Measuring Prevalence, Profiling and Evaluating the Potential of Policy Impacts using Two Food Security Indicators in Guatemala

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Introduction

The concept of food security[1] can be applied and used to analyze individuals, households, nations or even the entire globe. In particular, a household is said to achieve food security when all its members have access to the food they need for an active and healthy life (FAO, 1996), and thus, food security at this level is usually measured in the access dimension[2] of the food security concept. Prominent examples of indicators developed for this purpose are the Latin American and Caribbean Food Security Scale (ELCSA) and the household level IFPRI's undernourishment indicator. Although the two indicators are calculated differently, both use information collected at the household level and can also be used to estimate the prevalence of food insecurity in a region or country, making them suitable for national level policy analyses (FAO, 2012; Smith and Subandoro, 2007).

ELCSA is an experiential measure obtained by asking households a series of questions aimed to evaluate their food security concerns and experience. Modeled after the United States Department of Agriculture's (USDA) Household Food Security Survey Module, this food security indicator has been adapted and validated for use in Latin America and the Caribbean

[1] Food security exists when all people, at all time, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996).
[2] Four dimensions can be identified from the food security concept: availability, economic and physical access, utilization and stability.

(FAO, 2012). On the other hand, IFPRI's undernourishment indicator is constructed using Household Expenditure Surveys (HES) data (Smith and Subandoro, 2007).

Because indicators such as ELCSA and IFPRI's undernourishment indicator operate in the same dimension of food security (access), at the same level (household level), and provide the same output (food security status of the household), they tend to be used interchangeably, which may result in the misclassification of households as food secure or insecure with further implications regarding their inclusion or exclusion from assistance programs (Maxwell *et al.*, 2014). For example, as shown in this paper, the use of these two indicators can result in different estimates of the prevalence of food insecurity in a region or country, which in turn can lead to substantially different policy recommendations or courses of action aimed to address food security problems. Therefore, the objectives of this paper are: 1) to measure and compare the prevalence of food insecurity in a country using the alternative ELCSA and IFPRI's undernourishment indicator, 2) to identify the factors affecting households' food security status using the two indicators, and 3) to assess the use of the two indicators for policy analysis.

Data for the study comes from the 2011 National Survey of Living Standards (ENCOVI) from Guatemala, which collects the necessary information to estimate both indicators for the same households. We focus on these two indicators given their growing importance to assess the status of food security. ELCSA is gaining popularity in Latin America and the Caribbean and is now included as part of the nationally representative HES in several countries. IFPRI's undernourishment is also being used more frequently as more countries are periodically conducting national representative HES. Even though several studies have compared food security indicators, their focus has been in the estimation of the prevalence of food insecurity

without attention to the implications of their use for policy analysis (Maxwell *et al.*, 2014; Leroy *et al.,* 2015; Haen *et al.,* 2011).

The Latin America and Caribbean Food Security Scale (ELCSA)

The ELCSA is a survey based food security *Experiential Measure* that operates on the *access* dimension of the food security concept. The indicator evaluates how households' experience food security by assessing their concerns and experiences, during the last three months prior to the interview, with respect to the quantity and quality of their diet and their use of coping strategies, such as eating less than usual or skipping meals.

Several reasons make the ELCSA an attractive food security indicator. First, the ELCSA is a direct measure of household food security significantly less expensive to implement than food security measurements based on food consumption and expenditure surveys. Second, since it is a standardized measure it can be used for cross country comparisons (FAO, 2012). Finally, ELCSA does not only classify households as food secure and insecure but also provides different levels of food insecurity (see Table 1). ELCSA has been validated in several Latin American countries and is currently included in national surveys in Brazil, Bolivia, Colombia, El Salvador, Guatemala and Mexico (FAO, 2012).

ELCSA consists of a set of 15 questions. The answer to each of the questions are simple 'yes' or 'no' and the food security status of the household is then estimated depending on the number of affirmative answers to the questionnaire. When households have no children only the first eight questions are asked, since the following seven question are intended to measure the food security status of children only. There are four possible categories for the food security status of a household: food secure, mild food insecure, moderate food insecure and severely food

insecure (see Table1). Appendix 1 includes the ELCSA questionnaire currently used in Guatemala.

Table 1. ELCSA's food security categories and required affirmative answers.

Category	Households with children	Households without children
Food secure	0	0
Mild food insecure	1 – 5	1 – 3
Moderate food insecure	6 – 10	4 – 6
Severe food insecure	11 – 15	7 – 8

Source: Melgar-Quiñonez and Samayoa (2011).

IFPRI's Undernourishment Indicator

IFPRI's undernourishment indicator is estimated from HES and compares the caloric requirements of a households with the calories it has available for consumption from all food sources to determine if the household is energy deficient (Smith and Subandoro, 2007). Household consumption and expenditure surveys are part of nationally representative living standard surveys that are now being periodically conducted in several countries in the world. These surveys became popular in the 1980's thanks to efforts such as the Living Standards Measurement Study of the World Bank, which works with national statistics offices to help them design multi-topic household surveys (World Bank, 2016). In 2007, researchers at IFPRI developed a technical guide to measure food security using household expenditure surveys (Smith and Subandoro, 2007). Their objective was to reduce the gap between *more accurate* and costly measurements of undernourishment at the individual and household level that were being

carried out in only small populations, such as dietary recall diaries[3] and *less accurate* and aggregate methods for large populations, such as FAO's prevalence of undernourishment indicator. Smith and Subandoro (2007) show how the information from HES can be used to define several household level food security indicators including a household level undernourishment indicator, which we refer to as IFPRI's undernourishment indicator[4]. The other indicators proposed by these researchers were: an indicator of diet diversity, percentage of dietary energy in the household derived from staples, quantities of individual food consumed per capita, and percentage of household expenditures devoted to food. In this paper, we focus only on IFPRI's household level undernourishment indicator since all other indicators do not provide cutoff points to classify households as food secure or insecure.

Literature Review

Most of the literature comparing food security indicators concentrates on discussing the advantages and disadvantages of the different indicators and little research has been conducted to evaluate differences on food security assessments when the indicators are implemented (Maxwell *et al.*, 2014; Maxwell *et al.*, 2013). To the best of our knowledge, no previous study has compared ELCSA and IFPRI's undernourishment indicator; however, we did identify one study that compared an indicator very similar to ELCSA, the Household Food Insecurity Access Scale (HFIAS), to other food insecurity indicators, and three studies exploring the relationship

[3] In dietary recall diaries households recall what they ate, by member of the household, for a given period of time. Because the required level of detail it's necessary to train households in its utilization, which increases their implementation cost.

