Appendix A

Methodogy

1. Sample Design

A Stratified Two - Stage Sampling was adopted for the survey. Provinces were constituted strata. The primary and secondary sampling units were blocks for municipal areas / villages for non - municipal areas and private households / persons in the special households respectively.

Stratification

Provinces were constituted strata. There were altogether 76 strata. Each stratum was divided into two parts according to the type of local administration, namely municipal areas and non - municipal areas.

Selection of Primary Sampling Unit

The sample selection of blocks / villages were performed separately and independently in each part by using probability proportional to size - total number of households. The total sample blocks / villages was 5,796 from 109,966 blocks / villages.

The total number of sample blocks / villages selected for enumeration by region and type of local administration was as follows :

Region / Stratum	Total	Municipal Areas	Non - Municipal Areas
Bangkok Metropolis	312	312	-
Central (Excluding Bangkok Metropolis)	1,968	1,080	888
North	1,236	696	540
Northeast	1,296	720	576
South	984	528	456
Total	**5,796**	**3,336**	**2,460**

Selection of Secondary Sampling Unit

Private households were our ultimate sampling units. A new listing of private households were made for every sample block / village to serve as the sampling frame. In each sample block / village, a systematic sample of private households were selected with the following sample size :

Municipal areas : 15 sample households per block

Non - municipal areas : 12 sample households per village

Before selecting sample private households in each sample block / village, the list of private households was rearranged by household ' s size - member of the household and type of economic household.

All special households located within the sample areas were included in the sample and the persons in the special household were systematically selected for the interviewing.

The total number of sample private households selected for enumeration by region and type of local administration was as follows :

Region / Stratum	Total	Municipal Areas	Non - Municipal Areas
Bangkok Metropolis	4,680	4,680	-
Central (Excluding Bangkok Metropolis)	26,856	16,200	10,656
North	16,920	10,440	6,480
Northeast	17,712	10,800	6,912
South	13,392	7,920	5,472
Total	**79,560**	**50,040**	**29,520**

Method of Estimation

The survey results were presented separately for 2 parts : Part 1 Characteristic of Persons and Part 2 Characteristic of Households, the results were presented at provincial level and regional level. At regional level, the results were presented separately for the Bangkok Metropolis and the remaining 75 provinces were classified by region, municipal areas and non-municipal areas.

Let			
	l =	1 , 2 , 3 , ... , 22	(age - sex group)
	k =	1 , 2 , 3 , ... , m_{hij}	(sample block / village)
	j =	1 , 2	(type of local administration)
	i =	1 , 2 , 3 , ... , A_h	(province)
	h =	1 , 2 , 3 , 4 , 5	(region)

Part 1 : Characteristic of Persons

1.1 Estimate of the Total Number of Persons with Characteristic X

1.1.1 Adjusted estimate of the total number of persons with characteristic X for the l^{th} age - sex group, j^{th} area, i^{th} province, h^{th} region was based on the formula :

$$x''_{1hijl} = \frac{x'_{1hijl}}{y'_{1hijl}} Y_{1hijl} = r_{1hijl}\, Y_{1hijl} \qquad \text{....................... (1)}$$

where x'_{1hijl} is the ordinary estimate of the total number of persons with characteristic X for the l^{th} age - sex group, j^{th} area, i^{th} province, h^{th} region.

y'_{1hijl} is the ordinary estimate of the total population for the l^{th} age - sex group, j^{th} area, i^{th} province, h^{th} region.

Y_{1hijl} /1 is the estimate, based on the population projection of the total population for the l^{th} age - sex group, j^{th} area, i^{th} province, h^{th} region.

r_{1hijl} is the ratio of the estimate of the total number of persons with characteristic X to the estimate of the total population for the l^{th} age - sex group, j^{th} area, i^{th} province, h^{th} region.

