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Agricultura y economía municipal en Michoacán desde una perspectiva de vulnerabilidad

Agriculture and municipality economics in Michoacan from a perspective of vulnerability

Agricultura e economia municipal em Michoacán a partir de uma perspectiva de vulnerabilidade

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Resumen

La agricultura aporta 7 % del PIB en Michoacán, sin embargo, para algunos municipios y regiones constituye una fuente importante de ingresos y los productores agrícolas contribuyen hasta en más del 30 % a la economía municipal. La producción agrícola ante el Cambio Ambiental Global (CAG) enfrenta amenazas de distinta naturaleza (fenómenos hidro-meteorológicos, cambio climático, cambio en las relaciones comerciales, creciente competencia ─regional, nacional, internacional─, inestabilidad de precios y cambio tecnológico). El objetivo del presente fue identificar la vulnerabilidad económico-agrícola a escala municipal, para lo cual se emplearon tres índices: 1) el Índice de Vulnerabilidad de los Productores Agrícolas (IVUPA), 2) el Índice de Especialización Agrícola Relativo (ERM), y el Índice de Concentración Económica Municipal (IHH). Además, se realizaron dos análisis estadísticos: 1) de componentes principales que ayudó a validar la pertinencia del empleo del IVUPA, y 2) de regresión para verificar la relación entre IHH y ERM. Los resultados sugieren una relación positiva entre el ERM y la IHH, que promovería la concentración económica, sumada a la vulnerabilidad de los productores agrícolas. El cruce de

ambos análisis resulta en la identificación de los municipios más vulnerables a las amenazas del CAG. La información puede emplearse como instrumento de política pública para reducir la vulnerabilidad económico-agrícola municipal.

Palabras clave: agricultura, vulnerabilidad, productores agrícolas, economía agrícola, especialización agrícola.

Abstract

Agriculture contributes with 7 % of Michoacán GDP, however in local scale represents an important source of income reaching more than 30% in some municipals economies. In this sense, agricultural production faces several threats of a different nature in the context of the Global Environmental Change, (GEC) [(hydro-meteorological phenomena, climate change, changing trade relations, increasing competition -regional, national, international-, market reduction, price instability and technological change]. The objective of this paper is to identify the vulnerability of economic-agricultural, by means of three indexes; 1) the Vulnerability of Agricultural Producers (VAP), 2) Relative Municipality Agriculture Specialization (RMAS) and Concentration Index (IHH). Two statistical analyzes were done, 1) an analyzes of principal components that helped to validate the feasibility of VAP and, 2) an analyzes of simple linear regression, showed a positive relationship between RMAS and IHH. As a result of linking concentration and VAP, were identified the more vulnerable municipalities of Michoacan at the GEC. This information can be used as an instrument in the design of public policy for reducing the regional and municipal economic-agriculture vulnerability.

Key words: agriculture, vulnerability, agricultural producers, agricultural economy, agricultural especialization.

Resumo

A agricultura contribui com 7% do PIB em Michoacán, no entanto, para alguns municípios e regiões, constitui uma importante fonte de renda e os produtores agrícolas contribuem com mais de 30% para a economia municipal. A produção agrícola em face da Global Environmental Change (CAG) enfrenta ameaças de natureza diferente (fenômenos hidrometeorológicos, mudanças

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climáticas, mudanças nas relações comerciais, aumento da concorrência - regional, nacional, internacional - instabilidade de preços e mudanças tecnológicas). O objetivo do presente estudo foi identificar a vulnerabilidade econômico-agrícola no nível municipal, para a qual foram utilizados três índices: 1) Índice de Vulnerabilidade aos Produtores Agrícolas (IVUPA); 2) Índice de Especialização Agrícola Relativa (MRS); Índice de Concentração Econômica Municipal (IHH). Além disso, foram realizadas duas análises estatísticas: 1) componentes principais que ajudaram a validar a relevância do uso de IVUPA e 2) regressão para verificar a relação entre HHI e MRA. Os resultados sugerem uma relação positiva entre MRE e HHI, o que promoveria a concentração econômica, juntamente com a vulnerabilidade dos produtores agrícolas. O cruzamento de ambas as análises resulta na identificação dos municípios mais vulneráveis às ameaças do CAG. A informação pode ser usada como instrumento de política pública para reduzir a vulnerabilidade econômico-agrícola municipal.

Palavras-chave: agricultura, vulnerabilidade, produtores agrícolas, economia agrícola, especialização agrícola.

Clasificación JEL: D11, Q26, Q01 y Q57.

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Introduction

Global Environmental Change (CAG) is the synergistic sum of the most common planetary problems. It is contextualized within the framework of global problems and is conceived as a product of actions taken by individuals, families, organizations, companies and governments at different scales: national, state or municipal (Ostrom, 2010). It is also understood as the result of the general interaction between the different elements that have had implications for food security, the provision of ecosystem services and social welfare (Ericksen, 2008). The CAG has had

implications in the different socio-political and economic sectors, in the alimentary systems, reason why the rural production has experienced an acceleration of processes, interactions and paradigms. This situation has led regional economies linked to the rural sector to face challenges such as climate change, changes in trade and production policies, changes in consumption patterns and price instability. The current scenario points to an intensification of the CAG, so that threats to agricultural producers and regional economies will continue and can be increasingly strong.

Field and rural production are key since 47%[1] of the world's population inhabits rural areas (World Bank, 2014), and occupation in the primary sector accounts for one-third of the employed population. Of this, about 500 million farmers belong to the family nucleus, ie the most vulnerable producers (FAO, 2013). Latent threats attributed in part to the CAG are multiple and varied for agriculture, for example: hydro-meteorological phenomena, climate change, changing trade relations, increasing competition (regional, national, international), market reduction, price instability and technological change. The impact of agriculture on employment generation and regional economies depends on the degree of development of the countries (Stern, 2007). In general, there is an inverse relationship between these variables and the tendency to outsource the economy. On the continents, Africa has the most rural population with 58%, while North America has only 2% (World Bank, 2014). Worldwide, 75% of the populations living in the rural areas of the planet depend on agriculture, forestry and / or fisheries (Torres et al., 2011).

In Mexico, agriculture represents 3.8% of GDP, while in Michoacan this figure amounts to 7%, or 10% of the nation's agricultural GDP (INEGI, 2015). Michoacán specializes in the agricultural sector at national level. Although from the state perspective the share of agriculture in GDP does not reach 10%, at the municipal level it reaches a third of the economy without counting the multiplier effects of the sector as a supplier of inputs. The nature of agricultural activity faces threats of various kinds, such as lack of productive diversification or economic concentration, and economic specialization in agricultural activity. In some cases it is accompanied by a greater dependence on agricultural incomes, a situation that makes these municipalities vulnerable in two

[1] 3 336 millones de personas.

ways: (1) high dependence on agriculture (with high risks); and (2) the conditions peculiar to agricultural producers. Given the CAG scenario and the threats facing the agricultural sector, to what extent would the municipal economies be vulnerable to the various threats of the CAG? How does the relative agricultural specialization relate to the concentration of the municipal economy in this activity?

The objective of the present investigation was to identify the economic vulnerability due to the agricultural concentration, the agricultural economic specialization and the vulnerability of the agricultural producers. The municipal agricultural relative specialization index (ERM), the economic concentration index (IHH) and the agricultural vulnerability index (IVUPA) were calculated. Likewise, to reach the objective, three analyzes were implemented: 1) quadrants, 2) regressions and 3) main components. The contribution lies in two ways: 1) the methodology implemented for the integration of vulnerability indexes, and 2) the information generated from vulnerability, specialization, concentration and measurement techniques. It is intended to demonstrate what the conditions would be for specialization to focus on concentration and thus contribute to increasing the vulnerability of Michoacan agricultural producers. The document is composed of four sections: the first deals with the theoretical elements about vulnerability as well as previous studies, the second section presents the methodology and techniques used, the third presents the results, and finally, the fourth section shows the conclusions.

Theoretical aspects: vulnerability, global environmental change and agricultural producers

Global Environmental Change

Understanding CAG should be approached from a non-reductionist multidisciplinary perspective, the first step in understanding the transformation that lies at the heart of the CAG (Mauelshaguen, 2017). The CAG is associated with the notion of crisis and has, first of all, a focus on the identification of negative effects and causal relationships between different complex systems, it also represents a construct that allows an interdisciplinary view and as a concept of a condition of possibility of a paradigm of deliberate transformation, in the search for social change (Blanco, Günther, Gutiérrez and Valencia, 2017). The change was recognized from the sixties and in the

present century has been experienced with greater intensity in the social, cultural, political, ecological-environmental, urban and economic. The CAG is a concept that encompasses not only the processes of climate change, but also other processes of global changes linked to society-nature, nature-economy. From this perspective, the environmental dimension integrates the ecological with the economic and the social, including here also the political, institutional and cultural dimensions.

