Food Security in Guatemala after Tropical Storm Agatha

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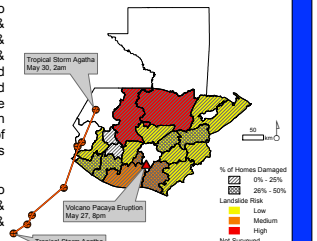
Introduction

Background

Tropical Storm Agatha hit on May 29 2010, immediately following the eruption of volcano Pacaya; causing ~$982 million in damages & affecting 338,543 people in Guatemala.[1] Floods & landslides destroyed infrastructure, agriculture & homes causing a national emergency.[2] World Food Programme (WFP) conducted an Emergency Food Security Analysis (EFSA) of the affected areas.[1] The main objective was to identify households at high risk for food insecurity. Figure 1 shows the path of the storm, along with risk of landslides & % houses damaged by department.

The purpose of this analysis is to use the ESFA to analyze different measures of food security. & demonstrate the added value of using GIS to map & spatially analyze food security.

Figure 1: Trajectory of Tropical Storm Agatha, Landslide Risk & Home Damage by Department



Measuring Food Security

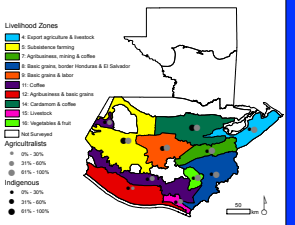
One definition of food security is "when all people, at all times, have physical, social, & economic access to sufficient, safe, & nutritious food that meets their dietary needs."[3] The concept of food security is elusive and there is no single way of measuring it. WFP's Food Consumption Score (FCS) has been used as a proxy for household food security because it captures both food frequency & diet diversity components.[4] Household acess to food is recognized to be an obstacle as it is closely tied to livelihoods, income, assets & external threats. For this reason, WFP developed a composite indicator, Food Access (FA) based on: the number & sources of income & household food expenditure. FA (long-term indicator) can be combined with FCS (short-term indicator) to classify households into three categories of overall food security (FS): severely food insecure, moderately food insecure/at risk & food secure.[7] Descriptions of creating these scores are found elsewhere.[4,5]

Methods

ESFA Data

The EFSA was conducted from July 16-28th. Two-stage cluster, stratified random sampling was used to capture differences in livelihood zones; each stratum was a community with ten randomly selected households. "Agriculturalist" was determined by a positive response to "Do you normally work in agriculture?" "Indigenous" was determined by response of mother tongue other than Spanish.

Figure 2: Area Covered by ESFA



Analysis methods

Data was analyzed using STATA 10 & SVYSET commands to account for the complex survey design. Data was then uploaded into ArchGIS & linked to geographic shapefiles for mapping & spatial analysis. Figure 2 shows the livelihood zones that were covered by the ESFA & the proportion of agriculturalist & indigenous households surveyed in each livelihood zone.

Demographics

Agriculturalist & Indigenous households were hypothesized to be different in terms of income opportunities, assets & inequalities in healthcare & education. Demographic analysis (Table 1) showed agriculturalist-indigenous households to be the most disadvantaged with lower education, less goods & larger families. Household damage was not significantly different between the groups, suggesting differences in food security may be related more to underlying factors than due to losses from the storm.

Table 1: Household Demographics by Agriculturalist & Indigenous Status

Demographics	Agriculture Indigendus	Non-Indigenous	P	Non-agriculture Indigenous	Non-indigenous	P
n*=1966	461	441	-	249	815	-
Mean number of members	6.3 (2.9)**	5.8 (2.0)**	0.009	5.4 (2.1)**	4.9 (2.1)**	0.185
Mean number of goods	2.4 (1.6)	3.6 (2.5)	0.000	2.4 (1.5)	3.8 (2.1)	0.000
Completed primary school- HOH (%)	37.0	48.0	0.015	40.0	52.7	0.156
Completed primary school- Spouse (%)	24.3	44.8**	0.000	33.9	55.1**	0.042
House damage due to Agatha (%)	22.2	22.1	0.985	24.1	13.9	0.113

*overall n takes into account svy weights, n for each variable may vary depending on number of missing responses
** indicates statistical differences between livelihoods within same indigenous status, using adjusted wald , P<0.05

Food Security & Determinants

Indicators & Determinants

Table 2 shows Indigenous households had a lower mean FCS & a higher % of households fell into moderate or poor food consumption categories, regardless of agriculturalist status. Non-indigenous agriculturalists had the highest % of households with poor food access. Tables 3 & 4 show the results of two regression analyses of possible determinants of FCS. In both analyses (red), being indigenous or an agriculturalist & increasing monthly health expenditure lead to a lower FCS, while increasing goods, spouse's completion of primary school & improved water or sanitation lead to a better FCS. Home damage, aid recipient status & food expenditure were not significant determinants. Many areas had a statistically significant lower mean FCS when compared to the area with the highest mean FCS, even after controlling for many factors. These results show the importance of location in determining FCS & possibly food security, as well as the importance of pre-disaster vulnerabilities.