The formula of the estimate from a stratified two - stage sampling was as follows :

i) $$x'_{1hijl} = \frac{1}{m_{hij}} \sum_{k=1}^{m_{hij}} \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} x_{1hijkg} \qquad \text{....................... (2)}$$

where x_{1hijkl} is the total number of persons with characteristic X for the l^{th} age - sex group, k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

N_{hijk} is the total number of listing households in the k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

n_{hijk} is the total number of sample households in the k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

P_{hijk} is the probability of selection of the k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

m_{hij} is the total number of sample blocks / villages in the j^{th} area, i^{th} province, h^{th} region.

ii) $$y'_{1hijl} = \frac{1}{m_{hij}} \sum_{k=1}^{m_{hij}} \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} y_{1hijkl} \qquad \text{....................... (3)}$$

y_{1hijkl} is the total number of the population enumerated for the l^{th} age - sex group, k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

1.1.2 Adjusted estimate of the total number of persons with characteristic X for the j^{th} area, i^{th} province, h^{th} region was based on the formula :

$$x''_{1hij} = \sum_{l=1}^{22} x''_{1hijl} \qquad \text{....................... (4)}$$

/1 Population Projections for Thailand 2000 - 2030, National Economic and Social Development Board, The Tenth National Economic and Social Development Planning, October 2007.

1.1.3 Adjusted estimate of the total number of persons with characteristic X for the l^{th} age - sex group, i^{th} province, h^{th} region was based on the formula :

$$x''_{1hil} = \sum_{j=1}^{2} x''_{1hijl} \qquad \text{.......................} (5)$$

1.1.4 Adjusted estimate of the total number of persons with characteristic X for the i^{th} province, h^{th} region was based on the formula :

$$x''_{1hi} = \sum_{j=1}^{2} x''_{1hij} = \sum_{l=1}^{22} x''_{1hil} \qquad \text{.......................} (6)$$

1.1.5 Adjusted estimate of the total number of persons with characteristic X for the l^{th} age - sex group, j^{th} area, h^{th} region was based on the formula :

$$x''_{1hjl} = \sum_{i=1}^{A_h} x''_{1hijl} \qquad \text{.......................} (7)$$

Where A_h is the total number of provinces in the h^{th} region and $\sum_{h=1}^{5} A_h = 76$

1.1.6 Adjusted estimate of the total number of persons with characteristic X for the j^{th} area, h^{th} region. was based on the formula :

$$x''_{1hj} = \sum_{i=1}^{A_h} x''_{1hij} = \sum_{l=1}^{22} x''_{1hjl} \qquad \text{.......................} (8)$$

1.1.7 Adjusted estimate of the total number of persons with characteristic X for the l^{th} age - sex group, h^{th} region was based on the formula :

$$x''_{1hl} = \sum_{i=1}^{A_h} x''_{1hil} = \sum_{j=1}^{2} x''_{1hjl} \qquad \text{.......................} (9)$$

1.1.8 Adjusted estimate of the total number of persons with characteristic X for the h^{th} region was based on the formula :

$$x''_{1h} = \sum_{i=1}^{\ddot{A}_h} x''_{1hil} = \sum_{j=1}^{2} x''_{1hj} = \sum_{l=1}^{22} x''_{1hl} \qquad \text{.......................} (10)$$

1.1.9 Adjusted estimate of the total number of persons with characteristic X for the j^{th} area was based on the formula :

$$x''_{1j} = \sum_{h=1}^{5} x''_{1hj} \qquad \text{.......................} (11)$$

1.1.10 Adjusted estimate of the total number of persons with characteristic X for the l^{th} age - sex group was based on the formula :

$$x''_{1l} = \sum_{h=1}^{5} x''_{1hl} \qquad \text{.......................} (12)$$

1.1.11 Adjusted estimate of the total number of persons with characteristic X for the whole kingdom was based on the formula :

$$x''_{1} = \sum_{h=1}^{5} x''_{1h} = \sum_{j=1}^{2} x''_{1j} = \sum_{l=1}^{22} x''_{1l} \qquad \text{.......................} (13)$$

1.2 Estimate of Variance of the Total Number of Persons with Characteristic *X*

1.2.1 The estimate variance of x''_{1hijl} was

$$\hat{V}(x''_{hijl}) = \left[\frac{Y_{1hijl}}{y'_{1hijl}}\right]^2 \frac{1}{m_{hij}(m_{hij}-1)} \sum_{k=1}^{m_{hij}} z'^2_{1hijkl} \qquad \text{.......} (14)$$

where

$$z'_{1hijkl} = x'_{1hijkl} - r_{1hijl}\, y'_{1hijkl}$$

$$x'_{1hijkl} = \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} x_{1hijkl}$$

$$y'_{1hijkl} = \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} y_{1hijkl}$$

