

APPENDIX B: SAMPLING ERRORS

The estimates from a sample survey are affected by two types of errors: (1) nonsampling error, and (2) sampling errors. Nonsampling errors are the results of mistakes made in implementing data collection and data processing, such as failure to locate and interview the correct household, misunderstanding of the questions on the part of either the interviewer or the respondent, and data entry errors. Although numerous efforts were made during the implementation of the MIS to minimise these type of errors, nonsampling errors are impossible to avoid and difficult to evaluate statistically.

Sampling errors, on the other hand, can be evaluated statistically. The sample of respondents selected in the MIS is only one of many samples that could have been selected from the same population, using the same sample design and expected size. Each of these samples would yield results that differ somewhat from the results of the actual sample selected. Sampling errors are a measure of the variability between all possible samples. Although the degree of variability is not known exactly, it can be estimated from the survey results.

A sampling error is usually measured in terms of *standard error* for a particular statistic (mean, percentage, etc.), which is the square root of the variance. The standard error can be used to calculate confidence intervals within which the true value for the population can reasonably be assumed to fall. For example, for any given statistic calculated from a sample survey, the value of that statistic will fall within a range of plus or minus two times the standard error of that statistic in 95 percent of all possible samples of identical size and design.

If the sample of respondents had been selected as a simple random sample, it would have been possible to use straightforward formulae for calculating sampling errors. However, the MIS sample is the results of a stratified two stage design, and, consequently, it was necessary to use more complex formulae. The computer software CLUSTERS developed for the MIS by UNICEF was used to calculate sampling errors.

Sampling errors for selected variables for the country as a whole are presented in the following Table. In addition to the value (R) of type of statistic (mean, proportion) and standard error (SE), the tables includes the weighted number (WN) of cases, the relative standard error (the standard error divided by the value of the statistic) and the 95 percent confidence limits ($R \pm 2SE$). The confidence limits may be interpreted by using the following example: the overall estimate of the proportion of women who have ever been pregnant is 0.691 and its standard error is 0.054. To obtain the 95 percent confidence interval, twice the standard error is added to and subtracted from the estimate of CEB, $0.691 \pm 2 * 0.054$. Thus, there is a 95 percent probability that the true value of CEB lies between 0.583 and 0.800.

Table: Sampling errors for all women aged 15-49 years, Botswana, 2000

	Value of statistic (R)	Standard Error (SE)	Weighted cases (WN)	Relative error (SE/R)	95 Percent confidence limits	
					R-2SE	R+2SE
All women						
1. Proportion who attended school	0.897	0.057	370,005	0.064	0.783	1.011
2. Proportion who have ever been pregnant	0.691	0.054	370,005	0.079	0.583	0.800
3. Proportion currently using contraceptives	0.423	0.038	370,005	0.090	0.347	0.498
4. Mean age at first pregnancy	19.3	0.009	255,830	0.0005	19.282	19.318
5. Mean age at first birth	19.7	0.009	252,782	0.0005	19.682	19.718
6. Mean number of children ever born (CEB)	2.0	0.004	370,005	0.002	1.960	2.004
Birth during the past twelve months						
1. Proportion of mothers who had tetanus injection	0.096	0.011	370,005	0.112	0.075	0.118
2. Proportion who attended antenatal care	0.104	0.011	370,005	0.104	0.082	0.125
HIV/AIDS knowledge						
1. Proportion who heard about HIV/AIDS	0.949	0.031	370,005	0.032	0.887	1.010
2. Proportion who would one partner to avoid HIV/AIDS	0.733	0.022	370,005	0.030	0.689	0.777
3. Proportion who would use condom every time	0.747	0.042	370,005	0.056	0.662	0.831
4. Proportion who would abstain	0.784	0.063	370,005	0.081	0.657	0.911
HIV/AIDS transmission						
1. Proportion who know mother to child transmission	0.801	0.046	370,005	0.058	0.709	0.893
2. Proportion who say during pregnancy	0.762	0.050	370,005	0.066	0.661	0.863
3. Proportion who say at delivery	0.638	0.037	370,005	0.058	0.564	0.712
4. Proportion who say at breast feeding	0.696	0.046	370,005	0.066	0.604	0.789
Children 1-59 months						
1. Proportion registered	0.575	0.038	185,522	0.067	0.499	0.652
2. Proportion breastfed	0.912	0.026	185,522	0.028	0.861	0.964
3. Proportion who had diarrhoea (past 24hours)	0.062	0.014	185,522	0.226	0.034	0.089
4. Proportion who had diarrhoea (past 2 weeks)	0.065	0.006	185,522	0.100	0.052	0.078
5. Proportion who had cough (past 2 weeks)	0.383	0.038	185,522	0.098	0.308	0.458
6. Proportion who had other illness (past 2 weeks)	0.123	0.009	185,522	0.071	0.106	0.141
7. Proportion with health cards	0.851	0.032	185,522	0.038	0.786	0.915
Children 12-23 months						
1. Proportion immunised -BCG	0.834	0.040	185,522	0.048	0.753	0.914
2. Proportion immunised -DPT1	0.793	0.033	185,522	0.042	0.726	0.859
3. Proportion immunised -Polio1	0.783	0.038	185,522	0.048	0.708	0.859
4. Proportion immunised -HB1	0.817	0.041	185,522	0.051	0.734	0.899
5. Proportion immunised -Measles	0.623	0.022	185,522	0.035	0.579	0.666

