(SB61) Factors associated to social vulnerability to natural disasters in the north of the state of Veracruz, México.

Factores asociados con la vulnerabilidad social a desastres naturales en el norte del estado de Veracruz, México.

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ABSTRACT

The aim of this study was to identify factors that influence social vulnerability to floods in the northern state of Veracruz. At the end of 2008, 208 surveys were implemented in Costa Esmeralda, Panuco, Poza Rica, Tuxpan in Veracruz, and Teziutlán in the mountains east of Puebla. The survey contained questions on various social, economic, demographic, and response to environmental contingencies. In a first stage, all variables were tested against vulnerability by simple linear correlation. The relevant variables were then included in various models to see which provides the greatest predictive value. Factors that showed statistically significant correlation ($p < 0.05$) with the vulnerability were: place, neighborhood, schooling, economic activity, employee benefits law, average monthly income, type of street living, yet housing characteristics soil, maintenance of the area, existing drainage, availability of radio, access to home phone, type of toilet, kids rooms under the same roof, living with a brother or sister of spouse, living with other family / friends , receiving remittances from abroad, own car, number of cars he owns, availability of medical services, duration of flooding (in days), means by which learned of the disaster, kind of government support (local, state, federal) , membership in an association. The final model retained as significant variables ($p < 0.05$): place, neighborhood, schooling, average monthly wage, street type, slope of the home, duration of flooding (in days), means by which he learns from disasters . We conclude that these factors should be considered and emphasized in prevention programs of social vulnerability to natural disasters.

Key words: Statistical models, social vulnerability, natural disasters, risk factors, Veracruz.

RESUMEN

El objetivo de este estudio fue identificar los factores que influyen sobre la vulnerabilidad social a inundaciones ocurridas en el norte del estado de Veracruz. A fines del año 2008 se aplicaron 208 encuestas en Costa Esmeralda, Pánuco, Poza Rica y Tuxpan en Veracruz, y en Teziutlán, en la sierra oriente de Puebla. El cuestionario contenía preguntas sobre diversos aspectos sociales, económicos, demográficos y de respuesta frente a contingencias ambientales. En una primera etapa, se probaron todas las variables contra vulnerabilidad mediante correlación lineal simple. Las variables relevantes fueron entonces incluidas en diversos modelos hasta encontrar el que proporciona el mayor valor predictivo. Los factores que exhibieron correlación estadística significativa ($p< 0.05$) con la condición de vulnerabilidad fueron: lugar, colonia, escolaridad, actividad económica, prestaciones laborales de ley, salario promedio mensual, tipo de calle en que habita, pendiente de la vivienda, características del suelo, mantenimiento de la zona, existencia de drenaje, disponibilidad de aparatos de radio, acceso a teléfono domiciliario, tipo de baño, hijos habitando bajo el mismo techo, cohabitación con hermanos o hermanos del cónyuge, cohabitación con otros familiares y/o amigos, recepción de remesas externas, automóvil propio, numero de automóviles que posee, disponibilidad de servicio médico, duración de la inundación (en días), medio por el que se enteró del desastre, tipo de gobierno que apoyo (municipal, estatal, federal), pertenencia a alguna asociación. El modelo final retuvo como variables significativas ($p< 0.05$): lugar, colonia, escolaridad, sueldo promedio mensual, tipo de calle, pendiente de la vivienda, duración de la inundación (en días), medio por el que se entera de los desastres. Se concluye que estos factores deben ser considerados y enfatizados en programas de prevención de la vulnerabilidad social a desastres naturales.

Palabras claves: Modelo estadístico, vulnerabilidad social, desastres naturales, factores de riesgo, estado de Veracruz.

INTRODUCTION

Natural hazards and disasters include, among others, hurricanes, tropical storms, tornados, floods, drought, earthquakes and fires (Coenraads, 2006). Vulnerability is the susceptibility of a social unit (family, community or society), physical structure or activity, to be damaged by the action of a threat (Kelly and Adger, 2000). Cutter and Emrich (2006) define vulnerability in terms of the ability or inability of individuals or social groups to respond, cope, recover and adapt to various stress events that affect their livelihoods and welfare. This definition underlines and emphasizes an approach to the human dimension, focusing on socioeconomic and institutional constraints that limit the ability to respond. Therefore, although the causes of disasters are related to a natural event, the analysis of the social construction of risk appears to be a multifactorial process (Rios and Murgida, 2004). Apparently, the risk of death by natural disaster is greater in localities with higher percentages of socially vulnerable or disadvantaged populations (Cutter, 1996; Cutter *et al*., 2003). Studies carried out in the United States point out a tendency in poor communities to suffer disproportionately in terms of human death and injury (Wright *et al.,* 1979; Peacock *et al*., 2006; Fothergill and Peek, 2004). However, few quantitative studies exist on the degree to which flood events affect socially vulnerable populations differently.

Because of its location, population living along the Gulf of Mexico face frequent and severe natural disturbances, such as intense rainfall resulting from tropical cyclones and other meteorological phenomena. Deforestation and poor management of natural resources in the region also add to the hazard for disasters. Risk of disaster is increased by human settlement on places such as banks of rivers, wetlands, and mangroves, associated to poverty and marginalization. Hence, disasters do not affect all alike, and its consequences are proportional to the vulnerability of the population and territory. Therefore, it is considered that a large number of socio-economic processes that have increased inequality in Mexico, have also created and allowed the accumulation of vulnerability, which has become the dominant social paradigm in Latin America (Pizarro, 2006). The aim of this study was to identify factors that influence social vulnerability to floods in the northern state of Veracruz.

