Climate Change and Water Access Vulnerability in the Human Settlement Systems of Mexico: **The Merida Metropolitan Area, Yucatan**

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El acceso al agua en los asentamientos humanos de México está siendo impactado por el cambio climático, lo cual pone en riesgo su desarrollo humano y crecimiento económico. Poco se ha estudiado este fenómeno a escala urbano-regional. Desde la aproximación vulnerabilidad al cambio climático se propone un índice compuesto para estudiar este fenómeno en la Zona Metropolitana de Mérida, Yucatán, México. Basado en fuentes secundarias generadas por confiables instituciones mexicanas, el resultante índice de vulnerabilidad de acceso al agua (WAVI, por sus siglas en inglés) permite la identificación y priorización de esta vulnerabilidad y los factores que contribuyen a ésta en los asentamientos humanos de la zona estudiada. Los resultados de la aplicación del WAVI muestran cómo este tipo de vulnerabilidad varía dentro de la zona de estudio y sugieren que este fenómeno se intensificará en relación con factores sociales.

Palabras clave: Yucatán, cambio climático, vulnerabilidad, asentamientos humanos e índices compuestos.

Climate change affects water access in the human settlements of México, thus threatening their human development and economic growth. There has not been paid enough attention to this phenomenon at the urban-regional scale. The vulnerability approach to climate change is used to propose a compound index for studying this phenomenon in the Merida Metropolitan Area, Yucatan state, Mexico. Based in secondary-sources data generated by trustworthy Mexican institutions, the resulting Water Access Vulnerability Index (WAVI) allows identification and prioritization of this vulnerability and the factors contributing to it in the human settlements of the study area. WAVI results show that this kind of vulnerability vary within the study area and suggest that this phenomenon will intensify in relation to social factors.

Keywords: Climate change vulnerability, Water, Human settlements, Secondary-sources data, Compound indexes.

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1. Introduction

Water is an essential component for the proper functioning of human settlements. Water access is crucial to human development and economic growth (Parkin 1982; Rich 1982). In nature, water availability is governed by environmental phenomena. Many of these phenomena are beginning to reflect climate change impacts, frequently threatening water availability for humans (IPCC 2007). However environmental factors may influence water availability, water access is primarily determined by social factors. Millions of people worldwide face water access problems (UN-HABITAT 2006b). These and many other authors address water access from a social perspective, yet their explicative effectiveness within urban-regional contexts is being tested as climate change affects significantly water access in human settlements. An alternative for study of this challenge is the vulnerability approach to climate change (James, Osvaldo et al. 2001).

Human settlements are dynamic, complex socio-ecological systems which arise from the interaction of socio-economic and environmental processes on various scales; cities are a physical manifestation of these interactions (Sanchez 2007). This perspective is fundamental for the developing of urban studies using the vulnerability approach to climate change. Research utilizing this approach is rare in developing countries, Mexico being no exception. It is even rarer at the urban-regional scale; that is, considering the complete human settlement system and not just one city or some neighborhoods within it.

In this study we used the vulnerability approach to climate change in order to evaluate water

access in the human settlement system known as the Merida Metropolitan Area (MMA). No specific method exists to evaluate water access with this approach, so we proposed a method for this kind of evaluation. It employed a strong quantitative emphasis and was designed to 1) define vulnerability levels for a given human settlement system; 2) map this vulnerability and locate priority areas, and 3) identify and prioritize the contributing factors to water access vulnerability in the system.

1.1. The Merida Metropolitan Area (MMA)

Located in Yucatan state, MMA is one of the 55 metropolitan areas in Mexico (SEDESOL, CONAPO et al. 2004). MMA encompass 288 locations in the municipalities of Conkal, Kanasin, Merida, Progreso, Ucu and Uman. Overall, the MMA covers 1 978 km^2 and had a population of 947 194 inhabitants in 2005; the most populous of the six municipalities was Merida, capital city of Yucatan state (INEGI 2005). In a recent report, the MMA was divided into two main sub-zones: a contiguous urban or conurbation sub-zone (from here on referred to as the conurban sub-zone) and a peripheral-urban sub-zone (from here on referred to as the peri-urban sub-zone) (OMY 2011). The conurban sub-zone is formed by 19 locations (i.e. 6.25% of the regional total) but contained 89.27% of regional population. In contrast, the peri-urban sub-zone contains 269 locations but only had 101 601 inhabitants in 2005. This dual structure in regional population and population center concentration-dispersion is a result of the "metropolization" process in the MMA. Even though this process has begun at least 40 years ago, it has become more accelerated recently, with important roles played by transformations in the region's productive and economic bases. Growth rates over these 40 years have varied, but three major patterns have occurred between 2000 and 2005: 1) the city of Merida has continued to grow, although at lower rates; 2) coastal population centers have stabilized, with some indications of expulsion, and 3) conurban sub-zone population has grown steadily while growth in the peri-urban sub-zone has been heterogeneous (Domínguez 2009).

The regional metropolization process has been accompanied by the appearance or exacerbation of environmental problems affecting water access, such as pollution of the local aquifer (the only permanent natural water source for the regional population), and land use substitution. Urban development in the area has not been homogeneous, as it can be seen in certain water access indicators: 10.75% of households in the MMA have no access to the public drinkable water system;[1] 68.49% have no flushing toilet;[2] and only 1.82% are connected to a public sewage system[3] (INEGI 2005). Among other factors, this unequal water accessibility in MMA is related to the control that some actors exert on public budget, as well as both water and land rights (Domínguez 2008).

Two climatic regimes can be identified within the MMA —a semi-arid climate on the coast and a sub-humid one in the remaining area. However, the real difference between these two regimes is the amount of rainfall, since temperature (approx. 26° C average annual temperature) is almost uniform across the MMA (García, López et al. 2000). Regional substrate is a karstic plain with high permeability, porosity and dissolution. It has no surface drainages or water bodies, and the only water source is the aquifer. Recharged by rainfall, this aquifer consists of a layer of freshwater flowing south to north and a deeper saltwater layer. It is highly productive, but also extremely vulnerable to anthropogenic pollution and saltwater intrusion (Marín and Perry 1994; Graniel et al. 1998; González-Herrera and Pérez 1999; Escolero, Marín et al. 2000; Escolero 2002). Current saltwater intrusion in the region is more related to anthropogenic activities in the coast, and it also represents one of the most dangerous threats of climate change due to future sea level rise. Other expected climate-change impacts in the region are an increase in the hurricane frequency and a rainfall variation (Bates, Kundzewicz et al. 2008; Orellana, Espadas et al. 2009).

1 In this context, access consists of a connection to the public drinkable water system inside the household, or at least at the edge of the property.
2 This assumes the toilet is inside the dwelling and can be flushed directly or manually.
3 Public sewage systems are defined as providing adequate wastewater treatment and disposal.

2. Theory and calculations

2.1. Climate change vulnerability

The concept of vulnerability evolved from risk research (Cutter 2001). A number of definitions exist for vulnerability (Cutter 1996), although most vulnerability research can be classified as addressing physical or social risk. Physical risk, also called "exposure" in Intergovernmental Panel on Climate Change (IPCC) terminology, encompasses physic-environmental characteristics and processes, which increase the risk of experiencing damage. Social risk, also known as "social susceptibility" or "social sensitivity" (IPPC), helps to understand how a diversity of social aspects intervene in creating the myriad results arising from exposure of a socio-ecological system to different types of risk (Cutter 1996; Schmidtlein, Deutsch et al. 2008).

Within climate-change research, vulnerability has expanded to become a more complete concept by encompassing the exposure and sensitivity of a socio-ecological system to the impacts of climate change, as well as the system's adaptive capacity. That is, its ability to resist, recover from and even take advantage of the effects caused by change (James, Osvaldo et al. 2001). This acknowledges climate-change vulnerability as an interactive phenomenon requiring an understanding of how environmental processes function within an unequal socio-economic and political context at different scales (Kasperson, Kasperson et al. 2001; Turner II, Kasperson et al. 2003; Hahn, Riederer et al. 2009). Socio-ecological systems have differential sensitivity to disturbances and are dynamic in terms of their adaptive capacities and the strategies implemented in response to disturbances. These abilities and strategies are based on social, economic, institutional and political structures (Turner II, Kasperson et al. 2003).

An approach to climate-change vulnerability consists in evaluating it from current climate perspective (Jones et al. 2007 mentioned in Carter, Jones et al. 2007). This approach is useful in the uncertain context within which socio-ecological systems are currently developing. It helps in the process of risk detection, improves decision-making and can even function as a development framework (O'Brien, Leichenko et al. 2004).

Within the methodological approaches used to study vulnerability are compound indexes (Hahn, Riederer et al. 2009). Measurement methods are being developed actively within vulnerability research, and are clearly influenced by the way the analyzed system is conceived (Turner II, Kasperson et al. 2003). Vulnerability depends heavily on context and scale (Downing and Patwardhan 2005).

2.2 Conceptualizing water access in human settlements from a focus on climate-change vulnerability, and developing the Water Access Vulnerability Index (WAVI)

Water is used by different sectors in urban contexts, but the present study focuses on domestic use; that is, water access for the general population. Climate change impacts are generating a new risk dimension affecting the already complexity of water-access phenomenon. In this new situation, the entire socio-ecological system represented by the extended human settlement, becomes vulnerable. Study of water access within the context of climate change requires integrating concepts such as the IPCC climate-change vulnerability concept, which is understood as the function of the character, magnitude and rate of climate variations to which a system is exposed, as well as that system's sensitivity and adaptive capacity (James, Osvaldo et al. 2001).

Among the methodological alternatives in vulnerability research, we chose to address water access by building a compound index to integrate social and environmental factors deemed as relevant in appropriate literature, as well as important aspects of MMA. Existing compound indices were reviewed during the design process, including the *Livelihood Vulnerability Index* (LVI) (Hahn, Riederer

et al. 2009), the *Water Poverty Index* (WPI) (Sullivan, Meigh et al. 2003) and the *Human Development Index* (HDI) (UNDP 2007). The result was the Water Access Vulnerability Index (WAVI), intended, like all compound indices, to use a single numerical value to express the complexity of a phenomenon unable to be directly observed or measured. WAVI contributing factors (sub-components) were organized based on their relationship to the principal components of the climate-change-vulnerability definition. A key aspect when using the WAVI to estimate water-access vulnerability is factor's data variability.

Myriad environmental factors can influence the climate change exposure of a socio-ecological system or its components. Correctly interpreting the WAVI requires taking into account the complexity of these factors. The sensitivity of a water resource to climate change is the result of variation in rainfall and temperature among other factors (Klinder and Russel mentioned in Strzepek, Campos et al. 1998). These can clearly affect this resource; for instance, saltwater intrusion, which in coastal zones is associated with an increase in mean sea level and uncontrolled aquifer use by humans. Of the three environmental factors mentioned above, the WAVI incorporates rainfall variation and saltwater intrusion (Table 1).

A number of social factors affect climate change sensitivity in a socio-ecological system. These include population health, social capital, beliefs and customs (Hahn, Riederer et al. 2009), as well as features of the built environment such as urban infrastructure coverage and technology (Cutter et al. 2003, mentionated in Schmidtlein,

Table 1

Water Access Vulnerability Index (WAVI) model applied to the Merida Metropolitan Zone

Principal components	Sub-components	Sub-component description	Data source
Climate change exposure (EXP)	Rainfall variation (RV)	Average rainfall variation during the regional rainy season; 1985-2009 versus 1961-1984. Note: The result is multiplied by the inverse multiplicative: $1/(a+1)$ where, a is the value corresponding to the unit of analysis. This step was done to invert the directionality of the original value and thus meet the index condition, which states that higher values should indicate greater vulnerability.	CONAGUA, 2010. Hydrological basin organisms, technical office, Head of Surface Water Project, and Meteorology. Yucatan, Mexico.
	Saltwater intrusion (SI)	Risk of saltwater intrusion in use of underground water. 2000. Notes: 1. These values are on a 1 to 4 scale, where 1 is equal to the lowest negative influence and 4, to the highest negative influence. 2. The value assigned to a human settlement (location) corresponds to the location of the natural water source that supplies the drinkable water system.	CONAGUA, 2000. Map of Water Extraction Regulation in State of Yucatan, Mexico.
Climate change sensitivity (SEN)	Safe water access deficit (WD)	Percent of houses not connected to the public drinkable water network. 2005.	INEGI, 2005. Microdata. Second Population and Housing Census, 2005. Mexico.
Climate change adaptation capacity (ADC)	Urban poverty (UP)	Adaptation of the UN slum concept used as proxy to measure urban poverty; building of this sub-component was done as the percentage of the population living in households with at least one of two deprivations: sufficient living space and structure durability. 2005.	INEGI, 2005. Microdata. Second Population and Housing Census, 2005. Mexico.

Source: Developed by the authors.

Deutsch et al. 2008). In the present study, the WAVI incorporated just one social factor to evaluate water-access sensitivity in the MMA. Called "safe water access deficit", it adapts the "safe water" concept of the United Nations (Schäfer, Werchota et al. 2007) to local infrastructure coverage, thus describing the existing deficit in basic drinkable water infrastructure in the settlements within the metropolitan area (Table 1). In the future will be important to statistically prove and incorporate in the WAVI other factors such as quantity and quality of the drinkable water service since having the basic infrastructure doesn't necessarily mean that all the community have an effective access to this resource. In the MMA case it was impossible to incorporate these two last factors because data wasn't available at the appropriate scale.

