land, and fruit trees are cropped in 6% of this area. The total land area in this stratum potentially available for intensive agriculture, including tree crops, is 171,000 ha. This is 14% of the total land area in the stratum. Pasture is another important resource for livestock production in the area. Pastures occupy 103,655 ha, about 10% of the total land in the stratum.

Table 5. Estimates of Agricultural Land Areas in Stratum 3, Area Survey 1993

Land Use	Total of Segments (ha)	Average of Segments (ha)	Total of Stratum (ha)	Percentage of Agricultural Land
Agricultural Land	560.42	8.006	171,000	100.0
Arable Crops	495.72	7.082	151,258	88.5
Winter Wheat Harvested	119.15	1.702	36,356	21.3
Maize Planted	121.63	1.738	37,113	21.7
Alfalfa	33.66	0.481	10,271	6.0
Fodder	27.56	0.394	8,409	4.9
Oats	9.60	0.137	2,929	1.7
Barley	0.90	0.013	275	0.2
Dry Beans	15.72	0.225	4,797	2.8
Soybeans	0.00	0.000	0	0.0
Sunflower	0.00	0.000	0	0.0
Sugar Beets	0.00	0.000	0	0.0
Potatoes	19.12	0.273	5,834	3.4
Tobacco	5.53	0.079	1,687	1.0
Cotton	0.00	0.000	0	0.0
Vegetables	38.75	0.554	11,824	6.9
Other Crops	10.82	0.155	3,301	1.9
Idle	93.28	1.333	28,462	16.6
Tree Crops	64.70	0.924	19,742	11.5
Vineyards	9.06	0.129	2,764	1.6
Fruits	33.61	0.480	10,255	6.0
Olives	22.03	0.315	6,722	3.9
Pasture	339.71	4.853	103,655	
Total Land			1,218,499	

Note:
Number of segments sampled = 70
Total number of segments in stratum = 21,539

- Tables 6 and 7 include statistics of distribution of agricultural land in the mountains (low and high) for strata 4A and 4B. This land is mostly occupied by pastures and forest. Pastures occupy 217,677 ha, about 25% of the total land area in these two strata. The agricultural land potentially available for agriculture is 50,555 ha. This is about 6% of the total land area in the two strata. Maize and vegetables are the main food crops. Maize and vegetables are cropped in 19% and 8%, respectively, of the agricultural area in the two strata. Fruit trees occupy 35% of agricultural area in the low mountains and about 17% in the high mountains. Idle land is 17% of the agricultural area in the low mountains and 25% in the high mountains.
- Table 8 contains summary results of crop areas and total land distribution based on the land survey conducted in Albania during 1993. Included in Table 8 are estimations of total agricultural land, pasture, forest and unproductive land, lakes, and land for military use and for major cities. A few areas were not completely

Table 6. Estimates of Agricultural Land Areas in Stratum 4A, Area Survey 1993

Land Use	Total of Segments (ha)	Average of Segments (ha)	Total of Stratum (ha)	Percentage of Agricultural Land
Agricultural Land	333.70	16.685	41,279	100.0
Arable Land	216.11	10.806	26,733	64.8
Winter Wheat Harvested	31.28	1.564	3,869	9.4
Maize Planted	59.90	2.995	7,410	18.0
Alfalfa	11.22	0.561	1,388	3.4
Fodder	9.81	0.491	1,213	2.9
Oats	9.96	0.498	1,232	3.0
Barley	0.26	0.013	32	0.1
Dry Beans	6.20	0.310	767	1.9
Soybeans	0.00	0.000	0	0.0
Sunflower	0.00	0.000	0	0.0
Sugar Beets	0.00	0.000	0	0.0
Potatoes	5.26	0.263	651	1.6
Tobacco	0.00	0.000	0	0.0
Cotton	0.00	0.000	0	0.0
Vegetables	21.34	1.067	2,640	6.4
Other Crops	4.31	0.216	533	
Idle	56.57	2.829	6,998	17.0
Tree Crops	117.59	5.880	14,546	35.2
Vineyards	0.13	0.007	16	0.0
Fruits	117.46	5.873	14,530	35.2
Olives	0.00	0.000	0	0.0
Pasture	363.20	18.160	44,928	
Total Land			278,059	

Note:
Number of segments sampled = 20
Total number of segments in stratum = 2,738

identified on the maps and were classified as "other" areas (i.e., beaches, marsh).

The estimate of total agricultural land area was 662,244 ha. This area is slightly smaller than the area estimations obtained by MOAF, based on reports sent by district officers. However, the difference is within the expected limits established in this type of land survey.

According to the results summarized in Table 8, agricultural land amounts to about 23% of the total land area of the country—estimated as 2,873,987 ha. Pastures occupy about 15% of the total land. Forest and unproductive land occupy 58% or 1,663,664 ha. Forest and unproductive areas were not specifically surveyed; instead, they were estimated by difference between the ASF survey estimates and estimates of total land in the country. The estimates of total land were obtained by using software supporting geographic information systems (GIS) combined with satellite imagery and thematic maps used in the ASF construction.

Table 7. Estimates of Agricultural Land Areas in Stratum 4B, Area Survey 1993

Land Use	Total of Segments (ha)	Average of Segments (ha)	Total of Stratum (ha)	Percentage of Agricultural Land
Agricultural Land	38.45	1.923	9,276	100.0
Arable Land	29.7	1.485	7,165	77.2
Winter Wheat Harvested	0.20	0.010	48	0.5
Maize Planted	9.51	0.476	2,294	24.7
Alfalfa	2.05	0.103	495	5.3
Fodder	0.27	0.014	65	0.7
Oats	0.00	0.000	0	0.0
Barley	0.00	0.000	0	0.0
Dry Beans	0.25	0.013	60	0.7
Soybeans	0.00	0.000	0	0.0
Sunflower	0.00	0.000	0	0.0
Sugar Beets	0.00	0.000	0	0.0
Potatoes	0.79	0.040	191	2.1
Tobacco	0.00	0.000	0	0.0
Cotton	0.00	0.000	0	0.0
Vegetables	5.03	0.251	1,213	13.1
Other Crops	2.00	0.100	483	5.2
Idle	9.60	0.480	2,316	25.0
Tree Crops	8.75	0.438	2,111	22.8
Vineyards	2.33	0.117	562	6.1
Fruits	6.42	0.321	1,549	16.7
Olives	0.00	0.000	0	0.0
Pasture	716.06	35.803	172,749	
Total Land			559,547	

Note:

