TECHNICAL NOTES PART B

Annexure-I

ESTIMATION PROCEDURE ADOPTED FOR PSLM SURVEY

NOTATIONS:

N_h = Total number of Primary Sampling Units (PSUs) in the hth stratum of a province.

n_h = Total number of sample PSUs in the hth stratum of a province.

M_{hi} = Total number of Secondary Sampling Units (SSUs) in the ith sample PSU of hth stratum of a province.

m_{hi} = Number of sample SSUs in the ith sample PSU of hth stratum of a province.

P_{hi} = Assigned probability of selection of ith PSU of the hth stratum of a province.

y_{hij} = Value of any characteristic y of jth SSU within ith PSU of hth stratum of a province.

x_{hij} = Value of any characteristic x of jth SSU within ith PSU of hth stratum of a province with whose respect proportion is required.

(i): ESTIMATION FORMULAE FOR TOTALS AND THEIR VARIANCES

$$N = \sum_{h=1}^{L} N_h$$

$$n = \sum_{h=1}^{L} n_h$$

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

OR

$$\hat{Y}_h = \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{1}{p_{hi}} \frac{M_{hi}}{m_{hi}} \sum_{j=1}^{m_{hi}} y_{hij}$$

$$\hat{Y} = \sum_{h=1}^{L} \hat{Y}_h = \sum_{h=1}^{L} \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{\hat{Y}_{hi}}{p_{hi}}$$

For X, another variable of interest, we have

$$\hat{X}_h = \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{\hat{X}_{hi}}{P_{hi}} = \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{1}{P_{hi}} \frac{M_{hi}}{m_{hi}} \sum_{j=1}^{m_{hi}} x_{hij}$$

$$\hat{X} = \sum_{h=1}^{L} \hat{X}_h = \sum_{h=1}^{L} \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{\hat{X}_{hi}}{p_{hi}}$$

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

$$v(\hat{y}_h) = \frac{1}{n_h} s^2{}_{ht} = \frac{1}{n_h(n_h-1)} \left(\sum_{i=1}^{n_h} \frac{\hat{Y}^2{}_{hi}}{P^2{}_{hi}} - \frac{(\sum_{i=1}^{n_h} \frac{\hat{y}_{hi}}{P_{hi}})^2}{n_h} \right)$$

$$v(\hat{Y}) = \sum_{h=1}^{L} \frac{1}{n_h} s^2{}_{ht} = \sum_{h=1}^{L} \frac{1}{n_h(n_h-1)} \left(\sum_{i=1}^{n_h} \frac{\hat{Y}^2{}_{hi}}{P^2{}_{hi}} - \frac{(\sum_{i=1}^{n_h} \frac{\hat{y}_{hi}}{P_{hi}})^2}{n_h} \right)$$

(ii): FORMULA FOR RATIO ESTIMATES

$$r = \frac{\hat{Y}}{\hat{X}}$$

Where Y^ and X^ can be estimated by equations under item (i) given above.

$$Rel\ V(r) = \frac{1}{\hat{X}^2} \sum_{h=1}^{L} \frac{1}{n_h} s^2{}_{hb} + \frac{1}{\hat{x}^2} \sum_{h=1}^{L} \frac{1}{n_h} \sum_{i=1}^{n_h} \frac{M^2{}_{hi}}{p^2{}_{hi} m_{hi}} \frac{(M_{hi} - m_{hi})}{M_{hi}} s^2{}_{hw}$$

Where

$s^2_{hb} = s^2_{ht} - s^2_{hw}$

$$s^2_{ht} = s^2_{hy} + r^2 s^2_{hx} - 2r\, s_{hxy}$$

$$s^2_{hx} = \frac{1}{(n_h - 1)}\left[\sum_{i=1}^{n_h} \frac{\hat{x}^2_{hi}}{p^2_{hi}} - \frac{\left(\sum_{i=1}^{n_h} \frac{\hat{x}_{hi}}{p_{hi}}\right)^2}{n_h}\right]$$

$$s_{hxy} = \frac{1}{n_h - 1}\left[\sum_{i=1}^{n_h}\left(\frac{\hat{X}_{hi}}{p_{hi}}\frac{\hat{y}_{hi}}{p_{hi}}\right) - \frac{\left(\sum_{i=1}^{n_h} \frac{\hat{X}_{hi}}{P_{hi}}\right)\left(\sum_{i=1}^{n_h} \frac{\hat{y}_{hi}}{P_{hi}}\right)}{n_h}\right]$$

