THE REPUBLIC OF UGANDA

UGANDA BUREAU OF STATISTICS

POST ENUMERATION SURVEY:

2002 UGANDA POPULATION AND HOUSING CENSUS

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ACRONYMS

GENERAL

ADPESO	Assistant District Post Enumeration Survey Officer
CST	Country Support Team
CTAC	Census Technical Advisory Committee
CTO	Census Technical Officer
DCO	District Census Officer
DNN	Deputy National Census Coordinator
DPC	Data Processing Centre
DPESO	District Post Enumeration Survey Officer
EA	Enumeration Area
IDP	Internally Displaced Persons' Camps
ISAE	Institute of Statistics and Applied Economics, Makerere University
LC	Local Council
PES	Post Enumeration Survey
SDA	Seventh Day Adventist
TWG	Technical Working Group
UBOS	Uganda Bureau of Statistics
UNFPA	United Nations Population Fund
DFID	Department for International Development

TECHNICAL

C.I.	Confidence Interval
Cov	Covariance
CV	Coefficient of Variation
Deff	Design Effect
EIR	Erroneous inclusions Rate
GDR	Gross Difference Rate
I	Index of Inconsistency
IAG	Aggregate Index of Inconsistency
LCL	Lower Confidence Limits
NDR	Net Difference Rate
PSU	Primary Sampling Unit
RA	Rate of Agreement
S.E.	Standard Error
UCL	Upper Confidence Limit

FOREWORD

The Uganda Bureau of Statistics Act 1998 mandates the Uganda Bureau of Statistics "***as the principal data collecting and disseminating agency responsible for coordinating, monitoring and supervising the National Statistical System***". The Act was the legal basis for conducting the 2002 Uganda Population and Housing Census, which was conducted by the Bureau in collaboration with partner institutions.

Following the successful completion of census enumeration; UBOS conducted a Post Enumeration Survey (PES), to provide information on Census coverage and magnitude of content errors.

In order to achieve the PES objective of providing quantitative information on Census accuracy, all persons in Uganda living in private households were targeted for the survey. However, due to time and resources constraints, a one-stage stratified cluster design was used in selecting the population for interview.

This was the first time the PES was planned and successfully implemented since the history of censuses in Uganda. It has therefore been a learning experience for the technical staff who were involved in the exercise.

On behalf of the Uganda Bureau of Statistics, I would like first, to extend my appreciation to the Government of Uganda and development partners (NORAD, DFID, and UNFPA) for making available the necessary financial and technical resources for undertaking the PES. Secondly, I would like to thank all partner institutions that collaborated with the Bureau in carrying out this exercise. I have no doubt that if it were not for the strong partnership between Government, partners in development and collaborating national institutions, the PES would not have been properly organized and implemented. I extend my appreciation to the CST/UNFPA consultant Mr.Janson Onsembe and the local PES Consultant Prof. James Ntozi for the valuable inputs that made the PES exercise a success. I would also like to thank the management of the Bureau, the Census Technical Office and all those who in one way or another participated in the planning and implementation of the PES especially data processing staff, field supervisors and enumerators and all the individual respondents.

The results of the PES will be useful to government, data analysts and other users of the census data such as training institutions, researchers, students etc.

The results indicate a high coverage of the 2002 Uganda population and Housing Census. This gives additional confidence in the use of the census data

John B. Male - Mukasa
Executive Director

EXECUTIVE SUMMARY

Background

Uganda conducted the Post Enumeration Survey (PES) in January 2003 to evaluate the coverage and content errors of 2002 population and housing census. Two major domains of study were selected namely; urban and rural. The rural domain was stratified into four regions; Central, Eastern, Northern and Western. A total of 350 enumeration areas were selected as primary sampling units (PSUs) using the probability proportional to size.

Highly experienced enumerators who worked during the census were retrained to collect data on a few selected variables. For absolute independence, organizers ensured that the enumerators worked in different areas from those covered during the main census.

A matching exercise was undertaken after data collection, which was basically aimed at investigating whether the PES persons/households were enumerated during the census. Unmatched records were then reconciled in the field with the main purpose of identifying erroneous inclusions. The CSPRo software was used for data capture, verification and tabulation.

Evaluation of Coverage Errors

In evaluating the coverage, a dual system of estimation was used. The PES results showed that the 2002 census national coverage rate was 94.4% with an omission rate of 5.6%. The figures compare favourably with data from other countries in the sub-region. Generally the coverage in rural areas was higher than urban areas. The dual system methodology gives estimated total population as 25,738,549 while the census gives a population of 25,206,696 a value which lies within the 95% confidence interval limits built around the estimate.

Analysis of regional coverage rate indicates moderate differences. The Rural Western region had the highest coverage rate of 96.1% while there was no significant difference in coverage between the Northern and Central regions, which had the lowest coverage rates of 93.6% and 94.1%, respectively. However, urban areas showed a significant difference in coverage compared to the rural areas.

The national erroneous inclusion rate was 3.6% and the gross coverage error rate was 9.2%. The erroneous inclusion rate was higher in urban areas (7.6%) than rural areas which registered a value of 3.3%. The Northern region had the highest erroneous inclusion rate of 5.9% while the Central region had the lowest amongst the rural areas of 1.0%. The coverage error rates follow the same trend as the erroneous inclusion rates.

Evaluation of Content Errors

In order to measure the correctness of responses between the census and the PES, the rate of agreement, net difference rate and index of inconsistency were used.

Sex had the highest rate of agreement of 98% and lowest aggregate index of inconsistency of 4%.

In contrast, age had the lowest rate of agreement of 71%. This is because while sex as a characteristic of individuals is easy to report accurately, age depends on the person reporting.

The rates of agreement of other characteristics were as follows: relationship to the household head-86%, religion-88% and marital status-85%.

Implications of the results

With the high coverage rate arising from the evaluation, the census results can confidently be used for planning and policy formulation. Thus, the PES findings should guide users to better interpret the 2002 population and housing census results.

CHAPTER 1: BACKGROUND

The Uganda Bureau of Statistics conducted a Population and Housing Census in September 2002 that covered the whole country. For the purpose of enumeration, the country was sub-divided into 34,068 Enumeration Areas (EAs), with an average of 140 households. The exercise involved about 50,000 enumerators, who, in most cases covered one EA each. Regardless of the quality control measures adopted, errors were expected to occur with serious impact on quality of the census data. As part of the mechanisms to evaluate the quality of the data, UBOS conducted a Post Enumeration Survey (PES) in January 2003.

For the design and implementation of the PES, UBOS received technical assistance from the UNFPA Country Support Team (CST) and a Local Consultant.

1.1 Experience of PES in sub-Saharan Africa

Post enumeration surveys have been conducted in Africa for four decades with the aim of evaluating coverage and content errors. The first initiative of PES in sub-Saharan Africa was in Ghana in 1960 to evaluate the 1960 Ghana Census. Other African countries, especially Francophone countries, conducted PES in 1970s. The result of this early experience was not encouraging because poor African countries felt this survey was another expensive item following the censuses that were costly in terms of money, time and human resources. For one to two decades, a number of African countries did not conduct PES because of financial limitations.

Some African countries however resumed conducting PES during the 1990s. For instance, in December 1990, Zambia conducted a PES to evaluate the Census of Population and Housing held in September the same year. The objective of this survey was to measure both the census coverage and content errors, which could not be measured using the limited data from the unreliable civil registration systems and other methods of data collection. The Zambian PES excluded persons living in institutions and collective dwellings. It was observed that the net coverage error was 1.9 percent, ranging from 0.9 percent in the rural areas to 2.6 percent in urban centres. The provinces that had high net coverage errors were attributed to poor mapping and inefficient demarcation of enumeration areas. This PES also found high index of inconsistency for ages in rural than urban areas. High index of inconsistency was observed in the relationship of son/daughter to head of household.

Another PES conducted in 1990 was in Burundi. A single stage stratified cluster sample design was used, where the country was stratified according to rural areas and urban

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centres followed by the geopolitical subdivisions being used to select the enumeration areas (EAs). Seventy out of 5,500 EAs were selected for the exercise. All the PES staff were selected from the best-qualified census staff pool. Only two weeks after the census, data collection was conducted with a response rate of 98.0 percent.

Rwanda conducted a PES in 1991 where a single stage stratified cluster sample design was also used and the country was stratified according to rural areas, urban centres and capital city of Kigali followed by the geopolitical subdivisions being used to select the enumeration areas (EAs). One hundred and twenty out of 6,200 EAs were selected. Most of the PES staff were selected from the best-qualified census staff pool, but some of the PES enumerators had not participated in the census. Only two weeks after the census, data collection was conducted with a response rate of 99.9%.

In the PES of Namibia of 1991, the selection of EAs was based on equal probability sample design. However, the survey experienced many problems including the first stage of matching census and PES data yielding low percentage of matched cases due to unqualified staff used in PES and the field reconciliation not being done to verify the non-matches.

Gambia conducted a PES in May 1993 within 3 months after her 1993 census. A one stage random systematic sampling procedure was used to select 25 out of a total 1593 EAs. The best census field workers were used to collect data from the areas they did not know until on the first day of fieldwork. Coverage error was found to be 3.6%, erroneously enumerated rate 0.9 percent and net error rate 2.7 percent. Rates of agreement between PES and census of selected respondents' characteristics subjected to content error measurement were: age – 77.3 percent, literacy – 89.7 percent, school attendance – 84.7 percent, highest grade attained at school – 88.2 percent and nationality – 85.6 percent.

South Africa conducted a PES in November and December 1996 following the first post apartheid era census of population and housing in October 1996. The PES was based on 800 EAs, approximately one percent of all census EAs. Stratification was done on the basis of provinces, before systematic sampling procedure was used to select EAs. Census staff recommended to be highly competent was used as PES enumerators and deployed in areas different from those they worked in during the census. Comparison of PES and census data found an undercount of 10.7 percent for the whole of South Africa, ranging from 8.7 percent in Western Cape to 15.6 percent in Northern Cape Province. These results were used in the adjustment of census results at the national and provincial levels.

Overall, the experience of PES in sub-Saharan Africa can be summarized as follows: first, with exception of South Africa, the PES results have not been used for adjusting the census results for fear of political implications. However, PES has been used as part of the methodological work to help improve future censuses and surveys in the region. Second, best practices of conducting PES have not been strictly adhered to. For instance, due to financial constraints, the same statistical or census agency has been used to plan, manage and collect data using same enumerators in both census and PES, an action that compromises the independence of PES, a cardinal assumption of the PES theory. Third, use of alternative names has made it difficult to match census and PES cases. Fourthly, content errors analysis has found that age reporting is more accurate than expected, perhaps implying improvement of age reporting in the region. Lastly, pretests of survey instruments have often been overlooked.

1.2   Objectives of the Uganda 2002 PES

The purpose of the PES was to facilitate the measurement of magnitude, direction and sources of errors for the 2002 population and housing census.

The specific objectives of the PES were to:
- Quantitatively evaluate accuracy of the census in terms of coverage and content error, at national, urban/rural and regions.
- Provide, if necessary, concrete statistical basis for adjustment of the census data
- Evaluate quality of Enumeration Areas as sampling units for future intercensal household based surveys
- Act as a basis for documenting lessons learnt for implementing future censuses.
- Furnish information on sources and causes of errors,
- Provide quantitative information required for determining the success of the 2002 Uganda population and housing census and enhance its credibility.
- Enhance skills in census evaluation at UBOS

1.3   Planning of PES

The Post-Enumeration Survey was an integral part of the 2002 Census Programme, whose implementation was initiated in June 2002 with the development of the PES Framework. The framework outlined specific issues including: purpose and objectives of the PES; and, outputs, survey strategies/methodology and activities. It also contained the work plan, the budget, and draft questionnaire.

The Survey strategy/methodology included development of a sampling design; data collection; procedures for matching PES and census records; reconciliation; and, data processing; and, estimating coverage and content errors.

1.3.1   Institutional Arrangements

The office of the Census Technical Officer (CTO), UBOS, implemented the PES who drew expertise from ISAE as well as the UNFPA Country Support Team (CST). For purposes of implementing the PES, a Technical Working Group (TWG) under the chairmanship of the Deputy National Census Coordinator (DNCC) was established.

The PES Data Processing was situated in the same building as the census processing, and this was an advantage because the PES processing benefited from the equipment and personnel meant for census processing. This also eased the process of searching for, utilizing and return of census questionnaires for the sample EA.