Number of segments sampled = 20

Total number of segments in the stratum = 4,825

Table 8. Summary Results of Survey on Agricultural and Land Use Areas, ASF 1993

Land and Crop Use	ASF Summary (ha)						% of Total Land
	1	2	3	4A	4B	Total	
Agricultural Land	263,355	177,334	171,000	41,279	9,276	662,244	23.0
Arable Land	237,297	121,336	151,258	26,733	7,165	543,789	18.9
Winter Wheat Harvested	76,815	38,144	36,356	3,869	48	155,233	5.4
Maize Planted	41,867	25,791	37,113	7,410	2,294	114,475	4.0
Alfalfa	27,887	5,775	10,271	1,388	495	45,815	1.6
Fodder	10,359	7,663	8,409	1,214	65	27,710	1.0
Rye (Oats)	1,296	1,331	2,929	1,232	0	6,788	0.2
Barley	1,372	68	275	32	0	1,747	0.1
Dry Beans	9,645	2,969	4,797	767	60	18,238	0.6
Soybean	55	7	0	0	0	61	0.0
Sunflower	303	458	0	0	0	762	0.0
Sugar Beets	1,633	34	0	0	0	1,668	0.1
Potatoes	2,042	1,772	5,834	651	191	10,490	0.4
Tobacco	4,582	5,220	1,687	0	0	11,490	0.4
Cotton	1,554	0	0	0	0	1,554	0.1
Vegetables	13,512	5,316	11,824	2,640	1,213	34,505	1.2
Other Crops	1,339	1,779	3,302	533	483	7,435	0.3
Idle	43,036	25,008	28,462	6,998	2,316	105,819	3.7
Tree Crops	26,058	55,998	19,742	14,546	2,111	118,455	4.1
Vineyards	9,665	4,906	2,765	16	562	17,913	0.6
Fruit	14,918	12,196	10,255	14,530	1,549	53,447	1.9
Olives	1,475	38,897	6,722	0	0	47,094	1.6
Pasture	13,758	94,827	103,655	44,927	172,749	429,917	15.0
Land							
Forest & Unproductive	41,816	109,701	943,844	190,783	377,522	1,663,664	57.9
Military						31,808	1.1
Lakes						58,362	2.0
Major Cities						8,069	0.3
Other						19,923	0.7
						2,873,987	100.0

The statistics in Table 8 also show a total area for wheat of 155,233 ha in 1993. This area represents a 17% increase in area over the area harvested in 1992 as estimated using the ASF approach. The estimate of total area for maize planted was 114,475 ha. This represents about a 28% increase in area over the area planted in 1992. There were increases in land area for alfalfa, fodder, oats, dry beans, barley, sugar beets, and potatoes. Decreases in land area were observed in sunflower, tobacco, cotton and some vegetables.

2. Update of the Agricultural Area Survey

The area sampling frame constructed proved to be a powerful instrument in area surveys. The results for arable areas are highly reliable and consistent. However, future area surveys will need more detailed clarification of idle, abandoned, and waste land to avoid biases in the estimates. The estimates of areas for land reported as idle, unproductive, or not used may be high. Several factors accounted for these results, specially the following: (1) farmers reported that some land was

not planted because boundaries or land limits were still not clear, (2) land was not distributed in time to plant, (3) land was still to be distributed, and (4) the field was in saline areas, lost to floods, drought, grazed, eroded, and/or was very steep to crop.

Estimates for "Other Crops" included some mixed cropping either in large fields or in backyards of small holdings. Expanding areas with mixed crops could have introduced some bias in the estimates. It is convenient in future surveys to report mixed crop areas separately from those of pure stand. Besides the usefulness in agricultural statistics, this division makes estimation of production easy for both pure stand and crop mixtures.

Yield Estimates Using Objective Survey

Some of the following yield-survey techniques are commonly used by many countries: (1) grower opinions and subjective appraisals, (2) crop cutting or objective yield estimation based on plant characteristics, (3) agroclimate-yield empirical relationships, and (4) crop growth simulation models. The first approach is a subjective method, and the yield and production estimates may be biased or frequently not representative of the population. In either case, the probable yields require adjustment or correction for the various kinds of unknown biases. Approach 2 requires intensive training and precise instruction manuals and should be conducted in time to be used for forecasting purposes. Approaches 3 and 4 rely on historical data, sometimes not available, on detailed plant and soil data, and on the observation and/or validation of plant responses throughout several cropping seasons.

Recent developments in crop growth simulation models and the present state of computer technology using geographic/attribute databases offer promising alternatives in approaches 3 and 4. These two approaches will be useful when combined with the area sampling frame to provide information on crop responses and management strategies for specific areas. They will be fundamental in the implementation at national scale of long-term dynamic crop forecasting services.

From a practical point of view, approach 2 is preferred as the starting point for estimating and forecasting yields. The strategy is to provide not only rapid, accurate, and unbiased estimates of the yield rate for the country as a whole, but also similar estimates for main strata or administrative divisions. The development and use of sampling strategies based on probability sampling and the stratification using the ASF have also made it possible to use rapid techniques based on crop cuttings or preharvest surveys. Crop cutting techniques were used in yield estimation and production forecasting for winter wheat and maize during the 1993 cropping season in Albania.

1. Wheat Yield Survey

Ideally, a complete data set collected from the 1993 MOAF survey would have been used to select statistically representative samples for the wheat yield survey. However, the late start of the 1993 survey required slight modification of this method in stratum 1. The procedures used for collecting samples in the strata are described below, along with the distribution of the collected sample:

- The yield survey was conducted by enumerators, who walk a selected number of rows, pace into a field, and mark off a small sample unit, regardless of the field's condition or crop quality at that location. This practice ensured objectivity by removing human bias that ultimately could affect the estimates. At the designated unit location in the field, the enumerator counted the number of plants and measured the distance between rows to estimate plant population per unit area. Next, the enumerator counted immature and mature heads and the number of grains per head, and recorded the plant stage of development.
- Fifty segments in stratum 1 were sampled from the 60 segments of the 1992 ASF. Fields on farms reporting wheat grain harvest had a random chance of being selected for preharvest wheat cuts. There were 47 samples processed for the average wheat yield in this stratum.
- All 40 segments of stratum 2 of the 1993 ASF were sampled. Enumerators were instructed to take the sample in the first wheat field they found in the segment. The team was aware that there would be some segments that did not have wheat. Twenty-five samples were processed to estimate the average yield in stratum 2.
- Thirty-five segments in stratum 3 and ten segments in stratum 4A were sampled. Enumerators were instructed to take the sample in the first wheat field found in the segment. Nine preharvest samples were obtained from stratum 3, and one for stratum 4A.
- No samples were allocated to stratum 4B (high mountain areas).

The complete crop cut was done during June and July, corresponding to the winter crop harvest period in Albania. The survey included two plots from 82 segments resulting in 164 samples. Each sample unit was 0.5 m^2. The wheat samples were processed for total grain weight and grain moisture percentage, and adjusted to a 12% moisture level. A gleaning survey showed that there was an average loss of 2.2 q/ha during harvest. This was subtracted from each stratum's average yield calculated from the crop cut sample data.