$$s^2_{hy} = \frac{1}{(n_h - 1)}\left[\sum_{i=1}^{n_h} \frac{\hat{y}^2_{hi}}{p^2_{hi}} - \frac{\left(\sum_{i=1}^{n_h} \frac{\hat{y}_{hi}}{p_{hi}}\right)^2}{n_h}\right]$$

$$s^2_{hw} = \frac{1}{n_h - 1}\sum_{i=1}^{n_h} \frac{1}{p^2_{hi}} \frac{M^2_{hi}}{m_{hi}} \frac{(M_{hi} - m_{hi})}{M_{hi}} s^2_{hi}$$

And

$$s^2_{hi} = s^2_{hiy} + r^2 s^2_{hix} - 2r\, s_{hixy}$$

$$s^2_{hiy} = \frac{1}{(m_{hi} - 1)} \left[\sum_{j=1}^{m_{hi}} y^2_{hij} - \frac{\left(\sum_{j=1}^{m_{hi}} y_{hij} \right)^2}{m_{hi}} \right]$$

$$s^2_{hix} = \frac{1}{(m_{hi} - 1)} \left[\sum_{j=1}^{m_{hi}} x^2_{hij} - \frac{\left(\sum_{j=1}^{m_{hi}} x_{hij} \right)^2}{m_{hi}} \right]$$

$$s^2_{hixy} = \frac{1}{(m_{hi} - 1)} \left[\sum_{j=1}^{m_{hi}} x_{hij}\ y_{hij} - \frac{\left(\sum_{j=1}^{m_{hi}} x_{hij} \sum_{j=1}^{m_{hi}} y_{hij} \right)}{m_{hi}} \right]$$

District-Wise Distribution of Sample Areas and Household – PSLM 2012-13

S.no/code	Districts	Sample Area			Sample Household		
		Urban	Rural	Total	Urban	Rural	Total
Pakistan		**2306**	**3105**	**5411**	**27672**	**49680**	**77352**
Khyber Pakhtunkhwa		**272**	**594**	**866**	**3264**	**9504**	**12768**
111	Bannu	8	22	30	96	352	448
112	Lakki Marwat	8	21	29	96	336	432
121	D.I.Khan	12	25	37	144	400	544
122	Tank	7	19	26	84	304	388
131	Abbottabad	16	25	41	192	400	592
132	Batagram	0	22	22	0	352	352
133	Haripur	14	24	38	168	384	552
134	Kohistan	0	23	23	0	368	368
135	Manshera	10	28	38	120	448	568
136	Torgarh	0	17	17	0	272	272
141	Hangu	10	21	31	120	336	456
142	Karak	6	23	29	72	368	440
143	Kohat	14	23	37	168	368	536
151	Bonair	0	29	29	0	464	464
152	Chitral	9	24	33	108	384	492
153	Lower Dir	8	25	33	96	400	496
154	Malakand	8	24	32	96	384	480
155	Shangla	0	25	25	0	400	400
156	Swat	12	26	38	144	416	560
157	Upper Dir	8	25	33	96	400	496
161	Mardan	18	27	45	216	432	648
162	Swabi	14	24	38	168	384	552
171	Charsada	14	22	36	168	352	520
172	Nowsehra	16	26	42	192	416	608
173	Peshawar	60	24	84	720	384	1104
Punjab		**1103**	**1196**	**2299**	**13236**	**19136**	**32372**
211	Bhawanagar	21	42	63	252	672	924
212	Bahawalpur	39	42	81	468	672	1140
213	Rahim Yar Khan	24	54	78	288	864	1152
221	D.G Khan	19	33	52	228	528	756
222	Layyah	15	24	39	180	384	564
223	Muzaffar Garh	15	39	54	180	624	804
224	Rajanpur	15	27	42	180	432	612
231	Chiniot	20	24	44	240	384	624
232	Faisalabad	102	69	171	1224	1104	2328
233	Jhang	24	44	68	288	704	992