Some analyzes place CAG as the result of the interaction of three elements: food security, provision of ecosystem services and social welfare in general. At the same time, food systems in CAG are integrated by a variety of activities, from production to consumption, and are complex because they include the interaction of multiple environmental, social, political and economic factors. On the other hand, they include at least three aspects: a) bio-geo-physical and human-environmental interactions that determine a set of activities; b) own activities from production to consumption and c) the result of these activities: food security and social welfare (Ericksen, 2008). On these interactions, agricultural production is one of the links of the food system that faces increasingly intense and changing challenges, two of them being the vulnerability of producers and the economy dependent on agricultural activity.

Vulnerability in agriculture and its impact on the regional economy

The economy of the agricultural sector can be vulnerable internally and externally. The first has to do with their ability to cope with "unexpected" events; an example is the well-known Global Environmental Change. The external aspect is related to the market and other factors out of reach. From the economic point of view, agriculture revolves around the following three aspects (Bejarano, 1998, pp. 11-12):

1) Neglections in the development of the agricultural sector can hinder overall development, especially if agriculture has a significant weight and producers do not receive incentives.
2) The performance of agriculture in general is affected by the implementation of policies in other sectors such as incentives to industry, provision of public goods and trade liberalization.

3) Macroeconomic policies affect the agricultural sector because they directly influence the economic structure; the protection or liberalization policies of other sectors will have an impact on agriculture. In this sense, changes in agriculture can affect local and municipal economies.

Vulnerability in this case means that some element may be affected or suffer a loss. Consequently, the difference in vulnerability of the elements determines the selectivity of the severity of the effects coming from an external event. Vulnerability can be classified as technical (physical and functional elements) and social (economic, educational, cultural, ideological, etc.). A vulnerability analysis is a process by which the level of exposure and predisposition to loss of element (s) to a specific threat is determined (Cardona, 1993).

In this respect, vulnerability can be understood as a social concept (Blaikie et al., 1996, Buch and Turcios, 2003, Eakin, 2005, Constantino and Dávila, 2011); it is thus a state of risk, of being susceptible or of having the intrinsic predisposition to be affected, which determines the conditions that favor or facilitate that there is harm against a threat (Cardona, 2001). Vulnerability is understood as fragility, the opposite of capacity and strength (Lavell, 2001). In terms of communities or populations, vulnerability would be the inability of a community to absorb, through self-adjustment, the effects of a given change in its environment, ie, its inflexibility or inability to adapt to that change (Wilches-Chaux, 1993).

In the case of agricultural producers, vulnerability is related to their internal capacities to deal with threat situations, for example: changing climatic conditions, pests, intensifying competition and reducing demand. Certain groups of the population may be more vulnerable, such as farmers. However, in the aggregate and in a systems approach, the vulnerability of some may affect other groups that may have a direct or indirect relationship; in the case of agricultural producers in the municipality or region, the local economy would be sensitive to agriculture to a greater or lesser extent according to its dependence.

Disaster risk is the likely extent of damage in a given period in the presence of a hazardous activity. And it is divided into two components: the potential threat and vulnerability of the system to that threat (Vargas, 2002). Disaster risk management and adaptation focus on reducing exposure, vulnerability, and thereby increasing resilience to potential external adverse impacts. Vulnerability can be conceived at different scales and actors according to the object of study, which can be: national, regional or local, for producers, consumers or communities. In this way, vulnerability to an event depends to a large extent on internal capabilities to deal with latent hazards and threats that can cause harm. Likewise, the capacity for resilience, adaptation and resilience to the environment represents the potential reduction of vulnerability, since it is largely dependent on internal capacities.

Evidence is measured in droughts, floods, frosts and fires, as well as trends towards reduced or increased precipitation or the number of days without rainfall or maximum temperatures. Therefore, risks are becoming more important in economic costs, human lives and destruction of infrastructure, a situation that draws the attention of scientists. In this sense, risk management can be understood as a structured approach to managing the uncertainty related to a threat, through a sequence of human activities that include risk assessment, development strategies for its management and risk mitigation using resources management (Magaña, 2012, p. 5).

Studies on vulnerability in agricultural producers

According to Musseta and Barrientos (2015), rural producers in the province of Mendoza in Argentina show vulnerability from seven components (natural, economic, technological, social, institutional, infrastructure and knowledge / information), which affect the sensitivity and adaptive capacity. To do this, they carried out an analysis of the strategies and adaptations that have been practiced by producers in recent years, highlighting the conflicts and relationships for access to water and the disadvantages of being small producers. They also highlighted socio-economic adaptation strategies (migration, labor availability, production fragmentation, low profitability, and diversification of income sources) and revealed the constraints on adaptive capacity or factors that increase vulnerability related to knowledge, technology, associative and organizational capacity, as well as lack of institutional solidity. Among the findings is that the adaptations have not been

beneficial because they generate negative impacts for some producers: the logic of winners and losers (Musseta and Barrientos, 2015).

Other vulnerability studies address this issue at country or region level, considering climate change as a threat and vulnerability of the agricultural sector in relation to climate variability, degree of exposure and sensitivity, all inherent in natural systems and humans. The effects of climate change are also present in climate-sensitive activities, for example agriculture, which requires regional and economic diagnostics (Espinosa and Gutiérrez, 2010). Vulnerability is related to the concept of risk; the risk of disaster is likely damage in the presence of a hazardous activity. Risk is composed of two elements: the potential threat and vulnerability of the system (Vargas, 2002).

Some papers address the vulnerability of agriculture from the perspective of agri-environmental processes, with emphasis on the impacts of climate change where vulnerability must be conceived as a dynamic and alterable quality. Producers and rural communities are key players in economic development, food security, and the management and conservation of the environment and ecosystems. In this sense, the agendas of political intervention (national and international) must contemplate that the design of adaptation strategies be dynamic, while planning is incorporated into these elements (Torres, Cruz and Acosta, 2011).

Other studies have addressed the issue of vulnerability in soil erosion using geographic information systems and vulnerability factors related to the type of soil, a situation that although not so much dependent on the agricultural producers, is exacerbated by practices agricultural activities. However, the erosive character is mainly water in the communities of Tepic and Santa María del Oro, Nayarit (Zamudio y Méndez, 2012).

Matherials and Methods

The list of threats is long: pests, hurricanes, floods, droughts, desertification, erosion, forest fires, landslides, earthquakes and volcanic activity, as well as changes in socio-political conditions, trade negotiations, intensification of competition and so on. For agricultural production systems, vulnerability or susceptibility to threats and increased risks depending on the characteristics of the territory can be: rural population, agricultural facilities and facilities, agricultural activities,

environment and ecosystems. Therefore, variables, indicators and indices are proposed to quantify the vulnerability of agricultural producers and the regional economy.

Vulnerability of agricultural producers, the calculation of IVUPA

The variables used to calculate the Agricultural Producers Vulnerability Index (IVUPA) were based on the following dimensions: technical conditions, infrastructure conditions, institutional support, surface quality, training and organization. These variables were grouped into indices (technicality, irrigation, traction, facilities, surface quality and access to financing), based on indicators showing the proportion of producers that had the item identified (fertilizers, seeds, fertilizers, irrigation, herbicides , etc.) (see Table 1).

The VUPA measurement was carried out using the Agricultural Producers Vulnerability Index (IVUPA), using the information on agricultural units in Michoacán that provides the Ejidal Census of the National Institute of Statistics Geography and Informatics (INEGI, 2007). With 21 indicators (described in Table 1), each identified first the type of impact: direct or inverse (+ or -), then the information was standardized, based on the quotient of the difference between the municipality data and the state average for each of the items (see equation 1), and finally, the addition of the standardization by item was added a final sum, which represents the Agricultural Advancement (AA), thus obtaining the inverse of the result and with it the IVUPA, which allows to compare the municipalities and the regions of Michoacán, see annex (methodological note 1).

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Table 1. Variables sobre vulnerabilidad de los productores agrícolas.