Table 9 contains yield and production estimates integrating data from both the crop cut and the 1993 area survey. The yield data estimates in the table represent averages calculated by using farmers' expected yields as reported on the MOAF survey, the yields calculated from the crop cut survey, and the empirical model used to estimate grain yield. Each stratum's estimated average yield was then multiplied by the stratum's wheat hectares harvested, reported from the ASF survey, to obtain the total wheat production in Albania.

Estimates in Table 9 show a total wheat production of 4,656,999 q in Albania. The highest production, 2,458,096 q, was obtained in stratum 1. Farmers in this stratum are producing about 32 q/ha wheat. The average productivity in the country is 30 q/ha.

Empirical models were estimated using the data from the cut samples. The objective was to find plant characteristics that correlate with yield and can be used as wheat yield predictors in future preharvest yield forecasting surveys. The number of heads in a 1 m^2 area and the average grains per head were found to be highly correlated with wheat yields. Estimates of the models are presented in Table 9. The model that best correlated with wheat yield was model 2. In this model, wheat yields are associated with the logarithmic function of the number of heads multiplied by the average number of grains per head as follows:

$$\text{Log } Y = \text{Log } \alpha + \beta \log Z + \varepsilon$$

where Y = Wheat yield in quintals per hectare.

Z = Number of heads * Number of grains/head in 1 m^2.

α = Estimated parameter for unaccounted factors.

β = Estimated parameter for changes in number of heads and grain per head.

ε = Random variations.

The selected model and yield projections based on plant characteristics are presented in Figure 7. This is an empirical model, which means that the model can be used for forecasting purposes provided that a proper sampling procedure is used and the predictor values or plant characteristics are within the limits specified in Table 9 and Figure 7. A summary of the sampling procedures includes: (1) random selection of wheat fields (segments) based on ASF, (2) random sampling of 1 m^2 of the selected segment area, and (3) counting in the sampled area the number of heads and estimating the average number of grains per head.

2. Maize Yield Survey

A maize yield survey based on crop cuts was performed using the 1993 area frame. The survey sample was done by selecting one segment or field (with two units) for each 1,000 ha of the estimated total area of maize. The estimated total area was obtained from the ASF survey. The number of fields was 40, 25, 40, 10, and 5 for strata 1, 2, 3, 4A, and 4B, respectively. A random number selection was used to locate the specific area to cut. The following procedure was used to measure grain yields:

- Selection and marking of an area comprising five rows and measuring 3 m in length along the rows. Counting the number of ears of maize (any and all sizes that contain grain within the marked area in rows number two and four). Recording the number of ears or cobs in each row.
- Harvesting the ears from four plants each in row two and row four. The plants to harvest were identified by preselected random numbers for individual rows. The ears from the four harvested plants were placed in a paper bag that had been properly marked with the segment number, sample number, and row number.
- Shelling, cleaning, and weighing the maize from individual bags. Moisture determinations were recorded and used to correct grain weight to standard moisture content. Also, grain counts by ear were recorded. Maize yield in kilograms per hectare was calculated for each row using the distance from row one to row five, the number of plants within the marked 3 m of rows, and the grain weight in kilograms corrected to

Table 9. Albania's 1993 Winter Wheat Yield and Total Production Using Objective Survey Methods—Estimates of Yield Productivity Models

Stratum	Hectares Harvested	Average Yield (q/ha)	Production (q)
1	76,816	32	2,458,096
2	38,144	31	1,182,470
3	36,356	26	945,259
4A	3,869	21	81,255
4B	48	21	1,012
Total	155,233	30	4,656,999

Estimates	Wheat Productivity		
	Model 1	Model 2	Model 3
Intercept	-0.23	-0.48	6.54
	(0.22) *	(0.23)	(1.86)
Log (Heads/m^2)	1	-	-
	(0.04)		
Log (Heads/m^2*Grains/Head)	-	0.39	-
		(0.02)	
Heads/m^2*Grains/Head	-	-	0.0011
			(0.0001)
Adjusted R^2	0.75	0.80	0.75
Mean Square Error	0.25	0.24	6.10
Mean Wheat Yield (q/ha)			33.4
Heads/m^2			
Min.			92
Max.			1,061
Mean			415
Grains/Head:			
Min.			26
Max.			101
Mean			64