Diverse social factors also affect a socio-ecological system's climate-change-adaptation capacity. These can include the political-institutional framework, within which resource access rights are vital (Adger, Agrawala et al. 2007), and infrastructure assignment via public programs (Domínguez 2008). Poverty is another key factor influencing adaptation capacity and is considered a complex, multidimensional phenomenon (Fields 2005). Research into poverty has produced various theories and approaches; for instance, "urban poverty" is perceived as a distinct form of poverty (FIPU 1996). A physical manifestation of "urban poverty" is housing deprivations, which helps in "slum" differentiation. The UN has defined five dimensions of housing deprivations for "slums": structure durability; living space; safe water access; sanitation access; and secure tenure (UN-HABITAT 2006a). The WAVI incorporated only one factor to evaluate human settlement adaptive capacity; this is an adaptation of the UN "slum" concept used here to indirectly measure "urban poverty" in the MMA (Table 1).

In meeting the objectives of the present study (Section 1), and following the practice of other indices (Ebert, Kerle et al. 2009), statistical evaluations were done to test the predictive relevance of the variables used to measure the social and environmental sub-components. As a result, some factors initially considered in the design process were eliminated, even though they are reported as significant in the related literature.[4] Only those WAVI sub-components shown to have a significant correlation were used.[5] The same procedure was applied to test the index's principal components, which exhibited significant correlations.[6] This makes the WAVI a much more trustworthy index. As has been done with other indices (Sullivan, Meigh et al. 2003; Hahn, Riederer et al. 2009), the WAVI was designed to allow for possible future adjustments by using a balanced approximation of average weights in which each sub-component contributes equally to the index value, even though the principal components contain differing numbers of sub-components.

The WAVI sub-components represent the negative dimension of the measured social and environmental factors. This was done to ensure that the results provided a specific, organized representation of the factors requiring attention (primarily from different levels of government) to reduce water-access vulnerability in the human settlements of the appointed region.

The WAVI was designed to focus analysis on current vulnerability rather than on future vulnerability. This was done because development of adequate climate-change adaptive capacities largely depends on the attention paid by a society to current vulnerability (Carter, Jones et al. 2007).

One of the goals in developing the WAVI was that it would be easily adaptable to other regional urban contexts in Mexico —or other countries nearby—WAVI being perfectible over time. Some authors have criticized the use of secondary source data, claiming it limits measurement of the analyzed phenomena and is not consistently available (Hahn, Riederer et al. 2009). This is true in some

4 The contributing factors eliminated from the WAVI model were toilet in household; variation in drinkable water coverage; rights to health services; and ethnicity.

5 Correlations between the WAVI and its sub-components: $R^2_{\text{WAVI-index RV}} = 0.568$; $R^2_{\text{WAVI-index SI}} = 0.457$; $R^2_{\text{WAVI-index WD}} = 0.332$; and $R^2_{\text{WAVI-index UP}} = 0.417$.

6 Correlations between the WAVI and its principal components: $R^2_{\text{WAVI-EXP}} = 0.68$; $R^2_{\text{WAVI-SEN}} = 0.332$; and $R^2_{\text{WAVI-ADC}} = 0.417$.

cases, although use of secondary source data aids in mitigating financial and other limitations in the study of climate-change implications in certain communities, an especially relevant issue in developing-countries such as Mexico. We believe that existing secondary data sources need not be rejected *a priori*, especially if they are generated by trustworthy institutions with a proven reputation, as this is the case with the data used in developing the WAVI (Table 1). When primary-source data is not available, it is essential to carefully select data sources, so that they meet data requirements for the index variables, confirm their theoretical significance and then statistically test them. In developing the WAVI, trustworthy secondary data sources were vital to meeting the objectives proposed in the present study.

3. Materials and methods

3.1 Calculating the WAVI

As stated above (Sections 1 and 2.2), the WAVI was designed as an approximation of the studied urban-regional phenomenon, meaning the index needed to evaluate groups of locations or other territorial units within a region; this is analogous to the Basic Geostatistical Area (Área Geoestadística Básica —AGEB[7]—) used in Mexico. These groups are to be defined in each study, and labeled as "units of analysis" (Section 3.2).

When applying the WAVI to a human settlement system, the first step is to calculate the sub-component values for each unit of analysis. All the sub-component results must meet the condition that the higher is their value, the greater their contribution to vulnerability will be in the unit. This also applies to calculating and interpreting the results for the principal components and the WAVI. To verify that the sub-components used in the present study meet this condition, the sub-component results were compared to the known reality; if inverse behavior was identified, sub-component direction was inverted. In the case of the MMA, directionality of the rainfall variation sub-component was inverted because analysis indicated that the zone had been experiencing increased rainfall during the rainy season (June-October). This was qualified as positive; as rainfall increases, the environment will have greater water-access and vulnerability will decrease. In this context it was decided that a low or null increase in rainfall should be interpreted as increasing water-access vulnerability in the units of analysis, thus sub-component direction was inverted to meet this WAVI condition. Direction was inverted by applying the inverse multiplicative formula directly to the sub-component results.[8]

The next step in calculating the WAVI is to normalize all sub-component measurements since these are in different scales. As is done in the LVI (Hahn, Riederer et al. 2009), this procedure was carried out by adapting the life expectancy formula, an integral part of the HDI. Another similarity between the WAVI and the LVI is that variables which measure frequency do not use existing values in the MMA units of analysis as the maximum and minimum values[9]. Instead, they use 100% as the maximum value and 0% as the minimum value since these represent the real limits in which these units can adopt a value. The formula for making this calculation is equation (1):

$$\text{index}_{Sd} = S_d - S_{\min} / S_{\max} - S_{\min} \qquad (1)$$

where S_d = the original sub-component value for unit of analysis d; and $S_{\max}$ and $S_{\min}$ are respectively the maximum and minimum sub-component values used to normalize unit d.

Once the sub-components are normalized, the three principal components of the IPCC climate

7 The AGEB was developed by the National Institute of Statistics and Geography (Instituto Nacional de Estadística y Geografía — INEGI—) to report the results for censuses and population and housing surveys.

8 The inverse multiplicative formula is 1/(a+1), where *a* corresponds to each unit of analysis.

9 The WAVI sub-components which measure frequency are "safe water access deficit" and "urban poverty".

change vulnerability definition are calculated for each unit of analysis (James, Osvaldo et al. 2001). Each principal component is calculated separately using equation (2), which represents the average of the number of sub-components contained within it:

$$M_d = {}^{n}{}_{i=1} \text{index}_{Sdi} / n \qquad (2)$$

where M_d = one of the three principal components for unit of analysis *d*; index_{Sdi} = sub-components normalized by *i*, which integrate the principal component *d*; and *n* = the number of sub-components in principal component *d*.

Finally, once the three principal components are calculated for each unit of analysis, they are averaged with a weighted procedure to produce their WAVI value, using equation (3):

$$\text{WAVI}_d = {}^{3}{}_{i=1} w_{Mi} M_{di} / {}^{3}{}_{i=1} w_{Mi} \qquad (3)$$

where WAVI_d = Water Access Vulnerability Index for unit of analysis *d*; and w_{Mi} = each principal component's weight, determined by the number of sub-components it contains.

3.2 Units of analysis in the MMA

In 2005, there were 288 locations within the MMA (INEGI 2005), of which 78 were included in the present study. These correspond to the 78 locations with complete data that were used to develop the four WAVI model sub-components.[10] However, the WAVI was calculated for many more units of analysis because these 78 identified locations were subdivided into two groups based on availability of AGEB data. AGEB data provides more detail for evaluating the studied phenomenon inside the MMA locations with this level of disaggregation.[11] The WAVI was calculated for a total of 529 units of analysis: 71 locations and 451 AGEB.

3.3 Analysis procedures for urban-regional water-access vulnerability levels and distribution among human settlements and the contribution of social and environmental factors

In indices such as the LVI (Hahn, Riederer et al. 2009), scale results have been defined, although methods are not included to define vulnerability levels between units of analysis. This shortcoming reduces the practical possibilities of using the index-generated data to make concrete decisions aimed at diminishing vulnerability in any given regional population. The WAVI represents progress in this sense because it sets a scale results[12] and it also includes a method to calculate vulnerability levels. To do this, the natural breaks (Jenks) classification method is applied, due to its ability to optimize the best arrangement for the values in a given number of classes by reducing variance within classes and maximizing it between them (Jenks 1967; McMaster 1997).

Analysis of water-access vulnerability levels and their territorial distribution within the MMA was done at the units of analysis scale. Evaluation of the contributing factors to this vulnerability was done by selecting case studies among the units of analysis with medium to high vulnerability; these were catalogued as "priority areas" in the MMA (Section 1). Case study definition was done by applying three selection criteria to these areas: 1) Their location inside the conurban/peri-urban zoning proposed by OMY (OMY 2011). In an effort to generate a more detailed territorial view of these factors through

10 The 210 locations in the MMA for which the WAVI could not be calculated are mostly small, disperse settlements, which represent barely 0.14% of total MMA population. Calculating the sub-components for these locations was not possible due to census data confidentiality (INEGI).

11 The data for seven locations in the MMA were broken down: Kanasin, Merida and Uman (each belonging to the municipality of the same name); and Progreso, Chelem, Chicxulub and Chuburna (all within Progreso municipality).

12 WAVI scale range from zero (lowest vulnerability) to one (highest vulnerability). The same range applies to the sub-components and principal components.

out the MMA and in response to an exploratory exercise which identified behavioral variations in some socio-demographic variables between certain sub-zones, the location criterion was complemented with an additional sub-zone location classification. 2) Homogeneous zones[13] were delimited for those locations with data broken down by AGEB. 3) A random sample of locations was taken of the disperse settlements to ensure they were representative of all the MMA priority areas. A total of 19 case studies were chosen and their sub-component,[14] principal component and WAVI values calculated. For these 19 cases, the natural breaks method was applied to their indexed sub-component and principal component results to evaluate the contributions of the social and environmental factors included in the WAVI.[15]

4. Results

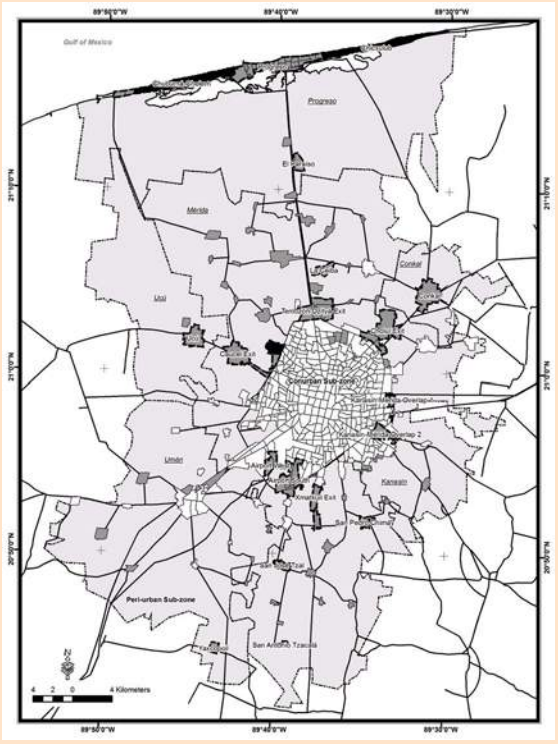
4.1 Vulnerability levels and territorial distribution

Three levels of water-access vulnerability were defined in the MMA: low (WAVI ≤ 0.137), moderate (WAVI = 0.138-0.355) and high (WAVI ≥ 0.356). Of the total number of units of analysis, 72% had a low level, 21% had a moderate level and 6% had a high level. All values for normalized sub-components, principal components and WAVI for the 529 units of analysis, as well as their population at risk, are shown in Appendix A (Online Resource 1).

Territorial distribution of the WAVI values within the MMA showed the low vulnerability units of analysis to be concentrated in the conurban sub-zone. Moderate vulnerability units of analysis were concentrated in the peri-urban sub-zone, although some were identified on the periphery of the conurban sub-zone. High vulnerability zones were concentrated on the coast with some on the periphery of the conurban sub-zone (Figure 1).

Figure 1

Territorial distribution of WAVI values within the Merida Metropolitan Zone, Yucatan, Mexico



Source: Developed by the authors.
Abbreviation: WAVI: Water Access Vulnerability Index.
Legend: Light gray: Merida Metropolitan Zone; White polygons: Low vulnerability areas (WAVI=< 0.137); Dark gray polygons: Intermediate vulnerability areas (WAVI= 0.138 to 0.355); Black polygons: High vulnerability areas (WAVI=> 0.356); Dark gray and black polygons: Priority areas; Polygons with bold hidden lines: Case studies; Black solid lines: Roads; Polygons with dotted lines: Municipalities; *Municipality name*.

4.2 Factors contributing to vulnerability

Previous to the contributing factors analysis, a correlation analysis of the indexed sub-components and the WAVI values was made. It suggested that the main contributing factors (in descending order) are rainfall variation ($R^2_{\text{WAVI-index } PV} = 0.568$);

13 Homogeneous zones were defined as those formed by grouping adjacent AGEB´s with medium and high vulnerability values.

14 The data used to calculate sub-components for priority areas coinciding with homogeneous zones were acquired by summing frequency indicator data for the units of analysis within them and assigning this value to the locations for the sub-components (RV and SI). The rest of the procedure was the same as described in Section 3.1.

