REPUBLIC OF THE PHILIPPINES
PHILIPPINE STATISTICS AUTHORITY BOARD

PSA Board Resolution No. 06
Series of 2018

APPROVING AND ADOPTING THE SURVEY DESIGN OF THE EXPANDED NATIONAL NUTRITION SURVEY

WHEREAS, in Executive Order (EO) No. 128, "Reorganizing the National Science and Technology Authority" issued on 30 January 1987, the Food and Nutrition Research Institute(FNRI) is mandated to define and update the country's food and nutrition situation, particularly that of children and other nutritionally vulnerable groups;

WHEREAS, FNRI conducts the National Nutrition Survey (NNS) every five years since 1978 and the Updating Survey of the Nutritional Status of the Filipino Children and Other Population Groups in between the conduct of the NNS since 1989 as the country's official sources of data on the citizenry's nutritional status; and bases of the national and regional menu calculations for poverty estimation, the Philippine Dietary Reference Intakes (PDRI), and the Desirable Dietary Patterns/food production targets, among others;

WHEREAS, the NNS has expanded over the years to include other components relevant to health such as the measurement of lifestyle risk factors for elevated blood pressure and blood sugar, smoking and alcohol intake, physical *inactivity, and other disease conditions*;

WHEREAS, Executive Order (EO) No. 352, "Designation of Statistical Activities that will Generate Critical Data for Decision Making of the Government and the Private Sector" issued on 01 July 1996, established the System of Designated Statistics (SDS) in the Philippine Statistical System (PSS);

WHEREAS, per EO No. 352, the National Nutrition Survey (NNS) and the Updating Survey of the Nutritional Status of the Filipino Children and Other Population Groups were included in the activities specified as Designated Statistical Activities;

WHEREAS, the latest survey round conducted for the NNS was in 2013 and that for the Updating Survey of the Nutritional Status of the Filipino Children and Other Population Groups was in 2015;

WHEREAS, recognizing the growing demand for provincial estimates specifically for targeting households with undernourished children or nutritionally-vulnerable groups, or targeting areas with high levels of malnutrition, or being a channel for delivering nutrition-specific interventions, the FNRI will conduct in 2018 the Expanded National Nutrition Survey (ENNS) which adopts a survey design that is capable to generate data at the provincial level (Annex BR 06-20180509-01);

WHEREAS, the design for the ENNS entails changes in the schedule and duration of data collection, schedule of release and dissemination of results, and level of disaggregation and quality of statistics that can be generated;

WHEREAS, as a designated statistical activity, the change in the design of the NNS necessitates the approval of the PSA Board;

WHEREAS, on 13 February 2018, the PSA Board expressed the need to examine thoroughly the ENNS design and its implications to users, hence establishing the PSA Board Subcommittee, which was tasked to review the ENNS in terms of its implications in the quality of statistics generated from the design as well as the design's responsiveness to stakeholders' needs;

WHEREAS, the PSA Board Subcommittee recommends the approval and adoption of the survey design of the ENNS subject to FNRI's compliance to the conditions listed below;

NOW, THEREFORE, BE IT RESOLVED, that the Board approve for adoption the ENNS survey design;

RESOLVED FURTHER, that the FNRI shall:

1. Prepare and submit to the PSA Board a complete documentation of the ENNS methodology preferably before the release of the 2018 ENNS results;

2. Inform data users of the trade-off on the quality of national level estimates and present along with the ENNS results the assumptions and coefficients of variation (CVs);

3. Come up with a methodology to calculate regional estimates from the ENNS for consideration of the Inter-Agency Committee on Health and Nutrition Statistics(IACHNS);

4. Submit to the PSA Board an evaluation report comparing the previous NNS with the ENNS in terms of effectiveness (accuracy and utilization) and cost efficiency after the cycle (3 years) of conduct of survey is completed; and

5. Provide the metadata and public use file (PUF) one year after completion of the three-year data collection pursuant to PSA Board Resolution No. 01-167, "Approving and Adopting the General Policy on the Production,

Release and Dissemination of Microdata in the Philippine Statistical System", which was issued in 2011.

6. Conduct the ENNS in a schedule harmonized with those of the PSA's to minimize response burden.

Approved this 9th day of May 2018, in Pasig City.

