ATD/W
PN-ABL-452

ASPAP/DAI Report No. 196

ASPAP/DSA Technical Report:

Preliminary Recommendations for the Sample Design for the Rwanda National Agricultural Survey Program

March 1992

Agricultural Surveys and Policy Analysis Project (ASPAP)

(*Projet des Enquêtes Agricoles et Analyse des Politiques Economiques du Secteur Rural*)

USAID Contract No. 696-0126

David J. Megill*
Short-Term Sampling Consultant, DAI**

Kigali, Rwanda
March 1992

*1504 Kenwood Ave., Alexandria, VA 22305, USA

**Development Alternatives, Incorporated (DAI), 7250 Woodmont Avenue, Suite 200, Bethesda, MD 20814, USA, principal institutional contractor for ASPAP. USAID Contract No. 696-0126-C-00-7777-00

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1. Background

The *Direction des Statistiques Agricoles* (DSA) has conducted a series of nationwide agricultural surveys and special studies on a continuous basis since 1982. One of the main objectives of this survey program is to produce national and subnational estimates of agricultural area and production.

The basic sample design used for the national agricultural survey program from 1983 until the present is decribed in the report "*Aperçu Historique et Methodologique - Enquête Nationale Agricole 1984*," which also describes the design for the Pilot Survey. This 1984 sample design has been adapted over time based on different operational constraints (see Section 3), although there has not been any comprehensive documentation of the sample design since the 1984 report. The current sample of *districts de recensement* (DR's) was selected in 1989, following a similar sampling strategy to the original design.

The objective of this first consultancy is to collaborate with DSA staff in designing a new sample for the national agricultural survey program based on the updated sampling frame from the 1991 Rwanda Census of Population and Housing (*Recensement General de la Population et de l'Habitat*). The new sample design should provide maximum efficiency (precision for a fixed cost) while taking into account operational considerations such as interviewer mobility. It should meet the precision requirements for the main survey estimates, while respecting the resource constraints.

The purpose of this report is to provide sampling recommendations for the future survey program and to document the research carried out for maximizing the efficiency of the sample design. The new estimation procedures for weighting the data and calculating the variances will be specified in a follow-up consultancy.

All work was accomplished in close collaboration with Mr. Samuel Munyaneza, DSA Statistician, and Dr. Daniel Clay of Michigan State University. The invaluable assistance and support provided by Mr. Anastase Murekezi, ASPAP Director, Mr. Serge Rwamasirabo, Analyst, and the other DSA staff, as well as Dr. Tardif-Douglin, Agriculture Policy Analyst and Special Studies Coordinator, Development Alternatives, Incorporated, must also be recognized.

2. Objectives of the National Agricultural Survey Program

The DSA survey program consists of multi-purpose agricultural surveys conducted on a continuous basis, with different modules used for various specialized studies. Data on the following topics are covered by the survey on a regular basis: crop production; crop area and density; livestock inventory and production; and farm income and expenditures. The information on farm size and area in different crops are obtained through objective area measurement. In addition to the basic survey, specialized surveys are conducted using the same sample, so that the data from each module can be merged with the data from the basic questionnaires. The following specialized studies have been carried out: coffee, root crops (sweet potatoes and *manioc*), agro-forestry, women in development, and food security and nutrition of rural households.

In designing the new sample for the DSA survey program, it was necessary to concentrate on the main objective of the surveys, which is to measure crop production at the national level, and to

the extent possible, at subnational levels, such as by *prefecture*. As indicated in Section 4, the sampling errors at the *prefecture* level from the current survey data are fairly high, with most crop production estimates having coefficients of variation (C.V.'s) above 20 percent. This is due to the small number of sample DR's (an average of about 8) per *prefecture*, and the large design effects (see Section 5). There were early discussions about having survey results for the *unités operationelles*, which are below the *prefecture* level, but the DSA realizes that the sample size requirements would not make it possible to disaggregate the survey data down to that level. One of the objectives of the new sample design will be to improve the efficiency of the design and increase the number of sample DR's within the limitations of resource constraints, in order to improve the estimates at the subnational levels.

3. Sample Designs for 1989 and Current Survey Programs

The 1989 national agricultural survey was based on a sample design adapted from the original 1984 design, documented in the report "*Aperçu Historique et Methodologique - Enquête Nationale Agricole 1984*." A stratified multistage sample design was used for each survey. The 1984 sample design was based on the sampling frame of *secteurs* and DR's defined for the 1978 Rwanda Census of Population and Housing. The stratification was based on the 10 *prefectures* and the 12 *zones agro-ecologiques*. After collapsing the smaller groups of *zones agro-ecologiques* within *prefecture*, a total of 35 strata were defined. A sample of 150 DR's was allocated to the strata proportionally to size (in terms of number of households). Within each stratum the sample DR's were selected in two stages with probability proportional to size, where the measure of size was the count of households from the 1978 census frame. Although *secteurs* were selected at the first stage within each stratum, the DR is treated as the PSU, since one DR was selected in each sample *secteur*. Within each sample DR, two compact clusters of seven households each were included in the sample, for an overall sample size of 2,100.

In 1989 a new sample of DR's was selected for the survey, in order to provide a new sample of farm households, and to adjust the sampling plan based on new operational constraints. The number of sample DR's in the 1989 design was 78, which also corresponded to the number of interviewers. Within each sample DR four clusters of four households each (for a total of 16 households) were selected. Therefore the overall sample size became 1248, before accounting for noninterviews. The consultant has not seen documentation on the 1989 sample design, but based on discussions with the DSA staff and a review of the 1989 survey data, it appears that the original 12 *zones agro-ecologiques* were combined into five major *zones*, and the original strata were collapsed into 21 new strata. Apparently the 78 sample DR's were allocated to the strata proportionally to the number of households, and the sample DR's were selected within each stratum using similar procedures to those used for the 1984 design. In the 1989 survey data file, data were only found for 76 sample DR's, so apparently two sample DR's were missing.

The current survey is based on the same sample of 78 DR's selected for the 1989 survey, although the sampling strategy at the last stage was changed. Now there are four compact clusters of eight households each selected within each sample DR, so the overall sample size has doubled. One reason for the larger sample is that an experiment is being conducted using different data collection procedures for two half-samples. In one half-sample the interviewer collects the crop production data on a weekly basis, while in the other half-sample the interviewer collects the production data monthly. The data from each half-sample are being compared to determine

whether there are significant differences. The initial results indicate that the crop production estimates from the half-sample with monthly data collection are somewhat lower for many crops. Since the weekly data collection involves a heavier interviewer workoad, the type of data collection procedures to be used affects the potential sample size. This issue is discussed in more detail in Section 6.3 on "Sample Size and Allocation."

Compact clusters of four households (1989 design) or eight households (current design) are selected within a sample DR in order to reduce the requirements for interviewer mobility within the DR. This also has a tendency to increase the design effect, as indicated by the research described in Section 5. The new sample design will take into account both sampling efficiency and field operational considerations.

4. Calculation of Sampling Errors from 1989 Survey Data

It is important to estimate the sampling errors for the results from past survey data, in order to estimate the level of precision which can be expected from the new sample design. The variance tabulations also make it possible to research how to improve the efficiency of the sample design, as described in the following section. Crop production data from the 1989 survey were used for this purpose, as these are the most recent edited survey data available. Since variances had not previously been calculated for the 1989 survey data, the new variance tabulations will also serve as part of the documentation on the accuracy of the results from that survey.

The standard error, or square root of the variance, is used to measure the sampling error, although it may also include a small part of the nonsampling error. The variance estimator should take into account the different aspects of the sample design, such as the stratification and clustering. A microcomputer software package available for calculating the variances for survey data from stratified multi-stage sample designs such as the sample for the national agricultural survey program is PC CARP (Cluster Analysis and Regression Program), developed by Iowa State University. PC CARP is menu-driven and fairly user-friendly. It can be used to calculate the variances of totals, means, proportions and other ratios, as well as regression coefficients. It uses an ultimate cluster variance estimator. The formulas for the variance estimator used by PC CARP are presented in the manual, which is available at the DSA. These formulas will also be specified in the report on estimation procedures, which will be drafted as part of the next consultancy.

In order to run PC CARP, it is necessary to produce an ASCII data input file with the design parameter codes (stratum and cluster), the weights (expansion factors), and the survey variables for which variances will be calculated. For each type of estimate included in the analysis, the PC CARP output presents the value of the estimate, the standard error, the coefficient of variation (C.V.), the design effect (DEFF, defined in the next section) and the number of observations. The C.V. represents the relative standard error, that is, the standard error divided by the estimate. Unfortunately, the format of the PC CARP output is not very user-friendly, since all the numbers are in scientific notation, and the subpopulation groups are only identified by code. Therefore it is advisable to transform the PC CARP output into a more publishable format with a software package such a LOTUS. The PC CARP results from the 1989 survey data are presented in this type of publishable format.

Tables A.1 to A.11 in Annex A show the estimates of total production for selected crops from the 1989 data, and the estimate of the total number of farm households for each domain, with the corresponding standard errors, coefficients of variation, 95 percent confidence intervals and design effects. Table A.1 shows the results at the national level, and Tables A.2 to A.11 present the results for each *prefecture*. Since the C.V.'s represent the relative standard error, they can be compared across crops. It can be seen in Table A.1 that at the national level the C.V.'s are reasonable for the production estimates of major crops, as low as 6.6 percent for total beans (*haricots total*). However, the C.V.'s are quite high for crops which are rare or concentrated in small areas, such as potatoes (*pomme de terre*), with a C.V. of 42.4 percent, and wheat (*blé*), with a C.V. of 30.1 percent. It can be seen in Tables A.2 to A.11 that the C.V.'s are quite high at the *prefecture* level. This is a result of the small number of sample DR's in each *prefecture*, as well as the large design effects, described in the next section.

5. Study of Design Effects

One of the most important considerations in designing an efficient sample is to determine the optimum number of households to select in each sample primary sampling unit (PSU). The 1989 survey data was used to research the efficiency of alternative sampling schemes, in order to optimize the efficiency of the new design (within the operational and logistical constraints of the survey). In addition to the sampling efficiency, it is necessary to take into account the operational feasibility and cost-effectiveness of each alternative sampling scheme.

A relative measure of the efficiency of a particular sample design is the design effect (DEFF), defined as the variance of a survey estimate based on the actual sample design divided by the corresponding variance of the estimate based on a simple random sample. In general, the DEFF's for survey estimates from multistage sample designs are greater than 1 because of the clustering effects, although it is possible to have DEFF's less than 1 due to the effects of stratification. The microcomputer software PC CARP, described in the previous section, was used to calculate the DEFF's for selected crop production estimates from the 1989 survey data.

The sample design for the 1989 survey provides for the selection of four compact clusters of four households each within a sample DR. Since the intraclass correlation within compact clusters is potentially higher than that within clusters of dispersed households (selected systematically from the entire DR listing), a study was conducted to compare the efficiency of these alternative approaches. This research was based on two separate PC CARP input files from the 1989 survey data. The first file consisted of one compact cluster of four households from each sample DR, and the second file consisted of one household selected from each of the four compact clusters within a sample DR (to represent the dispersed cluster). Given that a few sample households were missing from the 1989 survey data (due to noninterviews, etc.), some of the clusters only had three households. Each file contained the records for 297 sample households, which is about one quarter of the 1989 survey data file. Table 1 presents the DEFF's for a selected group of crops based on these data sets for the compact and dispersed clusters, as well as the percentage difference between the two DEFF's for each crop; the averages across all crops are also shown. It can be seen in this table that the DEFF's are generally higher for the compact clusters, with an average difference of 10.7 percent. Given such a small overall sample size, the differences vary in both directions due to sampling variability. Since the purpose of this study was to determine the general tendency of the DEFF's, it can be concluded that a greater dispersion in the

households within a sample DR reduces the DEFF, as expected. However, it is also necessary to take into account operational considerations of the data collection procedures, such as the mobility of the interviewers between households within a sample DR.

