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METHODOLOGY FOR TWO WEIGHTING APPLICATIONS FOR THE 2008 ZAMBIA SUPPLEMENTAL SURVEY

By

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The views expressed in this document are exclusively those of the authors.

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ACRONYMS

CSO	**Central Statistical Office**
MACO	**Ministry of Agriculture and Cooperatives**
MSU	**Michigan State University**
PHS	**Post Harvest Survey**
FSRP	**Food Security Research Project**
SEA	**Standard Enumeration Area**
SS	**Supplemental Survey**
USAID	**United States Agency for International Development**
Sida	**Swedish International Development Agency**

Methodology for Two Weighting Applications for the 2008 Zambia Supplemental Survey

1. Background To Supplemental Surveys in Zambia

In 2001 the first Supplemental Survey (SS) was conducted using the panel of the sample households selected for the 1999/2000 Post-Harvest Survey (PHS). All of the sample households in the PHS 99/00 that were found in the sample standard enumeration areas (SEAs) in 2001 were included in the sample for this first SS. The SS04 and SS08 followed this same panel of sample households three and seven years later to provide additional longitudinal data for these households. The main objective of the SS was to provide longitudinal data for the sample households in the panel that can be used to study micro-level changes in agricultural practices and socio-economic characteristics over time. The correlation in the sample data between each SS and the PHS 99/00 will improve the precision of the estimates of trends over time for relative indicators such means and proportions.

Two different weighting applications were developed for the SS08 data. The first application was based on strictly following the original panel households for a longitudinal study. The second weighting application was based on using the full sample, including the new sample households, to represent the current population of rural households at the time of the survey. The purpose of this report is to document the methodology used for each weighting application. The reports on "Recommendations for Adjusting Weights for Zambia Post-Harvest Survey Data Series and Improving Estimation Methodology for Future Surveys" (Megill, March 2005) and "Revised Weights for 2001 and 2004 Supplemental Surveys" (Megill, June 2005) describe the previous weighting procedures used for SS01 and SS04. Those reports should be used as reference documents together with the current report.

The sampling and survey procedures used for SS08 were modified slightly from the previous SS methodology. A new listing of households was conducted in the sample SEAs, and new sample households were selected by farm size category in addition to the panel households, in order to complete about 20 interviews per sample SEA. Non-agricultural households in the new listing were included with the farm size category A agricultural households for the sample selection. The selection procedures are described in the field manual. Some of the panel households were interviewed outside the sample SEA if they did not move very far.

The purpose of this report is to document the methodology used for the two different SS08 weighting applications. These weighting procedures are described separately below.

2. SS08 Panel Weights for Longitudinal Analysis

The SS08 panel weights were designed to follow the panel households over time. The SS08 panel represents households enumerated in the PHS 99/00 that still exist in the same general location in 2008. For the SS08 weights the panel households interviewed outside the SEA boundaries are included in the calculation of the weights, since these households were found and interviewed near the original sample SEA. Given the attrition over time from households moving or dissolving, the weighted total number of households is decreasing over time. The SS08 panel weights were calculated using a similar methodology to that used for the

corresponding SS01 and SS04 panel weights, so reference can be made to the previous documentation. The series of PHS weights had been adjusted based on the projected total number of agricultural households by district at the mid-point of each survey. Since the SS followed a panel of sample households from the PHS 99/00, the adjusted weights for that survey were used as a basis for calculating the SS08 panel weights. The PHS 99/00 weights were further adjusted to account for the attrition of the agricultural households over time, as follows:

$$W_{AS08hi} = W_{A00hi} \times \frac{n_{00hi} - m_{S01hi} - d_{S01hi} - m_{S04hi} - d_{S04hi} - m_{S08hi} - d_{S08hi}}{c_{S08hi}},$$

where:

W_{AS08hi} = adjusted weight for the sample panel households in SS08 in the i-th sample SEA (by farm size category) in stratum (district) h

