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RECOMMENDATIONS ON SAMPLING AND ESTIMATION METHODOLOGY FOR RWANDA AGRICULTURAL SURVEYS

Food Security Research Project (FSRP)

Rwanda Ministry of Agriculture, Livestock and Forestry

U.S. Agency for International Development

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1. BACKGROUND

The *Direction des Statistiques Agricoles* (DSA) had conducted a series of nationwide agricultural surveys and special studies on a continuous basis from 1982 up to the beginning of the 1994 civil war. One of the main objectives of this survey program was to produce national and subnational estimates of agricultural area and production. Prior to the 1994 civil war, the Agricultural Surveys and Policy Analysis Project (ASPAP) had assisted with the design and implementation of the national agricultural survey program. In 1992 a new sample design for the National Agricultural Survey was introduced based on the updated sampling frame from the 1991 Rwanda Census of Population and Housing (*Recensement General de la Population et de l'Habitat*). More than 1 year of agricultural data from the new sample had been collected and partially processed before the war, but much of this information was lost during the conflict.

The Food Security Research Project (FSRP) is currently planning a new program of agricultural surveys on a much smaller scale than the previous program, with the intention of building up the agricultural statistics program over time. Given the limited resources currently available for this project, cost-effective approaches are being developed to produce reliable and timely agricultural data in collaboration with the *Direction de Statistique* (DS). The DS is planning to conduct the *Enquête Integrée sur les Conditions de Vie des Ménages au Rwanda* (EICV) as early as September 1999; this is a multipurpose household survey designed to measure household income, expenditures and many other socioeconomic characteristics. One of the various survey modules includes agricultural production and inputs, and therefore will be a valuable source of primary agricultural data which the FSRP can use for its analytical studies. In addition, the FSRP is planning to conduct small-scale follow-on surveys on special topics, using a subsample of the EICV sample households.

Given the cost-effective approach of using the EICV in collaboration with the DS, the consultant and his FSRP counterparts reviewed the EICV sample design and discussed the implementation plans with the DS staff. This report first examines issues related to the sample design for the EICV, followed by considerations for selecting a subsample for special follow-on surveys. Recommended estimation procedures for weighting the data and calculating variances are presented in Section 7 of this report.

In order to ensure that the results from the planned agricultural surveys meet the desired levels of precision, data from a previous agricultural survey were used to calculate the sampling errors. The software package CENVAR (Census Variance Calculation System) was used to tabulate measures of precision (standard errors, coefficients of variation, 95 percent confidence intervals and design effects) for different types of estimates and domain levels. These results were then used to estimate the expected levels of precision based on the sample design for the EICV and follow-on surveys.

The findings and recommendations in this report were developed in collaboration with Dr. Daniel Clay, FSRP Coordinator, Michigan State University, Edson Mpyisi, FSRP In-Country Coordinator, and Jean Baptiste Nyarwaya, FSRP Statistician. The report also reflects valuable discussions with Philippe Gafishi Ngango, Director of DS, and Théophile

Ntawukuliryayo, DS Statistician, and data processing support from Emmanuel Shingiro, FSRP Systems Analyst.

2. EICV SAMPLE DESIGN

The sample design for the *Enquête Integrée sur les Conditions de Vie des Ménages au Rwanda* (EICV) is described in Dr. Christopher Scott's report on "*Plan de Enquête et Plan de Sondage*" (July 1997). As indicated in that report, a major objective of this survey is to represent the income and expenditures of the households over time as well as space (geography). The sampling frame was based on the 1997 updated count of households for each *cellule* in Rwanda, although the information for some areas were based on the 1996 frame for the *Enquête Socio-Démographique*. A stratified two-stage sample design will be used for the EICV. The sampling frame was stratified by prefecture, urban and rural. The urban strata consisted of Kigali-ville and other urban, while the rural part of each prefecture was treated as a separate stratum. Within each stratum, the sample segments were selected systematically with probability proportional to size (PPS), where the measure of size for each segment was based on the number of households from the sampling frame.

Table 1. Distribution of Segments and Households in Frame and Sample for EICV, by Stratum

DOMAIN	Frame		EICV Sample	
	No. *Cellules*/ Segments	Number of Households	No. *Cellules*/ Segments	Number of Households
RWANDA	9,136	1,587,495	80	6,450
URBAN TOTAL	571	92,312	130	1,170
Kigali-ville	402	52,956	80	720
Other Urban	169	39,356	50	450
RURAL TOTAL	8,565	1,495,183	440	5,280
Butare	615	135,573	40	480
Byumba	615	148,289	40	480
Cyangugu	680	99,005	40	480
Gikongoro	851	94,294	40	480
Gisenyi	826	237,591	40	480
Gitarama	1,079	157,160	40	480
Kibungo	641	127,686	40	480
Kibuye	627	84,277	40	480
Kigali (Rural)	1,339	166,112	40	480
Ruhengeri	923	168,791	40	480
Umutara	369	76,405	40	480

Table 1 shows the distribution of the *cellules* and households in the frame and the sample for the EICV. Given that the agricultural studies will be limited to the rural areas, the FSRP will only use the data for the 5,280 sample households selected in the 440 rural sample segments. In reviewing the sampling frame for the EICV, it was found that six *cellules* were missing information on the number of households, so they had a zero probability of being selected in the EICV sample; five of these *cellules* were in Ruhengeri (rural) and one in Gisenyi (rural). This is only a minor problem, so it is not necessary to reselect the sample segments for these strata. However, the number of households in these six *cellules* should be obtained in order to use the correct total number of households in each stratum for calculating the weights, as specified in Section 7.

In 1997 a listing of households was conducted in some of the 570 sample segments for the EICV. However, given the 2 year postponement of the survey, there may be considerable changes in households during this period. Therefore the DS plans to conduct a new listing in each sample segment approximately 1 or 2 months prior to the data collection. Conducting the listing on a flow basis in this manner will ensure an updated frame for the selection of sample households in each sample segment. Following the updated listing, 12 households will be selected within each rural sample segment and 9 households will be selected within each urban sample segment for the EICV.

3. DISTRIBUTION OF EICV SAMPLE OVER TIME

In order to represent seasonality in the data, the sample segments (*cellules*) are distributed across the 12 months of the year. It is also important to consider the distribution of the sample segments within each month and quarter, to ensure an adequate geographic distribution of the sample for each period. The survey design distributes the sample segments into 10 cycles throughout the year. In the case of the urban strata, the data collection in each sample segment lasts for 33 days. Within each rural sample segment a group of two enumerators collect the EICV data during a period of 16 days, so each group completes two rural segments in each of the 10 cycles. The urban sample households will be visited every 3 days, while the rural sample households will be visited every 2 days.

It would be ideal to have an optimum geographical distribution of the sample segments within each stratum for each cycle in order to ensure that the EICV sample represents seasonal variability. However, in reviewing the preliminary assignment of sample segments by cycle, it was found that the sample segments within each prefecture are clustered together each cycle within about two *communes*. In this case the sample each cycle does <u>not</u> represent the entire prefecture; it only represents the particular *communes* included in the sample. This is a serious disadvantage given the seasonal and geographical variation in the agricultural production data. For example, the four sample segments in a prefecture for the particular cycle would all be concentrated in one part of the prefecture, which may have different cropping patterns than other areas of the prefecture. The income and expenditures from crops in the *communes* which are not selected would not be represented that month. Unfortunately, this grouping effect continues from one cycle to the next, given that the preliminary assignment of sample segments continues in the same or an adjacent *commune* the following cycle. In this way, the sample for the first 6 months (5 cycles) only represents half of the prefecture; this half will only be represented for one cropping season, and the other half will only be represented for the other cropping season. This is a critical limitation of the preliminary distribution of sample segments by cycle since it will seriously bias the survey results at the completion of the 10 cycles and for interim (quarterly) results.

The DS plans to process the EICV data on a flow basis to refine the editing and tabulation procedures over time, and obtain preliminary results at the national level for each period. In this way, the final survey results will be available soon after the data are collected for the last cycle. However, the preliminary distribution of sample segments within each prefecture will provide biased results each month or quarter; they would not be nationally representative. This will also affect any follow-on surveys using a subsample of segments based on a few cycles, such as the special topic surveys being planned by the FSRP in collaboration with the DS. In this case, if a survey is based on the EICV sample for two cycles in the rural strata, the sample of 1,056 rural households would not be nationally representative; they would be concentrated in about two to four *communes* within each prefecture.

The sample distribution problem described above can be remedied easily and with only minor additional survey costs by taking the following action:

The sample segments can be re-assigned to each cycle in such a way that they are representative of the entire prefecture. A simple way to maximize the geographical representativeness of the sample for each cycle within a prefecture would be to systematically assign the sample segments to the cycles using the order in which they were originally selected. The sampling frame of segments within each stratum had been ordered geographically in a serpentine manner before the segments were selected systematically with PPS; this provides an implicit geographic stratification which increases the efficiency of the sample design.

A total of 40 sample segments were selected systematically with probability proportional to size within the rural stratum of each prefecture. These sample segments can be assigned sequential numbers from 1 to 40 in the same order in which they were selected. The sample for one cycle can consist of segments no. 1, 11, 21 and 31; for the next cycle segments no. 2, 12, 22 and 32 could be assigned; followed by segments no. 3, 13, 23 and 33, etc. One of these groups can be selected at random to be assigned to the first cycle, and the remaining groups can be assigned consecutively to the following cycles. For example, if the group of segments no. 9, 19, 29 and 39 are selected for the first cycle, the group of segments no. 10, 20, 30 and 40 can be assigned to the second cycle, the group of segments no. 1, 11, 21 and 31 to the third cycle, etc.

The main reason the sample segments are clustered together in the preliminary distribution for each cycle is to facilitate the field operations, since a team of one supervisor and four enumerators will be working in the rural stratum of each prefecture. However, even if the four segments are dispersed throughout the prefecture, the distances to be covered are generally not very large. The four rural sample segments assigned to the prefecture each cycle can be divided into two groups based on their proximity, in order to reduce the amount of travel required by each group of two enumerators to reach the next rural sample segment each 16 days.

