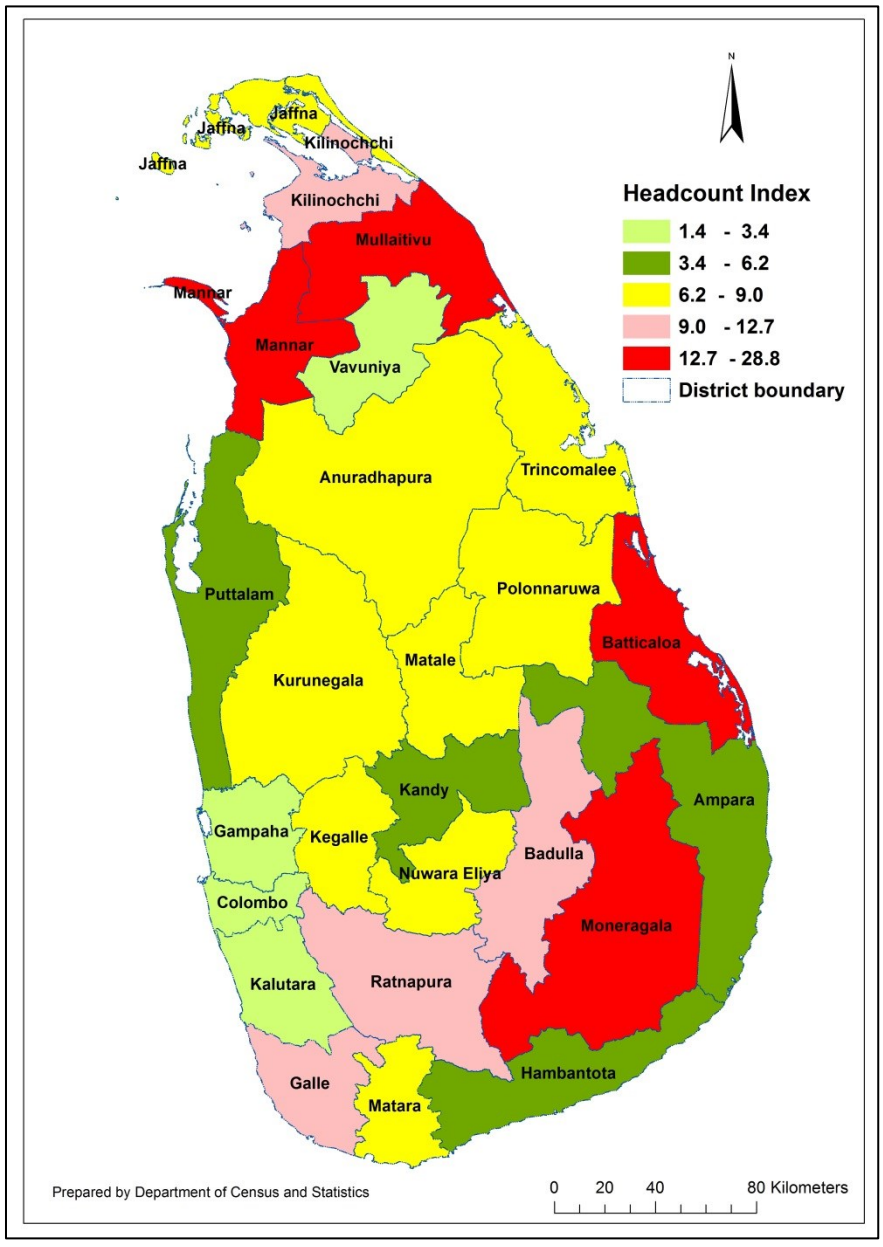
The Spatial Distribution of Poverty in Sri Lanka



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Poverty Global Practice, World Bank Group

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Acronyms

BIC	Bayesian Information Criterion
CCPI	Colombo Consumers' Price Index
CPH	Census of Population and Housing
CI	Confidence Interval
DCS	Department of Census and Statistics
DS	Divisional Secretariat
GDP	Gross Domestic Product
GN	Grama Niladhari
HIES	Household Income and Expenditure Survey
HCI	Headcount Index
SE	Standard Error

1. Measuring and monitoring poverty in Sri Lanka[1]

As part of a long-term commitment to reduce poverty in Sri Lanka, in 2005, the World Bank collaborated with the Department of Census and Statistics (DCS) to conduct the country's first official poverty mapping exercise to measure poverty incidence at the Divisional Secretariat (DS) level (Vishwanath and Yoshida, 2007)[2]. Using data from the 2001 Census of Population and Housing (CPH) and the 2002 Household Income and Expenditure Survey (HIES), this exercise revealed considerable spatial heterogeneity in poverty and identified areas where poverty remained more prevalent. The poverty headcount ratio in Colombo, the country's capital and the least poor district, was estimated to be 6 percent, while the corresponding ratio in both Badulla and Moneragala, the two more poor districts, was 37 percent each.[3] Many pockets of high poverty existed even in affluent districts, including Colombo.

The poverty map for 2002 has proved to be a powerful tool in measuring and comparing poverty at disaggregate administrative levels. One of the most important applications of this map was to inform policy makers during the reform of the samurdhi transfer program in 2005, when the Ministry of Samurdhi used the map to identify the poorest 119 DS divisions in the country. The widespread acceptance and use of the map, which gave poverty-related estimates at the DS division level, is a testament to DCS's success in disseminating the results of the poverty mapping exercise throughout the government agencies as well as to the general public.

Despite its usefulness in guiding policies to reduce poverty, however, the 2002 poverty map has become outdated, and no longer reflects recent developments in Sri Lanka's economic conditions. From 2002 to 2013, Sri Lanka enjoyed an average real GDP growth rate of 5.5 percent per year, with the national poverty rate falling from 22.7 percent to 6.7 percent.[4] Inequality, as measured by the Gini coefficient of household expenditure, fell from 0.41 in 2002 to 0.37 in 2009/10, before rising back to 0.40 in 2012/13. Economic growth and changes in the distribution of consumption have benefited some districts more than others. A new poverty map,

[1] This report was authored by Dung Doan, under the guidance of David Newhouse, and a team of DCS staff headed by Ms. Dilhanie Deepawansa, under the guidance of Dr. Amara J. Satharasinghe, Director General of Census and Statistics. The team gratefully acknowledges Nobuo Yoshida and Dhiraj Sharma, who conducted a training with DCS on the methodology and usage of the poverty map software and provided expert advice for the exercise. Hafiz Zainudeen helped coordinate the communication between the DCS and the World Bank. The initiative and determination of DCS to undertake this poverty mapping exercise have been essential for its success.

[2] A poverty map at DS division level was also published by the International Food Policy Research Institute in 2005 (IFPRI 2005). The map is estimated by the synthetic estimation method, based on data from the 2001 Census of Population and Housing, the 2003 Agriculture Census, and information generated for DS divisions using GIS by the International Water Management Institute. While informative, this map uses a different estimation method and is not the official map endorsed by DCS.

[3] The poverty headcount ratio is defined as the ratio of the number of poor people to the total population. In this policy note, the terms "poverty headcount ratio", "poverty headcount index", and "poverty rate" are used interchangeably and expressed in percentage form.

[4] For further details on Sri Lanka's economic growth, see http://www.statistics.gov.lk/national_accounts/Press%20Release/2014ANNUAL.pdf

therefore, can inform policy makers whether previous pockets of poverty have persisted and whether new pockets have emerged. An update of Sri Lanka's poverty map based on the newly available 2012 CPH and 2012/13 HIES is particularly timely because the new map provides information on poverty in Northern and Eastern provinces, which were not covered in the previous map due to the lack of Household Income and Expenditure Survey and Census of Population and Housing data from these areas.

2. Poverty mapping exercise for Sri Lanka

2.1. Methodology and data

This poverty mapping exercise uses the small area estimation method developed by Elbers, Lanjouw, and Lanjouw (2003). This is a standard poverty mapping method that has been widely used by both the World Bank and international researchers to estimate poverty at disaggregate administrative levels in several countries, such as India, Indonesia, Malawi, Nicaragua, Tajikistan, and Vietnam.[5] It is also the same method that the World Bank adopted in the previous poverty mapping in Sri Lanka.

The method combines information from a household survey and a population census to estimate household expenditure for small areas. Census data are necessary because household surveys such as the Sri Lanka Household Income and Expenditure Survey do not enumerate enough households to reliably estimate statistics below the district level. The small area estimation method involves three main steps. The first step is to identify a set of potential common household and individual characteristics that are present in both the Household Income and Expenditure Survey and the Census of Population and Housing. Second, the household survey is used to develop a set of models that can be used to predict household expenditure per capita. In this case, 16 separate models were estimated for different regions (provinces) and residential sectors (urban, rural, estate) of the country, to better capture geographical and sectoral differences. Pages 19-29 in Appendix 2 contain additional information on the models and how they were selected. In the third step, the models are used to impute expenditure for every household in the census, based on the common explanatory variables in the census data. The prediction includes a random component to reflect the uncertainty inherent in the prediction exercise. Poverty measures can then be estimated for the population at the DS division level. Appendix 2 provides a more detailed description of the estimation and simulation processes. Appendix 4 in the table 9 shows the district level poverty estimates got directly from HIES and poverty mapping exercise. There are some differences for these estimates as these two estimates

[5] Examples of poverty maps for other countries can be found at http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20239128~menuPK:462078~pagePK:148956~piPK:216618~theSitePK:430367~isCURL:Y,00.html

have calculated from two different methods. Headcount index from 2012/13 HIES was calculated directly using HIES actual data. However, estimated headcount index from poverty mapping was calculated using set of models developed by using HIES 2012/13 and Census of Population and Housing 2012 data and imputing expenditure for every individuals in the census as described the methods above. However the average discrepancy between these two methods is 1.1 percent points. For more details see the description in Appendix 4.

This poverty mapping exercise employs data from Sri Lanka's 2012 Census of Population and Housing (CPH) and 2012/13 Household Income and Expenditure Survey (HIES). The World Bank's PovMap 2.0 software was used to carry out the model estimation and simulation.

2.2. Poverty line

According to Sri Lanka's official national poverty line, a person is identified as being poor in the 2012/13 HIES if his or her real per capita consumption expenditure falls below Rs. 3,624 per month, which is equivalent to about $1.50 in 2005 purchasing power parity term. This consumption threshold is based on Sri Lanka's official poverty line developed by DCS and the World Bank using data from the 2002 HIES. The official poverty line for 2002, defined as the expenditure for a person to meet the daily calorie intake of 2,030 kcal with a non-food allowance, was set at Rs. 1,423. To obtain the 2012/13 poverty line, the 2002 line was inflated using the base 2002 Colombo Consumer Price Index (CCPI) to 2006/07, and then subsequently inflated from 2006/07 to 2012/13 using the base 2006/07 CCPI (DCS 2004).

An advantage of estimating a new poverty map based on the inflated 2002 line is that the new map is comparable to the old one. In other words, comparing them can reveal how poverty and spatial disparity changed over the period of 2002-2012/13.

3. Poverty rates at the district level

Before presenting the poverty map estimates at the DS division level, it is worth examining broad trends in poverty at the district level. Table 1 below presents the estimated headcount ratios under the official poverty lines in 2002 and 2012/13. These figures, which are calculated directly from the 2002 and 2012/13 rounds of the HIES, have already been publicly released by the DCS.