Table 1. Estimated Design Effect (DEFF) and Intraclass Correlation for Crop Production Estimates From Alternative Clustering Designs, Based on 1989 Crop Production Survey Data

Crop	Type of Clustering Design								
	Compact Cluster of 4 Housenolds Each		Disperse Cluster of 4 Households Each		% Diff. in DEFF [(1)-(2)]	4 Subclusters of 4 Households Each (16 Hhs)		4 Subclusters of 8 Households Each (32 Hhs)	
	DEFF (1)	Intr. Corr.	DEFF (2)	Intr. Corr.		DEFF (3)	Intr. Corr.	Est. DEFF (4)	Est. Intr. Corr.
Haricots Total	2.11	0.369	1.76	0.254	16.4%	4.05	0.203	7.31	0.203
Pois Total	1.44	0.147	1.02	0.007	29.2%	1.90	0.060	2.85	0.060
Sorgho	1.49	0.162	1.63	0.210	-9.8%	3.22	0.148	5.58	0.148
Mais Total	2.23	0.412	0.90	-	59.9%	2.78	0.119	4.69	0.119
Patate Douce	2.99	0.665	2.34	0.446	22.0%	7.41	0.427	14.24	0.427
Manioc Total	1.70	0.233	1.98	0.327	-16.6%	4.07	0.205	7.35	0.205
Pomme de Terre	1.60	0.201	1.78	0.260	-11.1%	7.14	0.409	13.69	0.409
Banane a Cuire	1.41	0.137	1.09	0.029	23.0%	2.71	0.114	4.54	0.114
Banane a Bière	1.75	0.251	2.32	0.439	-32.3%	4.04	0.203	7.29	0.203
Café	2.18	0.394	1.62	0.208	25.6%	4.40	0.227	8.02	0.227
Blé	0.83	-	1.19	0.065	-43.0%	1.22	0.015	1.45	0.015
Average	1.80	0.297	1.60	0.224	10.7%	3.90	0.194	7.00	0.194

Table 1 also presents the DEFF's calculated from the entire 1989 sample, which included 16 sample households in each sample DR (four compact clusters of four households each). It can be seen that the DEFF's become much higher when the number of sample households per DR is increased from 4 to 16 households. This indicates the effect of the intraclass (intracluster) correlation on the design effect. The DEFF for the estimate of a total X from a stratified two-stage sample such as the 1989 Crop Production Survey can be expressed as follows:

$$DEFF(X) = [1+\delta*(\bar{n}-1)]*e_s,$$

where:

δ = intraclass correlation coefficient, a measure of the homogeneity of households within a cluster for variable X

$\bar{n}$ = average number of households selected within the cluster (DR)

e_s = effect of stratification

There were actually two stages of clustering in the 1989 sample design (the DR and the compact cluster of four households within the DR), with corresponding intraclass correlation coefficients δ_1 and δ_2, respectively. However, in order to simplify this study it was assumed that there was one stage of clustering, with δ measuring the combined effects of δ_1 and δ_2.

In order to estimate the DEFF's based on a different number of households selected per sample DR, the intraclass correlation coefficients were estimated from the calculated DEFF's, using the formula for DEFF(X) specified above. The effect of stratification, e_s, is ignored in estimating the values of δ. Most of the factors e_s should be slightly less than 1, since the stratification should improve the efficiency of the sample design over a simple random sample. Therefore the effect of dropping the factor e_s when estimating the value of δ would be to slightly underestimate δ, and the values for the intraclass correlation coefficients presented in Table 1 may be considered minimum estimates. Thus the following formula was used to estimate the value of δ:

$$\delta = (DEFF-1)/(\bar{n}-1)$$

It can be seen in Table 1 that the intraclass correlation coefficients are reduced as the households become more dispersed within a sample DR. The average value of δ across the different crop production estimates based on the 1989 sample design is 0.194, which indicates a considerable homogeneity within DR's. This is the main reason for the high DEFF's for that survey (averaging 3.9). For the current sample design, the number of households selected per sample DR were doubled to 32 (4 compact clusters of 8 households each). It can be seen from the formula for DEFF(X) that increasing the value of $\bar{n}$ from 16 to 32 will result in a large increase in the DEFF. The values of δ calculated from the 1989 sample design were used to estimate the DEFF's for the same crop production estimates based on the current design. These results are also presented in Table 1. Since larger compact clusters (of 8 households each) are used for the current survey, the estimates of δ from the 1989 survey can generally be considered minimum estimates of the corresponding values of δ for the current survey. It can be seen in Table 1 that the average DEFF across the different crop production estimates is 7.0, indicating the inefficiency of the current design from a sampling point of view.

The estimates of DEFF and δ calculated for the 1989 sample design were also used to determine the relative efficiency of alternative sampling strategies which may be considered for the new sample design. By comparing the relative efficiency of each alternative and taking into account the operational considerations of the fieldwork, it is possible to determine the most cost-effective and practical approach for the new design. Tables 2.1 to 2.4 present the estimates of the

percentage gain in precision (that is, reduction in the sampling errors) of the current sample design and 10 alternative designs compared to the 1989 sample design. These estimates were obtained from the ratio of the estimated standard error from each alternative new sample design to that from the 1989 design. This ratio was calculated as follows:

$$\mathrm{SQRT}[\mathrm{Var}_{ND}(X)/\mathrm{Var}_{89}(X)] =$$

$$= \mathrm{SQRT}\{[(N^2*\sigma^2)/n_{ND}]*\mathrm{DEFF}_{ND}\}/\{[(N^2*\sigma^2)/n_{89}]*\mathrm{DEFF}_{89}\} =$$

$$= \mathrm{SQRT}[(n_{89}/n_{ND})*(\mathrm{DEFF}_{ND}/\mathrm{DEFF}_{89})],$$

where:

SQRT[ ]: square root of expression

$\mathrm{Var}_{ND}(X)$ = variance of estimate of total X based on new sample design

$\mathrm{Var}_{89}(X)]$ = variance of estimate of total X based on 1989 sample design

N = total number of households in the population

σ^2 = population variance (square of standard deviation) for variable X

n_{ND} = overall sample size (number of sample households) for new sample design

DEFF_{ND} = design effect from new sample design

n_{89} = overall sample size (number of sample households) for 1989 sample design

DEFF_{89} = design effect from 1989 sample design

Note: The expression $[(N^2*\sigma^2)/n]$ represents the simple random sample variance of a total (X).

This ratio expresses the standard error (precision) from the new design as a proportion of the standard error from the 1989 design. Therefore the complement of this proportion (subtracting it from 1) represents the proportion of gain in precision of the new sample design over the 1989 design, presented in Tables 2.1 to 2.4 in the form of a percentage.

In Tables 2.1 to 2.4 the estimates of DEFF for the designs involving 16 and 32 households selected per DR were copied from Table 1. The DEFF's for the alternatives involving 8 and 24 households per DR were calculated assuming the same values for δ estimated from the 1989 survey data.

Table 2.1 illustrates the sampling inefficiency of selecting 32 households within a sample DR in the current sample design. Although the overall sample size from the 1989 survey was doubled, the average gain in precision across the various crops was only about 7.6 percent. Therefore in the new sample design for the

agricultural surveys the number of households per DR will be reduced to 8, and the overall number of sample DR's will be increased, as described in Section 6.3.

Table 2.1. Estimated Gain in Precision for Crop Production Estimates From Alternative Sampling Schemes, Compared to Sample Design for 1989 Crop Production Survey

Crop	Type of Sampling Scheme						
	1989 Sample Design - 76 PSU's, with 16 Hhs. Each: Sample size = 1,216	Current Sample Design - 76 PSU's, with 32 Hhs. Each: Sample size = 2,432		Sample Design Alternative 1 - 100 PSU's, with 16 Hhs. Each: Sample size = 1,600		Sample Design Alternative 2 - 120 PSU's, with 16 Hhs. Each: Sample Size = 1,920	
	DEFF	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)
Haricots Total	4.05	7.31	5.0%	4.05	12.8%	4.05	20.4%
Pois Total	1.90	2.85	13.3%	1.90	12.8%	1.90	20.4%
Sorgho	3.22	5.58	6.9%	3.22	12.8%	3.22	20.4%
Mais Total	2.78	4.69	8.3%	2.78	12.8%	2.78	20.4%
Patate Douce	7.41	14.24	2.0%	7.41	12.8%	7.41	20.4%
Kanioc Total	4.07	7.35	5.0%	4.07	12.8%	4.07	20.4%
Pomme de Terre	7.14	13.69	2.1%	7.14	12.8%	7.14	20.4%
Banane a Cuire	2.71	4.54	8.5%	2.71	12.8%	2.71	20.4%
Banane a Bière	4.04	7.29	5.1%	4.04	12.8%	4.04	20.4%
Café	4.40	8.02	4.5%	4.40	12.8%	4.40	20.4%
Blé	1.22	1.45	22.8%	1.22	12.8%	1.22	20.4%
Average	3.90	7.00	7.6%	3.90	12.8%	3.90	20.4%

Table 2.2. Estimated Gain in Precision for Crop Production Estimates From Alternative Sampling Schemes, Compared to Sample Design for 1989 Crop Production Survey

Crop	Type of Sampling Scheme						
	1989 Sample Design - 76 PSU's, with 16 Hhs. Each: Sample size = 1,216	Sample Design Alternative 3 - 76 PSU's, with 24 Hhs. Each: Sample size = 1,824		Sample Design Alternative 4 - 100 PSU's, with 24 Hhs. Each: Sample size = 2,400		Sample Design Alternative 5 - 120 PSU's, with 24 Hhs. Each: Sample size = 2,880	
	DEFF	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)
Haricots Total	4.05	5.68	3.3%	5.68	15.7%	5.68	23.1%
Pois Total	1.90	2.37	8.6%	2.37	20.4%	2.37	27.3%
Sorgho	3.22	4.40	4.5%	4.40	16.8%	4.40	24.0%
Mais Total	2.78	3.74	5.4%	3.74	17.5%	3.74	24.7%
Patate Douce	7.41	10.82	1.3%	10.82	14.0%	10.82	21.5%
Manioc Total	4.07	5.71	3.3%	5.71	15.7%	5.71	23.1%
Pomme de Terre	7.14	10.42	1.4%	10.42	14.0%	10.42	21.5%
Banane a Cuire	2.71	3.63	5.6%	3.63	17.7%	3.63	24.9%
Banane a Bière	4.04	5.66	3.3%	5.66	15.7%	5.66	23.1%
Café	4.40	6.21	3.0%	6.21	15.4%	6.21	22.8%
Blé	1.22	1.34	14.5%	1.34	25.5%	1.34	32.0%
Average	3.90	5.45	4.9%	5.45	17.1%	5.45	24.3%

Table 2.3. Estimated Gain in Precision for Crop Production Estimates From Alternative Sampling Schemes, Compared to Sample Design for 1989 Crop Production Survey

Crop	Type of Sampling Scheme						
	1989 Sample Design - 76 PSU's, with 16 Hhs. Each: Sample size = 1,216	Sample Design Alternative 6 - 100 PSU's, with 32 Hhs. Each: Sample size = 3,200		Sample Design Alternative 7 - 120 PSU's, with 32 Hhs. Each: Sample size = 3,840		Sample Design Alternative 8 - 150 PSU's, with 16 Hhs. Each: Sample size = 2,400	
	DEFF	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)
Haricots Total	4.05	7.31	17.2%	7.31	24.4%	4.05	28.8%
Pois Total	1.90	2.85	24.4%	2.85	31.0%	1.90	28.8%
Sorgho	3.22	5.58	18.8%	5.58	25.9%	3.22	28.8%
Mais Total	2.78	4.69	20.0%	4.69	27.0%	2.78	28.8%
Patate Douce	7.41	14.24	14.5%	14.24	22.0%	7.41	28.8%
Manioc Total	4.07	7.35	17.2%	7.35	24.4%	4.07	28.8%
Pomme de Terre	7.14	13.69	14.6%	13.69	22.1%	7.14	28.8%
Banane a Cuire	2.71	4.54	20.2%	4.54	27.2%	2.71	28.8%
Banane a Bière	4.04	7.29	17.2%	7.29	24.4%	4.04	28.8%
Café	4.40	8.02	16.7%	8.02	24.0%	4.40	28.8%
Blé	1.22	1.45	32.7%	1.45	38.6%	1.22	28.8%
Average	3.90	7.00	19.4%	7.00	26.4%	3.90	28.8%

Table 2.4. Estimated Gain in Precision for Crop Production Estimates From Alternative Sampling Schemes, Compared to Sample Design for 1989 Crop Production Survey

Crop	Type of Sampling Scheme				
	1989 Sample Design - 76 PSU's, with 16 Hhs. Each: Sample size = 1,216	Sample Design Alternative 9 - 150 PSU's, with 8 Hhs. Each: Sample size = 1,200		Sample Design Alternative 10 - 300 PSU's, with 8 Hhs. Each: Sample size = 2,400	
	DEFF	DEFF	Gain in Prec. (%)	DEFF	Gain in Prec. (%)
Haricots Total	4.05	2.42	22.1%	2.42	44.9%
Pois Total	1.90	1.42	12.9%	1.42	38.4%
Sorgho	3.22	2.03	19.9%	2.03	43.4%
Mais Total	2.78	1.83	18.3%	1.83	42.2%
Patate Douce	7.41	3.99	26.1%	3.99	47.8%
Manioc Total	4.07	2.43	22.2%	2.43	45.0%
Pomme de Terre	7.14	3.87	25.9%	3.87	47.6%
Banane a Cuire	2.71	1.80	18.0%	1.80	42.0%
Banane a Bière	4.04	2.42	22.1%	2.42	44.9%
Café	4.40	2.59	22.8%	2.59	45.4%
Blé	1.22	1.10	4.3%	1.10	32.3%
Average	3.90	2.36	19.5%	2.36	43.1%

Tables 2.1 to 2.4 can also be used in conjunction with Table A.1 to calculate the standard error and C.V. of the production estimates for particular crops based on one of the alternative sample designs. This can be done by looking up the corresponding gain in precision for a specific crop based on the alternative sample design in the appropriate table (2.1 to 2.4). The standard error (and C.V.) for that crop in Table A.1 would then be reduced by the corresponding proportion of gain in precision. For example, to estimate the standard error for sorghum (*sorgho*) based on sample design alternative 10 (300 sample PSU's, with 8 sample households per PSU), the standard error for this estimate from the 1989 design (12,928) would be reduced by a factor of 0.566 (that

is, 1-0.434, from the corresponding 43.4 percent gain in precision found in Table 2.4), resulting in 7,317. In the same way, the C.V. for sorghum would be reduced from 10.2 percent to 5.8 percent.