Tecnicidad (Tec) (+)	**Riego (R) (+)**	**Tracción (Tr) (+)**	**Instalaciones (I) (+)**	**Calidad de la Superficie (CS) (-)**	**Acceso a Financiamiento (+)**
Fertilizantes químicos (Fq), semilla mejorada (Sm), abonos naturales (An), herbicidas químicos (Hq), insecticidas químicos (Iq), insecticidas orgánicos (Io), quema controlada (Qc) y otra tecnología (Ott)	Usa riego (Rs)	Mecánica (Me), No Mecánica (NMe), sólo Herramientas Manuales (Hm)	Beneficiadora (Be), Deshidratadora (Ds), Empacadora(Em), Seleccionadora (Se), Desfibradora (De) Y Otras) Instalaciones (Oi)	Ensalitrada (Er) o Erosionada (En)	Seguros (Se) y/o Créditos (Cr)
Operatividad de las variables para el cálculo del IVUPA					
Operatividad (Paso 1): $VNx_1 = \frac{(x_1 - x_m)}{ax}$ *(Ecuación 1)* *Donde:* VNx_1: valor normalizado de x_1 x_1: valor del indicador x_m: media de la serie *x* σ_x: *desviación estándar de la serie* x	Operatividad (Paso 2): Tec = $\sum(Fq + Sm + An + Hq + Iq + Io + Oc + Ott)$ Ri = $\sum Rs$ Tr = $\sum(Me + NMe + Hm)$ I = $\sum(Be + Ds + Em + Se + De + Oi)$ CS = $\sum(Er + En)$ Af = $\sum(Seg + Cr)$		Operatividad (Paso 3): $AA = \sum_{i=1}^{n}(Tec + Ri + Tr + I - Cs + Af)$ *(Ecuación 2)* $IVUPA = AA^{-1}$ *(Ecuación 3)*		

Source: elaboración propia.

Based on the premise that regional or municipal economic vulnerability related to agricultural activity depends on two aspects: a) VUPA, b) economic specialization in agriculture, there is a risk in the degree of concentration. So the most vulnerable municipalities are those with high concentration. The municipal wealth in agriculture shows low competitive capacity, or high vulnerability of its producers to respond to external events such as those manifested in the CAG.

Municipal Relative Economic Specialization (ERM)

The ERM Municipal Relative Specialization Index = (Vij/ΣiVij)/(ΣjVij/ΣiΣjVij) is a measure that expresses in relative terms the importance of economic activity in relation to a territorial reference. The participation of agriculture (i) in region "j" and the participation of the sector in the state total

is used as a measure of "relative or interregional specialization". The relative specialization of a region in the sector occurs if: ERM> 1 (Lira, 2003; Lira y Quiroga, 2009).

Municipal Economic Concentration Index (IHH)

This index aims to show the degree of concentration of the local economy in one or a few activities. This situation is known as a lack of productive diversification and in essence shows that those regions that are little or nothing diversified face the risks involved in over-specialization or concentration. The calculation consists of IHH[2] $= (\sum_{i=1}^{n} w^2)^{-1}$(Varian, 1992). Where "$w$" represents the proportion of economic activity "i" in the municipal economy.

Information processing

The information processing appears in a quadrant analysis that exposes the relationship between ERM and IHH. Starting from the quadrants IV and I, a simple linear regression model is established to verify if the expected relation is obtained and if the parameters are significant. The objective is to identify municipalities with two characteristics: specialized and concentrated in agriculture. To facilitate the analysis, once the indices of: ERMij, IHH y VUPA, were transformed into standardized values to relativize them to ranges between 0 y 1, and thus facilitate the interpretation.

Resultados: vulnerabilidad económica municipal causada por el impacto agrícola en Michoacán

The construction of the IVUPA and its results

The factorial analysis of the main components for the IVUPA served to validate if the variables used were representative. It was observed that the contribution to the variance is concentrated in factor 1, highlighting technicality, facilities and traction, so this factor is associated with capacities developed by the producers in terms of infrastructure. Factor two has a prominent presence of irrigation availability, the main contribution of factor 3 is access to financing and, finally, factor four seems to indicate a different relationship to all factors in surface quality , with a smaller contribution to the behavior of the variance (see Tables 2, 3 and 4). The information used to know

[2] Índice de Herfindahl - Hirschman

the vulnerability of agricultural producers is relevant in terms of the number of variables and their contribution to the variance is distributed in the first four factors, with greater weight in the first.

Table 2. Vectores propios y cargas factoriales de las variables del IVUPA en Michoacán.

	F1 (Infraestructura y mejoramiento de la producción)	F2 (Riego)	F3 (Financiamiento)	F4 (Superficie)	F5	F6
Tecnicidad	0.550	0.175	0.269	-0.233	0.170	0.715
Riego	-0.091	-0.832	0.340	-0.427	0.035	-0.002
Instalaciones	0.535	-0.099	-0.196	-0.021	0.661	-0.478
Tracción	0.503	0.114	0.015	-0.369	-0.673	-0.381
CS*	0.303	-0.491	-0.587	0.403	-0.262	0.302
Financiamiento	-0.241	0.113	-0.655	-0.681	0.109	0.157

*Calidad de la superficie

Source: elaboración propia con información de la Nota 1 del anexo metodológico.

Table 3. Componentes principales: valores propios y aporte a la varianza del IVUPA.

	F1	F2	F3	F4	F5	F6
Valor propio	2.11	1.01	0.97	0.92	0.60	0.37
Variabilidad (%)	35.18	16.85	16.26	15.42	10.01	6.25
% acumulado	35.18	52.03	68.30	83.72	93.74	100

*Calidad de la superficie

Source: elaboración propia con información de la Nota 1 del anexo metodológico.

Table 4. Aporte de las variables la varianza del IVUPA (%).

	F1	F2	F3	F4	F5	F6
Tecnicidad	30.273	3.066	7.232	5.415	2.899	51.115
Riego	0.822	69.248	11.539	18.269	0.121	0.000
Instalaciones	28.607	0.976	3.852	0.046	43.676	22.844
Tracción	25.300	1.291	0.022	13.642	45.266	14.480
CS*	9.168	24.142	34.484	16.256	6.846	9.104
Financiamiento	5.830	1.278	42.870	46.372	1.192	2.457

*Calidad de la superficie

Source: elaboración propia con información de la Nota 1 del anexo metodológico.

Table 5. Clasificación de la Vulnerabilidad de los Productores Agrícolas de Michoacán.

Muy Baja (27)	Baja (22)	Alta (33)	Muy Alta (30)
Jiménez	Ecuandureo	Aporo	Chinicuila
Álvaro Obregón	Epitacio Huerta	Nuevo P.	Nocupétaro
Contepec	Numarán	Santa Ana Maya	Huiramba
Pajacuarán	Parácuaro	Lagunillas	Madero
Penjamillo	Paracho	Quiroga	Tzintzuntzan
Maravatío	Panindícuaro	Sahuayo	Coahuayana
Tanhuato	San Lucas	Tangamandapio	Juárez
Zacapu	Tepalcatepec	Angangueo	Chucándiro
Angamacutiro	Jacona	Coeneo	Tlazazalca
Hidalgo	Morelia	Ixtlán	Chilchota
Nahuatzen	Tingambato	Nuevo Urecho	Huandacareo
Yurécuaro	Tiquicheo	Susupuato	Morelos
José S.	Acuitzio	Aguililla	Aquila
Huacana, La	Apatzingán	Cuitzeo	Tumbiscatío
Tacámbaro	Carácuaro	Tangancícuaro	Tzitzio
Tancítaro	Los Reyes	Tlalpujahua	Cojumatlán de R.
Zinapécuaro	Tuzantla	Indaparapeo	Churumuco
Zitácuaro	Turicato	Peribán	Charapan
Ario	La Piedad	Queréndaro	Cherán
Tarímbaro	Villamar	Taretan	Pátzcuaro
Venustiano C.	Zináparo	Ziracuaretiro	Senguio
Vista Hermosa	Zamora	Irimbo	Tuxpan
Huetamo		Jiquilpan	Purépero
Uruapan		Tocumbo	Huaniqueo
Puruándiro		Churintzio	Gabriel Zamora
Salvador Escalante		Erongarícuaro	Briseñas
Buenavista		Lázaro Cárdenas	Copándaro
		Tingüindín	Arteaga
		Coalcomán	Charo
		Chavinda	Marcos C.
		Cotija	
		Jungapeo	
		Ocampo	

Source: elaboración propia con información de la Nota 1 del anexo metodológico.