15 Vulnerability contribution ranges for each social and environmental factor: Rainfall variation, low (0.00-0.28), moderate (0.29-0.46) and high (0.47-1.00); Saltwater intrusion, low (0.00), moderate (0.001-0.333) and high (0.334-0.667); Safe water access deficit, low (0.007-0.125), moderate (0.126-0.358) and high (0.359-0.781); and Urban poverty, low (0.000-0.141), moderate (0.142-0.254) and high (0.255-0.336).

saltwater intrusion ($R^2_{\text{WAVI-index } SI} = 0.457$); urban poverty ($R^2_{\text{WAVI-index } UP} = 0.417$); and safe water-access deficit ($R^2_{\text{WAVI-index } WD} = 0.332$).

The contributing factors to vulnerability for the 19 case studies (defined in section 3.3) are shown in Table 2; their analysis by sub-zone level indicate that rainfall variation mostly makes low contributions in the South Conurban Sub-zone, and high contributions in the Coast Sub-zone, while moderately contribute in the other three sub-zones. Saltwater intrusion mostly generated high contributions to vulnerability in the Coast Sub-zone, and low contributions in the rest. Finally, safe water access deficit and urban poverty contributing factors have a diverse behavior through MMA sub-zones, even though there is a tendency to moderate values (Table 2).

Continues

Table 2

WAVI indexed sub-component values for 19 study cases (priority areas) in the Merida Metropolitan Area

Priority Area Study Cases by Sub-zone	$index_{RV}$	$index_{SI}$	$index_{WD}$	$index_{UP}$	At Risk Population (2005)	Priority Area Type	
						Locations (total)	AGEB´s (total)
North Conurban Sub-zone					**14 658**	-	**16**
Cholul Exit, *Mérida*	0.290	0.000	0.262	0.075	5 499		
Temozón-Dzityá Exit, *Mérida.*	0.425	0.000	0.781	0.114	451		
Caucel Exit, *Mérida*	0.425	0.000	0.231	0.135	6 860		
North Peri-urban Sub-zone					**26 483**	**23**	-
Ucú, *Ucú*	0.425	0.000	0.230	0.141	2 360		
Conkal, *Conkal*	0.425	0.000	0.172	0.087	6 620		
La Ceiba, *Mérida*	0.256	0.333	0.008	0.000	1 023		
El Paraíso, *Progreso*	0.000	0.667	0.466	0.247	285		
South Conurban Sub-zone					**17 314**	-	**35**
West Airport, *Mérida*	0.138	0.000	0.339	0.254	1 432		
South Airport, *Mérida*	0.138	0.000	0.230	0.336	7 509		
Xmatkuil Exit, *Mérida*	0.463	0.000	0.470	0.238	1 434		
Kanasín-Mérida Overlap 1, *Kanasín*	0.138	0.000	0.309	0.281	1 137		
Kanasín-Mérida w Overlap 2, *Kanasín*	0.138	0.000	0.358	0.232	1 905		

Table 2 Concludes

WAVI indexed sub-component values for 19 study cases (priority areas) in the Merida Metropolitan Area

Priority Area Study Cases by Sub-zone	$index_{RV}$	$index_{SI}$	$index_{WD}$	$index_{UP}$	At Risk Population (2005)	Priority Area Type	
						Locations (total)	AGEB´s (total)
South Peri-urban Sub-zone					**15 438**	**19**	-
San Antonio Tzacalá, *Mérida*	0.463	0.000	0.007	0.290	618		
San José Tzal, *Mérida*	0.463	0.000	0.125	0.214	3 092		
San Pedro Chimay, *Mérida*	0.463	0.000	0.076	0.319	1 012		
Yaxcopoil; *Umán*	0.463	0.000	0.047	0.214	1 102		
Coast Sub-zone					**45 311**	-	**51**
Progreso, *Progreso*	1.000	0.000	0.022	0.087	35 519		
Chuburná-Chelem, *Progreso*	1.000	0.667	0.052	0.176	3 061		
Chicxulub, *Progreso*	1.000	0.667	0.095	0.140	5 052		

Source: Developed by the authors.

Abbreviations: WAVI: Water Access Vulnerability Index; $index_{RV}$: Rainfall variation indexed sub-component; $index_{SI}$: Saltwater intrusion indexed sub-component; $index_{WD}$: Safe water access deficit indexed sub-component; $index_{UP}$: Urban poverty indexed sub-component; AGEB: Área Geoestadística Básica (Basic Geostatistical Area). Names in underlined italics within sub-zones indicate *municipalities*.

Notes: Contribution levels to vulnerability of indexed sub-components. Rainfall variation: low (0.00 to 0.28), moderate (0.29 to 0.46), high (0.47 to 1.00); Saltwater intrusion: low (0.00), moderate (0.001 to 0.333), high (0.334 to 0.667); Safe water access deficit: low (0.007 to 0.125), moderate (0.126 to 0.358), high (0.359 to 0.781); and Urban poverty: low (0.000 to 0.141), moderate (0.142 to 0.254), high (0.255 to 0.336).

5. Discussion

5.1 Water-access vulnerability in the MMA

A number of different social and environmental factors have been linked to water access in societies, but contextualizing this phenomenon within the vulnerability approach to climate change and the present study area suggested that not all of these factors have the same potential usefulness in evaluating this phenomenon. Indeed, the analysis raised doubts about the explicative relevancy of some, at least from a statistical-quantitative perspective and within the MMA. The WAVI aided in identifying and prioritizing the factors contributing to water-access vulnerability in the MMA (Sections 2.2 and 2.4), but also helped to define vulnerability levels among the region's human settlements, analyze the territorial distribution of this vulnerability and identify priority areas.

The most vulnerable population was that living in the priority areas, and accounted for 12.58% of total MMA population. This may be a small percentage compared to the population living in low vulnerability areas, but it nonetheless represents 119 157 people, a substantial portion of the population in 2005.

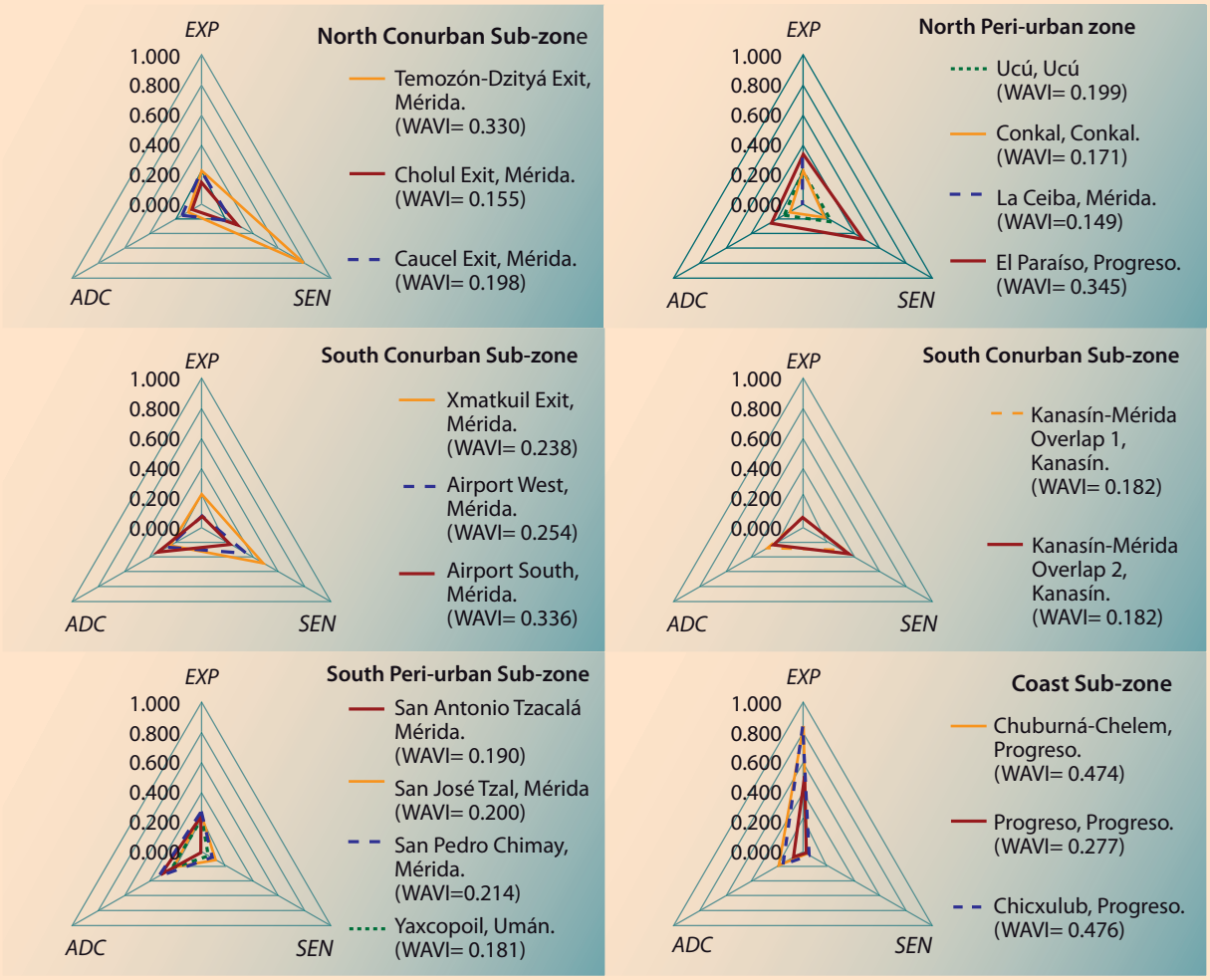
Interpretation of the MMA WAVI results in terms of the IPCC climate-change vulnerability definition components suggested the presence of differential sensitivity between human settlements (Turner II, Kasperson et al. 2003), as well as different levels

of exposure and adaptive capacity, even when some settlements were near one another (Figures 1 and 2). There were also differing behavior patterns among contributing factors, although many settlements shared the same vulnerability level (Table 2 and Figure 2), Progreso is a good example of both situations.

One of the aims in developing the WAVI was to create a tool for implementing actions to address water access vulnerability in the MMA, although these actions did not form part of the present study's objectives. Before these actions can be undertaken, further research will be needed on the society's capacities and adaptive strategies, and the present results will need to be linked to the social, economic, institutional, urban, and political processes and structures which actually generate them.

Figure 2

WAVI principal component values for 19 case studies (priority areas) defined within Merida Metropolitan Area



Source: Developed by authors.

Abbreviation: WAVI: Water Access Vulnerability Index; *EXP*: Climate change exposure principal component; *SEN*: Climate change sensitivity principal component; *ADC*: Climate change adaptation capacity principal component.

Notes: First name: Case study name; Second name (after comma): Municipality name. Water access vulnerability levels: Low (WAVI ≤ 0.137), Intermediate (WAVI = 0.138 to 0.355), High (WAVI ≥ 0.356); Principal component contribution levels to vulnerability. For *EXP*: low (0.069 to 0.141), moderate (0.142 to 0.500), high (0.501 to 0.833); for *SEN*: low (0.007 to 0.125), moderate (0.126 to 0.358), high (0.359 to 0.781); for *ADC*: low (0.000 to 0.141), moderate (0.142 to 0.254), high (0.255 to 0.336).

5.2 WAVI benefits and limitations

The WAVI is an effective way of evaluating water-access vulnerability from a climate-change perspective at the complete human-settlement system scale, an underutilized scale in studies of this phenomenon. When applied to the MMA, the WAVI identified the effects of concrete social and environmental factors. However, the most outstanding aspects of the WAVI are its focus and flexibility in studying this phenomenon, which will allow its adaptation to different regional contexts over time, and may even make it a promising model for evaluating the climate-change vulnerability of other social phenomena in human settlements.

This index specifies and breaks down the areas of weakness and opportunity within each human-settlement system that requires further attention to reduce water access vulnerability. Using this aspect will help in designing effective climate change vulnerability programs. The WAVI also uses existing secondary-data sources developed by trustworthy institutions —in this case at federal level. Other authors may disregard these sources (Hahn, Riederer et al. 2009), but in developing the WAVI they were not eliminated *a priori* since the problem is not the data source *per se* but incorrect selection of sources and/or variables, deficient theoretical justification, and inadequate statistical proofing. Using secondary data sources also reduces the cost and time needed to generate vulnerability evaluations, a key advantage when generating a critical mass of climate-change vulnerability research in developing countries such as Mexico.

One limiting factor encountered during WAVI development was the difficulty in including some phenomena relevant to water-access vulnerability in the index. This was a challenge for a number of reasons, including data availability; for instance, factors considered initially such as natural water source quality were eliminated from the MMA analysis for lack of sufficient data. As a way of compensating for this limiting factor and allowing for future inclusion of other relevant factors in human settlement systems yet to be studied, the WAVI can incorporate new factors without affecting its scientific rigor. One aspect to consider, however, is that the presence of differences between contributing factors used to evaluate more than one human-settlement system may create difficulty in results comparison. This challenge can be overcome through expert opinion.