Table 1: Poverty headcount index and poverty reduction by district-2002, 2012/13

District	Poverty headcount index		Poverty reduction	
	HIES 2002	HIES 2012/13	Absolute reduction	Relative reduction
	(%)	(%)	(%)	(%)
Sri Lanka	**22.7**	**6.7**	**16.0**	**72.6**
Hambantota	32.0	4.9	27.1	84.7
Puttalam	31.0	5.1	25.9	83.5
Kegalle	32.0	6.7	25.3	79.1
Badulla	37.0	12.3	24.7	66.8
Ratnapura	34.0	10.4	23.6	69.4
Matale	30.0	7.8	22.2	74.0
Matara	27.0	7.1	19.9	73.7
Kandy	25.0	6.2	18.8	75.2
Kurunegala	25.0	6.5	18.5	74.0
Polonnaruwa	24.0	6.7	17.3	72.1
Kalutara	20.0	3.1	16.9	84.5
Nuwara Eliya	23.0	6.6	16.4	71.3
Moneragala	37.0	20.8	16.2	43.8
Galle	26.0	9.9	16.1	61.9
Anuradhapura	20.0	7.6	12.4	62.0
Gampaha	11.0	2.1	8.9	80.9
Colombo	6.0	1.4	4.6	76.7
Jaffna	_	8.3	_	_
Mannar	_	20.1	_	_
Vavuniya	_	3.4	_	_
Mullaitivu	_	28.8	_	_
Kilinochchi	_	12.7	_	_
Batticaloa	_	19.4	_	_
Ampara	_	5.4	_	_
Trincomalee	_	9.0	_	_

Note: HIES 2002 could not be conducted in Northern and Eastern provinces due to the prevailed unsettled conditions.

Overall, poverty reduction is observed in all districts, as would be expected given the substantial decline in the national poverty rate between 2002 and 2012/13 from 22.7 percent to 6.1 percent in districts outside Northern and Eastern provinces[6]. Yet poverty rates fell more rapidly in some districts than others. The largest reduction in poverty, in both absolute and relative terms, was recorded in Hambantota and Puttalam districts. In contrast, the smallest relative reduction was in Galle and Moneragala districts, while in absolute terms the smallest reductions were seen in Colombo and Gampaha districts.

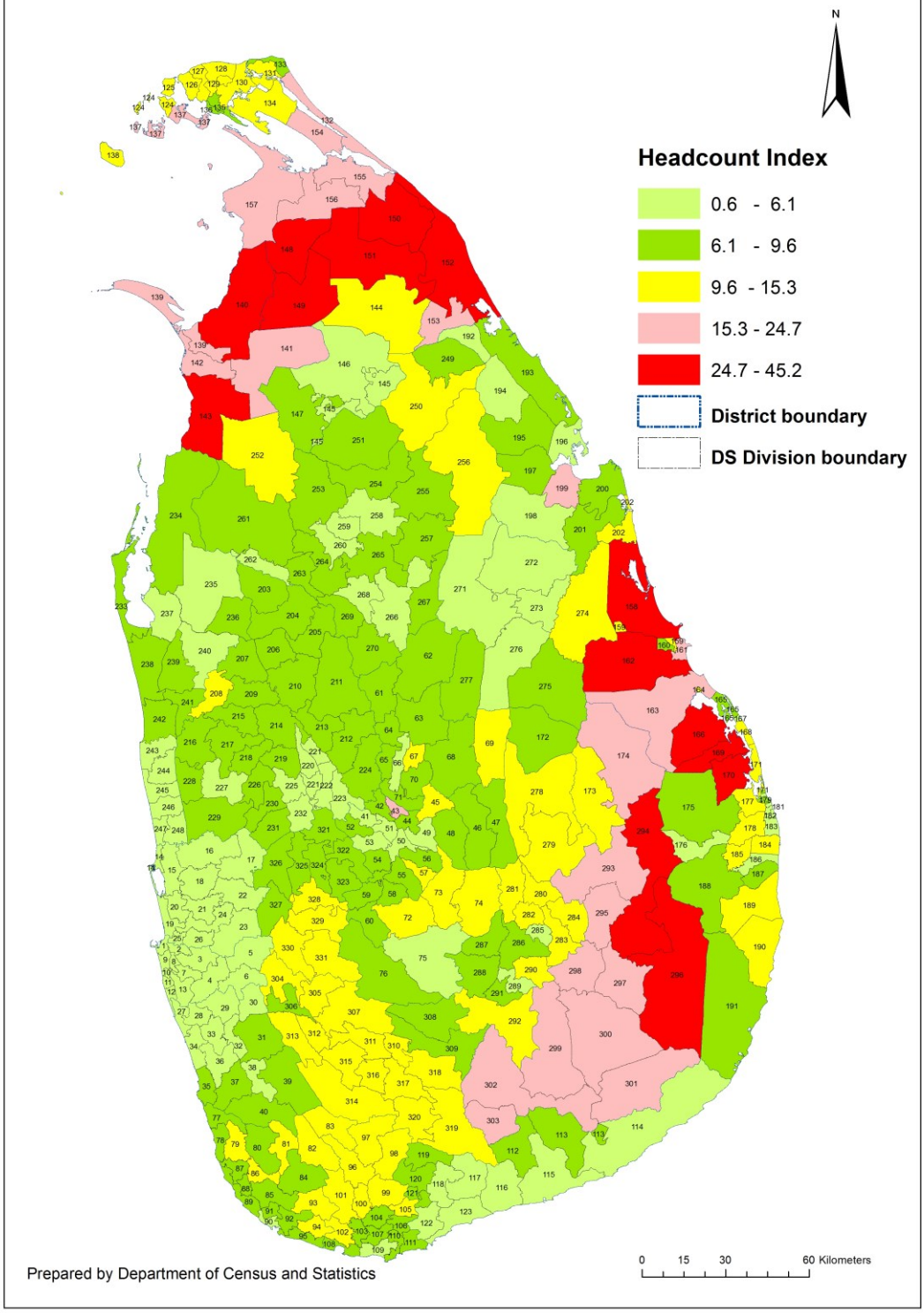
The ranking in terms of poverty rate among districts, however, does not change much between 2002 and 2012/13. Colombo and its neighbor Gampaha remain the least poor; while Moneragala is still has high poverty incidence. People in Sri Lanka suffered from the civil conflict for over 30 years, and the 2012/13 HIES was conducted when much of the displaced population particularly in Northern and Eastern provinces was being resettled following the end of the conflict. Estimates from the 2012/13 HIES revealed, that high poverty incidence is also concentrated in some parts of Northern and Eastern provinces, particularly in Mannar, Mullaitivu, and Batticaloa districts.

4. Poverty rates at the DS division level

This section presents the poverty estimates at the DS division level, based on data from the 2012/13 HIES and 2012 CPH and the poverty mapping method described in Section Two. Figure 1 below presents Sri Lanka's poverty headcount ratios estimated at the DS division level for 2012/13 in a thematic map. The darkest red on the maps denotes poverty rates between 24.7 and 45.1 percent; the lightest green denotes poverty rate between 0.62 and 6.13 percent.

[6] The national poverty rate in 2012/13 was 6.7 percent when considering all 25 districts.

Figure 1: Distribution of poverty headcount index by DS division - 2012/13



As can be seen in Figure 1, poverty rate is below 15 percent for a large part of the country. A majority of DS divisions in Colombo and Gampaha districts, as well as sizable parts of Kalutara and Polonnaruwa districts are particularly well-off, with estimated poverty rates below 5 percent. In contrast, high poverty incidence concentrates in Mannar, Mullaitivu, Batticaloa and Moneragala district. The map also reveals significant geographical disparity among DS divisions in some districts. Poverty rates in DS divisions in Batticaloa, for example, vary widely from 5.3 percent to 45.1 percent.

To track how poverty has changed over time Figure 2 displays the poverty maps for the year 2002 and 2012/13 side by side. Since both maps are estimated using the same small area estimation method in real terms, the estimated poverty rates for each DS division are comparable.[7] The color red on the maps denotes estimated poverty rates between 36.4 and 51.8 percent; light green denotes 0.6-12.5 percent; and the white areas shown in the 2002 map indicates DS divisions were not covered in the 2002 HIES.

In preparing the maps, the Natural Break method was applied to Headcount Index (HCI) to classify the DS divisions into five classes. This method identifies breaks points by looking for grouping and patterns inherent in the data. The DS divisions are divided into classes whose boundaries are set where there are relatively big jump in HCI data values by which within class boundaries is minimized. This classification was carried out at the DS division level of the country so that within country level variation of the HCI can be compared across DS divisions.

The two maps in Figure 2. demonstrate the impressive progress that Sri Lanka has achieved in alleviating poverty. The estimated reduction of the poverty headcount ratio at the DS division level ranges from 1.0 to 37.1 percentage points, with an average of 15.9 percentage points (see Table 2). These absolute reductions translate into a relative decrease in the headcount ratio between 5.0 and 86.3 percent, with an average of 65.6 percent. Many of the poverty pockets in North-Western and Central provinces previously found in the 2002 map have disappeared. Most notably Kalpitiya, Mundel, and Vanathawilluwa in Puttalam district, and Minipe and Udadumbara in Kandy district made considerable progress out of deep poverty. In each case, their headcount rate shrank from over 37 percent in 2002 to less than 10 percent in 2012/13.

[7] More details on differences in terms of modelling and prediction power between the 2002 map and 2012/13 map are presented in Appendix 3.

Figure 2: Distribution of poverty headcount index by DS division - 2002 and 2012/13

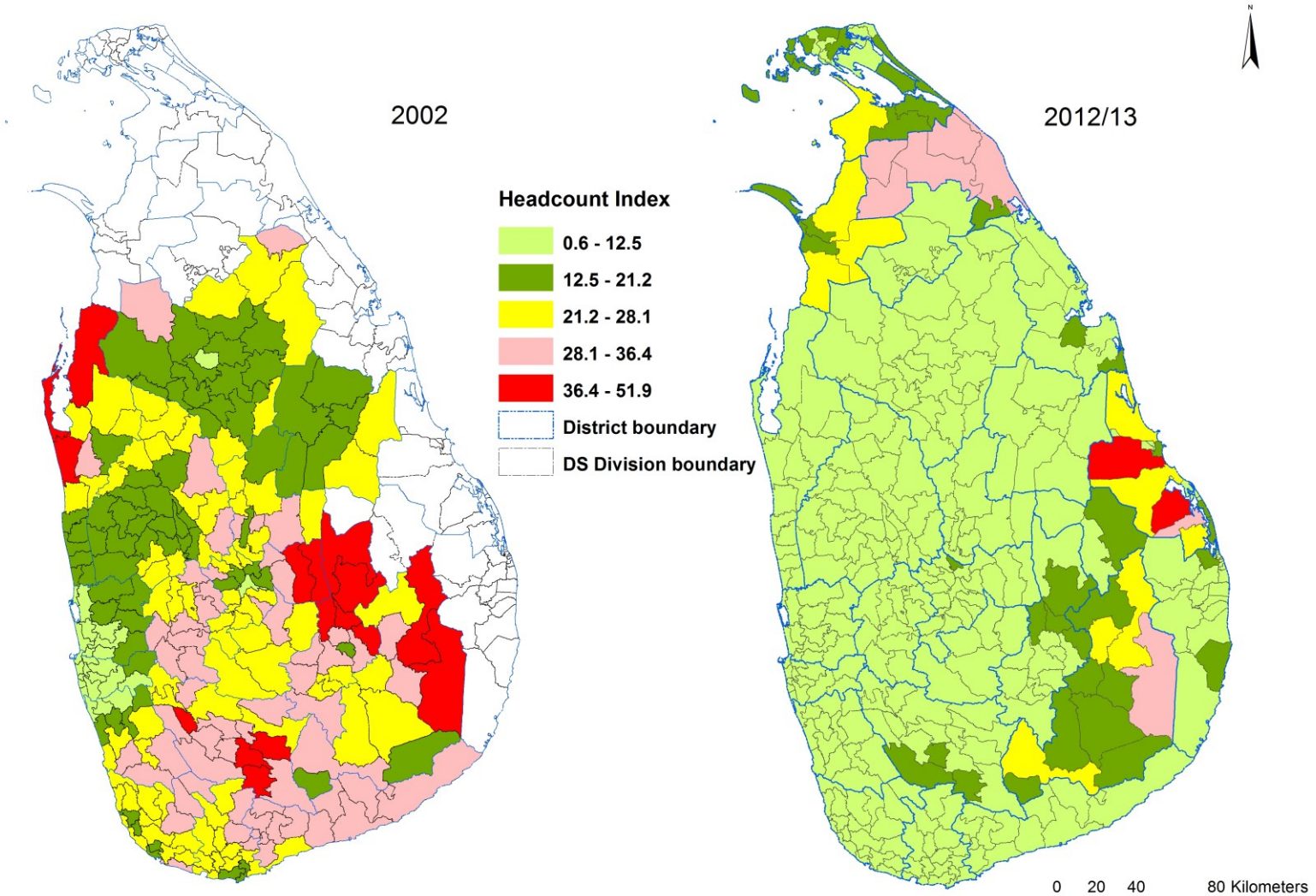


Table 2: Estimated absolute and relative poverty reductions by DS divisions with largest, smallest values and districts