Comparing the DEFF for a particular crop from Table A.1 to the corresponding DEFF's at the *prefecture* level (from Tables A.2 to A.11), it can be seen that the DEFF's are higher for some *prefectures* and lower for others. Although the estimates of the DEFF's and gain in precision in Tables 2.1 to 2.4 were only calculated at the national level, it is possible to estimate the approximate standard error of a particular crop production estimate at the *prefecture* level based on an alternative sample design as follows:

$$s_{acp} = (1-g_{acn}) * SQRT(DEFF_{89cp}/DEFF_{89cn}) * s_{89cp},$$

where:

s_{acp} = approximate standard error for the production estimate for crop **c** in *prefecture* **p**, based on alternative sample design **a**

g_{acn} = proportion gain in precision at the national level from alternative sample design **a** (compared to 1989 design) for the production estimate for crop **c**, from Tables 2.1 to 2.4

$DEFF_{89cp}$ = design effect for the production estimate for crop **c** in *prefecture* **p**, based on 1989 sample design, from Tables A.2 to A.11

$DEFF_{89cn}$ = design effect for the production estimate for crop **c** at the national level based on the 1989 sample design, from Table A.1

s_{89cp} = standard error for the production estimate for crop **c** in *prefecture* **p**, based 1989 sample design, from Tables A.2 to A.11

6. Recommended Sample Design for New Agricultural Survey Program

6.1. Sampling Frame and Units

The sampling frame for household surveys such as the national agricultural survey is generally based on the most recent census data and cartographic materials. The preliminary counts of households and population and updated sketch maps of DR's are now available from the 1991 Rwanda Census of Population and Housing, which are ideal for constructing the new sampling frame.

Rwanda is divided hierchically into the following administrative areas: *prefectures*, *communes* and *secteurs*. There are a total of 11 *prefectures* (including Kigali-Ville, which is almost exclusively urban), 145 *communes* and 1490 *secteurs* in the country. For the 1991 census enumeration, the *secteurs* were further divided into *districts de recensement* (DR's), with an average of about 250 households each, the workload for one census enumerator. A total of 6,204 DR's were thus defined for the census, or about four DR's per *secteur*.

The units of analysis for the agricultural surveys are the farm households. The universe for the national agricultural survey program includes all farm households within the rural areas of Rwanda, excluding the islands with the following geographic identifications:

Prefecture	*Commune*	*Secteur*	*District*
Gisenyi	Kayove	Kinunu	045
Gisenyi	Kayove	Busanza	046
Cyangugu	Gatare	Birembo	101
Cyangugu	Kamembe	Bugumira	ALL
Cyangugu	Kamembe	Mpawe	ALL

A total of 10 DR's are included in these islands. Given the small percentage of households in these islands (only 0.17 percent according to the 1991 census) and the high operational costs which would have been required to enumerate them, it was was decided that it would not be cost-effective to include them in the sampling frame.

The *Service National du Recensement* (SNR) has classified the DR's into the following four categories, based on the *de jure* (*de droit*) and *de facto* (*de fait*) urbanity classifications:

	De jure	*De facto*
(1)	Rural	Rural
(2)	Rural	Urban
(3)	Urban	Rural
(4)	Urban	Urban

There are a total of 91 DR's in category (2) and 16 DR's in category (3). It was decided to include categories (1) through (3) in the sampling frame for the new national agricultural survey program, in order to maximize the coverage of farm households. If any DR's in categories (2) or (3) fall into the sample, it may be necessary to screen out nonfarm households at the listing stage. The 262 DR's in category (4) are excluded from the sampling frame. These strictly urban DR's only contain about 4.6 percent of the households in Rwanda.

After excluding the islands and urban areas, the final sampling frame for the national agricultural survey program consists of 5,932 DR's. Table 3 presents the distribution of the DR's and households by *prefecture* in this sampling frame from the 1991 preliminary census data, with the corresponding average number of households per DR for each *prefecture*.

Table 3. Distribution of DR's and Households in New Sampling Frame by Prefecture, and Average Number of Households per DR, Based on Preliminary 1991 Census Results

Prefecture	Total Number of DR's	Total Number of Households	% of Households	Average No. of Households per DR
BUTARE	652	160,550	11.3%	234
BYUMBA	695	162,939	7.2%	252
CYANGUGU	412	103,813	7.0%	242
GIKONGORO	414	100,119	10.5%	239
GISENYI	629	150,163	11.9%	232
GITARAMA	737	170,789	9.5%	252
KIBUNGO	540	136,202	6.8%	251
KIBUYE	386	97,042	13.5%	244
KIGALI	793	193,398	11.2%	239
RUHENGERI	674	161,191	11.2%	239
RWANDA	5,932	1,436,211	100.0%	242

The primary sampling units (PSU's) for the survey will be DR's. The farm households are uniquely identified within housing units, or *concessions*, and each housing unit is uniquely associated with a DR. Since the rural DR's (both *de facto* and *de jure*) cover the areas of Rwanda specified for the survey, the frame should adequately represent the specified universe.

The SNR provided the DSA with an ASCII data file containing the number of households and the population (male/female, present/absent) for each of the 6,204 DR's, based on the preliminary manual counts. The number of households for each DR from the preliminary census data will be used as the measure of size for selecting the sample DR's with probability proportional to size. The microcomputer software SPSS-PC+ was used to produce frequency counts and summary information from this preliminary census data file. A few DR's were found with a very high or very low average number of persons per household. The identification of these DR's was provided to staff of the SNR, who verified the corresponding data.

The SPSS-PC+ software was used to produce the database file with the new sampling frame from the preliminary census frame ASCII file obtained from the SNR. Codes for the urban/rural status and *zones agro-ecologiques* (described in Section 6.2) were introduced into the file, and the records for urban and island DR's excluded from the frame were removed into a separate file. SPSS-PC+ was also used to produce summary tables for the distribution of the sampling frame. Individual LOTUS files with the sampling frame for each *prefecture* (stratum) were produced from the database file for selecting the sample DR's.

An alternative sampling scheme which was discussed with the DSA staff was to define the *secteurs* as PSU's, and select two DR's within each sample *secteur*; the number of households to be selected in the PSU would be split between the two sample DR's. This would result in a somewhat greater dispersion of the households within PSU, thus slightly reducing the intraclass correlation and the DEFF; at the same time, the mobility of the interviewer would be limited to travel within the *secteur*. No data are available from previous surveys to measure the intraclass correlation within the *secteur*. Given that there are only about four DR's per *secteur*, there would still be much homogeneity of households within *secteur*. Since this alternative would have doubled the amount of listing required and may only have resulted in a slight reduction in the DEFF, it was decided to maintain the DR as the PSU.

For the second stage of sampling, a listing of households will be conducted within each sample DR. The secondary sampling units (SSU's) will be the compact clusters of households within the sample DR's. These compact clusters will be defined based on the listing information (see Section 6.4).

6.2. Stratification

In order to increase the efficiency of the sample design for the national agricultural survey program, it is important to divide the sampling frame of DR's into strata which are as homogeneous a possible. The sample selection is carried out independently within each stratum. The nature of the stratification depends on the most important characteristics to be measured in the survey, as well as the domains of analysis; the strata should be consistent with the geographic disaggregation to be used in the survey tables. It is also desirable to order the PSU's within each stratum by certain criteria which are correlated with key survey variables, in order to provide further implicit stratification when systematic selection is used.

The first level of stratification will correspond to the *prefectures*, given that survey estimates will be obtained at the *prefecture* level. In the case of Kigali-Ville, there are only 28 DR's included in the frame, which belong to the category *de jure* rural/*de facto* urban. These DR's were added to the end of the stratum for Kigali *prefecture*, so a total of 10 strata (*prefectures*) are used for the survey.

Since cropping patterns should be correlated with the *zones agro-ecologiques*, the efficiency of the sample can be further improved through implicit stratification by ordering the PSU's by *zones*. The territory of Rwanda has been recently mapped into 18 distinct *zones agro-ecologiques* based on soil samples and other criteria. Given that these new *zones* can cross *secteur* and DR boundaries, and there is insufficient time available for coding the DR's by predominant *zone*, it was decided to use the 12 *zones agro-ecologiques* used previously, defined as follows:

(1) *Imbo*
(2) *Impara*
(3) *Bords du lac Kivu*
(4) *Terres des laves*
(5) *Crête Zaïre-Nili*
(6) *Hautes terres du Buberuka*
(7) *Plateau central*
(8) *Dorsale granitique*
(9) *Mayaga*
(10) *Bugesera*
(11) *Plateau central*
(12) *Savane de l'Est*

Although it was not feasible to obtain the coding of *secteurs* by *zone agro-ecologique* used for the previous sampling frame, the *communes* were coded by primary and secondary *zone* (based on the proportion of area). There are 36 unique combinations of the primary and secondary *zone* codes. These codes were introduced into the sampling frame database, and the DR's within each *prefecture* were ordered accordingly. Table 4 shows the distribution of DR's and households in the sampling frame by primary *zone agro-ecologique*.

Table 4. Distribution of DR's and Households in New Sampling Frame by Primary *Zone Agro-Ecologique*, Based on Preliminary 1991 Census Results

Primary *Zone Agro-ecologique*	Total Number of DR's	Total Number of Households	% of Households
(1) *Imbo*	39	11,310	0.8%
(2) *Impara*	253	62,732	4.4%
(3) *Bords du lac Kivu*	276	66,318	4.6%
(4) *Terres des laves*	396	94,865	6.6%
(5) *Crête Zaïre-Nili*	920	227,351	15.8%
(6) *Hautes terres du Buberuka*	562	131,418	9.2%
(7) *Plateau central*	1,143	264,335	18.4%
(8) *Dorsale granitique*	807	194,165	13.5%
(9) *Mayaga*	175	45,490	3.2%
(10) *Bugesera*	201	52,875	3.7%
(11) *Plateau central*	903	220,861	15.4%
(12) *Savane de l'Est*	257	64,491	4.5%
RWANDA	5,932	1,436,211	100.0%

As indicated in Section 6.1, in the new sampling frame there are 91 DR's in the category *de jure* rural/*de facto* urban, and 16 DR's in the category *de jure* urban/*de facto* rural. In order to take these DR's into account in the implicit stratification, the DR's in the sampling frame for each *prefecture* are ordered by rural/urban code within *zone agro-ecologique*. The DR's are further ordered by *commune*, *secteur* and *district* in order to provide additional implicit geographic stratification.

In the case of surveys designed to measure total crop production, it is generally advisable to use stratification by farm size, either through a separate frame of large commercial farms, or through post-stratification of the farm households by size from the listing in sample PSU's. The Government of Rwanda already has a separate data statistical reporting operation in place for the large commercial plantations (such as tea and other industrial crops). Since it is not feasible to collect data on farm area at the listing stage, post-stratification by farm size is not used.