APPENDIX C: SAMPE DESIGN

SAMPLING METHODOLOGY FOR BOTSWANA MULTIPLE INDICATOR SURVEY (MIS) 2000

1 The Frame

The frame for the Multiple Indicators Survey (MIS) 2000 consists of 2,438 enumeration areas (EAs)/Blocks. This is after removing 10 blocks from the original frame that, contains 2,448 blocks, being the total number of enumeration areas delineated during the 1991 Population and Housing Census. The reasons for removing the blocks were empty blocks, Botswana Defense Force (BDF) barracks, Railways tin huts etc.

Category	Stratum No.	District	Blocks
Cities/ Towns	1	Gaborone	249
	2	Francistown	124
	3	Selebi Phikwe	94
	4	Lobatse	43
	5	Small Towns*	43
Urban Villages**	6	Urban Villages	523
Rural District	7	Southern	197
	8	South East	26
	9	Kweneng	185
	10	Kgatleng	65
	11	Central	571
	12	North East	79
	13	North West	147
	14	Gantsi	38
	15	Kgalagadi	54
		Total	2438

*Jwaneng, Orapa, and Sowa

- Stratum 6 (Urban Villages) is a derived stratum of blocks of Urban Villages of rural / strata/districts (7-15).
- ****Urban Villages:** These are villages each with a 1991 population of at least 5000 and at least 75 percent of the workforce engaged in non-agricultural economic activities.
- There are 19 urban villages viz. 1. Kanye, 2. Moshupa (Southern); 3. Ramotswa, 4. Tlokweng (South-East); 5. Molepolole, 6. Thamaga, 7. Gabane, 8. Mogoditshane (Kweneng); 9. Mochudi (Kgatleng); 10. Mahalapye, 11. Palapye, 12. Serowe, 13. Letlhakane, 14. Bobonong, 15. Tonota, 16. Tutume (Central); 17. Maun, 18. Kasane (North-West or Ngamiland), and 19. Ghanzi (Ghanzi) belongs to respective rural district as mentioned in brackets.

2 Sample Size, Number of PSUs (Blocks) and Block Sizes (Households)

The sample size calculation for measuring the Mid Decade Goals was determined on the basis of basic assumptions regarding design effect, household size etc. The number of households for this study was determined approximately 7000. The details of the calculation can be seen in ANNEXURE-I.

2.1 Number and Allocation of Blocks

While, in general, the more PSUs (Blocks) the better, but the decision on the total number of blocks in the sample was taken on the basis of cost, personnel and vehicle resources available, as well as the previous experience in listing of blocks. It was estimated that one enumerator lists an average of about seven (7) blocks in a month. There were 10 enumerators for the MIS listing exercise. Thus in the three (3) months period of listing of households, 210 (10x7x3) blocks are expected to be completed. This makes about 9% of the total blocks in frame.

The allocation of 210 blocks to 14 strata was carried out using proportional allocation according to MOS (size being number of households in 1991 Population and Housing Census) as shown in ANNEXURE-II

2.2 Block Size

The number of households selected in a block was determined as proportion to the total number of listed households in that block. (see ANNEX-II)

3 Sample Design

A stratified two-stage probability sample design is utilised for the selection of the sample.

The first stage is the selection of blocks as Primary Sampling Units (PSUs) selected with probability proportional to measures of size (PPS), where measures of size (MOS) are the number of households/dwellings in the block as defined by the 1991 Population and Housing Census. In all 215 blocks were selected with probability proportional to size.

At the second stage of sampling, the households were systematically selected from fresh list of occupied households prepared at the beginning of the survey's fieldwork (i.e. listing of households for the selected blocks). Overall 7001 households were drawn systematically.

The sample is not self-weighting because it was stratified by districts.

4 Weighting

There are three components to the weighting:

- **From Block/EA to Stratum Level**

First stage weights account for the varying probability of selection. That is they

are proportional to the inverse of the size measure.

- **From Household Level to Block Level**

This is a simple weight obtained by dividing the block listed total business households by the number of selected business households in that block.

- **A Non-Response Adjustment**

For MIS no substitution was allowed for non-response and household questionnaire had to be returned for all households, responding or non-responding. The response code was entered on the computer records. The results are:

Code	Final visit result	Percent
1	Completed	88.3
2	Household present but no respondent at home (Non Contact)	7.0
3	Postponed	0.0
4	Refused	0.3
5	Partly completed	0.2
6	Dwelling Vacant	3.6
7	Dwelling out of scope	0.4
8	Other	0.2
	Total	100.0

Only non-contact and refusals are taken as non-response. The other sample loss is effectively taken as zero i.e. no one lived in these households. The non-response rate is made at the block level. The adjustment is equal to the presumed total households in the block (codes 1+2+4+5) divided by the presumed valid response in that block (codes 1+5). In effect non-contacts and refusals are given the characteristics of average valid respondents in the block.