1.3.2: Data collection and analysis

The activities of the PES included;

- Planning and analysis: survey design, sample selection, data analysis and report preparations
- Field activities; administration of household/person questionnaires and field reconciliation visits
- Matching exercise: office matching of household and person records
- Data processing: development of computer programs, manual editing, data entry and tabulation.

1.4   Outline of Chapters

The report is arranged into eight chapters. Chapters 2 – 4 provide details on implementation of the PES; the overall methodology used is described in chapter 2; a description of how the fieldwork was implemented is given in chapter 3; and the post enumeration activities of matching, field reconciliation and processing of the data are explained in chapter 4.

On the other hand, Chapter 5, provides an analysis of the coverage errors of the rural-urban areas as well as regional differentials; the analysis of the content errors is presented in chapter 6; sampling errors and confidence intervals for estimates derived are presented in chapter 7; finally, chapter 8 summarizes the challenges and lessons learnt and provides the way forward.

CHAPTER 2: METHODOLOGY

This chapter describes the concept of the PES and methodology. Specifically, it outlines detailed information on PES concept, the sample design, the weighting procedure and the process used in developing the PES instruments.

2.1   Concept of Post Enumeration Survey

Population and housing census is an expensive and massive exercise which inevitably has inaccuracies arising from coverage and content errors. Coverage error is the error in the count of persons or housing units in form of omissions, erroneous inclusions and duplications due to defective field operations, carelessness of enumerators, misunderstanding, lack of cooperation of respondents or loss of census forms. Content error is an error in recording characteristics of those persons that were enumerated because of erroneous or inconsistent reporting, failure of enumerators to obtain or record accurately the required data and clerical and processing errors. To measure these errors and evaluate the data, Post Enumeration Survey (PES) is one of the methods used.

Due to paucity of data from other sources, PES is perhaps the most ideal method of census evaluation in developing countries, especially in sub-Saharan Africa. This is because alternative sources are not easy to use. For instance, civil registration systems are virtually nonexistence in most African countries and where they exist they are grossly incomplete to be of much use in evaluation. In addition, population surveys are carried out irregularly and are of limited use in evaluating censuses.

PES is an independent survey that replicates a census in sampled areas. The PES and census records are then matched (compared item by item) in terms of households, individuals in the households and characteristics. The results of the comparison are used to measure the coverage and content errors.

PES methodology was first used in USA and has since been applied in a number of censuses including USA censuses of 1950, 1960, 1980, 1990 and 2000. The main purpose of the PES after the first mentioned two censuses was to apply more rigorous methods of collecting data than those used in censuses to obtain better total population. In contrast, the emphasis of PES after latter censuses was on independence of PES from the census. In developing countries, India first used PES after the 1951 census, which was followed by those in 1961, 1971, 1981, 1991 and 2001.

The major purpose of PES is fourfold. The first purpose is to indicate to data users where specific coverage and content problems occur in the census data and to quantify these errors. Secondly, PES identifies difficult-to-enumerate subgroups and hard to capture characteristics of the population and erroneous procedures used in the census. The third purpose is to guide census planners in designing future censuses. Lastly, PES provides detailed information to be used in adjusting census data.

PES is used in dual and multiple system of evaluating census data. The dual system is where data from PES are matched with data from the census only, while the multiple system is where PES data are matched with data from several sources, such as the census, regular household survey and administrative records. A triple system is where PES data are matched with data from only two other sources, such as census and administrative records.

When PES is used in the dual system, the following four assumptions apply:

- Closed population: between the census and PES the number of external migrations are insignificant and the composition of the population remained relatively unchanged.
- There is independence between census and PES, i.e., different personnel manage the organization and field operations of the two exercises.
- There is absence of erroneous inclusions in either census or PES. Ideally the census population total and the PES population total are free from erroneous inclusions.
- No incomplete matches. Any failure to match the census and PES items should be due to actual omission and not to inability to match.

The primary purpose of PES is to measure census omissions, erroneous inclusions and duplications. In the dual system, data from PES is compared (matched) with census data. In case of individuals in households in the areas covered by both census and PES, the matching of person to person results into population showed by Table 2.1.

Table 2.1:   Estimation of Population in an Area

	In Census	**Out of Census**	**Total**
In PES	N_1	D	$N_1 + D$
Out of PES	C	N_2	$N_2 + C$
Total	$N_1 + C$	$N_2 + D$	Pop.

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Where:

N_1 = estimated number of persons counted in both Census and PES,

D = estimated number of persons counted in only the PES,

C = estimated number of persons counted in only the Census,

N_2 = estimated number of persons missed in both the census and PES

Hence:

$N_1 + C$ = the estimate of the total number of persons counted correctly in the Census.

$N_2 + D$ = the estimate of the total number of persons counted correctly in the PES.

$$\text{Pop} = \{ (N_1 + D) \} \{ (N_1 + C) \} / N_1 = \text{the estimate of the total number}$$
of persons.

PES has several common constraints:

- It is not usual that planning and management of PES is undertaken by independent staff as required;
- The design of PES, especially the matching and reconciliation stages are complex and needs a highly experienced person to carry it out efficiently.
- There is shortage of experienced staff to manage PES in most developing countries;
- There are difficulties of matching names, where individuals report different names;
- There is lack of unique physical addresses in the rural areas of developing countries needed for comparing names of individuals and households; and,
- Only a few countries have used the results of PES to adjust the census data.

2.2   PES Sample Design

In order to achieve the objective of providing quantitative information on census accuracy, the PES targeted all persons in Uganda living in private households. The population in institutions, floating and homeless population were excluded. A sample of the population was selected through a one-stage stratified cluster design and interviewed by use of a structured questionnaire. The detailed sampling design methodology is provided below.

(a)   Sampling frame
The Cartographic Section within UBOS carried out administrative area boundary mapping and delineation of the country into Enumeration Areas (EAs). The census 2002 EA

cartographic maps and census household counts (within the EAs) formed the sampling frame for the PES.

In order to allow better distribution of the sample among sub-strata and hence enhance precision of the estimates, the administrative units within each sub-stratum were listed in a serpentine manner. This was done in 3 stages namely:

    i.   Districts within the stratum

    ii.   Sub-counties within the district

    iii.   EAs within the parish

(b)   Levels of estimation

The population was divided into two major domains of study namely urban and rural. The urban stratum is constituted by 75 gazetted urban centers at different levels. Within the rural areas, the country is divided into four regions, each of which was considered as a separate stratum. The five strata were:

- Urban areas
- Rural Central
- Rural Eastern
- Rural Northern
- Rural Western

(c)   Sample size

The census EAs were the Primary Sampling Units (PSUs) and the PES aimed at achieving reliable coverage estimates for each main stratum. Thus, to determine the minimum sample size necessary for that purpose, the following formula was applied:

$n = \{t^2_\alpha \, pq\}/d^2$ Where:

n = sample size

p = universe proportion

q = 1 -p

d = desired level of precision (margin of error)

t_α = t-statistics value for the 95% confidence interval (= 1.96)

From previous experience, the margin of error and level of confidence were fixed at 0.03% and 95%, respectively, and p was assumed from variables closely related to coverage.

Other considerations were:

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- the need to maintain a minimum of 30 PSUs per stratum;
- the need to have, at least, two selections per sub-stratum;
- the need to reduce clustering effect, especially given that all households in sample EAs would be interviewed.

Using the criteria above, the total sample size for the PES was calculated as 350 EAs.

(d)   Distribution of EAs among strata
To enhance reliability, EAs were distributed among the strata according to measures of size (Probability Proportional to Size), where the size was the provisional Census Household Count. The distribution of the PSUs among the strata was as follows:

Table 2.2:   Distribution of Households and Primary Sampling Units among strata

Stratum	% Distribution of the Households	Number of Sample PSUs
Urban Areas		
Urban	14.1	52
Rural Areas		
Central	21.9	69
Eastern	22.9	80
Northern	17.6	67
Western	23.4	82
All Areas	**100.0**	**350**

(e)   Selection of PSUs and households
Each EA was accurately and uniquely identified together with the number of households. Within each stratum, the EAs (PSUs) were selected systematically with Probability Proportional to measures of size as illustrated below:

Let **I,** the sampling Interval be defined as;

$$I = M_h/a_h$$

where

M_h = cumulative total figure of all households in the hth stratum

a_h = desired number of sample EAs for the hth stratum

Taking R as the random start (a number between 1 and I), the sample EAs were selected as the EAs containing the Rth, R+Ith; R+2Ith, R+3Ith, …. R+(ah-1)Ith household on the cumulated list.

Complete canvassing of the selected EAs and interviewing all households is a requirement for coverage measurement. Thus, all households in selected EAs were interviewed and there was no sub-sampling.

2.3   Weighting procedure

The PES was based on a probability sample of 350 EAs and therefore the need to assign a sampling weight to each sample household and population in order to calculate the estimates for the population parameters. The sampling weight of a given EA is obtained as the inverse of the probability of selection of the EA.

The weight (W_{ij}) for the jth EA in the ith stratum is calculated as:

$$W_{ij} \equiv \frac{N_h}{n_{hx}N_{ij}}$$

Where

N_{ij}	=	Total number of households in the jth EA in the ith stratum
n_h	=	Number of selected EAs in the hth stratum
N_h	=	Total number of households in the h_{th} stratum

Since all units within the EA were covered, the same EA is applied to each household and individual within an EA.

The derived weights were applied in obtaining estimates of coverage, but were not used in obtaining content indices.

2.4 PES Instruments

The PES involved two major instruments namely the PES Questionnaire and the Enumerator's Instructions Manual. Also developed were material control forms. However, because of the experience from the main census, it was decided that the Summary Sheets were to be compiled in the office.

2.4.1   Questionnaire
The initial draft of the PES questionnaire was designed by the Census Technical Office and further revised by the PES technical working group (TWG), and finally approved by the census technical and advisory committee (CTAC).

The questionnaire was designed such that it captured main elements for measurement of coverage and content. Only a few elements from the main census questionnaire, which

are not likely to change within a short period, were retained. The selected variables for the PES questionnaire included:

- Full name
- Relationship
- Sex
- Age
- Religion
- Ethnicity
- Marital Status
- Existence of an Agricultural Holding

For purposes of matching, information on agricultural holding and ethnicity were not used. The structure and content of the questionnaire is outlined below. It has five main sections namely:

The Cover page (showing Identification Particulars down to the LC I, Enumeration details, Data Processing Information and Summary Information)
Section 1: Identification section
Section 2: Household Matching Particulars
Section 3: Characteristics of Household Members
Section 4: Characteristics of the Out movers
Section 5: (Agriculture Section)

A copy of the questionnaire and cover page is given in Appendix 2.

2.4.2 Enumerators' manual and Maps

Alongside the development of the PES questionnaire, an Enumerators' Instructions Manual was developed, and contained concepts and enumeration procedures.

After selection of the sample EAs, EA maps were reproduced by the cartographic section of UBOS, and given to each enumerator before being trained on how to use them. The maps were used for boundary identification and to guide enumerators in covering the selected EAs without omission or duplication.

CHAPTER 3: FIELDWORK

After the initial preparations for PES (questionnaire design, preparation of enumerators instruction manuals, sample selection and preparation of EA maps) field activities were initiated. This chapter describes how staffing, recruitment, training, publicity, field logistics and enumeration were done and the associated challenges.

3.1 Staffing, Recruitment and Training

3.1.1 Staffing and Recruitment
The qualities of staff recruited and training have a big bearing on the quality of work obtained from the field. It is very important therefore to recruit high quality staff who should undergo adequate training. The PES fieldwork started with the identification of zonal supervisors from UBOS regular staff who were responsible for the training of District Post Enumeration Survey Officers (DPESOs), Assistant District Post Enumeration Survey Officers (ADPESOs) and Enumerators. The DPESOs and ADPESOs were appointed by UBOS after being recommended by their respective Chief Administrative Officers. The ADPESOs were appointed to help the DPESOs where districts had nine or more EAs selected for the PES. Fifty-one of the 55 DPESOs were former district Census Officers (DCOs).

The recruitment of the PES enumerators was carried out by the DPESOs in early January 2003. The enumerators were recruited for the 350 EAS spread over 55 districts excluding Kalangala. To avoid double counting or omission, one enumerator was expected to cover an EA. However, EAs exceeding 250 households had more than one enumerator recruited so as to enable the work be completed within the stipulated time. A total of 429 enumerators were recruited mostly from the Census 2002 better qualified enumerators. These were recruited from the parish where the selected EAs belonged but organizers were to ensure that they did not work in the same EAs as for the census.