It should be noted that the recommended distribution of the sample segments by cycle would not require selecting a new sample. It would be very easy to rearrange the order in which the sample segments are assigned. Then the DS staff can examine the alternative distribution of sample segments by cycle on a map before the final decision is made. However, they should take into account the importance of ensuring that the final sample is representative over both space and time. Given that the EICV represents a very large investment of national resources and the results will be very important for national planning, it will be especially cost-effective to allocate the small additional funding required to collect data on a more dispersed sample of segments each cycle to represent seasonality geographically. If the preliminary distribution of the sample segments is used, outside users of the data may be critical of the representativeness of the sample over space and time, and may have less confidence in the survey results.

Based on a discussion with Philippe Gafishi Ngango, Director of Statistics, the FSRP has agreed to collaborate with the DS on analyzing the agricultural data from the EICV, and in conducting follow-on surveys. Therefore the FSRP staff can work with the DS staff on the re-assignment of EICV sample segments to each cycle. In follow-up discussions with Gafishi and Robert A. Ngong, UNDP Technical Advisor, another alternative distribution of the rural sample segments over time was considered. This option involved grouping the sample segments in close pairs for each 16-day data collection period, and randomly assigning these pairs throughout the prefecture. This would facilitate the fieldwork and supervision for each 16-day period while increasing the dispersion of the sample. This seems like a reasonable compromise if it is not feasible to implement a maximum dispersion of the segments each cycle.

4. SUBSAMPLES FOR FOLLOW-ON AGRICULTURAL SURVEYS ON SPECIAL TOPICS

In addition to using the EICV agricultural data, the FSRP plans to conduct follow-on agricultural surveys on special topics. It will be cost-effective to use a subsample of the households selected for the EICV for such follow-on surveys, since it will be possible to match the survey data files to have a comprehensive database for the analysis.

The most effective and timely approach to selecting the subsample for a follow-on survey will be to use the national subsamples identified for the first cycles of the EICV. For each cycle within a particular prefecture, a subsample of four segments were selected. Assuming that these four segments are representative of the prefecture, as discussed in the previous section, a combination of two or three cycles can be used for the follow-on survey.

If the problem with the preliminary distribution of the EICV sample segments described in the previous section is not resolved, a representative subsample should be selected based on the recommended distribution. One disadvantage of this approach is that it would be necessary to wait until the end of the EICV data collection period to conduct the follow-on survey, since the updated listing and selection of households for the EICV for each cycle is being conducted on a flow basis about one month prior to the data collection.

If the FSRP decides to conduct an agricultural survey which is independent of the EICV, it would still be cost-effective to use a subsample of the EICV sample segments, given that updated sketch maps and a new listing of households would be available. The number of segments in the subsample would depend on the objectives of the agricultural survey. In this case, the FSRP can use the new DS listing for each segment in the subsample, and select a new sample of households. If the FSRP prefers to avoid an overlapping sample, the new sample can exclude the households selected for the EICV in each segment.

5. CALCULATION OF VARIANCES FROM PREVIOUS AGRICULTURAL DATA

In order to study the measures of precision and design effects from previous agricultural surveys, CENVAR tabulations were produced using data from the 1990-91 National Agricultural Survey (NAS). The sampling frame for the NAS was stratified by prefecture and ecological zone. A total of 78 segments were selected for the NAS. Within each sample segment 16 households were selected; in order to facilitate the field operations, these 16 sample households were divided into two compact clusters of 8 households each. Table 2 shows the distribution sample segments and sample households by prefecture for the 1990-91 NAS; the number of sample households is based on the actual number of complete records in the survey data file, so it excludes noninterview households.

Table 2. Distribution of Segments and Households in Sample for 1990-91 National Agricultural Survey, by Prefecture

Prefecture	Number of Sample Segments	Number of Sample Households
RWANDA	78	1,208
Butare	10	151
Byumba	8	126
Cyangugu	6	94
Gikongoro	6	91
Gisenyi	8	128
Gitarama	10	155
Kibungo	6	95
Kibuye	6	88
Kigali	10	154
Ruhengeri	8	126

The methodology used by CENVAR to calculate the variances is described in Section 7. Different types of survey estimates were selected for this analysis, including the total production for major crops, and the most important estimates of means such as average farm size, cultivated area, income, household expenditure for agricultural inputs, etc. Each type of estimate was tabulated at the national and prefecture levels. For each variable CENVAR tabulates the estimate, standard error, coefficient of variation (CV), 95 percent confidence interval and design effect. The data dictionary listing for the CENVAR data input file is presented in Annex I, and the CENVAR results are shown in Annex II.

The CV is defined as the standard error of the estimate divided by the value of the estimate, and is therefore a measure of the relative standard error. It can be seen from the results in Annex II that the CVs are generally high at the prefecture level, given the small sample sizes; as a result, the corresponding confidence intervals are wide. The 95 percent confidence interval is defined as a range which has a 95 percent chance of including the true value being estimated. The design effect (DEFF) is defined as the variance of an estimate based on the actual sample design for the survey (in this case, a stratified cluster design) divided by the corresponding variance of the estimate based on a simple random sample of the same size; it is therefore a measure of the relative efficiency of the sample design. Design effects greater than 1 result from the clustering effects due to homogeneity of the households within sample segments; in this case, a larger number of sample households per cluster will increase the design effect. The CENVAR results were also used to estimate the design effects and CVs which can be expected from the EICV sample design, as described in the next section.

6. EXPECTED LEVELS OF PRECISION FOR RESULTS FROM EICV AND FOLLOW-ON SURVEYS

The CENVAR results from the 1990-91 NAS were used to determine the approximate level of precision which can be expected from the proposed sample design for the EICV. The standard error based on the EICV sample design will be affected by the new design effect and sample size. The new design effects can be estimated by adjusting the design effect from the 1990-91 NAS sample design based on the change in the number of sample households per cluster. Since sampling frame for the 1990-91 NAS was limited to the rural areas, only the rural strata in the EICV sampling frame are included in this study.

Within each prefecture, the design effect only measures the clustering effect, since the sample for the 1990-91 NAS is approximately self-weighting within prefecture. Therefore the design effect for a particular survey estimate for prefecture h based on the sample design for the 1990-91 NAS can be defined follows:

$$DEFF_{NASh} = 1 + \delta_h \times [\bar{m}_{NASh} - 1] ,$$

where:

$DEFF_{NASh}$ = design effect for a particular survey estimate for prefecture h based on sample design for the 1990-91 NAS

$\delta_h =$ coefficient of intraclass correlation or measure of homogeneity within the segments in prefecture h for the particular characteristic

$\bar{m}_{NASh} =$ 16 = average number of households selected per sample segment within prefecture h for the 1990-91 NAS

This expression can be used to estimate the intraclass correlation coefficient for prefecture h, δ_h, as follows:

$$\delta_h = \frac{DEFF_{NASh} - 1}{\bar{m}_{NASh} - 1}$$

The design effect based on the proposed sample design for the EICV can then be estimated from the CENVAR results based on the 1990-91 NAS data, as follows:

$$DEFF_{EICVh} = 1 + (\bar{m}_{EICVh} - 1) \times \left[\frac{(DEFF_{NASh} - 1)}{(\bar{m}_{NASh} - 1)} \right],$$

where:

$DEFF_{EICVh} =$ design effect for a particular survey estimate in prefecture h based on sample design for the EICV

$\bar{m}_{EICVh} =$ average number of households selected per sample segment within prefecture h in the proposed sample design for the EICV; $\bar{n}_{EICVh}$ = 12 for the rural strata

Actually, there were additional clustering effects in the 1990-91 NAS sample, given that the 16 sample households within a segment were divided into two compact clusters of 8 households each. As a result, the estimate of $DEFF_{EICVh}$ can be considered to slightly overestimate the actual design effect.

The ratio between the variance (square of the standard error) for the survey estimate of the mean for a particular characteristic (such as average household income) in prefecture h based on the proposed sample design for the EICV and the corresponding variance based on the 1990-91 NAS design can be expressed as follows:

$$\frac{var_{EICV}(\bar{x}_h)}{var_{NAS}(\bar{x}_h)} = \frac{\dfrac{\sigma_{xh}^2}{m_{EICVh}} \times DEFF_{EICVh}}{\dfrac{\sigma_{xh}^2}{m_{NASh}} \times DEFF_{NASh}},$$

where:

$var_{EICV}(\bar{x}_h) =$ variance (square of standard error) for the survey estimate of the mean for a particular characteristic *x* (such as average household income) in prefecture h based on the proposed sample design for the EICV

$var_{NAS}(\bar{x}_h) =$ variance for the survey estimate of the mean in prefecture h based on the sample design for the 1990-91 NAS

$\sigma_{xh}^2 =$ population variance for the particular characteristic (such as household income) in prefecture h

$m_{EICVh} =$ number of sample households in prefecture h for the EICV

$m_{NASh} =$ number of sample households in prefecture h for the 1990-91 NAS

From this ratio the variance for the survey estimate of a mean based on the proposed sample design for the EICV can be expressed as follows:

$$var_{EICV}(\bar{x}_h) = var_{NAS}(\bar{x}_h) \times \frac{m_{NASh}}{m_{EICVh}} \times \frac{DEFF_{EICVh}}{DEFF_{NASh}} ,$$

where $DEFF_{EICVh}$ is calculated using the formula specified previously.

This formula was used to calculate the approximate variance for the estimates of means for different characteristics by prefecture which would result from the proposed sample design for the EICV. The variance for the survey estimate of the mean at the national level was derived as a weighted combination of the variances for the strata. However, to take into account the additional 480 rural sample households which will be selected for the Umutara Prefecture, it was necessary to adjust this variance for the national estimate of the mean as follows:

$$var_{EICV}(\bar{x}_N) = \left(\frac{4800}{5280}\right) \times \sum_{h=1}^{10} \left(\frac{M_h}{M}\right)^2 \times var_{EICV}(\bar{x}_h) ,$$

where:

$var_{EICV}(\bar{x}_N) =$ variance for national estimate of the mean based on proposed sample design for EICV

$M_h =$ total number of households in the EICV sampling frame for the rural part of prefecture h

$$M = \sum_{h=1}^{10} M_h =$$ total number of households in the EICV sampling frame

The sum in this expression is across all of the 10 prefectures which existed in 1991 (excluding Umutara).