1.2.2 The estimate variance of x''_{1hij} was

$$\hat{V}(x''_{1hij}) = \sum_{l=1}^{22} \hat{V}(x''_{1hijl}) \qquad \text{.....................} (15)$$

1.2.3 The estimate variance of x''_{1hil} was

$$\hat{V}(x''_{1hil}) = \sum_{j=1}^{2} \hat{V}(x''_{1hijl}) \qquad \text{.................... (16)}$$

1.2.4 The estimate variance of x''_{1hi} was

$$\hat{V}(x''_{1hi}) = \sum_{j=1}^{2} \hat{V}(x''_{1hij}) = \sum_{l=1}^{22} \hat{V}(x''_{1hil}) \qquad \text{.................... (17)}$$

1.2.5 The estimate variance of x''_{1hjl} was

$$\hat{V}(x''_{1hjl}) = \sum_{i=1}^{A_h} \hat{V}(x''_{1hijl}) \qquad \text{.................... (18)}$$

1.2.6 The estimate variance of x''_{1hj} was

$$\hat{V}(x''_{1hj}) = \sum_{i=1}^{A_h} \hat{V}(x''_{1hij}) = \sum_{l=1}^{22} \hat{V}(x''_{1hjl}) \qquad \text{.................... (19)}$$

1.2.7 The estimate variance of x''_{1hl} was

$$\hat{V}(x''_{1hl}) = \sum_{i=1}^{A_h} \hat{V}(x''_{1hil}) = \sum_{j=1}^{2} \hat{V}(x''_{1hjl}) \qquad \text{.................... (20)}$$

1.2.8 The estimate variance of x''_{1h} was

$$\hat{V}(x''_{1h}) = \sum_{i=1}^{A_h} \hat{V}(x''_{1hi}) = \sum_{j=1}^{2} \hat{V}(x''_{1hj}) = \sum_{l=1}^{22} \hat{V}(x''_{1hl}) \qquad \text{........ (21)}$$

1.2.9 The estimate variance of x''_{1j} was

$$\hat{V}(x''_{1j}) = \sum_{h=1}^{5} \hat{V}(x''_{1hj}) \qquad \text{.................... (22)}$$

2.10 The estimate variance of x''_{1l} was

$$\hat{V}(x''_{1l}) = \sum_{h=1}^{5} \hat{V}(x''_{1hl}) \quad \text{.....................} (23)$$

2.11 The estimate variance of x''_{1} was

$$\hat{V}(x''_{1}) = \sum_{h=1}^{5} \hat{V}(x''_{1h}) = \sum_{j=1}^{2} \hat{V}(x''_{1j}) = \sum_{l=1}^{22} \hat{V}(x''_{1l}) \quad \text{.....................} (24)$$

1.3 Estimate of Coefficient of Variation of the Total Number of Persons with Characteristic *X*

1.3.1 The estimate coefficient of variation of x''_{1hijl} was

$$cv(x''_{1hijl}) = \frac{\sqrt{\hat{V}(x''_{1hijl})}}{x''_{1hijl}} \times 100\,\% \quad \text{.....................} (25)$$

1.3.2 The estimate coefficient of variation of x''_{1hij} was

$$cv(x''_{1hij}) = \frac{\sqrt{\hat{V}(x''_{1hij})}}{x''_{1hij}} \times 100\,\% \quad \text{.....................} (26)$$

1.3.3 The estimate coefficient of variation of x''_{1hil} was

$$cv(x''_{1hil}) = \frac{\sqrt{\hat{V}(x''_{1hil})}}{x''_{1hil}} \times 100\,\% \quad \text{.....................} (27)$$

1.3.4 The estimate coefficient of variation of x''_{1hi} was

$$cv(x''_{1hi}) = \frac{\sqrt{\hat{V}(x''_{1hi})}}{x''_{1hi}} \times 100\,\% \quad \text{.....................} (28)$$