6.3. Sample Size and Allocation

The sample size for a particular survey is determined by the accuracy required for the survey estimates for each domain, as well as by the resource and operational constraints. The accuracy of the survey results depends on both the sampling error, which can be measured through variance estimation, and the nonsampling error, which can only partially be measured through expensive reinterview or validation studies. The sampling error is inversely proportional to the sample size. On the other hand, the nonsampling error may increase with the sample size, since it is more difficult to control the quality of a larger operation. It is therefore important that the overall sample size be manageable for quality and operational control purposes.

The major factors which will determine the sample size for the new agricultural survey program are the resource and operational constraints. The DSA has expressed a desire to obtain crop production estimates for the *unités operationelles*, which are below the *prefecture* level. However, the sample for the current survey does not even provide sufficient reliability at the *prefecture* level, as indicated by the C.V.'s in Tables A.2 to A.11.

The main reason for the high C.V.'s at the subnational level is that the average number of sample DR's per *prefecture* is only about eight. Another problem affecting the precision of the survey estimates from the current sample is the high design effect due to the relatively high intraclass correlation within DR's and the large number of sample farm households interviewed within a sample DR. The conclusion from the study on design effects is that the only way to substantially reduce the sampling errors at the subnational level is to significantly increase the number of sample DR's. With a corresponding decrease in the number of households selected per sample DR, the sample will be more efficient (that is, a given sample size will provide a higher level of precision), as illustrated by the gain in precision for the sampling alternatives presented in Tables 2.1 to 2.4.

The total number of sample DR's to be selected for the new survey program depends on the number of interviewers available for the survey, as well as the number of sample DR's which each interviewer can cover. The latter issue is affected by the data collection methodology used for the survey and interviewer mobility. If an interviewer can collect part of the crop production

data based on a monthly visit to the sample farm households instead of weekly interviews, it will be easier to have the interviewers cover additional DR's.

An experimental design was incorporated into the current survey design in order to compare the crop production estimates based on weekly and monthly data collection procedures. Dr. Clay carried out a preliminary analysis of the results of this study, and found that the monthly data collection procedures had a tendency to provide somewhat lower estimates of production for various crops, indicating possible under-reporting, although some of the differences were not statistically significant. The findings from this study are described in Dr. Clay's report. The DSA decided to continue including both the weekly and monthly data collection procedures in the survey design. If a bias resulting from the monthly data collection procedures can be measured over time, it may be possible to adjust the corresponding crop production estimates accordingly.

The current survey uses 78 interviewers, and each one collects data from about 32 households within a single DR. At this time it is not certain whether more interviewers will be contracted for the new agricultural survey program. Therefore the DSA decided to base the new survey design on having the same number of interviewers cover additional sample DR's. This will be accomplished by reducing the number of sample households per DR to eight (two clusters of four households each), and using the monthly data collection procedures for crop production in the additional sample DR's. The main constraint in the number of sample DR's one interviewer can cover is the mobility of the interviewers between DR's.

The systematic selection of the DR's from the geographically-ordered list maximizes the geographic dispersion of the sample. The territory of Rwanda covers an area of about 26,000 km^2. Based on a national sample of 156 DR's, the average distance between the center of one sample DR to the center of the closest sample DR is about 13 km; if a sample of 312 sample DR's is used, this average distance is reduced to about 9 km.

In order to determine the number of sample DR's which can be covered by one interviewer, it will be necessary to conduct fields tests and further study the logistical constraints of interviewer mobility. Preliminary plans for the national agricultural survey program will be based on each interviewer covering one DR using the weekly data collection procedures, and up to three additional sample DR's using the monthly data collection procedures (for a maximum of 312 sample DR's). Given that the objective area measurement procedures are very time-consuming, each interviewer will only collect the farm size and crop area data in the sample DR with the intensive (weekly) data collection procedures for crop production. Depending on the results of the field tests, it may be necessary to limit the number of additional sample DR's covered by each interviewer to one or two.

It is important to provide flexibility in the sample design to address the different options for the number of sample DR's per interviewer. Therefore a sample of 312 DR's will be selected for the new agricultural survey program, divided into four nationally-representative subsamples of 78 DR's each. One of these subsamples will be randomly selected for the intensive objective area measurement and weekly collection of crop production data. The final number of subsamples to be used for the agricultural survey will depend on the number of DR's which can be covered by each interviewer. Therefore the total number of sample DR's for the new agricultural survey may be 152, 234 or 312. Even if the new sample is limited to 152 or 234 initially, this sampling

approach allows the possibility of expanding the sample the following year by increasing the number of interviewers, providing more transportation to the interviewers, or modifying the data collection procedures.

This sampling approach will also provide more flexibility for individual survey modules on specialized topics, since the sample size requirements may vary for the different surveys based on the new sample. A particular survey may be based on one, two, three or four subsamples.

For national-level estimates it is most efficient to allocate the sample to each stratum (*prefecture*) proportionally to its size (in terms of the number of households). Table 5 shows the distribution of the households by *prefecture* in the new sampling frame from the 1991 preliminary census data, with the corresponding proportional allocation of the 312 sample DR's by *prefecture*. It can be seen in this table that the number of sample DR's by *prefecture* based on proportional allocation varies from 21 for Kibuye to 42 for Kigali. At the same time, it is important to ensure that each *prefecture* has a sufficient number of sample DR's to ensure an adequate level of precision for the *prefecture*-level estimates. In order to obtain a reasonable precision for survey estimates from a particular domain (such as *prefecture*), it is ideal to have at least 30 primary sampling units (PSU's), or DR's, in the sample for that domain; a sample of 20 PSU's may provide estimates of moderate reliability (with C.V.'s within 20 percent).

As a compromise between the requirements of the national-level and *prefecture*-level estimates, the number of sample DR's allocated proportionally to each *prefecture* was adjusted in order to have a minimum of 24 sample DR's and a maximum of 36 sample DR's in each. At the same time, it is ideal to have the number of sample DR's in each *prefecture* be a multiple of 4, in order to provide four representative subsamples. Table 5 also presents the recommended alternative allocation of the sample DR's which meets these requirements; the new sample of DR's for the agricultural survey program was selected based on this allocation.

The number of sample farm households in each *prefecture* under the alternative allocation is shown in Table 5, based on the assumption that eight sample farm households will be selected per sample DR. It can be seen in Table 2.4 that this sample design is significantly more efficient than the 1989 design. Given a sample of 312 DR's, with eight sample farm households selected per DR, there will be an average gain in precision of over 40 percent for crop production estimates, compared to the 1989 sample design. At the same time, the total number of sample farm households (2,496) is small enough to ensure good quality control and improve the timeliness of the results.

Table 5. Proportional Allocation of Sample DR's by Prefecture, Based on Number of Households from 1991 Census, and Alternative Allocation of Sample DR's and Households

Prefecture	Total Number of Households	% of Households	Proportional Allocation of Sample DR's	Alternative Allocation	
				No. of Sample DR's	No. of Sample Households
BUTARE	160,550	11.2%	35	36	288
BYUMBA	162,939	11.3%	35	36	288
CYANGUGU	103,818	7.2%	23	24	192
GIKONGORO	100,119	7.0%	22	24	192
GISENYI	150,163	10.5%	33	32	256
GITARAMA	170,789	11.9%	37	36	288
KIBUNGO	136,202	9.5%	29	28	224
KIBUYE	97,042	6.8%	21	24	192
KIGALI	193,398	13.5%	42	36	288
RUHENGERI	161,191	11.2%	35	36	288
RWANDA	1,436,211	100.0%	312	312	2,496

6.4. Sample Selection Procedures

Once the number of sample DR's to be selected in each *prefecture* were determined (see Table 5), the sample DR's within each *prefecture* were selected systematically with probability proportional to the number of households. In order to improve the efficiency of the sample design through implicit stratification (see Section 6.2), the DR's within a *prefecture* were listed in the following order: *zone agro-ecologique* (primary and secondary), rural/urban status, *commune*, *secteur* and *district*. The following procedures are used to select the sample DR's from the ordered list for each *prefecture*:

(1) Obtain a list of the all the DR's in the *prefecture* ordered by the stratification criteria, with the number of households for each DR from the sampling frame. Cumulate the measures of size (number of households) down the ordered list of DR's within the *prefecture*. The final cumulated measure of size is the total number of rural households in the *prefecture*, N_h.

(2) Calculate the first stage sampling interval (I_h) as follows:

$$I_h = N_h/m_h,$$

where m_h is the number of sample DR's to be selected in *Prefecture* h, specified in Table 5.

(3) Select a random number (R_h) between 0 and I_h. The sample DR's will be identified by the following selection numbers:

$$S_{hi} = R_h + [I_h * (i-1)], \text{ rounded up,}$$
$$\text{where } i = 1, 2, \ldots, m_h$$

The i-th selected DR is the one with a cumulated measure of size closest to S_{hi} without exceeding it.

A LOTUS spreadsheet was used to select the sample DR's in each *prefecture* based on these procedures. The number of sample DR's selected in each *prefecture* was based on the alternative allocation specified in Table 5. The sampling interval, random start and selection numbers used to select the sample DR's in each *prefecture* are documented in Annex B.

In order to provide greater flexibility in adjusting the final sample size, the 312 sample DR's were divided systematically into four nationally-representative subsamples. This was carried out by assigning sequential subsample codes 1 to 4 to the sample DR's selected within each *prefecture*; that is, the sample DR's were numbered 1, 2, 3, 4, 1, 2, 3, 4, etc., in the same order in which they were selected. All sample DR's receiving code 1 are assigned to subsample 1, those receiving code 2 are assigned to subsample 2, etc. Since the number of sample DR's allocated to each *prefecture* is a multiple of 4, each subsample within a *prefecture* has the same sample size. Based on this approach, each subsample of DR's can be considered to be selected systematically with probability proportional to the number of households within each *prefecture*. Annex C specifies the geographic identification of each of the 78 sample DR's within each of the four national subsamples (a total of 312 sample DR's).

Since the intensive data collection procedures (for the objective area measurement and weekly collection of crop poduction data) will be based on one subsample of 78 DR's, it is necessary to randomly select one of the four subsamples (with equal probability). This can be done by selecting a random integer between 1 and 4 (inclusive). The consultant selected the random number 2, so the DSA may use subsample number 2 for the intensive data collection procedures if they have not yet selected a random subsample for this purpose.

The remaining three subsamples may be used for the monthly collection of crop production data. If it is necessary to reduce the number of sample DR's to two or three per interviewer (because of interviewer mobility constraints), the subsample(s) to be used for the monthly collection of crop production data should also be randomly selected from remaining three subsamples. Assuming that subsample number 2 will be used for the intensive data collection procedures, the consultant randomly selected two additional integers between 1 and 4 in the following order: 4 and 1. If the DSA has not yet selected the random subsamples, they may use these numbers. In addition to

subsample number 2 to be used for the intensive data collection, the survey can use subsample 4 for the monthly collection of crop production data if the interviewers can only cover one additional sample DR each; or subsamples 4 and 1 if they can cover two additional sample DR's each.

The second stage selection of farm households will be based on a new listing of households in each sample DR. It is recommended to update the listing each year in order to ensure that the sample remains representative over time, and to avoid a reduction in the effective sample size when selected households move.

Based on the previous DSA survey experience, it was decided to select compact clusters of households within sample DR's. This will reduce the requirements for interviewer mobility within a sample DR. Although the results in Table 2 showed an average reduction of about 10 percent in the design effect by using disperse rather than compact clusters, the results varied by crop. Given a sample of 8 households per sample DR, it is recommended to select 2 compact clusters of 4 households each. There are two alternative methods for defining and selecting the compact clusters, specified as follows:

Alternative (1):
Divide the total number of farm households listed in the DR by 4, and round the result to determine the total number of compact clusters. Assign consecutively-listed households in groups of four to individual compact clusters. Since the total number of households listed in the sample DR is generally not a multiple of 4, one to three households may be left over at the end, in which case some compact clusters may have either three or five households each. In order to maintain the sample size, it would be preferable to allow clusters of five households. For the procedure to be unbiased, the cluster(s) receiving three or five households should be randomly assigned. Select two compact clusters systematically (using a random start), with equal probabilities of selection.

Alternative (2):
Select two households from the listing systematically, with a random start. Obtain the sampling interval by dividing the total number of farm households listed in the DR by 2. Select a random number between 0 and the interval (rounded to the next integer) to select the first household, and add the interval to the random start (rounded to the next integer) to select the second household. Each of these two sample households would be defined as the first in a series of four consecutively-listed households forming the sample compact cluster. If the second household selected is one of the last three households in the listing, the counting would continue with the first household in the listing. For example, if 250 households were listed in a sample DR and the households with numbers 124 and 249 were selected, the first sample cluster would consist of households with numbers 124, 125, 126 and 127, and the second sample cluster would consist of households with numbers 249, 250, 1 and 2.