[4] It is important to do not confuse IFPRI's undernourishment indicator with FAO's prevalence of undernourishment. FAO's indicator relies on FAO's food balance sheets and measures the probability that a randomly selected individual would consume less calories than his requirement for an active and healthy life. (FAO, IFAD, and WFP, 2016).

between ELCSA and data from household expenditure surveys (Valencia-Valero and Ortiz-Hernandez, 2014; Carrasco *et al.*, 2010; Vega-Macedo *et al.*, 2014)

Maxwell *et al.* (2014) compared seven frequently used indicators of food access using data from a panel survey of rural households in Ethiopia. The study compared an experiential measure, the HFIAS, which is very similar to ELCSA, to dietary diversity, food frequency, consumption behaviors and self-assessment indicators but no undernourishment. Their results showed correlations between 0.46 and 0.85 (absolute values) between the HFIAS and the other food security indicators with the HFIAS always producing between 15 to 75% higher prevalence of food insecurity than the other indicators. They concluded that HFIAS tends to give higher estimates of prevalence of food insecurity because it captures physiological anxiety and preferences, which are not severe manifestations of food insecurity. Moreover, a single occurrence of a food insecurity experience can move a household towards a more critical food insecurity category. Despite the differences in the categorization of food insecure households, all the indicators exhibited similar trends across time in the incidence of food insecurity. Moreover, these authors argue that the observed differences in the percentages of households that are classified as food insecure using different indicators are due to three main reasons. First, the cut-offs points for the classification of households as food secure or insecure are not harmonized across indicators; second, different indicators measure different dimensions of food insecurity; and third, the indicators differ in their sensitivity to the severity of food insecurity.

Data and Methods

Data for our analyses comes from the 2011 *National Survey of Living Standards* (ENCOVI) from Guatemala. According to Guatemala's National Institute of Statistics (INA), the main objective of the survey was to estimate the incidence of poverty in the country. The survey

was conducted between March and August and reached more than 13 thousand households (INE, 2011). The ELCSA questionnaire was collected as part of the dwelling and household chapter of the survey and food expenditures were collected as part of the expenses and self-consumption chapter. The food expenditures section collected quantity and monetary value of food purchases for a 2-week recall period, quantity and monetary value of self-produced food products or obtained free of charge for the 2-week recall period and weekly expenditures in food eaten away from home. Age, sex and activity level of the household members, required for estimating the household's energy requirements, were also collected as part of the demographic characteristics and the employment and activities sections.

Nutritional information on the food items found in the HES was obtained from the Table of Nutritional Composition of Central American Foods by the Central America and Panama Institution of Nutrition (INCAP, 2012). The table provides information on the content of 28 nutrients for 1,169 food products in the region.

Estimation of the Indicators

The procedures to estimate ELCSA and IFPRI's undernourishment indicators are summarized in Figure 1.

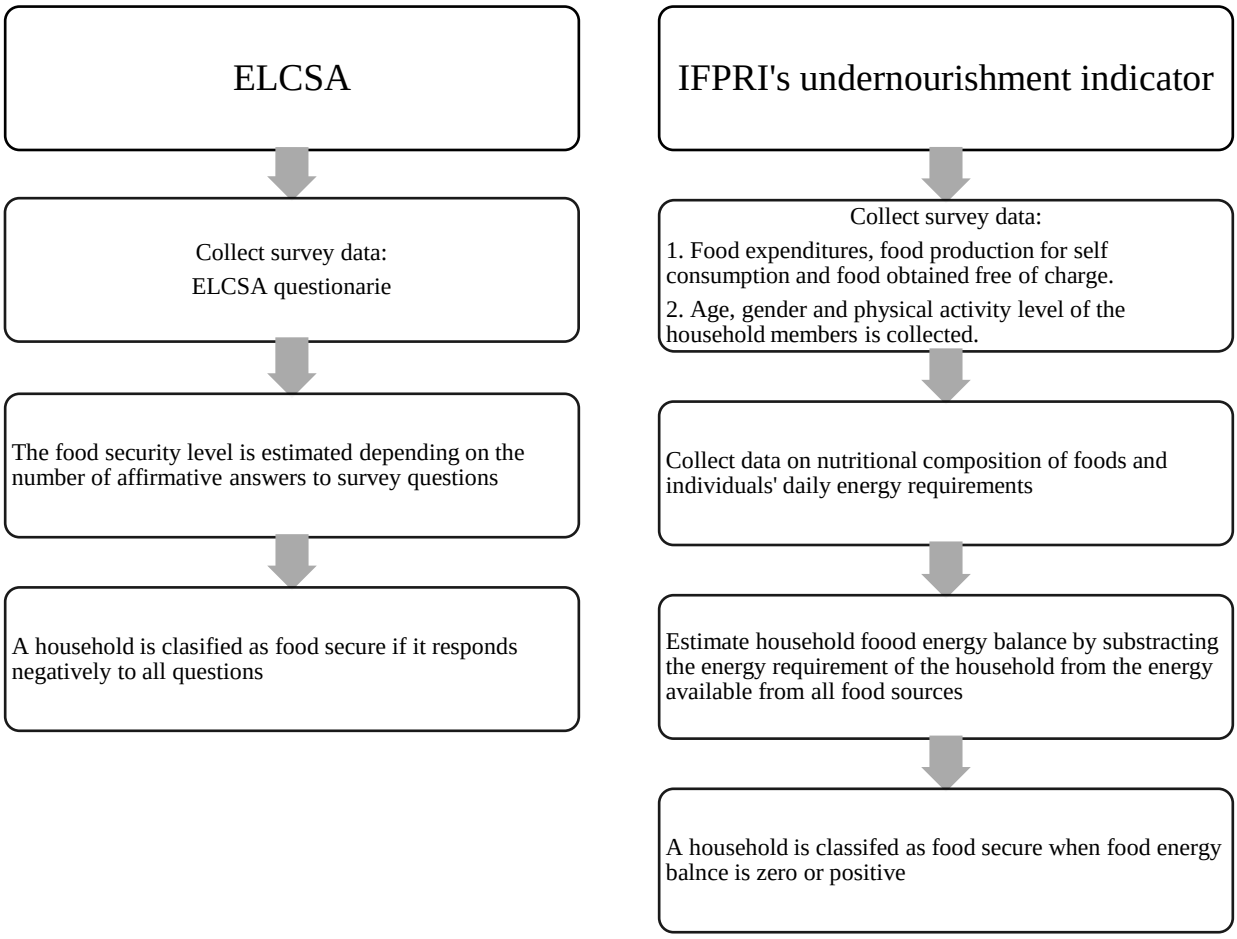


Figure 1. Summary of procedure used for estimating ELCSA and IFPRI's undernourishment indicators.