ANNEX-I

SAMPLE SIZE CALCULATIONS FOR MEASURING MID DECADE GOALS (MDGs)

BASIC ASSUMPTIONS	Low	High	Formula for required target sample
Design effect (deff)	2	10	$n = 4 * p * (1-p) * deff / e^2$
Persons per household	4.2		
Pct of population <5 years	0.145		
Prevalence of diarrhea 15 days	0.25		

GOAL NUMBER	INDICATOR	Target population	Estimated Prevalence	Margin Of error	Required target sample	Required number of households
1.1	DPT3 coverage	12-23 mo	0.5	0.05	800	6568
1.2	Measles coverage	12-23 mo	0.32	0.05	696	5717
1.3	OPV3 coverage	12-23 mo	0.5	0.05	800	6568
1.4	BCG coverage	12-23 mo	0.8	0.05	512	4204
1.6	TT2 coverage (pregnancy)	0-11 mo	0.12	0.05	338	2774
5.1	Vitamin A coverage	0-23 mo	0.3	0.05	672	2759
6.1	Iodized salt consumption	Households	0.1	0.05	288	288
7.1	Use of ORT(1) in diarrhea	Diar <5 yr	0.4	0.05	768	5044
7.2	Use of ORT(2) in diarrhea	Diar <5 yr	0.5	0.05	800	5255
11.1	Percent low weight/age	All < 5 yr	0.4	0.05	768	1261
12.4	School enrolment	5-9 yr	0.63	0.05	746	1225
13.1	Safe water	Population	0.6	0.05	3840	914
13.2	Sanitation	Population	0.16	0.05	2150	512

Required number of households = 6568

The design effects (deff.) for goal 1.1 to 12.4 is taken as 2, while for goals 13.1 and 13.2 it is 10.

ANNEX-II

DISTRIBUTION OF BLOCKS IN FRAME, BLOCKS IN SAMPLE, HOUSEHOLDS LISTED, HOUSEHOLDS FINALLY SELECTED

Sl. No.	District	Blocks in Frame			Blocks in Sample			Percent block selected			Occupied Hholds listed			H'holds Selected			Valid HH entered	% Valid HH
		Urban	Rural	Total	Urban	Rural	Total	% Urban	% Rural	% Total	Urban	Rural	Total	Urban	Rural	Total		
1	Gaborone	249	-	249	29	-	29	11.6	-	11.6	5516	-	5516	1212	-	1212	1211	22.0
2	Fr. Town	124	-	124	12	-	12	9.7	-	9.7	2266	-	2266	489	-	489	489	21.6
3	Sel. Phikwe	94	-	94	8	-	8	8.5	-	8.5	1185	-	1185	254	-	254	254	21.4
4	Lobatse	43	-	43	5	-	5	11.6	-	11.6	1045	-	1045	212	-	212	212	20.3
5	Small Towns***	43	-	43	4	-	4	9.3	-	9.3	910	-	910	183	-	183	183	20.1
	Sub-Total	553		553	58		58	10.5		10.5	10922		10922	2350		2350	2349	21.5
6	Southern	67	197	264	7	14	21	10.4	7.1	8.0	1156	2000	3156	249	377	626	624	19.8
7	South-East	43	26	69	5	5	10	11.6	19.2	14.5	786	614	1400	170	116	286	286	20.4
8	Kweneng	120	185	305	12	13	25	10.0	7.0	8.2	2619	1571	4190	566	315	881	877	20.9
9	Kgatleng	38	65	103	4	5	9	10.5	7.7	8.7	927	634	1561	200	115	315	313	20.1
10	Central	207	571	778	18	41	59	8.7	7.2	7.6	2724	5013	7737	588	932	1520	1517	19.6
11	North-East	-	79	79	-	6	6	-	-	7.6	-	864	864	-	158	158	158	18.3
12	North-West	40	147	187	4	12	16	10.0	8.2	8.6	1093	1471	2564	237	268	505	505	19.7
13	Ghanzi	8	38	46	1	5	6	12.5	13.2	13.0	194	630	824	41	119	160	159	19.3
14	Kgalagadi	-	54	54	-	5	5	-	-	9.3	-	1075	1075	-	200	200	200	18.6
	Sub-Total**	523	1362	1885	51	106	157	9.8	7.8	8.3	9499	13872	23371	2051	2600	4651	4639	19.8
	Total	1076	1362	2438	109	106	215	10.1	7.8	8.8	20421	13872	34293	4401	2600	7001	6988	20.4

APPENDIX D: LIST OF PERSONNEL INVOLVED IN THE BOTSWANA MIS-2000

MEMBERS OF THE REFERENCE GROUP

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3. M. P. Kerekang	Principal Statistician	CSO
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15. T. J. Bandeke	Nutrition Unit	FHD
16. K. Tautona	Nutrition Unit	FHD
17. Dr. B. Mduma	Nutrition Unit	FHD
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