In order to maintain an equal workload for each interviewer, it was decided to define the compact clusters based on Alternative (2). A minor disadvantage of this approach is that one of the clusters may be split between households at the end of the listing and households at the beginning, although this would only happen in about 3 percent of the sample DR's. If the DSA plans to

substitute sample farm households which are noninterviews (refusals, not at home, etc.), the households immediately following the cluster households in the listing can be used as replacements. For this purpose the sample cluster can initially be defined with six sequentially listed households, where the last two may be used as replacements for noninterviews. However, it is very important to record the nature of each noninterview in order to determine whether a weight adjustment is needed, and to tabulate the rate of substitution.

In some countries compact clusters are defined based on Alternative (1), using sketch maps to physically divide the area of the PSU into compact clusters with identifiable boundaries. In this case it is only necessary to update the listing within the area of the sample compact clusters each year, thus reducing the operational costs over time. Of course, this will also result in slightly variable cluster sizes, and sometimes it is difficult to delineate clear boundaries for small compact clusters. However, in future survey designs, the long-term cost savings of this approach should be weighed against the disadvantages of variable workloads. Perhaps a small test could be conducted to evaluate the feasibility of this approach.

ANNEX A

Table A.1. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - RWANDA

Number of Observations in Domain = 1,187

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	209,783	13,808	6.6%	182,719	236,847	4.05
Pois Total	15,592	1,398	9.0%	12,851	18,333	1.90
Sorgho	126,356	12,928	10.2%	101,018	151,694	3.22
Mais Total	93,880	14,426	15.4%	65,605	122,156	2.78
Patate Douce	769,385	53,768	7.0%	664,000	874,770	7.41
Manioc Total	310,997	29,912	9.6%	252,369	369,625	4.07
Pomme de Terre	239,489	101,479	42.4%	40,590	438,388	7.14
Banane a Cuire	630,969	60,660	9.6%	512,075	749,863	2.71
Banane a Bière	2,006,250	157,049	7.8%	1,698,434	2,314,066	4.04
Café	27,248	4,205	15.4%	19,006	35,489	4.40
Blé	10,398	3,128	30.1%	4,267	16,530	1.22
Total Number of Households	1,226,390	41,156	3.4%	1,145,725	1,307,055	-

Table A.2. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - BUTARE

Number of Ob ervations in Domain = 156

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	16,131	4,156	25.8%	7,985	24,277	5.29
Pois Total	1,361	434	31.9%	510	2,212	3.42
Sorgho	13,392	4,905	36.6%	3,777	23,006	7.45
Mais Total	1,926	728	37.8%	500	3,352	5.53
Patate Douce	109,215	14,657	13.4%	80,487	137,943	2.03
Manioc Total	55,420	8,586	15.5%	38,590	72,249	1.32
Pomme de Terre	4,741	1,137	24.0%	2,512	6,970	2.24
Banane a Cuire	28,500	8,000	28.1%	12,820	44,179	4.94
Banane a Bière	203,155	44,660	22.0%	115,621	290,689	3.99
Café	4,081	1,288	31.6%	1,556	6,606	2.71
Blé	-	-	-	-	-	-
Total Number of Households	151,428	15,327	10.1%	121,387	181,469	1.71

Table A.3. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - BYUMBA

Number of Observations in Domain = 108

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	32,997	2,826	8.6%	27,458	38,535	0.57
Pois Total	2,981	501	16.8%	1,999	3,963	0.74
Sorgho	23,053	2,515	10.9%	18,124	27,982	0.72
Mais Total	5,328	981	18.4%	3,406	7,250	1.16
Patate Douce	117,596	25,044	21.3%	68,510	166,682	4.33
Manioc Total	19,247	1,348	7.0%	16,605	21,888	0.14
Pomme de Terre	6,021	1,131	18.8%	3,804	8,238	0.90
Banane a Cuire	71,288	4,356	6.1%	62,750	79,827	0.24
Banane a Bière	200,990	30,441	15.1%	141,326	260,654	1.58
Café	3,604	1,966	54.5%	-249	7,457	5.02
Blé	1,594	1,007	63.2%	-380	3,568	3.17
Total Number of Households	134,908	13,825	10.2%	107,811	162,005	1.54

Table A.4. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - CYANGUGU

Number of Observations in Domain = 93

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	7,030	2,521	35.9%	2,089	11,970	6.89
Pois Total	765	478	62.5%	-173	1,703	3.38
Sorgho	469	300	64.0%	-120	1,057	6.01
Mais Total	6,316	1,630	25.8%	3,120	9,511	1.82
Patate Douce	36,975	14,285	38.6%	8,977	64,973	7.30
Manioc Total	23,165	10,082	43.5%	3,404	42,926	4.51
Pomme de Terre	3,254	1,079	33.2%	1,139	5,369	2.21
Banane a Cuire	49,484	23,556	47.6%	3,314	95,654	6.57
Banane a Bière	111,113	41,836	37.7%	29,115	193,111	5.24
Café	4,493	2,411	53.7%	-233	9,219	7.58
Blé	681	681	100.0%	-654	2,015	2.04
Total Number of Households	87,481	14,734	16.8%	58,603	116,359	2.58

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Table A.5. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - GIKONGORO

Number of Observations in Domain = 94

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	4,152	700	16.9%	2,780	5,523	1.59
Pois Total	1,639	471	28.7%	716	2,563	2.85
Sorgho	4,253	920	21.6%	2,449	6,056	2.29
Mais Total	3,405	1,159	34.0%	1,133	5,677	2.49
Patate Douce	80,300	14,910	18.6%	51,076	109,524	2.22
Manioc Total	9,017	2,737	30.4%	3,652	14,383	2.29
Pomme de Terre	3,283	1,026	31.3%	1,271	5,294	1.70
Banane a Cuire	3,657	1,507	41.2%	703	6,611	2.54
Banane a Bière	44,795	10,498	23.4%	24,220	65,370	1.81
Café	643	294	45.7%	68	1,219	1.96
Blé	987	490	49.7%	26	1,949	2.73
Total Number of Households	97,832	6,962	7.1%	84,187	111,477	0.52

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Table A.6. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - GISENYI

Number of Observations in Domain = 124

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	13,836	5,035	36.4%	3,967	23,706	4.18
Pois Total	904	403	44.6%	114	1,694	2.07
Sorgho	692	372	53.8%	-38	1,421	2.34
Mais Total	27,663	11,938	43.2%	4,264	51,062	2.69
Patate Douce	57,454	16,051	27.9%	25,994	88,914	3.63
Manioc Total	6,580	2,474	37.6%	1,731	11,429	2.14
Pomme de Terre	49,164	27,658	56.3%	-5,045	103,373	5.78
Banane a Cuire	16,719	7,352	44.0%	2,308	31,1[illegible]	7.41
Banane a Bière	129,557	75,728	58.5%	-18,871	277,985	5.72
Café	1,680	1,368	81.4%	-1,002	4,362	12.86
Blé	586	399	68.1%	-196	1,368	0.69
Total Number of Households	120,002	15,750	13.1%	89,132	150,872	2.22

Table A.7. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - GITARAMA

Number of Observations in Domain = 156

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	25,872	2,991	11.6%	20,009	31,735	1.55
Pois Total	1,440	471	32.7%	518	2,363	2.37
Sorgho	14,866	3,233	21.7%	8,530	21,202	2.45
Mais Total	2,354	552	23.4%	1,273	3,435	3.16
Patate Douce	87,305	14,537	16.7%	58,812	115,798	2.89
Manioc Total	74,427	17,149	23.0%	40,814	108,039	3.53
Pomme de Terre	9,476	4,304	45.4%	1,041	17,912	2.61
Banane a Cuire	50,392	5,689	11.3%	39,242	61,542	1.06
Banane a Bière	316,371	37,075	11.7%	243,703	389,039	1.49
Café	2,978	875	29.4%	1,263	4,693	2.05
Blé	588	386	65.6%	-169	1,345	0.89
Total Number of Households	159,439	10,343	6.5%	139,166	179,712	0.75

Table A.8. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - KIBUNGO

Number of Observations in Domain = 93

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	31,502	5,712	18.1%	20,307	42,698	1.90
Pois Total	1,230	496	40.3%	259	2,202	2.49
Sorgho	19,902	3,706	18.6%	12,639	27,165	1.01
Mais Total	3,560	935	26.3%	1,727	5,393	2.30
Patate Douce	39,620	10,082	25.4%	19,859	59,381	3.33
Manioc Total	16,940	4,178	24.7%	8,751	25,130	1.56
Pomme de Terre	5,119	1,999	39.0%	1,201	9,036	2.49
Banane a Cuire	252,063	45,852	18.2%	162,193	341,933	1.73
Banane a Bière	359,662	65,146	18.1%	231,975	487,349	1.68
Café	4,132	1,467	35.5%	1,256	7,008	1.75
Blé	508	328	64.6%	-135	1,150	0.44
Total Number of Households	92,324	14,301	15.5%	64,293	120,354	2.32

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Table A.9. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - KIBUYE

Number of Observations in Domain = 96

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	7,475	910	12.2%	5,692	9,258	0.76
Pois Total	2,853	414	14.5%	2,041	3,665	0.66
Sorgho	2,438	1,149	47.1%	186	4,690	4.64
Mais Total	18,977	4,318	22.8%	10,514	27,440	1.08
Patate Douce	58,209	3,986	6.8%	50,397	66,021	0.34
Manioc Total	9,197	2,408	26.2%	4,477	13,917	1.67
Pomme de Terre	9,681	2,593	26.8%	4,599	14,762	1.25
Banane a Cuire	5,394	1,999	37.1%	1,476	9,313	3.59
Banane a Bière	37,945	8,265	21.8%	21,745	54,145	1.44
Café	105	94	89.3%	-79	290	3.18
Blé	2,547	1,862	73.1%	-1,103	6,197	0.56
Total Number of Households	88,780	3,572	4.0%	81,778	95,781	0.15

Table A.10. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - KIGALI

Number of Observations in Domain = 142

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	42,313	7,352	17.4%	27,902	56,724	3.20
Pois Total	1,006	248	24.6%	520	1,491	1.15
Sorgho	39,345	10,003	25.4%	19,739	58,951	3.35
Mais Total	7,246	1,589	21.9%	4,131	10,360	2.19
Patate Douce	79,840	11,726	14.7%	56,856	102,823	2.50
Manioc Total	88,503	18,637	21.1%	51,974	125,032	4.05
Pomme de Terre	9,296	7,190	77.3%	-4,796	23,389	2.37
Banane a Cuire	120,459	25,215	20.9%	71,038	169,880	4.24
Banane a Bière	466,644	72,159	15.5%	325,212	608,076	1.97
Café	5,397	1,206	22.3%	3,034	7,760	2.39
Blé	522	478	91.5%	-414	1,458	0.99
Total Number of Households	159,797	15,572	9.7%	129,276	190,318	1.69

Table A.11. Estimates of Total Production for Selected Crops, with Corresponding Standard Errors, Coefficients of Variation, 95% Confidence Intervals and Design Effects, Based on 1989 Agricultural Production Survey - RUHENGERI

Number of Observations in Domain = 125

Crop	Estimate of Total Production (Tons)	Standard Error (Tons)	C.V. (%)	95% Confidence Interval		DEFF
				Lower Limit	Upper Limit	
Haricots Total	28,476	6,061	21.3%	16,595	40,356	2.69
Pois Total	1,413	449	31.8%	532	2,293	2.31
Sorgho	7,947	3,177	40.0%	1,720	14,174	3.98
Mais Total	17,106	6,144	35.9%	5,063	29,150	6.25
Patate Douce	102,870	29,976	29.1%	44,117	161,623	5.05
Manioc Total	8,502	6,263	73.7%	-3,775	20,778	7.53
Pomme de Terre	139,454	97,197	69.7%	-51,052	329,960	7.27
Banane a Cuire	33,014	14,522	44.0%	4,552	61,476	6.41
Banane a Bière	136,021	57,046	41.9%	24,211	247,831	8.48
Café	134	43	32.1%	50	218	0.72
Blé	2,385	1,989	83.4%	-1,513	6,283	8.84
Total Number of Households	134,395	13,688	10.2%	107,566	161,224	1.51