*Numbers in parentheses are standard errors of estimates

Model 1: Natural log of heads/m^2 counted

Model 2: Natural log of number of heads/m^2 * grains per head

Model 3: Heads/m^2 * grains per head

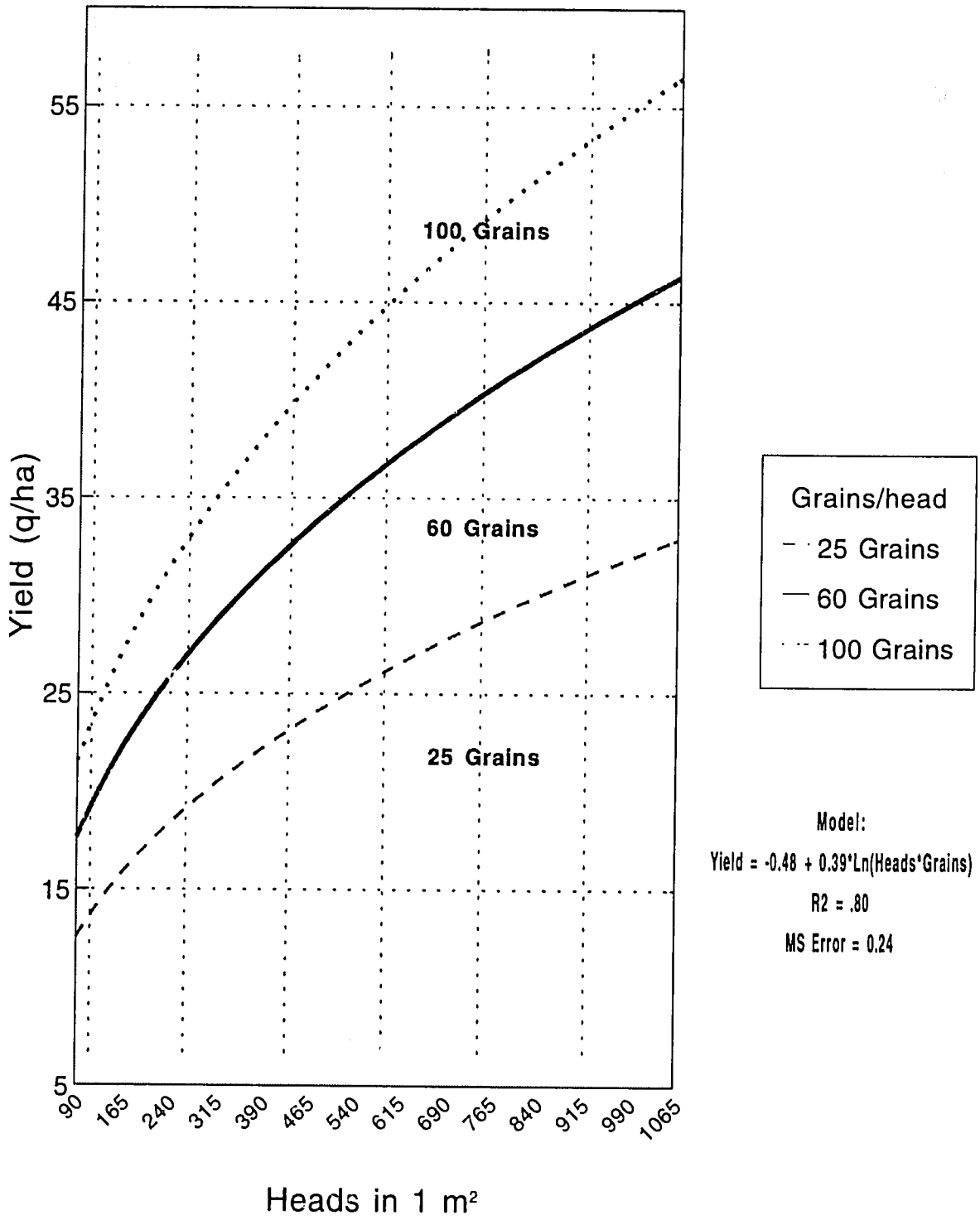

Figure 7. Wheat Yields as Function of Plant Characteristics—Objective Yield Survey (Productivity Model).

14% moisture content as standard. The following relation was used to calculate yields in the sample segments:

$$Y = (100 \div (3*D/4)) * (N/4)*Ws$$

where Y = Maize yield in quintals per hectare.

D = Distance (meters) from row 1 to row 5.

N = Number of plants within the marked 3 m of row length.

Ws = Weight (kg) of grain adjusted to standard moisture content.

Table 10 presents maize yield and production estimates integrating data from both the crop cut and the 1993 ASF survey. The maize yield data for each stratum displayed in the table represent an average calculated from the two rows measured in the crop cut survey. Each stratum's average yield was then multiplied by hectares of maize planted in the stratum, as reported from the ASF survey, to obtain total maize production in Albania. Because the area survey results of maize were estimated as area of maize planted, the maize net area used for grain was estimated by assuming that, during 1993, 45% of the total gross area planted was used by the farmer for grain and 55% was used for fodder. This assumption was based on the results from the survey and from suggestions by MOAF agronomists who worked in the sampled areas.

Table 10. Albania's 1993 Maize Yield and Total Production Using Objective Survey Methods—Estimates of Yield Productivity Models

Stratum	Hectares Planted	Grain Yield Min. (q/ha)	Max. (q/ha)	Average (q/ha)	Production (q)
1	41,867.5	8.1	72.2	28	527,531
2	25,790.9	11.4	57.5	31	359,783
3	37,112.8	12.8	64.2	32	534,424
4A	7,409.6	23.5	37.7	31	103,364
4B	2,294.3	7.3	54.1	29	29,941
Total	114,475.1			30	1,555,042

Estimates	Maize Productivity Model 1	Model 2
Intercept	0.34	-2.36
	(0.13)	(4.64)
Cobs/3 m	-	1.34
		(0.45)
Log (Cobs/3 m*Grains/Cob)	0.40	-
	(.02)	
Grains/Cob	-	0.01
		(0.02)
(Grains/Cob)**.5	-	1.19
		(0.58)
Adjusted R^2	0.89	0.72
Mean Square Error	0.20	7.31
Mean Maize Yield (q/ha)		28.13
Average Grains/Cob		
Min.		15
Max.		900
Mean		300
Number of Cobs/3 m		
Min.		2
Max.		12
Mean		7

*Numbers in parentheses are standard errors of estimates

Model 1: Natural log of grains per cob (Logarithmic Model)
Model 2: Grains per cob (Squared Root Model)

Results in Table 10 show a total production of 1,555,042 q of maize. The major producer areas are the low and level lands in stratum 1 and the upland hills in stratum 3. Maize productivity was not significantly different among the different strata. The average national productivity was 30 q/ha.

Empirical models were estimated using the maize data from the cut samples. The main objective was to find a plant characteristic that correlates well with yield and can be used as maize yield predictor in future yield sample surveys. The

number of cobs and number of grains per ear were found to correlate well with maize grain yields. Estimates of the models are presented in Table 10. The model that best correlated with maize yield is model 1. In this model, maize yields are associated with the logarithmic function of number of grains per ear or cob and number of cobs per area sampled as follows:

$$\text{Log } Y = \text{Log } \alpha + \beta \log Z + \varepsilon$$

where Y = Maize yield in quintals per hectare.

Z = Number of cobs * Number of grains/cob.

α = Estimated parameter for unaccounted factors.

β = Estimated parameter for number of cobs and grain changes.

ε = Random variations.

The selected model is presented in Figure 8. The model in Figure 8 is a statistical model. This model can be used for prediction purposes provided that proper sampling techniques are used and that the numerical values of predictor variables or plant characteristics are within the limits specified in Table 10 and Figure 8. The proper sampling techniques include (1) selection of a field (segment) based on ASF, (2) selection of one area comprising five rows and measuring 3 m in length along the rows, (3) random selection of one row within the sampled area, and (4) counting the total number of cobs within the 3 m of row length and the average number of grains per cob of the selected row.

Results of Fertilizer Use Survey

The survey was done using the sample of segments selected for the area survey from ASF. The data and results are presented in Table 11. The data indicate that farmers are increasingly using more fertilizer, particularly urea. Farmers used 31,715 mt of urea, of which 31% was used in stratum 1 and about 30% in stratum 2. The average rates of application of urea are 49 and 89 kg/ha for strata 1 and 2 respectively.

Table 11 shows that farmers in Albania are applying other fertilizer products besides urea. Ammonium nitrate is used principally in strata 1 and 3. The total amount of ammonium nitrate was about 14,000 mt. Single superphosphate is used principally in the strata with intensive agriculture. The total amount of single superphosphate used was about 8,000 mt with rates varying from 11 kg/ha in stratum 3 to 23 kg/ha in

Table 11. Summary Results of Survey on Fertilizer Use in Albania, ASF 1993

Product	Use per Stratum (mt)					
	1	2	3	4A	4B	Total
Urea	11,487 (49)*	10,047 (89)	8,962 (63)	1,013 (38)	205 (29)	31,715
Ammonium Nitrate	7,210 (31)	1,511 (13)	5,075 (35)	327 (12)	169 (24)	14,290
Single Superphosphate	3,850 (17)	2,633 (23)	1,521 (11)	0 (0)	0 (0)	8,003
Diammonium Phosphate	2,520 (11)	348 (3)	399 (3)	57 (2)	0 (0)	3,323
Organic	253,357 (1,087)	205,660 (1,822)	457,787 (3,174)	113,173 (4,253)	62,146 (8,753)	1,092,123
Other	1,510 (6)	0 (0)	368 (3)	4 (1)	0 (0)	1,882

*Numbers in parentheses are average rates in kg/ha.