A limiting factor intrinsic to the WAVI model used to study the MMA is that its sub-components (i.e. rainfall variation and saltwater intrusion) were normalized via maximum and minimum values applicable only in the study area. As stated by Hahn and Vincent, this presents a challenge to comparing the present results with those from other human settlement systems, even if exactly the same sub-components were used (Vincent 2007; Hahn, Riederer et al. 2009). Another potentially limiting factor mentioned by these authors is that the sub-components were averaged within the principal components, therefore ignoring variance in these phenomena inside the MMA. To counterbalance this effect, we field-checked data and generated tables and thematic maps to observe some aspects of this variability (Section 4.2).

Finally, as a compound index the WAVI could be qualified as an over-simplification of the studied phenomenon (Vincent 2007). Despite this possibility, we believe that the WAVI is the most adequate possible model for evaluating the water access phenomenon in the study area (Sections 2.2, and 3.1 to 3.3). Indeed, the idea behind building an index is precisely the use of a numerical value to express the complexity of a phenomenon which would be difficult or impossible to directly observe and/or measure.

6. Conclusions

WAVI was influenced by the IPCC vulnerability approach to climate change (James, Osvaldo et al. 2001), the urban-regional scale adopted from the outset and our conception of the studied socio-ecological system's structure and functioning (Turner II, Kasperson et al. 2003; Downing and Pat-

wardhan 2005). MMA is a complex socio-ecological system in which climate change impacts, and the consequent associated vulnerabilities, operate in specific ways that can be differentiated from those in other systems, be it for their physico-environmental and/or socio-spatial characteristics. This clearly highlights the need for climate-change researchers to understand how the environmental processes involved in this phenomenon operate differentially depending on context and scale (Kasperson, Kasperson et al. 2001; Turner II, Kasperson et al. 2003; Hahn, Riederer et al. 2009).

Water access has been widely studied as a social phenomenon, but climate-change impacts create the need to develop new approaches. We are conscious of some of the model's limitations and the need to continue developing it in the future, but we believe it to be a promising proposal for quantitatively addressing this phenomenon at the complete human-settlement system scale, one that is rarely used in climate-change vulnerability research.

Water-access vulnerability within MMA is more intense on the coast and in the peri-urban subzone than inside the conurban sub-zone. However, the contributing factors vary throughout the study area. Using the components of the climate-change vulnerability definition, it can be said that the coastal population are more vulnerable due to climate-change exposure, while the peri-urban population are vulnerable due to their limited adaptive capacity and sensitivity. Over time, the dynamism of these factors (Turner II, Kasperson et al. 2003), will probably increase vulnerability levels and/or the impacts from social contributing factors will become more generalized. These factors will include those used now in the WAVI as well as others.

Concrete actions aimed at reducing the current status of water-access vulnerability in the human settlements of the MMA did not form part of the present study objectives, but the results reported here can help to generate actions towards this goal.

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Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Chicxulub, Progreso (AGEB 039-5)	1.00	0.67	1.00	0.80	0.83	1.00	0.80	0.867	High	20	No data
Chicxulub, Progreso (AGEB 040-8)	1.00	0.67	0.50	0.38	0.83	0.50	0.38	0.635	High	52	No data
Chicxulub, Progreso (AGEB 041-2)	1.00	0.67	0.50	0.33	0.83	0.50	0.33	0.625	High	21	No data
Chelem, Progreso (AGEB 017-9)	1.00	0.67	0.50	0.25	0.83	0.50	0.25	0.604	High	20	No data
Chicxulub, Progreso (AGEB 042-7)	1.00	0.67	0.60	0.00	0.83	0.60	0.00	0.567	High	26	No data
Chicxulub, Progreso (AGEB 026-8)	1.00	0.67	0.36	0.20	0.83	0.36	0.20	0.557	High	106	No data
Chelem, Progreso (AGEB 021-5)	1.00	0.67	0.08	0.46	0.83	0.08	0.46	0.551	High	44	No data
Chicxulub, Progreso (AGEB 043-1)	1.00	0.67	0.41	0.10	0.83	0.41	0.10	0.546	High	100	No data
Chelem, Progreso (AGEB 016-4)	1.00	0.67	0.17	0.33	0.83	0.17	0.33	0.542	High	21	No data
Mérida, Mérida (AGEB 476-3)	0.14	0.00	1.00	1.00	0.07	1.00	1.00	0.534	High	6	No data
Chelem, Progreso (AGEB 018-3)	1.00	0.67	0.00	0.43	0.83	0.00	0.43	0.524	High	32	No data
Chelem, Progreso (AGEB 070-9)	1.00	0.67	0.08	0.28	0.83	0.08	0.28	0.506	High	354	No data
Progreso, Progreso (AGEB 079-A)	1.00	0.00	0.00	1.00	0.50	0.00	1.00	0.500	High	9	No data
Chicxulub, Progreso (AGEB 038-0)	1.00	0.67	0.13	0.20	0.83	0.13	0.20	0.500	High	54	No data
Chelem, Progreso (AGEB 054-A)	1.00	0.67	0.06	0.25	0.83	0.06	0.25	0.496	High	630	No data
Chicxulub, Progreso (AGEB 025-3)	1.00	0.67	0.11	0.18	0.83	0.11	0.18	0.491	High	1 248	No data
Chicxulub, Progreso (AGEB 065-8)	1.00	0.67	0.13	0.16	0.83	0.13	0.16	0.489	High	173	No data
Chicxulub, Progreso (AGEB 066-2)	1.00	0.67	0.04	0.15	0.83	0.04	0.15	0.464	High	587	No data
Chicxulub, Progreso (AGEB 056-9)	1.00	0.67	0.05	0.13	0.83	0.05	0.13	0.461	High	1 248	No data
Chicxulub, Progreso (AGEB 086-A)	1.00	0.67	0.00	0.17	0.83	0.00	0.17	0.458	High	61	No data
Chelem, Progreso (AGEB 069-6)	1.00	0.67	0.05	0.11	0.83	0.05	0.11	0.456	High	706	No data
Chelem, Progreso (AGEB 055-4)	1.00	0.67	0.03	0.11	0.83	0.03	0.11	0.452	High	1 184	No data
Kanasín, Kanasín (AGEB 042-2)	0.14	0.00	1.00	0.67	0.07	1.00	0.67	0.451	High	11	No data
Kanasín, Kanasín (AGEB 044-1)	0.14	0.00	0.67	1.00	0.07	0.67	1.00	0.451	High	10	No data
Chicxulub, Progreso (AGEB 057-3)	1.00	0.67	0.04	0.08	0.83	0.04	0.08	0.447	High	1 356	No data
Chelem, Progreso (AGEB 022-A)	1.00	0.67	0.00	0.00	0.83	0.00	0.00	0.417	High	13	No data
Chelem, Progreso (AGEB 084-0)	1.00	0.67	0.00	0.00	0.83	0.00	0.00	0.417	High	13	No data
Kanasín, Kanasín (AGEB 030-A)	0.14	0.00	1.00	0.50	0.07	1.00	0.50	0.409	High	24	No data
Kanasín, Kanasín (AGEB 045-6)	0.14	0.00	0.96	0.50	0.07	0.96	0.50	0.399	High	101	No data
Mérida, Mérida (AGEB 487-1)	0.14	0.00	0.96	0.41	0.07	0.96	0.41	0.377	High	177	No data
Mérida, Mérida (AGEB 475-9)	0.14	0.00	0.88	0.44	0.07	0.88	0.44	0.364	High	103	No data
Progreso, Progreso (AGEB 061-A)	1.00	0.00	0.02	0.43	0.50	0.02	0.43	0.362	High	559	No data
Chuburná, Progreso (AGEB 091-0)	1.00	0.00	0.00	0.44	0.50	0.00	0.44	0.361	High	26	No data
El Paraíso, Progreso	0.00	0.67	0.51	0.25	0.33	0.51	0.25	0.355	Intermediate	285	1.16

Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Kanasín, Kanasín (AGEB 033-3)	0.14	0.00	0.95	0.29	0.07	0.95	0.29	0.344	Intermediate	81	No data
Kanasín, Kanasín (AGEB 041-8)	0.14	0.00	0.60	0.60	0.07	0.60	0.60	0.334	Intermediate	29	No data
Mérida, Mérida (AGEB 447-7)	0.14	0.00	1.00	0.14	0.07	1.00	0.14	0.320	Intermediate	94	No data
Mérida, Mérida (AGEB 498-A)	0.14	0.00	1.00	0.13	0.07	1.00	0.13	0.316	Intermediate	49	No data
Chuburná, Progreso (AGEB 090-6)	1.00	0.00	0.07	0.19	0.50	0.07	0.19	0.314	Intermediate	635	No data
Progreso, Progreso (AGEB 027-2)	1.00	0.00	0.25	0.00	0.50	0.25	0.00	0.313	Intermediate	27	No data
Progreso, Progreso (AGEB 087-4)	1.00	0.00	0.07	0.15	0.50	0.07	0.15	0.307	Intermediate	499	No data
Mérida, Mérida (AGEB 345-A)	0.14	0.00	0.89	0.17	0.07	0.89	0.17	0.300	Intermediate	196	No data
Chuburná, Progreso (AGEB 089-3)	1.00	0.00	0.01	0.17	0.50	0.01	0.17	0.295	Intermediate	1 041	No data
Progreso, Progreso (AGEB 053-5)	1.00	0.00	0.04	0.13	0.50	0.04	0.13	0.294	Intermediate	3 212	No data
Mérida, Mérida (AGEB 387-3)	0.14	0.00	0.71	0.32	0.07	0.71	0.32	0.292	Intermediate	230	No data
Progreso, Progreso (AGEB 073-2)	1.00	0.00	0.01	0.15	0.50	0.01	0.15	0.289	Intermediate	1 030	No data
Noc Ac, Mérida	0.43	0.33	0.15	0.24	0.38	0.15	0.24	0.289	Intermediate	437	2.20
Progreso, Progreso (AGEB 063-9)	1.00	0.00	0.03	0.12	0.50	0.03	0.12	0.289	Intermediate	1 109	No data
Mérida, Mérida (AGEB 492-2)	0.14	0.00	1.00	0.00	0.07	1.00	0.00	0.284	Intermediate	6	No data
Mérida, Mérida (AGEB 497-5)	0.14	0.00	0.89	0.11	0.07	0.89	0.11	0.284	Intermediate	62	No data
Progreso, Progreso (AGEB 076-6)	1.00	0.00	0.03	0.11	0.50	0.03	0.11	0.283	Intermediate	1 586	No data
Progreso, Progreso (AGEB 051-6)	1.00	0.00	0.03	0.09	0.50	0.03	0.09	0.281	Intermediate	3 957	No data
Progreso, Progreso (AGEB 044-6)	1.00	0.00	0.04	0.09	0.50	0.04	0.09	0.281	Intermediate	3 244	No data
Progreso, Progreso (AGEB 075-1)	1.00	0.00	0.02	0.10	0.50	0.02	0.10	0.281	Intermediate	1 409	No data
San Ignacio Tesip, Mérida	0.46	0.00	0.34	0.31	0.23	0.34	0.31	0.280	Intermediate	329	2.56
Progreso, Progreso (AGEB 049-9)	1.00	0.00	0.02	0.09	0.50	0.02	0.09	0.278	Intermediate	2 649	No data
Progreso, Progreso (AGEB 071-3)	1.00	0.00	0.00	0.11	0.50	0.00	0.11	0.277	Intermediate	523	No data
Progreso, Progreso (AGEB 077-0)	1.00	0.00	0.02	0.09	0.50	0.02	0.09	0.277	Intermediate	691	No data
Progreso, Progreso (AGEB 074-7)	1.00	0.00	0.01	0.09	0.50	0.01	0.09	0.276	Intermediate	1 146	No data
Progreso, Progreso (AGEB 072-8)	1.00	0.00	0.02	0.07	0.50	0.02	0.07	0.273	Intermediate	1 123	No data
Progreso, Progreso (AGEB 064-3)	1.00	0.00	0.02	0.07	0.50	0.02	0.07	0.273	Intermediate	933	No data
Progreso, Progreso (AGEB 045-0)	1.00	0.00	0.02	0.07	0.50	0.02	0.07	0.272	Intermediate	3 533	No data
Progreso, Progreso (AGEB 052-0)	1.00	0.00	0.01	0.08	0.50	0.01	0.08	0.271	Intermediate	687	No data
Campestre Flamboyanes, Progreso	0.00	1.00	0.03	0.02	0.50	0.03	0.02	0.264	Intermediate	3 022	-1.92
Kikteil, Mérida	0.38	0.33	0.07	0.26	0.36	0.07	0.26	0.262	Intermediate	216	0.66
Progreso, Progreso (AGEB 046-5)	1.00	0.00	0.01	0.04	0.50	0.01	0.04	0.262	Intermediate	731	No data
Progreso, Progreso (AGEB 047-A)	1.00	0.00	0.01	0.04	0.50	0.01	0.04	0.261	Intermediate	3 538	No data
Progreso, Progreso (AGEB 050-1)	1.00	0.00	0.01	0.02	0.50	0.01	0.02	0.258	Intermediate	2 166	No data
Progreso, Progreso (AGEB 060-5)	1.00	0.00	0.00	0.03	0.50	0.00	0.03	0.257	Intermediate	520	No data
Progreso, Progreso (AGEB 048-4)	1.00	0.00	0.01	0.02	0.50	0.01	0.02	0.256	Intermediate	638	No data
Mérida, Mérida (AGEB 428-4)	0.14	0.00	0.79	0.09	0.07	0.79	0.09	0.254	Intermediate	135	No data
Mérida, Mérida (AGEB 493-7)	0.14	0.00	0.63	0.25	0.07	0.63	0.25	0.253	Intermediate	28	No data
Mérida, Mérida (AGEB 360-4)	0.14	0.00	0.56	0.30	0.07	0.56	0.30	0.250	Intermediate	425	No data
Mérida, Mérida (AGEB 458-5)	0.14	0.00	0.86	0.00	0.07	0.86	0.00	0.249	Intermediate	80	No data
Mérida, Mérida (AGEB 480-A)	0.14	0.00	0.57	0.29	0.07	0.57	0.29	0.249	Intermediate	21	No data
Mérida, Mérida (AGEB 427-A)	0.14	0.00	0.67	0.17	0.07	0.67	0.17	0.243	Intermediate	117	No data