Table 5 shows the classification of IVUPA results, placing municipalities in four vulnerability ranges: high and very high vulnerability in 66 municipalities, low vulnerability in 22 and low in 20. According to the IVUPA, the most vulnerable municipality is Chinicuila, followed by Nocupétaro, Huiramba, Madero and Tzintzuntzan. The IVUPA allows quantifying vulnerability on a comparable scale; However, among its limitations the relative degree of the index is reflected because when each of the variables is quantified, relative indicators are obtained, that is, in

proportions. This can make the analysis biased, for example, when there are few units of agricultural production the relative weight of a producer is greater in the municipal total and vice versa. In this way, the interpretation in terms of averages and proportions saves the common biases of this type of calculation.

Relationship between ERM and IHH in the municipalities of Michoacán

In the descriptive analysis of the relationship between economic economic specialization (ERM) and concentration of the economy in few activities (HHI), the following was obtained: Figures 3 and 4 show the relationship found in both variables, so that in the quadrant I obtained 20 of 113 municipalities with high specialization and high concentration of agricultural activity in the municipal economy; and in quadrant II, 33 of the 113 municipalities with a high concentration of the municipal economy were positioned, although there is no agricultural specialization (figure 2). In quadrant III, 34 of 113 municipalities were presented; these are diversified, poorly concentrated and non-MRE economies in agriculture. In this quadrant are located municipalities with low dependence on agriculture. The fourth quadrant locates 26 specialized municipalities, but with a little concentrated or diversified economy. Quadrants I and IV present a situation that relates to the municipalities with the specialized and concentrated economy. That is to say, when a greater specialization is obtained also the tendency to a greater concentration is appreciated.

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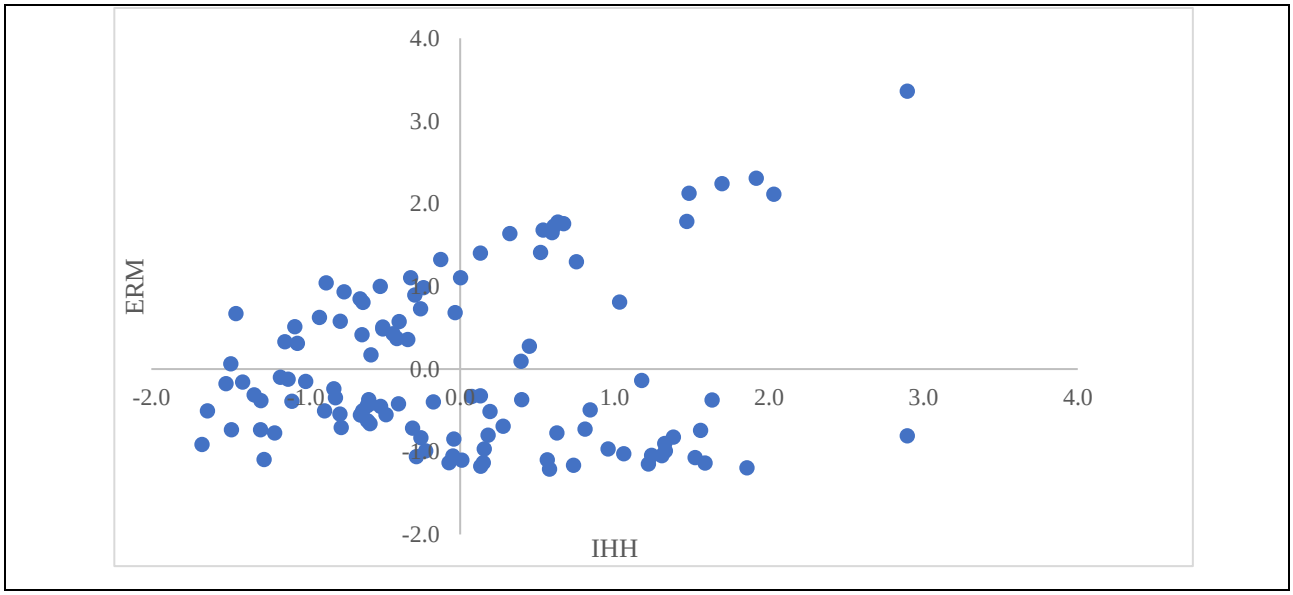
Figure 1. Representación de la ERM y el IHH.



Source: elaboración propia con datos de las Notas 1 y 2 del anexo.

Figure 2. Identificación del ERM e IHH.

Cuadrante IV (26) Penjamillo, Tangancícuaro, Copándaro, Tuxpan, Coahuayana, Briseñas, Tocumbo, Buenavista, José Sixto Verduzco, Venustiano Carranza, Carácuaro, Alvaro Obregón, Yurécuaro, Tingambato, Tuzantla, Epitacio Huerta, Contepec, Chavinda, Senguio, Pajacuarán, Panindícuaro, Turicato, Santa Ana Maya, Tacámbaro, Indaparapeo, Cojumatlán de Régules y Queréndaro.	*ERM* (+)	**Cuadrante I (20/113)** Tancítaro, Tingüindín, Ecuandureo, Villamar, Peribán, Tzitzio, Nuevo Urecho, Juárez, Jungapeo, Salvador Escalante, Parácuaro, Ixtlán, Susupuato, Nuevo Parangaricutiro, Ario, Tanhuato, Chinicuila, Ziracuaretiro, Los Reyes.
IHH (-)	0	*IHH* (+)
Cuadrante III (34/113) Hidalgo, Tepalcatepec, Cherán, Tlazazalca, Purépero, Churumuco, Zináparo, Morelos, Huaniqueo, Coeneo, Huetamo, Tangamandapio, Tarímbaro, Charapan, Irimbo, Zinapécuaro, Tumbiscatío, Chucándiro, Aguililla, La Huacana, Cotija, Aquila, Aporo, Charo, Erongarícuaro, Coalcomán de Vázquez Pallares, Arteaga, Madero, Tzintzuntzan, Jiménez, Numarán, Ocampo, Acuitzio y Angangueo.	*ERM* (-)	**Cuadrante II (33/113)** Gabriel Zamora, Vista Hermosa, Nocupétaro, San Lucas, Angamacutiro, Puruándiro, Churintzio, Chilchota, Huiramba, Maravatío, Tiquicheo de Nicolás Romero, Uruapan, Múgica, Taretan, Tlalpujahua, Nahuatzen, Jiquilpan, Jacona, Apatzingán, Zitácuaro, Zamora, Lagunillas, Huandacareo, Cuitzeo, Paracho, Quiroga, Marcos Castellanos, Sahuayo, Zacapu, Pátzcuaro, La Piedad, Lázaro Cárdenas y Morelia,

Source: elaboración propia con datos de las Notas 1 y 2 del anexo.

After analyzing the relationship between ERM and HHI in quadrants I and IV (Figure 3), specialization can lead to concentration as the territorial comparative advantages are exploited. Assuming that the economic concentration depends on the degree of specialization, then: IHH = f (ERM), which would verify the type of relation of table 6, that is, the specialization as starting point. Under this assumption, the concentration of the municipal economy in the sector would continue after the specialization.

An optimistic scenario would indicate that these conditions detonate better conditions for local-regional development, under the premise of moving from comparative advantage to competitive advantage. From the point of view of regional economic growth theory, the specialization or economic base of a region develops according to the productive vocations and comparative advantages that lead to the initial concentration of certain activities. However, as regions improve their development and production conditions, they concentrate more economic activity, which can

lead to competitive advantages that depend not only on factor endowments but also on other elements such as: innovation, technological development, transport and knowledge (Krugman, 1991).

Table 6. Relación IHH = f (ERM) en Michoacán para los municipios en cuadrantes IV y I.

Estadísticos de bondad del ajuste (IHH)		**Parámetros (coeficientes) (IHH)**			**Análisis de varianza (IHH)**		**Matriz de correlaciones**		
		Fuente	Intercepción	ERM	Fuente	Modelo		ERM	IHH
Obs.	45.000	Valor	-1.162	1.143	GL	1	ERM	**1**	0.839
Suma de los pesos	45.000	Error estándar	0.143	0.113	F	102.066	IHH	0.839	**1**
GL	43.000	t	-8.122	10.103	Pr > F	< 0.0001			
R^2	0.704	Pr > |t|	< 0.0001	< 0.0001					
R^2 ajustado	0.697								
DW	1.238								

Source: elaboración propia con datos del anexo estadístico 1 y 2. Para los 45 municipios que se ubicaron en los cuadrantes I y III.