ERNESTO M. PERNIA
Secretary of Socioeconomic Planning
National Economic Development Authority
PSA Board Chairperson

Attested by:

LISA GRACE S. BERSALES
Undersecretary
National Statistician and Civil Registrar General
Chairperson, PSA Board Secretariat

TECHNICAL NOTES

on the

Proposed Expanded National Nutrition Survey (ENNS) Design for 2018-2020

Prepared by:

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Design Motivation

- For 2018, the FNRI is scheduled to conduct a National Nutrition Survey.
- However, to be responsive to the needs of the users of NNS results, the FNRI management decided to conduct the survey with the primary objective of generating statistically reliable estimates at the province/HUC level [PSA Domains].
- To achieve this primary objective, the FNRI could use the full sample of the PSA 2015 MS.

2015 PSA Master Sample Design

- A total of 117 domains – provinces and HUCs
- In each domain, PSUs (a barangay or part of a barangay with about 200-400 HHs and clear boundaries) are grouped into replicates in such way that replicates are similar in characteristics.
- Each replicate is a systematic sample of PSUs (from an ordered list) and within each sample PSU a sample of HHs is selected with equal probability and equal sampling rate to ensure a self-weighting sample (# of sample HHs varies depending on the size of the PSU)
- Each replicate should provide an unbiased estimator of certain domain-level parameters.
- To achieve reliable domain-level estimates, a random sample of about 16 replicates with a total sample size of about 1,500 HHs. Note that the replicates are independent of one another.
- This translates to a total sample size of about 175,500 HHs.
- This is a major difference of this design as compared to the 2003 MS which was designed to provide reliable estimates at the regional level. The old design has a total sample size of about 50,000 HHs.

Design Considerations

- One important constraint for the forthcoming ENNS design to achieve its main goal of generating **reliable domain level estimates** is the massive resource requirement. Note that because of the more "specialized" nature of data collection requirement of the NNS, the survey cost is more prohibitive as compared to the usual HH survey that relies heavily of face-to-face interviews.
    - The use of licensed Medical Technologists (for the blood samples)
    - The use of Nutritionists (Food consumption)
    - The use of more specialized equipment (weights and height measurements)
    - Travel cost to transport all of these equipment and team to survey area.
- In addition to these survey requirements, the budget allocated has been significantly reduced.
- With the new MS design, it would not be possible to conduct such survey (to yield reliable domain level estimates).

- With these constraints, the question raised was whether or not it is possible to spread out data collection for a period of three years covering about 40 domains in a year?
- For this approach, it would be possible to generate domain-level estimates with varying reference period. However, to achieve national level (and regional level) estimates, one needs to cumulate the sample after three years.
- The process of sample cumulation would result to some serious concerns such as the comparability of the reference-periods used in data collection every year.
- Cumulating samples this long period is not entirely new. For instance the American Community Survey (ACS) conducted by the US Bureau of the Census cumulates samples over a 5-year period to generate reliable sub-state level estimates. A similar practice is also conducted in France with their innovative "rolling census"
- To eliminate the possible problem arising from sample cumulation, the basic question considered in formulating the design for the ENNS is whether or not it is possible to select a sample of provinces in every year that would allow the generation of national level estimates of adequate precision and at the same time generates reliable estimates at the domain levels.

This could be possible by:

1. Divide the provinces into replicates (e.g. 24 replicates with 5 domains in 22 replicates and 4 in 3 replicates).
2. Randomly assign the replicates into three groups (8 replicates per group) corresponding to the years 2018, 2019 and 2020.
3. To ensure that the national level estimates will be of adequate precision (e.g. CV of national estimates <10%), the replicates should be formed in such a way that the replicates are similar in characteristics [This is based on the theory of replicated sampling (c.f. Deming, 1960)

Formation of Replicates

- The Basic Idea is to group domains into replicates.
- Each replicate will consist of 5 provinces (4 in three) resulting into 24 replicates.
- Allocate randomly equal number of replicates to be covered every year.
    - 8 replicates in a year
    - About 40 provinces/domains in a year
- To form the replicates, all 24 systematic samples will be identified from the ordered list.
- These 24 replicates will be assigned randomly to each year. Thus replicates will be independent of one another
- Utilize the 2010 CPH as test data to empirically validate design.
- Test Variables: (HH Level) Number of persons, Number of Births Registered, Number of OFW, Number of women of reproduction age, Number of infants, Number of Children below 5, and Number of disabled members.
- These variables would serve as proxy variables and are related to the variables to be covered in the proposed eNNS. It covers a wide range of characteristics (from the most common to the relatively rare variables)

Tested Three Options in the formation of replicates:

- OPTION 1 [GEOREP]: Arrange provinces/domains in geographic order (North-South Configuration). Number of Provinces/Domains consecutively from 1 to 24 repeatedly. Provinces/Domains with the same assigned number will form a replicate.
- OPTION 2 [POPREP]: Arrange provinces/domains in decreasing order of total population. Number of Provinces/Domains consecutively from 1 to 24 repeatedly. Provinces/Domains with the same assigned number will form a replicate.