As it can be seen from Figure 1 the estimation procedure of the food security status of a household is simpler using the ELCSA method than with IFPRI's method. In the case of IFPRI's undernourishment indicator, we followed the method suggested by Smith and Subandoro (2007). First, we converted the quantities of foods acquired from all sources to calories (i.e., energy) to have an estimate of the household available energy. Second, the household caloric requirement was estimated taking into consideration the sex, age and physical activity of each household member following FAO's recommendations and tables (2001). Finally, the household energy

balance was estimating by subtracting the household's available energy from its caloric requirement.

For the purpose of our analysis we focused on the classification of households as either food secure or food insecure. In the case of ELCSA, households that respond negatively to all questions in the instrument are classified as food secure (see Table 1). If they respond affirmatively to at least one of the questions they are classified as food insecure. When using IFPRI's undernourishment indicator, households are classified as food secure if they are not energy deficient (they have more calories available than their daily requirement) and as food insecure if they are energy deficient.

Logistic Regression

To evaluate the effect of socio-demographic characteristics on household food security status we estimated logistic regression models using ELCSA and IFPRI's undernourishment indicators as dependent variables. For each dependent variable, we estimated two regression models, one for the entire population and another only for poor households since they are the focus of our policy simulations. In addition, preliminary data analysis suggested significant differences in the parameter estimates between models using the entire population and models for the poor only. The probability of households being food insecure can be expressed as $\pi = \Pr(Y = 1|\boldsymbol{x})$, where $\boldsymbol{x}$ is a vector explanatory variables (see Table 2). The logistic model has the following functional form (Greene, 2012):

(1) $log\left(\frac{\pi}{1-\pi}\right) = \alpha + \boldsymbol{\beta}'\boldsymbol{x}$,

where α and $\boldsymbol{\beta}$ are parameters to be estimated. All models were estimating by Maximum Likelihood using the LOGISTIC procedure of the SAS® 9.4 software.

Table 2. Explanatory variables for the logistic regression models

Category	Variable	Description	Mean	Standard Deviation	Minimum	Maximum
Continuous variables	Number of household members	Number of household members.	4.934	2.451	1.000	22.000
	Per-capita annual expenditures	Per-capita annual expenditures in Guatemalan quetzals (GTQ).	11.797	12.356	0.535	305.999
Dummy variables	North	Indicates if the household is located in the North region.	0.069	0.254	0.000	1.000
	Northeast	Indicates if the household is located in the Northeast region.	0.224	0.417	0.000	1.000
	Southeast	Indicates if the household is located in the Southeast region.	0.103	0.304	0.000	1.000
	Central	Indicates if the household is located in the Central region.	0.157	0.364	0.000	1.000
	Southwest	Indicates if the household is located in the Southwest region.	0.271	0.444	0.000	1.000
	Northwest	Indic0.031ates if the household is located in the Northwest region.	0.071	0.256	0.000	1.000
	Peten	Indicates if the household is located in the Peten region.	0.031	0.173	0.000	1.000
	Female	Indicates if the head of the household is female.	0.206	0.405	0.000	1.000
	Indigenous	Indicates if the head of the household is indigenous.	0.344	0.475	0.000	1.000
	Rural	Indicates if the household is located in the rural area.	0.586	0.493	0.000	1.000

	July-August	Indicates if the survey was taken during the last third of the lean season[5].	0.200	0.400	0.000	1.000
	Presence of Children	Indicates if there are under 18 years old in the household.	0.792	0.406	0.000	1.000
	Primary and middle school education	Indicates if the head of the household has primary or middle school education.	0.651	0.477	0.000	1.000
	University education	Indicates if the head of the household has university education	0.035	0.183	0.000	1.000
	Poverty	Indicates if the household is considered poor by the government.	0.54	0.498	0.000	1.000

[5] Lean season is period of the year in which rural and poor households are most food insecure and most likely to require food aid (FAO, IFAD and WFP, 2016)

Policy Simulation

The policy simulations used the results of the regression analyses and consisted in analyzing the change in in the probability of households being food insecure as result of a cash transfer to households classified as poor and extremely poor by the Guatemalan government. The poverty line for the representative household in 2012 was set at $1,192/year for the representative household while the extreme poverty line was set at $578/year (INE, 2011). It is important to consider that by this measure more than half the population in Guatemala lives in poverty conditions, with 41% of the population living in poverty and 13% in extreme poverty (INE, 2011). The amount of our cash transfer was set at $25/month (~Q. 188) per household, independently of the number of household members. We chose this amount based on observed conditional cash transfers in the region (Adato and Hoddinott, 2010). The cost of implementing a policy of this magnitude in Guatemala adds up to $39 million per month, excluding administrative costs. Table 3 shows the estimated number of poor and extremely poor households and the amount of the cash transfer by region.

Table 3. Average monthly benefits of the cash transfer policy simulation.

	Percentage of poor and extremely poor households	Number of poor and extremely poor households	Value of the cash transfer
Metropolitan	36%	270,192	$6,754,801
North	66%	176,057	$4,401,435
Northeast	48%	126,203	$3,155,082
Southeast	53%	127,555	$3,188,874
Central	54%	188,284	$4,707,107
Southwest	61%	424,231	$10,605,778
Northwest	57%	210,003	$5,250,065
Peten	56%	73,166	$1,829,140
Total		1,595,691	$39,892,282

Before simulating the effect of the cash transfer on food insecurity, the predictive power of the models was evaluated using sensitivity and specificity measures. Sensitivity is the proportion of events that are correctly predicted, in this case food insecure households, and specificity is the proportion of non-events that are correctly predicted, in our case the food secure households (Allison, 2012). Using probability cutoff points of 0.5 both models showed low sensitivity and high specificity. Therefore, following Allison's (2012) recommendation, we searched probability cutoff points that provided us with similar levels of sensitivity and specificity (Table 6).