3.1.2 Training
Training was undertaken to update the participants on PES data collection procedures and reading of EA maps. The training exercise began by Training of Trainers who were officers of UBOS who had participated as district Supervisors/Trainers.

The training of DPESOs, ADPESOs and Enumerators was carried out at zonal level. The following were identified as the training centres for the zones: Mukono, Masaka, Mbarara, Kabarole, Arua, Soroti, Iganga, and Lira. The training lasted for a period of two days.

The training began with the debriefing of the DPESOs and ADPESOs at their respective training venues. This covered operational and administrative procedures since they were going to participate in the joint training with the enumerators. Also, the training programme included one field day for the enumerators to familiarize with their EAs.

3.2 Publicity

A standard message was put on local radios informing people about the intention of the PES and dates of enumeration and this was to ensure that people could not confuse the PES exercise with census. Local languages were used to inform the community in the areas covered by the PES and what was expected of them, and this played a vital role in publicizing the exercise.

In addition to the radio announcements, LCs distributed handbills to all households in the selected EAs and mobilized the community prior to enumeration.

3.3   Field Logistics and PES Enumeration

The PES training and enumeration materials were delivered to the training venues by the zonal supervisors/trainers. Similarly, both used and unused materials were carried back to UBOS from the districts by the zonal supervisors.

The PES materials used during the exercise were distributed to the enumerators during training and this enabled them to fill in the identification particulars and it also eliminated the problem of distributing the materials before the start of the exercise.

The PES fieldwork lasted 5 days. However, in a few districts, the enumeration took longer than expected because some EAs were large. All persons who slept in that particular household the night before were enumerated. In addition, information was collected about those who were enumerated in that household during the 2002 census but did not stay in the household during the reference night (out mover).

Supervision of PES fieldwork was carried out at three levels; national, zonal and district. At the district level, the DPESOs and their Assistants supervised the exercise. Each zonal supervisor looked after, at least, three districts. Senior Officers from UBOS carried out the national level supervision.

3.4   Challenges

During the main census, DCOs zoned out EAs that were reflected in the sampling frame. Where such EAs were selected, their maps did not exist and identifying their boundaries was a problem. Similarly some maps for the selected EAs had problems and enumerators had to depend on the LCs (guides) for boundary identification.

Secondly, some selected enumerators did not report for training on the scheduled date. Special arrangements were made to train those who never turned up, but such training was difficult to monitor.

Thirdly, UBOS did not have direct control over staff recruitment to an extent that in some areas the recruited enumerators had worked in the same EAs selected for the PES. This compromised the independence of the PES from the census.

Due to insecurity, some people had moved from the selected EAs to the camps for Internally Displaced Persons (IDPs) while in other areas, where the security situation had improved people had moved from camps to their places of origin. Unfortunately, some of the selected EAs fell in refugee camps where the population is always fluctuating.

CHAPTER 4: MATCHING AND PROCESSING OF DATA

This chapter describes the methodology used in matching census 2002 PES records with census records, the data processing procedure applied and the field reconciliation exercise. The challenges faced during the process of implementing the exercises are also presented.

4.1 Staffing and Training

A one-week training session on matching procedures facilitated by the CST/UNFPA was conducted in April 2003 for the census technical office staff. The staff later participated in the training of matching clerks, data entry clerks and reconciliation clerks.

A total of 30 matching clerks, 3 matching supervisors and 4 data entry clerks were recruited in September 2003 to implement the PES matching and data capture process. They received training in matching procedures. After mastering the matching techniques, the data entrants were later released and trained to capture 2002 PES data.

Following the review of the workload and progress of the matching and data entry activities, it was decided to recruit and train 6 more matching clerks in data entry. They were reassigned duties from matching to data entry in November 2003. Also, 10 more data entrants were recruited after that.

Reconciliation clerks were selected from the matching clerks bearing in mind the local language. These clerks were briefed for a period of 1 day on the process of field reconciliation.

4.2 The Matching Exercise

4.2.1 The process

Matching was implemented with the aim of determining whether a PES household/individual was enumerated in the census by comparing the individual PES characteristics and census characteristics.

In January 2003, the PES consultant designed the methodology for matching the field returns of the PES with those of the Census and also developed a manual of matching instructions. These matching guidelines were developed and later reviewed by the CST/UNFPA International expert together with the PES working team.

The matching clerks were divided into teams of three each with a team leader who was responsible for allocation of work to individuals within the team. Team members first matched households and then matched individuals within the matched households.

Matching of households involved comparing the names of Administrative units, census household numbers and the names of household members therein.

In matching households, team leaders were responsible for PES questionnaire booklets. Starting from the first listed PES household the team leader read loudly the census number and names of household members. The team members checked for the census number and similar names in the census household questionnaire booklet. The households were judged as matching if name(s) in the census questionnaire were similar to the name(s) in the PES questionnaire with minor spelling differences. The household head name and/or spouse were adequate for deciding whether the household matched or not. The matching PES household questionnaire was removed from the PES questionnaire and clipped to the corresponding census questionnaire. Where more than one PES households matched one census household and vice versa, the matching households were clipped together. Where names of household members somehow agreed the cases were taken as possible matches. The matching clerks referred possible matches to supervisors to decide whether they were matches or non-matches. The following were the distinct categories in the matching of households:

      (a)   Matched households;
      (b)   Households, which were non – matches;
      (c)   Households, which were created after the main census.

After matching households in a specified EA, each team member was assigned PES and census books to match individuals. The person's name and the four characteristics; relationship, age, sex and marital status were used to determine whether the individual matched. Persons above 10 years and having at least three of the above characteristics similar were considered to match. For people below 11 years, relationship, age and sex were the variables considered in matching and if at least two of them were similar, the person was taken to be matching. Table 4.1 shows the age tolerance limits used when matching individuals.

Table 4.1:   Age Tolerance limits used in matching individuals

Age	Tolerance (in years)
Under 10 years	± 1
10 to 20 years	± 2
20 to 40 years	± 3
Over 40 years	± 4

Matching clerks then transcribed information from the census questionnaires to the PES questionnaires and assigned the matching and moving status codes for individuals who were appearing in both questionnaires. Where the entire census household was not in the PES, the census information was transcribed from the census questionnaire to a blank PES questionnaire pending field reconciliation. The PES matching supervisors verified all the matched cases. This was necessary to minimize mistakes committed by the matching clerks.

The distinct categories assigned to individuals in the matching operation were

> Match;
> Non-match
> Born after census

4.2.2   Failure to locate some Census EAs during matching
Although 350 EAS had been sampled, 5 Census EAs couldn't be found from the data processing centre stores during the time of matching rendering it impossible to match them with the corresponding PES records and later failing to capture them.

These EAs were distributed among strata as shown in table 4.2

Table 4.2:   Distribution of missing EAs during matching by strata

Strata	No of EAs	District	County	Sname	Parish	LC1
Rural Central	2	Mubende	Kassanda	Kassanda	Bweyogedde	Mayikiti 'A'
		Wakiso	Busiiro	Kakiri	Kamuli	Ddambwe
Rural Eastern	1	Kumi	Ngora	Kapir	Kapir	Atiira
Rural Western	2	Mbarara	Kashari	Rubaya	Nyabuhama	Nyaruhanga
		Kamwenge	Kitagwenda	Ntara	Kabale	Kyabatimbo

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PES records matching, generation of PES analytical tables and the writing of the PES report were done before the exercise of stores audit.

To ascertain whether enumeration took place in the affected EAs, a search was carried out at the data processing centre after the stores audit exercise. All the five 5 were discovered. However a sample of 345 EAs was found to be representative enough rendering it useless to match the 5 EAs. This was because the addition of the 5 EAs couldn't have had a significant effect on the results and already the PES report had been produced by this time.

4.3   Field Reconciliation

During the process of office matching, it was discovered that a number of households/individuals enumerated in the census could not correspond with households/individuals enumerated in the PES. Likewise, a number of households/individuals enumerated in the PES could not correspond with census households/individuals. Hence the main purpose of reconciliation visits was to identify suspected erroneous enumerations, defined as:

Persons enumerated in the EA (during census) but reported by the PES as not staying in the EA and vice versa.

Specifically, the reconciliation visits were to establish the status of:

- Households/individuals enumerated in the census but not in the PES
- Households/individuals enumerated in the PES but not in the census
- Individuals who could not be matched after applying the established matching rules

Based on the findings, it was determined whether these persons were the PES erroneous enumerations or genuine census erroneous enumerations.

Due to time and resource constraints, a sample of cases requiring reconciliation was selected from the total number of cases. In selecting sample EAs for reconciliation, some areas were deliberately excluded. These included:

- Districts experiencing insecurity and mobile Populations: These included Gulu, Kitgum, Pader, Lira and Apac districts
- Areas with relatively high match rates
- EAs where it was not possible to retrieve all corresponding census questionnaires.

The PES field reconciliation exercise was carried out in two phases. The 1st phase comprised 9 teams while the second phase consisted of 7 teams. Each team was in charge of a zone consisting of 3-5 districts.

All the four regions were represented during field reconciliation. A total of 105 EAs out of 350 were selected for the exercise. The distribution of EAs by strata for field reconciliation is given in Table 4.3.

Table 4.3:   Distribution of EAs among strata

Stratum	Number of EAs
Urban	18
Central Rural	26
Eastern Rural	24
Northern Rural	11
Western Rural	26
Total	**105**

The un-weighted cases of matched and Non-matched cases are as indicated in Table 4.3.

Table 4.4:   Un-weighted Number of matched and non-matched cases

Stratum	Total	Match	Non-Match
Urban	18,813	18,649	164
Rural Central	37,288	37,080	208
Rural Eastern	54,612	54,387	225
Rural Northern	41,676	41,402	274
Rural Western	57,129	56,838	291
Total	209,518	208,356	1,162

These values differ slightly from the values in chapter six because the absent heads are not included in this section while they are included in chapter six.

4.4   Data Processing

Data capture was carried out using the Census and Survey Processing (Cspro) software. To minimize errors in the data capture, data entry verification was maintained at 100% throughout the exercise. Cspro was also used to generate the initial tables. The initial tables were exported from Cspro to Stata and Microsoft Excel in order to produce the final tables for the report.

4.5   Challenges

Owing to financial constraints, payments to matching clerks were often delayed. This led to reduced morale among these categories of staff.

Secondly, due to insecurity in the districts of Apac, Lira, Gulu, Kitgum and Pader during the time of field reconciliation, EAs from those districts were not considered for field reconciliation. Although a reconciliation team was sent to Karamoja area, because of the insecurity in the area, it was not possible to reconcile all households allocated to the team.

Thirdly it was not possible to retrieve all census books for 4 EAs because the matching exercise was implemented before the DPC stores audit operations. This eventually led to low match rates in the effected areas leading to 'artificial' low coverage rates in these EAs.

Lastly, locating of households especially in urban areas and Karamoja sub-region was hard during the reconciliation process. A number of households had migrated during this period. This was attributed mostly to the long time lag between the census enumeration and the reconciliation process. This contributed to a higher rate of un-seen households in the affected areas.

CHAPTER 5: COVERAGE ERROR EVALUATION

Census coverage was evaluated by examining errors in the count of persons or households. These errors are due to omissions, erroneous inclusions and duplications because of defective field operations, carelessness of enumerators, misunderstanding, lack of cooperation of respondents or loss of census forms. The errors are estimated by using matched population, census population, PES population, census omissions, omission rate, coverage rate, erroneous inclusions rate, true population, net coverage error, net error rate and gross coverage error. The formulas used to calculate these rates are described below. This chapter presents the results of applying these formulas to the census and PES data.

5.1   Definition of Indicators of Coverage Evaluation

The following concepts and symbols were adopted for the calculation and presentation of coverage indicators.

a = total number of non-movers

b = total number of out-movers

c = total number of in-movers

d = total number of matched non-movers

d^1 = the compliment of the total matched non-movers

e = total number of matched out-movers in the universe

f = total number of matched in-movers

g = total number of census erroneous inclusions in the population

h = total number of census cases correctly enumerated in the census but missed in the PES

Matched Population = Matched non-movers + matched in-movers
                                = d + f

Census Population = d + e + g + h

PES Population = a + c

Census Omissions = (a +c) − (d +f)

Coverage Rate = Matched Population
                          PES Population

Erroneous Inclusion Rate = <u>Erroneous inclusions</u>
                                       Census population.