1.3.5 The estimate coefficient of variation of x''_{1hjl} was

$$cv(x''_{1hjl}) = \frac{\sqrt{\hat{V}(x''_{1hjl})}}{x''_{1hjl}} \times 100\,\% \quad \text{.....................} (29)$$

1.3.6 The estimate coefficient of variation of x''_{1hj} was

$$cv(x''_{1hj}) = \frac{\sqrt{\hat{V}(x''h_{1hj})}}{x''_{1hj}} \times 100\% \qquad \text{................ (30)}$$

1.3.7 The estimate coefficient of variation of x''_{1hl} was

$$cv(x''_{1hl}) = \frac{\sqrt{\hat{V}(x''_{1hl})}}{x''_{1hl}} \times 100\% \qquad \text{..................... (31)}$$

1.3.8 The estimate coefficient of variation of x''_{1h} was

$$cv(x''_{1h}) = \frac{\sqrt{\hat{V}(x''_{1h})}}{x''_{1h}} \times 100\% \qquad \text{..................... (32)}$$

1.3.9 The estimate coefficient of variation of x''_{1j} was

$$cv(x''_{1j}) = \frac{\sqrt{\hat{V}(x''_{1j})}}{x''_{1j}} \times 100\% \qquad \text{..................... (33)}$$

1.3.10 The estimate coefficient of variation of x''_{1l} was

$$cv(x''_{1l}) = \frac{\sqrt{\hat{V}(x''_{1l})}}{x''_{1l}} \times 100\% \qquad \text{..................... (34)}$$

1.3.11 The estimate coefficient of variation of x''_{1} was

$$cv(x''_{1}) = \frac{\sqrt{\hat{V}(x''_{1})}}{x''_{1}} \times 100\% \qquad \text{..................... (35)}$$

Part 2 : Characteristic of Households (Private Households)

2.1 Estimate of the Total Number of Characteristic *X* of Household

2.1.1 Adjusted estimate of the total number of characteristic X of household for the j^{th} area, i^{th} province, h^{th} region was based on the formula :

$$x''_{2hij} = \frac{x'_{2hij}}{y'_{2hij}} Y_{2hij} = r_{2hij} Y_{2hij} \qquad \text{....................... (36)}$$

where x'_{2hij} is the ordinary estimate of the total number of characteristic X of household in the j^{th} area, i^{th} province, h^{th} region.

y'_{2hij} is the ordinary estimate of the total number of households in the j^{th} area, i^{th} province, h^{th} region.

Y_{2hij} /2 is the estimate, based on the population projection, of the total number of households in the j^{th} area, i^{th} province, h^{th} region.

r_{2hij} is the ratio of the estimate of the total number of characteristic X to the estimate of the total number of households in the j^{th} area, i^{th} province, h^{th} region.

The formula of the estimate from a stratified two - stage sampling was as follows :

i)
$$x'_{2hij} = \frac{1}{m_{hij}} \sum_{k=1}^{m_{hij}} \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} x_{2hijk} \qquad \text{……….…...... (37)}$$

x_{2hijk} is the characteristic X of every sample household in the k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

/2 Population Projections for Thailand 2000 - 2030, National Economic and Social Development Board, The Tenth National Economic and Social Development Planning, October 2007.

ii) $$y'_{2hij} = \frac{1}{m_{hij}} \sum_{k=1}^{m_{hij}} \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} y_{2hijk} \quad \text{……………. (38)}$$

y_{2hijk} is the total number of the household enumerated in the k^{th} sample block / village, j^{th} area, i^{th} province, h^{th} region.

2.1.2 Adjusted estimate of the total number of characteristic X of household for the i^{th} province, h^{h} region was based on the formula :

$$x''_{2hi} = \sum_{j=1}^{2} x''_{2hij} \quad \text{.......................... (39)}$$

2.1.3 Adjusted estimate of the total number of characteristic X of household for the j^{th} area, h^{h} region was based on the formula :

$$x''_{2hj} = \sum_{i=1}^{A_h} x''_{2hij} \quad \text{...................... (40)}$$

2.1.4 Adjusted estimate of the total number of characteristic X of household for the h^{h} region was based on the formula :

$$x''_{2h} = \sum_{i=1}^{A_h} x''_{2hi} = \sum_{j=1}^{2} x''_{2hj} \quad \text{...................... (41)}$$