Table 4. Sensitivity and specificity of logistic models estimated using ELCSA and IFPRI's food security indicators at different cutoff points for prediction

	ELCSA		IFPRI's undernourishment	
Probability cutoff point	0.5	0.1	0.5	0.24
Sensitivity	0.0	60.2	19.0	67.2
Specificity	100.0	62.1	95.0	67.4

Results and Discussion

Food insecurity prevalence is estimated at 83.3% and 61% using ELCSA and IFPRI's undernourishment indicator, respectively. When analyzing food insecurity prevalence by region (see Figure 2), it can be observed that ELCSA consistently yields higher estimates of food insecurity across all regions. ELCSA food insecurity prevalence estimates are, on average, 22.1% higher than prevalence estimates using IFPRI's indicator. The smallest difference between prevalence estimates is the Metropolitan areas (7.1% difference) area and the largest in the Northwest (44.3% difference).

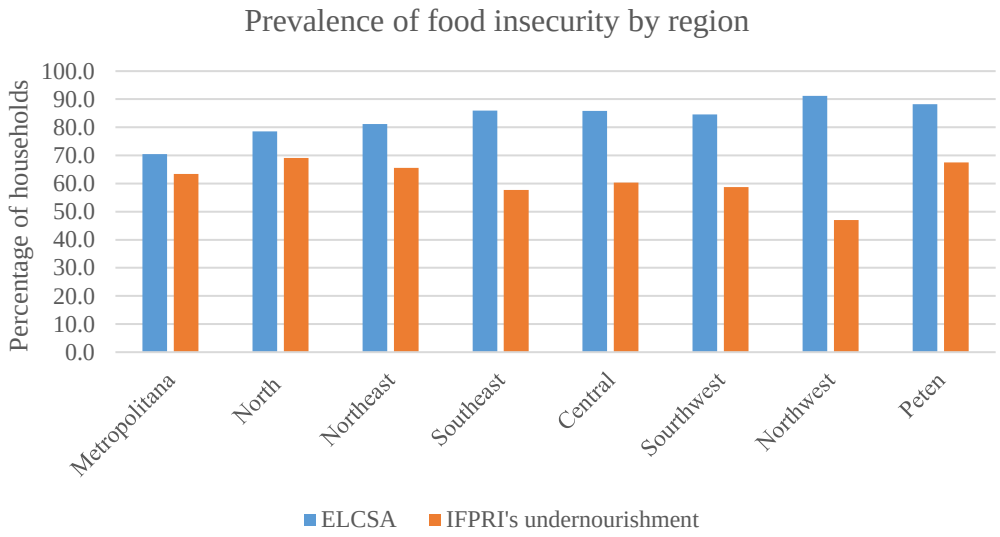


Figure 2. Food insecurity prevalence by region.

When multiplying the population of the regions by the prevalence estimates of food insecurity, it is estimated that 12,376,496 and 9,051,756 people are food insecure, according to ELCSA and IFPRI's indicator, respectively; thus, more than 3 million people may or may not be categorized as food insecure depending on the indicator used (Table 5).

The different indicators also identify different regions in Guatemala as the regions with the highest prevalence of food insecurity in the country (Table 5). Regional prevalence estimates using ELCSA identify the Northwest, Petén, Southeast and Central regions as the top four most food insecure regions. The top four most food insecure regions according to IFPRI's indicator are North, Petén, Northeast and Metropolitan regions. Thus, the only region identified by both indicators as highly food insecure was Petén. These observed differences could in turn lead to difference in the selection of priority regions to implement programs or project addressing food insecurity.

Estimates of the number of food insecure households in each region also show substantial differences depending on the indicator used. ELCSA identify the Southwest, Metropolitan, Northwest and Central regions as the top four regions with the highest number of food insecure households, with a total 8.7 million food insecure individuals. When using IFPRI's indicator, the top four regions with the highest number of food insecure households are the Southwest, Metropolitan, Central and Northwest, with a total of 6.1 million food insecure individuals.

Table 5. Percentage and population estimates of food insecurity.

	Percentage estimate		Population estimate	
Region	ELCSA	IFPRI's undernourishment	ELCSA	IFPRI's undernourishment
Metropolitan	70%	63%	2,261,028	2,033,289
North	79%	69%	1,119,601	984,371
Northeast	81%	66%	964,643	779,514
Southeast	86%	58%	967,381	649,795
Central	86%	60%	1,434,445	1,006,901
Southwest	85%	59%	3,073,866	2,135,134
Northwest	91%	47%	1,970,696	1,015,043
Petén	88%	68%	584,836	447,707
Totals			12,376,496	9,051,756

In addition to the 22.1% difference in the food insecurity prevalence estimates, there are very large discrepancies regarding the food security classification of individual households. Both indicators only agree in the food insecurity status of 59.2% of households whereas the remaining 40.8% of households are classified differently (Table 6). This finding is also consistent with

Jimenez *et al.'s* (2012) study comparing the two indicators and using household undernourishment[6] as the reference method in Colombia. They found that ELCSA only correctly predicted between 62 and 64% of the food secure households and between 46 and 62% of the food insecure households.

Table 6. Classification of households by ELCSA and IFPRI's undernourishment.

		ELCSA	
		Food secure	Food insecure
IFPRI's undernourishment	Food secure	7.5%	31.6%
	Food insecure	9.2%	51.7%

Logistic regression models

We first present and contrast the results of the two logistic regressions modeling the probability that a household is food insecure using ELCSA and IFPRI's undernourishment indicators, and using data representative of the entire country's population (Table 6). We present both the model parameter estimates as well as marginal effects. In the logistic regression model, the parameter estimates corresponding to continuous variables are interpreted as the change in the log-odds for every 1-unit increase in the value of the variable, ceteris paribus. Parameters corresponding to dummy variables are interpreted as differences in the log-odds relative to characteristics of the dummy variables which were not included in the model (e.g., Metropolitan

[6] Jimenez *et al.'s* (2012) estimate of household undernourishment is virtually identical to IFPRI's undernourishment, however do not reference to it.

Region). Alternatively, the marginal effects measure changes in the probability of being food insecure at the average values of the explanatory variables.

When comparing the regression models, first, it is important to highlight the fact in most cases the sign of the estimated coefficients differ across models. Out of 19 estimated coefficients, only 3 have the same sign in both models: coefficients corresponding to the dummy variable identifying poverty status, per-capita annual expenditures and the interaction of both variables (Table 6). The variables North, number of household members, both educational variables and the interaction between rural and July-August were found to have a negative impact in the probability of households being food insecure in the ELCSA model, and a positive impact in the probability of households being food insecure in the IFPRIS's undernourishment model. The opposite happened with the variables Northeast, Southeast, Central, Southwest, Northwest, Peten, female, indigenous, rural, July-August and presence of children which were found to have a positive impact in the ELCSA model and a negative impact in the IFPRI's undernourishment model. Second, regarding the statistical significance of the variables, while most of the variables were significant in both models, number of household members and the interaction between rural and July-August were statistical significance in the IFPRI's undernourishment model but not in the ELCSA's model. The opposite happened for the variable female.