Discussion of results: complementarity, scope and limitation between IVUPA, IHH and ERM

The present study assumes that the CAG represents a potential threat through different routes for municipal agriculture in Michoacán, so that the proposal to identify municipal vulnerability provides a framework for analysis and quantification. Such information can constitute an input for the design of public policy and thus improve the capacity of producers. However, it is necessary to take into account some scope and limits of the same; on the one hand, the calculation of the IVUPA is expressed in averages, which derive from aggregate information and must be understood in relative terms, that is, the average loses sight of quantities of producers and therefore the diversity of producers loses detail.

Another aspect to consider is that it is assumed that specialization leads to concentration and that specialization constitutes a vulnerability that results in lack of productive diversification. From this perspective it is assumed that as more is dependent on an economic activity there is greater vulnerability.

The concentration of the municipal economy in agriculture constitutes a risk, since the lack of productive diversification reduces the options of response to a changing environment. At the municipal level, an economy that specializes in the extreme of concentrating its economy on few products depends on the environment for the realization of its production. Emphasis is given to the importance of diversification in the firm to improve its position in negotiation with suppliers or buyers (Porter, 2015). At the regional level, productive diversification reduces the level of economic risk in the sectoral structure (Reig and Picazo, 1997). Therefore, at local, regional and national levels, some authors propose economic diversification, beyond the primary activities that characterize the specialization and concentration of developing countries. For Gyfalson and Zoega (2006), a major challenge for economic policy in developed countries has been to reduce the dependence of the economy on natural resources and to diversify the economy towards higher value-added activities (Gyfalson and Zoega, 2006, p. 1092).

The present study assumes the municipal economic concentration in the agriculture as a complement of the vulnerability of the agricultural producers, in what would be denominated like municipal economic-agricultural vulnerability. From this perspective, the vulnerability of agricultural producers (IVUPA) and the economic dependence of agriculture, expressed in the IHH, would generate high risk conditions for municipalities that combine both aspects. The sum of the standardized values of both indicators (IVUPA + IHH) would result in municipalities with economies most vulnerable to the effects of agriculture as a result of the CAG. In this sense, table 7 shows the municipalities of high and very high economic-agricultural vulnerability (47 of 113). At the same time, municipalities that presented an IVUPA and an HHI simultaneously above the state average were shaded in the table.

The analysis of quadrants between concentration and specialization shows the conditions where the relation becomes narrower: quadrants I and IV. Therefore, the municipalities located in these quadrants have a greater sensitivity, or a propensity between these variables with vulnerability.

Table 7. Concentración económica en la agricultura y VUPA.

IVEA Muy Alto (13)	IVEA Alto (34)	IVEA Bajo (32)	IVEA Muy Bajo (34)
Múgica, Tzitzio, Peribán, Chinicuila, Sahuayo, Huiramba, Gabriel Zamora, Ecuandureo, Morelos, Cuitzeo, Lagunillas, Juárez y Tingüindín	Pátzcuaro, Taretan, Chilchota, Nocupétaro, Zamora, Huandacareo, Ixtlán, Nuevo Urecho, Ziracuaretiro, Marcos Castellanos, Susupuato, Nuevo P., Parácuaro, Churintzio, Quiroga y Jiquilpan	Tlalpujahua	Cotija, Tuzantla
	Angamacutiro, Briseñas, Maravatío, Lázaro Cárdenas, Paracho, Copándaro, Jungapeo, Churumuco, Chucándiro, Tancítaro, Apatzingán, Villamar, Tlazazalca, Coahuayana, Jacona, Purépero, Tuxpan y Cherán	Morelia, San Lucas, Tangancícuaro, Charapan, Tumbiscatío, Huaniqueo, Tiquicheo, Tangamandapio, Tzintzuntzan, Los Reyes, Tocumbo, Senguio, Aquila, Tepalcatepec, Coeneo, La Piedad, Madero, Nahuatzen, Aguililla, Chavinda, Irimbo, Zacapu, Santa Ana Maya, Cojumatlán, Aporo, Charo, Ario, Penjamillo, Epitacio Huerta, Carácuaro y Zináparo	Arteaga, Coalcomán, Tingambato, Indaparapeo, Queréndaro, Erongarícuaro, Alvaro Obregón, Tanhuato, Pajacuarán, Panindícuaro, Salvador E. Angangueo, Turicato, Numarán, Ocampo, Zitácuaro, José S. V., Acuitzio, Hidalgo, Puruándiro, Contepec, Tacámbaro, Yurécuaro, Vista Hermosa, La Huacana, Jiménez, Venustiano C., Tarímbaro, Uruapan, Huetamo, Zinapécuaro y Buenavista

Fuente: Anexo 2.

Conclusions

An approach was made to municipalities that are more sensitive or vulnerable to the impacts of different phenomena that pose a threat to the agricultural sector under the CAG context. It is recommended to continue this line of research on crop types and the impact on them. For example, in Tancítato and Tingüindin avocado cultivation predominates, reason why a commercial prohibition of this product would bring dire consequences to the economy of these municipalities. On the other hand, for Nuevo Urecho or Villamar the conditions are different. It is necessary to carry out a more in depth study on each type of crop to know with more precision its conditions in the municipal economy.

The variables used to measure the IVUPA were: technicity, irrigation, facilities, traction, surface quality, access to financing and value of agricultural production. Technicity and irrigation explain mainly the behavior of variance. In municipalities with VUPA that are above average, due to internal capacities that make them vulnerable to external effects. In this way the agricultural producers of minors and of greater capacities to face the CAG were identified.

The objective is to quantify vulnerability from three perspectives: the vulnerability of agricultural producers, agricultural specialization and the lack of economic diversification or concentration. In the analysis of quadrants, ERM and IHH pointed to the expected relationship. While it is not known whether ERM depends on IHH or vice versa, it is assumed that first is the specialization and then the concentration. After that, it was observed that between HH and ERM, statistical significance was obtained in the tests of goodness, however, the DW shows that at the origin both indices share the value of production data in relative terms, although in different procedures. This can answer the question of the research and justify the methodology of exploration by quadrants. There are cases in which ERM and IHH find a relationship that strengthens the municipal vulnerability in the dependence of agriculture when complemented with IVUPA. Therefore, the objective of identifying the economic-agricultural vulnerability of the municipalities of Michoacán through the calculation of the IVUPA and its complementarity with the economic concentration in the agricultural activity was reached. In this sense we can appreciate agriculture and its relationship with the municipal economy from a perspective of vulnerability to the CAG.

The analysis approach can be applied to other case studies, so the present study provides an innovative methodological element that suggests a technique that allows this purpose to be achieved. The results show that Michoacán possesses a "mosaic" of municipalities with diverse vulnerability in agricultural matters.

The CAG represents a transformation of society in a deeper way in some sectors, among them the food systems and the challenge of food supply to the population. There are many threats that this change represents for the sector, which in itself already has intrinsic risks in the activity. Here the

subject was treated in a novel way, applying it in the municipalities of Michoacán to evidence its economic-agricultural vulnerability, as well as contributing factors.

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Anexo 1. Datos para la generación de IVUPA