The variance of the survey estimate of a total, such as total crop production, for prefecture h, can be expressed in terms of the corresponding variance of the mean for the same variable, as follows:

$$var_{EICV}(\hat{X}_h) = var(M \times \bar{x}_h) \times DEFF_{EICVh} = M^2 \times \frac{\sigma_{xh}^{\ 2}}{m_{EICVh}} \times DEFF_{EICVh} \ ,$$

where:

$var_{EICV}(\hat{X}_h) =$ variance of survey estimate of the total for a particular characteristic *x* in stratum h

Given that the variance of the total for prefecture h can be obtained from the variance of the mean times the constant M^2, the same procedures specified for the variance of a mean can be used to estimate the approximate variance of the estimate of a total for prefecture h from the EICV sample design, as follows:

$$var_{EICV}(\hat{X}_h) = var_{NAS}(\hat{X}_h) \times \frac{m_{NASh}}{m_{EICVh}} \times \frac{DEFF_{EICVh}}{DEFF_{NASh}}$$

This formula was used to calculate the approximate variance for the estimates of the total production for major crops by prefecture which would result from the proposed sample design for the EICV. The variance of the national estimate of the total would simply be the sum of the variances for the individual prefectures, adjusted to take into account the additional 480 rural sample households which will be selected for the Umutara Prefecture. This variance for the national estimate of the total from the EICV data can be expressed as follows:

$$var_{EICV}(\hat{X}_N) = \left(\frac{4800}{5280} \right) \times \sum_{h=1}^{10} var_{EICV}(\hat{X}_h) \ ,$$

The standard error of each estimate (mean or total) is equal to the square root of its variance, and the coefficient of variation (CV) of the estimate is equal to the standard error divided by the value of the estimate.

These procedures were used to estimate the approximate CVs for different estimates of means and totals based on the proposed sample design for the EICV. These results are shown in Annex III, together with the corresponding CVs from the 1990-91 NAS data, and the difference between the CVs from the two surveys. It can be seen in Annex III that the CVs based on the EICV sample design are much lower than those from the 1990-91 NAS, since the EICV has a total sample size of 5,280 rural households while the 1990-91 NAS estimates are based on the data for 1,208 sample households. The design effects for the EICV are also slightly lower, given the smaller number of sample households per cluster. It should be noted that since the Umutara Prefecture was formed after the war from areas which were previously part of the prefectures of Byumba and Kibungo, the estimates in Annex III for the latter two prefectures will be affected. However, assuming that the variability in agricultural characteristics in the new prefectures of Byumba and Kibungo is similar to that based on their 1991 boundaries, the CVs in Annex III for these provinces should be reasonable indicators of the level of precision which can be expected based on the proposed sample design for the EICV. Since no estimates are available for Umutara Prefecture, the results for Byumba and Kibungo in Annex III can also be used as an indication of the general level of precision which can be expected for Umutara Prefecture.

Since the FSRP is initially planning to use the EICV sample for two cycles for the follow-on agricultural surveys, a similar estimation approach was used to determine the approximate level of precision which can be expected from this subsample. The tables in Annex III include the approximate CVs based on a subsample of two EICV cycles (with a sample of 1,056 households), and the difference from the corresponding CVs from the 1990-91 NAS. It can be seen in these tables that the precision of the survey estimates from the subsample based on two EICV cycles is similar to that for the 1990-91 NAS results, given that the sample sizes for these surveys are similar. For six of the nine major crops in Annex III, the CVs for the national estimates of total production based on the subsample for two EICV cycles are slightly smaller than the corresponding CVs from the NAS because of lower design effects. The situation is similar for the seven survey estimates of means appearing in Annex III, with four having slightly lower CVs based on the subsample for two EICV cycles. The differences in the CVs vary by prefecture, with more than half of the CVs from the EICV subsample lower than those from the NAS.

Given the high CVs at the prefecture level, the FSRP may consider increasing the number of cycles included in the subsample in order to improve the level of precision. Another possibility would be to group the prefectures into regions to decrease the CVs for the geographical domains.

In comparing the accuracy of the expected results from the EICV with that of the previous NAS results, it is also important to take into account the nonsampling error in the survey estimates. The nonsampling error depends on the data collection methodology. In the case of the EICV, the annual crop production data is obtained through respondent recall, so the quality of these data can be highly affected by recall error. The previous agricultural surveys used more objective data collection techniques for measuring crop production, and may also be affected by measurement error, but the quality of the crop production data should be better. Perhaps the FSRP can conduct small-scale studies on the nonsampling error based on different data collection methodologies.

7. ESTIMATION PROCEDURES FOR EICV AND FOLLOW-ON AGRICULTURAL SURVEYS

7.1. Weighting Procedures for Full EICV Sample

In order for the sample estimates from a particular survey to be representative of the population, it is necessary to multiply the data by a sampling weight, or expansion factor. The basic weight for each sample household would be equal to the inverse of its probability of selection (calculated by multiplying the probabilities at each sampling stage). The EICV will be approximately self-weighting within stratum. Since all survey data will be processed by computer, it should be easy to attach a weight to each sample household record in the computer files, and the tabulation programs can weight the data automatically. The sampling frame information needed to calculate the probabilities at each stage of selection should be maintained in a spreadsheet file so that the overall probability and corresponding weight can be calculated for each sample segment. The weights will probably vary somewhat by sample segment, since in many cases the measure of size for the segment in the sampling frame may be slightly different from the actual number of households in the updated listing.

The EICV sample design is generally based on two stages of selection. At the first stage the primary sampling units (PSUs) are defined as the *cellules*, which were selected with PPS within each stratum. In most cases the households are selected at the second stage. However, there are a few cases of large *cellules* which will be subdivided into smaller segments. Therefore the overall probability of selection for the sample households would be calculated as follows:

$$p_{hi} = \frac{n_h \times M_{hi}}{M_h} \times p_{2hi} \times \frac{m_{hi}}{M_{hi}^{/}} ,$$

where:

p_{hi} = probability of selection for the sample households in the i-th sample segment in stratum (prefecture, rural) h

n_h = number of sample PSUs selected in stratum h; in the case of the rural stratum of each prefecture, n_h = 40 for the EICV sample

M_h = total number of households in the EICV sampling frame for stratum h

M_{hi} = total number of households in the EICV sampling frame for the i-th sample PSU (*cellule*) in stratum h

p_{2hi} = probability of selecting sample segment within the i-th sample PSU which is subdivided in stratum h; for PSUs which are completely listed, p_{2hi} = 1

m_{hi} = number of sample households selected in the i-th sample segment in stratum h; in the case of the rural strata for the EICV, m_{hi} = 12

M'_{hi} = total number of households from the updated listing in the i-th sample segment in stratum h

The three components of this probability of selection correspond to the individual sampling stages; p_{2hi} is equal to 1 for all sample *cellules* except for those which are subdivided before the updated listing of households. If a sample *cellule* is divided into equal segments and one segment is selected at random, p_{2hi} would be calculated as follows:

$$p_{2hi} = \frac{1}{s_{hi}} ,$$

where:

s_{hi} = total number of segments in the i-th PSU in stratum h

In cases where it is not possible to divide a sample *cellule* into segments of equal size, the DS may consider selecting one segment with PPS within the *cellule*, using the number of households as the measure of size. It is important for the DS to document which sample *cellules* are segmented and the corresponding probabilities of selection.

The basic sampling weight, or expansion factor, is calculated as the inverse of this probability of selection. For the EICV, the weight can be expressed as follows:

$$W_{hi} = \frac{M_h \times M_{hi}^{/}}{n_h \times M_{hi} \times p_{2hi} \times m_{hi}} ,$$

where:

W_{hi} = basic weight for the sample households in the i-th sample segment in stratum h

It can be seen that if m_{hi} is constant for each stratum (for example, 12 sample households per segment in the case of the rural strata for the EICV), p_{2hi} = 1, and $M'_{hi} = M_{hi}$ (that is, the number of households listed in the sample segment is equal to the corresponding number in the frame), the sample would be self-weighting within the stratum. These weights will actually vary slightly based on the difference between M'_{hi} and M_{hi}.

It is also important to adjust the weights to take into account the noninterview rate for each survey. Since the weights will be calculated at the level of the sample segment, it would be advantageous to adjust the weights at this level. The final weight (W'_{hi}) for the sample households in the i-th sample segment in stratum h can be expressed as follows:

$$W_{hi}^{/} = W_{hi} \times \frac{m_{hi}^{/}}{m_{hi}^{//}} ,$$

where:

W'_{hi} = final weight for the sample households in the i-th sample segment in stratum h

m'_{hi} = total number of valid (occupied) sample households selected in the i-th sample segment in stratum h (that is, the number of interviews plus the number of noninterviews in the sample segment)

m''_{hi} = total number of interviewed sample households in the i-th sample segment in stratum h, including replacement households

In the case of a sample segment where the DS selects a replacement household to substitute each household noninterview, the noninterview adjustment factor would be equal to 1, and $W'_{hi} = W_{hi}$. If a selected housing unit which is destroyed or abandoned is replaced, the noninterview adjustment factor could be less than 1, since m'_{hi} could be smaller than m''_{hi}.

In order to calculate the weight for each sample segment, a spreadsheet file was developed with the sampling frame information for each of the 440 rural segments selected for the EICV. This file currently has the measure of size for the first stage of selection. Following the updated listing and EICV data collection, it will be necessary to complete the weighting spreadsheet with the number of households listed in each sample segment, and the number of noninterviews. Then the formulas in the spreadsheet will automatically calculate the final weight for the sample households in each segment. It is also important to enter in this spreadsheet the same geographic codes or unique identification code for each sample segment which is used on the survey questionnaires, so that the spreadsheet can be used to automatically assign the correct weight to the household records for each sample segment in the survey data file.