Finally, we also found large differences in the magnitude of the effects for variables whose coefficients had the same sign in both models (poverty status and per-capita annual expenditures). Both parameter estimates and marginal effects both variables are higher, in absolute values, in the IFPRI's undernourishment indicator model, suggesting they play a more significant role in the probability of the households being food insecure than in the ELCSA model.

Table 7. Parameter estimates of logistic models for the food insecurity status of households using data representative of the entire population

Variable	Parameter estimates		Average marginal effects	
	ELCSA	IFPRI's undernourishment	ELCSA	IFPRI's undernourishment
Intercept	1.1895***	0.4481**		
	(0.1295)	(0.1244)		
North	-0.6518***	-0.3423**	-0.0806	-0.0631
	(0.1222)	(0.1140)	(0.0386)	(0.0222)
Northeast	0.0694	-0.2403**	0.0086	-0.0443
	(0.0933)	(0.0869)	(0.0041)	(0.0156)
Southeast	0.3005**	-0.8418***	0.0372	-0.1551
	(0.1138)	(0.0990)	(0.0178)	(0.0547)
Central	0.4885***	-0.5215***	0.0604	-0.0961
	(0.1005)	(0.0888)	(0.0290)	(0.0339)
Southwest	0.0007	-0.8206***	0.0001	-0.1512
	(0.0939)	(0.0864)	(0.00004)	(0.0533)
Northwest	0.4840**	-1.3942***	0.0599	-0.2569
	(0.1457)	(0.1120)	(0.0287)	(0.0906)
Peten	0.4154**	-0.3370**	0.0514	-0.0620
	(0.1787)	(0.1409)	(0.0246)	(0.0219)
Female	0.1885**	-0.0395	0.0233	-0.0073
	(0.0630)	(0.0506)	(0.0112)	(0.0026)
Indigenous	0.3394***	-0.4398***	0.0420	-0.0811
	(0.0652)	(0.0515)	(0.0201)	(0.0286)
Rural	0.4302***	-0.4888***	0.0532	-0.0901
	(0.0641)	(0.0566)	(0.0255)	(0.0318)
July-August	0.2824**	-0.1662**	0.0349	-0.0306
	(0.0922)	(0.0769)	(0.0167)	(0.0108)
Rural*July-August	-0.1329	0.2992**	-0.0164	0.0551
	(0.1296)	(0.1022)	(0.0079)	(0.0194)
Presence of Children	0.4063***	-0.4940***	0.0502	-0.0910
	(0.0655)	(0.0576)	(0.0241)	(0.0321)
Primary and middle school education	-0.3695***	0.2073***	-0.0457	0.0382
	(0.0633)	(0.0481)	(0.0219)	(0.0135)
University education	-1.0770***	0.5842***	-0.1332	0.1077
	(0.1235)	(0.1223)	(0.0639)	(0.0380)
Number of household members	-0.0188	0.2718***	-0.0023	0.0501
	(0.0139)	(0.0124)	(0.0011)	(0.0177)

Poverty	1.1116***	2.5525***	0.1375	0.4704
	(0.1360)	(0.1095)	(0.0659)	(0.1659)
Per-capita annual expenditures	-0.0222***	-0.0413***	-0.0027	-0.0076
	(0.0025)	(0.0032)	(0.0013)	(0.0027)
Poverty*Per-capital annual	-0.0686***	-0.2390***	0.0085	-0.0440
expenditures	(0.0166)	(0.0137)	(0.0041)	(0.0155)

Standard Errors shown in parenthesis.
*, **, ***, denote significance at 0.1, 0.05, and 0.0001 respectively.

Table 7 displays the logistic regression models using both sources of data but using only data for poor households. As in the case of the models estimated for the entire population, the signs of most of the estimated coefficients differ across models (14 out of 18 coefficients). Only the variables North, Peten, per-capita annual expenditures (with a negative impact) and the variable female (with a positive effect) had the same sign in both models. The direction of the effect of the variable female was different to that found in the models for the general population. The interaction variable between rural and the lean season, primary and secondary education, university education and number of household members were found to have a negative effect in the probability of a household being food insecure in the ELCSA model, while they had a positive effect in the IFPRI's undernourishment model. These variables exhibited the same pattern in the general models. On the other hand, most of the regional variables, indigenous, rural, July-August and presence of children were found to have a positive effect on the probability of households being food insecure in the ELCSA model and the opposite effect in the IFPRI's undernourishment model. These variables also exhibited the same pattern as in the general models.

In short, according to the models estimated using ELCSA, poor households whose head is female and/or indigenous with a low educational level, located in the rural area, with children,

not that many members and low incomes are more likely to be food insecure, especially during the lean season. On the other hand, models estimated using IFPRI's undernourishment indicator find that large households with low incomes, and located in the urban area are the ones more likely to be food insecure.

Table 8. Parameter estimates of logistic models for the food insecurity status of households using data representative of poor households only

Variable	Parameter estimates		Marginal effects	
	ELCSA	IFPRI's undernourishment	ELCSA	IFPRI's undernourishment
Intercept	2.3822***	4.3799***		
	(0.2991)	(0.2671)		
North	-0.7018**	-1.0444***	-0.0613	-0.1613
	(0.2024)	(0.1939)	(0.0297)	(0.0715)
Northeast	0.2394	-0.7124***	0.0209	-0.1100
	(0.1784)	(0.1739)	(0.0102)	(0.0487)
Southeast	0.3649*	-1.2372***	0.0318	-0.1910
	(0.2023)	(0.1827)	(0.0155)	(0.0847)
Central	0.4732**	-0.9453***	0.0414	-0.1459
	(0.1824)	(0.1700)	(0.0201)	(0.0647)
Southwest	-0.1089	-1.3377***	-0.0095	-0.2065
	(0.1680)	(0.1658)	(0.0046)	(0.0915)
Northwest	0.8896**	-1.8612***	0.0778	-0.2874
	(0.2858)	(0.1911)	(0.0378)	(0.1274)
Peten	0.5053	-0.9063	0.0442	-0.1399
	(0.3113)	(0.2358)	(0.0215)	(0.0620)
Female	0.1904*	0.0856	0.0166	0.0132
	(0.1098)	(0.0792)	(0.0081)	(0.0059)
Indigenous	0.4310***	-0.4620***	0.0377	-0.0713
	(0.0973)	(0.0723)	(0.0183)	(0.0316)
Rural	0.2805**	-0.7694***	0.0245	-0.1187
	(0.1158)	(0.0905)	(0.0119)	(0.0527)
July-August	0.5117**	-0.1383	0.0447	-0.0214
	(0.1463)	(0.1036)	(0.00217)	(0.0095)
Rural*July-August	-0.6576**	0.3823**	-0.0575	0.0590
	(0.2034)	(0.1036)	(0.0279)	(0.0262)
Presence of Children	0.6528***	-0.7676***	0.0571	-0.1185