W_{A00hi} = adjusted weight for the PHS 99/00 sample households in the i-th sample SEA (by farm size category) in district h, described in previous report

n_{00hi} = number of panel households in the PHS 99/00 sample for the i-th sample SEA (by farm size category) in district h

m_{S01hi} = number of sample panel households that moved from the i-th sample SEA (by farm size category) in district h prior to SS01

d_{S01hi} = number of sample panel households in the i-th sample SEA (by farm size category) in district h that dissolved prior to SS01

m_{S04hi} = number of sample panel households that moved from the i-th sample SEA (by farm size category) in district h between SS01 and SS04

d_{S04hi} = number of sample panel households in the i-th sample SEA (by farm size category) in district h that were dissolved between SS01 and SS04

m_{S08hi} = number of sample panel households that moved from the i-th sample SEA (by farm size category) in district h between SS04 and SS08

d_{S08hi} = number of sample panel households in the i-th sample SEA (by farm size category) in district h that were dissolved between SS04 and SS08

c_{S08hi} = total number of sample panel households with completed interviews for SS08 in the i-th sample SEA (by farm size category) in district h

Since the SS08 panel weights only represent households that still exist in the same location since the baseline PHS 99/00, the weighted total number of households will be decreasing over the years based on the attrition rate (corresponding to households that moved or were

dissolved). After generating the adjusted panel weights for the SS08 data, the resulting weighted total number of households was compared to the corresponding results from the 1999/2000 PHS and the previous rounds of the SS. It is interesting to follow the weighted total number of panel households over time, shown in Table 1.

Table 1. Weighted Total Number of Households in Frame Represented by Each SS Panel, and Corresponding Percent of PHS 99/00 Frame

Panel	Weighted no. hhs.	% PHS 99/00
PHS99/00	1,084,471	100.0%
SS01	1,020,690	94.1%
SS04	861,201	79.4%
SS08	697,091	64.3%

Considering that 9 years have passed since the beginning of this panel of sample households, the implied level of attrition appears to be reasonable. As pointed out in the previous documentation, these panel weights will mostly be used for measuring relative values and trends within the data set for the panel households.

3. SS08 Weights for Full Sample of Panel and New Households

One difference between the SS08 and the previous rounds of the SS in 2001 and 2004 is that new households were selected for the SS08 from the listing in addition to interviewing the original panel households. Also, replacement households were selected for the SS08 from the new listing to complete 20 interviews per SEA. Therefore the calculation of the weights for the SS08 full sample uses a different methodology than that used for the SS04 weights for the full sample, which had been based on weighting up the panel data. Non-agricultural households were included in the selection of the small farms in size category A for SS08. Since no information on the new non-interviews was recorded, we can only calculate approximate weights. We will again use the adjusted weights from the PHS 99/00 as the starting point for calculating the new weights for the full SS08 sample, given that the first stage probabilities for the SEAs were established at the time the panel was originally selected, based on the previous sampling frame.

Given that the original panel was based on a frame of agricultural households and part of the weight adjustment is based on the projected total number of agricultural households, the weights are calculated based on the sample agricultural households with completed interviews from the panel and the new listing. The non-agricultural households with completed interviews in each SEA will then receive the weight of the category A agricultural households in the same SEA in order to weight up the total number of households. This will be further explained later.

The change in the full sample weights for the households in each sample SEA and farm size category between the original PHS 99/00 and the SS08 comes from the last stage of selection. This change (generally an increase) in the weights can be expressed as the ratio of the corresponding last stage components of the weights as follows:

$$\frac{M_{08hij} \big/ m_{08hij}}{M_{99hij} \big/ m_{99hij}} = \frac{M_{08hij}}{M_{99hij}} \times \frac{m_{99hij}}{m_{08hij}},$$

where:

M_{08hij} = number of agricultural households listed in the j-th size category in the i-th sample SEA in district h for the 2008 SS, including panel households

m_{08hij} = total number of sample agricultural households selected in the j-th size category in the i-th sample SEA in district h, including new and panel households, with completed interviews for the 2008 SS