	DS division	District	Absolute poverty reduction (%)	DS division	District	Relative poverty reduction (%)
Largest	Kalpitya	Puttalam	37.1	Tangalle	Hambantota	86.3
2	Rideemaliyadda	Badulla	36.4	Tissamaharama	Hambantota	84.4
3	Kandaketiya	Badulla	32.9	Ambalantota	Hambantota	84.1
4	Mundel	Puttalam	32.7	Nuwaragam Palatha East	Anuradhapura	83.7
5	Meegahakivula	Badulla	31.7	Hambantota	Hambantota	82.9
6	Vanathavilluwa	Puttalam	31.5	Beliatta	Hambantota	82.4
7	Aranayaka	Kegalle	29.0	Weeraketiya	Hambantota	82.1
8	Udadumbara	Kandy	28.9	Angunkolapelessa	Hambantota	81.8
9	Minipe	Kandy	28.7	Kalpitya	Puttalam	81.7
10	Mahiyanganaya	Badulla	28.0	Walasmulla	Hambantota	80.6
10	Wattala	Gampaha	3.4	Akurana	Kandy	38.7
9	Kesbewa	Colombo	3.4	Madulla	Moneragala	36.2
8	Thimbirigasyasa	Colombo	3.1	Moneragala	Moneragala	33.2
7	Buttala	Moneragala	2.7	Badalkumbura	Moneragala	31.4
6	Rathmalana	Colombo	2.6	Wellawaya	Moneragala	27.4
5	Maharagama	Colombo	2.4	Medagama	Moneragala	21.7
4	Sri Jayawardanapura Kotte	Colombo	1.5	Bibile	Moneragala	20.5
3	Dehiwala	Colombo	1.5	Buttala	Moneragala	12.5
2	Katharagama	Moneragala	1.3	Katharagama	Moneragala	6.3
Smallest	Sewanagala	Moneragala	1.0	Sewanagala	Moneragala	5.0

A few DS divisions have not benefited from this overall progress. For an example Figure 2 shows that as of 2012/13 all DS divisions in Moneragala district still remained severely poor. Furthermore, pockets of poverty remain even in the affluent districts, namely Akurana DS division in Kandy district and Kinniya DS division in Trincomalee district.

The Northern and Eastern provinces, which were not included in the 2002 poverty map, contain some DS divisions which show high poverty incidence in 2012/13 poverty map. The high rates of poverty in these areas were to be expected, given that they lay at the center of the civil conflict for more than 30 years. In 2012/13, the two provinces were at the beginning of a rapid process of resettlement and economic rehabilitation, which have been funded by many local and outside sources. Since then, development programs as well as continued economic growth may have considerably improved conditions in these areas.

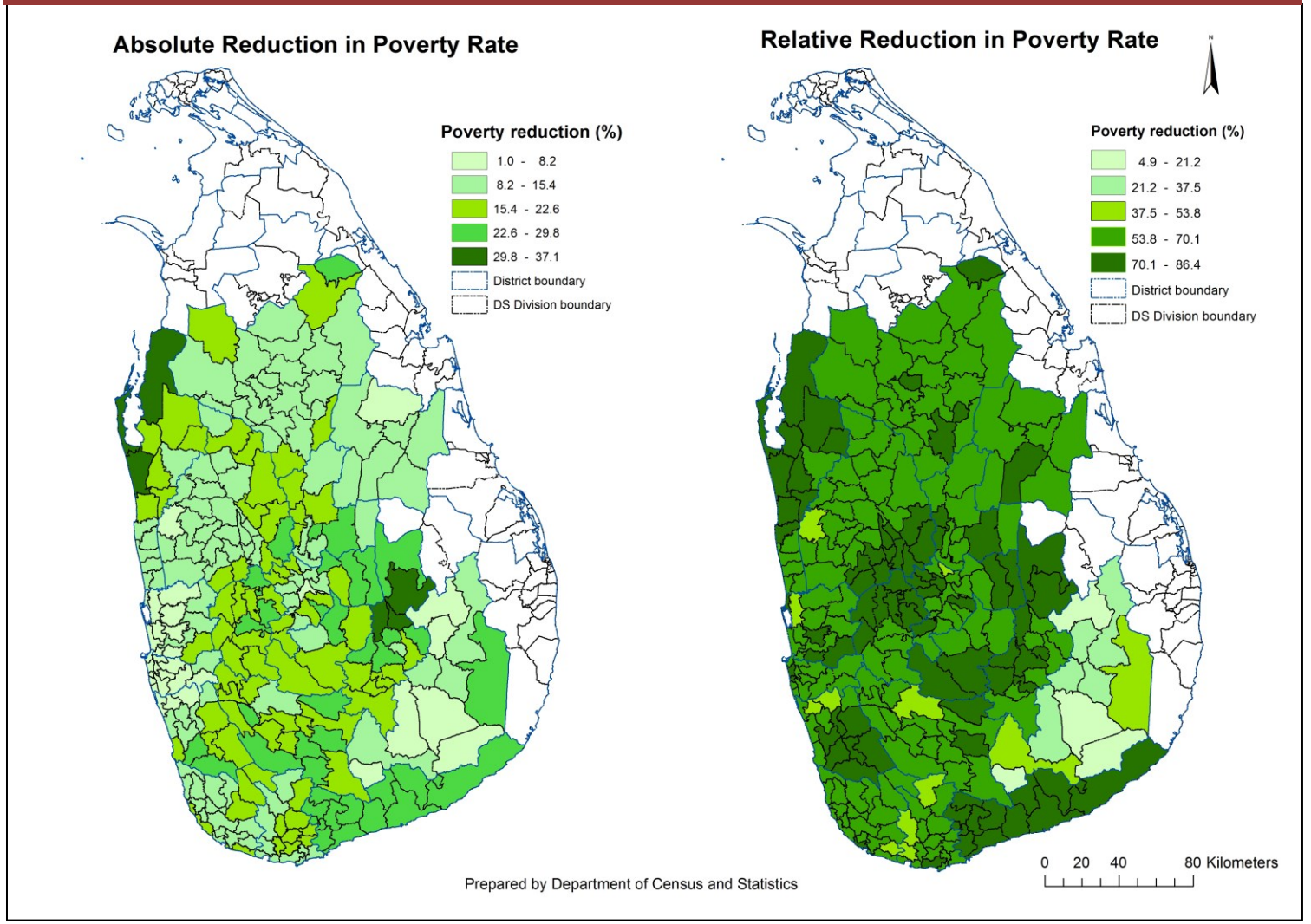
The estimates of poverty at the DS division level in Table 3 , like the district level estimates in Table 1, demonstrate considerable geographical inequality. The estimated poverty rate at the DS division level ranges from 0.6 percent in Dehiwala (Colombo district) to 45.1 percent in Manmunai-west (Batticaloa district). Most of the DS divisions with the lowest estimated poverty rates, as expected, are in Colombo, the district with the lowest poverty rate.

Table 3: Estimated poverty rates of 10 poorest and 10 least poor DS divisions with districts

		DS division	District	Estimated poverty headcount index (%)
Poorest		Manmunai-West	Batticaloa	45.1
	2	Koralai Pattu South	Batticaloa	37.7
	3	Puthukkudiyiruppu	Mullaitivu	35.7
	4	Thunukkai	Mullaitivu	34.0
	5	Manthai East	Mullaitivu	33.7
	6	Oddusuddan	Mullaitivu	33.5
	7	Manmunai South-West	Batticaloa	28.9
	8	Siyambalanduwa	Moneragala	28.7
	9	Maritimepattu	Mullaitivu	28.6
	10	Koralai Pattu North	Batticaloa	28.0
	10	Kelaniya	Gampaha	2.2
	9	Nuwaragam Palatha East	Anuradhapura	2.0
	8	Kaduwela	Colombo	1.9
	7	Kesbewa	Colombo	1.9
	6	Negombo	Gampaha	1.7
	5	Rathmalana	Colombo	1.6
	4	Thimbirigasyasa	Colombo	1.3
	3	Sri Jayawardanapura Kotte	Colombo	1.2
	2	Maharagama	Colombo	1.1
Least poor		Dehiwala	Colombo	0.6

Because of the existence of the 2002 poverty map, it is possible to look at changes in poverty in more detail. Figure 3 below displays the decrease in poverty incidence between 2002 and 2012/13, in both absolute and relative terms. Darker shades of green indicate the better performing DS divisions.

Figure 3: Distribution of poverty reduction from 2002 to 2012/13 by DS division



5. Number of poor population by district and DS division

The analysis has until now focused on documenting the estimated poverty rates, but areas with the highest poverty rates do not necessarily contain the largest number of poor people. As shown in Figure 5 below, low poverty rates in populous districts such as Ratnapura, Galle, and Kurunegala mask a large number of people living under the poverty line. Kurunegala, for instance, is home to 7.7 percent of the country's poor population even though only 6.5 percent of its population lives under the official poverty line. In contrast, Mullaitivu and Mannar, where estimated poverty rates are very high (28.8 percent and 20.1 percent, respectively), collectively account for only 3.4 percent of poor people nationwide due to their small population sizes. Similarly, the number of people living in poverty in each DS division is the product of the poverty rate and the population size of the DS division. The distribution of the poor population by DS division is presented in Figure 6.