	Tec	Ri	I	Tr	CS	Af	AA	AA ^-1 = IVUPA St		Tec	Ri	I	Tr	CS	Af	AA	AA ^-1 = IVUPA St
Acuitzio	11.0	4.6	0.0	1.2	-0.2	3.3	19.9	0.33	Nocupétaro	4.7	2.6	0.0	1.5	-0.1	3.2	11.9	-1.38
Aguililla	8.0	3.9	0.0	1.3	-0.2	3.3	16.4	-0.42	Nuevo P.	6.9	2.6	1.1	1.4	0.0	3.3	15.2	-0.67
Álvaro O.	11.5	2.9	2.3	1.7	-0.1	3.3	21.6	0.69	Nuevo U.	4.9	6.3	0.2	1.5	-0.2	3.3	16.0	-0.50
Angamacutiro	9.8	10.4	0.0	1.4	-0.2	3.2	24.6	1.33	Numarán	5.5	8.9	0.0	1.0	-0.2	3.2	18.5	0.03
Angangueo	4.4	7.1	0.0	1.2	-0.2	3.3	15.9	-0.52	Ocampo	6.7	5.7	0.0	2.0	-0.1	3.3	17.5	-0.18
Apatzingán	9.6	3.6	1.0	1.8	0.1	3.3	19.4	0.22	Pajacuarán	13.7	2.8	1.0	1.4	-0.2	3.2	21.9	0.76
Aporo	4.2	6.8	0.0	0.9	-0.2	3.3	15.1	-0.68	Panindícuaro	5.5	9.1	0.0	1.2	-0.2	3.3	18.9	0.11
Aquila	4.7	3.1	0.3	1.9	-0.2	3.2	13.0	-1.14	Parácuaro	8.5	5.4	0.2	1.4	-0.2	3.2	18.5	0.04
Ario	18.3	2.9	0.8	2.5	0.1	3.3	27.8	2.02	Paracho	5.4	8.3	0.0	1.4	-0.1	3.3	18.3	0.00
Arteaga	4.9	4.0	1.1	1.7	-0.1	3.2	14.8	-0.74	Pátzcuaro	6.1	2.6	0.0	1.9	0.0	3.3	13.8	-0.97
Briseñas	7.6	2.6	0.5	1.2	-0.2	3.2	14.9	-0.74	Penjamillo	11.8	3.6	1.5	1.8	-0.2	3.3	21.7	0.72
Buenavista	14.0	8.7	4.6	1.9	0.0	3.3	32.4	2.98	Peribán	7.1	4.2	0.7	1.5	-0.2	3.2	16.5	-0.39
Carácuaro	4.6	9.8	0.0	1.3	0.3	3.2	19.3	0.20	La Piedad	9.4	6.7	0.2	1.5	-0.2	3.3	20.8	0.52
Coahuayana	4.9	2.6	0.7	1.0	-0.2	3.4	12.5	-1.25	Purépero	5.8	4.1	0.2	1.1	-0.2	3.2	14.3	-0.85
Coalcomán	4.6	6.5	0.0	1.5	0.7	3.3	16.7	-0.35	Puruándiro	17.3	2.8	2.5	3.8	-0.2	3.3	29.4	2.36
Coeneo	7.2	2.6	0.3	2.3	0.0	3.3	15.7	-0.56	Queréndaro	7.0	4.9	0.0	1.5	-0.1	3.3	16.6	-0.36
Contepec	10.0	4.5	1.5	2.5	-0.1	3.3	21.7	0.72	Quiroga	4.5	6.2	0.0	1.4	-0.1	3.4	15.4	-0.63
Copándaro	5.3	5.2	0.2	1.0	-0.1	3.3	14.8	-0.74	Cojumatlán	6.4	2.6	0.2	1.1	-0.1	3.2	13.5	-1.03
Cotija	7.0	5.0	0.7	1.7	-0.2	3.3	17.5	-0.18	Los Reyes	7.4	6.2	0.9	2.0	-0.2	3.2	19.6	0.28
Cuitzeo	6.4	4.1	1.0	1.4	-0.1	3.3	16.1	-0.47	Sahuayo	6.1	5.4	0.1	1.0	-0.2	3.3	15.7	-0.56
Charapan	4.7	4.7	0.0	1.1	-0.2	3.4	13.8	-0.98	San Lucas	8.7	5.9	0.0	1.6	-0.2	3.2	19.2	0.19
Charo	6.5	2.6	1.0	1.6	-0.2	3.3	14.9	-0.73	Santa A. M.	7.6	3.7	0.0	1.2	-0.2	3.2	15.5	-0.61
Chavinda	9.0	4.2	0.0	1.2	-0.2	3.2	17.5	-0.19	Salvador E.	12.3	9.4	0.6	2.2	0.8	3.3	28.7	2.20
Cherán	4.8	4.7	0.0	1.4	-0.2	3.3	14.0	-0.92	Senguio	5.8	3.5	0.0	1.8	-0.2	3.3	14.2	-0.88
Chilchota	5.5	2.6	0.0	1.5	0.0	3.2	12.8	-1.18	Susupuato	4.5	6.8	0.0	1.5	-0.1	3.2	15.9	-0.51
Chinicuila	4.1	2.9	0.0	1.3	-0.2	3.3	11.5	-1.45	Tacámbaro	12.4	4.3	2.4	3.4	-0.1	3.2	25.6	1.55
Chucándiro	5.5	2.7	0.0	1.3	-0.1	3.3	12.7	-1.20	Tancítaro	14.6	5.5	1.1	2.1	-0.1	3.3	26.4	1.71
Churintzio	7.4	5.6	0.0	1.1	-0.2	3.2	17.2	-0.24	Tangamandapio	6.2	4.9	0.0	1.4	-0.2	3.2	15.6	-0.59
Churumuco	4.9	3.8	0.0	1.7	-0.2	3.4	13.6	-1.00	Tangancícuaro	8.0	3.2	0.5	1.5	-0.1	3.2	16.3	-0.43
Ecuandureo	11.1	2.7	0.2	1.5	-0.2	3.3	18.6	0.05	Tanhuato	9.0	5.9	3.3	1.4	-0.2	3.3	22.7	0.93
Epitacio H.	8.2	4.8	0.5	1.9	-0.2	3.3	18.5	0.04	Taretan	4.4	7.4	0.0	1.7	-0.2	3.3	16.5	-0.39
Erongarícuaro	5.4	6.9	0.0	1.7	-0.2	3.3	17.1	-0.26	Tarímbaro	10.9	9.9	1.6	1.7	-0.1	3.3	27.3	1.91
Gabriel Z.	7.4	2.6	0.2	1.4	-0.2	3.3	14.7	-0.77	Tepalcatepec	7.9	6.3	0.0	1.3	0.0	3.4	18.8	0.10
Hidalgo	6.9	10.4	1.0	2.2	0.2	3.3	24.0	1.20	Tingambato	6.8	7.4	0.4	1.6	-0.1	3.2	19.3	0.21
La Huacana	7.4	3.9	4.8	1.8	2.5	3.3	23.5	1.11	Tingüindín	8.3	3.6	0.0	1.3	0.4	3.2	16.9	-0.31
Huandacareo	5.3	3.6	0.0	1.1	-0.2	3.2	13.1	-1.13	Tiquicheo	6.3	3.5	3.5	1.8	0.3	3.2	18.7	0.09
Huaniqueo	4.7	5.5	0.0	1.2	-0.2	3.3	14.5	-0.81	Tlalpujahua	7.6	2.7	0.6	2.1	-0.1	3.3	16.1	-0.48
Huetamo	16.2	5.7	1.0	2.8	-0.2	3.3	28.8	2.23	Tlazazalca	5.1	3.4	0.0	1.2	-0.2	3.3	12.8	-1.17
Huiramba	4.8	3.2	0.0	1.2	-0.2	3.3	12.3	-1.29	Tocumbo	5.5	6.7	0.0	1.4	-0.1	3.3	16.8	-0.34
Indaparapeo	8.6	2.7	0.9	1.4	-0.1	3.3	16.6	-0.38	Tumbiscatío	4.4	4.2	0.0	1.3	-0.2	3.2	13.0	-1.14
Irimbo	5.2	7.3	0.0	1.1	0.0	3.3	16.8	-0.32	Turicato	9.5	2.6	0.3	3.2	0.5	3.3	19.3	0.21
Ixtlán	7.7	4.2	0.0	1.1	-0.2	3.2	16.0	-0.51	Tuxpan	6.1	3.4	0.0	1.5	-0.2	3.3	14.1	-0.89
Jacona	6.8	7.7	1.0	1.0	-0.2	3.2	19.5	0.24	Tuzantla	8.6	5.8	0.0	1.9	0.0	3.3	19.6	0.28
Jiménez	7.3	8.3	0.9	1.6	-0.2	3.3	21.2	0.62	Tzintzuntzan	5.1	2.9	0.0	1.3	-0.2	3.3	12.4	-1.26
Jiquilpan	6.2	6.6	0.0	1.1	-0.2	3.2	16.9	-0.31	Tzitzio	4.7	3.5	0.0	1.6	0.0	3.2	13.0	-1.14
Juárez	3.9	4.1	0.0	1.4	-0.2	3.3	12.5	-1.24	Uruapan	12.7	2.7	6.9	2.5	0.1	3.3	28.1	2.07
Jungapeo	4.8	7.1	0.7	1.8	-0.1	3.3	17.6	-0.16	Venustiano C.	13.5	8.1	1.7	1.5	0.0	3.2	28.0	2.06
Lagunillas	5.1	6.4	0.0	1.1	-0.2	3.3	15.7	-0.57	Villamar	8.6	7.0	0.6	1.5	-0.2	3.2	20.7	0.51
Madero	4.6	2.7	0.0	1.8	-0.2	3.3	12.3	-1.29	Vista H.	14.4	3.9	5.0	1.7	-0.2	3.2	28.0	2.06
Maravatío	11.6	2.9	1.8	2.9	0.0	3.2	22.4	0.87	Yurécuaro	8.8	9.7	1.2	1.5	-0.2	3.3	24.4	1.30
Marcos C.	5.4	5.4	0.0	1.1	-0.2	3.3	15.0	-0.71	Zacapu	7.1	7.9	3.1	1.8	-0.1	3.3	23.1	1.01
Lázaro C.	8.6	2.7	1.1	1.6	-0.1	3.2	17.1	-0.27	Zamora	12.9	3.0	0.4	1.4	0.0	3.2	21.0	0.56
Morelia	9.7	3.5	0.3	2.5	0.0	3.3	19.3	0.21	Zináparo	7.1	9.4	0.0	1.1	-0.2	3.3	20.6	0.49
Morelos	5.1	3.2	0.0	1.4	-0.2	3.4	12.9	-1.16	Zinapécuaro	11.7	2.6	5.2	2.4	0.3	3.3	25.5	1.52
Múgica	7.1	4.3	1.6	1.4	0.1	3.2	17.7	-0.13	Ziracuaretiro	5.2	4.9	0.6	1.5	0.6	3.2	16.1	-0.48
Nahuatzen	6.9	10.8	1.3	1.9	-0.2	3.3	24.1	1.22	Zitácuaro	8.7	8.3	0.8	4.9	0.0	3.3	25.9	1.62
Suma estandarizada de: Tec [(Fq + Sm + An +Hq Iq + oI +Qc + Ott)] Rs + Tr [(Me + NMe + Hm)] + I [Be + Ds + Em +Se + De + Oi] + CS [Er + En] + Af [Seg + Cr]. St. = estandarizado.									José S. V.	14.7	4.6	0.5	2.3	0.0	3.2	25.3	1.48