M_{99hij} = number of agricultural households listed in the j-th size category in the i-th sample SEA in district h for the PHS 99/00

m_{99hij} = number of sample agricultural households selected in the j-th size category in the i-th sample SEA in district h, with completed interviews for the PHS 99/00

The first component of this last stage weighting factor (M_{08hij} / M_{99hij}) represents the growth in the total number of agricultural households in the sample SEA for each farm size category. However, in our estimation procedures we are representing this growth by applying a weight adjustment based on the projected total number of agricultural households in the (old) district. Therefore the weights for the full sample were calculated using the following formula, using notation consistent with that used in the previous report:

$$W_{S08hij} = W'_{00hij} \times \frac{m_{99hij}}{m_{08hij}} \times \frac{\hat{M}_{AS08h}}{\hat{M}_{A00h}},$$

where:

W_{S08hij} = revised SS08 full sample weight for the sample households in the j-th farm size category in the i-th sample SEA in district h

W'_{00hij} = adjusted PHS 99/00 weight for the sample agricultural households in the j-th farm size category in the i-th sample SEA in district h (column labeled ADJWT99 in the weighting spreadsheet)

$\hat{M}_{AS08h}$ = projected total number of rural agricultural households for SS08 in district h, with a reference date of June 20, 2008

$\hat{M}_{A00h}$ = projected total number of rural agricultural households for reference date May 1, 2000 (used for adjusting the PHS 99/00 weights) in district h

For SS08 there were six sample SEAs where a corresponding incorrect SEA was listed and new households were selected and interviewed. Later the interviewers went back to the correct SEA and interviewed the panel households that they could find, but they did not do a new listing or interview new households in those SEAs. In these cases the FSRP team decided to use only the data for the new households interviewed in the incorrect SEAs in the analysis of the full SS08 sample. Since we do not have information on the number of households in the original frame for the correct and incorrect SEAs for adjusting the weights, the full sample weights for these six SEAs were calculated using the formula above with the average value for the adjusted PHS 99/00 weight (W'_{00hij}) in the corresponding farm size category across all the sample SEAs in the same district. Even though there may be a slight bias in the resulting weights for these few SEAs, this would not have much effect on the overall results. The increased precision based on the larger effective sample size from including the data for the new households in these six SEAs would more than offset any corresponding small bias. It should also be pointed out that the panel analysis excludes the data from new households, so the panel weights are based on the original (correct) SEAs where the panel households were interviewed.

There were another five sample SEAs where it was discovered that the original weights were calculated using the frame information for an incorrect SEA, although the SEA with the panel households was listed, and new households were interviewed as well as the panel households. In this case there would also be a slight bias in the weights based on the difference in measures of size from the sampling frame for the correct and incorrect SEAs. These weights were not adjusted given the lack of information on the number of households in the frame for the correct and incorrect SEAs. Again, this bias should be very small since the SEAs were delineated to have a similar size for the census enumeration; therefore such bias should not have much effect on the SS08 results.

In some SEAs the interviewers selected more or less than the 20 households specified in the manual. However, the current weighting procedures automatically adjust the weights based on the actual number of agricultural households with completed interviews for each farm size category in the sample SEA, so this is not a problem.

As shown in Table 2, using the full sample weights, the weighted total number of agricultural households from the SS08 data is approximately 1,493,197, which is very close to the projected total number of agricultural households for the mid-point of the survey (June 20, 2008), 1,496,892. The small difference is partly due to sample SEAs where no panel households were interviewed for farm size category B. However, given the nature of the projections, we can consider that this weighted total number of agricultural households is a validation of the full weights. When the full weights are applied to all households including the non-agricultural households, the weighted total number of households is approximately 1,617,870. The difference of about 125,000 can be considered the weighted total estimate of non-agricultural households represented in the frame.

It is important to recognize a major caveat that the projected total number of agricultural households in the old districts is based on the assumption that the estimated growth trends in the old districts between the 1990 and 2000 censuses are continuing at the same rate. Fortunately Zambia is planning a new census next year that will make it possible to develop a new representative sampling frame. Perhaps the weights for the historical series of PHS and SS data can be re-examined following the census.