	(0.1191)	(0.1020)	(0.0277)	(0.0525)
Primary and middle school education	-0.3063**	0.2512**	-0.0267	0.0387
	(0.0929)	(0.0670)	(0.0130)	(0.0172)
University education	-0.3686	0.9967**	-0.0322	0.1539
	(0.4116)	(0.3851)	(0.0157)	(0.0682)
Number of household members	-0.0379**	0.2507***	-0.0033	0.0387
	(0.0188)	(0.0166)	(0.0016)	(0.0172)
Per-capita annual expenditures	-0.1205***	-0.3483***	-0.0105	-0.0538
	(0.0211)	(0.0177)	(0.0051)	(0.0238)

The remarkable difference in the estimation results, we believe, can be explained by the difference in the specific sub-dimension of food access being measured by both indicators. Whereas ELCSA focuses on "feelings" of food insecurity, IFPRI's indicator refers to calorie consumption. For this perspective, for example, the ELCSA model indicates that households tend to feel more food insecure (as measured by ELCSA) outside the metropolitan area of Guatemala but they are not necessarily more likely to be calorie deficient. Similarly, although indigenous and rural households seem to feel more insecure, they are between 7 and 11% less likely to be calorie deficient.

Policy Simulation

Simulation results show that the assumed cash transfer to poor households in Guatemala result in a total reduction of 2.4% and 7.5% in the levels of food insecurity when using the models estimated using ELCSA's and IFPRI's undernourishment indicators based models, respectively. The simulation results also show consistently higher reductions in food insecurity

as a result of the cash transfer program when using the using IFPRIS's undernourishment model across all the regions in the country[7].

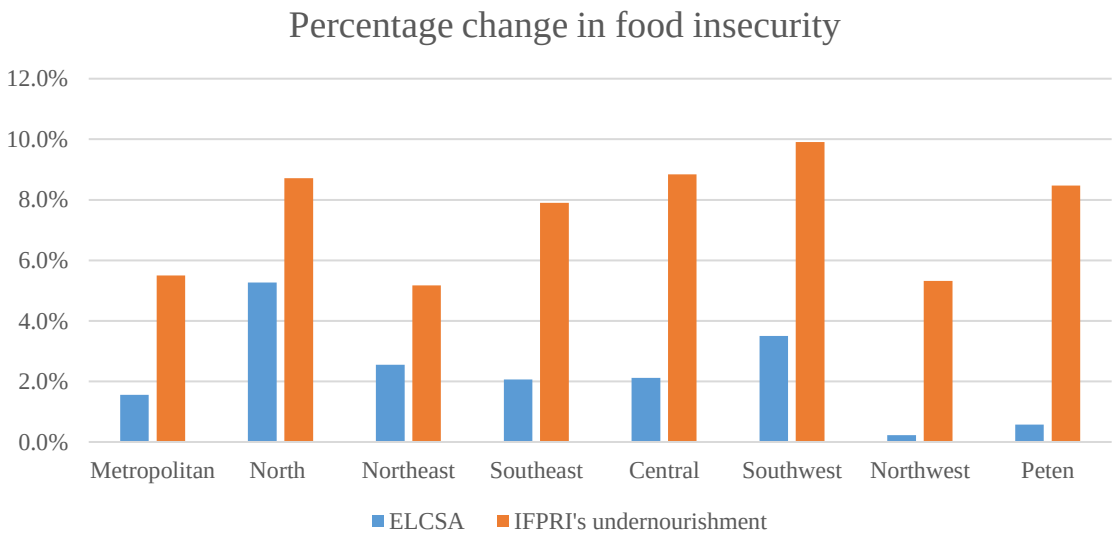


Figure 3. Percentage reduction in the incidence of food insecurity from a simulated cash transfer policy.

Despite yielding different quantitative results, both simulation analyses suggest small reductions in the food insecurity prevalence as a result of the assumed cash transfer which can be explained by the relatively small magnitude of the per-capital annual expenditure coefficients in the logistic regression models; thus, only very large cash transfer programs can result in high levels of reduction in the prevalence of food insecurity, which is not sustainable and neither efficient for reducing food insecurity in the long run. This also suggest that increasing income

[7] The simulation used the "optimal" cutoff points shown in Table 4. When 0.5 is used as the cutoff points for both models, the simulated average reduction in the prevalence of food insecurity are 0% and 3.1%, for ELCSA and IFPRI's models, respectively.

alone, via cash transfers for example, may not be an efficient policy for improving food security and that a holistic approach is necessary if Guatemala is to take important steps towards reducing the incidence of food insecurity. This holds true independently of the methodology used to measure food security.

Summary and Conclusions

The main objectives of this study were to measure the prevalence of food insecurity in Guatemala, to assess factors associated with household food insecurity, and to evaluate the potential impact of a cash transfer policy when measuring food insecurity using two alternative food security indicators: ELCSA and IFPRI's undernourishment. Our results show that even though both indicators operate in the same dimension of the concept of food security (access) and at the same level (households), they do not only yield different estimates of the prevalence of food insecurity, but also differ significantly (in 40% of cases) when classifying households' food insecurity status. This disagreement results in differences in the estimates of food insecure prevalence across regions. Logistic regression models estimated to asses and identify drivers of household food insecurity also found large differences both in the direction and magnitude of factors affecting food insecurity using the alternative food security indicators. Finally, policy simulation results show that cash transfer policies are likely to have only a small effect at reducing the prevalence of food insecurity. However, more research is needed to evaluate the cost effectiveness of cash transfers relative to other alternative policies. Although, the remarkable differences found in the results of the analyses suing both indicators is at first sight very troubling, it also reflects the fact that each food security dimension (in this case access) is composed of several sub-dimensions.