Fuente: elaboración propia con datos de INEGI, 2007. La codificación de los indicadores se aprecia en la tabla 1.

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Anexo 2. Datos para la generación de ERM, IHH y datos estandarizados

					Datos para el cálculo de ERM								
	IVEIA	**IVUPA**	**IHH**	**ERMSt**	**Agric.**	**Ganad**	**Pesca**	**For.**	**Min.**	**Ind.**	**Com.**	**Serv.**	**ERM**
Acuitzio	0.31	0.55	0.18	-0.52	13%	15%	0%	15%	0%	19%	27%	10%	1.8
Aguililla	0.50	0.59	0.25	-0.24	16%	6%	0%	13%	0%	42%	15%	7%	2.3
Alvaro O.	0.37	0.49	0.28	0.53	42%	12%	1%	0%	0%	9%	27%	10%	5.8
Angamacutiro	0.63	0.45	0.46	-0.13	16%	10%	2%	0%	0%	2%	64%	6%	2.2
Angangueo	0.34	0.57	0.18	-0.9	6%	8%	0%	10%	14%	13%	23%	27%	0.8
Apatzingán	0.73	0.53	0.43	-0.9	4%	2%	0%	0%	0%	17%	61%	15%	0.6
Aporo	0.47	0.60	0.23	-0.46	16%	10%	0%	12%	0%	38%	16%	7%	2.2
Aquila	0.52	0.62	0.24	0.25	20%	15%	11%	4%	39%	0%	10%	1%	2.8
Ario	0.44	0.43	0.38	0.87	47%	1%	0%	3%	0%	3%	39%	6%	6.6
Arteaga	0.41	0.58	0.21	-0.9	2%	22%	2%	14%	0%	8%	30%	22%	0.3
Briseñas	0.63	0.62	0.29	-0.13	30%	3%	0%	0%	0%	33%	30%	4%	4.1
Buenavista	0.00	0.29	0.29	0.62	30%	7%	0%	0%	0%	10%	41%	13%	4.1
Carácuaro	0.43	0.52	0.28	0.24	32%	36%	0%	0%	0%	6%	19%	6%	4.4
Coahuayana	0.66	0.64	0.29	1.11	44%	14%	4%	1%	0%	5%	28%	6%	6.1
Coalcomán	0.41	0.57	0.22	-0.65	8%	13%	0%	23%	0%	10%	34%	11%	1.2
Coeneo	0.51	0.58	0.27	-0.53	10%	34%	0%	0%	1%	8%	36%	11%	1.4
Contepec	0.29	0.47	0.26	0.85	40%	16%	0%	1%	2%	18%	18%	4%	5.6
Copándaro	0.61	0.60	0.3	0.86	37%	14%	0%	0%	0%	7%	37%	5%	5.1
Cotija	0.42	0.55	0.25	-0.6	13%	8%	0%	3%	0%	14%	39%	21%	1.9
Cuitzeo	0.83	0.58	0.45	-0.93	3%	3%	2%	0%	0%	61%	25%	7%	0.4
Charapan	0.58	0.62	0.27	-0.55	14%	15%	0%	2%	0%	26%	40%	3%	2
Charo	0.45	0.59	0.23	-0.45	20%	36%	0%	20%	2%	9%	9%	3%	2.9
Chavinda	0.50	0.59	0.25	0.27	34%	6%	0%	0%	0%	27%	23%	10%	4.7
Cherán	0.63	0.61	0.3	-0.86	4%	6%	0%	3%	0%	20%	46%	20%	0.6
Chilchota	0.77	0.64	0.34	-0.8	10%	5%	1%	0%	0%	26%	51%	8%	1.4
Chinicuila	0.90	0.65	0.41	1.57	38%	50%	0%	0%	0%	1%	8%	3%	5.3
Chucándiro	0.61	0.64	0.25	-0.24	13%	28%	0%	0%	0%	12%	37%	10%	1.8
Churintzio	0.64	0.58	0.34	-0.53	13%	13%	0%	0%	0%	11%	53%	10%	1.8
Churumuco	0.61	0.61	0.29	-0.51	9%	27%	5%	0%	0%	5%	45%	9%	1.3
Ecuandureo	0.85	0.57	0.46	1.44	65%	6%	0%	0%	0%	6%	16%	6%	9.1
Epitacio Huerta	0.43	0.54	0.27	1.2	39%	25%	1%	0%	0%	9%	20%	6%	5.4
Erongarícuaro	0.37	0.55	0.22	-0.54	21%	12%	2%	7%	0%	35%	18%	6%	2.9
Gabriel Z.	0.85	0.62	0.42	-0.01	20%	8%	0%	0%	0%	4%	60%	8%	2.8
Hidalgo	0.31	0.42	0.31	-0.97	1%	2%	0%	9%	0%	28%	45%	15%	0.2
La Huacana	0.23	0.44	0.25	-0.21	18%	14%	3%	0%	7%	5%	42%	11%	2.6
Huandacareo	0.72	0.64	0.32	-0.92	3%	43%	0%	0%	0%	10%	32%	11%	0.4
Huaniqueo	0.58	0.61	0.28	-0.31	14%	43%	0%	0%	0%	16%	21%	6%	2
Huetamo	0.15	0.38	0.27	-0.64	15%	15%	0%	0%	3%	7%	44%	15%	2.1
Huiramba	0.86	0.65	0.39	-0.57	9%	21%	0%	0%	4%	3%	57%	6%	1.3
Indaparapeo	0.40	0.59	0.2	-0.05	35%	13%	0%	13%	8%	14%	10%	7%	4.9
Irimbo	0.50	0.57	0.27	-0.71	13%	8%	0%	13%	3%	14%	45%	4%	1.9
Ixtlán	0.70	0.61	0.35	1.89	54%	18%	0%	0%	3%	2%	12%	11%	7.5
Jacona	0.66	0.53	0.4	-0.85	5%	0%	0%	0%	0%	45%	44%	6%	0.6
Jiménez	0.22	0.48	0.21	-0.28	17%	30%	0%	0%	3%	21%	17%	12%	2.4
Jiquilpan	0.63	0.58	0.33	-0.91	5%	3%	0%	0%	0%	48%	26%	19%	0.7
Juárez	0.81	0.63	0.37	2.39	56%	11%	0%	2%	0%	3%	21%	6%	7.8
Jungapeo	0.61	0.53	0.37	2.01	55%	5%	0%	0%	22%	3%	10%	4%	7.7
Lagunillas	0.82	0.59	0.43	-0.86	3%	62%	0%	5%	0%	6%	18%	5%	0.4
Madero	0.51	0.63	0.21	-0.13	16%	10%	0%	17%	0%	11%	35%	11%	2.2
Maravatío	0.62	0.46	0.45	-0.69	9%	3%	0%	1%	0%	9%	64%	14%	1.2
Marcos C.	0.68	0.60	0.33	-0.95	2%	11%	0%	0%	0%	41%	38%	9%	0.2
Lázaro C.	0.87	0.57	0.47	-0.98	0%	0%	0%	0%	6%	64%	23%	6%	0
Morelia	0.60	0.53	0.37	-0.98	0%	1%	0%	0%	0%	21%	29%	49%	0
Morelos	0.62	0.63	0.28	-0.38	12%	39%	0%	0%	0%	10%	32%	8%	1.7
Múgica	1.00	0.55	0.56	-0.72	8%	2%	0%	0%	0%	6%	73%	10%	1.1
Nahuatzen	0.51	0.41	0.43	-0.82	6%	5%	0%	0%	0%	60%	24%	4%	0.8
Nocupétaro	0.75	0.65	0.33	-0.22	17%	48%	0%	0%	0%	5%	24%	6%	2.3