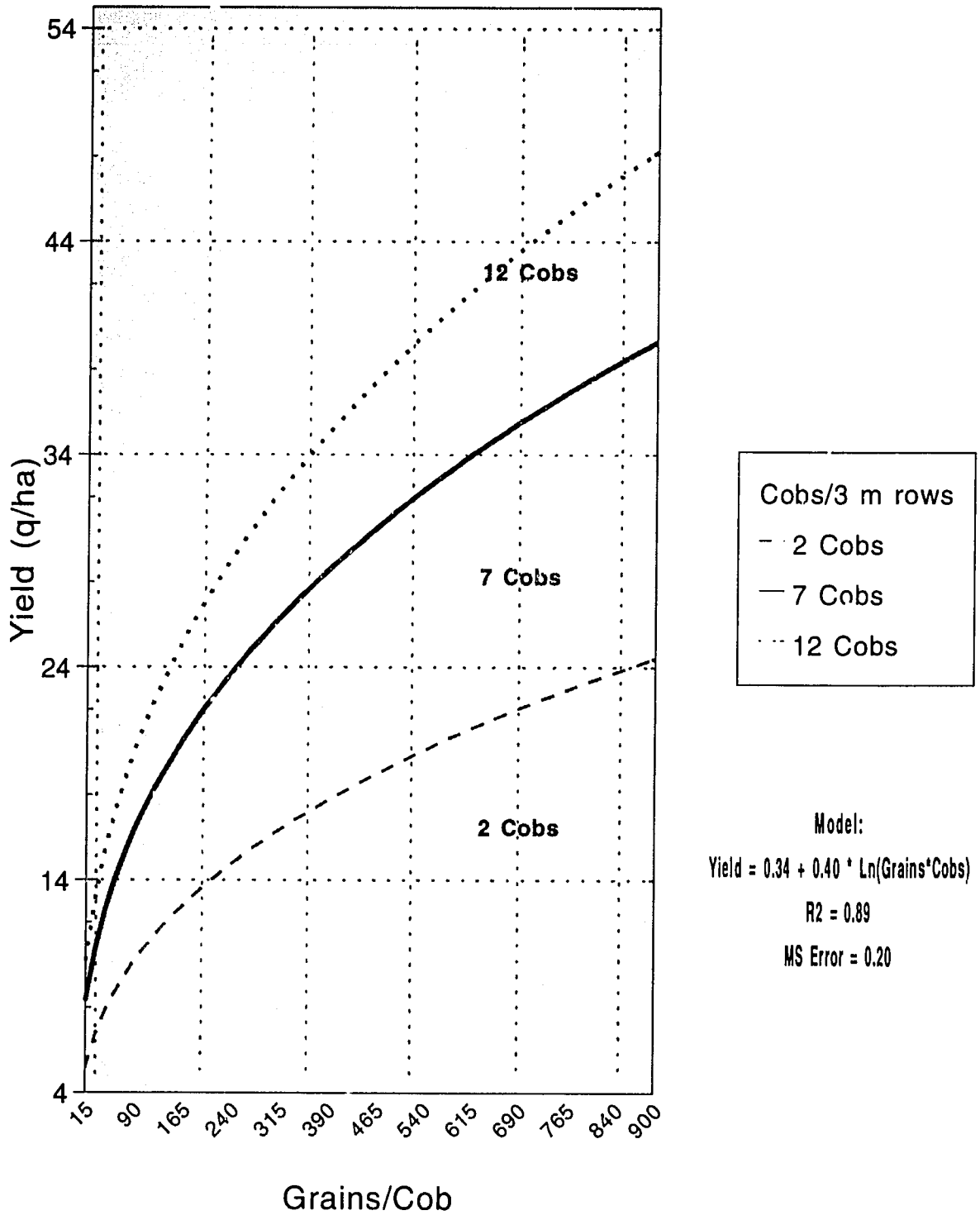

Figure 8. Maize Yields as Function of Plant Characteristics—Objective Yield Survey (Productivity Model).

stratum 2. Farmers continue using high amounts of organic fertilizers. The total amount of organic fertilizer was 1,092,123 mt.

The results obtained from the fertilizer survey in 1993 were compared with the results obtained during the 1992 ASF survey. Results from the 1992 ASF survey showed very little fertilizer applied at the time of the survey, which was conducted during May and June. The results in 1993, however, proved the impact of the IFDC fertilizer program. It is unquestionable that farmers are now using more fertilizers and improving the efficiency of fertilizer management.

Recommendations

The activities and results of the area frame construction and surveys performed in 1993 have led to the following recommendations for the maintenance and continued development of agricultural assessment strategies in Albania:

1. Albania's agricultural sector is undergoing rapid structural changes aimed to sustain economic recovery. Land use assessments and productivity evaluation using rapid and efficient methods, including probability sampling and ASF techniques, are basic during these initial steps. There is also a necessity to continue using and improving ASF-based surveys to support the implementation of a national agricultural statistical system in the country.
2. The use of ASF strategies for area and agricultural resource assessment in Albania is quite recommended because (1) no other suitable frame or reliable cadastral system exists in the country, (2) a check is desired on the accuracy of some other frames and census, and (3) a cluster of neighboring elements is desired for spatial analysis of regional indicators. Area frames have been found useful in the establishment of national agricultural statistical systems and improvement of cadastral systems and have a wide range of applications in biological, physical, and socioeconomic fields—wherever a universe or population can be defined in terms of areas.
3. Albania should continue making national level surveys associated with land areas. These surveys will be very important to monitoring crop production and determining farming changes. Albania should make efforts to implement ASF techniques to evaluate actual information from animal census and to monitor livestock production. Probability surveys of farms or small producing units like the ones used in ASF surveys are also the only satisfactory fieldwork techniques of improving current information and/or ensuring accurate and unbiased methods of measuring area and agricultural and livestock production.

   The MOAF should continue working to update sampling procedures and monitoring systems based on the ASF methodology. The techniques based on ASF should be specifically designed for preparing production estimates at regional, village, commune, and district levels.
4. In the estimation of cropped areas, greater frequency and more detailed data are needed for major crops than for minor crops. Wheat and maize are the two major crops in Albania. For these two crops, seasonal data on standing crops at the beginning of the season, crop harvested during the season, and new plantings for the season should be collected; for other crops and vegetables, data on harvested areas can be collected only annually.
5. Estimates based on ASF could have sometimes serious biases. These biases are usually ascribable to faulty work by investigators in accounting for the elements in the sampled area because of indefiniteness of boundaries of segments or improper identification of reporting units. Segment localization, boundary and field determination, and reporting unit identification and measuring can be improved by using images from photographic sensors such as aerial photos. Aerial photos should be obtained for each selected segment.