More work need to assess the external reliability of food security indicators in general. However, whereas there is some body of literature that has evaluated the use of HES to measure nutritional outcomes (Fiedler *et al.*, 2012; Jariseta *et al.*, 2012; Smith and Subandoro, 2007) most of the literature evaluating ELCSA focuses only on its internal reliability; thus, more work is urgently needed to evaluate this indicator.

Although several arguments can be made in favor or against using one indicator or the other, including aspects related to implementation costs or reliability, the choice of one indicator over another should ultimately be based on policy objectives. It is also very important for both researchers and policy makers to avoid using the two indicators subject of this study, or any other indicators for that matter, interchangeably. When possible, several alternative food security indicators within each food security dimension should be used for policy analysis and implementation.

References

Adato, M. and Hoddinott, J. 2010. Conditional cash transfers in Latin America. The Johns Hopkins University Press. 386p.

Allison, P. D. 1999. Logistic Regression Using the SAS® System: Theory and Application. Cary, NC. : SAS Institute Inc.

Carrasco, B., Peinador, R. and Aparicio, R. 2010. La Escala Mexicana de Seguridad Alimentaria en el ENIGH: evidencias de la relación entre la inseguridad alimentaria y la calidad de dieta en los hogares mexicanos. Presented at the X national meeting of demographic investigation In Mexico of the Mexican Society of Demography. Mexico, D.F., 3-6 November of 2010.

Conover, W.J. 1999. Practical nonparametric statistics. 3rd edition. John Wiley &Sons, Inc. U.S.A., 584p.

Famine Early Warning System (FEWS NET). 2013. Guatemala, Seasonal Calendar. Available at: http://www.fews.net/central-america-and-caribbean/guatemala

FAO. 2001. Human energy requirements. *Report of a joint FAO/WHO/UNU expert consultation.* Rome, 17-24 October 2001.

FAO. 1996. World Food Summit. November 13-17, 1996. Rome.

FAO. 2012. Escala Latinoamericana y Caribeña de Seguridad Alimentaria (ELCSA), Manual de uso y aplicación. 86 p.

FAO, IFAD and WFP. 2015. The State of Food Insecurity in the World. Meeting the 2015 international hunger targets: taking stock of uneven progress. Rome, FAO. 62p.

Fiedler, J. L., Lividini, K., Bermudez, O. I., & Smitz, M. F. (2012). Household Consumption and Expenditures Surveys (HCES): a primer for food and nutrition analysts in low-and middle-income countries. Food & Nutrition Bulletin, 33(Supplement 2), 170S-184S.

Greene, W.H. 2012. Econometric Analysis. 7th edition. Prentice Hall, NJ, U.S.A. 1188p.

Haen, H., Klasen, S. and Qaim, M. 2011. What do we really know? Metric for food insecurity and undernutrition. *Food Policy* 36: 760-769.

Headey, D. and Ecker, O. 2012. Improving the Measurement of Food Security. IFPRI Discussion Paper 01225.

Instituto de Nutricion de Centro America y Panama (INCAP). 2012. Tabla de Composicion de los Alimentos de Centro America. INCAP/OPS, Guatemala. 2nd ed. 137p.

Instituto Nacional de Estadística (INE). 2011. Encuesta Nacional de Condiciones de Vida 2011. Report. 24p.

Jariseta, Z. R., Dary, O., Fiedler, J. L., & Franklin, N. 2012. Comparison of estimates of the nutrient density of the diet of women and children in Uganda by Household Consumption and Expenditures Surveys (HCES) and 24-hour recall. Food & Nutrition Bulletin, 33(Supplement 2), 199S-207S.

Jimenez, A.Z., Prada, G.E. and Herran, O.F. 2012. Escalas para medir la seguridad alimentaria en Colombia, son validas? Rev Chil Nutr 39(1): 8-17.

Leroy, J.L., Ruel, M., Frongillo, E.A., Harris, J. and Ballard T.J. 2015. Measuring the Food Access Dimension of Food Security: A Critical Review and Mapping of Indicators. *Food and Nutrition Bulletin* 36(2): 167-195.

Maxwell, D., Vaitla, B. and Coates, J. 2014. How do indicators of household food insecurity measure up? An empirical comparison from Ethiopia. *Food Policy* 47: 107-116.

Maxwell, D., Coates, J. and Vaitla, B. 2013. How Do Different Indicators of Household Food Security Compare? Empirical Evidence from Tigray. Feinstein International Center, Tufts University: Medford, USA.

Melgar Quiñnez, H. and Samayoa, L. 2011. Prevalencia de inseguridad alimentaria del hogar en Guatemala, Encuesta nacional de condiciones de vida 2011 (ENCOVI). Report: 14p.

Pangaribowo, E. H., Gerber, N. and Torero, M. 2013. Food and nutrition security indicators: a review. Working paper. *Center for Development Research, University of Bonn.*

Smith, L.C. and Subandoro, A. 2007. Measuring Food Security Using Household Expenditure Surveys. Food Security in Practice thecnical guide series. Washington, D.C.: International Food Policy Research Institute.

USDA. 2016. Supplemental Nutrition Assistance Program, Eligibility. Available at: http://www.fns.usda.gov/snap/eligibility

Valencia-Valero, R.G. and Ortiz-Hernandez, L. 2014. Disponibilidad de alimentos en los hogares mexicanos de acuerdo con el grado de inseguridad alimentaria. *Salud pública de Mexico* 56(2): 154-164.

Vega-Macedo, M., Shamah-Levy, T., Peinador-Roldan, R., Mendez-Gomez, I. and Melgar-Quiñonez, H. 2014. Food insecurity and variety of food in Mexican households with children under five years. *Salud Pública de Mexico* 56(1).

World Bank. Living Standards Measurement Studies. Available online at: econ.worldbank.org. Last visited: October 4, 2016.

Annex 1. ELCSA's questions.