- OPTION 3 [MPOPREP]: Arrange provinces/domains in decreasing order of total population. Number of Provinces/Domains consecutively from 1 to 24 for the first group. For the second group reverse the numbering. Repeat pattern. Provinces/Domains with the same assigned number will form a replicate.

Note that for the POPREP and MPOPREP, total number of persons per domain was used in the formation of replicates due to high correlation with the other test variables.

Correlation Matrix of Domain Totals. 2010 CPH Form 2

VARIABLE		A	B	C	D	E	F	G	H	I	J	K	L	M	N
Total Persons	A	1.000													
Total Number of Registered Births	B	0.991	1.000												
Total Number of Persons with Disability	C	0.960	0.958	1.000											
Total Number of OFW members	D	0.882	0.893	0.831	1.000										
Total Number of Infants (under 1)	E	0.993	0.988	0.962	0.854	1.000									
Total Number of Persons below 5	F	0.993	0.974	0.959	0.842	0.993	1.000								
Total Number of Women of Reproductive Age	G	0.993	0.987	0.934	0.900	0.981	0.977	1.000							
Total Number of Ever-married Women	H	0.995	0.988	0.939	0.901	0.987	0.983	0.997	1.000						
Total Number of Persons with Difficulty Seeing	I	0.949	0.945	0.919	0.804	0.951	0.942	0.948	0.946	1.000					
Total Number of Persons with Difficulty Hearing	J	0.908	0.892	0.939	0.732	0.916	0.925	0.864	0.873	0.891	1.000				
Total Number of Persons with Difficulty Walking	K	0.951	0.943	0.971	0.814	0.953	0.955	0.917	0.923	0.914	0.981	1.000			
Total Number of Persons with Difficulty Remembering	L	0.887	0.861	0.920	0.710	0.890	0.908	0.842	0.845	0.842	0.971	0.961	1.000		
Total Number of Persons with Difficulty Caring for Self	M	0.951	0.937	0.957	0.828	0.946	0.955	0.921	0.923	0.889	0.965	0.988	0.968	1.000	
Total Number of Persons with Difficulty Communitating	N	0.937	0.923	0.960	0.802	0.938	0.947	0.897	0.905	0.874	0.968	0.985	0.962	0.986	1.000

Empirical Evaluation

- To test empirically the performance of the proposed design on the test variables, we shall assume that for a given domain, a two-stage design is utilized with each stage of sampling selected with equal probability (Simple Random Sampling).
- While the actual design would utilize the 2015 MS in the selection of HHs in a domain, such assumption would still be valid since the 2015 MS design is more efficient that a simple two stage design.
- In effect, the results of the empirical study in terms of expected CV of national estimates are expected to be larger than the CV of national estimates based on the actual design.

- The derived formulae used for the empirical evaluation are shown in Annex A. Notations employed by Kish are used.
- The actual estimation procedure for the proposed designed are likewise attached (earlier submitted to the PSA SMU)
- Annex B shows the replicates randomly assigned for a given year and the sample domain to be covered.

Results (Expected CV of National Estimates)

PARAMETERS	VALUE	CV(%) NATIONAL ESTIMATES		
		GEOREP	POPREP	MPOPREP
Total Population	92,097,978	10.14	8.61	5.42
Total Persons with Births Registered	86,080,637	10.62	8.77	6.29
Total Persons with Functional Difficulty	1,442,586	9.63	8.51	6.49
Total OFW	1,505,219	15.81	14.65	14.95
Total Number of Infants	1,967,576	10.63	8.82	5.55
Total Children Under 5	12,324,330	10.24	8.72	5.22
Total Women of Reproductive Age	23,849,921	10.66	9.41	6.37
Total Ever Married Women	14,856,160	10.74	9.39	6.22
Total Persons with Difficulty Seing	1,792,461	12.22	10.17	8.31
Total Persons with Difficulty Hearing	520,850	10.73	8.97	7.44
Total Persons with Difficulty Walking	600,079	9.73	8.13	6.41
Total Persons with Difficulty Remembering	354,375	11.39	9.16	7.51
Total Persons with Difficulty Caring for Self	250,433	10.89	8.86	7.06
Total Persons with Difficulty Communicating	287,196	10.00	8.99	6.97