   The importance of aerial photos in ASF should not be underestimated. They generally offer good resolution data and are readily available in the country at a reasonable cost. In using aerial photos, the scale of photography affects the resolution of the image and could create problems in segment boundary identification and recording unit measuring. The following classification may help to put the scale in perspective:

   - Very large scale: 1:100 to 1:500
   - Large scale: 1:600 to 1:2,000
   - Medium scale: 1:5,000

- Normal scale: 1:12,000 to 1:30,000 (most common scales for ASF activities)
- Small scale: 1:30,000 or less
- Very small scale: (taken from orbital altitudes) 1:100,000 to 1:2,500,000

6. To avoid coverage errors in estimating land areas in ASF, prior to the ASF survey, each selected segment should be measured in hectares and this information recorded. This figure should be used by enumerators as a control or check during identification and measuring of recording units and data collection. Surveyors or enumerators must account for segment areas that are at least 90% and not more than 110% of the predetermined segment size.
7. The use of nonphotographic sensors or remote multiband sensing imagery appears to hold considerable potential in Albania, in reducing coverage errors and providing current data on crop areas which complement fieldwork in ASF surveys. Research in other countries has demonstrated the feasibility of inflight recording of spectral signatures of several crop species, including wheat, oats, maize, soybeans, alfalfa, red clover and rice. Good crop signatures, however, depend on crops reaching a sufficient amount of development to reflect enough energy for reliable identification. For this reason, satellite data are not quite appropriate for making early season crop area estimates.
8. Periodic ASF surveys should be institutionalized in the MOAF and other appropriate institutions responsible for statistical reports. It is possible to conduct a satisfactory ASF survey within a short period (1 or 2 months) provided that technical expertise is sufficiently high to overcome inevitable barriers or constraints.

   The area frame materials and sampling documentation need to be managed by one coordinating unit in the MOAF to maintain quality and assure the physical integrity of the frame and sample segments. The unit would need to designate good filing equipment and appropriate management specifically for these tasks.
9. The national office in charge of the ASF activities should play an active role in data collection, training, and reporting. Questionnaires have to be periodically reviewed to meet the ever-increasing demand of users and for further progress. Proper instructions and periodical training should be given to all those involved in the collection and assembling of data including field training. Such steps should ensure rapid and uniform reporting.
10. For many crops, national and regional estimates of yields and crop production forecasting do not exist in Albania. The developing of techniques to evaluate crop growth conditions prior to harvest can be useful in crop management, resource use, and sanitation strategies. Opportune crop areas and yield determinations also affect market management. Yield forecasts can also affect the price and sales policies of agricultural commodities, the associated storage and handling requirements on farms as well as national and international terminal points, and the cost of transportation or shipping to markets.
11. To ensure that objective yield estimates and short-range forecasting surveys can be carried out in a timely and efficient manner, the methodology should be associated with ASF surveys and must be planned over a period of months. The following items are the major steps which normally should be spread over a 3- to 6-month period depending on the experience of the data collection staff:
    - Determine plant and plot characteristics and measurements that will be needed.
    - Prepare forms for field-plot and laboratory work.
    - Prepare training materials.
    - Obtain results of area surveys to prepare area estimates and select sample fields.
    - Conduct training school for collection of plant data: covering fieldwork instruction manual, demonstrating plot work in the field, and giving practical experience to workers using field forms.
    - Conduct the objective survey using crop calendar dates.
    - During the survey, arrange daily review of the completed forms (by field supervisors).
    - Process plant parts in the laboratory.
    - Transfer complete forms to data-analysis unit.
12. To improve future survey efforts for projections or forecasting, MOAF survey data should also be collected and processed using modern techniques in data analysis, crop growth simulation modeling, and geographic information systems (GIS). The possibility of

forecasting crop yields, several years in advance, would be of great value in the planning of agricultural production in Albania. The success of long-range forecasts is contingent not only on the knowledge of weather and management factors determining yield, but also on the ability to predict weather and determine risk involved in using certain practices. Crop growth simulation models and GIS techniques have proven to be reliable and scientific tools to support this forecasting approach.

13. In the future, the ASF data surveys and yield projections of crop and livestock production in Albania need to be linked with socioeconomic and marketing data to monitor changes and provide current supply and demand information to government officers, farmers, and traders. A management information system (MIS) and data decision support systems (DSS) should be designed and implemented to support agricultural services and the decisionmaking process. The MIS would provide past, present, and projected information about agricultural land and socioeconomics. The DSS will facilitate decisionmaking by providing tools for ad hoc data manipulation and reporting. These information support systems should contain basic elements of surveying and analytical tools to provide timely, reliable, and dynamic information to Albanian government institutions, policymakers, and private sector entrepreneurs. These will ultimately be the main objectives in establishing a national agricultural statistical system, urgently needed in the country.

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Appendix A. Methods of Preparing Statistics for Agriculture

Importance of Agricultural Statistics

Agricultural leaders and data users increasingly call for reliable, timely, and detailed crop and livestock information. These statistics help develop a stable economic atmosphere and reduce risks related to production, marketing and distribution. Farm organizations, researchers, agribusinesses, foreign agricultural buyers or sellers, and donor organizations all benefit from accessible and accurate agricultural statistics.

Government agencies at all levels need statistical estimates of crop areas, production, stocks, prices, and incomes for planning and policymaking. Economic planners and analysts use farm statistics to project outcomes of alternative courses of action. Such economic analysis and projections augment the usefulness of agricultural statistics.

As Albania's agricultural sector rapidly proceeds through its transitions from public to private holdings, the demand for accurate, timely and reliable data will be greatly enhanced. An advanced and efficient agricultural information system will be required in order to evaluate evolving practices in relation to optimal production, sustainable success, and future planning.

Increasing competitiveness has surfaced with Albania's transition toward a free market economy. If the country is to become a viable participant in international markets, the implementation of an agricultural data and information system comparable to that of other nations is critical. The system needs to be capable of generating timely and reliable forecasts of product supply and demand. Likewise, data users need information to support their efforts to meet international quality requirements and to develop strategies that capitalize on special market opportunities and price advantages.

Basic Agricultural Statistics Needed in Albania

Albania's agriculture encompasses vast productivity and diversity. Crops and livestock need to be continually counted, measured, weighed, and priced to provide facts for decisionmakers operating throughout the agricultural economics sector. Therefore, it is important to use the appropriate methodology to monitor agricultural resources to provide accessible and accurate estimates.