MATERIAL AND METHODS

A survey was applied at the end of 2008 and early 2009 to 208 inhabitants from five localities (Costa Esmeralda, Panuco, Poza Rica, Tuxpan in Veracruz, and Teziutlán in the east of Puebla) which were affected by natural disasters. The survey contained questions on various social, economic, demographic, and response to environmental contingencies. From the questionnaire 78 response variables were extracted and considered for further analysis. Response variable was defined as being affected at least once by a natural phenomenon in the last 12 months. All variables were tested against vulnerability by simple linear correlation. Variables showing statistical significance were then included in various models to find the one with the greatest predictive value. Goodness of fit of final model was evaluated using diverse criteria. Statistical analysis was performed in SPSS v. 19. Significance levels were defined at 0,05 for all the analysis.

RESULTS AND DISCUSSION

Factors that showed statistically significant correlation ($p < 0.05$) with vulnerability were: place, neighborhood, education, economic activity, employee benefits according to law, average monthly income, type of residing street, house slope, soil characteristics, maintenance in the area, existing drainage, availability of radio, access to home phone, type of toilet, offspring dwelling under the same roof, living with brother or sister of spouse, living with other family/friends, receiving remittances from abroad, own car, number of owned cars, availability of medical services, duration of flooding (in days), means by which learned of the disaster, kind of government support (local, state, federal), and membership in an association. The final model retained as significant variables ($p < 0.05$): place, neighborhood, education, average monthly wage, street type, slope of the home, duration of flooding (in days), and means by which he learns from disasters (Tables 1 and 2).

Table 1. Contrasts of effects in the final model for social vulnerability to natural disasters in the north of the state of Veracruz, México.

Source	Type III		
	Wald Chi-square	Df	Sig.
(Intersection)	415,680	1	0,000
Place	.[a]	.	.
Neighborhood	68,671	16	0,000
Education	11,232	4	0,024
Average monthly income,$	90,249	31	0,000
Type of residing street	24,325	2	0,000
House slope	33,365	18	0,015
Telephone at home	19,570	1	0,000
Days in flood	31,947	13	0,002
Means by which learned of the disaster	11,112	4	0,025

a. unable to calculate due to computation difficulties

According to Muñoz-Pedreros (2004) identifying factors associated to vulnerability is an important aspect for land use planning or land use. Collecting such information is a tool to support the solution of current problems facing humanity as environmental degradation and climate change, decline in environmental quality, soil productivity, and hence the poverty of its inhabitants, which magnifies the risk from disasters (Kasperson *et al*., 2006).

Table 2. Goodness of fit of final model effects for social vulnerability to natural disasters in the north of the state of Veracruz, México.

[b]

	Value	df	Value/df
Deviance	26,333	111	0,237
Scaled Deviance	207,000	111	
Pearson Chi-cuadrado de	26,333	111	0,237
Scaled Pearson Chi-cuadrado	207,000	111	
Log likelihood[a]	-80,316		
Akaike Information Criterion (AIC)	354,631		
Corrected AIC for finite samples (AICC)	529,053		
Bayesian Information Criterion (BIC)	677,905		
Consistent AIC (CAIC)	774,905		

a. Complete log-likelihood function is shown and was used to calculate the information criteria.

b. Information criteria are interpreted as “smaller is better”.

In a study conducted in the same region during 2009 and 2010, Del Angel-Pérez and Linares- Bravo (2011) found that the highest levels of vulnerability were associated with economic, cultural and institutional factors. Among the cultural factors, they highlight the reduction of social capital due to family changes, lack of community support mechanisms, increase in single parent households, low preventive culture, and marginal revenue, which are factors of social exclusion that indicate a weak sustainability in the regional economic structure and an increase in the risk of disaster.

Studies on the impacts of hurricanes, tropical storms, and tornados indicate that socially vulnerable populations and poor communities suffer disproportionately in human death and injury (Fothergill *et al.*, 1999; Castro, 2005; Zahran *et al.*, 2008). In turn, Cervantes and Bueno (2009) argue that vulnerability is a multi-causal measure of risk and danger of damage experienced by people, households and communities, with no possibilities of effectively enable assets available and sometimes remaining defenseless. Furthermore, economic growth in developing countries is more sensitive to natural disasters because more sectors are affected and the magnitudes are non-trivial (Loayza *et al.*, 2009).

Despite the refinement in the way risk and vulnerability are addressed, there is not actually a concept unifying the different points of view, or even collecting consistently different approaches (Cardona, 2003).

Cultural aspects such as family solidarity, mutual aid, and community reciprocity usually represent strengths in human groups (Harris,1997). Cultural factors such as low reciprocity, weak community or family support networks also increase social vulnerability. This results in a greater dependence on government programs, and obscures the self-management and individual and local capabilities. The erosion of these cultural traits that in other times and places have functioned as supporting mechanisms under risk or in cases of disaster, damage the potential that otherwise could lead to a stronger community.

This study considered vulnerability as an interaction of social, economic, and cultural traits of the population, as well as geographical and ecological conditions, and access to private, public and social resources (Brown *et al.* 2005; Villa and McLeod, 2005). If the vulnerability is built on development schemes, then it is likely to change as a result of human decisions and actions (Macías, 1992; García, 2005), so it is important to integrate systems for collecting and analyzing information that can prevent disaster support and strengthen the capacity of communities and local governments to plan and carry out preventive actions and/or protection for the population to natural disasters (CIAT, 2001). Laurent (2010) calls for attention to the necessary articulation between social justice and environmental concerns, and the need to acknowledge and integrate the notions of environmental justice and environmental inequalities as part of public policy, particularly concerning vulnerability and exposure to environmental risk.

CONCLUSIONS

The findings of this study appear to substantiate the claim that disasters inflict unequal harm by minority and income status. It is suggested to consider and include the identified variables into programs for preventing social vulnerability to natural disasters in the area of study.

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