7.2. Weighting Procedures for Subsamples of EICV for Follow-on Agricultural Surveys

In the case of the follow-on agricultural surveys based on a subsample of the EICV households, the weight of the households will depend on the subsampling rate. The EICV sample segments within each prefecture will be divided into 10 equal subsamples assigned to the 10 cycles throughout the year. In the case of the rural stratum within each prefecture, the 40 sample segments will be divided into subsamples of 4 segments each, selected with equal probability. In this case, the subsampling rate for each cycle would be equal to 4/40, or 1/10. If two cycles are selected for the follow-on agricultural survey, the subsampling rate would be equal to 8/40, or 1/5. Therefore the weight for the EICV sample households specified previously would have to be multiplied by the inverse of this subsampling rate. In general, the basic weight of the households in the subsample for the follow-on agricultural survey can be expressed as follows:

$$W_{Shi} = W_{hi} \times \frac{n_h}{n_h'} = \frac{M_h \times M_{hi}'}{n_h \times M_{hi} \times p_{2hi} \times m_{hi}} \times \frac{n_h}{n_h'} = \frac{M_h \times M_{hi}'}{n_h' \times M_{hi} \times p_{2hi} \times m_{hi}} ,$$

where:

W_{Shi} = basic weight for the households in the i-th sample segment in the subsample for stratum h

n'_h = number of segments selected in the subsample for stratum h; in the case of the rural stratum of each prefecture, $n_h^{/} = 4 \times c$, where c is the number of cycles included in the subsample

As in the case of the full EICV sample, the basic weight should be adjusted for noninterviews, so the final weight for the households in the subsample would be the following:

$$W_{Shi}^{/} = W_{Shi} \times \frac{m_{hi}^{/}}{m_{hi}^{//}}$$

In order to calculate the weight for each segment in the subsample for the follow-on survey, the weighting spreadsheet for the full EICV sample was adapted for the subsample. Since it is not certain how many cycles of the EICV will be included in the subsample for the follow-on survey, the spreadsheet was designed to be flexible. The number of cycles included in the subsample will be entered as a variable on the spreadsheet, and the weights will be adjusted automatically. This spreadsheet will have to be updated with the final list of segments in the subsample, information on the number of households from the new listing and the number of noninterviews for each sample segment.

7.3. Estimates from Survey Data

The most common survey estimates to be calculated from the household surveys are in the form of totals and ratios. The survey estimate of a total can be expressed as follows:

$$\hat{X} = \sum_{h=1}^{10} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}^{//}} W_{hi}^{/} \, x_{hij} \quad ,$$

where:

x_{hij} = value of variable y for the j-th sample household in the i-th sample segment in stratum h

In the case of the follow-on agricultural surveys based on a subsample of the EICV households, W'_{hi} would be replaced by W'_{Shi}.

The survey estimate of a ratio is defined as follows:

$$\hat{R} = \frac{\hat{Y}}{\hat{X}} ,$$

where $\hat{Y}$ and $\hat{X}$ are estimates of totals for the variables y and x, respectively, calculated as specified previously.

When cluster designs are involved, means and proportions are special types of ratios. In the case of the mean, the variable X, in the denominator of the ratio, is defined to equal 1 for each element so that the denominator is the sum of the weights. In the case of a proportion, the variable X in the denominator is also defined to equal 1 for all elements; the variable Y in the numerator is binomial and is defined to equal either 0 or 1, depending on the absence or presence, respectively, of a specified attribute in the element observed.

7.4. Calculation of Variances for Survey Estimates

In the publication of the results from each survey it is important to include a statement on the accuracy of the survey data. In addition to presenting tables with calculated sampling errors for the most important survey estimates, the different sources of nonsampling error should be described.

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. The CENVAR software, a component of the Integrated Microcomputer Processing System (IMPS) developed by the U.S. Bureau of the Census, was designed to calculate the variances for survey data from stratified multi-stage sample designs similar to that of the EICV. CENVAR is menu-driven and user-friendly. It uses the data dictionary defined in the DATADICT component of IMPS. It can be used to calculate the variances of totals, means, proportions and other ratios. It produces subpopulation estimates for each category of a classification variable, and these variables can be cross-classified. For each estimate, CENVAR calculates the standard error, coefficient of variation (CV), 95 percent confidence interval and the design effect (DEFF). This software package uses an ultimate cluster variance estimator. The FSRP has a copy of the CENVAR software and the corresponding manual.

In order to tabulate estimates of standard errors using CENVAR, it is generally necessary to produce a new data input file in a text (ASCII) format from the original survey data. Since the CENVAR package will only accept one type of record, it is necessary to generate one record for each unit of analysis in the CENVAR data input file. For example, in the case of the estimates by household, such as average household income, the CENVAR input file should have one record for each sample household. Each record in the CENVAR data input file should include fields for the stratum, cluster and weight, in addition to the classification and analysis variables which are required for the particular CENVAR analysis. The classification variables are used to produce subpopulation estimates for all their respective categories. The analysis variables are generally continuous variables, such as income and crop production, or count variables, which are equal to 1 if the unit has a certain characteristic and 0 otherwise. CENVAR automatically creates a count variable named INTERCEPT, which is equal to 1 for each record. The INTERCEPT variable can be used to obtain the estimate of the weighted total number of units (for example, the total number of households), or it can be used in the denominator of a ratio in order to obtain a mean or proportion. The INTERCEPT variable can also be used as a classification variable to obtain national-level estimates, since it only has one category for all the records.

The stratum code used in the CENVAR data input file should uniquely identify the lowest level of stratification. The cluster code should uniquely identify the PSUs within each stratum. The calculation of variances using CENVAR requires at least two clusters per stratum; an example of "collapsing" two strata with one sample cluster each is shown in the CENVAR application developed for the 1990-91 NAS data, described later in this report.

The CENVAR data input file should be sorted by stratum and cluster, and should be zero-filled (that is, any blanks should be replaced with 0's). The IMPS software can only handle implied decimals in the data files, identified in the data dictionary. In order to avoid decimals points in the CENVAR data input file, it is necessary to multiply any variables with decimal values by 10^x, where x is the number of decimals.

CENVAR does not accept any blanks in the file. In the case of classification variables, any record with a blank should be imputed with a special code to identify "missing" or "not applicable." The CENVAR output will include estimates for these categories, which can be deleted from the tabulations which will be published. For analysis variables, CENVAR assumes that any missing values are imputed. Once the file is zero-filled, CENVAR will treat any missing value as 0, thus introducing a downward bias in the estimates of means when there are missing values. One way of resolving this problem is to introduce an indicator variable for each analysis variable with missing data. The indicator variable would have two categories: (1) “with data” and (2) “missing data.” For each application using this analysis variable, the corresponding indicator variable would have to be used as a classification variable, to be crossed with each other classification variable to run subpopulation totals, means or ratios. When the CENVAR output is reformatted to produce the final tables with the measures of precision, all of the estimates for the category “missing data” would be deleted. This type of procedure was used for the CENVAR application developed for the 1990-91 NAS data, described later in this report.

The ultimate cluster variance estimator for a total used by CENVAR can be expressed as follows:

Variance Estimator of a Total

$$V(\hat{Y}) = \sum_{h=1}^{L} \left[\frac{n_h}{n_h - 1} \sum_{i=1}^{n_h} \left(\hat{Y}_{hi} - \frac{\hat{Y}_h}{n_h} \right)^2 \right],$$

where:

$$\hat{Y}_{hi} = \sum_{k=1}^{m''_{hij}} W'_{hij} \, y_{hijk}$$

$$\hat{Y}_h = \sum_{i=1}^{n_h} \hat{Y}_{hi}$$

The variance estimator of a ratio used by CENVAR can be expressed as follows:

Variance Estimator of a Ratio

$$V(\hat{R}) = \frac{1}{\hat{X}^2} \left[V(\hat{Y}) + \hat{R}^2 \, V(\hat{X}) - 2 \, \hat{R} \, COV(\hat{X},\hat{Y}) \right] ,$$

where:

$$COV(\hat{X},\hat{Y}) = \sum_{h=1}^{L} \left[\frac{n_h}{n_h - 1} \sum_{i=1}^{n_h} \left(\hat{X}_{hi} - \frac{\hat{X}_h}{n_h} \right) \left(\hat{Y}_{hi} - \frac{\hat{Y}_h}{n_h} \right) \right]$$

$V(\hat{Y})$ and $V(\hat{X})$ are calculated according to formula for the variance of a total.

7.5. CENVAR Application for 1990-91 NAS

The 1990-91 NAS data were used to develop a prototype CENVAR application for tabulating measures of precision for different survey estimates and levels of disaggregation. This application provided the FSRP staff with hands-on experience in developing and running CENVAR analyses which they can use for tabulating the standard errors for future survey data. The CENVAR results were also used to determine the approximate level of precision which can be expected from the EICV sample and subsamples for follow-on agricultural surveys, as described in Section 6.

The IMPS data dictionary produced for this CENVAR application is shown in Annex I. In developing the CENVAR data input file for the 1990-91 NAS data, it was first necessary to specify the stratum and cluster codes. Based on the sample design, the PSUs were stratified by prefecture and ecological zone. Therefore the 3-digit stratum code (STRATE) was specified as follows:

STRATE = PREFECTURE (2 digits) + ZONE (1 digit)

Since the PREFECTURE and ZONE items are also used as classification variables, they are defined in the data dictionary as sub-items of the STRATE field by specifying the appropriate SUBSTART position. For this application the cluster variable specified in the

CENVAR design menu corresponds to the sample segment, identified in the SPSS data file by the unique ID code; in the IMPS data dictionary this variable was named GRAPPE. The STRATE and GRAPPE variables are defined under the COMMON menu of the data dictionary. The remaining variables are defined under the RECORD menu, with the record type specified as MENAGE, since there is one record per household in the data file.

The weight variable specified under the CENVAR design menu was obtained directly from the original data file, maintaining two decimal places. For the CENVAR data input file it was necessary to multiply this weight by 100 for the two implied decimal places. In the data dictionary the corresponding variable name is POIDS.

The first nine analysis variables in the CENVAR data input file correspond to the production (KG) of the major crops: *haricots, pois sec, sorgho, mais, riz, patate douce, pomme de terre, banane a bière* and *café*. Each of these variables has two decimal places, so the original values were multiplied by 100 in the CENVAR data file. The CENVAR application involved running the SUBPOPULATION TOTALS analysis for these variables to estimate total production for each crop at the national and prefecture levels.

For the remaining analysis variables (kilocalories of crop production, cost of inputs, income from off-farm labor, total household income, farm size, cultivated area, etc.), the SUBPOPULATION MEANS analysis was used to produce estimates of averages per household. Some of these variables had to be multiplied by 100 in the CENVAR data input file to reflect the two implied decimals defined in the data dictionary. A few of the records had missing data for these variables, in which case the corresponding field was coded with 9's. Therefore it was necessary to create an indicator variable for each of these analysis variables, with codes for two categories, as follows:

0 -> SANSDONNEES (missing data)
1 -> AVECDONNEES (with data)

In the CENVAR application an individual SUBPOPULATION MEANS analysis was run for each analysis variable, crossing the corresponding indicator variable with INTERCEPT and PREFECTURE to produce the estimates at the national and prefecture levels. In the CENVAR output tables, only the results from the AVECDONNEES category will be used, since they represent the average across the sample households with data.