Table 2: Indicators by Agriculturalist and Indigenous Status

FCS Food Access & Food Security	Agriculture Indigenous	Agriculture Non-Indigenous	Non-agriculture Indigenous	Non-agriculture Non-Indigenous
n*=1966	461	441	249	815
Mean FCS	52.2[β]	67.1[α]	54.4[γ]	73.4[γ,•]
Acceptable consumption (FCS >42) (%)	70[β]	91[β•]	74[γ]	96[γ•]
Moderate (at risk) consumption (FCS 28.5-42) (%)	27[β]	7[β•]	21[γ]	4.1[γ•]
Poor consumption (FCS <28.5) (%)	3	2	5[γ]	0.2[γ]
Good food access	14[β]	8[β•]	17	14[•]
Limited food access	45	39[•]	50	47[•]
Poor food access	41[β]	54[β•]	34	39[•]
Food secure (%)	38	36	38[γ]	46[γ]
At risk for food insecurity (%)	34[β]	53[β•]	39	39[•]
Food insecure (%)	28[β]	11[β]	23	15

** indicates statistical differences between groups in the same row, using adjusted wald ; P<0.05

Table 3: Possible Determinants of FCS

Independent Variables	Unstd. Coeff.	P-value
Indigenous	-8.0	0.001
Agriculturalist	-3.34	0.027
House damage due to Agatha	0.411	0.535
Household members	0.073	0.764
Household goods	1.85	0.000
Completed primary school- Spouse	2.47	0.008
Monthly food expenditure (%)	-0.005	0.853
Monthly health expenditure (%)	-0.074	0.027
Food assistance recipient	-1.82	0.250
Monetary assistance recipient	-1.43	0.387
Improved sanitations facilities	5.38	0.000
Improved water facilities	3.07	0.012
Department:*		
Jutiapa	5.36	0.043
Sacatepéquez	-9.80	0.0014
Izabal	-7.04	0.005
El Progreso	-9.31	0.004
Baja Verapaz	-6.10	0.05
Retalhuleu	-11.96	0.000
Chimaltenango	-8.13	0.015
Totonicapan	-7.57	0.042
Chiquimula	-12.76	0.000
Alta Verapaz	-10.45	0.009
Solala	-11.98	0.001
Constant	59.23	0.000
R-squared:	**0.3379**	

*Omitted: Escuintla, highest mean FCS, non-sign. departments excluded
n=1539.3, design df= 191, F(20, 163)=24.34

Table 4: Possible Determinants of FCS

Independent Variables	Unstd. Coeff.	P-value
Indigenous	-10.61	0.000
Agriculturalist	-4.14	0.004
House damage due to Agatha	0.59	0.401
Household members	-0.13	0.959
Household goods	2.17	0.000
Completed primary school- Spouse	2.49	0.009
Monthly food expenditure (%)	-0.013	0.615
Monthly health expenditure (%)	-0.08	0.027
Food assistance recipient	-3.34	0.058
Monetary assistance recipient	-0.73	0.666
Improved sanitations facilities	5.00	0.000
Improved water facilities	3.51	0.007
Livelihood Zone:*		
12: Agribusiness & basic grains	-5.79	0.036
4: Export agriculture & livestock	-6.57	0.002
11: Coffee	-6.08	0.003
7: Agribusiness, mining & coffee	-6.58	0.013
9: Basic grains & labor	-6.19	0.015
5: Subsistence farming	-6.64	0.035
14: Cardamom & Coffee	-9.81	0.006
Constant	60.40	0.000
R-squared:	**0.3044**	

*Omitted: Livestock (15), highest mean FCS, non-sign. zones excluded
n=1539.3, design df= 191, F(21, 171)=22.14

Comparison of Indicators

No municipality, department or livelihood zone fell below the defined cut-off for poor food consumption (FCS <28.5). Defined FCS cut-offs were not valuable once FCS was aggregated up since the data no longer showed the 2% with poor consumption. But, as highlighted in Tables 5 & 6, the 1/3rd of departments (6) & livelihood zones (3) with the lowest mean FCS agree with areas that had the highest percentage of food insecurity by 67%. Areas with a high percent of poor food access were generally not in agreement with areas of low FCS or high percentages of food insecurity. Since most households were net consumers, the areas with the highest % households with poor access might also be considered for aid by using FA as a separate indicator. The areas with the highest % households receiving monetary & food aid are highlighted in green. These do not appear to overlap with the neediest regions, but the percentages represent households receiving aid prior to the storm as well as immediately after. Therefore, these indicators may reflect areas of poor food security both in the past & currently.