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Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Dzidzilché, Mérida	0.00	0.67	0.11	0.19	0.33	0.11	0.19	0.241	Intermediate	153	-8.91
Mérida, Mérida (AGEB 349-8)	0.14	0.00	0.58	0.24	0.07	0.58	0.24	0.241	Intermediate	1.050	No data
Hotzuc, Umán	0.46	0.00	0.08	0.42	0.23	0.08	0.42	0.241	Intermediate	265	-1.65
San Antonio Hool, Mérida	0.43	0.00	0.07	0.47	0.21	0.07	0.47	0.240	Intermediate	135	4.76
Mérida, Mérida (AGEB 348-3)	0.14	0.00	0.44	0.36	0.07	0.44	0.36	0.235	Intermediate	523	No data
Umán, Umán (AGEB 032-9)	0.14	0.00	0.40	0.40	0.07	0.40	0.40	0.234	Intermediate	27	No data
San Ignacio, Progreso	0.00	0.67	0.19	0.08	0.33	0.19	0.08	0.234	Intermediate	767	1.13
Kanasín, Kanasín (AGEB 021-0)	0.14	0.00	0.58	0.20	0.07	0.58	0.20	0.228	Intermediate	814	No data
Umán, Umán (AGEB 038-6)	0.14	0.00	0.18	0.59	0.07	0.18	0.59	0.226	Intermediate	68	No data
Mérida, Mérida (AGEB 496-0)	0.14	0.00	0.75	0.00	0.07	0.75	0.00	0.222	Intermediate	28	No data
Sierra Papacal, Mérida	0.38	0.33	0.04	0.13	0.36	0.04	0.13	0.221	Intermediate	986	0.49
San Pedro Chimay, Mérida	0.46	0.00	0.10	0.32	0.23	0.10	0.32	0.220	Intermediate	1 012	1.70
Yaxnic, Mérida	0.46	0.00	0.09	0.31	0.23	0.09	0.31	0.216	Intermediate	703	1.46
Hunxectamán, Mérida	0.46	0.00	0.10	0.30	0.23	0.10	0.30	0.216	Intermediate	104	-6.17
Cheumán, Mérida	0.43	0.00	0.28	0.13	0.21	0.28	0.13	0.207	Intermediate	197	1.05
San José Tzal, Mérida	0.46	0.00	0.15	0.21	0.23	0.15	0.21	0.205	Intermediate	3 092	1.64
Kanasín, Kanasín (AGEB 039-0)	0.14	0.00	0.30	0.38	0.07	0.30	0.38	0.203	Intermediate	172	No data
Ucú, Ucú	0.43	0.00	0.23	0.14	0.21	0.23	0.14	0.199	Intermediate	2 360	2.01
Petac, Mérida	0.46	0.00	0.03	0.31	0.23	0.03	0.31	0.199	Intermediate	183	-0.75
Xmatkuil, Mérida	0.46	0.00	0.11	0.22	0.23	0.11	0.22	0.199	Intermediate	357	1.22
Mérida, Mérida (AGEB 350-0)	0.14	0.00	0.22	0.42	0.07	0.22	0.42	0.196	Intermediate	1 342	No data
Caucel, Mérida	0.43	0.00	0.22	0.13	0.21	0.22	0.13	0.193	Intermediate	6 655	2.03
Tamanché, Mérida	0.23	0.33	0.13	0.08	0.28	0.13	0.08	0.192	Intermediate	555	3.29
Kanasín, Kanasín (AGEB 040-3)	0.14	0.00	0.38	0.25	0.07	0.38	0.25	0.191	Intermediate	141	No data
Mérida, Mérida (AGEB 359-1)	0.14	0.00	0.56	0.06	0.07	0.56	0.06	0.191	Intermediate	77	No data
San Antonio Tzacalá, Mérida	0.46	0.00	0.01	0.29	0.23	0.01	0.29	0.190	Intermediate	618	-0.19
Tahdzibichén, Mérida	0.46	0.00	0.06	0.23	0.23	0.06	0.23	0.189	Intermediate	678	2.14
Suytunchén, Mérida	0.38	0.33	0.00	0.04	0.36	0.00	0.04	0.188	Intermediate	92	-3.16
Yaxcopoil, Umán	0.46	0.00	0.07	0.21	0.23	0.07	0.21	0.188	Intermediate	1 102	1.28
Mérida, Mérida (AGEB 459-A)	0.14	0.00	0.57	0.04	0.07	0.57	0.04	0.187	Intermediate	695	No data
Molas, Mérida	0.46	0.00	0.08	0.20	0.23	0.08	0.20	0.186	Intermediate	1 859	0.91
Dzibilchaltún, Mérida	0.26	0.33	0.11	0.03	0.29	0.11	0.03	0.182	Intermediate	156	-0.25
Poxilá, Umán	0.14	0.00	0.19	0.38	0.07	0.19	0.38	0.179	Intermediate	801	1.76
Mérida, Mérida (AGEB 155-7)	0.14	0.00	0.52	0.05	0.07	0.52	0.05	0.176	Intermediate	512	No data
Tixcuytún, Mérida	0.43	0.00	0.13	0.14	0.21	0.13	0.14	0.175	Intermediate	348	1.19
Dzibikak, Umán	0.14	0.00	0.11	0.45	0.07	0.11	0.45	0.175	Intermediate	1 238	2.98
Conkal, Conkal	0.43	0.00	0.17	0.09	0.21	0.17	0.09	0.171	Intermediate	6 620	1.92
Texán Cámara, Mérida	0.46	0.00	0.02	0.20	0.23	0.02	0.20	0.171	Intermediate	483	2.30
Mérida, Mérida (AGEB 478-2)	0.14	0.00	0.00	0.54	0.07	0.00	0.54	0.170	Intermediate	211	No data
San Antonio Tehuitz, Kanasín	0.46	0.00	0.03	0.18	0.23	0.03	0.18	0.168	Intermediate	732	2.31
Petec Biltún, Umán	0.31	0.00	0.06	0.30	0.15	0.06	0.30	0.167	Intermediate	155	4.23
Kantoyna, Conkal	0.07	0.33	0.04	0.22	0.20	0.04	0.22	0.167	Intermediate	133	-0.30

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Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Dzityá, Mérida	0.43	0.00	0.13	0.11	0.21	0.13	0.11	0.167	Intermediate	1 496	3.86
Dzoyaxché, Mérida	0.14	0.00	0.13	0.40	0.07	0.13	0.40	0.167	Intermediate	412	2.40
Komchén, Mérida	0.07	0.33	0.11	0.13	0.20	0.11	0.13	0.162	Intermediate	3 778	1.35
Taníl, Umán	0.14	0.00	0.13	0.37	0.07	0.13	0.37	0.161	Intermediate	427	1.11
Mérida, Mérida (AGEB 471-0)	0.14	0.00	0.11	0.39	0.07	0.11	0.39	0.159	Intermediate	367	No data
Umán, Umán (AGEB 030-A)	0.14	0.00	0.50	0.00	0.07	0.50	0.00	0.159	Intermediate	59	No data
Xcunyá, Mérida	0.07	0.33	0.11	0.12	0.20	0.11	0.12	0.159	Intermediate	837	2.08
Umán, Umán (AGEB 019-3)	0.14	0.00	0.33	0.16	0.07	0.33	0.16	0.157	Intermediate	2 480	No data
Mérida, Mérida (AGEB 362-3)	0.14	0.00	0.20	0.29	0.07	0.20	0.29	0.156	Intermediate	1 612	No data
Mérida, Mérida (AGEB 363-8)	0.14	0.00	0.15	0.33	0.07	0.15	0.33	0.155	Intermediate	2 735	No data
La Ceiba, Mérida	0.26	0.33	0.03	0.00	0.29	0.03	0.00	0.154	Intermediate	1 023	3.53
Mérida, Mérida (AGEB 401-5)	0.14	0.00	0.28	0.19	0.07	0.28	0.19	0.154	Intermediate	909	No data
Kanasín, Kanasín (AGEB 046-0)	0.14	0.00	0.23	0.25	0.07	0.23	0.25	0.153	Intermediate	1 002	No data
Bolón, Umán	0.14	0.00	0.11	0.34	0.07	0.11	0.34	0.148	Intermediate	1 271	2.69
Mérida, Mérida (AGEB 435-4)	0.14	0.00	0.17	0.29	0.07	0.17	0.29	0.148	Intermediate	279	No data
Cosgaya, Mérida	0.07	0.33	0.07	0.11	0.20	0.07	0.11	0.146	Intermediate	584	1.50
Sac-Nicté, Mérida	0.07	0.33	0.03	0.14	0.20	0.03	0.14	0.145	Intermediate	278	0.96
Xcucul Sur, Umán	0.14	0.00	0.15	0.29	0.07	0.15	0.29	0.144	Intermediate	401	3.17
Cholul, Mérida	0.28	0.00	0.22	0.07	0.14	0.22	0.07	0.144	Intermediate	5 161	3.06
Temozón Norte, Mérida	0.43	0.00	0.07	0.07	0.21	0.07	0.07	0.144	Intermediate	270	1.55
Yaxché de Peón, Ucú	0.43	0.00	0.07	0.08	0.21	0.07	0.08	0.142	Intermediate	691	-0.90
Mérida, Mérida (AGEB 434-A)	0.14	0.00	0.00	0.43	0.07	0.00	0.43	0.142	Intermediate	41	No data
Mérida, Mérida (AGEB 386-9)	0.14	0.00	0.17	0.25	0.07	0.17	0.25	0.141	Intermediate	410	No data
Mérida, Mérida (AGEB 500-9)	0.14	0.00	0.29	0.14	0.07	0.29	0.14	0.141	Intermediate	592	No data
Xcanatún, Mérida	0.43	0.00	0.06	0.07	0.21	0.06	0.07	0.140	Intermediate	1 350	2.54
Kanasín, Kanasín (AGEB 022-5)	0.14	0.00	0.16	0.26	0.07	0.16	0.26	0.140	Intermediate	1 091	No data
Mérida, Mérida (AGEB 383-5)	0.14	0.00	0.06	0.35	0.07	0.06	0.35	0.139	Intermediate	150	No data
Kanasín, Kanasín (AGEB 034-8)	0.14	0.00	0.19	0.22	0.07	0.19	0.22	0.137	Low	454	No data
Susulá, Mérida	0.14	0.00	0.14	0.26	0.07	0.14	0.26	0.135	Low	447	2.66
Umán, Umán (AGEB 031-4)	0.14	0.00	0.34	0.07	0.07	0.34	0.07	0.135	Low	436	No data
Leona Vicario, Mérida	0.14	0.00	0.22	0.18	0.07	0.22	0.18	0.134	Low	1 822	4.64
Opichén, Mérida	0.14	0.00	0.15	0.25	0.07	0.15	0.25	0.134	Low	327	17.18
Dzununcán, Mérida	0.14	0.00	0.14	0.26	0.07	0.14	0.26	0.134	Low	1 528	2.15
Mérida, Mérida (AGEB 402-A)	0.14	0.00	0.19	0.20	0.07	0.19	0.20	0.132	Low	1 171	No data
Mérida, Mérida (AGEB 308-9)	0.14	0.00	0.21	0.18	0.07	0.21	0.18	0.131	Low	1 432	No data
Santa María Chí, Mérida	0.14	0.00	0.14	0.24	0.07	0.14	0.24	0.129	Low	328	0.81
Teya, Kanasín	0.31	0.00	0.03	0.17	0.15	0.03	0.17	0.129	Low	554	3.39
Kanasín, Kanasín (AGEB 032-9)	0.14	0.00	0.16	0.22	0.07	0.16	0.22	0.128	Low	1 497	No data
Tixcacal, Mérida	0.14	0.00	0.15	0.23	0.07	0.15	0.23	0.128	Low	765	3.19
Santa Cruz Palomeque, Mérida	0.14	0.00	0.20	0.18	0.07	0.20	0.18	0.127	Low	718	4.84
Mérida, Mérida (AGEB 516-A)	0.14	0.00	0.09	0.28	0.07	0.09	0.28	0.126	Low	2 016	No data
Kanasín, Kanasín (AGEB 026-3)	0.14	0.00	0.15	0.21	0.07	0.15	0.21	0.125	Low	1 579	No data