Table 2. Projected Number of Rural Agricultural Households by District and Year

OLD DISTRICTS	PHS Post Harvest Year, Reference Date for Listing															Total Hhs. 1990 Census PHS Frame	Total Hhs. Rural Areas 2000 Census	Total Rural Agric. Hhs. 2000 Census
	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	06/08			
	01-May-91	01-May-92	01-May-93	01-May-94	01-May-95	01-May-96	01-May-97	01-May-98	01-May-99	01-May-00	01-May-01	01-May-02	01-May-03	01-May-04	20-Jun-08	01-Aug-90	01-Aug-00	01-Aug-00
11 KABWE-RURAL	29,478	31,796	34,289	36,978	39,877	43,013	46,386	50,023	53,945	58,187	62,750	67,670	72,976	78,715	107,591	32,960	70,162	59,305
12 KABWE-URBAN	2,224	2,308	2,395	2,486	2,580	2,677	2,779	2,884	2,993	3,106	3,223	3,345	3,471	3,603	4,201	2,559	3,709	3,135
13 MKUSHI	13,912	13,943	13,975	14,006	14,038	14,069	14,101	14,133	14,165	14,197	14,229	14,261	14,293	14,326	14,460	16,923	17,309	14,205
14 MUMBWA	15,503	15,993	16,498	17,018	17,555	18,110	18,682	19,271	19,879	20,508	21,155	21,822	22,511	23,223	26,409	17,019	23,224	20,669
15 SERENJE	14,365	14,874	15,400	15,944	16,508	17,093	17,697	18,322	18,970	19,642	20,337	21,055	21,799	22,572	26,062	14,903	21,098	19,815
21 CHILILABOMBWE	1,737	1,786	1,836	1,888	1,941	1,996	2,052	2,110	2,169	2,230	2,293	2,358	2,424	2,492	2,796	2,092	2,762	2,246
22 CHINGOLA	3,458	3,545	3,634	3,724	3,817	3,913	4,011	4,111	4,214	4,319	4,427	4,537	4,651	4,767	5,280	3,871	4,955	4,346
23 KALULUSHI	2,108	2,241	2,383	2,534	2,694	2,865	3,046	3,239	3,444	3,662	3,894	4,140	4,402	4,681	6,034	2,425	4,480	3,719
24 KITWE	2,030	2,026	2,021	2,016	2,011	2,007	2,002	1,997	1,993	1,988	1,984	1,979	1,974	1,970	1,951	2,733	2,670	1,987
25 LUANSHYA	2,761	2,954	3,160	3,380	3,615	3,868	4,137	4,425	4,734	5,064	5,417	5,794	6,198	6,631	8,762	3,666	7,192	5,151
26 MUFULIRA	2,779	2,904	3,036	3,173	3,316	3,466	3,623	3,786	3,957	4,137	4,324	4,519	4,723	4,937	5,927	3,106	4,833	4,183
27 NDOLA-RURAL	29,469	30,444	31,448	32,485	33,557	34,667	35,810	36,992	38,212	39,476	40,778	42,123	43,512	44,952	51,415	32,584	45,088	39,800
31 CHADIZA	11,137	11,479	11,830	12,192	12,565	12,950	13,346	13,754	14,175	14,610	15,056	15,517	15,992	16,482	18,671	11,372	15,374	14,721
32 CHAMA	9,437	9,795	10,164	10,548	10,946	11,361	11,790	12,235	12,697	13,177	13,675	14,191	14,727	15,284	17,819	9,505	13,773	13,301
33 CHIPATA	44,859	46,478	48,151	49,884	51,679	53,545	55,472	57,468	59,537	61,686	63,906	66,206	68,589	71,065	82,267	46,483	66,220	62,238
34 KATETE	25,431	26,220	27,031	27,868	28,731	29,623	30,539	31,485	32,459	33,467	34,503	35,571	36,672	37,810	42,896	26,865	36,449	33,725
35 LUNDAZI	31,298	32,377	33,490	34,641	35,833	37,068	38,342	39,661	41,024	42,439	43,898	45,407	46,969	48,588	55,886	31,692	44,451	42,802