Table 5: Indicators & Aid by Department.

Department (n=1970)	FCS	Poor Food Access (%)	Poor Food Security (%)	Monetary assistance (%)	Food assistance (%)
Escuintla	76.4 (1.7)*	37.1 (0.03)*	15.8 (0.04)*	7.0 (0.03)*	2.8 (0.02)
Jutiapa	75.8 (2.2)*	70.5 (0.04)*	7.1 (0.02)*	18.3 (0.04)*	6.4 (0.03)*
Jalapa	73.4 (1.4)*	50.0 (0.03)*	10.6 (0.02)*	41.6 (0.05)*	9.7 (0.03)*
Santa Rosa	71.7 (1.2)*	60.6 (0.05)*	9.1 (0.03)*	28.5 (0.05)*	2.3 (0.01)*
Zacapa	70.9 (2.8)*	50.0 (0.03)*	11.7 (0.3)*	10.4 (0.05)*	10.4 (0.05)
Quetzaltenango	68.9 (5.5)*	40.5 (0.05)*	10.9 (0.03)*	6.5 (0.04)	0
Suchitepéquez	67.9 (2.8)*	29.8 (0.1)*	19.0 (0.09)*	0	3.5 (0.02)
Sacatepéquez	66.7 (5.1)*	28.6 (0.1)*	57.0 (0.02)*	0	14.3 (0.04)
Izabal	63.6 (2.4)*	35.6 (0.05)*	12.9 (0.03)*	12.9 (0.06)*	1.8 (0.01)
El Progreso	63.1 (3.6)*	51.3 (0.07)*	16.0 (0.03)*	23.5 (0.09)*	16.9 (0.07)*
Quiche	62.4 (5.0)*	39.5 (0.05)*	29.7 (0.06)*	14.7 (0.1)	0
Baja Verapaz	59.9 (1.7)*	54.4 (0.04)*	7.8 (0.02)*	27.8 (0.08)*	12.4 (0.1)
Retalhuleu	57.3 (1.4)*	42.1 (0.06)*	15.8 (0.08)	0	7.5 (0.04)
Chimaltenango	56.0 (1.1)*	34.6 (0.1)*	23.2 (0.03)*	4.4 (0.02)	4.2 (0.04)
Totonicapan	52.9 (1.7)*	38.7 (0.04)*	29.0 (0.05)*	23.4 (0.08)*	0
Chiquimula	51.7 (1.6)*	50.0 (0.03)*	8.0 (0.04)	24.0 (0.1)*	8.0 (0.1)
Alta Verapaz	51.2 (2.6)*	63.4 (0.04)*	23.1 (0.03)*	17.3 (0.05)*	0.6 (0.01)
Solala	49.1 (2.7)*	42.5 (0.06)	27.5 (0.02)*	62.5 (0.2)*	2.5 (0.02)

*n takes into account weights, (SE), mean unless denoted (%) * = P<0.05

Table 6: Indicators & Aid by Livelihood Zone.

Livelihood Zone (n=1970)	FCS	Poor Food Access (%)	Poor Food Security (%)	Receiving monetary assistance (%)	Receiving food assistance (%)
15	75.9 (1.8)*	62.0 (0.04)*	9.7 (0.02)*	16.9 (0.04)*	10.9 (0.03)*
8	71.5 (3.1)*	57.1 (0.06)*	7.1 (0.02)*	20.1 (0.05)*	5.0 (0.03)*
12	71.4 (2.6)*	39.7(0.03)*	14.7 (0.03)*	8.3 (0.02)*	4.2 (0.02)*
16	70.7 (2.0)*	63.7 (0.04)*	10.2 (0.03)*	47.5 (0.06)*	9.5 (0.03)*
4	68.4 (1.9)*	34.7 (0.05)*	10.4 (0.03)*	3.5 (0.02)*	2.0 (0.02)
11	66.4 (1.4)*	39.7 (0.05)*	16.9 (0.04)*	10.9 (0.03)*	4.4 (0.02)*
7	66.3 (2.7)*	49.7 (0.05)*	14.4 (0.02)*	19.3 (0.06)*	6.2 (0.03)
9	57.6 (1.5)*	47.0 (0.04)*	13.8 (0.02)*	23.5 (0.06)*	24.0 (0.06)
5	56.1 (2.5)*	39.2 (0.03)*	27.6 (0.03)*	27.2 (0.07)*	2.7 (0.02)
14	50.5 (2.4)*	52.6 (0.04)*	24.0 (0.03)*	68.7 (0.2)*	0.5 (0.01)