True Population = <u>Census Population – Erroneous inclusions</u>
                                   Coverage Rate

Net Coverage Error = True Population – Census Population

Net Coverage Error Rate = <u>Net Coverage error</u>
                                      True Population

Gross Coverage Error = Omissions + Erroneous Inclusion

Gross Coverage Error Rate = <u>Gross Coverage Error</u>
                                       True Population

All the rates were computed from unweighted sample data and are presented in form of percentages in this chapter.

5.2   Census Coverage

The national coverage rate was the ratio of matched population to the PES population, and matched population was the sum of matched non-movers and estimated matched in movers; like wise, PES population was the sum of non-movers and in movers. The levels of estimates on coverage rate, omission rates, erroneous inclusions, gross coverage rate and net coverage rates are given in Table 5.1 below.

The national coverage rate was 94.4 percent while the omission rate, which was the ratio of the difference between the PES population and the census population to the PES population, was 5.6 percent. The erroneous inclusion rate, which was computed from the ratio of the erroneous inclusions to the census population stood at 3.7 percent. The gross coverage rate, which was calculated from the ratio of the sum of omissions and erroneous inclusions and the true population, was found to be 8.9 percent.   The national net coverage error rate was on the other hand 2.1%. The coverage estimates compares favourably with results from other countries in the sub-region.

The National coverage rate was 94.4%

5.3   Differentials in coverage rates

There was no significant difference in coverage rate between the males and females. The urban coverage rate (88.6%) was lower than that of the rural areas (95.0%). There was some difference among rural strata. The rural northern had the lowest coverage rate of 93.6% while the rural Western had the highest coverage rate of 96.1%.

Urban coverage rate was lower than the rural coverage rate

Table 5.1: **Estimates of the Coverage rates**

	Coverage rate	Omission rate	Erroneous Inclusion rate	Gross coverage Error rate	Net coverage Error rate
National	94.4	5.6	3.7	8.9	2.0
Age group					
0-4	94.4	5.6	4.0	9.5	1.7
5-9	96.1	3.9	2.8	6.6	1.2
10-19	94.8	5.2	3.3	8.2	2.0
20-39	92.4	7.6	4.7	11.9	3.1
40+	95.4	4.4	2.6	6.6	1.8
Sex					
Male	94.7	5.3	3.7	8.5	1.6
Female	94.2	5.8	3.7	9.2	2.5
Residence					
Urban	88.6	11.4	8.8	20.3	2.9
Rural	95.0	5.0	3.3	8.2	1.7
Strata					
Urban	88.6	11.4	8.8	20.3	2.9
Rural Central	94.1	5.9	1.0	5.6	4.9
Rural Eastern	95.7	4.3	2.7	6.7	1.6
Rural Northern	93.6	6.4	5.9	11.2	0.6
Rural Western	96.1	3.9	1.5	5.5	2.4

The age groups category 20 - 39 had the lowest coverage rate of 92.4% followed by 0 - 4 with a coverage rate of 94.4% because the former is a mobile category while the latter tend to be forgotten.

The urban omission and erroneous inclusion rates were, 11.4% and 8.8%, respectively. On the other hand, the rural omission and erroneous inclusion rates were 5.0% and 3.3%, respectively. The differences affected the urban gross coverage error rate and net error rate, which were highest at 20.3 percent and 2.9% respectively.

Rural Western had the lowest omission rate (3.9 percent), erroneous inclusion (1.7 percent) rate and gross coverage error rate (5.5 percent).

The net error rates were higher in urban areas than rural areas. There was no significant difference in net coverage error rates among the rural areas, which were generally low on average.

5.4   Population Estimates

The sample population estimates are shown in table 5.2. The PES population National estimate which is the sum of nonmovers and inmovers is 24,731,466 with 12.0 million males and 12.8 million females.

Table 5.2:   Population Estimates

	PES Population	Census Population	True Population
National	24,731,466	25,206,696	25,738,549
Age group			
0-4	4,200,510	4,305,089	4,380,172
5-9	4,195,659	4,273,486	4,323,819
10-19	6,419,971	6,526,628	6,661,157
20-39	6,291,883	6,440,653	6,643,580
40+	3,623,445	3,665,500	3,733,077
Sex			
Male	11,974,406	12,298,387	12,502,286
Female	12,757,060	12,908,309	13,236,263
Residence			
Urban	2,647,057	2,815,372	2,899,306
Rural	22,084,409	22,391,324	22,839,243
Strata			
Urban	2,647,057	2,815,372	2,899,306
Rural Central	4,454,320	4,347,525	4,573,902
Rural Eastern	6,300,023	6,394,583	6,496,703
Rural Northern	5,583,955	5,961,286	5,996,642
Rural Western	5,746,112	5,687,930	5,827,791

The dual system methodology gives estimated total population as 25,738,549 comprising of 12.5 males and 12.2 females while the census gives a population of 25,206,696.

CHAPTER 6: CONTENT ERROR EVALUATION

Content errors are errors in recording characteristics of persons who are enumerated both in the census and PES. These errors may arise out of mistakes in data processing, interviewer bias, respondents' bias, unclear questionnaire and misreporting. Five measures used in analysing the data are the rate of agreement, net difference rate, index of inconsistency, aggregate index of inconsistency and gross difference rate. This chapter presents the findings on the five measures with respect to five characteristics, namely sex, age, relationship, marital status and religion. The results are presented at national, urban-rural residence and region.

6.1   Rate of Agreement

The rate of agreement indicates the level at which the information given in the Census matches that given during the PES. A low rate of agreement indicates a high degree of variability and vice-versa. The rate of agreement is therefore a good measure of the gross error for an item.

The Rate of Agreement (RA) is given by the following formulae:

$$RA = \frac{1}{n} \sum_{i=1}^{c} Y_{ii} \times 100$$

Where Y_{ii} =   number of cases where category i was given as response in both Census and PES

n =   The total number of PES cases for which there was a report in both census and PES

c =   Number of categories for a given characteristic

Table 6.1: **Rate of Agreement by characteristics, residence and Region**

	Sex	Relationship	Age	Religion	Marital Status
Overall	98.00	86.11	70.74	87.59	84.62
Residence					
Rural	98.06	86.71	70.57	87.68	84.71
Urban	97.29	79.87	75.69	86.62	83.71
Region					
Central	97.96	85.96	73.39	87.15	84.90
Eastern	98.53	87.14	70.79	85.38	84.78
Northern	97.78	85.33	64.41	87.02	83.02
Western	97.90	87.78	73.08	90.74	85.78

Rate of
agreement
highest for sex
at 98.0%

Table 6.1 shows that at the national level, the rate of agreement was highest for sex at 98.0%. This result is expected because sex of individuals does not change at all. A similarly high rate of agreement has been obtained in Zambia (96.2% for 1990 Census). The 2% variations for sex could have arisen from enumerators' mis-recording or confusing names that are shared by both sexes, or during data entry.

Rate of
agreement
lowest for age
at 70.7%

Other variables resulted in lower rates of agreement than sex. Relationship, religion, and marital status, which are fairly stable variables had rates of 86.1%, 87.6% and 84.6% respectively. Not surprisingly, the rate of agreement for age was the lowest at 70.7% because of variability of age. Similarly, the PES of Gambia in 1993 and Zambia resulted in low rate of agreement on age of 77% and 79% respectively.

As expected the rural-urban variation in the rate of agreement is not much. The rural respondents showed a slightly higher level of agreement than the urban people on all variables except age. The higher rate of agreement on age for the urban could be due to the higher level of education.

6.1.1   Regional Differentials

Age showed the widest variation in rate of agreement ranging from 64.4% in Northern region to 73.4% in Central. Otherwise small variations in the rate of agreement were observed at the regional level for other characteristics, such as relationship to the head of household, age, marital status and religion, with Western region recording the highest and Northern the lowest.

6.2   Gross Difference Rate (GDR)

The Gross difference rate (GDR) is the complement of the rate of agreement. It measures the percentage of responses reported/recorded differently to questions asked by Census enumeration and PES. The formula used is:

GDR = 100 – RA.

6.3   Net Difference Rate (NDR)

The NDR approximates the level of under reporting or over reporting for each response in the Census and the PES relative to the total number of matched persons in all response categories.   It can be interpreted as a measure of the bias only when the PES is considered to have been more accurate closer to the true value than the original response.

The NDR is calculated using the formula;

$$NDR = \frac{Y_{ci} - Y_{pi}}{N_m} \times 100$$

Where,

Y_{ci} = Un-weighted Census number of cases in the i th category,

Y_{pi} = Un-weighted PES number of cases in the i th category,

N_m = Un-weighted number of matched cases.

Table 6.2 shows the NDR of various characteristics. It can be seen from the table that on average, almost all categories were either under or over reported by less than one percent with a few cases, which were about two percent.

Sex is highly accurately reported, with a tendency of males being under reported while the females are over reported. In the categories of relationship household head, spouse and

Sex highly accurately reported

other relative were over reported varying from 0.02 to 0.5 percent and the rest were under reported by less than one percent. The over reporting of the household head in urban areas of 0.3% is more than any of the four rural regions of Central, Eastern, Northern and western which recorded –0.06%,-0.1%, 0.06% and 0.12% respectively. Anglican Protestant response was over reported in the rural than urban areas. Catholics and Moslems were on average under reported both in the rural and urban areas by less than one percent as shown in Appendix C.

Table 6.2 also shows that 'never married' and 'not applicable' categories under marital status and '0 to 4' age group were the only ones over or under reported on average by about two percent among all the categories probed by the PES. The high NDR of ' Not applicable' being reflected under marital status categories can be partly attributed to the change of the age from below 10 years during the Census to above 10 years during the PES enumeration and general age misreporting.

The 'currently married/cohabiting/ monogamous' response was over reported and 'currently married/cohabiting/ polygamous' under reported in urban areas by about one percent. This pattern could be due to some respondents misunderstanding the definition of the two categories and reporting one for the other.

6.4   Index of Inconsistency

The index of Inconsistency (I) is the ratio of the Simple Response Variance (SRV) to the total variance for a given item. It is computed for each response category i according to the formula below:

$$I \equiv \frac{(y.i - yi. - 2yii)}{\frac{1}{n}[y.i(n - yi.) + yi.(n - y.i)]} * 100$$

The Aggregate Index of Inconsistency (IAG) is a summary measure of the index of Inconsistency (that is for all the response categories of the characteristic as a whole). The computation formula is as follows:

$$IAG \equiv \frac{\left(n - \sum_{i}^{c} yii\right)}{n - \frac{1}{n}\sum_{i}^{c} y.iyi.} X100$$

The category specific Indices are given in Appendix C. At national level very little inconsistency is observed in the reporting of sex with the index of Inconsistency being only 4%. Under relationship the head had the lowest index of inconsistency of 8% and the step child the highest of 82%. The low index of inconsistency for the head category can be partly attributed to the fact that the household head rarely changes and is always known. The marital status indices varied from 14% to 53%, religion from 5% to 102% and age from 8% to 24%.

A review of all indices showed on average slightly higher indices in the urban areas compared to the rural areas except in the case of age. This means that rural areas were more consistent than the urban areas in reporting individual characteristics. However, for age, the urban areas show a reversed trend with only 40+ having a higher index. This is an indication that the urban population is much more consistent in reporting of age than the rural population.

At the regional level, the Eastern region showed a much lower inconsistency in reporting of sex (3%) compared to the other regions, which have indices greater than 3%. The inconsistency in reporting of marital status was lowest for the categories of never married and married monogamous.

Table 6.2:   Net Difference rate and Index of Inconsistency by characteristics

	Number of Cases in PES	Number of Cases in Census	Net Difference rate	Index of inconsistency
Sex				
Male	105,867	106,050	-0.09	3.971
Female	107,223	107,040	0.09	3.967
Relationship				
Head	45,052	44,978	0.03	7.9
Spouse	32,455	32,407	0.02	8.9
Child	108,951	109,563	-0.29	11.1
Step Child	3,922	4,069	-0.07	82.1
Parent of Head or Spouse	1,037	1,080	-0.02	48.8
Brother/Sister of Head or Spouse	3,683	4,011	-0.15	54.2
Other relative	16,213	15,109	0.52	44.1
Non-Relative	1,411	1,507	-0.05	53.8
Marital Status				
Never Married	5,382	5,324	-1.88	22.2
Currently Married/Cohabiting (Monogamous)	5,135	5,363	0.73	17.5
Currently Married/Cohabiting (Polygamous)	610	418	-0.49	45.5
Widowed	529	534	-0.29	30.4
Divorced/Separated	708	552	-0.39	52.7
Not Applicable	5,063	5,236	2.32	13.8
Religion				
Catholic	90,288	90,520	-0.11	14.9
Anglican Protestant	78,840	77,501	0.63	18.0
SDA	2,289	2,564	-0.13	32.4
Pentecostal	9,634	10,252	-0.29	39.8
Moslem	24,013	24,168	-0.07	5.0
Others	6,841	6900	-0.03	102.1
Age groups				
0-4	35,514	38,964	1.63	11.93
5-9	35,821	35,017	-0.38	24.10
10-19	53,987	51,892	-0.99	15.53
20-39	54,402	53,962	-0.21	11.63
40+	32,500	32,389	-0.05	8.37

Table 6.2 gives the index of Inconsistency for all PES variables. For the relationship categories for Uganda as a whole, the Index of Inconsistency for household heads is 7.9%. Equally low levels of inconsistency are observed for the spouse and children.