36 PETAUKE	44,251	45,298	46,366	47,460	48,580	49,729	50,902	52,103	53,332	54,594	55,882	57,201	58,550	59,935	66,009	45,215	57,100	54,916
41 KAWAMBWA	15,036	15,101	15,166	15,231	15,296	15,362	15,428	15,495	15,561	15,628	15,695	15,763	15,830	15,899	16,183	16,881	17,621	15,645
42 MANSA	21,082	22,069	23,098	24,176	25,304	26,488	27,724	29,017	30,371	31,792	33,276	34,828	36,454	38,159	46,088	21,985	34,701	32,160
43 MWENSE	17,363	17,712	18,068	18,430	18,800	19,178	19,562	19,954	20,355	20,764	21,180	21,605	22,038	22,481	24,407	18,078	22,052	20,868
44 NCHELENGE	17,714	18,566	19,457	20,389	21,367	22,395	23,468	24,594	25,773	27,012	28,307	29,665	31,087	32,582	39,553	24,218	38,700	27,333
45 SAMFYA	20,758	21,472	22,209	22,971	23,760	24,577	25,420	26,293	27,195	28,131	29,096	30,094	31,127	32,198	37,025	22,511	31,553	28,371
51 LUANGWA	2,649	2,667	2,685	2,704	2,722	2,741	2,759	2,778	2,797	2,816	2,835	2,855	2,874	2,894	2,976	2,999	3,210	2,821
52 LUSAKA-RURAL	18,216	19,047	19,913	20,819	21,766	22,759	23,794	24,877	26,008	27,194	28,431	29,725	31,077	32,494	39,064	27,892	43,533	27,501
61 CHILUBI	7,987	8,359	8,747	9,153	9,578	10,024	10,489	10,976	11,485	12,020	12,578	13,161	13,772	14,413	17,391	8,655	13,629	12,158
62 CHINSALI	14,719	15,337	15,979	16,648	17,344	18,073	18,829	19,617	20,439	21,297	22,188	23,117	24,085	25,096	29,740	15,431	23,262	21,518
63 ISOKA	20,364	21,140	21,943	22,776	23,641	24,542	25,474	26,442	27,446	28,492	29,574	30,698	31,864	33,078	38,598	20,752	30,138	28,761
64 KAPUTA	7,175	7,668	8,193	8,755	9,354	9,997	10,681	11,413	12,195	13,033	13,925	14,879	15,898	16,990	22,352	9,329	18,105	13,252
65 KASAMA	29,693	30,713	31,765	32,853	33,978	35,145	36,349	37,594	38,882	40,217	41,595	43,019	44,493	46,021	52,907	31,182	43,681	40,560
66 LUWINGU	11,302	11,561	11,825	12,095	12,371	12,654	12,943	13,239	13,541	13,851	14,167	14,491	14,821	15,161	16,646	12,712	15,934	13,930
67 MBALA	23,232	24,253	25,315	26,424	27,581	28,793	30,054	31,370	32,744	34,183	35,680	37,243	38,874	40,582	48,462	26,163	40,181	34,554
68 MPIKA	16,748	17,235	17,736	18,250	18,780	19,326	19,887	20,464	21,058	21,670	22,299	22,946	23,612	24,299	27,353	19,081	25,405	21,827
69 MPOROKOSO	9,114	9,495	9,891	10,304	10,734	11,183	11,650	12,136	12,642	13,172	13,721	14,294	14,890	15,514	18,375	9,563	14,398	13,308
71 MUFUMBWE	3,776	4,001	4,239	4,491	4,758	5,041	5,341	5,658	5,995	6,352	6,729	7,129	7,553	8,003	10,164	3,856	6,872	6,445
72 KABOMPO	8,178	8,506	8,846	9,199	9,567	9,951	10,348	10,762	11,192	11,640	12,106	12,589	13,093	13,617	16,016	8,804	13,032	11,756