When CENVAR was run the first time for this application, a warning appeared in the output table indicating that strata 083 and 084 only had one cluster each; these strata correspond to ZONE 3 and 4 in Kibuye. Since the calculation of variances using CENVAR requires at least two clusters per stratum, it was necessary to "collapse" (combine) these strata. This was done by simply changing the STRATE code 084 to 083 in the data file. In this case the collapsed stratum with STRATE code 083 now has two clusters.

In order to illustrate how publication-quality tables on measures of precision for the different survey estimates can be produced from the CENVAR output, the text file with the CENVAR tables was converted to a Word Perfect file in which a descriptive title is shown for each estimate, and all of the results for the "missing data" category for each variable were deleted.

These results are presented in Annex II, which can serve as a prototype for presenting the results from future CENVAR applications in the survey reports.

Resolving the problems with missing data and the need to collapse strata gave the FSRP staff experience in “trouble-shooting” which will be valuable for future CENVAR applications. The staff have copies of the IMPS dictionary file, CENVAR input data file and parameter specification file for this application which can be used for future reference.

ANEXXES

ANNEX I

Data Dictionary: RWANDACV IMPS Version 3.1
Created: 15/06/99 09:46:48

Record Length: 168

The following records have been defined:

Record Name	Record Type Value (RECTYPE)	Required	Max. Records
MENAGE		Y	1

The following COMMON items have been defined. They occur on all records.

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Value Name	Values
STRATE	N	1-3	3		
PREFECTURE	N	1-2	2	BUTARE	01
				BYUMBA	02
				CYANGUGU	03
				GIKONGORO	04
				GISENYI	05
				GITARAMA	06
				KIBUNGO	07
				KIBUYE	08
				KIGALI	09
				RUHENGERI	10
ZONE	N	3	1		
GRAPPE	N	4-5	2		

Record Name: MENAGE Record Type:

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
POIDS	N	6-12	7	2		
HARICOTS	N	13-19	7	2		
POISSEC	N	20-26	7	2		
SORGHO	N	27-33	7	2		
MAIST	N	34-40	7	2		
RIZ	N	41-47	7	2		
PATATEDOUCE	N	48-54	7	2		
POMMEDETERRE	N	55-61	7	2		
BANANEABIERE	N	62-68	7	2		
CAFE	N	69-75	7	2		
KCALTOTAL	N	76-87	12	2	AVECDONNEES	000000000000: 999999999998
					SANSDONNEES	999999999999
INDKCALTOTAL	N	88	1	0	SANSDONNEES	0
					AVECDONNEES	1
INTRANTSCOUT	N	89-97	9	2	AVECDONNEES	000000000: 999999998
					SANSDONNEES	999999999
INDINTRTOT	N	98	1	0	SANSDONNEES	0
					AVECDONNEES	1
OFF-FARMLABORINC	N	99-107	9	2	AVECDONNEES	000000000: 999999998
					SANSDONNEES	999999999
INDOFF-FARMLABIN	N	108	1	0	SANSDONNEES	0
					AVECDONNEES	1
INCOME	N	109-118	10	2	AVECDONNEES	0000000000: 9999999998
					SANSDONNEES	9999999999
INDINCOME	N	119	1	0	SANSDONNEES	0
					AVECDONNEES	1

Record Name: MENAGE Record Type:

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
TLU	N	120-124	5	2	AVECDONNEES	00000:99998
					SANSDONNEES	99999
INDTLU	N	125	1	0	SANSDONNEES	0
					AVECDONNEES	1
PLUVIEMETRIE	N	126-130	5	0	AVECDONNEES	00000:99998
					SANSDONNEES	99999
INDPLUV	N	131	1	0	SANSDONNEES	0
					AVECDONNEES	1
ALTITUDE	N	132-136	5	0	AVECDONNEES	00000:99998
					SANSDONNEES	99999
INDALTI	N	137	1	0	SANSDONNEES	0
					AVECDONNEES	1
SUPERFICIEBLOCK	N	138-144	7	2		
INDSUPBL	N	145	1	0	SANSDONNEES	0
					AVECDONNEES	1
SUPERFCULTBLOCK	N	146-147	2	0		
INDSUPCUBL	N	148	1	0	SANSDONNEES	0
					AVECDONNEES	1
OBAN	N	149-157	9	2	AVECDONNEES	000000000: 999999998
					SANSDONNEES	999999999
INDOBAN	N	158	1	0	SANSDONNEES	0
					AVECDONNEES	1
BEERSALE	N	159-167	9	2	AVECDONNEES	000000000: 999999998
					SANSDONNEES	999999999
INDBEERSALE	N	168	1	0	SANSDONNEES	0
					AVECDONNEES	1

ANNEX II

TABLEAUX DES ERREURS DE SONDAGE POUR L'ENQUÊTE AGRICOLE 1990-91

1. Production total de haricots (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	161,585,916	14,898,155	9.22	132,385,533	190,786,300	3.89	1,208
PREFECTURE							
BUTARE	10,625,239	3,592,338	33.81	3,584,257	17,666,221	5.38	151
BYUMBA	30,584,740	8,173,985	26.73	14,563,730	46,605,750	3.06	126
CYANGUGU	4,181,497	1,664,000	39.79	920,058	7,442,937	6.84	94
GIKONGORO	2,070,269	516,833	24.96	1,057,276	3,083,262	1.34	91
GISENYI	5,262,944	2,062,938	39.20	1,219,585	9,306,303	5.78	128
GITARAMA	15,797,867	2,753,758	17.43	10,400,502	21,195,232	2.90	155
KIBUNGO	22,470,038	3,681,764	16.39	15,253,781	29,686,296	1.70	95
KIBUYE	4,914,842	710,623	14.46	3,522,021	6,307,663	0.95	88
KIGALI	45,902,798	8,131,168	17.71	29,965,708	61,839,888	2.82	154
RUHENGERI	19,775,682	6,869,128	34.74	6,312,191	33,239,173	3.16	126

2. Production total de pois sec (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	7,952,952	987,906	12.42	6,016,655	9,889,249	2.62	1,208
PREFECTURE							
BUTARE	525,676	216,453	41.18	101,428	949,924	3.83	151
BYUMBA	1,140,607	390,219	34.21	375,778	1,905,435	2.62	126
CYANGUGU	446,294	211,506	47.39	31,743	860,845	2.66	94
GIKONGORO	911,266	351,707	38.60	221,920	1,600,612	1.88	91
GISENYI	649,975	291,007	44.77	79,600	1,220,349	1.96	128
GITARAMA	700,696	207,813	29.66	293,383	1,108,009	2.33	155
KIBUNGO	560,235	224,220	40.02	120,764	999,707	1.88	95
KIBUYE	1,571,022	337,569	21.49	909,388	2,232,657	1.42	88
KIGALI	671,325	282,834	42.13	116,970	1,225,679	1.88	154
RUHENGERI	775,856	486,118	62.66	-176,934	1,728,647	4.30	126

3. Production total de sorgho (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	141,834,951	23,093,721	16.28	96,571,258	187,098,644	5.80	1,208
PREFECTURE							
BUTARE	14,088,785	4,530,693	32.16	5,208,627	22,968,944	4.36	151
BYUMBA	43,171,469	18,867,143	43.70	6,191,868	80,151,069	5.84	126
CYANGUGU	1,112,732	492,326	44.24	147,773	2,077,692	1.26	94
GIKONGORO	4,615,644	766,614	16.61	3,113,081	6,118,207	1.02	91
GISENYI	1,430,612	879,439	61.47	-293,088	3,154,313	4.33	128
GITARAMA	10,473,587	1,918,685	18.32	6,712,965	14,234,209	1.71	155
KIBUNGO	20,078,804	6,327,289	31.51	7,677,318	32,480,290	3.59	95
KIBUYE	3,454,523	1,889,585	54.70	-249,063	7,158,110	7.51	88
KIGALI	27,364,934	7,630,912	27.89	12,408,346	42,321,522	4.26	154
RUHENGERI	16,043,860	7,050,027	43.94	2,225,806	29,861,913	4.32	126

4. Production total de mais (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	95,973,017	18,625,976	19.41	59,466,105	132,479,930	3.62	1,208
PREFECTURE							
BUTARE	2,122,828	1,184,480	55.80	-198,753	4,444,409	7.26	151
BYUMBA	8,267,527	2,567,825	31.06	3,234,591	13,300,463	3.00	126
CYANGUGU	5,153,198	1,430,680	27.76	2,349,065	7,957,330	2.71	94
GIKONGORO	3,065,674	1,243,287	40.56	628,832	5,502,516	3.44	91
GISENYI	30,826,017	16,663,454	54.06	-1,834,354	63,486,388	3.63	128
GITARAMA	3,105,791	829,834	26.72	1,479,316	4,732,266	2.81	155
KIBUNGO	3,559,852	676,640	19.01	2,233,638	4,886,066	1.11	95
KIBUYE	18,662,620	5,293,159	28.36	8,288,029	29,037,212	1.90	88
KIGALI	4,071,668	973,334	23.91	2,163,932	5,979,403	3.28	154
RUHENGERI	17,137,842	5,249,339	30.63	6,849,137	27,426,547	4.52	126

5. Production total de riz (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	6,163,227	1,795,703	29.14	2,643,648	9,682,806	1.57	1,208
PREFECTURE							
BUTARE	4,341,930	1,575,220	36.28	1,254,498	7,429,362	1.52	151
BYUMBA	97,378	97,378	100.00	-93,483	288,240	1.04	126
CYANGUGU	16,435	16,435	100.00	-15,778	48,647	0.39	94
GIKONGORO	0	0	******	0	0	******	91
GISENYI	206,811	206,811	100.00	-198,539	612,162	1.47	128
GITARAMA	0	0	******	0	0	******	155
KIBUNGO	1,126,512	763,853	67.81	-370,639	2,623,664	2.02	95
KIBUYE	0	0	******	0	0	******	88
KIGALI	349,884	327,165	93.51	-291,359	991,128	1.06	154
RUHENGERI	24,276	14,166	58.35	-3,489	52,041	0.48	126