Nuevo P.	0.66	0.60	0.33	0.69	49%	1%	0%	5%	0%	15%	25%	5%	6.9
Nuevo Urecho	0.69	0.57	0.37	2.74	56%	19%	0%	8%	0%	5%	11%	1%	7.8
Numarán	0.33	0.55	0.2	-0.18	20%	21%	0%	0%	6%	18%	28%	7%	2.8
Ocampo	0.32	0.55	0.2	-0.67	9%	6%	1%	20%	4%	31%	20%	8%	1.3
Pajacuarán	0.37	0.52	0.24	0.43	35%	16%	0%	0%	0%	8%	26%	15%	4.8
Panindícuaro	0.35	0.53	0.23	0.47	29%	23%	0%	0%	0%	10%	27%	10%	4
Parácuaro	0.65	0.56	0.37	2.08	54%	10%	0%	0%	0%	5%	25%	7%	7.5
Paracho	0.61	0.54	0.37	-0.96	2%	1%	0%	2%	0%	38%	45%	11%	0.3
Pátzcuaro	0.79	0.62	0.38	-0.97	1%	1%	0%	4%	0%	17%	55%	21%	0.1
Penjamillo	0.43	0.50	0.31	1.31	48%	16%	1%	0%	0%	4%	21%	10%	6.7
Peribán	0.91	0.57	0.49	2.28	63%	1%	0%	0%	0%	1%	31%	4%	8.7
Piedad, La	0.51	0.52	0.33	-0.98	1%	5%	0%	0%	0%	42%	35%	18%	0.1
Purépero	0.64	0.62	0.3	-0.95	3%	13%	0%	0%	0%	34%	38%	12%	0.4
Puruándiro	0.30	0.34	0.39	-0.55	14%	4%	0%	0%	1%	8%	58%	16%	1.9
Queréndaro	0.37	0.58	0.19	-0.31	19%	12%	2%	17%	0%	5%	29%	16%	2.7
Quiroga	0.61	0.58	0.32	-0.96	2%	1%	0%	1%	0%	30%	42%	24%	0.3
Cojumatlán	0.49	0.64	0.2	0.24	24%	10%	5%	0%	0%	16%	23%	22%	3.3
Los Reyes	0.53	0.50	0.35	-0.39	25%	2%	0%	1%	0%	5%	51%	18%	3.4
Sahuayo	0.88	0.60	0.45	-0.97	1%	3%	0%	0%	0%	12%	62%	22%	0.2
San Lucas	0.60	0.54	0.35	-0.49	16%	12%	0%	0%	0%	6%	54%	12%	2.2
Santa A.M.	0.49	0.61	0.22	-0.13	29%	20%	1%	0%	0%	13%	27%	10%	4
Salvador E.	0.34	0.39	0.36	0.7	54%	2%	0%	3%	0%	16%	20%	4%	7.6
Senguio	0.52	0.61	0.25	0.54	42%	9%	0%	7%	6%	11%	19%	5%	5.9
Susupuato	0.68	0.57	0.36	2.28	49%	33%	0%	8%	0%	2%	3%	5%	6.9
Tacámbaro	0.25	0.39	0.32	0.4	36%	1%	0%	1%	0%	11%	41%	10%	5
Tancítaro	0.78	0.43	0.75	4	86%	1%	0%	0%	0%	2%	9%	2%	12
Tangamandapio	0.54	0.59	0.27	-0.44	16%	6%	0%	0%	0%	21%	41%	16%	2.2
Tangancícuaro	0.59	0.59	0.3	0.39	41%	3%	0%	0%	0%	12%	31%	12%	5.8
Tanhuato	0.37	0.45	0.32	0.9	44%	9%	0%	0%	0%	8%	33%	6%	6.1
Taretan	0.78	0.56	0.43	-0.7	7%	61%	0%	0%	0%	23%	6%	3%	1
Tarímbaro	0.16	0.39	0.27	-0.66	11%	4%	0%	0%	1%	37%	31%	16%	1.5
Tepalcatepec	0.52	0.55	0.3	-0.4	15%	14%	0%	0%	5%	6%	50%	10%	2.1
Tingambato	0.41	0.52	0.27	0.23	38%	4%	0%	1%	0%	20%	27%	10%	5.3
Tingüindín	0.94	0.60	0.48	1.05	66%	3%	0%	0%	0%	7%	18%	6%	9.2
Tiquicheo	0.56	0.50	0.37	-0.63	8%	55%	2%	0%	0%	3%	23%	9%	1.1
Tlalpujahua	0.59	0.58	0.32	-0.85	7%	6%	0%	6%	0%	50%	19%	13%	1
Tlazazalca	0.68	0.64	0.3	-0.65	7%	32%	0%	0%	0%	9%	41%	10%	1
Tocumbo	0.52	0.57	0.29	0.08	34%	7%	0%	0%	0%	13%	38%	8%	4.7
Tumbiscatío	0.58	0.63	0.26	-0.38	9%	34%	0%	29%	0%	3%	20%	4%	1.3
Turicato	0.33	0.52	0.23	0.47	32%	21%	0%	0%	0%	14%	23%	10%	4.5
Tuxpan	0.63	0.62	0.29	0.54	40%	10%	0%	0%	3%	3%	34%	12%	5.5
Tuzantla	0.42	0.53	0.27	0.81	31%	30%	0%	0%	0%	2%	26%	11%	4.3
Tzintzuntzan	0.53	0.65	0.21	-0.84	9%	8%	2%	1%	13%	31%	28%	9%	1.3
Tzitzio	0.92	0.63	0.44	2.61	56%	35%	0%	0%	0%	0%	5%	4%	7.9
Uruapan	0.16	0.32	0.33	-0.91	8%	1%	0%	1%	0%	21%	49%	20%	1.1
Venustiano C.	0.20	0.40	0.28	0.13	32%	5%	1%	0%	1%	10%	38%	11%	4.5
Villamar	0.70	0.51	0.44	1.8	63%	6%	0%	0%	0%	3%	19%	8%	8.8
Vista Hermosa	0.24	0.37	0.33	-0.36	17%	50%	0%	0%	0%	11%	19%	3%	2.3
Yurécuaro	0.24	0.43	0.27	-0.27	26%	11%	0%	0%	0%	15%	40%	8%	3.6
Zacapu	0.50	0.42	0.42	-0.97	1%	2%	0%	0%	0%	55%	33%	8%	0.2
Zamora	0.73	0.54	0.42	-0.93	3%	1%	0%	0%	0%	15%	59%	21%	0.4
Zináparo	0.42	0.51	0.29	-0.49	15%	39%	0%	0%	0%	6%	31%	8%	2.1
Zinapécuaro	0.15	0.38	0.27	-0.66	12%	4%	1%	4%	2%	10%	42%	25%	1.7
Ziracuaretiro	0.68	0.58	0.36	0.45	28%	51%	0%	2%	0%	3%	10%	5%	3.9
Zitácuaro	0.32	0.34	0.41	-0.91	4%	2%	0%	2%	0%	18%	59%	15%	0.5
José S. V.	0.31	0.46	0.28	0.31	31%	7%	0%	0%	0%	9%	40%	13%	4.3
Sectores/Michoacán					7%	3%	0%	1%	1%	24%	36%	27%	

Fuente: elaboración propia con datos de INEGI, 2015a; INEGI, 2015b y SIAP, 2016.

Notación: IVEIA = índice de vulnerabilidad económico-agrícola; IVUPA = índice de vulnerabilidad de los productores agrícolas; IHH = índice de concentración Herfindahl Hirschman; ERMSt = índice de especialización agrícola relativo

estandarizado municipal; Agric. Agricultura; Ganad = Ganaderaía; For. = actividad forestal; Min. = minería; Ind. = industria manufacturera; Com. = Comercio; Serv. = servicios; ERM