73 KASEMPA	5,420	5,643	5,875	6,116	6,367	6,629	6,901	7,185	7,480	7,788	8,107	8,440	8,787	9,148	10,806	5,623	8,411	7,867
74 MWINILUNGA	13,821	14,301	14,797	15,310	15,840	16,391	16,959	17,546	18,154	18,785	19,436	20,109	20,806	21,529	24,790	14,681	20,645	18,947
75 SOLWEZI	14,772	15,743	16,775	17,875	19,047	20,299	21,630	23,048	24,558	26,173	27,888	29,717	31,665	33,746	43,891	16,724	31,573	26,595
76 ZAMBEZI	12,175	12,565	12,968	13,383	13,811	14,254	14,711	15,181	15,667	16,170	16,688	17,222	17,773	18,343	20,899	12,995	17,812	16,299
81 CHOMA	15,732	16,328	16,944	17,584	18,248	18,939	19,654	20,396	21,166	21,968	22,797	23,658	24,551	25,481	29,706	17,752	25,724	22,174
82 GWEMBE	4,672	4,665	4,658	4,650	4,643	4,636	4,629	4,622	4,615	4,608	4,601	4,594	4,587	4,580	4,551	5,384	5,302	4,606
83 KALOMO	20,301	21,412	22,580	23,812	25,111	26,485	27,931	29,455	31,062	32,761	34,549	36,434	38,422	40,524	50,493	22,088	37,590	33,203
84 LIVINGSTONE	831	811	791	772	753	734	716	699	682	665	649	633	618	602	544	1,547	1,208	661
85 MAZABUKA	11,923	12,538	13,184	13,863	14,577	15,330	16,119	16,949	17,822	18,742	19,707	20,722	21,789	22,915	28,209	16,292	26,930	18,981
86 MONZE	13,829	14,409	15,011	15,639	16,293	16,976	17,686	18,425	19,196	20,000	20,837	21,708	22,615	23,564	27,918	14,434	21,748	20,208
87 NAMWALA	10,393	10,925	11,482	12,068	12,683	13,332	14,012	14,726	15,477	16,269	17,098	17,970	18,887	19,853	24,392	10,979	18,062	16,474
88 SIAVONGA	3,985	4,179	4,382	4,595	4,818	5,053	5,298	5,556	5,826	6,110	6,406	6,717	7,044	7,387	8,990	4,829	7,763	6,183
89 SINAZONGWE	5,811	5,994	6,182	6,376	6,576	6,783	6,996	7,215	7,442	7,676	7,917	8,165	8,422	8,687	9,872	8,621	11,745	7,736
91 KALABO	17,546	17,949	18,361	18,782	19,212	19,654	20,105	20,565	21,037	21,521	22,014	22,519	23,035	23,565	25,883	18,121	22,736	21,644
92 KAOMA	16,715	17,391	18,092	18,822	19,581	20,372	21,194	22,048	22,937	23,865	24,827	25,828	26,870	27,957	32,927	18,597	27,623	24,104
93 LUKULU	9,139	9,419	9,707	10,003	10,308	10,624	10,948	11,282	11,627	11,983	12,349	12,726	13,114	13,516	15,307	9,591	12,959	12,074
94 MONGU	17,900	18,190	18,484	18,783	19,087	19,396	19,710	20,028	20,352	20,682	21,017	21,356	21,702	22,053	23,567	20,464	24,027	20,766
95 SENANGA	21,000	20,640	20,288	19,941	19,601	19,265	18,936	18,613	18,295	17,982	17,675	17,373	17,076	16,784	15,629	22,984	19,345	17,904
96 SESHEKE	11,387	12,427	13,559	14,794	16,141	17,616	19,220	20,971	22,881	24,971	27,246	29,727	32,435	35,398	50,781	11,361	27,184	25,526
ZAMBIA	778,695	806,892	836,300	867,060	899,242	933,015	968,273	1,005,190	1,043,853	1,084,471	1,126,921	1,171,418	1,218,074	1,267,145	1,496,892	859,132	1,245,243	1,094,984

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