6. Production total de patate douce (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	819,279,157	61,672,239	7.53	698,401,569	940,156,745	8.90	1,208
PREFECTURE							
BUTARE	122,827,624	20,403,626	16.61	82,836,516	162,818,732	3.13	151
BYUMBA	91,467,668	19,035,363	20.81	54,158,357	128,776,979	4.02	126
CYANGUGU	35,590,512	11,620,295	32.65	12,814,733	58,366,290	5.90	94
GIKONGORO	79,021,247	17,331,472	21.93	45,051,563	112,990,932	2.96	91
GISENYI	66,664,608	22,866,809	34.30	21,845,663	111,483,553	7.10	128
GITARAMA	125,313,414	19,551,165	15.60	86,993,130	163,633,698	2.77	155
KIBUNGO	44,857,430	11,238,402	25.05	22,830,163	66,884,698	3.06	95
KIBUYE	57,770,675	6,252,089	10.82	45,516,579	70,024,770	0.81	88
KIGALI	80,805,034	14,564,427	18.02	52,258,756	109,351,311	3.85	154
RUHENGERI	114,960,945	36,148,984	31.44	44,108,937	185,812,953	6.05	126

7. Production total de pommes de terre (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	285,033,176	128,688,342	45.15	32,804,026	537,262,325	6.34	1,208
PREFECTURE							
BUTARE	4,898,911	1,255,138	25.62	2,438,840	7,358,982	1.88	151
BYUMBA	10,353,045	2,519,727	24.34	5,414,381	15,291,709	1.21	126
CYANGUGU	3,057,700	1,035,581	33.87	1,027,961	5,087,439	2.36	94
GIKONGORO	8,032,452	3,115,241	38.78	1,926,580	14,138,324	2.76	91
GISENYI	68,004,479	39,148,712	57.57	-8,726,996	144,735,954	5.20	128
GITARAMA	4,929,045	1,250,604	25.37	2,477,862	7,380,228	2.59	155
KIBUNGO	3,719,529	1,169,556	31.44	1,427,198	6,011,859	1.46	95
KIBUYE	12,196,807	1,236,154	10.14	9,773,947	14,619,668	0.18	88
KIGALI	5,861,761	3,286,757	56.07	-580,282	12,303,804	4.48	154
RUHENGERI	163,979,446	122,450,412	74.67	-76,023,361	403,982,253	6.42	126

8. Production total de bananes a bière (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	1,916,745,215	144,433,995	7.54	1,633,654,585	2,199,835,844	4.32	1,208
PREFECTURE							
BUTARE	194,903,188	42,941,079	22.03	110,738,673	279,067,704	4.07	151
BYUMBA	223,214,076	41,196,086	18.46	142,469,748	303,958,405	2.21	126
CYANGUGU	96,429,653	34,814,346	36.10	28,193,535	164,665,772	5.13	94
GIKONGORO	50,042,544	4,939,536	9.87	40,361,052	59,724,035	0.25	91
GISENYI	124,841,637	73,411,646	58.80	-19,045,189	268,728,462	6.66	128
GITARAMA	327,478,907	46,479,546	14.19	236,378,997	418,578,816	2.15	155
KIBUNGO	333,970,706	35,753,026	10.71	263,894,775	404,046,638	0.61	95
KIBUYE	39,570,083	15,117,796	38.21	9,939,204	69,200,963	5.17	88
KIGALI	393,032,349	65,479,022	16.66	264,693,465	521,371,233	2.72	154
RUHENGERI	133,262,070	52,342,530	39.28	30,670,711	235,853,429	7.72	126

9. Production total de café (KG)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	40,970,980	8,962,797	21.88	23,403,898	58,538,061	9.84	1,208
PREFECTURE							
BUTARE	3,154,661	1,169,243	37.06	862,945	5,446,377	5.53	151
BYUMBA	2,283,266	1,108,397	48.54	110,807	4,455,725	3.26	126
CYANGUGU	5,739,966	2,919,937	50.87	16,890	11,463,042	7.86	94
GIKONGORO	1,436,295	400,408	27.88	651,495	2,221,095	1.41	91
GISENYI	8,524,781	7,367,500	86.42	-5,915,518	22,965,081	16.38	128
GITARAMA	7,449,627	2,405,629	32.29	2,734,595	12,164,659	3.18	155
KIBUNGO	4,774,048	1,736,906	36.38	1,369,712	8,178,384	2.71	95
KIBUYE	175,158	89,052	50.84	615	349,700	1.51	88
KIGALI	6,976,439	2,425,230	34.76	2,222,988	11,729,890	4.68	154
RUHENGERI	456,738	275,821	60.39	-83,871	997,348	4.17	126

10. Production moyenne par ménage en kilocalories

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	3,235,814.09	136,265.28	4.21	2,968,734.14	3,502,894.04	2.97	1,123
PREFECTURE							
BUTARE	2,695,535.64	305,879.56	11.35	2,096,011.70	3,295,059.59	4.88	144
BYUMBA	3,490,700.73	259,690.58	7.44	2,981,707.20	3,999,694.27	1.50	104
CYANGUGU	2,353,157.12	677,197.63	28.78	1,025,849.78	3,680,464.47	10.14	89
GIKONGORO	1,722,338.64	160,246.52	9.30	1,408,255.46	2,036,421.81	1.70	88
GISENYI	2,404,559.08	393,460.19	16.36	1,633,377.11	3,175,741.05	2.14	117
GITARAMA	3,011,072.00	261,655.11	8.69	2,498,227.98	3,523,916.01	3.35	149
KIBUNGO	6,009,287.91	1,071,100.88	17.82	3,909,930.19	8,108,645.62	5.91	93
KIBUYE	2,376,090.34	89,697.27	3.77	2,200,283.69	2,551,896.98	0.23	86
KIGALI	4,567,716.55	367,572.31	8.05	3,847,274.81	5,288,158.28	2.49	131
RUHENGERI	3,429,510.22	506,212.00	14.76	2,437,334.70	4,421,685.74	4.18	122

11. Dépenses moyennes sur les intrants par ménage (FRW)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	2,595.76	260.27	10.03	2,085.64	3,105.89	1.53	1,173
PREFECTURE							
BUTARE	1,681.32	514.93	30.63	672.07	2,690.58	3.52	149
BYUMBA	3,291.94	1,174.23	35.67	990.45	5,593.43	1.68	114
CYANGUGU	684.83	170.99	24.97	349.69	1,019.98	0.61	92
GIKONGORO	583.49	185.56	31.80	219.79	947.20	1.07	90
GISENYI	2,611.30	770.47	29.51	1,101.18	4,121.43	1.53	120
GITARAMA	2,578.04	420.11	16.30	1,754.63	3,401.46	1.36	153
KIBUNGO	6,551.90	624.54	9.53	5,327.80	7,775.99	0.28	95
KIBUYE	622.95	324.29	52.06	-12.66	1,258.56	1.57	87
KIGALI	3,220.23	664.28	20.63	1,918.25	4,522.21	1.46	150
RUHENGERI	3,482.00	1,426.30	40.96	686.46	6,277.55	2.02	123

12. Revenue moyenne de main d’oeuvre en dehors du ménage (FRW)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	11,590.48	1,675.23	14.45	8,307.03	14,873.94	2.02	1,173
PREFECTURE							
BUTARE	3,786.37	933.00	24.64	1,957.69	5,615.05	0.75	149
BYUMBA	10,467.28	1,953.43	18.66	6,638.56	14,295.99	1.02	114
CYANGUGU	6,739.11	1,714.02	25.43	3,379.64	10,098.58	2.94	92
GIKONGORO	6,858.36	3,462.56	50.49	71.73	13,644.99	2.98	90
GISENYI	13,733.92	5,926.28	43.15	2,118.40	25,349.43	7.44	120
GITARAMA	6,893.92	1,870.43	27.13	3,227.88	10,559.96	1.77	153
KIBUNGO	29,282.88	14,341.17	48.97	1,174.19	57,391.58	2.69	95
KIBUYE	4,033.62	1,427.59	35.39	1,235.54	6,831.71	0.90	87
KIGALI	15,458.30	4,767.42	30.84	6,114.16	24,802.45	1.52	150
RUHENGERI	19,883.16	5,856.83	29.46	8,403.78	31,362.54	0.93	123

13. Revenue moyenne par ménage (FRW)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	47,512.65	1,964.90	4.14	43,661.45	51,363.85	1.83	1,173
PREFECTURE							
BUTARE	38,281.71	3,053.66	7.98	32,296.54	44,266.88	1.92	149
BYUMBA	48,609.12	4,009.34	8.25	40,750.81	56,467.43	1.20	114
CYANGUGU	36,747.41	6,435.57	17.51	24,133.70	49,361.12	6.18	92
GIKONGORO	28,767.66	6,598.41	22.94	15,834.78	41,700.54	4.91	90
GISENYI	45,968.67	8,185.05	17.81	29,925.96	62,011.37	4.50	120
GITARAMA	44,721.31	3,392.09	7.58	38,072.81	51,369.81	2.04	153
KIBUNGO	76,640.60	9,322.82	12.16	58,367.88	94,913.32	1.22	95
KIBUYE	25,267.41	1,389.40	5.50	22,544.19	27,990.64	0.68	87
KIGALI	63,465.45	6,235.62	9.83	51,243.64	75,687.26	1.99	150
RUHENGERI	57,896.07	8,235.16	14.22	41,755.16	74,036.98	1.34	123

14. TLU moyenne par ménage

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	0.73	0.06	7.57	0.62	0.84	2.77	1,157
PREFECTURE							
BUTARE	0.86	0.20	22.79	0.48	1.24	3.66	148
BYUMBA	0.76	0.18	23.81	0.40	1.11	1.74	106
CYANGUGU	0.25	0.03	12.90	0.19	0.32	0.43	90
GIKONGORO	0.65	0.11	16.77	0.44	0.86	1.41	90
GISENYI	0.49	0.14	28.71	0.21	0.76	3.63	120
GITARAMA	0.89	0.16	17.47	0.58	1.19	2.31	150
KIBUNGO	0.57	0.10	17.50	0.37	0.76	1.19	94
KIBUYE	1.15	0.35	30.93	0.45	1.84	5.25	87
KIGALI	0.81	0.11	13.35	0.60	1.02	1.51	149
RUHENGERI	0.67	0.17	25.46	0.34	1.01	3.73	123