n takes into account weights, (SE), mean unless denoted (%) * = P<0.05

Mapping & Spatial Analysis

Mapping Individual Indicators

All food security related indicators were aggregated from household surveys & mapped at municipality, department & livelihood zone levels. The data was broken into tertiles for each indicator with red representing areas of high concern, yellow showing areas at risk and green identifying the least at risk areas. Each map shows how identification of need & targeting of aid might be affected by what level of data is presented. Figure 3 shows tertiles of mean FCS; red represents the areas with the lowest 1/3rd of food consumption. Figure 4 depicts % households at each level with poor food access, with red representing the areas with the highest levels. Figure 5 shows % households at each level with severe food insecurity. Red again represents areas with the highest levels.

It is clear that the indicator of food security & the chosen level of aggregation will greatly affect the places and number of people who will receive aid. Since the same data is used in all geographic levels, general patterns are the same, but each aggregation creates more generalization. Analyzing multiple types of indicators identifies different regions with potentially different vulnerabilities to food insecurity.

Figure 3: Food Consumption Score

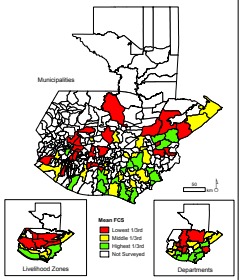


Figure 4: Poor Food Access

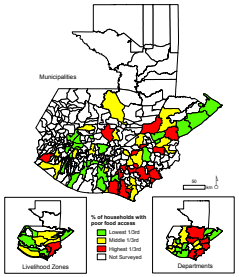
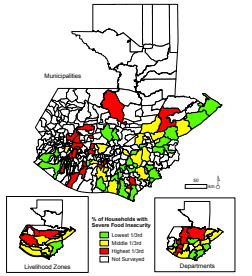


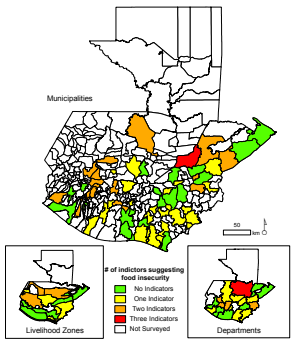
Figure 5: Severe Food Insecurity



Spatial Analysis

It is possible that no one indicator alone will be enough to identify the areas most in need after a disaster. Figure 6 shows the result of including all three indicators of food security on the same map: Food Consumption Score, Food Access and the composite indicator, Food Security. Using spatial analysis techniques, areas with zero to three of the indicators in the direction of household food insecurity can be identified. As shown, there are some municipalities & departments in red (3 indicators), while the livelihood zone map shows only orange (2 indicators). It is also possible, using ArcGIS, to see the combination of indicators in each area (not shown); this information can help point to what type of intervention is most appropriate in different areas. Analysis like this may help to identify areas of need that were not immediately obvious by looking at indicators individually. Any indicators or combination of indicators can be used in this system to help determine areas of food insecurity.

Figure 6: Poor Food Consumption, Access &/or Security



Conclusions

By seeing different aggregation levels of many variables, targeting & priorities can be refined. Depending on the aid or assistance provider, municipality & department might be the most useful geographic boundaries. However, analyzing food security at livelihood zone level might be most useful when planning types of interventions. Geographical Information Systems (GIS) adds value to ESFA surveys by allowing analysts to visualize multiple variables at once & may allow for better identification of patterns that may be missed by looking at tables alone. This analysis shows only the beginning of what can be accomplished by combining GIS with ESFA & other emergency surveys.

Sources and Contributions:

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4. WFP. Food Consumption Analysis: Calculation and use of food consumption score in food security analysis. 2008.
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Figure 1: Landslide risk: SERVIR/CATHALAC & NHC NOAA; Agatha trajectory: NHC NOAA; House damage: ESFA; Departments: GIST
Figure 2-6: ESFA, Fewsnet, GIST