However, for the other categories of relationship, the indices are high, higher than 100% for the other religion. These very high indices are mainly due to the low numbers of consistent persons in these categories.

On the other hand, the age bracket of 5 - 9 shows the highest level of inconsistency of 24%. This means that nearly one quarter of responses for this age bracket for the matched records were inconsistent. The table shows a decreasing level of the indices as the age increases up to 40+ years.

The Index of Inconsistency for the religious affiliation categories shows the Moslems having the lowest level of inconsistency of 5%. This is followed by 15% for the Catholics and 18% for the Anglicans. The "other" category with small proportions of the population show high levels of inconsistency with the index of more than 100%.

Considering the marital status categories, the married monogamous showed the lowest level of inconsistency of 18% followed by the Never Married. The divorced/separated and the married polygamous have the highest rates of 53 and 46 percent respectively.

CHAPTER 7: POST ENUMERATION ESTIMATES AND SAMPLING ERRORS

The PES was a sample survey. A sample survey is affected by two types of errors, that is sampling errors and non-sampling errors, mainly because only part of the population is considered. An acceptable sample for statistical analysis must represent the population and must have measurable reliability. The measurable reliability enables proper interpretation of the findings. It is upon this understanding that estimates and sampling errors have been generated.

This chapter presents the concept of standard errors and confidence intervals, and their estimates. Standard errors and confidence intervals of estimates of coverage and content errors are presented in this chapter to assist the interpretation of the results. Also presented is the design effect. The design effect gives the ratio of the variance of the estimate to the corresponding variance of the estimate from a simple random sample. The above estimates were computed using STATA software.

7.1   Concept of Standard Errors and Confidence Intervals

Standard errors are measures of the spread of the sampling distribution. They measure the variability of the sample estimates. The Census 2002 PES sample was a single stage stratified cluster sample. If the Population estimate is given by:

$$Y_h = \sum_{i=1}^{n_h} \sum_{j=1}^{m''_{hi}} W_{hi} Y_{hij}$$

where $$Y_{hi} = \sum_{j=1} W_{hi} Y h_{ij}$$

Then the standard error of the estimate is given by:

(i) $$SE[Y] = \left[\sum_{h=1}^{L} \frac{n_h}{n_h - 1} \sum_{i=1}^{n_h} (Y_{hi} - \frac{Y_h}{n_h})^2 \right]^{1/2}$$

Where

L=Number of Strata;

n_h= Number of Sample EAs selected in the hth Stratum;

Y_{hij}=Value of variable Y for the jth sample household (or person) in the ith sample EA in the hth stratum;

m"hi= Number of households with completed PES interviews in the ith sample EA in the hth stratum;

W'hi= Adjusted weight for households in the ith sample EA in the hth stratum

The sampling errors for Census 2002 PES ratios, rates and percentage estimates are given by the formula indicated below:

$$(ii) \ \ S.E(R) = \ \ \{ \ \frac{1}{X^2}(V(Y)+R^2V(X)-2RCov(X,Y) \ \}^{\frac{1}{2}}$$

Where

$$Cov(Y,X) = \sum_{h=1}^{L}(\frac{n_h}{n_h-1})\sum_{i=1}^{nh}(X_{hi}-\frac{X_h}{n_h})(Y_{hi}-\frac{Y_h}{n_h})$$

and V(Y) and V(X) are variances of PES survey estimates of totals in (i) above and

$$R = \frac{Y}{X}$$, Y and X are weighted total estimates.

Confidence intervals were generated for the estimates at 95% confidence levels. The formulas below were used to derive the lower and upper limits of the intervals:

Lower limit=Value of estimate-2xStandard error

Upper limit=Value of estimate+2xStandard error

(iii) Confidence Intervals of Net Difference Rate, Index of Inconsistency and Aggregate Index of Inconsistency

Confidence intervals were also computed for content error measures namely NDR, Index of Inconsistency and Aggregate Index of Inconsistency. The formulae are given below:

(a) The 95% Confidence Interval for the Net Difference Rate is given by

$$CI \equiv \frac{(y_{.i} - y_{i.}) \pm 2\sqrt{y_{.i} + y_{i.} - 2y_{ii} + 1}}{n} X(100)$$

(b) The 95% Confidence Interval for Index of Inconsistency for category i was obtained as

$$CI \equiv \frac{(y_{.i} + y_{i.} - 2y_{ii} + 2) \pm 2\sqrt{y_{.i} + y_{i.} - 2y_{ii} + 2}}{y_{.i}\left(1 - \frac{y_{i.}}{n}\right) + y_{i.}\left(1 - \frac{y_{.i}}{n}\right)} X(100)$$

(c)The 95% Confidence Interval for Aggregate Index of Inconsistency for category i was obtained as :

If $\left[\dfrac{n - \sum\limits_{i=1}^{c} Y_{ii}}{n}\right] \leq$ .10, ninety-five percent confidence limits are:

$$\frac{\left(n - \sum\limits_{i=1}^{c} Y_{ii} + 2\right) \pm 2\sqrt{\sum\limits_{i=1}^{c} Y_{ii} + 1}}{\left(n - \dfrac{1}{n}\sum\limits_{i=1}^{c} Y_{.i}Y_{i.}\right)} x(100)$$

If $\left[\dfrac{n - \sum\limits_{i=1}^{c} Y_{ii}}{n}\right] >$ .10, ninety-five percent confidence limits are:

$$\frac{\left(n - \sum\limits_{i=1}^{c} Y_{ii} + 2\right) \pm 2\sqrt{\dfrac{1}{n}\left(n - \sum\limits_{i=1}^{c} Y_{ii}\right)\left(\sum\limits_{i=1}^{c} Y_{ii}\right)}}{\left(n - \dfrac{1}{n}\sum\limits_{i=1}^{c} Y_{.i}Y_{i.}\right)} x(100)$$

(v) $Deff[X] = SampleVar(X)/Sample(SRS(X)$

Where SRS refers to the Simple Random Sampling.

The design effect (Deff) compares the variances of the estimates of a given sample design with simple random sampling. It is one of the measures that compare the efficiency of the estimates from simple random sampling with other sample designs.

7.2   Estimates of Reliability

The drawing of the sample for the PES was a single-stage stratified cluster sampling. All units (households) were grouped into clusters and a sample of clusters (Enumeration areas) were selected.   All households in the selected enumeration areas were enumerated. The measures of variability are calculated for selected estimates as shown in Table 7.1

Table 7.1:   **A list of PES estimates selected for computation of sampling errors**

Estimate	Type of Estimate	Derivation
PES Population	Population	Total Nonmovers+Total inmovers
Coverage rate	Percentage/ratio	Matched Population/PES Population
Omission rate	Percentage/ratio	Non-matched Population/PES Population

The standard errors, relative standard errors, 95% confidence intervals and design effect associated with the above estimates are presented in Tables 7.2, 7.3 and 7.4 for the national, urban centers and rural areas, respectively.

Table 7.2:   **Reliability of Estimates Based on Selected Indicators at National Level**

Variable	Estimate	Standard Error	Relative standard error	Confidence interval		Design Effect
				Lower	Upper	
PES Population	24,731,466	597,879	0.024	23,535,708	25,927,224	0.627
Coverage rate	0.944	0.008	0.008	0.928	0.960	1.406
Omission rate	0.056	0.008	0.143	0.040	0.072	1.406

The national census coverage and omission rates were 94.4% and 5.6% respectively and their standard error was 0.008.

Table 7.3:   **Reliability of Estimates Based on Selected Indicators For Urban Areas**

Variable	Estimate	Standard Error	Relative standard error	Confidence interval		Design Effect
				Lower	Upper	
PES population	2,647,057	219,786	0.083	2,207,485	3,086,629	0.243
Coverage rate	0.886	0.03	0.034	0.826	0.946	1.279
Omission rate	0.114	0.03	0.263	0.054	0.174	1.279

The 95% confidence limits for the census coverage of 0.926 to 0.960 implies that there was a high probability of 95% that the true census coverage rate was between 92.6% and 96.0%. The confidence limits for the estimates at the sub national levels can be interpreted in the same manner.

Table 7.4: Reliability of estimates Based on Selected indicators for rural Areas by Regions

Rural Central

Variable	Estimate	Standard Error	Relative error	Confidence interval		Design Effect
				Lower	Upper	
PES population	4,454,320	222,196	0.05	4,009,928	4,898,712	0.159
Coverage rate	0.941	0.02	0.021	0.901	0.981	1.504
Omission rate	0.059	0.02	0.339	0.019	0.099	1.504
Rural Eastern						
PES population	6,300,023	251,231	0.04	5,797,561	6,802,485	0.123
Coverage rate	0.957	0.009	0.009	0.939	0.975	1.114
Omission rate	0.043	0.009	0.209	0.025	0.061	1.114
Rural Northern						
PES population	5,583,955	400,354	0.072	4,783,247	6,384,663	0.34
Coverage rate	0.936	0.017	0.018	0.902	0.970	1.984
Omission rate	0.064	0.017	0.266	0.03	0.098	1.984
Rural Western						
PES population	5,746,112	184,556	0.032	5,377,000	6,115,224	0.072
Coverage rate	0.961	0.009	0.009	0.943	0.979	1.002
Omission rate	0.039	0.009	0.231	0.021	0.057	1.002

The relative standard errors are small except for the omission rates. It can also be noted that there were some differentials in the relative standard errors for estimates at various sub national levels. For instance under the rural population, the relative standard errors for coverage rate were 2.1%, 0.9%, 1.8% and 0.9% for central, eastern, northern and western region respectively.

CHAPTER 8: LESSONS LEARNT AND WAY FORWARD

This PES being the first ever held in Uganda means that there is a lot for UBOS in particular and the country in general to learn from the experience acquired in the process of implementing the survey. This chapter is a wrap-up of the report and gives the major lessons learned and the way forward.

8.1   Lessons Learned

It is reported that PES was conceived at the time the main census was being planned. There were attempts to plan the PES and the census together. However, towards the time of census enumeration, census work was so much that all efforts were focused on the census and PES activities were postponed until after census fieldwork. This meant that implementation of PES was delayed, resulting into the fieldwork being conducted four months after the census enumeration day. The lesson learnt is that if activities of PES are not planned together with the census, it becomes difficult to conduct the survey as soon as the census is completed. To avoid a large distortion of the population structure at the time of enumeration, the fieldwork should be carried out immediately (within the recommended 3 months) after the census.

Because of the delay of PES fieldwork, a mandatory pilot PES was not conducted, resulting in using untested instruments. The lesson here is that late planning of PES would lead to skipping of some important activities of the survey, with negative implications to the results of the exercise.

Due to financial constraints, the same organization (UBOS), unit (Census Technical Office) and field personnel that did the census planned and implemented PES. This arrangement compromised the independence of PES from census and violated a major assumption of the PES. The lesson learned is that if the results of PES are to be believed, the independence of PES from census should be observed.

At different stages of PES, there were persistent shortages of funds to pay for the activities of PES. This led to delays in the implementation of activities, such as fieldwork, data matching, data management and field reconciliation. The lesson here is that if the budget for different stages of PES is not planned, secured and strictly followed, it would cause delays in the implementation of different stages of PES.

Due to lack of funds, there was sample field reconciliation instead of all unmatched EAs being reconciled in the field. The effect of this on the results of reconciliation is unknown. Due to delayed PES fieldwork and field reconciliation, the mobile population was given a lot of time to move away from the place they had been enumerated in census. It was difficult for the PES to capture this population. As a consequence, the results of PES show low coverage rates and high omission errors, leading to an inflated true census population.