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Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 224-A)	0.14	0.00	0.16	0.20	0.07	0.16	0.20	0.124	Low	1 787	No data
San Antonio Chum, Umán	0.14	0.00	0.14	0.22	0.07	0.14	0.22	0.124	Low	866	2.22
Umán, Umán (AGEB 018-9)	0.14	0.00	0.22	0.13	0.07	0.22	0.13	0.123	Low	3 758	No data
Mérida, Mérida (AGEB 429-9)	0.14	0.00	0.15	0.19	0.07	0.15	0.19	0.121	Low	112	No data
Oxcum, Umán	0.14	0.00	0.08	0.27	0.07	0.08	0.27	0.120	Low	1 049	1.12
Kanasín, Kanasín (AGEB 024-4)	0.14	0.00	0.12	0.22	0.07	0.12	0.22	0.118	Low	1 068	No data
Kanasín, Kanasín (AGEB 031-4)	0.14	0.00	0.11	0.22	0.07	0.11	0.22	0.118	Low	1 042	No data
Kanasín, Kanasín (AGEB 047-5)	0.14	0.00	0.14	0.19	0.07	0.14	0.19	0.117	Low	1 424	No data
Oxholón, Umán	0.14	0.00	0.03	0.29	0.07	0.03	0.29	0.114	Low	797	0.77
Mérida, Mérida (AGEB 400-0)	0.14	0.00	0.11	0.20	0.07	0.11	0.20	0.111	Low	2 322	No data
Ticimul, Umán	0.14	0.00	0.05	0.26	0.07	0.05	0.26	0.110	Low	783	3.38
Chalmuch, Mérida	0.14	0.00	0.10	0.20	0.07	0.10	0.20	0.109	Low	454	3.57
Mérida, Mérida (AGEB 366-1)	0.14	0.00	0.21	0.09	0.07	0.21	0.09	0.109	Low	602	No data
Mérida, Mérida (AGEB 361-9)	0.14	0.00	0.07	0.23	0.07	0.07	0.23	0.107	Low	2 415	No data
Mérida, Mérida (AGEB 344-5)	0.14	0.00	0.06	0.23	0.07	0.06	0.23	0.107	Low	864	No data
Mérida, Mérida (AGEB 460-2)	0.14	0.00	0.29	0.00	0.07	0.29	0.00	0.107	Low	362	No data
Mérida, Mérida (AGEB 472-5)	0.14	0.00	0.08	0.21	0.07	0.08	0.21	0.106	Low	2 567	No data
Mérida, Mérida (AGEB 307-4)	0.14	0.00	0.10	0.18	0.07	0.10	0.18	0.105	Low	1 749	No data
Chablekal, Mérida	0.26	0.00	0.11	0.05	0.13	0.11	0.05	0.105	Low	3 165	2.60
Mérida, Mérida (AGEB 504-7)	0.14	0.00	0.09	0.18	0.07	0.09	0.18	0.103	Low	1 157	No data
Xtepén, Umán	0.14	0.00	0.09	0.18	0.07	0.09	0.18	0.102	Low	485	-0.88
Oncán, Mérida	0.14	0.00	0.11	0.16	0.07	0.11	0.16	0.101	Low	606	0.17
Mérida, Mérida (AGEB 311-0)	0.14	0.00	0.06	0.20	0.07	0.06	0.20	0.100	Low	2 588	No data
Kanasín, Kanasín (AGEB 023-A)	0.14	0.00	0.13	0.13	0.07	0.13	0.13	0.099	Low	1 435	No data
Mérida, Mérida (AGEB 329-0)	0.14	0.00	0.10	0.16	0.07	0.10	0.16	0.099	Low	2 645	No data
Mérida, Mérida (AGEB 515-5)	0.14	0.00	0.07	0.19	0.07	0.07	0.19	0.098	Low	2 811	No data
Kanasín, Kanasín (AGEB 025-9)	0.14	0.00	0.09	0.16	0.07	0.09	0.16	0.097	Low	1 249	No data
Mérida, Mérida (AGEB 499-4)	0.14	0.00	0.18	0.07	0.07	0.18	0.07	0.096	Low	643	No data
X-Cuyum, Conkal	0.14	0.00	0.05	0.19	0.07	0.05	0.19	0.094	Low	1 490	2.19
Tebec, Umán	0.14	0.00	0.03	0.20	0.07	0.03	0.20	0.091	Low	459	1.99
Mérida, Mérida (AGEB 396-2)	0.14	0.00	0.13	0.10	0.07	0.13	0.10	0.091	Low	738	No data
Mérida, Mérida (AGEB 312-5)	0.14	0.00	0.07	0.15	0.07	0.07	0.15	0.091	Low	2 405	No data
Kanasín, Kanasín (AGEB 027-8)	0.14	0.00	0.02	0.20	0.07	0.02	0.20	0.090	Low	4 069	No data
Mérida, Mérida (AGEB 358-7)	0.14	0.00	0.00	0.22	0.07	0.00	0.22	0.090	Low	42	No data
Kanasín, Kanasín (AGEB 037-1)	0.14	0.00	0.10	0.11	0.07	0.10	0.11	0.088	Low	1 023	No data
Kanasín, Kanasín (AGEB 007-0)	0.14	0.00	0.08	0.14	0.07	0.08	0.14	0.088	Low	1 974	No data
Kanasín, Kanasín (AGEB 036-7)	0.14	0.00	0.11	0.10	0.07	0.11	0.10	0.087	Low	1 376	No data
Mérida, Mérida (AGEB 324-8)	0.14	0.00	0.09	0.11	0.07	0.09	0.11	0.086	Low	2 489	No data
Mérida, Mérida (AGEB 468-9)	0.14	0.00	0.09	0.12	0.07	0.09	0.12	0.085	Low	2 079	No data
Mérida, Mérida (AGEB 154-2)	0.14	0.00	0.19	0.01	0.07	0.19	0.01	0.085	Low	989	No data
Mérida, Mérida (AGEB 199-A)	0.14	0.00	0.12	0.08	0.07	0.12	0.08	0.085	Low	752	No data
Yaxché Casares, Mérida	0.14	0.00	0.00	0.20	0.07	0.00	0.20	0.084	Low	50	-8.97

Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	*EXP*	*SEN*	*ADC*	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 151-9)	0.14	0.00	0.12	0.08	0.07	0.12	0.08	0.084	Low	2 255	No data
Mérida, Umán	0.14	0.00	0.12	0.08	0.07	0.12	0.08	0.084	Low	8 865	2.16
Mérida, Mérida (AGEB 157-6)	0.14	0.00	0.18	0.02	0.07	0.18	0.02	0.084	Low	1 190	No data
Hunxectamán, Umán	0.14	0.00	0.05	0.15	0.07	0.05	0.15	0.083	Low	250	-0.08
Mérida, Mérida (AGEB 353-4)	0.14	0.00	0.05	0.14	0.07	0.05	0.14	0.082	Low	1 846	No data
Mérida, Mérida (AGEB 469-3)	0.14	0.00	0.06	0.13	0.07	0.06	0.13	0.082	Low	1 807	No data
Umán, Umán (AGEB 034-8)	0.14	0.00	0.07	0.11	0.07	0.07	0.11	0.081	Low	2 827	No data
Mérida, Mérida (AGEB 334-1)	0.14	0.00	0.07	0.11	0.07	0.07	0.11	0.081	Low	1 081	No data
Mérida, Mérida (AGEB 340-7)	0.14	0.00	0.06	0.13	0.07	0.06	0.13	0.081	Low	1 110	No data
Mérida, Mérida (AGEB 321-4)	0.14	0.00	0.02	0.16	0.07	0.02	0.16	0.080	Low	1 316	No data
Mérida, Mérida (AGEB 275-2)	0.14	0.00	0.04	0.14	0.07	0.04	0.14	0.079	Low	1 824	No data
Mérida, Mérida (AGEB 367-6)	0.14	0.00	0.15	0.02	0.07	0.15	0.02	0.079	Low	534	No data
Mérida, Mérida (AGEB 479-7)	0.14	0.00	0.06	0.12	0.07	0.06	0.12	0.079	Low	71	No data
Mérida, Mérida (AGEB 184-3)	0.14	0.00	0.07	0.11	0.07	0.07	0.11	0.078	Low	5 737	No data
Mérida, Mérida (AGEB 416-1)	0.14	0.00	0.05	0.12	0.07	0.05	0.12	0.077	Low	1 744	No data
Kanasín, Kanasín (AGEB 016-A)	0.14	0.00	0.03	0.14	0.07	0.03	0.14	0.076	Low	6 847	No data
Mérida, Mérida (AGEB 245-1)	0.14	0.00	0.07	0.09	0.07	0.07	0.09	0.075	Low	1 130	No data
Mérida, Mérida (AGEB 298-3)	0.14	0.00	0.07	0.09	0.07	0.07	0.09	0.074	Low	2 485	No data
Mérida, Mérida (AGEB 229-2)	0.14	0.00	0.07	0.09	0.07	0.07	0.09	0.074	Low	1 666	No data
Mérida, Mérida (AGEB 305-5)	0.14	0.00	0.08	0.08	0.07	0.08	0.08	0.073	Low	2 213	No data
Mérida, Mérida (AGEB 512-1)	0.14	0.00	0.06	0.10	0.07	0.06	0.10	0.073	Low	1 977	No data
Mérida, Mérida (AGEB 365-7)	0.14	0.00	0.04	0.11	0.07	0.04	0.11	0.073	Low	842	No data
Mérida, Mérida (AGEB 398-1)	0.14	0.00	0.08	0.07	0.07	0.08	0.07	0.073	Low	1 131	No data
Mérida, Mérida (AGEB 503-2)	0.14	0.00	0.04	0.11	0.07	0.04	0.11	0.072	Low	1 736	No data
Mérida, Mérida (AGEB 320-A)	0.14	0.00	0.06	0.09	0.07	0.06	0.09	0.072	Low	1 322	No data
Mérida, Mérida (AGEB 473-A)	0.14	0.00	0.05	0.10	0.07	0.05	0.10	0.072	Low	1 835	No data
Kanasín, Kanasín (AGEB 028-2)	0.14	0.00	0.01	0.14	0.07	0.01	0.14	0.072	Low	3 292	No data
Sitpach, Mérida	0.14	0.00	0.07	0.08	0.07	0.07	0.08	0.071	Low	1 502	2.60
Mérida, Mérida (AGEB 185-8)	0.14	0.00	0.06	0.08	0.07	0.06	0.08	0.071	Low	3 680	No data
Mérida, Mérida (AGEB 328-6)	0.14	0.00	0.07	0.08	0.07	0.07	0.08	0.070	Low	2 777	No data
Kanasín, Kanasín (AGEB 009-A)	0.14	0.00	0.05	0.10	0.07	0.05	0.10	0.070	Low	3 797	No data
Mérida, Mérida (AGEB 270-A)	0.14	0.00	0.06	0.08	0.07	0.06	0.08	0.070	Low	1 633	No data
Umán, Umán (AGEB 033-3)	0.14	0.00	0.04	0.10	0.07	0.04	0.10	0.069	Low	3 142	No data
Mérida, Mérida (AGEB 276-7)	0.14	0.00	0.02	0.12	0.07	0.02	0.12	0.069	Low	1 899	No data
Umán, Umán (AGEB 020-6)	0.14	0.00	0.05	0.09	0.07	0.05	0.09	0.069	Low	4 638	No data
Mérida, Mérida (AGEB 339-4)	0.14	0.00	0.03	0.10	0.07	0.03	0.10	0.068	Low	1 608	No data
Mérida, Mérida (AGEB 078-A)	0.14	0.00	0.06	0.07	0.07	0.06	0.07	0.067	Low	649	No data
Mérida, Mérida (AGEB 281-8)	0.14	0.00	0.02	0.10	0.07	0.02	0.10	0.066	Low	2 675	No data
Mérida, Mérida (AGEB 369-5)	0.14	0.00	0.03	0.09	0.07	0.03	0.09	0.066	Low	1 095	No data
Mérida, Mérida (AGEB 208-0)	0.14	0.00	0.05	0.08	0.07	0.05	0.08	0.065	Low	1 693	No data
Mérida, Mérida (AGEB 464-0)	0.14	0.00	0.09	0.03	0.07	0.09	0.03	0.065	Low	1 438	No data
Umán, Umán (AGEB 016-A)	0.14	0.00	0.05	0.07	0.07	0.05	0.07	0.065	Low	3 762	No data