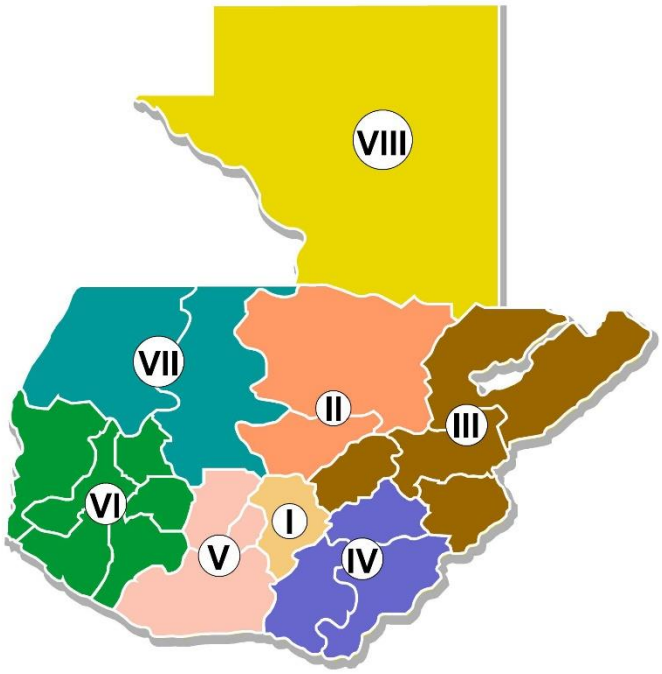
All the questions start with: *During the last 3 months, because of lack of money or other resources,*

No.	Question in Spanish	Translation to English	Dimension
1	… ¿alguna vez usted se preocupó porque los alimentos no se acabaran en su hogar?	… did you ever worry you may not have enough food at home?	Concern - household
2	… ¿alguna vez en su hogar se quedaron sin alimentos?	… has your household ever been left without food?	Food quantity - household
3	… ¿alguna vez en su hogar dejaron de tener una alimentación sana y balanceada?	… has your household ever not had a healthy diet?	Food quantity and quality - household
4	… ¿alguna vez usted o algún adulto en su hogar tuvo una alimentación basada en poca variedad de alimentos?	… have you or another adult in your household ever had a diet based in poor food variety?	Food quality - household
5	… ¿alguna vez usted o algún adulto dejó de desayunar, almorzar o cenar?	… have your or another adult in your household ever not had breakfast, lunch or dinner?	Food quantity - adults
6	… ¿alguna vez usted o algún adulto en su hogar comió menos de los debía comer?	… have you or another adult in your household ever eaten less than you should?	Food quantity - adults
7	… ¿alguna vez usted o algún adulto en su hogar sintió hambre pero no comió?	… have you or another adult in your household felt hunger but no eaten?	Hunger - adults
8	… ¿alguna vez usted o algún adulto en su hogar solo comió una vez al día o dejó de comer durante todo un día?	… have you or another adult in your household ever only eaten once a day or stopped eating for a whole day?	Hunger – adults
Survey continues only if the household has children (under 18 years)			

9	… ¿alguna vez algún menor de 18 años en su hogar dejó de tener una alimentación saludable y balanceada?	… has anyone under 18 in your household ever stopped having a healthy diet?	Quantity and quality – under 18
10	… ¿alguna vez algún menor de 18 años en su hogar tuvo una alimentación basada en poca variedad de alimentos?	… has anyone under 18 in your household ever had a diet based in poor food variety?	Food quality – under 18
11	… ¿alguna vez algún menor de 18 años en su hogar dejó de desayunar, almorzar o cenar?	… has anyone under 18 in your household ever stopped having breakfast, lunch or dinner?	Quantity – under 18
12	… ¿alguna vez algún menor de 18 años en su hogar comió menos de lo que debía?	… has anyone under 18 in your household ever eaten less than they should?	Quantity – under 18
13	… ¿alguna vez tuvieron que disminuir la cantidad servida en las comidas a algún menor de 18 años en su hogar?	… have you ever had to reduce the quantity of food served to anyone under 18 in your household?	Quantity – under 18
14	… ¿alguna vez algún menor de 18 años en su hogar sintió hambre pero no comió?	… has anyone under 18 in your household ever felt hunger but didn't eat?	Hunger – under 18
15	… ¿alguna vez algún menor de 18 años en su hogar solo comió una vez al día o dejó de comer durante todo un día?	… has anyone under 18 in your household ever only eaten once a day or stopped eating for a whole day?	Hunger – under 18

Annex 2. Regions and departments of Guatemala.

No.	Region	Department
I	Metropolitan	Guatemala
II	North	Baja Verapaz Alta Verapaz
III	Northeast	El Progreso Izabal Zacapa Chiquimula
IV	Southeast	Santa Rosa Jalapa Jutiapa
V	Central	Sacatepéquez Chimaltenango Escuintla
VI	Southwest	Sololá Totonicapán Quezaltenango Suchitepéquez Retalhuleu San Marcos
VII	Northwest	Huhuetenango Quiché
VIII	Peten	Petén



Source: Judicial body of the republic of Guatemala.

Annex 3. Population and food insecurity estimates.

			ELCSA		HCES		
Region	Department	Population	Food insecurity estimate	Food insecure population	Food insecurity estimate	Food insecure population	Difference (ELCSA - HCES)
1	Guatemala	3,207,587	0.7049	2,261,028	0.6339	2,033,289	227,739
2	Baja Verapaz	277,380	0.7857	217,937	0.6908	191,614	26,323
2	Alta Verapaz	1,147,593	0.7857	901,664	0.6908	792,757	108,907
3	El Progreso	160,754	0.8113	130,420	0.6556	105,390	25,029
3	Izabal	423,788	0.8113	343,819	0.6556	277,835	65,984
3	Zacapa	225,108	0.8113	182,630	0.6556	147,581	35,049
3	Chiquimula	379,359	0.8113	307,774	0.6556	248,708	59,066
4	Santa Rosa	353,261	0.8599	303,769	0.5776	204,044	99,726
4	Jalapa	327,297	0.8599	281,443	0.5776	189,047	92,396
4	Jutiapa	444,434	0.8599	382,169	0.5776	256,705	125,464
5	Sacatepequez	323,283	0.8589	277,668	0.6029	194,907	82,760
5	Chimaltenango	630,609	0.8589	541,630	0.6029	380,194	161,436
5	Escuintla	716,204	0.8589	615,148	0.6029	431,799	183,348
6	Solola	450,471	0.8458	381,008	0.5875	264,652	116,357
6	Totonicapan	491,298	0.8458	415,540	0.5875	288,638	126,902
6	Quetzaltenango	807,571	0.8458	683,044	0.5875	474,448	208,596
6	Suchitepequez	529,096	0.8458	447,509	0.5875	310,844	136,665
6	Retalhueu	311,167	0.8458	263,185	0.5875	182,811	80,374
6	San Marcos	1,044,667	0.8458	883,579	0.5875	613,742	269,837
7	Huehuetenango	1,173,977	0.9125	1,071,254	0.47	551,769	519,485
7	Quiche	985,690	0.9125	899,442	0.47	463,274	436,168
8	Peten	662,779	0.8824	584,836	0.6755	447,707	137,129
	Totals	15,073,373		12,376,496		9,051,756	3,324,741