The major advantage of PES is the enormous experience the personnel of UBOS have gained by conducting the PES themselves. They now know the challenges in planning the exercise, were exposed to problems of fieldwork after a census, have been trained in data matching procedures, have implemented the matching procedures, have participated in the field reconciliation and done the data processing, tabulation, analysis and write up. All this experience has contributed to a huge institutional memory built at UBOS. This will enable UBOS to conduct a better survey or be in position to oversee and evaluate the results of an independently conducted PES in the future.

8.2   Recommendations

Given the above challenges and lessons, it is proposed that:

- UBOS should set up a PES unit at the time of planning the census so that adequate funding and conduct of the PES is done to reduce delays in implementation.
- Independence of PES from census is vital and should be observed. This can be achieved if the suggested PES unit in UBOS is manned by the personnel that do not participate in census activities. Alternatively, an organization outside of UBOS can be contracted to plan and implement the PES, from the beginning to the end.
- Enough funds for the PES budget should be found in advance to ensure smooth running of the activities of the survey.
- Next time pretest survey and field reconciliation of every unmatched EAs should be planned for and carried out.
- Some of the UBOS staff, who participated in the 2003 PES activities should be used in the next PES in order to take advantage of their experience or as evaluators of the findings of an independent body outside UBOS.
- Given the findings of the PES, there are no good grounds to use the PES results for adjusting of the 2002 census results.

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APPENDICES

Appendix A: The Uganda Census 2002 Post Enumeration Survey Questionnaire

REPUBLIC OF UGANDA

2002 UGANDA POPULATION AND HOUSING CENSUS
POST-ENUMERATION SURVEY

HOUSEHOLD QUESTIONNAIRE BOOKLET

SUMMARY INFORMATION

IDENTIFICATION PARTICULARS

	NAME [IN PRINT]	CODE
DISTRICT		
COUNTY		
SUB-COUNTY		
PARISH		
EA		
LC1		

FOR CENSUS OFFICE USE ONLY

DATA PROCESSING ROUTING

DATA PREPARATION	DATE		CLERK		SUPERVISOR	
	Start	Finish	PIN	Signature	PIN	Signature
Edited						
Matched						
Entered						

ENUMERATOR'S NAME	
ENUMERATOR'S SIGNATURE	
DATE	
SUPERVISOR'S NAME	
SUPERVISOR'S SIGNATURE	
DATE	

Sr. No.	Household Number	Population			Sr. No.	Household Number	Population		
		Male	Female	Total			Male	Female	Total
1					26				
2					27				
3					28				
4					29				
5					30				
6					31				
7					32				
8					33				
9					34				
10					35				
11					36				
12					37				
13					38				
14					39				
15					40				
16					41				
17					42				
18					43				
19					44				
20					45				
21					46				
22					47				
23					48				
24					49				
25					50				
Sub-total					**Sub-total**				

	Male	Female	Total
Grand Total			

2

2002 UGANDA POPULATION AND HOUSING CENSUS - POST ENUMERATION SURVEY

For official use only

MATCHING STATUS

SECTION 1: IDENTIFICATION PARTICULARS

1. DISTRICT
2. COUNTY
3. SUB-COUNTY
4. PARISH
5. EA
6. LC 1
7. PES Household Number

Questionnaire Serial Number

SECTION 2: MATCHING PARTICULARS

PO1: Household Enumeration Status (Enumerated=1, Not Enumerated=2)

PO2: Was Census Household Number Seen? (Yes = 1, N0 = 2)

PO3: If Yes, Write Census Household Number

Otherwise, Go to P1

DO NOT WRITE IN THE SHADED COLUMNS/CELLS

SECTION 3: PERSONAL CHARACTERISTICS OF ALL PERSONS WHO STAYED IN HOUSEHOLD LAST NIGHT

	NAME P1			RELATIONSHIP P2		SEX P3	AGE P4		RELIGION P5		ETHNIC GROUP OR CITIZENSHIP P6		MARITAL STATUS P7		ENUMERATION STATUS P8	PLACE MOVED TO P9	MOVING STATUS P10	MATCHING STATUS P11
SERIAL NO	Give me full names of the household head and those of all persons who slept in this household last Night.			What is (NAME'S) relationship to the head of household? *(Write appropriate code)*		Is (NAME) male or female? *Male = 1* *Female = 2*	What is (NAME'S) age in completed years? *(If less than one year, write 00, if more than 94 write 95)*		What is (NAME'S) religion? *(Write appropriate code)*		Is (NAME) a Ugandan? *(If Ugandan, write ethnicity code, otherwise, write the country code of Citizenship)*		What is (NAME's) marital status? [Applicable for only those aged 10 years and above] *(Write appropriate code)*		Was (NAME) enumerated during the last census? *(Write appropriate code)*	Where did (NAME) move to? *(Write appropriate code)*	MOVING STATUS	MATCHING STATUS
	SURNAME	FIRST NAME	OTHER NAMES															
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
01																		
02																		
03																		
04																		
05																		
06																		
07																		
08																		
09																		
10																		

SECTION 4: OUTMOVERS - IF THERE ARE ANY PERSONS WHO SPENT THE CENSUS NIGHT IN THE HOUSEHOULD BUT HAVE SINCE MOVED OUT OR DIED, LIST THEM AND THEIR CHARACTERISTICS *(FOR DEAD MEMBERS, SKIP COLUMNS 10 - 16)*

SERIAL NO	SURNAME	FIRST NAME	OTHER NAMES	RELATIONSHIP		SEX	AGE		RELIGION		ETHNIC GROUP OR CITIZENSHIP		MARITAL STATUS		ENUMERATION STATUS	PLACE MOVED TO	MOVING STATUS	MATCHING STATUS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
01																		
02																		
03																		
04																		
05																		

SECTION 5: AGRICULTURE

A1: Did any member of this household engage in any of the following during the last Census period? (Yes = 1; No = 2)

Crop growing (1)	Livestock rearing (2)	Poultry keeping (3)	Fish farming (4)

A2: If yes (code 1) to any of the four in A1, what was the total size of the Holding? *(Acre = 1; Hectare = 2; Stick (Mwiigo) = 3)*

Unit Code

Size

Code List:

Relationship (P2)	Religion (P5)	Ethnicity (P6)							Marital Status (P7)	Enumeration Status (P8)	Moving Status (P9) for outmovers only
10 Usual Head of Household (Absent)	10 Catholic	**Central**	**Eastern**	**Northern**	**Northern (con'd)**	**Western**	**Other Ugandans**	**Country or Citizenship for Non-Ugandans**	1 Never Married	1 Enumerated in Household	1 Within District
11 Usual Head of Household (Present)	11 Anglican Protestant	17 Baganda	14 Babukusu	11 Acholi	59 Mvuba	13 Baamba	69 Other Ugandans	71 Kenya	2 Currently Married/cohabiting (Monogamous)	2 Enumerated elsewhere	2 Other District
12 Spouse	12 SDA	33 Baruli	18 Bagisu	12 Alur	60 Napore	15 Babwisi		72 Tanzania	3 Currently Married/cohabiting (Polygamous)	3 Not Enumerated	3 Outside Country
13 Child	13 Orthodox		20 Bagwe	41 Chope	61 Nubi	16 Bafumbira		73 Rwanda	4 Widowed	4 Born after Census	4 Dead
14 Step child	14 Pentecostal		21 Bagwere	42 Dodoth	62 Nyanga	19 Bagungu		74 Burundi	5 Divorced/Separated	5 Don't Know	5 Don't Know
15 Parent of head or Spouse	15 Other Christian		22 Bahehe	43 Ethur	63 Pokot	23 Bahororo		75 Sudan			
16 Brother/Sister of head or Spouse	16 Moslem		23 Bakenyi	44 Ik (Teuso)	65 So (Tepeth)	25 Bakiga		76 Dem. Rep. Of Congo			
17 Other Relative	17 Bahai		29 Banyara	47 Jie	66 Vonoma	26 Bakhonzo		77 Other Africa			
18 Non-relative	18 Other non-Christian		31 Banyole	48 Jonam		27 Banyabindi		81 United Kingdom			
	19 Traditional		34 Basamia	49 Kakwa		28 Banyankore		82 Other Europe			
	20 None		35 Basoga	50 Karimajong		30 Banyarwanda		83 Asia			
			45 Iteso	51 Kebu (Okebu)		32 Banyoro		84 USA			
			46 Jopadhola	52 Kuku		36 Basongora		85 Canada			
			53 Kumam	54 Langi		37 Batagwenda		86 Central & Latin America			
			64 Sabiny	55 Lendu		38 Batoro		87 Australia			
				56 Lugbara		39 Batuku		88 Oceania			
				57 Madi		40 Batwa		89 Non-Ugandan not stated			
				58 Mening							

Appendix B: Coverage measures estimates

Table B.1 PES Sample Estimate of the Population by Stratum

Age/Stratum	Sex		
Total	Total	Male	Female
National	24,731,466	11,974,406	12,757,060
0-4	4,200,510	2,096,989	2,103,521
5-9	4,195,659	2,127,604	2,068,055
10-19	6,419,971	3,226,829	3,193,142
20-39	6,291,883	2,794,905	3,496,978
40+	3,623,445	1,728,080	1,895,365
Urban			
Total	2,647,057	1,257,350	1,389,707
0-4	385,808	196,215	189,593
5-9	363,695	178,765	184,930
10-19	686,446	310,344	376,102
20-39	907,847	422,371	485,476
40+	303,260	149,653	153,607
Rural Central			
Total	4,454,320	2,222,014	2,232,306
0-4	728,164	356,096	372,068
5-9	777,219	404,741	372,478
10-19	1,216,747	639,866	576,881
20-39	1,041,819	491,138	550,681
40+	690,370	330,173	360,197
Rural Eastern			
Total	6,300,023	3,074,436	3,225,587
0-4	1,194,226	598,286	595,940
5-9	1,106,162	561,973	544,189
10-19	1,521,568	771,314	750,254
20-39	1,501,732	664,399	837,333
40+	976,335	478,464	497,871
Rural Northern			
Total	5,583,955	2,649,985	2,933,970
0-4	942,874	473,769	469,105
5-9	964,230	480,791	483,439
10-19	1,430,376	720,354	710,022
20-39	1,430,067	600,608	829,459
40+	816,407	374,462	441,945
Rural Western			
Total	5,746,112	2,770,622	2,975,490
0-4	949,436	472,622	476,814
5-9	984,352	501,334	483,018
10-19	1,564,836	784,952	779,884
20-39	1,410,416	616,387	794,029
40+	837,071	395,326	441,745

Table B.2 Sample Estimate of the Population Enumerated in the Census by Stratum and Sex

Age/Stratum	Sex		
National	Total	Male	Female
Total	25,206,696	12,298,387	12,908,309
0-4	4,305,089	2,144,068	2,161,022
5-9	4,273,486	2,205,845	2,067,639
10-19	6,526,628	3,322,929	3,203,699
20-39	6,440,653	2,880,999	3,559,655
40+	3,665,500	1,750,506	1,914,995
Urban			
Total	2,815,372	1,338,845	1,476,527
0-4	398,737	198,179	200,557
5-9	402,044	201,278	200,766
10-19	740,629	339,040	401,589
20-39	963,933	450,789	513,144
40+	308,121	148,616	159,505
Rural Central			
Total	4,347,525	2,181,611	2,165,913
0-4	694,147	342,869	351,279
5-9	753,904	392,663	361,240
10-19	1,191,838	634,495	557,343
20-39	1,020,648	483,506	537,142
40+	686,987	328,079	358,908
Rural Eastern			
Total	6,394,583	3,131,750	3,262,834
0-4	1,237,002	622,319	614,683
5-9	1,133,158	580,916	552,242
10-19	1,535,932	783,416	752,515
20-39	1,509,449	670,479	838,971
40+	987,670	481,988	505,682
Rural Northern			
Total	5,961,286	2,884,644	3,076,643
0-4	1,027,794	506,696	521,098
5-9	1,010,965	535,304	475,661
10-19	1,507,971	778,237	729,735
20-39	1,560,418	668,240	892,178
40+	854,160	396,168	457,992
Rural Western			
Total	5,687,930	2,761,537	2,926,392
0-4	947,410	474,005	473,405
5-9	973,415	495,685	477,729
10-19	1,550,258	787,741	762,519
20-39	1,386,205	607,984	778,219
40+	828,562	395,656	432,907