Figure 4: Estimated number of poor population by province - 2012/13

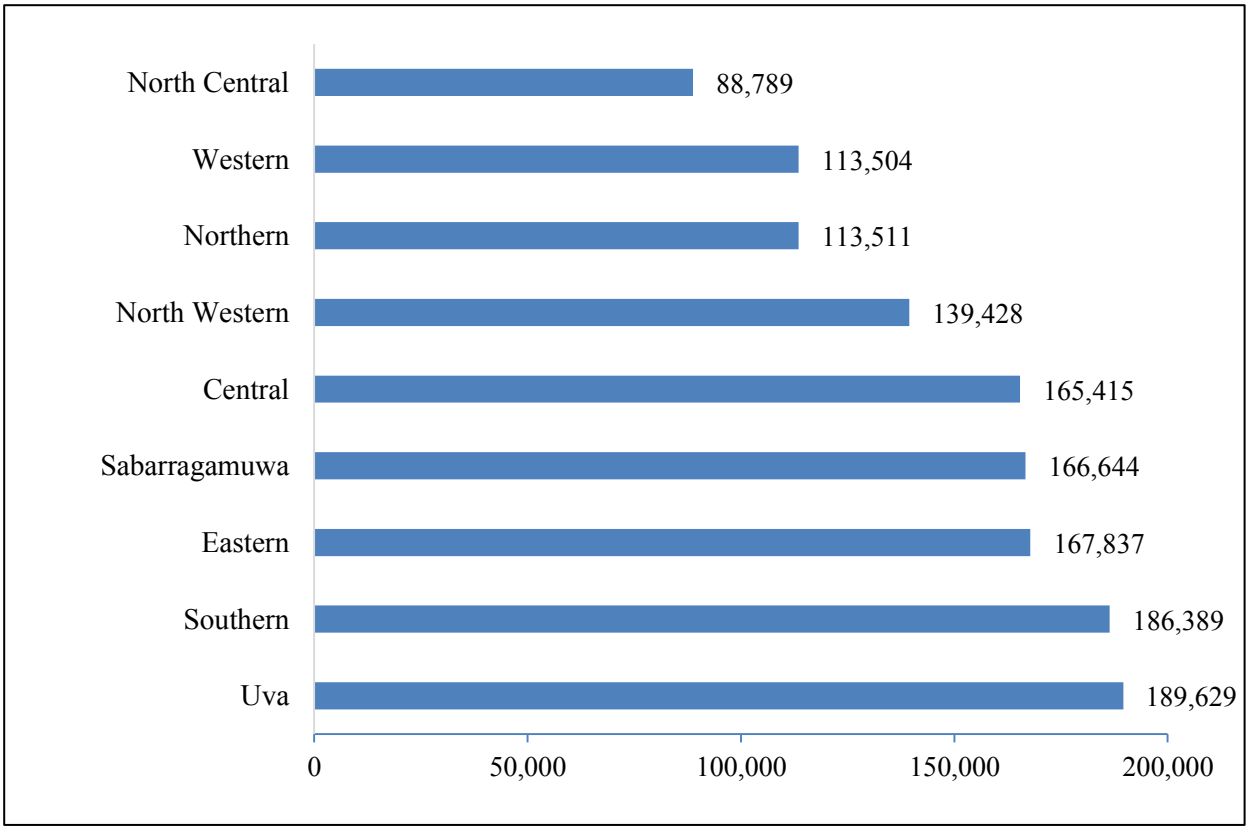


Figure 5: Estimated number of poor population by district - 2012/13

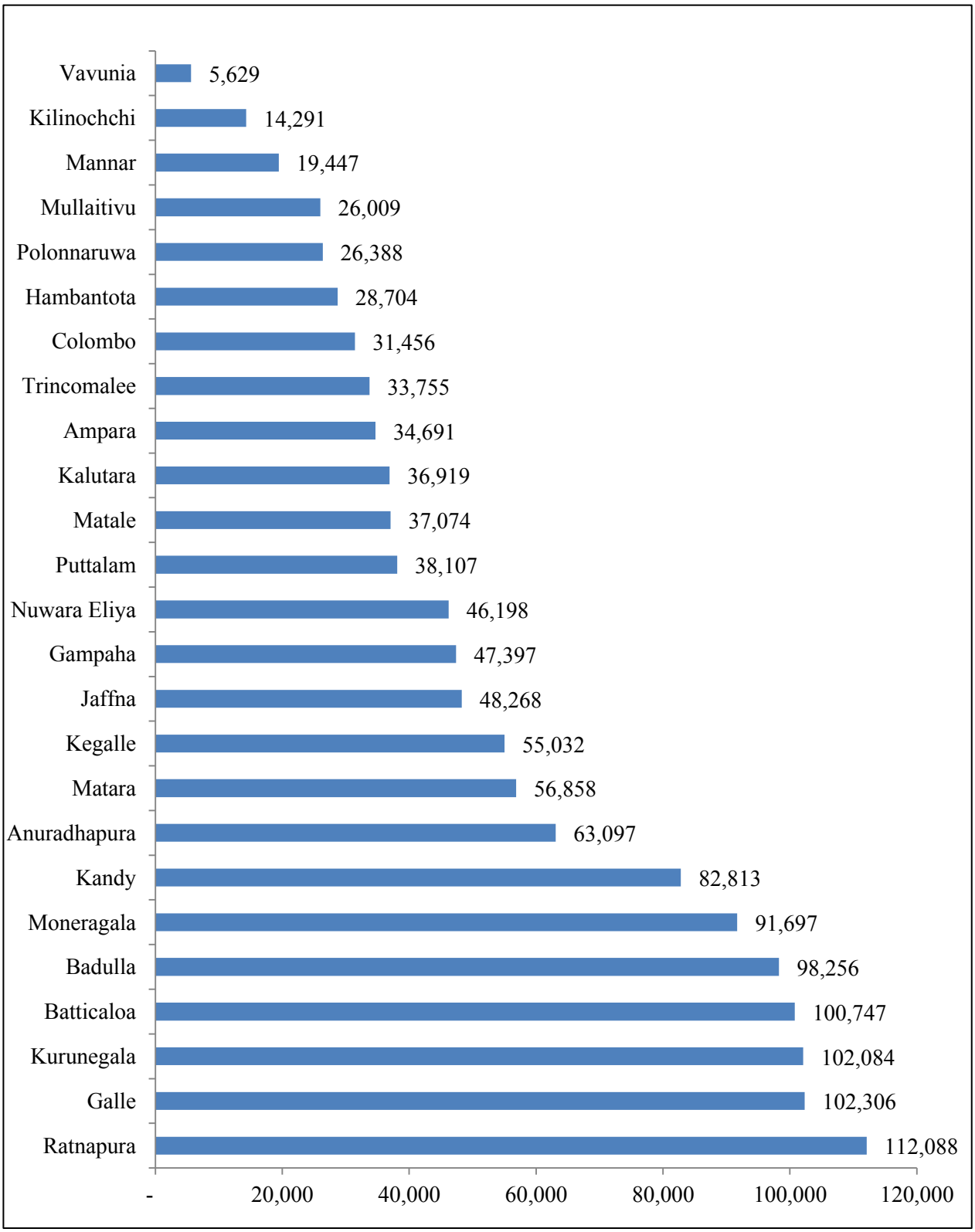
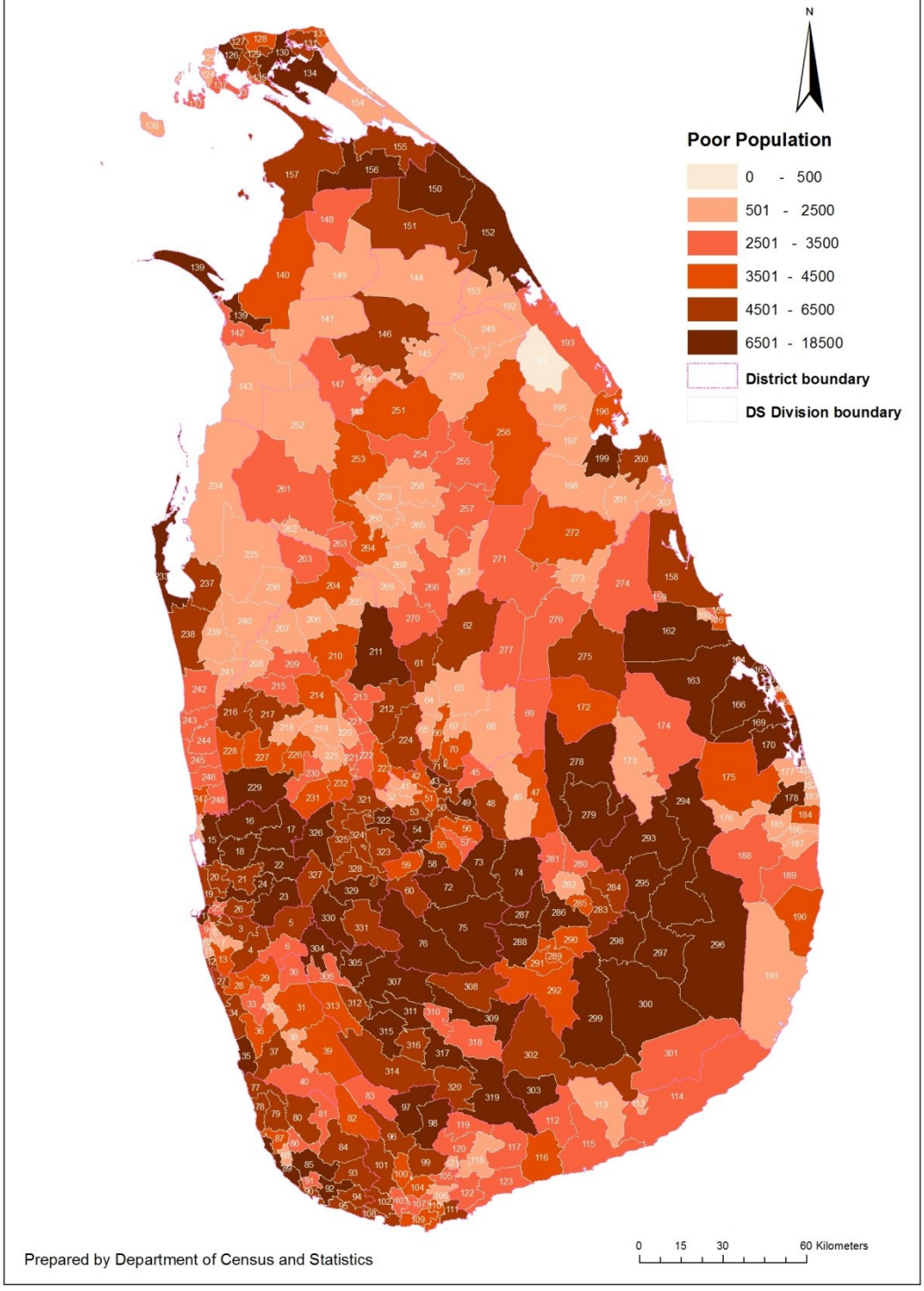


Figure 6: Estimated distribution of the poor population by DS division - 2012/13



Should policies and programs target to areas with high poverty rates or with a large number of poor people? If the benefit is largely a private benefit for households, then the number of beneficiaries is a key factor determining the total cost of the program. In these cases, a fixed budget is targeted to the poor more efficiently in areas where a large share of the population is poor. But for other types of interventions, such as improved roads or expanding access to electricity, the intervention creates public goods that can be shared by all residents of an area at little or no additional cost. For these types of programs, where the majority of the cost is fixed, targeting areas with large numbers will benefit more poor people.

6. Conclusions and limitations of poverty maps

Poverty maps are a useful and intuitive tool to locate the poor at disaggregated administrative levels, which often cannot be done using traditional poverty surveys. Together with the previous poverty map, this updated map can be used to monitor changes in poverty incidence over time. The prominent and persistent geographical disparity suggests the need for policies to boost economic growth in poor areas and narrow the income gap. In order to do so, identifying determinants of their lagging performance should be on top of the poverty and inequality reduction agenda.

It is worth pointing out a couple of caveats regarding the poverty map presented above. First, the poverty map is best interpreted as an approximation of well-being, for two reasons. First, the estimates are derived from predictions based on household and local characteristics such as assets and demographics. These characteristics often change slowly and may not fully capture economic shocks. Therefore, in comparison to the poverty estimates at the district level that are based solely on household consumption data from household surveys, the poverty map estimates reflects a longer-term measure of household well-being. Second, the methodology discussed in Section II relies on models of the average relationship between household characteristics and household consumption in different regional areas. This average relationship is assumed to be the same for all the DS divisions within each area. If these relationships in fact vary considerably across DS divisions within a broader area, then the poverty map estimates may not fully capture the variability in poverty across DS divisions, and may overstate the precision of the estimated prediction (Tarozzi and Deaton, 2009).

Besides income poverty, the poverty map does not cover other aspects of economic well-being and opportunities, such as access to school and clean water, the number of clinics within a community, and distance to major markets. Nor does the poverty map measure factors that potentially correlate with poverty incidence, such as labor market outcomes and social security income. As an extension to this poverty mapping exercise, overlaying the poverty map with geographical information on social services, infrastructure, and social conditions could help identify isolated areas, the reasons they remain economically stagnant, and potential solutions to improve their living standards.

Appendices

Appendix 1: Samples

The 2012/13 Household Income and Expenditure Survey (HIES) sample contains 20,540 households, whereas the 2012 Census of Population and Housing (CPH) contains nearly 19.9 million individuals from 5.3 million households. After accounting for missing data, the estimation sample from the 2012/13 HIES contains 20,208 households. The omitted observations account for only 1.6 percent of the original HIES sample; dropping them is therefore unlikely to cause meaningful bias. Table 4 below shows the geographical distribution of the HIES sample.