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Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 250-2)	0.14	0.00	0.12	0.00	0.07	0.12	0.00	0.065	Low	1 306	No data
Mérida, Mérida (AGEB 511-7)	0.14	0.00	0.06	0.06	0.07	0.06	0.06	0.065	Low	1 539	No data
Mérida, Mérida (AGEB 282-2)	0.14	0.00	0.03	0.09	0.07	0.03	0.09	0.064	Low	2 112	No data
Kanasín, Kanasín (AGEB 012-1)	0.14	0.00	0.06	0.06	0.07	0.06	0.06	0.064	Low	3 274	No data
Mérida, Mérida (AGEB 404-9)	0.14	0.00	0.04	0.07	0.07	0.04	0.07	0.062	Low	3 198	No data
Mérida, Mérida (AGEB 182-4)	0.14	0.00	0.04	0.07	0.07	0.04	0.07	0.062	Low	3 530	No data
Mérida, Mérida (AGEB 283-7)	0.14	0.00	0.05	0.06	0.07	0.05	0.06	0.062	Low	1 077	No data
Mérida, Mérida (AGEB 163-1)	0.14	0.00	0.03	0.07	0.07	0.03	0.07	0.061	Low	2 913	No data
Umán, Umán (AGEB 021-0)	0.14	0.00	0.05	0.05	0.07	0.05	0.05	0.061	Low	2 911	No data
Mérida, Mérida (AGEB 323-3)	0.14	0.00	0.03	0.07	0.07	0.03	0.07	0.060	Low	2 368	No data
Mérida, Mérida (AGEB 420-8)	0.14	0.00	0.04	0.06	0.07	0.04	0.06	0.060	Low	3 416	No data
Mérida, Mérida (AGEB 267-8)	0.14	0.00	0.04	0.07	0.07	0.04	0.07	0.060	Low	2 788	No data
Mérida, Mérida (AGEB 246-6)	0.14	0.00	0.03	0.07	0.07	0.03	0.07	0.060	Low	3 137	No data
Mérida, Mérida (AGEB 501-3)	0.14	0.00	0.05	0.05	0.07	0.05	0.05	0.059	Low	1 529	No data
Mérida, Mérida (AGEB 269-7)	0.14	0.00	0.05	0.05	0.07	0.05	0.05	0.059	Low	1 134	No data
Mérida, Mérida (AGEB 448-1)	0.14	0.00	0.05	0.05	0.07	0.05	0.05	0.059	Low	2 671	No data
Mérida, Mérida (AGEB 181-A)	0.14	0.00	0.03	0.06	0.07	0.03	0.06	0.058	Low	2 882	No data
Mérida, Mérida (AGEB 166-5)	0.14	0.00	0.02	0.07	0.07	0.02	0.07	0.058	Low	1 173	No data
Mérida, Mérida (AGEB 284-1)	0.14	0.00	0.03	0.07	0.07	0.03	0.07	0.058	Low	1 614	No data
Kanasín, Kanasín (AGEB 013-6)	0.14	0.00	0.02	0.07	0.07	0.02	0.07	0.057	Low	3 684	No data
Mérida, Mérida (AGEB 268-2)	0.14	0.00	0.03	0.06	0.07	0.03	0.06	0.057	Low	2 182	No data
Mérida, Mérida (AGEB 255-5)	0.14	0.00	0.03	0.06	0.07	0.03	0.06	0.057	Low	2 507	No data
Mérida, Mérida (AGEB 314-4)	0.14	0.00	0.03	0.06	0.07	0.03	0.06	0.056	Low	3 146	No data
Mérida, Mérida (AGEB 220-1)	0.14	0.00	0.05	0.04	0.07	0.05	0.04	0.056	Low	2 047	No data
Mérida, Mérida (AGEB 417-6)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.056	Low	1 969	No data
Mérida, Mérida (AGEB 413-8)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.056	Low	2 886	No data
Mérida, Mérida (AGEB 288-A)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.056	Low	3 141	No data
Mérida, Mérida (AGEB 467-4)	0.14	0.00	0.08	0.00	0.07	0.08	0.00	0.055	Low	48	No data
Mérida, Mérida (AGEB 082-6)	0.14	0.00	0.03	0.05	0.07	0.03	0.05	0.055	Low	4 068	No data
Mérida, Mérida (AGEB 295-A)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.055	Low	4 473	No data
Kanasín, Kanasín (AGEB 015-5)	0.14	0.00	0.04	0.04	0.07	0.04	0.04	0.055	Low	1 557	No data
Mérida, Mérida (AGEB 425-0)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.055	Low	2 885	No data
Mérida, Mérida (AGEB 296-4)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.054	Low	2 021	No data
Mérida, Mérida (AGEB 165-0)	0.14	0.00	0.01	0.07	0.07	0.01	0.07	0.054	Low	1 466	No data
Mérida, Mérida (AGEB 450-9)	0.14	0.00	0.03	0.05	0.07	0.03	0.05	0.054	Low	1 189	No data
Mérida, Mérida (AGEB 263-A)	0.14	0.00	0.03	0.05	0.07	0.03	0.05	0.054	Low	3 548	No data
Kanasín, Kanasín (AGEB 029-7)	0.14	0.00	0.00	0.08	0.07	0.00	0.08	0.054	Low	314	No data
Kanasín, Kanasín (AGEB 043-7)	0.14	0.00	0.06	0.02	0.07	0.06	0.02	0.053	Low	222	No data
Mérida, Mérida (AGEB 059-7)	0.14	0.00	0.02	0.06	0.07	0.02	0.06	0.053	Low	3 027	No data
Kanasín, Kanasín (AGEB 008-5)	0.14	0.00	0.06	0.01	0.07	0.06	0.01	0.053	Low	2 836	No data
Mérida, Mérida (AGEB 394-3)	0.14	0.00	0.00	0.07	0.07	0.00	0.07	0.053	Low	2 753	No data
Mérida, Mérida (AGEB 313-A)	0.14	0.00	0.02	0.05	0.07	0.02	0.05	0.052	Low	2 913	No data

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Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	*EXP*	*SEN*	*ADC*	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 306-A)	0.14	0.00	0.02	0.05	0.07	0.02	0.05	0.052	Low	3 350	No data
Mérida, Mérida (AGEB 039-A)	0.14	0.00	0.03	0.04	0.07	0.03	0.04	0.052	Low	3 381	No data
Mérida, Mérida (AGEB 315-9)	0.14	0.00	0.01	0.06	0.07	0.01	0.06	0.052	Low	3 959	No data
Kanasín, Kanasín (AGEB 018-9)	0.14	0.00	0.02	0.05	0.07	0.02	0.05	0.051	Low	1 427	No data
Mérida, Mérida (AGEB 247-0)	0.14	0.00	0.03	0.04	0.07	0.03	0.04	0.051	Low	1 829	No data
Mérida, Mérida (AGEB 461-7)	0.14	0.00	0.06	0.01	0.07	0.06	0.01	0.051	Low	1 092	No data
Mérida, Mérida (AGEB 006-5)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.051	Low	5 771	No data
Mérida, Mérida (AGEB 273-3)	0.14	0.00	0.04	0.03	0.07	0.04	0.03	0.051	Low	2 425	No data
Mérida, Mérida (AGEB 336-0)	0.14	0.00	0.02	0.05	0.07	0.02	0.05	0.051	Low	2 395	No data
Mérida, Mérida (AGEB 285-6)	0.14	0.00	0.01	0.06	0.07	0.01	0.06	0.051	Low	1 261	No data
Mérida, Mérida (AGEB 462-1)	0.14	0.00	0.04	0.02	0.07	0.04	0.02	0.050	Low	1 033	No data
Mérida, Mérida (AGEB 073-7)	0.14	0.00	0.01	0.05	0.07	0.01	0.05	0.050	Low	3 625	No data
Mérida, Mérida (AGEB 335-6)	0.14	0.00	0.04	0.02	0.07	0.04	0.02	0.050	Low	1 927	No data
Mérida, Mérida (AGEB 041-7)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.049	Low	3 303	No data
Mérida, Mérida (AGEB 225-4)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.049	Low	2 092	No data
Mérida, Mérida (AGEB 421-2)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.049	Low	2 653	No data
Mérida, Mérida (AGEB 412-3)	0.14	0.00	0.01	0.05	0.07	0.01	0.05	0.049	Low	2 629	No data
Mérida, Mérida (AGEB 525-9)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.049	Low	1 229	No data
Mérida, Mérida (AGEB 533-3)	0.14	0.00	0.04	0.02	0.07	0.04	0.02	0.049	Low	2 578	No data
Mérida, Mérida (AGEB 076-0)	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.049	Low	3 853	No data
Mérida, Mérida (AGEB 338-A)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.049	Low	2 671	No data
Mérida, Mérida (AGEB 456-6)	0.14	0.00	0.04	0.02	0.07	0.04	0.02	0.048	Low	2 361	No data
Mérida, Mérida (AGEB 050-6)	0.14	0.00	0.01	0.05	0.07	0.01	0.05	0.048	Low	1 117	No data
Mérida, Mérida (AGEB 403-4)	0.14	0.00	0.01	0.05	0.07	0.01	0.05	0.048	Low	4 318	No data
Mérida, Mérida (AGEB 466-A)	0.14	0.00	0.03	0.03	0.07	0.03	0.03	0.048	Low	2 758	No data
Mérida, Mérida (AGEB 074-1)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.048	Low	3 549	No data
Mérida, Mérida (AGEB 066-7)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.048	Low	4 205	No data
Mérida, Mérida (AGEB 297-9)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.048	Low	2 753	No data
Mérida, Mérida (AGEB 080-7)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.048	Low	4 712	No data
Mérida, Mérida (AGEB 532-9)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.048	Low	2 546	No data
Mérida, Mérida (AGEB 040-2)	0.14	0.00	0.02	0.04	0.07	0.02	0.04	0.048	Low	2 571	No data
Mérida, Mérida (AGEB 540-3)	0.14	0.00	0.05	0.00	0.07	0.05	0.00	0.047	Low	821	No data
Mérida, Mérida (AGEB 152-3)	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.047	Low	1 675	No data
Mérida, Mérida (AGEB 505-1)	0.14	0.00	0.05	0.00	0.07	0.05	0.00	0.047	Low	496	No data
Mérida, Mérida (AGEB 294-5)	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.047	Low	2 515	No data
Mérida, Mérida (AGEB 071-8)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.047	Low	5 166	No data
Mérida, Mérida (AGEB 148-7)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.047	Low	2 464	No data
Itzincab, Umán	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.046	Low	4 744	0.11
Mérida, Mérida (AGEB 483-3)	0.14	0.00	0.03	0.02	0.07	0.03	0.02	0.046	Low	1 404	No data
Mérida, Mérida (AGEB 534-8)	0.14	0.00	0.03	0.02	0.07	0.03	0.02	0.046	Low	2 299	No data
Mérida, Mérida (AGEB 260-6)	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.045	Low	1 712	No data
Mérida, Mérida (AGEB 177-3)	0.14	0.00	0.01	0.04	0.07	0.01	0.04	0.045	Low	2 931	No data

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Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 191-3)	0.14	0.00	0.03	0.01	0.07	0.03	0.01	0.045	Low	2 244	No data
Mérida, Mérida (AGEB 518-9)	0.14	0.00	0.03	0.02	0.07	0.03	0.02	0.045	Low	1 234	No data
Mérida, Mérida (AGEB 060-A)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.045	Low	7 201	No data
Mérida, Mérida (AGEB 299-8)	0.14	0.00	0.02	0.03	0.07	0.02	0.03	0.045	Low	2 653	No data
Mérida, Mérida (AGEB 156-1)	0.14	0.00	0.03	0.01	0.07	0.03	0.01	0.045	Low	1 332	No data
Mérida, Mérida (AGEB 286-0)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.044	Low	2 239	No data
Mérida, Mérida (AGEB 327-1)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.044	Low	2 947	No data
Mérida, Mérida (AGEB 316-3)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.044	Low	2 635	No data
Mérida, Mérida (AGEB 271-4)	0.14	0.00	0.02	0.02	0.07	0.02	0.02	0.044	Low	1 780	No data
Mérida, Mérida (AGEB 264-4)	0.14	0.00	0.02	0.02	0.07	0.02	0.02	0.044	Low	2 520	No data
Mérida, Mérida (AGEB 012-0)	0.14	0.00	0.02	0.02	0.07	0.02	0.02	0.044	Low	1 806	No data
Mérida, Mérida (AGEB 266-3)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.044	Low	2 882	No data
Mérida, Mérida (AGEB 484-8)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.044	Low	1 133	No data
Mérida, Mérida (AGEB 068-6)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.044	Low	3 099	No data
Mérida, Mérida (AGEB 489-0)	0.14	0.00	0.00	0.04	0.07	0.00	0.04	0.043	Low	561	No data
Kanasín, Kanasín (AGEB 014-0)	0.14	0.00	0.00	0.03	0.07	0.00	0.03	0.043	Low	1 440	No data
Mérida, Mérida (AGEB 242-8)	0.14	0.00	0.02	0.02	0.07	0.02	0.02	0.043	Low	1 843	No data
Mérida, Mérida (AGEB 300-2)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.043	Low	1 536	No data
Mérida, Mérida (AGEB 287-5)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.043	Low	2 569	No data
Mérida, Mérida (AGEB 385-4)	0.14	0.00	0.00	0.03	0.07	0.00	0.03	0.043	Low	2 785	No data
Mérida, Mérida (AGEB 048-9)	0.14	0.00	0.01	0.03	0.07	0.01	0.03	0.043	Low	3 464	No data
Mérida, Mérida (AGEB 399-6)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.043	Low	1 299	No data
Mérida, Mérida (AGEB 221-6)	0.14	0.00	0.02	0.01	0.07	0.02	0.01	0.043	Low	4 120	No data
Mérida, Mérida (AGEB 075-6)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	2 755	No data
Mérida, Mérida (AGEB 530-A)	0.14	0.00	0.00	0.03	0.07	0.00	0.03	0.042	Low	2 745	No data
Mérida, Mérida (AGEB 508-5)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	2 157	No data
Mérida, Mérida (AGEB 067-1)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	4 447	No data
Mérida, Mérida (AGEB 507-0)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	2 075	No data
Mérida, Mérida (AGEB 160-8)	0.14	0.00	0.02	0.01	0.07	0.02	0.01	0.042	Low	1 714	No data
Mérida, Mérida (AGEB 134-5)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	2 518	No data
Mérida, Mérida (AGEB 502-8)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	2 416	No data
Mérida, Mérida (AGEB 241-3)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	3 093	No data
Mérida, Mérida (AGEB 303-6)	0.14	0.00	0.02	0.01	0.07	0.02	0.01	0.042	Low	1 182	No data
Mérida, Mérida (AGEB 529-7)	0.14	0.00	0.02	0.01	0.07	0.02	0.01	0.042	Low	1 651	No data
Mérida, Mérida (AGEB 065-2)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.042	Low	3 568	No data
Mérida, Mérida (AGEB 042-1)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	3 375	No data
Mérida, Mérida (AGEB 178-8)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	2 761	No data
Mérida, Mérida (AGEB 030-9)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	2 680	No data
Mérida, Mérida (AGEB 063-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.041	Low	4 766	No data
Mérida, Mérida (AGEB 293-0)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	2 156	No data
Mérida, Mérida (AGEB 531-4)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	2 437	No data
Mérida, Mérida (AGEB 291-1)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.041	Low	2 810	No data

Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	*EXP*	*SEN*	*ADC*	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 455-1)	0.14	0.00	0.00	0.03	0.07	0.00	0.03	0.041	Low	1 504	No data
Mérida, Mérida (AGEB 026-2)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.041	Low	3 538	No data
Mérida, Mérida (AGEB 526-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.041	Low	1 686	No data
Mérida, Mérida (AGEB 524-4)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.040	Low	1 097	No data
Mérida, Mérida (AGEB 036-6)	0.14	0.00	0.01	0.02	0.07	0.01	0.02	0.040	Low	3 005	No data
Mérida, Mérida (AGEB 521-0)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.040	Low	1 104	No data
Mérida, Mérida (AGEB 470-6)	0.14	0.00	0.00	0.02	0.07	0.00	0.02	0.040	Low	2 503	No data
Mérida, Mérida (AGEB 272-9)	0.14	0.00	0.00	0.02	0.07	0.00	0.02	0.040	Low	1 397	No data
Mérida, Mérida (AGEB 426-5)	0.14	0.00	0.02	0.00	0.07	0.02	0.00	0.040	Low	367	No data
Mérida, Mérida (AGEB 289-4)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.040	Low	4 544	No data
Mérida, Mérida (AGEB 244-7)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.040	Low	2 206	No data
Mérida, Mérida (AGEB 527-8)	0.14	0.00	0.00	0.02	0.07	0.00	0.02	0.039	Low	1 707	No data
Mérida, Mérida (AGEB 254-0)	0.14	0.00	0.02	0.00	0.07	0.02	0.00	0.039	Low	1 640	No data
Mérida, Mérida (AGEB 280-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	2 357	No data
Mérida, Mérida (AGEB 226-9)	0.14	0.00	0.00	0.02	0.07	0.00	0.02	0.039	Low	3 225	No data
Mérida, Mérida (AGEB 062-9)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	2 760	No data
Mérida, Mérida (AGEB 318-2)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	2 750	No data
Mérida, Mérida (AGEB 406-8)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	1 226	No data
Mérida, Mérida (AGEB 031-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	2 893	No data
Mérida, Mérida (AGEB 258-9)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.039	Low	1 324	No data
Mérida, Mérida (AGEB 351-5)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	1 314	No data
Mérida, Mérida (AGEB 061-4)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	3 749	No data
Mérida, Mérida (AGEB 032-8)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	1 820	No data
Mérida, Mérida (AGEB 033-2)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.039	Low	3 476	No data
Mérida, Mérida (AGEB 522-5)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	1 592	No data
Mérida, Mérida (AGEB 049-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.039	Low	3 773	No data
Mérida, Mérida (AGEB 379-9)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 153	No data
Mérida, Mérida (AGEB 064-8)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.038	Low	3 443	No data
Mérida, Mérida (AGEB 261-0)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 058	No data
Mérida, Mérida (AGEB 054-4)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 869	No data
Mérida, Mérida (AGEB 304-0)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.038	Low	2 275	No data
Mérida, Mérida (AGEB 053-A)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.038	Low	4 744	No data
Mérida, Mérida (AGEB 259-3)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 328	No data
Mérida, Mérida (AGEB 034-7)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	3 514	No data
Mérida, Mérida (AGEB 021-A)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.038	Low	1 901	No data
Mérida, Mérida (AGEB 397-7)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	5 539	No data
Mérida, Mérida (AGEB 410-4)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 151	No data
Mérida, Mérida (AGEB 265-9)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	3 858	No data
Mérida, Mérida (AGEB 326-7)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	4 237	No data
Mérida, Mérida (AGEB 052-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	2 088	No data
Mérida, Mérida (AGEB 523-A)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	1 524	No data
Mérida, Mérida (AGEB 408-7)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.038	Low	1 371	No data

Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	EXP	SEN	ADC	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 274-8)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.037	Low	2 181	No data
Mérida, Mérida (AGEB 248-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	1 028	No data
Mérida, Mérida (AGEB 419-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	1 900	No data
Mérida, Mérida (AGEB 150-4)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.037	Low	1 673	No data
Mérida, Mérida (AGEB 488-6)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	1 098	No data
Mérida, Mérida (AGEB 528-2)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	1 780	No data
Mérida, Mérida (AGEB 169-9)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.037	Low	1 669	No data
Mérida, Mérida (AGEB 481-4)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	2 228	No data
Mérida, Mérida (AGEB 180-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	4 059	No data
Mérida, Mérida (AGEB 145-3)	0.14	0.00	0.01	0.01	0.07	0.01	0.01	0.037	Low	937	No data
Mérida, Mérida (AGEB 051-0)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	323	No data
Mérida, Mérida (AGEB 411-9)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	2 230	No data
Mérida, Mérida (AGEB 235-8)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.037	Low	408	No data
Mérida, Mérida (AGEB 044-0)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.037	Low	1 122	No data
Mérida, Mérida (AGEB 028-1)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.037	Low	1 250	No data
Mérida, Mérida (AGEB 393-9)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.037	Low	2 129	No data
Mérida, Mérida (AGEB 409-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.037	Low	766	No data
Mérida, Mérida (AGEB 309-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.037	Low	3 229	No data
Mérida, Mérida (AGEB 509-A)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	1 986	No data
Mérida, Mérida (AGEB 514-0)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	2 985	No data
Mérida, Mérida (AGEB 251-7)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	1 225	No data
Mérida, Mérida (AGEB 278-6)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	3 825	No data
Mérida, Mérida (AGEB 452-8)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	483	No data
Umán, Umán (AGEB 022-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	2 403	No data
Mérida, Mérida (AGEB 454-7)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	561	No data
Mérida, Mérida (AGEB 238-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 064	No data
Mérida, Mérida (AGEB 506-6)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	597	No data
Mérida, Mérida (AGEB 257-4)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	784	No data
Mérida, Mérida (AGEB 354-9)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	668	No data
Mérida, Mérida (AGEB 449-6)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	2 971	No data
Mérida, Mérida (AGEB 482-9)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	2 796	No data
Mérida, Mérida (AGEB 262-5)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	1 298	No data
Mérida, Mérida (AGEB 407-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 565	No data
Mérida, Mérida (AGEB 290-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	5 919	No data
Mérida, Mérida (AGEB 378-4)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	4 219	No data
Mérida, Mérida (AGEB 375-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	3 000	No data
Mérida, Mérida (AGEB 380-1)	0.14	0.00	0.00	0.01	0.07	0.00	0.01	0.036	Low	2 916	No data
Mérida, Mérida (AGEB 370-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 432	No data
Mérida, Mérida (AGEB 384-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	2 856	No data
Mérida, Mérida (AGEB 018-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 940	No data
Mérida, Mérida (AGEB 252-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	3 244	No data
Mérida, Mérida (AGEB 045-5)	0.14	0.00	0.01	0.00	0.07	0.01	0.00	0.036	Low	704	No data

Appendix A

Continues

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	*EXP*	*SEN*	*ADC*	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 319-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 429	No data
Umán, Umán (AGEB 023-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	2 599	No data
Mérida, Mérida (AGEB 463-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	2 242	No data
Mérida, Mérida (AGEB 486-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 349	No data
Mérida, Mérida (AGEB 330-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	4 993	No data
Mérida, Mérida (AGEB 146-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 870	No data
Mérida, Mérida (AGEB 239-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	1 668	No data
Mérida, Mérida (AGEB 377-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.036	Low	4 849	No data
Mérida, Mérida (AGEB 317-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 854	No data
Mérida, Mérida (AGEB 292-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 917	No data
Mérida, Mérida (AGEB 056-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 640	No data
Mérida, Mérida (AGEB 043-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 423	No data
Mérida, Mérida (AGEB 124-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 040	No data
Mérida, Mérida (AGEB 395-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 042	No data
Mérida, Mérida (AGEB 389-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	4 035	No data
Mérida, Mérida (AGEB 510-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 342	No data
Mérida, Mérida (AGEB 232-4)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 038	No data
Mérida, Mérida (AGEB 122-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	4 421	No data
Mérida, Mérida (AGEB 227-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 048	No data
Mérida, Mérida (AGEB 390-5)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 951	No data
Mérida, Mérida (AGEB 343-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 228	No data
Mérida, Mérida (AGEB 231-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 611	No data
Mérida, Mérida (AGEB 357-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 593	No data
Mérida, Mérida (AGEB 029-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 116	No data
Mérida, Mérida (AGEB 121-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 639	No data
Mérida, Mérida (AGEB 431-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 450	No data
Mérida, Mérida (AGEB 422-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 477	No data
Mérida, Mérida (AGEB 371-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 061	No data
Mérida, Mérida (AGEB 233-9)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 869	No data
Mérida, Mérida (AGEB 277-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 422	No data
Mérida, Mérida (AGEB 414-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 847	No data
Mérida, Mérida (AGEB 341-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 589	No data
Mérida, Mérida (AGEB 415-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	1 788	No data
Mérida, Mérida (AGEB 147-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 105	No data
Mérida, Mérida (AGEB 302-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 461	No data
Mérida, Mérida (AGEB 374-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	4 216	No data
Mérida, Mérida (AGEB 457-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 392	No data
Mérida, Mérida (AGEB 301-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 956	No data
Mérida, Mérida (AGEB 418-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 474	No data
Mérida, Mérida (AGEB 223-5)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 820	No data
Mérida, Mérida (AGEB 541-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	2 823	No data
Mérida, Mérida (AGEB 451-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 148	No data

Appendix A

Concludes

Indexed sub-component, principal component and WAVI values for units of analysis in Merida Metropolitan Area

Units of Analysis	$indexR_V$	$index_{SI}$	$index_{WD}$	$index_{UP}$	*EXP*	*SEN*	*ADC*	WAVI	Vulnerability level	At Risk Population (2005)	Growth rate 2000-2005
Mérida, Mérida (AGEB 391-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	4 367	No data
Mérida, Mérida (AGEB 228-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.035	Low	3 972	No data
Kanasín, Kanasín (AGEB 038-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1	No data
Mérida, Mérida (AGEB 016-9)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1 961	No data
Mérida, Mérida (AGEB 022-4)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1 126	No data
Mérida, Mérida (AGEB 168-4)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	983	No data
Mérida, Mérida (AGEB 171-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 708	No data
Mérida, Mérida (AGEB 222-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 370	No data
Mérida, Mérida (AGEB 234-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	348	No data
Mérida, Mérida (AGEB 236-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	544	No data
Mérida, Mérida (AGEB 237-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	485	No data
Mérida, Mérida (AGEB 240-9)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	959	No data
Mérida, Mérida (AGEB 243-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 015	No data
Mérida, Mérida (AGEB 249-A)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1 364	No data
Mérida, Mérida (AGEB 310-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 153	No data
Mérida, Mérida (AGEB 342-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1 978	No data
Mérida, Mérida (AGEB 372-7)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 564	No data
Mérida, Mérida (AGEB 376-5)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 509	No data
Mérida, Mérida (AGEB 423-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 196	No data
Mérida, Mérida (AGEB 430-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	499	No data
Mérida, Mérida (AGEB 432-0)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	331	No data
Mérida, Mérida (AGEB 433-5)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	543	No data
Mérida, Mérida (AGEB 453-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	86	No data
Mérida, Mérida (AGEB 485-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	932	No data
Mérida, Mérida (AGEB 490-3)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	25	No data
Mérida, Mérida (AGEB 491-8)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	141	No data
Mérida, Mérida (AGEB 513-6)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	1 513	No data
Mérida, Mérida (AGEB 517-4)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	2 127	No data
Mérida, Mérida (AGEB 537-1)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	185	No data
Umán, Umán (AGEB 035-2)	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.034	Low	25	No data

Source: Developed by authors.

Abbreviation: WAVI: Water Access Vulnerability Index; $Index_{RV}$: Rainfall, variation indexed sub-component; $index_{SI}$: Saltwater intrusion indexed sub-component; $index_{WD}$: Safe water access deficit indexed sub-component; $index_{UP}$: Urban poverty indexed sub-component; *EXP*: Climate change exposure principal component; *SEN*: Climate change sensitivity principal component; *ADC*: Climate change adaptation capacity principal component; AGEB: Spanish abbreviation for Basic Geostatistic Area. Units of analysis: First name = Location name, Second name (after comma) = Municipality name.