Table B.3 Omissions and Omission rates by Sex and Stratum

Age/Stratum	Total		Male		Female	
National	Omissions	Rate	Omissions	Rate	Omissions	Rate
National	1,329,256	5.6	589,967	5.3	739,289	5.8
0-4	238,590	5.6	120,450	5.6	118,140	5.6
5-9	161,329	3.9	68,522	3.7	92,807	4.2
10-19	321,202	5.2	119,079	4.1	202,123	6.4
20-39	460,508	7.6	212,482	8.1	248,026	7.3
40+	147,627	4.4	69,434	4.5	78,193	4.2
Urban						
Total	325,769	11.4	147,827	11.2	177,942	11.7
0-4	56,747	14.0	27,071	13.7	29,676	14.2
5-9	17,314	5.1	5,307	4.3	12,007	5.9
10-19	71,213	9.2	23,043	6.9	48,170	11.1
20-39	154,377	15.4	77,675	16.3	76,702	14.6
40+	26,118	8.2	14,731	9.6	11,387	6.8
Rural Central						
Total	197,440	5.9	87,684	5.6	109,756	6.3
0-4	44,297	6.8	18,087	6.1	26,210	7.5
5-9	31,433	4.7	15,694	4.5	15,739	4.9
10-19	39,043	4.8	13,381	3.5	25,662	6.3
20-39	63,861	8.8	31,429	9.4	32,432	8.2
40+	18,806	3.8	9,093	4.1	9,713	3.6
Rural Eastern						
Total	255,548	4.3	107,599	3.8	147,949	4.7
0-4	42,645	3.9	22,446	3.8	20,199	3.9
5-9	34,420	3.2	13,556	2.7	20,864	3.8
10-19	68,138	4.5	23,675	3.3	44,463	5.7
20-39	74,813	5.4	30,845	5.2	43,968	5.6
40+	35,532	3.7	17,077	3.7	18,455	3.8
Rural Northern						
Total	321,081	6.4	139,374	6.3	181,707	6.5
0-4	54,453	5.7	32,047	6.2	22,406	5.2
5-9	46,677	4.8	19,417	4.9	27,260	4.8
10-19	86,951	7.0	33,754	5.8	53,197	8.3
20-39	91,581	7.6	37,408	8.4	54,173	7.0
40+	41,419	6.0	16,748	5.9	24,671	6.0
Rural Western						
Total	229,413	3.9	107,479	3.7	121,934	4.0
0-4	40,446	4.1	20,798	4.2	19,648	4.0
5-9	31,484	3.1	14,548	3.1	16,936	3.1
10-19	55,859	3.5	25,227	3.0	30,632	4.1
20-39	75,874	5.1	35,123	5.2	40,751	5.0
40+	25,750	3.1	11,783	3.0	13,967	3.2

Table B.4 Coverage rates by Sex , Stratum and Age

Age/Stratum	Total	Male	Female
National	94.4	94.7	94.2
0-4	94.4	94.4	94.4
5-9	96.1	96.3	95.8
10-19	94.8	95.9	93.6
20-39	92.4	91.9	92.7
40+	95.6	95.5	95.8
Urban			
Total	88.6	88.8	88.3
0-4	86.0	86.3	85.8
5-9	94.9	95.7	94.1
10-19	90.8	93.1	88.9
20-39	84.6	83.7	85.4
40+	91.8	90.4	93.2
Rural Central			
Total	94.1	94.4	93.7
0-4	93.2	93.9	92.5
5-9	95.3	95.5	95.1
10-19	95.2	96.5	93.7
20-39	91.2	90.6	91.8
40+	96.2	95.9	96.4
Rural Eastern			
Total	95.7	96.2	95.3
0-4	96.1	96.2	96.1
5-9	96.8	97.3	96.2
10-19	95.5	96.7	94.3
20-39	94.6	94.8	94.4
40+	96.3	96.3	96.2
Rural Northern			
Total	93.6	93.7	93.5
0-4	94.3	93.8	94.8
5-9	95.2	95.1	95.2
10-19	93.0	94.2	91.7
20-39	92.4	91.6	93.0
40+	94.0	94.1	94.0
Rural Western			
Total	96.1	96.3	96.0
0-4	95.9	95.8	96.0
5-9	96.9	96.9	96.9
10-19	96.5	97.0	95.9
20-39	94.9	94.8	95.0
40+	96.9	97.0	96.8

Table B.5 Erroneous Inclusions and erroneous inclusion rates by Sex , Stratum and Age

Age/Stratum	Total		Male		Female	
	EI	EIR	EI	EIR	EI	EIR
National	902,243	3.7	456,975	3.7	445,268	3.7
0-4	171,585	4.0	83,764	3.9	87,821	4.1
5-9	119,577	2.8	73,382	3.3	46,195	2.2
10-19	213,930	3.3	107,590	3.2	106,340	3.3
20-39	304,639	4.7	149,288	5.2	155,351	4.4
40+	94,841	2.6	45,930	2.6	48,911	2.6
Urban						
Total	247,042	8.8	114,662	8.6	132,380	9.0
0-4	34,838	8.7	14,517	7.3	20,320	10.1
5-9	27,832	6.9	13,910	6.9	13,922	6.9
10-19	62,698	8.5	25,869	7.6	36,828	9.2
20-39	105,232	10.9	53,047	11.8	52,185	10.2
40+	15,489	5.0	6,847	4.6	8,643	5.4
Rural Central						
Total	45,322	1.0	23,641	1.1	21,681	1.0
0-4	5,141	0.7	2,430	0.7	2,711	0.8
5-9	4,058	0.5	1,808	0.5	2,251	0.6
10-19	7,067	0.6	4,005	0.6	3,062	0.5
20-39	21,345	2.1	11,899	2.5	9,447	1.8
40+	7,711	1.1	3,499	1.1	4,212	1.2
Rural Eastern						
Total	175,054	2.7	82,457	2.6	92,598	2.8
0-4	42,711	3.5	23,240	3.7	19,471	3.2
5-9	30,708	2.7	16,250	2.8	14,459	2.6
10-19	41,250	2.7	17,889	2.3	23,362	3.1
20-39	41,266	2.7	18,463	2.8	22,803	2.7
40+	23,433	2.4	10,300	2.1	13,133	2.6
Rural Northern						
Total	349,207	5.9	187,017	6.5	162,190	5.3
0-4	69,686	6.8	32,487	6.4	37,199	7.1
5-9	46,706	4.6	36,965	6.9	9,741	2.0
10-19	82,273	5.5	45,818	5.9	36,455	5.0
20-39	110,966	7.1	52,520	7.9	58,446	6.6
40+	39,586	4.6	19,227	4.9	20,359	4.4
Rural Western						
Total	85,617	1.5	49,198	1.8	36,419	1.2
0-4	19,210	2.0	11,090	2.3	8,119	1.7
5-9	10,273	1.1	4,449	0.9	5,824	1.2
10-19	20,641	1.3	14,008	1.8	6,633	0.9
20-39	25,831	1.9	13,360	2.2	12,471	1.6
40+	8,621	1.0	6,056	1.5	2,565	0.6

Table B.6 Dual Estimate of True Population by Sex and Stratum

Age/Stratum	Total	Male	Female
National			
Total	25,738,549	12,502,286	13,236,263
0-4	4,380,172	2,182,934	2,197,238
5-9	4,323,819	2,214,437	2,109,382
10-19	6,661,157	3,351,778	3,309,379
20-39	6,643,580	2,972,314	3,671,266
40+	3,733,077	1,784,167	1,948,910
Urban			
Total	2,899,306	1,377,857	1,521,448
0-4	422,956	212,816	210,140
5-9	394,393	195,768	198,625
10-19	746,883	336,405	410,479
20-39	1,015,189	475,334	539,855
40+	318,765	156,854	161,911
Rural Central			
Total	4,573,902	2,284,957	2,288,945
0-4	739,390	362,362	377,028
5-9	786,805	409,233	377,572
10-19	1,244,807	653,528	591,279
20-39	1,095,357	520,750	574,607
40+	706,307	338,422	367,886
Rural Eastern			
Total	6,496,703	3,169,065	3,327,639
0-4	1,242,179	622,937	619,241
5-9	1,139,423	580,508	558,915
10-19	1,565,187	791,984	773,203
20-39	1,552,449	687,708	864,741
40+	1,001,778	489,709	512,069
Rural Northern			
Total	5,996,642	2,879,609	3,117,033
0-4	1,016,331	505,672	510,660
5-9	1,013,144	523,954	489,190
10-19	1,533,149	777,302	755,848
20-39	1,568,075	671,978	896,097
40+	866,282	400,724	465,558
Rural Western			
Total	5,827,791	2,817,361	3,010,430
0-4	967,989	483,418	484,570
5-9	993,861	506,811	487,050
10-19	1,585,664	797,795	787,869
20-39	1,433,340	627,523	805,817
40+	845,799	401,444	444,355

Appendix B7: Gross and net coverage error rates

Age/Stratum	Gross Error Rates(%)			Net Error Rates(%)		
	Total	Male	Female	Total	Male	Female
National	8.9	8.5	9.2	2.0	1.6	2.5
0-4	9.5	9.5	9.5	1.7	1.8	1.6
5-9	6.6	6.4	6.7	1.2	0.4	2.0
10-19	8.2	6.8	9.6	2.0	0.9	3.2
20-39	11.9	12.6	11.3	3.1	3.1	3.0
40+	6.6	6.6	6.6	1.8	1.9	1.7
Urban						
Total	20.3	19.6	21.0	2.9	2.8	3.0
0-4	23.0	21.0	24.9	5.7	6.9	4.6
5-9	11.2	9.5	12.9	-1.9	-2.8	-1.1
10-19	18.1	14.4	21.2	0.8	-0.8	2.2
20-39	26.9	29.0	25.1	5.0	5.2	4.9
40+	13.5	14.5	12.6	3.3	5.3	1.5
Rural Central						
Total	5.6	5.1	6.1	4.9	4.5	5.4
0-4	7.1	6.0	8.2	6.1	5.4	6.8
5-9	4.7	4.5	5.0	4.2	4.0	4.3
10-19	3.9	2.7	5.2	4.3	2.9	5.7
20-39	8.3	9.0	7.8	6.8	7.2	6.5
40+	3.9	3.8	3.9	2.7	3.1	2.4
Rural Eastern						
Total	6.7	6.1	7.4	1.6	1.2	1.9
0-4	6.9	7.3	6.5	0.4	0.1	0.7
5-9	5.7	5.1	6.4	0.5	-0.1	1.2
10-19	7.1	5.3	9.0	1.9	1.1	2.7
20-39	7.7	7.4	8.0	2.8	2.5	3.0
40+	6.0	5.7	6.2	1.4	1.6	1.2
Rural Northern						
Total	11.2	11.3	11.2	0.6	-0.2	1.3
0-4	12.1	12.7	11.4	-1.1	-0.2	-2.0
5-9	9.2	10.5	7.8	0.2	-2.2	2.8
10-19	11.2	10.2	12.3	1.6	-0.1	3.5
20-39	13.0	13.5	12.6	0.5	0.6	0.4
40+	9.5	9.1	9.8	1.4	1.1	1.6
Rural Western						
Total	5.5	5.7	5.4	2.4	2.0	2.8
0-4	6.3	6.7	5.9	2.1	1.9	2.3
5-9	4.3	3.8	4.8	2.1	2.2	1.9
10-19	4.9	5.0	4.9	2.2	1.3	3.2
20-39	7.3	8.0	6.8	3.3	3.1	3.4
40+	4.1	4.5	3.8	2.0	1.4	2.6

Appendix C: Content error tables

Table C.1: Index of Inconsistency and Net Difference rate by Sex

	Number of Cases in PES	Number of Cases in Census	Net Difference rate	Index of inconsistency
Sex				
National				
Male	105,867	106,050	-0.086	3.97
Female	107,223	107,040	0.086	3.97
Urban				
Male	9,146	9,145	-0.005	5.4
Female	9,533	9,534	0.005	5.4
Central				
Male	24,557	24,525	-0.065	4.4
Female	24,401	24,433	0.065	4.4
Eastern				
Male	28,439	28,402	-0.065	2.91
Female	28,412	28,449	0.065	2.91
Northern				
Male	22,826	22,767	-0.128	4.5
Female	23,303	23,362	0.128	4.5
Western				
Male	30,228	30,173	-0.090	4.2
Female	30,924	30,979	0.090	4.2