Table 4: Geographical distribution of the HIES sample

District	Number of households	Share of sample (%)
Sri Lanka	**20,540**	**100.0**
Urban	5,172	25.2
Rural	13,515	65.8
Estate	1,853	9.0
Colombo	2,166	10.6
Gampaha	1,948	9.5
Kalutara	1,244	6.1
Kandy	983	4.8
Matale	604	2.9
Nuwara Eliya	791	3.9
Galle	1,299	6.3
Matara	1,148	5.6
Hambantota	735	3.6
Jaffna	643	3.1
Mannar	290	1.4
Vavuniya	282	1.4
Mullaitivu	263	1.3
Kilinochchi	325	1.6
Batticaloa	698	3.4
Ampara	739	3.6
Trincomalee	502	2.4
Kurunegala	1,157	5.6
Puttalam	654	3.2
Anuradhapura	743	3.6
Polonnaruwa	526	2.6
Badulla	731	3.6
Moneregala	576	2.8
Ratnapura	825	4.0
Kegalle	668	3.3

Appendix 2: Estimation and simulation processes

Step 1: Identify potential explanatory variables

Before estimating the consumption model and imputing household expenditure into the census data, we identified a set of potential explanatory variables that are common between the HIES and the CPH. This was first done by comparing the questionnaires of the household survey and the census to find variables that (i) are likely to be highly correlated with consumption and (ii) exist in or can be constructed from both the HIES and the CPH.

Based on conventional consumption modeling in the literature and discussion with DCS staff, nine potential sets of explanatory variables were shortlisted. They include district dummies, housing conditions, household assets, age, gender, and education of household head, household size, dependency ratio, and the sex ratio. Potentially relevant interaction terms between these variables were also constructed. Descriptive statistics of these variables, based on the 2012/13 HIES sample of 20,540 households, is presented in Table 5 below. The estimation in Step 2 aims to predict expenditure using the independent variables. Thus, the estimated coefficients do not necessarily reflect causal relationships; instead, they should be interpreted as conditional correlations between the independent variables and expenditure.

As described below, there are 16 models to be estimated in Step 2. The specific list of independent variables for each model varies, depending on model section criteria. Before running each model in Step 2, we plotted and summarized the potential explanatory variables in PovMap 2.0 and kept only those whose distributions were similar between the HIES and the CPH. Since the procedure predicts expenditure for households in the census based on the relationships estimated from the HIES data, it is important that the independent variables have similar statistical properties between the two data sources. In fact, the independent variables have similar means, standard deviation, and skewness in almost all cases. In a few models, age squared and age cubed do not. For brevity, the comparison of the explanatory variables between the HIES and the CPH is not reported here.

Table 5: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max	Definition
Real monthly expenditure per capita (Rs.)	20,540	11,618	13,178	797	352,449	
Characteristics of household (HH) head						
Gender of HH head	20,540	76.3				dummy variable: 1=male; 0=female
Age of HH head	20,536	50.93	13.96	12	98	
Marital status of HH head	20,540	78.9				dummy variable: 1=married; 0=otherwise
Working status of HH head	20,540	70.6				dummy variable: 1=working, 0=otherwise
Employment status of HH head	20,539	Unemployed			0.6	categorical variable
		Employed in public sector			10.3	
		Employed in private sector			60.3	
		Not in labor force			28.8	
Education of HH head	20,534	No schooling			3.93	
		Passed up to grade 5/Special education			24.18	
		Passed grades 6 to 10			45.37	
		GCE O/L, GCE A/L and passed GSQ			23.88	
		Tertiary degree and above			2.63	
HH characteristics						
HH size	20,540	3.92	1.634343	1	16	number of HH members
Sex ratio	20,540	46.4	21.8	0	100	number of male members divided by HH size
Economic dependency ratio	20,540	62.8	25.4	0	100	number of members not working divided by HH size
Highest education attainment in HH	20,540	No schooling			1.14	categorical variable: highest education attainment by all HH members
		Passed up to grade 5/Special education			3.15	
		Passed grades 6 to 10			12.96	
		GCE O/L, GCE A/L and passed GSQ			55.95	
		Tertiary degree and above			26.8	

Table 5: Summary statistics (contd.)

Variable	Obs.	Mean	Std. Dev.	Min	Max	Definition
Housing conditions						
Fuel	20,523	77	42.1			dummy variable: 1= HH's main cooking fuel is fire wood, 0=otherwise"
Electricity	20,539	88.5	31.9			dummy variable: 1= HH's main type of lighting is electric , 0=otherwise
Toilet	20,532	88.8	31.6			dummy variable: 1=HH has access to a private toilet, 0=otherwise
Water-sealed toilet	20,294	96.8	17.5			dummy variable: 1=HH has access to a water-sealed toilet, 0=otherwise
Waste disposal	20,529	24.6	43.1			dummy variable: 1=HH has access to waste disposal service by local authority, 0=otherwise
House ownership	20,535	82.8	37.8			dummy variable: 1= HH owns the house, 0=otherwise
Wall	20,535	92.8	25.8			dummy variable: 1= Wall made from permanent/semi-permanent materials; 0=otherwise
Floor	20,536	92.6	26.2			dummy variable: 1=Floor made from permanent/semi-permanent materials; 0=otherwise
Roof	20,535	98.4	12.7			dummy variable: 1=Roof made from permanent/semi-permanent materials; 0=otherwise
Drinking water	20,540	88.5	31.8			dummy variable: 1= HH's main source of drinking water is safe, 0=otherwise
Radio	20,539	69.3	46.2			dummy variable: 1= HH owns radio(s), 0=otherwise
TV	20,537	80.6	39.6			dummy variable: 1= HH owns TV(s), 0=otherwise
Land phone	20,534	35.3	47.8			dummy variable: 1= HH owns land phone(s), 0=otherwise
Mobile	20,538	80.8	39.4			dummy variable: 1= HH owns mobile phone(s), 0=otherwise
Computer	20,535	17.9	38.4			dummy variable: 1= HH owns computer(s), 0=otherwise

Table 5: Summary statistics (contd.)

Variable	Obs.	Mean	Std. Dev.	Min	Max	Definition
GN's characteristics						
Access to water	varies by estimated regions					GN's percentage of HH with safe drinking water
Access to electricity						GN's percentage of HH with electric lighting
Access to water-sealed toilet						GN's percentage of HH with water-seal toilet
Access to waste disposal service						GN's percentage of HH with access to waste disposal service
Access to roof						GN's percentage of HH with concrete roof
Access to internet						GN's percentage of HH with access to internet

Step 2: Estimate expenditure per capita from HIES data

Step 2 aims to find a consumption model that accurately predicts household consumption per capita. The estimation model is:

$$\ln(exp_{ic}) = \beta X_{ic} + u_{ic} \qquad (1)$$

where $ln(exp_{ic})$ is the log of per capita expenditure of the i^{th} household in the c^{th} survey cluster, X_{ic} is a vector of explanatory variables, and u_{ic} is the error term.

A technical challenge in estimating equation (1) is controlling for heteroskedasticity in the error term u_{ic}, which is often prominent in household data. This is addressed by breaking the error term into two components, one at the cluster level and the other at the household level:

$$u_{ic} = \eta_c + \varepsilon_{ic}$$

Both components are assumed to be independent of the explanatory variables X_{ic} and independent of each other. However, the variance of the second component (σ_ε^2) is assumed to vary across households. Equation (1) then becomes:

$$\ln(exp_{ic}) = \beta X_{ic} + \eta_c + \varepsilon_{ic} \qquad (2)$$

Equation (2) is estimated by the Feasible Generalized Least Square method, which takes into account differences in the distribution of errors across households. An important difference between the conventional Ordinary Least Square (OLS) method and the FGLS method is that FGLS estimates not only the coefficients but also the distributions of the coefficients β and errors η_c and ε_{ic}. These estimated distributions will be used to calculate poverty rates in Step 3. More detailed discussions on the small area estimation method can be found in Elbers, Lanjouw, and Lanjouw (2003), World Bank (2005), and Vishwanath and Yoshida (2007).

Create sub-samples

Aside from the clustering issue, the HIES contains complex geographical heterogeneity. Differences in lifestyles, preferences, and consumption patterns are likely to be significant across the urban, rural, and estate sectors, as well as across provinces. For example, ownership of a car might be a good indicator of economic wellbeing and high expenditure in urban areas. Car ownership may explain much less of the variation in expenditure in the estate sector, however, if only a small proportion of the most affluent households possess cars. In addition, the gender bias against households headed by females might also be stronger in mostly rural provinces such as North Central and North Western than in Colombo. Thus, estimating separate consumption models for smaller and relatively homogenous areas is likely to produce more accurate results than estimating a single model for the entire country.

The preferred option was to estimate the consumption model for each province-sector separately. However, each model must draw on a sufficiently large sample in the HIES to generate reliable regression results. This was not the case in for the estate sector in most provinces, as well as the urban sector in Sabaragamuwa, Southern, Uva, Northern, North Central, and North Western provinces.

As a result, we grouped all households in the estate sector into two regions called North Estate and South Estate, and the urban households of the aforementioned provinces into North Urban Areas and South Urban Areas. Overall, the country is categorized into 16 regions, shown in Table 6, each of which contains households from one sector of one or three neigbouring provinces. This grouping was done after careful consultation with DCS staff to ensure that the provinces bundled together have relatively similar socio-economic conditions. The consumption model was estimated for each of these regions separately.

Table 6 : HIES estimation samples

Model No.	Region	Province	Sector	Observations from 2012/13 HIES
	Sri Lanka			**20,208**
1	Western – urban	Western	urban	2,114
2	Western – rural	Western	rural	2,899
3	Central – urban	Central	urban	474
4	Central – rural	Central	rural	1,289
5	Eastern – urban	Eastern	urban	686
6	Eastern – rural	Eastern	rural	1,157
7	North Central – rural	North Central	rural	1,078
8	North Western – rural	North Central	rural	1,425
9	Northern – rural	Northern	rural	1,292
10	Sabaragamuwa – rural	Sabaragamuwa	rural	989
11	Southern – rural	Southern	rural	2,209
12	Uva – rural	Uva	rural	896
13	South urban areas	Sabaragamuwa, Southern, Uva	urban	1,062
14	North urban areas	Northern, North Central, North Western	urban	801
15	South Estates	Western, Central, Southern	estate	1,138
16	North Estates	North Western, Uva, Sabaragamuwa	estate	699

In principle, both this and the previous poverty mapping exercise break the national sample into smaller sub-samples to account for heterogeneity across sectors and provinces. The specific sub-samples differ between the two exercises, mostly because the 2002 HIES and 2012/13 HIES cover different populations. The previous exercise estimates 26 models in total, with one for the rural sector in each of the 17 covered districts, one for urban Colombo, one for urban Kandy, 5 other urban models in which at least two neighboring districts are bundled together, and 2 estate models. Moreover, each region in this exercise contains at least 474 observations, whereas the previous exercise allows 5 regions to have less than 400 observations, with the smallest having only 184 observations.

Such differences do not affect the compatibility of the estimated results between the two exercises. However, the larger regression samples also allow for more expansive model specifications, which could help improve prediction power without over-fitting the models. A rule of thumb is that a small area estimation model should not include more than the square root of *n* regressors, where *n* is the sample size (Zhao and Lanjouw, 2014, p.58). Even though this poverty mapping exercise generally uses more explanatory variables than its precedence (17-30 variables as compared to 9-29 variables), the larger samples in this map means that all of the models used for the new map satisfy this rule, while all but one in the previous exercise does.

Model selection criteria

Since Step 2 aims to predict expenditure, model specifications were selected based on their fit with the actual HIES data. The adjusted R-squared measure is a common metric for assessing the ability of a model to explain variation in the sample. However, relying only on adjusted R-squared favors over-fitting larger models. This is because adjusted R-squared tends to increase as the number of explanatory variables increases. In other words, adding more regressors can improve adjust R-squared but not necessarily improve the model's prediction power. In order to avoid over-fitting the models, we used the Bayesian Information Criterion (BIC)[8], which institutes a penalty for model complexity, and thus, is a more parsimonious model selection criterion than adjusted R-squared. Among the tested models, the one with the smallest BIC was selected.

[8] The BIC is calculated as follows:

$$BIC = kln(N) - 2\ln(\hat{L})$$

where k is the number of parameters estimated in the regression, N is the number of observations, and $\hat{L}$ is the maximized likelihood function. Under the assumption that the errors are normally distributed, the log-likelihood function in a regression model has the form

$$\ln(L) = -\left(\frac{N}{2}\right)\ln(2\pi\sigma^2) - \frac{ESS}{2\sigma^2}$$

where ESS is the sum of squared residuals, π=3.1415, and σ is the standard deviation of the error term in the regression.