ANNEX B

DOCUMENTATION OF SAMPLING PARAMETERS FOR FIRST STAGE OF SELECTION:
SAMPLING INTERVALS, RANDOM STARTS AND SELECTION NUMBERS FOR EACH *PREFECTURE*

BUTARE

Nombre Total de Menages =	160550
Nombre de Districts Selectionnés =	36
Intervalle de Selection =	4459.722
Nombre Aleatoire =	1235.700

Districts Selectionnés:

1	1235.70	1236
2	5695.42	5696
3	10155.15	10156
4	14614.87	14615
5	19074.59	19075
6	23534.31	23535
7	27994.03	27995
8	32453.76	32454
9	36913.48	36914
10	41373.20	41374
11	45832.92	45833
12	50292.65	50293
13	54752.37	54753
14	59212.09	59213
15	63671.81	63672
16	68131.53	68132
17	72591.26	72592
18	77050.98	77051
19	81510.70	81511
20	85970.42	85971
21	90430.15	90431
22	94889.87	94890
23	99349.59	99350
24	103809.31	103810
25	108269.03	108270
26	112728.76	112729
27	117188.48	117189
28	121648.20	121649
29	126107.92	126108
30	130567.65	130568
31	135027.37	135028
32	139487.09	139488
33	143946.81	143947
34	148406.53	148407
35	152866.26	152867
36	157325.98	157326

BYUMBA

Nombre Total de Menages =	162939
Nombre de Districts Selectionnés =	36
Intervalle de Selection =	4526.083
Nombre Aleatoire =	1712.267

Districts Selectionnés

1	1712.27	1713
2	6238.35	6239
3	10764.43	10765
4	15290.52	15291
5	19816.60	19817
6	24342.68	24343
7	28868.77	28869
8	33394.85	33395
9	37920.93	37921
10	42447.02	42448
11	46973.10	46974
12	51499.18	51500
13	56025.27	56026
14	60551.35	60552
15	65077.43	65078
16	69603.52	69604
17	74129.60	74130
18	78655.68	78656
19	83181.77	83182
20	87707.85	87708
21	92233.93	92234
22	96760.02	96761
23	101286.10	101287
24	105812.18	105813
25	110338.27	110339
26	114864.35	114865
27	119390.43	119391
28	123916.52	123917
29	128442.60	128443
30	132968.68	132969
31	137494.77	137495
32	142020.85	142021
33	146546.93	146547
34	151073.02	151074
35	155599.10	155600
36	160125.18	160126

CYANGUGU

Nombre Total de Menages =	103818
Nombre de Districts Selectionnés =	24
Intervalle de Selection =	4325.75
Nombre Aleatoire =	1864.597

Districts Selectionnés:

1	1864.60	1865
2	6190.35	6191
3	10516.10	10517
4	14841.85	14842
5	19167.60	19168
6	23493.35	23494
7	27819.10	27820
8	32144.85	32145
9	36470.60	36471
10	40796.35	40797
11	45122.10	45123
12	49447.85	49448
13	53773.60	53774
14	58099.35	58100
15	62425.10	62426
16	66750.85	66751
17	71076.60	71077
18	75402.35	75403
19	79728.10	79729
20	84053.85	84054
21	88379.60	88380
22	92705.35	92706
23	97031.10	97032
24	101356.85	101357

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GIKONGORO

Nombre Total de Menages =	100119
Nombre de Districts Selectionnés =	24
Intervalle de Selection =	4171.625
Nombre Aleatoire =	2301.627

Districts Selectionnés:

1	2301.63	2302
2	6473.25	6474
3	10644.88	10645
4	14816.50	14817
5	18988.13	18989
6	23159.75	23160
7	27331.38	27332
8	31503.00	31504
9	35674.63	35675
10	39846.25	39847
11	44017.88	44018
12	48189.50	48190
13	52361.13	52362
14	56532.75	56533
15	60704.38	60705
16	64876.00	64877
17	69047.63	69048
18	73219.25	73220
19	77390.88	77391
20	81562.50	81563
21	85734.13	85735
22	89905.75	89906
23	94077.38	94078
24	98249.00	98250

GISENYI

Nombre Total de Menages =	150163
Nombre de Districts Selectionnés =	32
Intervalle de Selection =	4692.593
Nombre Aleatoire =	3649.745

Districts Selectionnés:

1	3649.75	3650
2	8342.34	8343
3	13034.93	13035
4	17727.53	17728
5	22420.12	22421
6	27112.71	27113
7	31805.31	31806
8	36497.90	36498
9	41190.50	41191
10	45883.09	45884
11	50575.68	50576
12	55268.28	55269
13	59960.87	59961
14	64653.46	64654
15	69346.06	69347
16	74038.65	74039
17	78731.25	78732
18	83423.84	83424
19	88116.43	88117
20	92809.03	92810
21	97501.62	97502
22	102194.21	102195
23	106886.81	106887
24	111579.40	111580
25	116272.00	116272
26	120964.59	120965
27	125657.18	125658
28	130349.78	130350
29	135042.37	135043
30	139734.96	139735
31	144427.56	144428
32	149120.15	149121

GITARAMA

Nombre Total de Menages =	170789
Nombre de Districts Selectionnés =	36
Intervalle de Selection =	4744.138
Nombre Aleatoire =	2133.443

Districts Selectionnés:

1	2133.44	2134
2	6877.58	6878
3	11621.72	11622
4	16365.86	16366
5	21110.00	21110
6	25854.14	25855
7	30598.28	30599
8	35342.42	35343
9	40086.55	40087
10	44830.69	44831
11	49574.83	49575
12	54318.97	54319
13	59063.11	59064
14	63807.25	63808
15	68551.39	68552
16	73295.53	73296
17	78039.67	78040
18	82783.80	82784
19	87527.94	87528
20	92272.08	92273
21	97016.22	97017
22	101760.36	101761
23	106504.50	106505
24	111248.64	111249
25	115992.78	115993
26	120736.92	120737
27	125481.05	125482
28	130225.19	130226
29	134969.33	134970
30	139713.47	139714
31	144457.61	144458
32	149201.75	149202
33	153945.89	153946
34	158690.03	158691
35	163434.17	163435
36	168178.30	168179

KIBUNGO

Nombre Total de Menages =	136202
Nombre de Districts selectionnés =	28
Intervalle de Selection =	4864.357
Nombre Aleatoire =	1584.467

Districts selectionnés:

1	1584.47	1585
2	6448.82	6449
3	11313.18	11314
4	16177.54	16178
5	21041.90	21042
6	25906.25	25907
7	30770.61	30771
8	35634.97	35635
9	40499.32	40500
10	45363.68	45364
11	50228.04	50229
12	55092.40	55093
13	59956.75	59957
14	64821.11	64822
15	69685.47	69686
16	74549.82	74550
17	79414.18	79415
18	84278.54	84279
19	89142.90	89143
20	94007.25	94008
21	98871.61	98872
22	103735.97	103736
23	108600.32	108601
24	113464.68	113465
25	118329.04	118330
26	123193.40	123194
27	128057.75	128058
28	132922.11	132923

KIBUYE

Nombre Total de Menages =	97042
Nombre de Districts selectionnés =	24
Intervalle de Selection =	4043.416
Nombre Aleatoire =	3783.347

Districts selectionnés:

1	3783.35	3784
2	7826.76	7827
3	11870.18	11871
4	15913.60	15914
5	19957.01	19958
6	24000.43	24001
7	28043.85	28044
8	32087.26	32088
9	36130.68	36131
10	40174.10	40175
11	44217.51	44218
12	48260.93	48261
13	52304.35	52305
14	56347.76	56348
15	60391.18	60392
16	64434.60	64435
17	68478.01	68479
18	72521.43	72522
19	76564.85	76565
20	80608.26	80609
21	84651.68	84652
22	88695.10	88696
23	92738.51	92739
24	96781.93	96782

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KIGALI

Nombre Total de Menages = 193398
Nombre de Districts selectionnés = 36
Intervalle de Selection = 5372.166
Nombre Aleatoire = 2183.173

Districts selectionnés:

1	2183.17	2184
2	7555.34	7556
3	12927.51	12928
4	13299.67	18300
5	23671.84	23672
6	29044.01	29045
7	34416.17	34417
8	39788.34	39789
9	45160.51	45161
10	50532.67	50533
11	55904.84	55905
12	61277.01	61278
13	66649.17	66650
14	72021.34	72022
15	77393.51	77394
16	82765.67	82766
17	88137.84	88138
18	93510.01	93511
19	98882.17	98883
20	104254.34	104255
21	109626.51	109627
22	114998.67	114999
23	120370.84	120371
24	125743.01	125744
25	131115.17	131116
26	136487.34	136488
27	141859.51	141860
28	147231.67	147232
29	152603.84	152604
30	157976.01	157977
31	163348.17	163349
32	168720.34	168721
33	174092.51	174093
34	179464.67	179465
35	184836.84	184837
36	190209.01	190210

RUHENGERI

Nombre Total de Menages =	161191
Nombre de Districts selectionnés =	36
Intervalle de Selection =	4477.527
Nombre Aleatoire =	3422.496

Districts selectionnés:

1	3422.50	3423
2	7900.02	7901
3	12377.55	12378
4	16855.08	16856
5	21332.61	21333
6	25810.14	25811
7	30287.66	30288
8	34765.19	34766
9	39242.72	39243
10	43720.25	43721
11	48197.77	48198
12	52675.30	52676
13	57152.83	57153
14	61630.36	61631
15	66107.89	66108
16	70585.41	70586
17	75062.94	75063
18	79540.47	79541
19	84018.00	84018
20	88495.52	88496
21	92973.05	92974
22	97450.58	97451
23	101928.11	101929
24	106405.64	106406
25	110883.16	110884
26	115360.69	115361
27	119838.22	119839
28	124315.75	124316
29	128793.27	128794
30	133270.80	133271
31	137748.33	137749
32	142225.86	142226
33	146703.39	146704
34	151180.91	151181
35	155658.44	155659
36	160135.97	160136

ANNEX C

DISTRICTS SELECTIONNES DANS CHAQUE SOUS-ECHANTILLON

SOUS-ECHANTILLON 1

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
1	1	GISHAMVU	5	LIBA	10	700	0	1256	269	1	1
1	4	KIGEMBE	10	NYARUTEJA	26	700	0	922	192	5	1
1	15	NYAKIZU	1	BUNGE	13	700	0	992	198	9	1
1	18	RUNYINYA	1	BUHORO	9	700	0	1097	222	13	1
1	10	MUYIRA	1	BUSORO	8	800	0	1393	295	17	1
1	14	NYABISINDU	5	KIBINJA	1	807	0	1034	235	21	1
1	20	SHYANDA	9	KINTEKO	3	807	0	1499	360	25	1
1	13	NTYAZO	7	KARAMA	17	809	0	1197	275	29	1
1	9	MUYAGA	2	KABUMBWE	7	900	0	1311	286	33	1
2	3	CYUMBA	2	CYUMBA	22	600	0	1144	238	1	1
2	7	KIBALI	4	MUKARANGE	47	600	0	1410	286	5	1
2	10	KIYOMBE	5	KANICA	2	600	0	1247	263	9	1
2	17	TUMBA	10	TUMBA	22	600	0	808	182	13	1
2	8	KINYAMI	6	MUGINA	30	611	0	594	120	17	1
2	16	RUTARE	1	BUSHWAGARA	31	1106	0	775	161	21	1
2	14	MUVUMBA	2	GATUNDA	34	1206	0	1979	399	25	1
2	6	GITUZA	5	MUKAPANGE	25	1211	0	1287	284	29	1
2	13	MURAMBI	12	RUGARAMA	18	1211	0	1524	326	33	1
3	1	BUGARAMA	2	BUNYERERI	33	102	0	1633	325	1	1
3	2	CYIMBOGO	11	WINTEKO	13	200	0	1079	227	5	1
3	5	GISHOMA	8	RUHOKO	26	200	0	1081	219	9	1
3	9	KARENGERA	1	BUTARE	12	201	0	1120	245	13	1
3	11	NYAKABUYE	7	NYAKABUYE	31	201	0	1124	216	17	1
3	7	KAGANO	4	KAGARAMA	17	302	0	1638	314	21	1
4	4	KIVU	3	KIVU	27	500	0	1133	238	1	1
4	9	MUSEBEYA	1	BUSHIGISHIGI	15	500	0	1086	249	5	1
4	10	NSHILI	9	RUNYOMBYI	24	500	0	1246	268	9	1
4	5	MUBUGA	7	NYARUSHISHI	25	507	0	1002	202	13	1
4	11	NYAMAGABE	5	KIBILIZI	29	507	0	1080	209	17	1
4	3	KINYAMAKARA	9	NYARUSANGE	20	700	0	1320	265	21	1
5	5	KAYOVE	5	GISHWATI	16	305	0	1233	232	1	1
5	8	NYAMYUMBA	7	KIRAGA	18	305	0	1299	246	5	1
5	10	RUBAVU	3	BYAHI	27	403	0	1168	247	9	1
5	7	MUTURA	11	NYARUTEME	13	405	0	976	201	13	1
5	4	KARAGO	4	MWIYANIKE	14	500	0	1046	215	17	1
5	3	KANAMA	9	NYABIRASI	30	503	0	1714	362	21	1
5	9	RAMBA	2	KAGEYO	13	507	0	1146	231	25	1
5	6	KIBILIRA	11	RUBONA	46	705	0	855	181	29	1
6	12	NYAKABANDA	3	KAGOGWE	10	607	0	867	166	1	1
6	11	NYABIKENKE	5	KIGWAGURO	21	700	0	977	190	5	1
6	2	KAYENZI	4	CUBI	22	800	0	1216	235	9	1
6	6	MUKINGI	4	KIMEGELI	13	800	0	858	168	13	1
6	10	NTONGWE	5	KINAZI	47	800	0	1517	333	17	1
6	13	NYAMABUYE	10	RUKAZA	55	800	0	1264	277	21	1
6	4	MASANGO	2	KADAHO	28	807	0	1232	254	25	1
6	9	MUSHUBATI	2	GATIKABISI	30	807	0	1308	274	29	1
6	5	MUGINA	1	BIBUNGO	11	809	0	1134	221	33	1
7	11	SAKE	2	MABUGA I	47	1011	0	963	218	1	1
7	1	BIRENGA	5	GASHONGORA	19	1100	0	999	198	5	1
7	4	KIGARAMA	5	KABARE II	48	1100	0	1313	262	9	1
7	10	RUTONDE	3	NKUNGU	15	1100	0	978	229	13	1
7	3	KAYONZA	3	MBURABUTURO	39	1112	0	1476	287	17	1
7	8	RUKIRA	10	RURENGE	36	1112	0	1146	239	21	1
7	9	RUSUMO	7	MUSAZA	92	1112	0	1444	309	25	1