- The results show that among the three schemes for the formation of replicates utilized, MPOPREP yielded the smallest expected CVs of the national estimates.
- Except for Total OFW (which is considered a very challenging variable to cover in any survey), the expected CVs of national estimates are less than 10%. As mentioned, the actual CV values are expected to be lower due to the efficiency of the 2015 MS design in the selection of HHs within a domain.
- Remark: There is still room for improving the proposed design and is now the object of continuing research.

SUMMARY

- The proposed ENNS design is closely tied up with the 2015 PSA MS that was designed to provide flexibility allowing sufficient samples to generate statistically reliable domain level estimates (provinces and selected HUCs)
- With the design, it is possible to generate reliable National Level Estimates for each year and at the same time allow the generation of reliable domain level estimates for all MS domains after three years. There is no need for sample cummulation.
- However, the proposed ENNS design would not allow for **direct** regional level estimates. This is a result of prioritizing domain level estimates with limited resources (budget).

ANNEX A: Sampling Theory

National Level Estimator Based on a Single Replicate

$$\hat{Y}_l = k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}}\frac{D_{l\alpha\beta}}{d_{l\alpha\beta}}\sum_{\gamma=1}^{d_{l\alpha\beta}} y_{l\alpha\beta\gamma} = k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}\bar{y}_{l\alpha\beta}$$

These are unbiased and independent estimates of the population total for the year.

NOTES:

- Subscripts: *l* (replicate), α (province/domain), β (PSU/domain or barangay), γ (HH)
- *k* total number of replicates formed (=24)
- $B_{l\alpha}$ ($b_{l\alpha}$) total (sample) number of barangays from domain α in replicate *l*.
- $D_{l\alpha\beta}$($d_{l\alpha\beta}$) total (sample) number of HHs in barangay β.
- *r* number of replicates allocated for a year (=8).

Unbiasedness

$$E(\hat{Y}_l) = E_\alpha E_\beta E_\gamma(\hat{Y}_l)$$

$$= E_\alpha E_\beta E_\gamma\left(k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}\bar{y}_{l\alpha\beta}\right)$$

$$= E_\alpha E_\beta\left(k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}E_\gamma[\bar{y}_{l\alpha\beta}]\right)$$

$$= E_\alpha\left(k\sum_{\alpha=1}^{a_l}E_\beta\left[\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}\bar{Y}_{l\alpha\beta}\right]\right)$$

$$= E_\alpha\left(k\sum_{\alpha=1}^{a_l}E_\beta\left[\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{B_{l\alpha}} I_\beta Y_{l\alpha\beta.}\right]\right) = E_\alpha\left(k\sum_{\alpha=1}^{a_l}\left[\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{B_{l\alpha}} Y_{l\alpha\beta.}E_\beta(I_\beta)\right]\right)$$

$$Y_{l\alpha\beta.} = \sum_{\gamma=1}^{D_{l\alpha\beta}} y_{l\alpha\beta\gamma} = D_{l\alpha\beta}\bar{Y}_{l\alpha\beta}$$

$$\bar{Y}_{l\alpha\beta.} = (1/D_{l\alpha\beta})\sum_{\gamma=1}^{D_{l\alpha\beta}} y_{l\alpha\beta\gamma}$$

$$E(\hat{Y}_l) = E_\alpha\left(k\sum_{\alpha-1}^{a_l}\sum_{\beta-1}^{B_{l\alpha}} Y_{l\alpha\beta.}\right)$$

$$= E_\alpha\left(k\sum_{\alpha=1}^{a_l} Y_{l\alpha..}\right) = kE_\alpha\left(\sum_{\alpha=1}^{a_l} Y_{l\alpha..}\right)$$

$$= k\sum_{l=1}^{k}\left(\sum_{\alpha=1}^{a_l} Y_{l\alpha..}\right)p(\mathrm{s}) = k\sum_{l=1}^{k}\left(\sum_{\alpha=1}^{a_l} Y_{l\alpha..}\right)(1/k)$$

$$= \sum_{l=1}^{k}\sum_{\alpha=1}^{a_{l\alpha}} Y_{l\alpha..} = Y_{....} \text{ (Population Total)}$$