For each region, various model specifications were run and compared in STATA before the final one was selected and fed into the PovMap software program. It was observed that once a sufficient set of relevant and statistically significant explanatory variables was added to the model, adding more regressors did not considerably improve adjusted R-squared but lowered BIC. Table 7 below presents the final model specification for each of the 16 regions.

Table 7: Selected model specifications

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Characteristics of household (HH) head																
Gender of HH head													x			
Age of HH head		x		x											x	x
Marital status of HH head			x													
Working status of HH head																
Employment status of HH head																
Education of HH head	x	x	x	x	x	x	x	x		x	x	x	x	x	x	
HH characteristics																
HH size	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sex ratio	x							x							x	x
Economic dependency ratio		x	x		x	x			x					x	x	x
Highest education attainment in HH		x		x	x	x	x		x		x					x
Housing conditions																
Fuel	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Electricity										x		x	x			x
Toilet	x					x		x			x	x				
Water-sealed toilet	x					x					x	x			x	x
Waste disposal	x													x		
Wall	x		x			x		x	x	x		x	x		x	
Floor		x		x			x		x		x	x			x	
Roof														x		
Drinking water		x		x	x						x					
Owned house	x	x				x	x		x	x					x	
Owned radio	x	x	x					x		x	x					

Table 7: Selected model specifications (contd.)

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15	Model 16
Housing conditions (Contd.)																
Owned TV		x	x	x	x	x	x	x	x	x	x	x	x		x	
Owned land phone	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Owned mobile	x	x		x	x	x	x	x	x	x	x	x	x	x	x	
Owned computer	x	x	x	x	x		x	x		x	x	x	x	x	x	
District characteristics																
District dummy	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GN's characteristics																
Access to water	x	x			x						x					
Access to electricity																
Access to water-sealed toilet		x	x		x	x	x	x			x					
Access to waste disposal service		x	x								x					
Access to permanent roof			x	x			x					x	x			x
Access to internet	x	x		x							x		x			x
Interaction terms																
HH size squared		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
HH size powered three				x		x		x			x					
Age of HH head squared (divided by 100)		x		x											x	
Age of HH head powered 3 (divided by 1000)																
HH size * Economic dependency ratio		x	x													
HH size * Sex ratio																
Access to water-sealed toilet * District dummy								x								
Age * Economic dependency ratio															x	
Age * HH size															x	

Step 3: Simulate expenditure per capita on CPH data

After obtaining the estimated distributions of coefficients and errors from Step 2, PovMap 2.0 randomly draws coefficients and errors from these estimated distributions to simulate household expenditure for each household in the census. The software repeats the simulation 100 times and computes the poverty headcount ratios using the simulated household expenditures for each round. Finally, the estimated poverty rates are calculated as the average poverty rates over the 100 simulation rounds, and their standard errors as the standard deviations of the 100 simulation rounds.

Appendix 3: Goodness of Fit

The estimated coefficients and standard errors are not reported here for brevity. Instead, Table 8 focuses on a critical aspect of the estimation's performance: prediction power. The models fit the actual data reasonably well, with the average adjusted R-squared being 0.46 and adjust R-squared ranging from 0.387 to 0.612. This performance is reasonably high as compared to other countries' experiences. For example, the adjusted R-squared was only 0.34 in Papua New Guinea, ranges from 0.24 to 0.64 in Madagascar, and ranged from 0.46 to 0.74 in Ecuador (Vishwanath and Yoshida 2007).

Table 8: Adjusted R-squared of estimated models

Model No.	Region	No. of observations	No. of explanatory variables	Adjusted R-squared	F-value (p<F)
1	Western – urban	2,114	23	0.504	98.77
2	Western – rural	2,899	29	0.447	84.57
3	Central – urban	474	21	0.474	22.27
4	Central – rural	1,289	25	0.550	60.55
5	Eastern – urban	686	22	0.445	27.20
6	Eastern – rural	1,157	23	0.431	40.77
7	North Central – rural	1,078	21	0.390	35.43
8	North Western – rural	1,425	20	0.387	48.31
9	Northern – rural	1,292	20	0.416	49.33
10	Sabaragamuwa – rural	989	17	0.456	52.77
11	Southern – rural	2,209	29	0.443	63.61
12	Uva – rural	896	19	0.465	44.29
13	South urban areas	1,062	22	0.576	69.70
14	North urban areas	801	19	0.612	71.00
15	South Estates	1,138	30	0.415	28.77
16	North Estates	699	22	0.398	22.99
Average adjust R-squared				**0.463**	

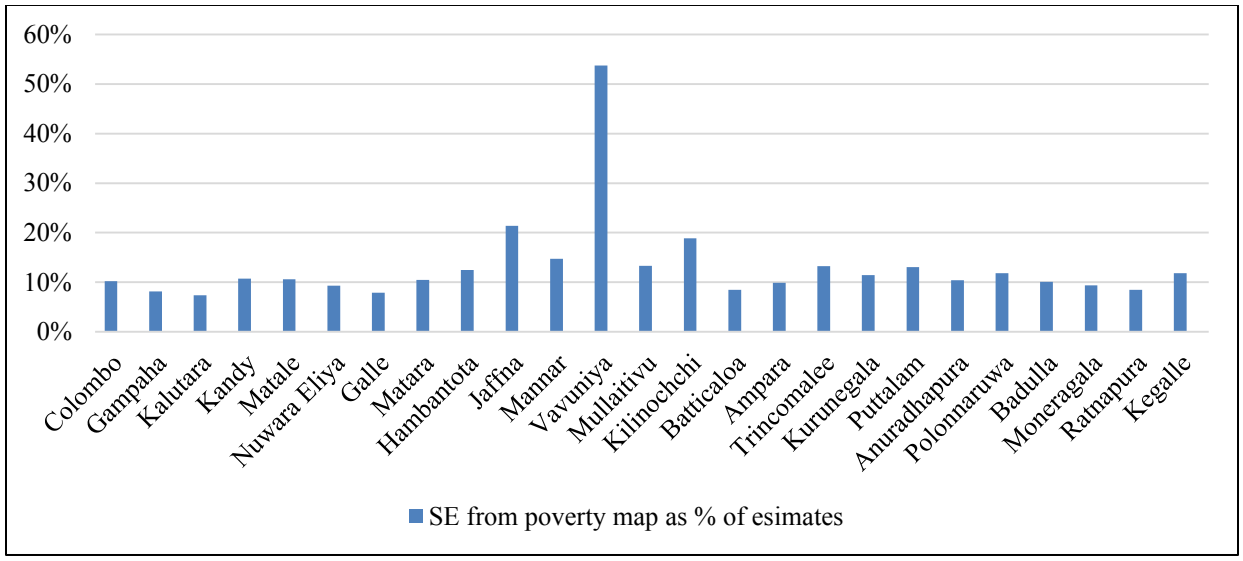
The models' goodness of fit also improves from the previous poverty map for Sri Lanka, in which the adjusted R-squared ranged from 0.27 to 0.72 and averaged 0.42 (Vishwanath and Yoshida 2005). This improvement could be partly attributed to more accurate and detailed consumption data from the 2012/13 HIES, and consequently, better model specifications. Unlike the 2002 HIES, the 2012/13 HIES includes questions on durable assets, which are often indicative of household's welfare level. Indeed, asset ownership variables are strong predictors of household expenditure in our models.

The regressions for the combined regions, namely models 13 through 16, do not produce a noticeably worse fit than the other single-province regressions. This suggests that the grouping of provinces does not visibly lower the estimation's prediction power.

Appendix 4: Robustness check and complete table of results

Estimated headcount ratios and number of poor people for all DS divisions are presented in Table 10. As a robustness check, the estimated poverty rates were compared with the existing consumption-based estimates from the 2012/13 HIES data at the district level.[9] When the poverty mapping estimates diverged too much from the HIES estimates, automatic trimming during the simulation stage was carried out in PovMap to ensure consistency with the HIES estimates. As shown in Table 9 below, the average discrepancy between the poverty map estimates and the consumption-based estimates is only 1.1 percentage points.

Figure 7: Standard Error as a percentage of the estimated headcount ratio



Moreover, the average standard error[10] (SE) at the district level is 1.37 percentage points for the poverty map estimates, as compared to 1.32 percentage points for the consumption-based estimates. Measured as a proportion of the estimated headcount ratios, the estimated SEs from the poverty mapping method are often smaller than those estimated directly from household data (see Figure 7). These suggest that the models are reasonably accurate.

[9] Since the DCS does not produce poverty headcount ratios by DS division, comparison cannot be done for estimates at the DS division level.

[10] As discussed in Appendix 3, for each estimation model, the SE of reported poverty rate was calculated in PovMap as the standard deviation over 100 simulation rounds. Since each estimation model covers only one sector, separate sector-specific SEs were computed for districts and DS divisions that consist of more than one sector. The SEs for those districts and DS divisions were then calculated as the square root of the weighted average of their sector-specific variances, with the square of the sectors' population shares as weights. This assumes no covariance between the simulated headcount ratios across sectors within the same region. This calculation, while being imperfect, provides an approximation of the real SEs, which we never know, and the accuracy of the estimation. These estimated SEs also provide a rough indication as to whether two areas' poverty rates are statistically different or not.

Table 9: Estimated poverty rates under Sri Lanka's official poverty line

District	Estimated headcount index from poverty mapping (%)	Estimated headcount index from 2012/13 HIES (%)	SE from poverty mapping (%)	SE from 2012/13 HIES (%)
Colombo	2.51	1.40	0.26	0.32
Gampaha	3.89	2.10	0.32	0.33
Kalutara	5.12	3.10	0.38	0.73
Kandy	7.31	6.20	0.79	0.94
Matale	7.81	7.80	0.83	1.16
Nuwara Eliya	8.28	6.60	0.77	0.90
Galle	8.74	9.90	0.69	0.71
Matara	9.19	7.10	0.97	1.38
Hambantota	5.71	4.90	0.71	0.59
Jaffna	11.53	8.30	2.46	1.39
Mannar	20.89	20.10	3.07	2.55
Vavuniya	6.41	3.40	3.45	1.98
Mullaitivu	31.44	28.80	4.19	2.45
Kilinochchi	20.81	12.70	3.93	2.16
Batticaloa	18.51	19.40	1.57	1.53
Ampara	8.19	5.40	0.81	1.67
Trincomalee	8.51	9.00	1.13	1.53
Kurunegala	7.01	6.50	0.80	0.95
Puttalam	6.22	5.10	0.81	0.89
Anuradhapura	6.80	7.60	0.71	1.11
Polonnaruwa	5.84	6.70	0.69	1.47
Badulla	9.51	12.30	0.96	1.46
Monaragala	21.11	20.80	1.98	2.00
Ratnapura	11.15	10.40	0.94	1.73
Kegalle	7.97	6.70	0.94	1.07
Average SE			**1.37**	**1.32**
Average discrepancy between poverty mapping and HIES estimates			1.1 percentage points	
Average absolute discrepancy			1.7 percentage points	
Mean squared discrepancy			0.053 percentage points	

Another way to compare the estimates from the poverty mapping method and the consumption-based estimation is to look at their confidence intervals. We present their 95 percent confidence intervals in Figure 8 below. The confidence intervals from the poverty mapping method either roughly coincide or fall within the confidence intervals from the consumption-based estimation for most districts. This provides reassurance that the two set of estimates are mutually consistent in estimating the true but unobserved poverty statistics. Notable exceptions are Kilinochchi, Ampara, Vanunya, and Mulaitivu districts, where the confidence intervals from the two methods are considerably different. The estimates for these district, therefore, should be used with caution.

In this aspect, the previous poverty map appears to perform better, since its confidence intervals at the district level not only have much narrower ranges but also fall within – in most districts – the consumption-based confidence intervals from the 2002 HIES (Vishwanath and Yoshida 2005, p. 6). Unfortunately, the previous poverty map does not report its estimated standard errors (SEs). It is therefore impossible to compare the previous map's standard errors with those from this poverty map.