SOUS-ECHANTILLON 1 (Cont.)

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
8	2	GISHYITA	4	MPEMBE	13	305	0	1058	251	1	1
8	9	RWAMATAMU	12	RWABISINDU	47	305	0	1169	247	5	1
8	4	GITESI	8	KAGABIRO	3	503	0	1179	258	9	1
8	6	MABANZA	13	RUBENGERA	26	503	0	1234	239	13	1
8	5	KIVUMU	3	KIBANDA	7	507	0	1424	309	17	1
8	7	MWENDO	10	RUGANDA	20	507	0	1321	275	21	1
9	9	MUGAMBUZI	3	KANYONI	25	700	0	1079	205	1	1
9	13	RUSHASHI	10	SHYOMBWE	22	700	0	839	175	5	1
9	15	SHYORONGI	5	NZOVE	23	706	0	1150	241	9	1
9	7	KANZENZE	7	MAYANGE	47	910	0	1235	237	13	1
9	11	NGENDA	6	MAREBA	31	1009	0	1100	256	17	1
9	3	GASHORA	6	MWENDO	46	1011	0	1728	440	21	1
9	4	GIKOMERO	6	KAYANGA	16	1100	0	1321	252	25	1
9	6	KANOMBE	8	RUSHESHE	4	1100	0	1093	203	29	1
9	1	BICUMBI	6	MURAMA	52	1110	0	1114	200	33	1
11	6	KIGOMBE	4	GASANZE	20	400	0	1044	238	1	1
11	8	MUKINGO	5	MUKINGO	23	400	0	1043	229	5	1
11	10	NKULI	10	RYINYO	35	405	0	1256	245	9	1
11	11	NKUMBA	11	RUHONDO	35	406	0	1039	227	13	1
11	1	BUTARO	1	BUHITA	24	600	0	1120	250	17	1
11	3	CYERU	8	MUGAMBA	1	600	0	958	223	21	1
11	13	NYAMUGALI	11	RUKORE	1	607	0	1236	280	25	1
11	2	CYABINGO	12	RUGIMBU	37	706	0	954	188	29	1
11	9	NDUSU	10	RUSORO	17	706	0	1167	231	33	1

SOUS-ECHANTILLON 2

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
1	1	GISHAMVU	10	SHOLI	25	700	0	906	204	2	2
1	5	MARABA	3	GISAKURA	21	700	0	1047	217	6	2
1	15	NYAKIZU	7	MARABA	20	700	0	881	193	10	2
1	18	RUNYINYA	7	MBASA	16	700	0	892	185	14	2
1	10	MUYIRA	5	MUNYINYA	11	800	0	1341	270	18	2
1	19	RUSATIRA	2	GAHANA	10	807	0	1200	260	22	2
1	8	MUGUSA	3	CYAYI	33	809	0	952	229	26	2
1	13	NTYAZO	12	NYAMURE	11	809	0	1131	274	30	2
1	9	MUYAGA	7	NYERANZI	28	900	0	1276	310	34	2
2	3	CYUMBA	7	MUSENDA	2	600	0	1031	216	2	2
2	7	KIBALI	8	RUHENDA	19	600	0	1229	256	6	2
2	12	MUKARANGE	1	BUGWE	5	600	0	989	213	10	2
2	1	BUYOGA	3	KAVUMU	29	607	0	1009	206	14	2
2	2	BWISIGE	3	GIHUKE	31	1106	0	1016	216	18	2
2	16	RUTARE	7	MWENDO	23	1106	0	1180	241	22	2
2	14	MUVUMBA	5	RUKOMO	2	1206	0	1615	353	26	2
2	13	MURAMBI	1	GAKENKE	74	1211	0	1127	215	30	2
2	15	NGARAMA	1	GAKOMA	17	1211	0	1530	291	34	2
3	1	BUGARAMA	4	KIBANGIRA	3	102	0	1379	357	2	2
3	3	GAFUNZO	4	GABIRO	3	200	0	1196	242	6	2
3	6	GISUMA	5	GASHIRABWOBA	32	200	0	1062	196	10	2
3	9	KARENGERA	3	GASUMO	10	201	0	1250	257	14	2
3	10	KIRAMBO	2	GAHISI	30	200	0	1324	287	18	2
3	7	KAGANO	10	RAMBIRA	37	302	0	1135	216	22	2
4	4	KIVU	7	RWISHWA	13	500	0	1119	274	2	2
4	9	MUSEBEYA	5	GIKUNGU	24	500	0	1104	260	6	2
4	13	RWAMIKO	4	MATA	3	500	0	1348	271	10	2
4	7	MUKO	2	CYOBE	17	507	0	1243	258	14	2
4	1	KARAMA	1	CYANIKA	13	700	0	1319	273	18	2
4	8	MUSANGE	5	KIBAGA	15	700	0	1177	239	22	2
5	5	KAYOVE	8	KINUNU	44	305	0	1094	217	2	2
5	8	NYAMYUMBA	12	RUSHUBI	3	305	0	1104	244	6	2
5	10	RUBAVU	8	MURARA	22	403	0	1195	286	10	2
5	1	GASEKE	3	GISEBEYA	18	500	0	1195	239	14	2
5	4	KARAGO	7	RAMBURA	24	500	0	1225	261	18	2
5	2	GICIYE	1	BIREMBO	40	507	0	1259	294	22	2
5	9	RAMBA	6	NYAMPILI	6	507	0	1152	235	26	2
5	12	SATINSYI	4	HINDIRO	10	705	0	1091	231	30	2
6	12	NYAKABANDA	8	NGARU	37	607	0	1387	315	2	2
6	11	NYABIKENKE	10	RUKARAGATA	34	700	0	1000	204	6	2
6	3	KIGOMA	1	BUTARE	41	800	0	986	225	10	2
6	6	MUKINGI	10	RUTAGARA	6	800	0	1199	239	14	2
6	10	NTONGWE	9	NYAKABUNGO	22	800	0	1157	252	18	2
6	13	NYAMABUYE	14	TAKWE	12	800	0	1401	279	22	2
6	4	MASANGO	7	NYAKOGO	15	807	0	1072	213	26	2
6	9	MUSHUBATI	6	KADUHA	23	807	0	896	176	30	2
6	5	MUGINA	6	MUKINGA	5	809	0	1567	299	34	2
7	11	SAKE	5	MURWA	24	1011	0	1263	298	2	2
7	1	BIRENGA	12	SAKARA	7	1100	0	1119	210	6	2
7	4	KIGARAMA	8	REMERA	30	1100	0	1344	262	10	2
7	10	RUTONDE	9	SOVU	24	1100	0	851	201	14	2
7	3	KAYONZA	7	RWINKWAVU	8	1112	0	1459	331	18	2
7	9	RUSUMO	2	GISENYI	60	1112	0	1091	230	22	2
7	9	RUSUMO	9	NYAMUGARI	73	1112	0	1440	384	26	2

SOUS-ECHANTILLON 2 (Cont.)

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
8	2	GISHYITA	8	NGOMA	7	305	0	1775	372	2	2
8	3	GISOVU	5	KAVUMU	23	503	0	1255	277	6	2
8	4	GITESI	12	RURAGWE	29	503	0	922	197	10	2
8	8	RUTSIRO	3	GASOVU	35	503	0	1182	236	14	2
8	5	KIVUMU	8	NGOBAGOBA	31	507	0	1224	265	18	2
8	1	BWAKIRA	3	MUGUNDA	9	705	0	1548	317	22	2
9	9	MUGAMBAZI	8	NTYABA	29	700	0	1279	257	2	2
9	14	RUTONGO	5	KABUYE	27	700	0	1824	413	6	2
9	16	TARE	1	BUMBA	7	706	0	1046	205	10	2
9	7	KANZENZE	11	MWOGO	2	910	0	1295	290	14	2
9	11	NGENDA	8	NYARUGENGE	67	1009	0	1368	309	18	2
9	3	GASHORA	8	RILIMA	34	1011	0	1420	285	22	2
9	5	GIKORO	2	DUHA	35	1100	0	1290	259	26	2
9	12	RUBUNGO	4	KINYINYA	2	1100	0	1393	324	30	2
9	1	BICUMBI	9	MWULIRE	71	1110	0	1070	208	34	2
11	7	KINIGI	3	GIHORA	19	400	0	1058	214	2	2
11	6	KIGOMBE	3	GAHONDOGO	107	400	1	600	129	6	2
11	5	KIDAHO	5	CYANIKA	18	406	0	1227	263	10	2
11	12	NYAKINAMA	4	KABERE III	21	504	0	929	209	14	2
11	1	BUTARO	4	KAYANGE	41	600	0	1259	302	18	2
11	3	CYERU	12	RUHOMBO	28	600	0	1059	206	22	2
11	16	RUHONDO	4	MUKONO	19	607	0	1057	222	26	2
11	4	GATONDE	3	GAHANGA	19	706	0	1152	234	30	2
11	15	NYARUTOVU	3	GASHENYI	47	706	0	1122	244	34	2