Sampling Variance

$$V(\hat{Y}_l) = \underbrace{V_\alpha E_\beta E_\gamma(\hat{Y}_l)}_{A} + \underbrace{E_\alpha V_\beta E_\gamma(\hat{Y}_l)}_{B} + \underbrace{E_\alpha E_\beta V_\gamma(\hat{Y}_l)}_{C}$$

$$\text{(A): } V_\alpha E_\beta E_\gamma(\hat{Y}_l) = V_\alpha E_\beta E_\gamma\left(k\sum_{\alpha-1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta-1}^{b_{l\alpha}} D_{l\alpha\beta}\bar{y}_{l\alpha\beta}\right)$$

$$= V_\alpha\left(k\sum_{\alpha=1}^{a_l} Y_{l\alpha..}\right)$$

$$= k^2 V_\alpha\left(Y_{l...}\right), \quad Y_{l...} = \sum_{\alpha=1}^{a_l} Y_{la..} \text{ true replicate totals}$$

$$= k^2\sum_{l=1}^{k}\left(Y_{l...} - \bar{\bar{Y}}\right)^2(1/k), \quad \bar{\bar{Y}} = (1/k)\sum_{l-1}^{k} Y_{l...}$$

$$= k\sum_{l=1}^{k}\left(Y_{l...} - \bar{\bar{Y}}\right)^2$$

$$\text{(B): } E_\alpha V_\beta E_\gamma(\hat{Y}_l) = E_\alpha V_\beta E_\gamma\left(k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}\bar{y}_{l\alpha\beta}\right)$$

$$= E_\alpha V_\beta\left(k\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{b_{l\alpha}} Y_{l\alpha\beta.}\right)$$

$$= E_\alpha\left(k^2\sum_{\alpha=1}^{a_l} B_{l\alpha}^2 V_\beta[\bar{y}_{l\alpha\beta.}]\right), \quad \bar{y}_{l\alpha\beta.} = (1/b_{l\alpha})\sum_{\beta=1}^{b_{l\alpha}} Y_{l\alpha\beta.}$$

$$= E_\alpha\left(k^2\sum_{\alpha-1}^{a_l} B_{l\alpha}^2\left(\frac{B_{l\alpha}-b_{l\alpha}}{b_{l\alpha}B_{l\alpha}}\right)S_{l\alpha}^2\right)$$

$$S_{l\alpha}^2 = \frac{1}{B_{l\alpha}-1}\sum_{\beta-1}^{B_{l\alpha}}(Y_{l\alpha\beta.} - \bar{Y}_{l\alpha..})^2 \qquad \bar{Y}_{l\alpha..} = (1/B_{l\alpha})\sum_{\beta=1}^{B_{l\alpha}} Y_{l\alpha\beta.}$$

$$E_\alpha V_\beta E_\gamma(\hat{Y}_l) = E_\alpha\left(k^2\sum_{\alpha=1}^{a_l} B_{l\alpha}^2\left(\frac{B_{l\alpha}-b_{l\alpha}}{b_{l\alpha}B_{l\alpha}}\right)S_{l\alpha}^2\right)$$

$$= k^2\sum_{l=1}^{k}\left(\sum_{\alpha=1}^{a_l} B_{l\alpha}^2\left(\frac{B_{l\alpha}-b_{l\alpha}}{b_{l\alpha}B_{l\alpha}}\right)S_{l\alpha}^2\right)p(s_l)$$

$$= k\sum_{l=1}^{k}\sum_{\alpha=1}^{a_l} B_{l\alpha}^2\left(\frac{B_{l\alpha}-b_{l\alpha}}{b_{l\alpha}B_{l\alpha}}\right)S_{l\alpha}^2$$

$$\text{(C): } E_\alpha E_\beta V_\gamma(\hat{Y}_l) = E_\alpha E_\beta\left(k^2\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}^2}{b_{l\alpha}^2}\sum_{\beta=1}^{b_{l\alpha}} D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2\right)$$

$$= E_\alpha\left(k^2\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}^2}{b_{l\alpha}^2}E_\beta\left[\sum_{\beta=1}^{B_{l\alpha}} I_\beta D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2\right]\right)$$

$$= E_\alpha\left(k^2\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}^2}{b_{l\alpha}^2}\left[\sum_{\beta=1}^{B_{l\alpha}} E_\beta[I_\beta] D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2\right]\right)$$