Objective statistical methods provide more accurate and reliable agricultural estimates than do subjective methods. Countries that apply objective methods typically have better estimates which give them an advantage in the world's marketplace and assist them in managing their agriculture programs. Objective methods can provide estimates that are credible, which is essential to produce information of practical value.

In order to be of optimal value to data users in Albania and other countries, agricultural statistics need to address an assortment of data needs and uses such as the following:

1. Crop reports are needed to provide estimates of area that farmers intend to plant, actual area planted and harvested, production and disposition of crops, and remaining stocks. Forecasts of yields for major crops and minor crops are issued during the growing season in some countries and, likewise, could be issued in Albania.
2. Livestock (cows, lambs, goats, etc.) and poultry reports are required to cover inventories on farms, ranches, and feedlots. Data are needed on the following areas:
   - Number, breeding, production, yearly flows, and disposition of major livestock and poultry species.
   - Slaughter number of major livestock—indigenous, imported, and exported—meat output, local meat consumption, and export or utilization by processing industries.
   - Poultry reports are needed to estimate production of chicken for meat and for eggs. Egg and meat production and utilization are also required.
   - Dairy reports are needed to indicate cow numbers, monthly and annual milk production, and milk utilization. Production should include:
     (a) Milk delivered to purchasing centers.
     (b) Quantities used by producers at places of milk production.

(c) Milk sold directly to consumers.

(d) Milk feed to livestock.

(e) Farm losses.

4. Agricultural economics reports serve to relay prices, farm labor and wage statistics, and other production expenses and gains. Statistics of "agricultural prices" are used largely to determine the type and volume of productive activity in agriculture.

   Two kinds of prices can be distinguished: (1) prices of agricultural products and (2) prices paid by farmers. The prices of agricultural products refer to (1) prices received by farmers, (2) wholesale prices of agricultural products, (3) retail prices, and (4) export and import prices.

   Prices paid by farmers cover all prices paid by farmers as they participate in the transaction of goods and services in their capacity as buyers. These prices include (1) price paid by farmers for the purchase of raw materials in current agricultural production; (2) prices of factor services—wage rates for farm labor, land rental rates, capital interest on fixed assets; and (3) prices of investment goods—these cover the prices of equipment and machinery which are generally not fully consumed during one accounting year as well as all construction materials which are used for building up fixed assets on farms.

5. Statistics for agricultural planning and investments. These cover a wide range of topics. Some of the important ones are given below:

   - Land utilization.
   - Irrigated areas.
   - Fertilizer use.
   - Employment in agriculture.
   - Agricultural power and machinery.
   - Agricultural credit.
   - Market intelligence.
   - Costs.

Data Collection Techniques

Information, in general, can be collected in many ways. In many countries, such as in Albania, data are primarily collected through personal interviews using questionnaires and in-the-field objective observations.

Most statistical estimates are based on probability sample surveys. From these sample surveys, activities of a total group are inferred using data from a smaller, scientifically selected and representative sample: That is, information from a sample of the group is used to generate estimates for the group as a whole. Probability sampling has two advantages over complete enumeration: (1) it requires less time and money and (2) it can be the most accurate and reliable because it requires fewer data entries that can be thoroughly edited, which results in fewer opportunities for reporting and data handling errors.

Remote sensing by satellite is another valuable method of data collection. With reasonable accuracy, satellite imagery can identify cropland and management differences. Different land covers reflect varying amounts of energy, which become the crop's signature. Once the signature of a given cover is known, people can identify other areas where that cover is present.

1. Probability Surveys

Statistical theory provides a basis for selecting samples so that the probability of each farm being selected for the sample is known. This approach offers three distinct advantages. First, it provides a way to "expand" the sample to population totals, and the calculable sampling to indicate the degree of survey precision. Second, the probability sample ensures a cross section of farms and provides unbiased estimates, which may not be the case with nonrepresentative samples or subjective surveys. Finally, the results of the survey stand alone: That is, the results do not depend upon relationships with other data sets.

Probability surveys are based on contacts with (1) farmers operating in areas selected at random from a constructed area frame or (2) farmers selected from a list of farmers that comprise a list sample frame. These two types of frames are described below.

(a) Area Sampling Frame—Area sampling frames use a sample of randomly selected land segments or parcels which vary in size for major agricultural areas—in Albania, the sampled segments range from 25 to 100 ha. In general, when an area sampling frame is used, the land within the total segments selected for survey is less than 1% of the country's total land area.

The chief advantages of a land-based area frame are that it provides complete coverage, is

not affected by changes in farm boundaries or operators, offers safeguards against omission and duplication, and comprises sample segments that may be used several times each year for 3 or more years without replacement. The main disadvantage is that it is not the most efficient sampling method for estimating specialized items such as production of minor crops or crops grown on farms that are few in number and/or concentrated in specific geographic areas.

The adaptability of ASF, however, as survey methodology is one of its most valuable characteristics. The frame can serve a variety of data requirements related to agriculture and rural populations. For this reason, it is useful for numerous and diverse data users, including those interested in examining, simultaneously, more than one area of interest, such as managers of agriculture production programs interested in food security or natural resource encroachment.

(b) List Frame—List sampling frames are also widely used in the United States and Europe. In Europe, many countries have agricultural censuses at the end of each year. These censuses create lists of farmer names that are taken as the universe for the population. Special surveys can be undertaken by selecting special purpose farms from the lists. In the United States, lists are developed for special or exceptional farms (i.e., when there are a few large farms that produce the majority of a particular crop or when farms are producing rare, specialty crops). When countries have very large operations, such as with cattle feedlots, hogs, poultry, potatoes, or rice, the use of special lists is appropriate. In fact, in such situations, integration of both list and area frames can generate the most accurate agricultural statistics. The method of integrating two sampling frames for data collection is called multiple frame sampling (MFS).

(c) Multiple Frame—Because list frames rarely are 100% complete and area frames rarely provide efficient sampling methods for specific specialty items, combining the sampling frames can generate statistically unbiased, efficient estimates. When done correctly, MFS can provide a comprehensive, nonredundant frame that results in a representative sample and ensures efficient data collection.

Two criteria must be satisfied in multiple frame sampling: (1) all farms must be associated with at least one of the sampling frames, that is, be a part of either the area or list frame, and (2) farms appearing in both frames must be identified and the duplication removed. Moreover, when a list frame is used, the list of names and addresses, grouped by unit and type, must be kept current through periodic comparisons with other information sources.

Conceptually, when the sample units are assigned to domains according to the frames to which they belong, independent estimates may be made for each domain. The different estimates for each domain may be weighed together optimally into an estimate for that domain. When these domain estimates are aggregated, they provide an estimate of the entire population. Domain weights may be selected so as to minimize sampling errors for the characteristic estimated.