15. Supérficie moyenne par ménage (are)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	94.79	5.14	5.42	84.71	104.87	4.12	1,141
PREFECTURE							
BUTARE	90.23	8.31	9.22	73.93	106.53	2.73	145
BYUMBA	104.24	14.63	14.03	75.57	132.90	3.44	111
CYANGUGU	65.42	14.60	22.31	36.81	94.03	5.23	89
GIKONGORO	97.51	17.15	17.59	63.90	131.13	3.63	90
GISENYI	48.06	4.47	9.29	39.31	56.81	0.92	119
GITARAMA	94.23	13.91	14.76	66.97	121.49	4.14	152
KIBUNGO	128.11	22.27	17.38	84.47	171.75	4.03	95
KIBUYE	126.13	20.46	16.23	86.02	166.24	3.83	86
KIGALI	102.88	10.46	10.17	82.38	123.38	2.58	148
RUHENGERI	94.63	28.82	30.46	38.13	151.12	8.40	106

16. Supérficie cultivée moyenne par ménage (are)

Catégorie	Valeur	Erreur Type	C.V. (%)	Intervalle de confiance 95% Lim. Infer.	Lim. Super.	Effet de Sondage	Nombre de Ménages
RWANDA	2.53	0.07	2.72	2.39	2.66	4.28	1,141
PREFECTURE							
BUTARE	2.66	0.16	6.10	2.35	2.98	3.30	145
BYUMBA	2.75	0.23	8.20	2.31	3.19	6.26	111
CYANGUGU	2.05	0.28	13.86	1.49	2.61	5.57	89
GIKONGORO	2.46	0.25	10.11	1.98	2.95	4.75	90
GISENYI	1.66	0.08	4.62	1.51	1.81	0.78	119
GITARAMA	2.49	0.19	7.78	2.11	2.87	4.78	152
KIBUNGO	3.04	0.29	9.42	2.48	3.60	6.50	95
KIBUYE	2.94	0.13	4.51	2.68	3.20	1.43	86
KIGALI	2.71	0.18	6.67	2.35	3.06	3.87	148
RUHENGERI	2.47	0.29	11.64	1.91	3.04	8.23	106

TABLEAUX DES COEFFICIENTS DE VARIATION APPROXIMATIFS POUR L'EICV ET SOUS-ECHANTILLON DE DEUX CYCLES

1. Production total de haricots (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	161,585,916	9.22%	4.22%	5.00%	9.43%	-0.21%	3.12
PREFECTURE							
Butare	10,625,239	33.81%	16.78%	17.03%	37.52%	-3.71%	4.21
Byumba	30,584,740	26.73%	12.40%	14.32%	27.73%	-1.01%	2.51
Cyangugu	4,181,497	39.79%	15.48%	24.32%	34.61%	5.19%	5.28
Gikongoro	2,070,269	24.96%	10.50%	14.47%	23.47%	1.50%	1.25
Gisenyi	5,262,944	39.20%	17.87%	21.33%	39.96%	-0.76%	4.51
Gitarama	15,797,867	17.43%	9.00%	8.43%	20.12%	-2.69%	2.39
Kibungo	22,470,038	16.39%	6.88%	9.51%	15.38%	1.01%	1.51
Kibuye	4,914,842	14.46%	6.19%	8.27%	13.84%	0.62%	0.95
Kigali	45,902,798	17.71%	9.13%	8.58%	20.41%	-2.70%	2.33
Ruhengeri	19,775,682	34.74%	16.09%	18.64%	35.99%	-1.25%	2.58

2. Production total de pois sec (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	7,952,952	12.42%	5.44%	6.98%	12.16%	0.26%	2.19
PREFECTURE							
Butare	525,676	41.18%	20.69%	20.48%	46.27%	-5.10%	3.08
Byumba	1,140,607	34.21%	16.02%	18.19%	35.82%	-1.61%	2.19
Cyangugu	446,294	47.39%	19.15%	28.24%	42.82%	4.58%	2.22
Gikongoro	911,266	38.60%	15.72%	22.87%	35.15%	3.44%	1.65
Gisenyi	649,975	44.77%	21.56%	23.21%	48.20%	-3.43%	1.70
Gitarama	700,696	29.66%	15.52%	14.14%	34.70%	-5.04%	1.98
Kibungo	560,235	40.02%	16.66%	23.37%	37.25%	2.78%	1.65
Kibuye	1,571,022	21.49%	9.20%	12.29%	20.57%	0.91%	1.42
Kigali	671,325	42.13%	22.32%	19.81%	49.92%	-7.79%	1.65
Ruhengeri	775,856	62.66%	28.63%	34.03%	64.02%	-1.36%	3.42

3. Production total de sorgho (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	141,834,951	16.28%	7.10%	9.18%	15.88%	0.40%	4.52
PREFECTURE							
Butare	14,088,785	32.16%	16.08%	16.08%	35.95%	-3.79%	3.46
Byumba	43,171,469	43.70%	19.76%	23.94%	44.19%	-0.49%	4.55
Cyangugu	1,112,732	44.24%	19.03%	25.21%	42.56%	1.68%	1.19
Gikongoro	4,615,644	16.61%	7.21%	9.40%	16.13%	0.48%	1.01
Gisenyi	1,430,612	61.47%	28.30%	33.17%	63.29%	-1.81%	3.44
Gitarama	10,473,587	18.32%	9.82%	8.50%	21.95%	-3.63%	1.52
Kibungo	20,078,804	31.51%	12.60%	18.91%	28.17%	3.34%	2.90
Kibuye	3,454,523	54.70%	23.42%	31.28%	52.37%	2.33%	7.51
Kigali	27,364,934	27.89%	14.09%	13.79%	31.51%	-3.62%	3.39
Ruhengeri	16,043,860	43.94%	20.07%	23.87%	44.89%	-0.95%	3.43

4. Production total de mais (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	95,973,017	19.41%	8.51%	10.89%	19.04%	0.37%	2.92
PREFECTURE							
Butare	2,122,828	55.80%	27.46%	28.33%	61.41%	-5.61%	5.59
Byumba	8,267,527	31.06%	14.43%	16.63%	32.27%	-1.21%	2.47
Cyangugu	5,153,198	27.76%	11.20%	16.56%	25.05%	2.71%	2.25
Gikongoro	3,065,674	40.56%	15.90%	24.65%	35.56%	5.00%	2.79
Gisenyi	30,826,017	54.06%	25.07%	28.98%	56.07%	-2.01%	2.93
Gitarama	3,105,791	26.72%	13.82%	12.90%	30.90%	-4.18%	2.33
Kibungo	3,559,852	19.01%	8.34%	10.66%	18.66%	0.35%	1.08
Kibuye	18,662,620	28.36%	12.14%	16.22%	27.15%	1.21%	1.90
Kigali	4,071,668	23.91%	12.22%	11.68%	27.33%	-3.42%	2.67
Ruhengeri	17,137,842	30.63%	13.97%	16.66%	31.24%	-0.61%	3.58

5. Production total de riz (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	6,163,227	29.14%	14.31%	14.82%	32.01%	-2.87%	1.42
PREFECTURE							
Butare	4,341,930	36.28%	19.40%	16.88%	43.37%	-7.10%	1.38
Byumba	97,378	100.00%	50.97%	49.03%	113.98%	-13.98%	1.03
Cyangugu	16,435	100.00%	52.68%	47.32%	117.80%	-17.80%	0.55
Gikongoro	0	-	-	-	-	-	-
Gisenyi	206,811	100. 00%	49.39%	50.61%	110.44%	-10.44%	1.34
Gitarama	0	-	-	-	-	-	-
Kibungo	1,126,512	67.81%	28.06%	39.75%	62.75%	5.06%	1.75
Kibuye	0	-	-	-	-	-	-
Kigali	349,884	93.51%	52.56%	40.94%	117.53%	-24.03%	1.04
Ruhengeri	24,276	58.35%	33.94%	24.41%	75.90%	-17.54%	0.62

6. Production total de patate douce (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	819,279,157	7.53%	3.31%	4.22%	7.40%	0.12%	6.79
PREFECTURE							
Butare	122,827,624	16.61%	8.43%	8.18%	18.85%	-2.24%	2.56
Byumba	91,467,668	20.81%	9.53%	11.28%	21.32%	-0.51%	3.21
Cyangugu	35,590,512	32.65%	12.75%	19.90%	28.51%	4.14%	4.59
Gikongoro	79,021,247	21.93%	8.67%	13.27%	19.38%	2.56%	2.44
Gisenyi	66,664,608	34.30%	15.55%	18.75%	34.78%	-0.47%	5.47
Gitarama	125,313,414	15.60%	8.08%	7.53%	18.06%	-2.45%	2.30
Kibungo	44,857,430	25.05%	10.10%	14.96%	22.58%	2.48%	2.51
Kibuye	57,770,675	10.82%	4.63%	6.19%	10.36%	0.46%	0.81
Kigali	80,805,034	18.02%	9.15%	8.88%	20.45%	-2.43%	3.09
Ruhengeri	114,960,945	31.44%	14.20%	17.24%	31.76%	-0.32%	4.70

7. Production total de pommes de terre (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	285,033,176	45.15%	19.44%	25.71%	43.47%	1.68%	4.92
PREFECTURE							
Butare	4,898,911	25.62%	13.44%	12.18%	30.06%	-4.44%	1.65
Byumba	10,353,045	24.34%	12.18%	12.16%	27.23%	-2.89%	1.15
Cyangugu	3,057,700	33.87%	13.79%	20.08%	30.83%	3.04%	2.00
Gikongoro	8,032,452	38.78%	15.38%	23.40%	34.40%	4.38%	2.29
Gisenyi	68,004,479	57.57%	26.33%	31.24%	58.88%	-1.31%	4.08
Gitarama	4,929,045	25.37%	13.19%	12.19%	29.48%	-4.11%	2.17
Kibungo	3,719,529	31.44%	13.39%	18.06%	29.94%	1.51%	1.34
Kibuye	12,196,807	10.14%	4.34%	5.80%	9.70%	0.43%	0.18
Kigali	5,861,761	56.07%	28.28%	27.79%	63.24%	-7.16%	3.55
Ruhengeri	163,979,446	74.67%	33.68%	41.00%	75.31%	-0.63%	4.97