2.1.5 Adjusted estimate of the total number of characteristic X of household for the j^{th} area was based on the formula :

$$x''_{2j} = \sum_{h=1}^{5} x''_{2hj} \quad \text{...................... (42)}$$

2.1.6 Adjusted estimate of the total number of characteristic X of household for for the whole kingdom was based on the formula :

$$x''_{2} = \sum_{h=1}^{5} x''_{2h} = \sum_{j=1}^{2} x''_{2j} \quad \text{...................... (43)}$$

2.2 Estimate of Variance of the Total Number of Characteristic *X* of Household

2.2.1 The estimate variance of x''_{2hij} was

$$\hat{V}(x''_{2hij}) = \left[\frac{Y_{2hij}}{y'_{2hij}}\right]^2 \frac{1}{m_{hij}(m_{hij}-1)} \sum_{k=1}^{m_{hij}} z'^2_{2hijk} \qquad \text{.......... (44)}$$

where $z'_{2hijk} = x'_{2hijk} - r_{2hij}\, y'_{2hijk}$

$$x'_{2hijk} = \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} x_{2hijk}$$

$$y'_{2hijk} = \frac{1}{P_{hijk}} \frac{N_{hijk}}{n_{hijk}} y_{2hijk}$$

2.2.2 The estimate variance of x''_{2hi} was

$$\hat{V}(x''_{2hi}) = \sum_{j=1}^{2} \hat{V}(x''_{2hij}) \qquad \text{..................... (45)}$$

2.2.3 The estimate variance of x''_{2hj} was

$$\hat{V}(x''_{2hj}) = \sum_{i=1}^{A_h} \hat{V}(x''_{2hij}) \qquad \text{..................... (46)}$$

2.2.4 The estimate variance of x''_{2h} was

$$\hat{V}(x''_{2h}) = \sum_{i=1}^{A_h} \hat{V}(x''_{2hi}) = \sum_{j=1}^{2} \hat{V}(x''_{2hj}) \qquad \text{..................... (47)}$$

2.2.5 The estimate variance of x''_{2j} was

$$\hat{V}(x''_{2j}) = \sum_{h=1}^{5} \hat{V}(x''_{2hj}) \qquad \text{..................... (48)}$$

2.2.6 The estimate variance of x''_2 was

$$\hat{V}(x''_2) = \sum_{h=1}^{5}\hat{V}(x''_{2h}) = \sum_{j=1}^{2}\hat{V}(x''_{2j}) \qquad \text{.....................} (49)$$

2.3 Estimate of Coefficient of Variation of the Total Number of Characteristic *X* of Household

2.3.1 The estimate coefficient of variation of x''_{2hij} was

$$cv(x''_{2hij}) = \frac{\sqrt{\hat{V}(x''_{2hij})}}{x''_{2hij}} \times 100\,\% \qquad \text{.....................} (50)$$

2.3.2 The estimate coefficient of variation of x''_{2hi} was

$$cv(x''_{2hi}) = \frac{\sqrt{\hat{V}(x''_{2hi})}}{x''_{2hi}} \times 100\,\% \qquad \text{.....................} (51)$$

2.3.3 The estimate coefficient of variation of x''_{2hj} was

$$cv(x''_{2hj}) = \frac{\sqrt{\hat{V}(x''_{2hj})}}{x''_{2hj}} \times 100\,\% \qquad \text{.....................} (52)$$

2.3.4 The estimate coefficient of variation of x''_{2h} was

$$cv(x''_{2h}) = \frac{\sqrt{\hat{V}(x''_{2h})}}{x''_{2h}} \times 100\,\% \qquad \text{.....................} (53)$$

2.3.5 The estimate coefficient of variation of x''_{2j} was

$$cv(x''_{2j}) = \frac{\sqrt{\hat{V}(x''_{2j})}}{x''_{2j}} \times 100\,\% \qquad \text{.....................} (54)$$

2.3.6 The estimate coefficient of variation of x''_2 was

$$cv(x''_2) = \frac{\sqrt{\hat{V}(x''_2)}}{x''_2} \times 100\,\% \qquad \text{.....................} (55)$$