S.no/code	Districts	Sample Area			Sample Household		
		Urban	Rural	Total	Urban	Rural	Total
234	T.T Singh	21	33	54	252	528	780
241	Gujranwala	57	36	93	684	576	1260
242	Gujrat	22	33	55	264	528	792
243	Hafaizabad	15	27	42	180	432	612
244	Mandi Bahauddin	15	27	42	180	432	612
245	Narowal	15	30	45	180	480	660
246	Sialkot	36	21	57	432	336	768
251	Kasur	27	42	69	324	672	996
252	Lahore	208	27	235	2496	432	2928
253	Nankana Sahib	12	22	34	144	352	496
254	Sheikhupura	21	29	50	252	464	716
261	Khanewal	15	39	54	180	624	804
262	Lodhrean	15	21	36	180	336	516
263	Multan	56	42	98	672	672	1344
264	Vehari	19	42	61	228	672	900
271	Ättock	15	27	42	180	432	612
272	Chakwal	15	27	42	180	432	612
273	Jehlum	15	24	39	180	384	564
274	Rawalpindi	72	36	108	864	576	1440
281	Okara	24	45	69	288	720	1008
282	Pakpatan	15	27	42	180	432	612
283	Sahiwal	15	36	51	180	576	756
291	Bhakar	15	24	39	180	384	564
292	Khushab	15	21	36	180	336	516
293	M ianwali	15	21	36	180	336	516
294	Sarghodha	39	39	78	468	624	1092
Sindh		**696**	**711**	**1407**	**8352**	**11376**	**19728**
311	Baddin	15	45	60	180	720	900
312	Dadu	10	38	48	120	608	728
313	Hyderabad	48	18	66	576	288	864
314	Jamshoro	15	19	34	180	304	484
315	Mitiari	10	20	30	120	320	440
316	Tando Allah Yar	13	17	30	156	272	428
317	Tando Mohd Khan	12	18	30	144	288	432
318	Thatta	15	48	63	180	768	948
321	Karachi	338	27	365	4056	432	4488
331	Jaccobabad	11	24	35	132	384	516
332	Kashmore	10	21	31	120	336	456
333	Larkana	13	27	40	156	432	588
334	Shahdadkot	10	33	43	120	528	648

S.no/code	Districts	Sample Area			Sample Household		
		Urban	Rural	Total	Urban	Rural	Total
335	Shiokarpur	15	30	45	180	480	660
341	Mir pur khas	20	38	58	240	608	848
342	Sanghar	15	51	66	180	816	996
343	Tharparkar	12	39	51	144	624	768
344	Ümer Kot	18	30	48	216	480	696
351	Ghotki	15	36	51	180	576	756
352	Khairpur	15	45	60	180	720	900
353	Nowshero Feroze	15	36	51	180	576	756
354	Nawabsha	15	30	45	180	480	660
355	Sukkur	36	21	57	432	336	768
Balochistan		**205**	**589**	**794**	**2460**	**9424**	**11884**
411	Awaran	0	20	20	0	320	320
412	Kalat	6	20	26	72	320	392
413	Kharan	5	26	31	60	416	476
414	Khuzdar	11	20	31	132	320	452
415	Lasbella	12	19	31	144	304	448
416	Mastung	8	20	28	96	320	416
417	Washuk	0	30	30	0	480	480
421	Gawadar	12	14	26	144	224	368
422	Keych/Turbat	8	22	30	96	352	448
	Panjgur	0	0	0	0	0	0
431	Jaffarabad	8	20	28	96	320	416
432	Jhal Magsi	2	20	22	24	320	344
433	Bolan/Kachhi	7	20	27	84	320	404
434	Nasirabad	6	21	27	72	336	408
441	Chaghi	5	22	27	60	352	412
442	Qilla Abdullah	8	20	28	96	320	416
443	Nauski	4	22	26	48	352	400
444	Pashin	6	20	26	72	320	392
445	Quetta	44	21	65	528	336	864
451	Dera Bugti	4	19	23	48	304	352
452	Harnai	5	18	23	60	288	348
453	Kohlu	2	19	21	24	304	328
454	Sibbi	12	17	29	144	272	416
455	Ziarat	2	17	19	24	272	296
461	Barkhan	5	19	24	60	304	364
462	Qilla Saifullah	4	21	25	48	336	384
463	Loralai	8	20	28	96	320	416
464	Musa Khel	3	21	24	36	336	372
465	Sherani	0	21	21	0	336	336

S.no/code	Districts	Sample Area			Sample Household		
		Urban	Rural	Total	Urban	Rural	Total
466	Zhob	8	20	28	96	320	416
611	Islamabad	30	15	45	360	240	600

Note: Non Contacted and Refusal households are included in the list of sample households.