$$= E_\alpha\left(k^2\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{B_{l\alpha}} D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2\right)$$

$$= k^2\sum_{l-1}^{k}\left(\sum_{\alpha-1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta-1}^{B_{l\alpha}} D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2\right)p(s_l)$$

$$= k\sum_{l=1}^{k}\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{B_{l\alpha}} D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2$$

$$V(\hat{Y}_l) = k\sum_{l=1}^{k}\left(Y_{l...} - \bar{\bar{Y}}\right)^2 + k\sum_{l=1}^{k}\sum_{\alpha=1}^{a_l} B_{l\alpha}^2\left(\frac{B_{l\alpha}-b_{l\alpha}}{b_{l\alpha}B_{l\alpha}}\right)S_{\alpha\beta}^2 + k\sum_{l=1}^{k}\sum_{\alpha=1}^{a_l}\frac{B_{l\alpha}}{b_{l\alpha}}\sum_{\beta=1}^{B_{l\alpha}} D_{l\alpha\beta}^2\left(\frac{D_{l\alpha\beta}-d_{l\alpha\beta}}{d_{l\alpha\beta}D_{l\alpha\beta}}\right)S_{l\alpha\beta}^2$$

Estimator for the Year (National Level Estimates)

$$\hat{Y} = \frac{1}{r}\sum_{l=1}^{r}\hat{Y}_l$$

$$E(\hat{Y}) = E\left(\frac{1}{r}\sum_{l-1}^{r}\hat{Y}_l\right) = \frac{1}{r}\sum_{l-1}^{r}E(\hat{Y}_l) = \frac{1}{r}\sum_{l-1}^{r}Y_{....} = Y_{....}$$

$$V(\hat{Y}) = V\left(\frac{1}{r}\sum_{l=1}^{r}\hat{Y}_l\right) = \frac{1}{r^2}\sum_{l=1}^{r}V(\hat{Y}_l) = \frac{V(\hat{Y}_l)}{r}$$

Sample Areas

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region II - Cagayan Valley	Cagayan	2	1
Region III - Central Luzon	Bulacan	2	1
Region VIII - Eastern Visayas	Eastern Samar	2	1
National Capital Region	Taguig City	2	1
Cordillera Administrative Region	Abra	2	1
Region III - Central Luzon	Olongapo City	4	1
Region VI - Western Visayas	Iloilo City	4	1
Region IX - Zamboanga Peninsula	Zamboanga del Norte	4	1
Region X - Northern Mindanao	Cagayan de Oro City	4	1
National Capital Region	Quezon City	4	1
Region II - Cagayan Valley	Nueva Vizcaya	5	1
Region IVA - CALABARZON	Laguna	5	1
Region VIII - Eastern Visayas	Tacloban City	5	1
Region VIII - Eastern Visayas	Northern Samar	5	1
Autonomous Region in Muslim Mindanao	Maguindanao	5	1
Region VI - Western Visayas	Iloilo	13	1
Region VII - Central Visayas	Mandaue City	13	1
National Capital Region	Las Pinas City	13	1
Cordillera Administrative Region	Mountain Province	13	1
Region IVB - MIMAROPA	Oriental Mindoro	13	1

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region V- Bicol	Camarines Norte	15	1
Region XII - SOCCSKSARGEN	Sultan Kudarat	15	1
National Capital Region	Manila City	15	1
National Capital Region	Mandaluyong City	15	1
National Capital Region	San Juan City	15	1
Region II - Cagayan Valley	Isabela	17	1
Region V- Bicol	Sorsogon	17	1
Region VI - Western Visayas	Aklan	17	1
Region IX - Zamboanga Peninsula	City of Isabela	17	1
Cordillera Administrative Region	Baguio City	17	1
Region III - Central Luzon	Zambales	18	1
Region VII - Central Visayas	Siquijor	18	1
Region VIII - Eastern Visayas	Samar (Western Samar)	18	1
National Capital Region	Caloocan City	18	1
Region XIII - Caraga	Butuan City	18	1
Region VI - Western Visayas	Capiz	19	1
Region X - Northern Mindanao	Camiguin	19	1
Region XI - Davao	Davao City	19	1
Region XI - Davao	Davao Occidental	19	1
National Capital Region	Makati City	19	1