Table C.2 : Index of Inconsistency and Net Difference rate by Relationship

Relationship	No of cases in PES	No of cases in Census	NDR	I
National				
Head	45,052	44,978	0.035	7.9
Spouse	32,455	32,407	0.023	8.9
Child	108,951	109,563	-0.288	11.1
Step Child	3,922	4,069	-0.069	82.1
Parent of Head or Spouse	1,037	1,080	-0.02	48.8
Brother/Sister of Head or Spouse	3,683	4,011	-0.15	54.2
Other relative	16,213	15,109	0.52	44.1
Non-Relative	1,411	1,507	-0.05	53.8
Urban				
Head	4,652	4,597	0.30	10.7
Spouse	2,579	2,594	-0.08	11.9
Child	8,127	8,150	-0.12	15.1
Step Child	311	140	0.92	97.9
Parent of Head or Spouse	94	91	0.02	46.2
Brother/Sister of Head or Spouse	732	818	-0.46	55.7
Other relative	1,790	1,906	-0.62	48.9
Non-Relative	320	309	0.06	51.3
Central				
Head	8,570	8,592	-0.06	7.1
Spouse	4,887	4,819	0.18	8.8
Child	17,595	17,889	-0.78	11.7
Step Child	604	700	-0.26	91.5
Parent of Head or Spouse	170	171	0.00	55.7
Brother/Sister of Head or Spouse	799	823	-0.06	50.5
Other relative	4,668	4,341	0.87	33.3
Non-Relative	342	300	0.11	51.8

Table C2 Continued

			NDR	I
Eastern	**No of cases in PES**	**No of cases in Census**		
Head	11,267	11,320	-0.10	7.0
Spouse	9,020	8,875	0.26	7.8
Child	29,486	29,516	-0.05	10.0
Step Child	1,017	1,479	-0.83	79.1
Parent of Head or Spouse	261	321	-0.11	42.1
Brother/Sister of Head or Spouse	707	804	-0.17	53.5
Other relative	3,646	3,071	1.03	48.8
Non-Relative	191	209	-0.03	70.3
Northern				
Head	8,770	8,746	0.06	10.3
Spouse	7,050	7,132	-0.19	11.6
Child	22,715	22,740	-0.06	12.0
Step Child	924	784	0.33	79.0
Parent of Head or Spouse	227	210	0.04	54.5
Brother/Sister of Head or Spouse	798	888	-0.21	56.4
Other relative	2,198	2,131	0.16	54.8
Non-Relative	77	128	-0.12	82.6
Western				
Head	11,793	11,723	0.12	6.6
Spouse	8,919	8,987	-0.12	7.3
Child	31,028	31,268	-0.41	10.0
Step Child	1,066	966	0.17	79.0
Parent of Head or Spouse	285	287	0.00	48.1
Brother/Sister of Head or Spouse	647	678	-0.05	56.0
Other relative	3,911	3,660	0.43	45.1
Non-Relative	481	561	-0.14	44.9

Table C.3 : Index of Inconsistency and Net Difference rate by Religion

Religion	Number of cases in PES	Number of cases in PES	NDR	I
National				
Catholic	90,288	90,520	-0.11	14.9
Anglican Protestant	78,840	77,501	0.63	18.0
SDA	2,289	2,564	-0.13	32.4
Pentecostal	9,634	10,252	-0.29	39.8
Moslem	24,013	24,168	-0.07	5.0
Others	6,841	6,900	-0.03	102.1
Urban				
Catholic	6,829	6,852	-0.12	11.9
Anglican Protestant	6,073	6,068	0.03	15.7
SDA	194	226	-0.17	34.3
7Pentecostal	1,146	1,102	0.24	32.6
Moslem	4,088	4,143	-0.30	4.4
Others	237	176	0.33	90.4
Central				
Catholic	16,582	16,799	-0.58	9.5
Anglican Protestant	11,973	11,713	0.69	15.7
SDA	679	634	0.12	28.3
Pentecostal	1,514	1,658	-0.38	41.0
Moslem	6,054	6,170	-0.31	4.8
Others	746	574	0.46	59.4
Eastern				
Catholic	15,131	15,283	-0.27	13.8
Anglican Protestant	24,958	24,526	0.78	12.2
SDA	227	309	-0.15	52.3
Pentecostal	3,567	3,459	0.20	44.2
Moslem	9,402	9,424	-0.04	4.1
Others	2,093	2,377	-0.51	58.1
Northern				
Catholic	25,490	25,303	0.44	9.1
Anglican Protestant	11,409	10,954	1.07	17.3
SDA	192	168	0.06	47.8
Pentecostal	1,732	2,156	-0.99	32.1
Moslem	2,772	2,779	-0.02	2.9
Others	1,126	1,361	-0.55	59.9
Western				
Catholic	26,256	26,283	-0.05	6.5
Anglican Protestant	24,427	24,240	0.32	7.9
SDA	997	1,227	-0.40	26.6
Pentecostal	1,675	1,877	-0.35	35.1
Moslem	1,697	1,652	0.08	9.8
Others	2,639	2,412	0.39	28.2

Table C.4 : Index of Inconsistency and Net Difference rate by marital status

Marital status	Number of cases in PES	Number of cases in Census	NDR	I
National				
Never Married	5,382	5,324	-1.88	22.2
Currently Married/Cohabiting(Monogomous)	5,135	5,363	0.73	17.5
Currently Married/Cohabiting(Polygamous)	610	418	-0.49	45.5
Widowed	529	534	-0.29	30.4
Divorced/Separated	708	552	-0.39	52.7
Not Applicable	5,063	5,236	2.32	13.8
Urban				
Never Married	5,324	5,382	-0.33	20.5
Currently Married/Cohabiting(Monogomous)	5,363	5,135	1.31	21.1
Currently Married/Cohabiting(Polygamous)	418	610	-1.10	74.9
Widowed	534	529	0.03	36.2
Divorced/Separated	552	708	-0.90	58.1
Not Applicable	5,236	5,063	0.99	10.8
Central				
Never Married	12,983	13,545	-1.23	21.3
Currently Married/Cohabiting(Monogomous)	12,096	12,035	0.13	18.2
Currently Married/Cohabiting(Polygamous)	1,153	1,209	-0.12	69.5
Widowed	1,588	1,643	-0.12	35.8
Divorced/Separated	1,986	2,164	-0.39	50.0
Not Applicable	15,742	14,952	1.73	11.8
Eastern				
Never Married	12,212	13,027	-1.52	23.0
Currently Married/Cohabiting(Monogomous)	14,587	14,123	0.87	17.6
Currently Married/Cohabiting(Polygamous)	3,459	3,882	-0.79	38.0
Widowed	1,583	1,763	-0.34	25.6
Divorced/Separated	1,101	1,281	-0.34	49.6
Not Applicable	20,671	19,537	2.12	14.3
Northern				
Never Married	10,635	11,646	-2.29	24.0
Currently Married/Cohabiting(Monogomous)	13,437	13,065	0.84	19.4
Currently Married/Cohabiting(Polygamous)	2,435	2,343	0.21	47.8
Widowed	1,158	1,430	-0.62	36.8
Divorced/Separated	674	956	-0.64	59.8
Not Applicable	15,760	14,659	2.50	15.6
Western				
Never Married	15,610	16,996	-2.40	21.2
Currently Married/Cohabiting(Monogomous)	16,291	15,729	0.97	15.4
Currently Married/Cohabiting(Polygamous)	2,173	2,777	-1.05	43.3
Widowed	1,869	1,939	-0.12	25.6
Divorced/Separated	1,125	1,269	-0.25	56.3
Not Applicable	20,616	18,974	2.85	13.6

Table C.5: Index of Inconsistency and Net Difference rate by Age group

Age	No of cases in PES	No of cases in Census	NDR	I
National				
0-4	35,514	38,964	1.63	11.9
5-9	35,821	35,017	-0.38	24.1
10-19	53,987	51,892	-0.99	15.5
20-39	54,402	53,962	-0.21	11.6
40+	32,500	32,389	-0.05	8.4
Urban				
0-4	2,578	2,812	1.27	9.2
5-9	2,648	2,549	-0.54	19.2
10-19	4,614	4,514	-0.54	12.9
20-39	6,386	6,345	-0.22	8.6
40+	2,262	2,268	0.03	10.6
Central				
0-4	7,434	8,030	1.23	9.6
5-9	7,914	7,722	-0.39	19.6
10-19	12,823	12,592	-0.47	12.4
20-39	13,202	13,066	-0.28	9.6
40+	7,264	7,227	-0.08	8.5
Eastern				
0-4	10,567	11,565	1.76	11.1
5-9	9,851	9,583	-0.47	23.7
10-19	13,415	12,832	-1.03	14.9
20-39	13,736	13,704	-0.06	10.8
40+	9,043	8,928	-0.20	8.6
Northern				
0-4	7,667	8,538	1.89	14.3
5-9	7,809	7,631	-0.39	28.0
10-19	11,574	10,966	-1.32	19.3
20-39	12,093	11,957	-0.30	13.7
40+	6,934	6,985	0.11	11.1
Western				
0-4	9,846	10,831	1.62	10.5
5-9	10,247	10,081	-0.27	20.6
10-19	16,175	15,502	-1.11	12.6
20-39	15,371	15,235	-0.22	10.0
40+	9,259	9,249	-0.02	7.5

Table C.6: Census and PES Population by Characteristics

Category	Census	PES	Consistent Population
Sex			
Male	105,867	106,050	103,823
Female	107,223	107,040	104,996
Total	213,090	213,090	208,819
Relationship			
All Heads	45,052	44,978	42,214
Head Absent	4,501	4,800	1,722
HHD Head – Present	40,551	40,178	35,050
Spouse	32,455	32,407	29,972
Child	108,951	109,563	103,367
Step Child	3,922	4,069	775
Parent of Head or Spouse	1,037	1,080	544
Brother/Sister of Head or Spouse	3,683	4,011	38
Other relative	16,213	15,109	174
Non-Relative	1,411	1,507	8
Total	212,724	212,724	171,650
Age			
0 to 4	38,964	35,514	33,226
5 to 9	35,017	35,821	27,702
10 to 14	30,914	32,703	24,646
15 to 19	20,978	21,284	15,525
20 to 24	16,591	16,554	11,066
25 to 29	14,756	15,051	9,369
30 to 34	13,085	12,909	7,702
35 to 39	9,530	9,888	5,412
40 to 44	8,382	7,986	4,407
45 to 49	5,429	5,871	2,733
50 to 54	5,029	5,039	2,459
55 to 59	3,020	2,962	1,164
60 to 64	3,781	3,703	1,745
65 to 69	2,237	2,368	959
70 to 74	2,118	2,138	970
75 to 79	942	1,045	376
80 to 84	896	847	385
85 Plus	555	541	274
Total	212,224	212,224	150,120
Marital Status			
Never Married	51,440	55,214	44,622
Currently Married/Cohabiting(Monogamous)	56,411	54,952	48,633
Currently Married/Cohabiting(Polygamous)	9,220	10,211	5,510
Widowed	6,198	6,775	4,579
Divorced/Separated	4,886	5,670	2,570
Not Applicable	72,789	68,122	64,134
Total	200,944	200,944	170,048
Religion			
Catholic	90,288	90,520	82,669
Anglican Protestant	78,840	77,501	69,299
SDA	2,289	2,564	1,649
Orthodox	420	257	81
Pentecostal	9,634	10,252	6,171
Other Christian	3,210	3,192	1,149
Moslem	24,013	24,168	23,017
Bahai	156	112	3
Other Non-Christian	1,663	1,346	1,068
Traditional	555	664	285
None	837	1,329	217
Total	211,905	211,905	185,608

Appendix D: Number of Participants in the training by venues and zones

Venue/ Zone	Districts	No of Participants			
		Trainers/Zonal Supervisors	DPESOs	ADPESOs	Enumerators
Mukono	Wakiso, Luwero, Nakasongola,Kayunga, Hoima, Masindi, Mukono	1	7	2	71
Masaka	Masaka, Sembabule, Rakai,Kiboga, Kampala, Kiboga	1	6	3	66
Mbarara	Mbarara, Kabaale, Rukungiri, Bushenyi, Ntungamo, Kisoro, Kanungu	1	7	2	52
Kabarole	Kabarole, Kasese, Bundibugyo Kibaale, Mubende, Kyenjojo, Kamwenge	3	7	0	46
Arua	Arua, Nebbi, Adjumani, Yumbe, Moyo	1	5	1	40
Soroti	Soroti, Mbale, Sironko, Nakapiripirit, Kaberamaido, Kumi, Kapchorwa, Kotido, Moroto, Katakwi	4	10	1	53
Iganga	Iganga, Bugiri, Mayuge, Busia, Kamuli, Tororo, Pallisa, Jinja	1	8	2	61
Lira	Kitgum,Pader,Gulu,Apac,Lira	1	5	1	40
Total		**13**	**55**	**12**	**429**