2. Objective Yield Surveys

Sample fields can be selected from area segments surveyed through an ASF survey. The selected fields are revisited during the growing season or at crop maturity for plant counts, measurements, crop development information, or crop cuttings. The collected information is then used to forecast or estimate yields and production.

After collecting data on plant population per hectare and projected yield per plant, statisticians can determine yield per hectare. They multiply the yield by the hectares for harvest to derive production forecasts and estimates. Objective yield surveys can be conducted for wheat, corn, rice, and other crops and trees.

3. Remote Sensing and Geographic Information Systems

The use of remotely sensed satellite data for identifying crops and areas and monitoring production is possible in Albania, but extensive and systematic ground data need to be available; that is, remotely sensed data should be collected in conjunction with conventional data sources such as ASF and GIS.

A GIS is a computer database which can combine spatial, thematic, statistical, and image data using the concept of superimposed data layers. Data layers can be combined to produce composite images or maps, identify combinations of data elements, perform statistical analysis or generate indicators based on classifications.

The emphasis on remotely sensed data relative to other data sources will depend very largely on the scale at which information is required. While it may not be feasible or cost-effective for very detailed studies, this is a viable alternative for synoptic regional studies.

Appropriate choice of a remote sensing system can provide a cost-effective method of data collection, particularly for repetitive coverage of large areas, and so is quite suited for monitoring purposes. There are, however, a number of constraints on the use of remotely sensed data which must be appreciated if the system is to be used effectively.

The most widely used image data for land resource studies are those from multispectral scanners such as Lansat MSS, TM, and sensors on SPOT, which operate in the spectral region from visible to thermal infrared (0.4-15 μm) and are used to detect radiation from the sum reflected by the earth's surface. The visible infrared data, however, cannot be collected under cloudy conditions, which may be a serious problem if the timing of observations is crucial or in humid areas where clouds are common.

In many remote sensing studies, the spectral response is used to group data into classes, for example on the basis of land use, area, vegetation or soil type. However, the empirical relationships between spectral response (signatures) and landscape characteristics are frequently not robust, and classifications developed for one scene cannot usually be transferred to another. Improvements in spatial analysis of data are also required to take full advantage of the increased spatial resolution of TM and SPOT data.

Data cost continues to be an issue, particularly for monitoring applications requiring purchase of several scenes or coverage. A realistic appraisal of the cost of remotely sensed data relative to data collection by other methods is required to put this issue into perspective.

Digital analysis of satellite data was not undertaken in this study. It can be done in the future in Albania, if required for special studies. However, it would require substantial resources including a ground data system, current satellite data, computers that can process a high volume of data within a specific time, and adequate training of potential operators and users.

ASF technology with modifications and GIS complemented with remote sensing techniques and other surveying sensors like the Global Position System (GPS) could be used in the future in Albania to collect accurate data that support dynamic agricultural statistical and cadastral systems. These systems will be of great value in the study of complex resource problems. They will be useful in Albania to generate terrain models that monitor forested areas and evaluate land degradation or land-cover changes, irrigation and rangeland management, salinization, soil fertility, and agricultural productivity.

Appendix B. ASF Survey Questionnaires

Purpose

The purpose of the questionnaires was (1) to collect data needed to estimate agricultural land and crop areas, (2) to collect field data of crops that are being planted and are ready to harvest to estimate prospective crop production and productivity, and (3) to collect fertilizer data to estimate fertilizer use and potential demand. The questionnaires were distributed in Albanian language to MOAF officers in charge of the survey.

MOAF officers received three days' classroom and field training in advance of the survey. During the training, the surveyors were instructed in ASF concepts, survey terminology, segment and tract identification and measurement, and farmer interview. Supervisors were available to answer questions and assist with special problems.

Materials and Guide for Enumeration

The following materials were distributed to surveyors and supervisors:

- An interviewers' manual.
- A screening questionnaire for each segment assigned.
- Farm questionnaires.
- Maps showing segment locations.
- Clipboards and pencils.

A step-by-step guide for enumeration was provided including the following:

1. Location of the segment using mapping materials and landmarks such as roads, ditches, streams, buildings, etc.
2. Selection of the farmer for the first interview and for the use of the screening questionnaire on farm and nonfarm tracts.
3. Determination of the "tract" boundaries. Codification of different tracts within the same segment, land use identification, and area determination.
4. Use and completion of the farm questionnaire for the farm operators. For the nonfarm tracts, such as schools, factories, churches, etc., only completion of the screening questionnaire was required.
5. Identification of tracts, measurement, coding, interviews, and recording until the completion of a selected segment.

The segment was assumed completed when the surveyor accounted for all parcels inside the segment boundaries. Before moving to the next segment, the surveyor was instructed to verify the total area of all tracts (agricultural and nonagricultural) and record this area on the screening questionnaire. This practice was required and followed for all segments in the sample.

Questionnaires

1. Screening Questionnaire

The screening questionnaire serves the following purposes: (1) to assist the interviewer in writing down names as he/she canvases the segment; (2) to record the tract code and name and address of all persons who operate land inside the segment; (3) to designate "agricultural tracts" for which a farm interview questionnaire must be completed; and (4) to record hectares for nonagricultural tracts. The following information was to be recorded in the screening questionnaire:

- Segment code number.
- Segment total area (measured and reported by farm operator).
- Tract code.
- Farm operator name and address.
- Tract area in cropland or pasture.
- Tract area in nonagricultural land.

2. Farm Questionnaire

The farm questionnaire includes information to be collected for estimating national agricultural land and crop areas, fertilizer use, and crop production. The questionnaire has been designed as a recording form rather than an interview form. It contains two parts: the header and the body. The header includes information for identifying farm operators, segments, tracts, and an assigned enumerator number. The body contains the bulk

of data being collected on crops, areas, and fertilizers. The following information constituted the main body of the questionnaire:

a. Agricultural land area for:
   - Tract or field number.
   - The crop or land use (cropland, farmstead, etc.).
   - Building, woods, wasteland, ditches, etc.
   - Pasture.
   - Cropland idle during 1993.
   - Area abandoned.
   - Two or more crops planted in the same place.
   - Wheat planted.
   - Wheat to be harvested for grain.
   - Maize to be harvested for grain.
   - Maize to be harvested for fodder.
   - Name and area of main crops planted or to be planted in 1993.
   - Lucerne harvested for hay.
   - Fodder harvested (exclude corn and lucerne and include sugarbeets for silage).
   - Vegetables planted (total of all kinds).
   - Grape vineyards.
   - Tree fruits (total of all kinds).
   - Olives to be harvested.
   - Other crops.

b. Fertilizer use area
   - Name of product, nutrient, or analysis.
   - Amount (kilos).

c. Crop production
   - Crop name and net area sampling.
   - Sampled grain weight.
   - Sampled plant characteristic (number or weight).