Figure 8: 95 Confidence intervals of estimated poverty rates by district

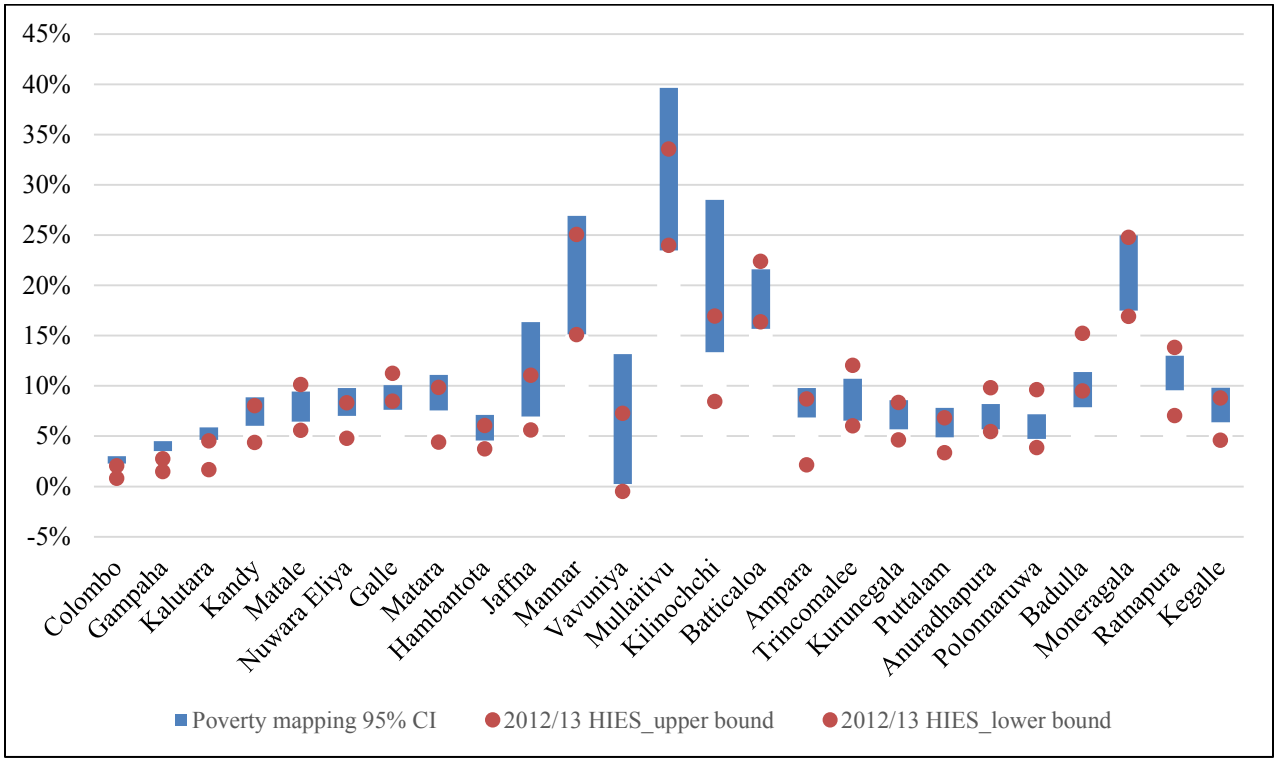


Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
10	Dehiwala	Colombo	0.62	533
7	Maharagama	Colombo	1.09	2,035
8	Sri Jayawardanapura Kotte	Colombo	1.20	1,224
9	Thimbirigasyaya	Colombo	1.29	2,766
11	Rathmalana	Colombo	1.57	1,439
14	Negombo	Gampaha	1.66	2,305
13	Kesbewa	Colombo	1.85	4,390
3	Kaduwela	Colombo	1.93	4,733
259	Nuwaragam Palatha East	Anuradhapura	1.96	1,290
25	Kelaniya	Gampaha	2.16	2,822
19	Wattala	Gampaha	2.68	4,567
4	Homagama	Colombo	2.75	6,335
21	Gampaha	Gampaha	2.86	5,562
27	Panadura	Kalutara	2.88	5,155
2	Kolonnawa	Colombo	2.92	5,455
20	Ja-Ela	Gampaha	3.08	6,072
181	Sainthamarathu	Ampara	3.16	800
26	Biyagama	Gampaha	3.33	6,068
12	Moratuwa	Colombo	3.68	5,979
276	Thamankaduwa	Polonnaruwa	3.69	2,923
24	Mahara	Gampaha	3.70	7,507
123	Tangalle	Hambantota	3.71	2,627
109	Matara Four Gravets	Matara	3.80	4,237
29	Horana	Kalutara	3.95	4,391
1	Colombo	Colombo	3.97	12,378
28	Bandaragama	Kalutara	3.98	4,273
15	Katana	Gampaha	4.07	9,288
180	Kalmunai	Ampara	4.14	1,827
50	Kandy Four Gravets and Gangawata Korale	Kandy	4.17	6,118
34	Kaluthara	Kalutara	4.20	6,499
271	Hingurakgoda	Polonnaruwa	4.26	2,624
221	Kurunegala	Kurunegala	4.33	3,390
32	Madurawala	Kalutara	4.41	1,495
6	Padukka	Colombo	4.53	2,893
182	Karativu	Ampara	4.62	770

Table 11: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
22	Attanagalla	Gampaha	4.63	8,085
176	Ampara	Ampara	4.67	1,940
198	Kantale	Trincomalee	4.69	2,120
220	Maspotha	Kurunegala	4.70	1,584
196	Trincomalee Town and Gravets	Trincomalee	4.72	4,489
18	Minuwangoda	Gampaha	4.85	8,508
145	Vavuniya South	Vavunia	4.86	604
285	Badulla	Badulla	4.89	3,507
122	Beliatta	Hambantota	4.97	2,726
114	Tissamaharama	Hambantota	5.03	3,347
183	Ninthavur	Ampara	5.03	1,321
192	Padavi Sri Pura	Trincomalee	5.11	587
51	Harispattuwa	Kandy	5.13	4,421
273	Lankapura	Polonnaruwa	5.13	1,836
243	Chilaw	Puttalam	5.20	3,218
5	Seethawake	Colombo	5.21	5,740
246	Nattandiya	Puttalam	5.23	3,193
247	Wennappuwa	Puttalam	5.25	3,515
167	Kattankudy	Batticoloa	5.26	2,101
116	Ambalantota	Hambantota	5.31	3,775
41	Thumpane	Kandy	5.34	1,953
115	Hambantota	Hambantota	5.35	2,991
146	Vavuniya	Vavunia	5.41	6,139
248	Dankotuwa	Puttalam	5.42	3,331
30	Ingiriya	Kalutara	5.45	2,876
186	Akkaraipattu	Ampara	5.48	2,143
23	Dompe	Gampaha	5.51	8,321
38	Agalawatta	Kalutara	5.51	1,974
53	Yatinuwara	Kandy	5.53	5,731
268	Ipalogama	Anuradhapura	5.54	2,072
245	Mahawewa	Puttalam	5.58	2,808
222	Mallawapitiya	Kurunegala	5.66	2,933
258	Mihintale	Anuradapura	5.68	1,810
235	Karuwalagaswewa	Puttalam	5.69	1,295
262	Rajanganaya	Anuradhapura	5.69	1,860

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount Index (%)	No. of poor people
240	Anamaduwa	Puttalam	5.70	2,116
66	Matale	Matale	5.71	4,176
90	Galle Four Gravets	Galle	5.74	5,639
225	Weerambugedara	Kurunegala	5.76	1,934
244	Madampe	Puttalam	5.76	2,712
237	Puttalam	Puttalam	5.78	4,669
33	Millaniya	Kalutara	5.80	2,981
118	Weeraketiya	Hambantota	5.82	2,371
232	Polgahawela	Kurunegala	5.87	3,733
36	Dodangoda	Kalutara	5.88	3,704
227	Kuliyapitiya West	Kurunegala	5.89	4,440
266	Kekirawa	Anuradhapura	5.98	3,433
49	Kundasale	Kandy	5.99	7,279
289	Bandarawela	Badulla	5.99	3,810
17	Mirigama	Gampaha	6.00	9,591
117	Angunukolapelessa	Hambantota	6.01	2,860
223	Mawathagama	Kurunegala	6.05	3,826
272	Medirigiriya	Polonnaruwa	6.05	3,839
16	Divulapitiya	Gampaha	6.09	8,649
194	Gomarankadawala	Trincomalee	6.10	424
260	Nachchadoowa	Anuradhapura	6.10	1,515
75	Nuwara Eliya	Nuwara Eliya	6.13	12,843
236	Nawagattegama	Puttalam	6.19	867
253	Nuwaragam Palatha Central	Anuradhapura	6.19	3,595
277	Elahera	Polonnaruwa	6.21	2,645
242	Arachchikattuwa	Puttalam	6.22	2,522
239	Mahakumbukkadawala	Puttalam	6.23	1,138
322	Mawanella	Kegalle	6.25	6,810
175	Uhana	Ampara	6.29	3,546
87	Ambalangoda	Galle	6.30	3,528
230	Narammala	Kurunegala	6.33	3,486
264	Thalawa	Anuradhapura	6.35	3,546
321	Rambukkana	Kegalle	6.36	5,127
44	Pathadumbara	Kandy	6.37	5,534
219	Bamunukotuwa	Kurunegala	6.39	2,266

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
37	Mathugama	Kalutara	6.41	5,123
40	Walallawita	Kalutara	6.42	3,430
261	Nochchiyagama	Anuradhapura	6.45	3,089
120	Walasmulla	Hambantota	6.49	2,695
52	Hatharaliyadda	Kandy	6.53	1,889
214	Wariyapola	Kurunegala	6.53	3,867
91	Bope-Poddala	Galle	6.55	3,174
136	Jaffna	Jaffna	6.58	3,234
269	Galnewa	Anuradhapura	6.58	2,215
324	Kegalle	Kegalle	6.62	5,837
257	Galenbidunuwawa	Anuradhapura	6.66	2,997
121	Okewela	Hambantota	6.69	1,243
35	Beruwala	Kalutara	6.70	10,856
191	Lahugala	Ampara	6.73	584
229	Pannala	Kurunegala	6.78	8,257
76	Ambagamuwa	Nuwara Eliya	6.80	13,890
113	Lunugamvehera	Hambantota	6.82	2,086
64	Pallepola	Matale	6.83	1,943
231	Alawwa	Kurunegala	6.83	4,246
224	Rideegama	Kurunegala	6.87	5,944
54	Udunuwara	Kandy	6.90	7,394
241	Pallama	Puttalam	6.94	1,675
31	Bulathsinhala	Kalutara	6.96	4,434
179	Kalmunai Tamil Division	Ampara	6.99	2,063
218	Katupotha	Kurunegala	7.09	2,251
323	Aranayaka	Kegalle	7.10	4,741
62	Dambulla	Matale	7.11	4,890
172	Dehiattakandiya	Ampara	7.16	4,174
119	Katuwana	Hambantota	7.20	3,296
212	Ibbagamuwa	Kurunegala	7.25	6,038
275	Dimbulagala	Polonnaruwa	7.26	5,600
326	Warakapola	Kegalle	7.32	8,096
135	Nallur	Jaffna	7.33	4,914
213	Ganewatta	Kurunegala	7.36	2,866
263	Thambuttegama	Anuradhapura	7.38	3,042