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region I - Ilocos Region	Pangasinan	3	2
Region IX - Zamboanga Peninsula	Zamboanga del Sur	3	2
Region X - Northern Mindanao	Lanao del Norte	3	2
National Capital Region	Marikina City	3	2
Region IVB - MIMAROPA	Marinduque	3	2
Region VII - Central Visayas	Cebu	6	2
Region XI - Davao	Davao	6	2
National Capital Region	Paranaque City	6	2
Cordillera Administrative Region	Benguet	6	2
Region IVB - MIMAROPA	Puerto Pricessa City	6	2
Region IVA - CALABARZON	Rizal	7	2
Region VIII - Eastern Visayas	Southern Leyte	7	2
Region IX - Zamboanga Peninsula	Zamboanga Sibugay	7	2
Cordillera Administrative Region	Kalinga	7	2
Autonomous Region in Muslim Mindanao	Lanao del Sur	7	2
Region I - Ilocos Region	Ilocos Norte	10	2
Region II - Cagayan Valley	Quirino	10	2
Region III - Central Luzon	Pampanga	10	2
Region XII - SOCCSKSARGEN	South Cotabato	10	2
National Capital Region	Malabon City	10	2

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region III - Central Luzon	Nueva Ecija	11	2
Region VI - Western Visayas	Guimaras	11	2
Region VII - Central Visayas	Lapu Lapu City	11	2
Region X - Northern Mindanao	Misamis Occidental	11	2
Region X - Northern Mindanao	Misamis Oriental	11	2
Region V- Bicol	Camarines Sur	12	2
Region VIII - Eastern Visayas	Biliran	12	2
Region IX - Zamboanga Peninsula	Zamboanga City	12	2
Region XIII - Caraga	Agusan Norte	12	2
Region XIII - Caraga	Surigao del Sur	12	2
Region III - Central Luzon	Angeles City	14	2
Region IVA - CALABARZON	Quezon	14	2
Region VI - Western Visayas	Antique	14	2
Region XIII - Caraga	Dinagat Island	14	2
Region IVB - MIMAROPA	Palawan	14	2
Region X - Northern Mindanao	Bukidnon	20	2
Region XI - Davao	Davao Oriental	20	2
National Capital Region	Pateros	20	2
Autonomous Region in Muslim Mindanao	Basilan	20	2
Autonomous Region in Muslim Mindanao	Sulu	20	2

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region IVA - CALABARZON	Cavite	1	3
Region IVA - CALABARZON	Lucena City	1	3
Region XII - SOCCSKSARGEN	Cotabato (North Cotabato)	1	3
National Capital Region	Muntinlupa City	1	3
Region XIII - Caraga	Agusan del Sur	1	3
Region III - Central Luzon	Aurora	8	3
Region VII - Central Visayas	Cebu City	8	3
National Capital Region	Valenzuela City	8	3
National Capital Region	Pasay City	8	3
Negros Island Region	Negros Occidental	8	3
Region IVA - CALABARZON	Batangas	9	3
Region V- Bicol	Masbate	9	3
Region XI - Davao	Davao Sur	9	3
Cordillera Administrative Region	Ifugao	9	3
Autonomous Region in Muslim Mindanao	Tawi-Tawi	9	3
Region I - Ilocos Region	La Union	16	3
Region VIII - Eastern Visayas	Leyte	16	3
Region X - Northern Mindanao	Iligan City	16	3
Region XII - SOCCSKSARGEN	General Santos City	16	3
Cordillera Administrative Region	Apayao	16	3

REGION NAME	DOMAIN NAME	REPLICATE	YEAR
Region II - Cagayan Valley	Batanes	21	3
Region XI - Davao	Compostela Valley	21	3
Region IVB - MIMAROPA	Romblon	21	3
Negros Island Region	Bacolod City	21	3
Negros Island Region	Negros Oriental	21	3
Region III - Central Luzon	Bataan	22	3
Region III - Central Luzon	Tarlac	22	3
Region XII - SOCCSKSARGEN	Saranggani	22	3
Region XII - SOCCSKSARGEN	Cotabato City	22	3
Region VII - Central Visayas	Bohol	23	3
National Capital Region	Pasig City	23	3
National Capital Region	Navotas City	23	3
Region IVB - MIMAROPA	Occidental Mindoro	23	3
Region I - Ilocos Region	Ilocos Sur	24	3
Region V- Bicol	Albay	24	3
Region V- Bicol	Catanduanes	24	3
Region XIII - Caraga	Surigao del Norte	24	3