SOUS-ECHANTILLON 3

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
1	2	HUYE	7	RUKIRA	10	700	0	1578	306	3	3
1	5	MARABA	9	RUSAGARA	29	700	0	1279	281	7	3
1	15	NYAKIZU	13	RUTOBWE	46	700	0	1074	216	11	3
1	12	NGOMA	2	CYARWA (CYIMANA)	108	700	1	1148	271	15	3
1	11	NDORA	1	CYAMUKUZA	13	807	0	1002	214	19	3
1	19	RUSATIRA	6	KINAZI	16	807	0	1401	313	23	3
1	8	MUGUSA	11	MUNYEGERA	4	809	0	858	195	27	3
1	3	KIBAYI	3	MUKINDO	22	900	0	1099	216	31	3
1	7	MUGANZA	4	GISHUBI	7	908	0	1144	259	35	3
2	4	CYUNGO	4	GITARE	30	600	0	1073	236	3	3
2	9	KIVUYE	2	BUSHENYA	23	600	0	878	172	7	3
2	12	MUKARANGE	5	MUKONO	21	600	0	1087	221	11	3
2	1	BUYOGA	7	NYABISIGA	1	607	0	1065	210	15	3
2	5	GITI	1	BIJUNDE	21	1106	0	1115	233	19	3
2	11	MUHURA	2	BUGARURA	12	1112	0	1192	254	23	3
2	14	MUVUMBA	5	RUKOMO	18	1206	0	605	127	27	3
2	13	MURAMBI	4	KIBURARA	8	1211	0	1044	235	31	3
2	15	NGARAMA	5	KIGASHA	38	1211	0	1024	236	35	3
3	1	BUGARAMA	8	NZAHAHA	8	102	0	1125	232	3	3
3	3	GAFUNZO	8	NYAMUGALI	14	200	0	1088	233	7	3
3	6	GISUMA	10	NTURA	16	200	0	1134	234	11	3
3	9	KARENGERA	9	RUHARAMBUGA	25	201	0	886	175	15	3
3	10	KIRAMBO	7	RUHERU	8	300	0	1378	286	19	3
3	4	GATARE	6	MACUBA	8	503	0	1235	251	23	3
4	6	MUDASOMWA	4	KITABI	18	500	0	1504	345	3	3
4	10	NSHILI	1	BUSANZE	9	500	0	1014	222	7	3
4	2	KARAMBO	2	KAVUMU	2	507	0	1171	228	11	3
4	7	MUKO	7	MUKO	24	507	0	1120	244	15	3
4	1	KARAMA	6	MUGANZA	1	700	0	890	172	19	3
4	12	RUKONDO	1	GAHUNGA	15	700	0	1055	244	23	3
5	5	KAYOVE	13	RUGAMBA	30	305	0	1186	259	3	3
5	11	RWERERE	5	KINYANZOVU	1	400	0	796	180	7	3
5	7	MUTURA	3	GIHORWE	52	405	0	1280	201	11	3
5	1	GASEKE	6	MUHANDA	16	500	0	1152	248	15	3
5	3	KANAMA	3	KANOMBE	33	503	0	1266	255	19	3
5	2	GICIYE	6	KINTARURE	17	507	0	997	245	23	3
5	6	KIBILIRA	1	GATUMBA	42	705	0	1295	259	27	3
5	12	SATINSYI	9	MUNINI	37	705	0	1124	236	31	3
6	1	BULINGA	2	BURAMBA	30	700	0	960	190	3	3
6	16	TABA	4	KAMONYI	3	700	0	1280	258	7	3
6	3	KIGOMA	5	KIGOMA	55	800	0	1262	272	11	3
6	8	MUSAMBIRA	5	KAMBYEYI	23	800	0	1016	198	15	3
6	10	NTONGWE	12	RUTABO	46	800	0	1463	289	19	3
6	17	TAMBWE	4	MAYUNZWE	5	800	0	1428	294	23	3
6	7	MURAMA	1	BWERAMANA	22	807	0	1343	254	27	3
6	9	MUSHUBATI	11	MWAKA	8	807	0	1229	242	31	3
6	14	RUNDA	1	GIHARA	24	811	0	1314	259	35	3
7	11	SAKE	11	RUYEMA I	4	1011	0	934	195	3	3
7	2	KABARONDO	6	RUBIRA	10	1100	0	979	221	7	3
7	6	MUHAZI	1	GATI	19	1100	0	1360	261	11	3
7	5	MUGESERA	5	KAGASHI	3	1110	0	1121	250	15	3
7	8	RUKIRA	1	GASHIRU	9	1112	0	1938	489	19	3
7	9	RUSUMO	3	KANKOBWA	53	1112	0	924	191	23	3
7	7	RUKARA	4	NYAKABUNGO	33	1211	0	1245	247	27	3

SOUS-ECHANTILLON 3 (Cont.)

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
8	9	RWAMATAMU	4	GITSIMBWE	25	305	0	1171	235	3	3
8	3	GISOVU	9	TWUMBA	30	503	0	1102	253	7	3
8	6	MABANZA	4	GITWA	13	503	0	964	199	11	3
8	8	RUTSIRO	8	MANIHIRA	8	503	0	1243	256	15	3
8	5	KIVUMU	11	SANZA	28	507	0	1683	342	19	3
8	1	BWAKIRA	8	NYABINOMBE	34	705	0	1089	227	23	3
9	10	MUSASA	6	MBILIMA	29	700	0	1226	222	3	3
9	14	RUTONGO	9	RUBINGO	37	700	0	1385	290	7	3
9	16	TARE	8	RUGANDA	2	706	0	1169	236	11	3
9	7	KANZENZE	14	RULINDO	75	910	0	1279	282	15	3
9	11	NGENDA	10	RUHUHA	63	1009	0	1113	235	19	3
9	2	BUTAMWA	2	BUTAMWA	16	1100	0	644	143	23	3
9	5	GIKORO	5	MUNINI	20	1100	0	1283	309	27	3
9	12	RUBUNGO	7	RUSORORO	20	1100	0	1517	331	31	3
9	1	BICUMBI	14	RUBONA	7	1110	0	1165	270	35	3
11	7	KINIGI	7	MUSANZE	45	400	0	1860	383	3	3
11	10	NKULI	1	GATOVU	4	405	0	1102	233	7	3
11	11	NKUMBA	1	GAHUNGA	7	406	0	1018	239	11	3
11	12	NYAKINAMA	10	RUBONA	14	504	0	763	165	15	3
11	1	BUTARO	9	RURIBA	42	600	0	1218	268	19	3
11	13	NYAMUGALI	1	GASEKE	17	607	0	920	214	23	3
11	16	RUHONDO	10	RYANDIZI	3	607	0	1011	215	27	3
11	4	GATONDE	8	NYAKAGEZI	13	706	0	1064	224	31	3
11	15	NYARUTOVU	7	KARAMBO	52	706	0	1050	238	35	3

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SOUS-ECHANTILLON 4

PREF	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
1	4	KIGEMBE	4	KIGEMBE	38	700	0	975	240	4	4
1	6	MBAZI	3	KARAMA	6	700	0	1296	273	8	4
1	16	NYARUHENGERI	4	KIBILIZI	21	700	0	1193	257	12	4
1	17	RUHASHYA	4	GIKIRAMBWA	2	708	0	1083	182	16	4
1	11	NDORA	6	MUKANDE	19	807	0	1085	244	20	4
1	20	SHYANDA	3	BWEYA	34	807	0	1227	286	24	4
1	13	NTYAZO	2	BUTARA	3	809	0	944	202	28	4
1	3	KIBAYI	7	RWAMIKO	37	900	0	1296	303	32	4
1	7	MUGANZA	10	REMERA	14	908	0	894	198	36	4
2	4	CYUNGO	10	MIYOVE	16	600	0	1463	315	4	4
2	9	KIVUYE	9	SHANJA	7	600	0	1495	326	8	4
2	17	TUMBA	3	CIHINGA	17	600	0	992	214	12	4
2	8	KINYAMI	2	CYURU	37	611	0	1174	222	16	4
2	5	GITI	6	KARUSHYA	39	1106	0	1565	291	20	4
2	11	MUHURA	6	MUHURA	2	1112	0	931	192	24	4
2	6	GITUZA	2	GITOKI	28	1211	0	779	168	28	4
2	13	MURAMBI	10	NYABISINDU	58	1211	0	1206	231	32	4
2	15	NGARAMA	7	NGARAMA	29	1211	0	1366	243	36	4
3	2	CYIMBOGO	6	MURURU	2	200	0	1427	305	4	4
3	5	GISHOMA	3	GISAGARA	15	200	0	1088	240	8	4
3	8	KAMEMBE	6	MUHARI	39	200	0	1173	233	12	4
3	11	NYAKABUYE	1	GITAMBI	23	201	0	1399	288	16	4
3	7	KAGANO	1	BUSHEKERI	18	302	0	2117	480	20	4
3	4	GATARE	10	NYANGE	23	503	0	1241	252	24	4
4	6	MUDASOMWA	9	NYAMIGINA	26	500	0	1137	224	4	4
4	10	NSHILI	5	GIKARARANGOMBE	14	500	0	1246	270	8	4
4	2	KARAMBO	8	RUGAZI	9	507	0	1082	238	12	4
4	7	MUKO	11	SOVU	6	507	0	932	213	16	4
4	3	KINYAMAKARA	4	KARAMA	16	700	0	1062	229	20	4
4	12	RUKONDO	6	NGARA	20	700	0	1226	248	24	4
5	8	NYAMYUMBA	3	BUSORO	20	305	0	1210	238	4	4
5	11	RWERERE	8	MUKINGO	43	400	0	1182	233	8	4
5	7	MUTURA	6	KORA	63	405	0	1038	198	12	4
5	1	GASEKE	10	RWILI	11	500	0	1032	225	16	4
5	3	KANAMA	5	KAYOVE	9	503	0	1306	302	20	4
5	2	GICIYE	11	RUBONA	25	507	0	1055	223	24	4
5	6	KIBILIRA	6	NGURUGUNZU	13	705	0	1058	216	28	4
5	12	SATINSYI	13	RUCANO	21	705	0	1272	261	32	4
6	1	BULINGA	9	FUGENDABARI	33	700	0	1297	264	4	4
6	16	TABA	7	MUSENYI	43	700	0	1139	227	8	4
6	3	KIGOMA	10	REMERA	20	800	0	1164	242	12	4
6	8	MUSAMBIRA	9	NYARUBAKA	19	800	0	1395	282	16	4
6	13	NYAMABUYE	6	MBUYE	64	800	0	1127	230	20	4
6	17	TAMBWE	7	NYAMAGANA	21	800	0	1063	233	24	4
6	7	MURAMA	6	NKOMERO	27	807	0	1708	288	28	4
6	15	RUTOBWE	4	GIKO	4	807	0	1122	219	32	4
6	14	RUNDA	5	RUNDA	17	811	0	1126	225	36	4
7	1	BIRENGA	3	GAHARA	24	1100	0	1317	305	4	4
7	4	KIGARAMA	1	FUKWE	1	1100	0	1265	232	8	4
7	6	MUHAZI	8	NKOMANGWA	4	1100	0	901	199	12	4
7	5	MUGESERA	12	NYANGE	6	1110	0	1180	269	16	4
7	8	RUKIRA	6	MUSHIKIRI	44	1112	0	1328	257	20	4
7	9	RUSUMO	5	KIGINA	25	1112	0	1323	292	24	4
7	7	RUKARA	7	RWIMISHINYA	5	1211	0	928	201	28	4

SOUS-ECHANTILLON 4 (Cont.)

PROV	COMM	NOMCOMM	SECT	NOMSECT	DR	ZONE	R_U	POPTOT	NBRMEN	S	SE
8	9	RWAMATAMU	8	NYABINAGA	21	305	0	1577	315	4	4
8	4	GITESI	4	BWISHYURA	15	503	0	1304	265	8	4
8	6	MABANZA	9	MUSHUBATI	29	503	0	1259	262	12	4
8	8	RUTSIRO	13	RUSEBEYA	3	503	0	1201	261	16	4
8	7	MWENDO	5	KIGOMA	17	507	0	1155	243	20	4
8	1	BWAKIRA	11	SHYEMBE	26	705	0	1487	327	24	4
9	13	RUSHASHI	4	JOMA	17	700	0	1299	286	4	4
9	8	MBOGO	6	NYABUKO	13	706	0	1290	239	8	4
9	7	KANZENZE	3	KANZENZE	13	910	0	1400	323	12	4
9	11	NGENDA	3	GAKOMEYE	75	1009	0	1307	312	16	4
9	3	GASHORA	2	JURU	15	1011	0	1286	233	20	4
9	4	GIKOMERO	1	BUMBOGO	40	1100	0	1215	241	24	4
9	6	KANOMBE	2	BUSANZA	30	1100	0	1290	283	28	4
9	1	BICUMBI	1	BICUMBI	75	1110	0	1512	300	32	4
10	1	KACYIRU	3	KAGUGU	113	1100	1	875	209	36	4
11	8	MUKINGO	1	BUSOGO	2	400	0	1035	231	4	4
11	10	NKULI	5	KINTOBO	38	405	0	1184	234	8	4
11	11	NKUMBA	5	KABAYA	40	406	0	1159	268	12	4
11	14	NYAMUTERA	3	MARANGARA	19	507	0	995	203	16	4
11	3	CYERU	4	KALINGORERA	4	600	0	955	189	20	4
11	13	NYAMUGALI	6	MUSHONGI	30	607	0	1027	230	24	4
11	2	CYABINGO	6	KIGANDA	9	706	0	1424	276	28	4
11	9	NDUSU	4	KILIBA	14	706	0	1382	281	32	4
11	15	NYARUTOVU	12	RUHINGA II	17	706	0	1170	235	36	4