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
209	Nikaweratiya	Kurunegala	7.40	2,890
210	Maho	Kurunegala	7.43	4,103
42	Poojapitiya	Kandy	7.44	4,183
325	Galigamuwa	Kegalle	7.44	5,418
195	Morawewa	Trincomalee	7.47	568
228	Ududdawa	Kurunegala	7.51	3,856
188	Damana	Ampara	7.55	2,826
270	Palagala	Anuradhapura	7.58	2,504
217	Panduwasnuwara	Kurunegala	7.64	4,776
63	Naula	Matale	7.67	2,298
88	Gonapeenuwala	Galle	7.71	1,638
288	Welimada	Badulla	7.72	7,598
160	Koralai Pattu West (Oddamavadi)	Batticoloa	7.73	1,703
61	Galewela	Matale	7.76	5,304
56	Pathahewaheta	Kandy	7.78	4,406
215	Kobeigane	Kurunegala	7.78	2,745
60	Pasbage Korale	Kandy	7.81	4,605
59	Ganga Ihala Korale	Kandy	7.90	4,286
89	Hikkaduwa	Galle	7.90	7,798
58	Udapalatha	Kandy	7.98	7,223
206	Ambanpola	Kurunegala	8.00	1,764
110	Devinuwara	Matara	8.03	3,806
165	Manmunai North	Batticoloa	8.06	6,705
205	Ehetuwewa	Kurunegala	8.08	2,008
251	Medawachchiya	Anuradhapura	8.08	3,599
267	Palugaswewa	Anuradhapura	8.08	1,203
265	Thirappane	Anuradhapura	8.11	2,105
112	Sooriyawewa	Hambantota	8.13	3,429
197	Thambalagamuwa	Trincomalee	8.13	2,276
327	Ruwanwella	Kegalle	8.17	5,140
103	Malimbada	Matara	8.18	2,804
65	Yatawatta	Matale	8.19	2,413
226	Kuliyapitiya East	Kurunegala	8.22	4,254
233	Kalpitiya	Puttalam	8.28	6,968
108	Weligama	Matara	8.30	5,913

Table 120: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
187	Alayadiwembu	Ampara	8.31	1,857
238	Mandel	Puttalam	8.34	5,043
204	Galgamuwa	Kurunegala	8.37	4,421
39	Palindanuwara	Kalutara	8.40	4,207
249	Padaviya	Anuradhapura	8.40	1,848
70	Rattota	Matale	8.46	4,261
55	Doluwa	Kandy	8.47	4,158
111	Dickwella	Matara	8.52	4,575
254	Rambewa	Anuradhapura	8.56	3,017
46	Udadumbara	Kandy	8.61	1,878
71	Ukuwela	Matale	8.62	5,740
80	Elpitiya	Galle	8.64	5,444
291	Haputhale	Badulla	8.66	4,121
216	Bingiriya	Kurunegala	8.68	5,317
78	Balapitiya	Galle	8.70	5,736
203	Giribawa	Kurunegala	8.75	2,661
47	Minipe	Kandy	8.76	4,428
207	Kotawehera	Kurunegala	8.76	1,789
92	Akmeemana	Galle	8.83	6,727
234	Vanathavilluwa	Puttalam	8.85	1,514
193	Kuchchaveli	Trincomalee	8.88	2,900
201	Seruvila	Trincomalee	8.89	1,179
286	Hali Ela	Badulla	8.91	7,915
255	Kahatagasdigiliya	Anuradhapura	8.97	3,457
85	Baddegama	Galle	8.99	6,590
95	Habaraduwa	Galle	9.01	5,450
287	Uva Paranagama	Badulla	9.01	6,868
211	Polpithigama	Kurunegala	9.04	6,638
133	Vadamarachchi North (Pointpedro)	Jaffna	9.13	4,317
306	Kiriella	Ratnapura	9.16	2,950
106	Kirinda Puhulwella	Matara	9.17	1,823
107	Thihagoda	Matara	9.22	3,026
104	Kamburupitiya	Matara	9.23	3,667
48	Medadumbara	Kandy	9.28	5,555
77	Bentota	Galle	9.28	4,519

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS division	District	Estimated headcount index (%)	No. of poor people
309	Balangoda	Ratnapura	9.33	7,481
308	Imbulpe	Ratnapura	9.36	5,330
200	Muttur	Trincomalee	9.42	5,279
147	Vengalacheddikulam	Vavunia	9.45	2,717
68	Laggala-Pallegama	Matale	9.59	1,128
84	Nagoda	Galle	9.60	5,071
330	Dehiovita	Kegalle	9.76	7,814
252	Mahavillachchiya	Anuradhapura	9.79	2,109
304	Eheliyagoda	Ratnapura	9.82	6,859
328	Bulathkohupitiya	Kegalle	9.82	4,548
72	Kothmale	Nuwara Eliya	9.85	9,813
81	Niyagama	Galle	9.86	3,422
290	Ella	Badulla	9.94	4,401
208	Rasnayakapura	Kurunegala	10.00	2,131
256	Horowpothana	Anuradhapura	10.01	3,536
319	Embilipitiya	Ratnapura	10.02	13,290
79	Karandeniya	Galle	10.06	6,183
307	Rathnapura	Ratnapura	10.14	11,985
250	Kebithigollewa	Anuradhapura	10.20	2,167
86	Welivitiya-Divithura	Galle	10.25	2,941
99	Mulatiyana	Matara	10.29	5,088
94	Imaduwa	Galle	10.31	4,550
69	Wilgamuwa	Matale	10.38	2,978
45	Panwila	Kandy	10.40	2,702
189	Thirukkovil	Ampara	10.56	2,659
278	Mahiyanganaya	Badulla	10.56	7,765
274	Welikanda	Polonnaruwa	10.59	3,432
105	Hakmana	Matara	10.63	3,290
67	Ambanganga Korale	Matale	10.67	1,643
283	Passara	Badulla	10.67	5,087
184	Addalachchenai	Ampara	10.71	4,315
101	Akuressa	Matara	10.72	5,579
144	Vavuniya North	Vavunia	10.74	1,176
282	Soranathota	Badulla	10.81	2,355
74	Walapane	Nuwara Eliya	10.92	11,162

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS Division	District	Estimated headcount index (%)	No. of poor people
159	Koralai Pattu Central	Batticoloa	10.99	2,761
164	Eravur Town	Batticoloa	10.99	2,664
57	Delthota	Kandy	11.03	3,281
329	Yatiyanthota	Kegalle	11.12	6,702
318	Weligepola	Ratnapura	11.22	3,421
83	Neluwa	Galle	11.30	3,168
93	Yakkalamulla	Galle	11.37	5,148
96	Pitabeddara	Matara	11.38	5,741
100	Athuraliya	Matara	11.41	3,589
98	Pasgoda	Matara	11.43	6,680
310	Opanayaka	Ratnapura	11.50	3,027
134	Thenmarachchi (Chavakachcheri)	Jaffna	11.51	7,391
292	Haldummulla	Badulla	11.61	4,276
97	Kotapola	Matara	11.70	7,290
129	Valikamam South (Uduvil)	Jaffna	11.85	6,203
331	Deraniyagala	Kegalle	11.85	5,341
82	Thawalama	Galle	11.87	3,801
73	Hanguranketha	Nuwara Eliya	11.90	10,252
102	Welipitiya	Matara	11.92	6,114
173	Padiyathalawa	Ampara	11.93	2,082
315	Nivithigala	Ratnapura	11.96	7,116
313	Ayagama	Ratnapura	11.97	3,664
317	Godakawela	Ratnapura	12.12	9,128
311	Pelmadulla	Ratnapura	12.16	10,776
185	Irakkamam	Ampara	12.18	1,749
312	Elapatha	Ratnapura	12.25	4,603
131	Vadamarachchi South-west (Karaveddy)	Jaffna	12.35	5,635
305	Kuruwita	Ratnapura	12.42	11,642
127	Valikamam South -West (Sandilipay)	Jaffna	12.44	6,436
178	Sammanthurai	Ampara	12.49	7,462
190	Pottuvil	Ampara	12.68	4,379
314	Kalawana	Ratnapura	12.71	6,432
177	Navithanveli	Ampara	12.81	2,389
320	Kolonna	Ratnapura	13.15	5,953
130	Valikamam East (Kopay)	Jaffna	13.18	9,528

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS Division	District	Estimated headcount index (%)	No. of poor people
316	Kahawaththa	Ratnapura	13.18	5,659
281	Kandaketiya	Badulla	13.19	2,955
128	Valikamam North	Jaffna	13.45	3,895
138	Delft	Jaffna	13.47	508
171	Manmunai South & Eruvil Pattu	Batticoloa	13.94	8,429
168	Manmunai Pattu (Araipattai)	Batticoloa	13.98	4,244
202	Verugal (Eachchilampattu)	Trincomalee	14.34	1,627
125	Karainagar	Jaffna	14.42	1,379
284	Lunugala	Badulla	14.60	4,519
126	Valikamam West (Chankanai)	Jaffna	14.63	6,751
279	Rideemaliyadda	Badulla	14.73	7,361
280	Meegahakivula	Badulla	14.77	2,826
124	Island North (Kayts)	Jaffna	15.25	1,476
199	Kinniya	Trincomalee	15.89	10,172
174	Mahaoya	Ampara	15.94	3,146
142	Nanattan	Mannar	15.97	2,766
132	Vadamarachchi East	Jaffna	16.37	2,077
137	Island South (Velanai)	Jaffna	16.75	2,803
43	Akurana	Kandy	16.80	10,451
299	Wellawaya	Moneragala	18.07	10,584
153	Welioya	Mullaitivu	18.25	1,249
303	Sewanagala	Moneragala	18.34	7,573
161	Koralai Pattu (Valachchenai)	Batticoloa	18.42	4,244
300	Buttala	Moneragala	18.55	9,597
301	Katharagama	Moneragala	18.55	3,219
154	Pachchilaipalli	Kilinochchi	18.64	1,541
298	Badalkumbura	Moneragala	19.13	7,497
297	Monaragala	Moneragala	19.56	9,297
139	Mannar Town	Mannar	19.88	9,801
156	Karachchi	Kilinochchi	20.36	12,291
293	Bibila	Moneragala	20.67	8,085
155	Kandavalai	Kilinochchi	21.13	4,875
302	Thanamalvila	Moneragala	21.33	5,561
141	Madhu	Mannar	22.00	1,631
157	Poonakary	Kilinochchi	22.73	4,543

Table 10: Estimated headcount index and number of poor people by DS divisions with districts - 2012/13 (contd.)

Serial No	DS Division	District	Estimated headcount index(%)	No. of poor people
295	Medagama	Moneragala	23.66	8,245
163	Eravur Pattu	Batticoloa	24.69	18,242
143	Musalai	Mannar	25.74	2,064
170	Porativu Pattu	Batticoloa	25.84	9,323
294	Madulla	Moneragala	25.95	7,830
140	Manthai West	Mannar	26.90	3,893
158	Koralai Pattu North (Vaharai)	Batticoloa	27.99	5,950
152	Maritimepattu	Mullaitivu	28.61	8,096
296	Siyambalanduwa	Moneragala	28.70	15,041
169	Manmunai South-West	Batticoloa	28.93	7,090
151	Oddusuddan	Mullaitivu	33.49	4,972
149	Manthai East	Mullaitivu	33.68	2,336
148	Thunukkai	Mullaitivu	34.03	3,244
150	Puthukkudiyiruppu	Mullaitivu	35.66	8,466
162	Koralai Pattu South (Kiran)	Batticoloa	37.68	9,811
166	Manmunai West	Batticoloa	45.14	12,776

References

DCS 2004, 'Official poverty line for Sri Lanka', Department of Census and Statistics, Colombo.

DCS 2015, 'Poverty Indicators 2012/13', available at http://www.statistics.gov.lk/poverty/PovertyIndicators2012_13.pdf

Elbers, C, Lanjouw, JO & Lanjouw, P, 2003, 'Micro-Level Estimation of Poverty and Inequality', *Econometrica,* vol. 71, no. 1, pp. 355-364.

Tarozzi, A & Deaton, A 2009, 'Using census and survey data to estimate poverty and inequality for small areas', *The Review of Economics and Statistics*, vol. 91, no. 4, pp. 773-792.

Vishwanath, T & Yoshida, N 2005, 'Poverty maps in Sri Lanka – Policy impacts and lessons', Chapter 12 in *More than a pretty picture: Using poverty mapto design better policies and interventions*, Tara Bedi, Aline Coudouel & Kenneth Simler (ed.), World Bank, Washington, DC.

World Bank 2005, 'A poverty map for Sri Lanka – Findings and lessons', Poverty Reduction and Economic Management South Asia Region, World Bank, Washington, DC.

Zhao, Q & Lanjouw, P 2014, 'Using PovMap 2: A User's Guide', available at: http://iresearch.worldbank.org/PovMap/PovMap2/PovMap2Manual.pdf