8. Production total de bananes a bière (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	1,916,745,215	7.54%	3.44%	4.10%	7.69%	-0.16%	3.43
PREFECTURE							
Butare	194,903,188	22.03%	11.04%	10.99%	24.70%	-2.66%	3.25
Byumba	223,214,076	18.46%	8.74%	9.72%	19.54%	-1.08%	1.89
Cyangugu	96,429,653	36.10%	14.16%	21.95%	31.66%	4.44%	4.03
Gikongoro	50,042,544	9.87%	5.77%	4.10%	12.89%	-3.02%	0.45
Gisenyi	124,841,637	58.80%	26.70%	32.10%	59.71%	-0.91%	5.15
Gitarama	327,478,907	14.19%	7.47%	6.73%	16.70%	-2.51%	1.84
Kibungo	333,970,706	10.71%	5.15%	5.55%	11.52%	-0.82%	0.71
Kibuye	39,570,083	38.21%	16.36%	21.85%	36.58%	1.63%	5.17
Kigali	393,032,349	16.66%	8.60%	8.06%	19.24%	-2.58%	2.26
Ruhengeri	133,262,070	39.28%	17.63%	21.64%	39.43%	-0.15%	5.93

9. Production total de café (KG)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	40,970,980	21.88%	9.39%	12.48%	21.00%	0.87%	7.48
PREFECTURE							
Butare	3,154,661	37.06%	18.38%	18.69%	41.09%	-4.03%	4.32
Byumba	2,283,266	48.54%	22.46%	26.09%	50.21%	-1.67%	2.66
Cyangugu	5,739,966	50.87%	19.72%	31.15%	44.09%	6.78%	6.03
Gikongoro	1,436,295	27.88%	11.66%	16.22%	26.07%	1.81%	1.30
Gisenyi	8,524,781	86.42%	38.64%	47.78%	86.40%	0.02%	12.28
Gitarama	7,449,627	32.29%	16.59%	15.70%	37.09%	-4.80%	2.60
Kibungo	4,774,048	36.38%	14.76%	21.62%	33.01%	3.38%	2.25
Kibuye	175,158	50.84%	21.77%	29.07%	48.68%	2.16%	1.51
Kigali	6,976,439	34.76%	17.50%	17.26%	39.14%	-4.38%	3.70
Ruhengeri	456,738	60.39%	27.63%	32.76%	61.78%	-1.39%	3.32

10. Production moyenne par ménage en kilocalories

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	3,235,814.09	4.21%	1.85%	2.36%	4.13%	0.08%	2.44
PREFECTURE							
Butare	2,695,535.64	11.35%	5.52%	5.83%	12.34%	-0.99%	3.85
Byumba	3,490,700.73	7.44%	3.31%	4.13%	7.39%	0.05%	1.37
Cyangugu	2,353,157.12	28.78%	10.80%	17.98%	24.15%	4.63%	7.70
Gikongoro	1,722,338.64	9.30%	3.76%	5.55%	8.40%	0.90%	1.51
Gisenyi	2,404,559.08	16.36%	7.48%	8.88%	16.73%	-0.37%	1.84
Gitarama	3,011,072.00	8.69%	4.37%	4.32%	9.76%	-1.07%	2.72
Kibungo	6,009,287.91	17.82%	6.92%	10.90%	15.48%	2.35%	4.60
Kibuye	2,376,090.34	3.77%	2.20%	1.58%	4.92%	-1.14%	0.44
Kigali	4,567,716.55	8.05%	3.85%	4.19%	8.62%	-0.57%	2.09
Ruhengeri	3,429,510.22	14.76%	6.64%	8.12%	14.86%	-0.10%	3.33

11. Dépenses moyennes sur les intrants par ménage (FRW)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	2,595.76	10.03%	4.61%	5.41%	10.31%	-0.29%	1.39
PREFECTURE							
Butare	1,681.32	30.63%	15.35%	15.28%	34.32%	-3.69%	2.85
Byumba	3,291.94	35.67%	16.42%	19.25%	36.71%	-1.04%	1.50
Cyangugu	684.83	24.97%	11.83%	13.14%	26.44%	-1.48%	0.71
Gikongoro	583.49	31.80%	13.65%	18.15%	30.52%	1.28%	1.05
Gisenyi	2,611.30	29.51%	14.05%	15.45%	31.43%	-1.92%	1.39
Gitarama	2,578.04	16.30%	8.87%	7.43%	19.83%	-3.54%	1.26
Kibungo	6,551.90	9.53%	5.51%	4.03%	12.31%	-2.78%	0.47
Kibuye	622.95	52.06%	21.06%	30.99%	47.10%	4.96%	1.42
Kigali	3,220.23	20.63%	11.04%	9.59%	24.68%	-4.05%	1.34
Ruhengeri	3,482.00	40.96%	19.29%	21.67%	43.13%	-2.17%	1.75

12. Revenue moyenne de main d'oeuvre en dehors du ménage (FRW)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	11,590.48	14.45%	6.60%	7.85%	14.77%	-0.31%	1.75
PREFECTURE							
Butare	3,786.37	24.64%	14.33%	10.32%	32.03%	-7.39%	0.82
Byumba	10,467.28	18.66%	9.07%	9.59%	20.28%	-1.62%	1.01
Cyangugu	6,739.11	25.43%	10.11%	15.33%	22.60%	2.83%	2.42
Gikongoro	6,858.36	50.49%	19.83%	30.66%	44.34%	6.14%	2.45
Gisenyi	13,733.92	43.15%	18.92%	24.23%	42.31%	0.84%	5.72
Gitarama	6,893.92	27.13%	14.40%	12.73%	32.20%	-5.07%	1.56
Kibungo	29,282.88	48.97%	19.88%	29.10%	44.45%	4.52%	2.24
Kibuye	4,033.62	35.39%	15.29%	20.10%	34.19%	1.20%	0.93
Kigali	15,458.30	30.84%	16.44%	14.41%	36.75%	-5.91%	1.38
Ruhengeri	19,883.16	29.46%	15.06%	14.40%	33.68%	-4.22%	0.95

13. Revenue moyenne par ménage (FRW)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	47,512.65	4.14%	1.94%	2.19%	4.34%	-0.21%	1.61
PREFECTURE							
Butare	38,281.71	7.98%	4.15%	3.83%	9.28%	-1.30%	1.67
Byumba	48,609.12	8.25%	3.93%	4.32%	8.79%	-0.54%	1.15
Cyangugu	36,747.41	17.51%	6.76%	10.76%	15.11%	2.41%	4.80
Gikongoro	28,767.66	22.94%	8.81%	14.12%	19.71%	3.23%	3.87
Gisenyi	45,968.67	17.81%	7.93%	9.88%	17.72%	0.08%	3.57
Gitarama	44,721.31	7.58%	3.98%	3.60%	8.90%	-1.32%	1.76
Kibungo	76,640.60	12.16%	5.28%	6.88%	11.81%	0.36%	1.16
Kibuye	25,267.41	5.50%	2.48%	3.02%	5.55%	-0.05%	0.77
Kigali	63,465.45	9.83%	5.12%	4.71%	11.44%	-1.61%	1.73
Ruhengeri	57,896.07	14.22%	6.95%	7.27%	15.55%	-1.32%	1.25

14. TLU moyenne par ménage

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	0.73	8.22%	2.97%	5.25%	6.63%	1.59%	2.30
PREFECTURE							
Butare	0.86	23.26%	11.59%	11.66%	25.93%	-2.67%	2.95
Byumba	0.76	23.68%	10.48%	13.20%	23.43%	0.25%	1.54
Cyangugu	0.25	12.00%	6.05%	5.95%	13.52%	-1.52%	0.58
Gikongoro	0.65	16.92%	7.04%	9.89%	15.74%	1.19%	1.30
Gisenyi	0.49	28.57%	12.83%	15.74%	28.69%	-0.12%	2.93
Gitarama	0.89	17.98%	9.26%	8.72%	20.70%	-2.73%	1.96
Kibungo	0.57	17.54%	7.60%	9.95%	16.99%	0.56%	1.14
Kibuye	1.15	30.43%	11.47%	18.96%	25.66%	4.78%	4.12
Kigali	0.81	13.58%	7.22%	6.36%	16.14%	-2.56%	1.37
Ruhengeri	0.67	25.37%	11.52%	13.85%	25.77%	-0.39%	3.00

15. Supérficie moyenne par ménage (are)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	94.79	5.42%	2.11%	3.31%	4.73%	0.69%	3.29
PREFECTURE							
Butare	90.23	9.21%	4.61%	4.60%	10.32%	-1.11%	2.27
Byumba	104.24	14.03%	6.08%	7.96%	13.59%	0.45%	2.79
Cyangugu	65.42	22.32%	8.51%	13.81%	19.03%	3.29%	4.10
Gikongoro	97.51	17.59%	6.84%	10.75%	15.30%	2.29%	2.93
Gisenyi	48.06	9.30%	4.68%	4.62%	10.47%	-1.17%	0.94
Gitarama	94.23	14.76%	7.42%	7.34%	16.59%	-1.83%	3.30
Kibungo	128.11	17.38%	6.91%	10.47%	15.46%	1.92%	3.22
Kibuye	126.13	16.22%	6.15%	10.07%	13.76%	2.46%	3.08
Kigali	102.88	10.17%	5.16%	5.00%	11.55%	-1.38%	2.16
Ruhengeri	94.63	30.46%	12.52%	17.94%	27.99%	2.46%	6.43

16. Supérficie cultivée moyenne par ménage (are)

Domaine	Valeur, 1991 Enquête Agricole	CV, 1991 Enquête Agricole	CV Approx. EICV	Différence, CV(91) - CV(EICV)	CV Approx. EICV 2 cycles	Différence, CV(91) - CV(EICV) 2 cycles	DEFF Approx., (EICV)
RWANDA	2.53	2.77%	1.04%	1.73%	2.32%	0.45%	3.41
PREFECTURE							
Butare	2.66	6.02%	2.98%	3.03%	6.67%	-0.66%	2.69
Byumba	2.75	8.36%	3.54%	4.82%	7.92%	0.44%	4.86
Cyangugu	2.05	13.66%	5.20%	8.46%	11.62%	2.03%	4.35
Gikongoro	2.46	10.16%	3.91%	6.25%	8.74%	1.42%	3.75
Gisenyi	1.66	4.82%	2.49%	2.33%	5.56%	-0.74%	0.84
Gitarama	2.49	7.63%	3.81%	3.82%	8.53%	-0.90%	3.77
Kibungo	3.04	9.54%	3.73%	5.80%	8.35%	1.19%	5.03
Kibuye	2.94	4.42%	1.80%	2.63%	4.01%	0.41%	1.32
Kigali	2.71	6.64%	3.30%	3.34%	7.39%	-0.74%	3.10
Ruhengeri	2.47	11.74%	4.83%	6.91%	10.80%	0.95%	6.30