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Artículos científicos

Índice de pobreza multidimensional en un municipio de Oaxaca

Multidimensional Poverty Index in a municipality of Oaxaca

Índice de pobreza multidimensional em um município de Oaxaca

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Resumen

La pobreza ha sido un problema a nivel mundial, el cual en México se ha presentado con mayor incidencia en los estados del sur. El objetivo de este trabajo fue elaborar el índice multidimensional de pobreza con la inclusión de las tecnologías de información y comunicación para generar una intervención pública, disminuir la pobreza y mejorar el bienestar, enfocado en salud, nutrición, características de la vivienda, equipos de tecnologías de información y comunicación, internet, redes sociales y saneamiento. La investigación se llevó a cabo en el municipio de Tepelmeme Villa de Morelos del estado de Oaxaca. Para ello, se aplicó una encuesta de pobreza a 128 hogares en tres comunidades rurales y se elaboró un

índice multidimensional de pobreza con la metodología de Alkire y Foster. En los resultados se encontró un índice de 0.431 para una línea de pobreza de 50 %. Los indicadores que contribuyeron a la pobreza en mayor cantidad fueron equipamiento del hogar (15.21 % para número de aparatos eléctricos, y 14.77 % para automóvil), salud (7.76 % para visita al médico especialista y 6.49 % para visita al médico general), y nutrición (7.51 % para proteína, 6.3 % para vegetales y 5.1 % para frutas). Asimismo, se realizó una simulación de una intervención pública del gobierno, para lo cual se ajustaron los valores de los indicadores de pobreza con mayor contribución al índice y se volvió a calcular el índice de pobreza. Con esto se logró disminuir el índice multidimensional de pobreza a un valor de 0.355. Se concluyó que se debe hacer una intervención del gobierno para realizar una reasignación de recursos, por lo que se planteó un escenario para disminuir la pobreza.

Palabras clave: comunidad rural, índice de pobreza, salud, Tepelmeme, TIC.

Abstract

Poverty has been a problem worldwide and in Mexico it has occurred in greater numbers in the southern states. The objective of this work was to prepare the Multidimensional Poverty Index with the inclusion of information and communication technologies, to generate a public intervention and reduce poverty and improve well-being, focused on health, nutrition, characteristics of housing, equipment of information and communication technologies, internet, social networks, and sanitation. The research was carried out in the municipality of Tepelmeme Villa de Morelos in the state of Oaxaca, a poverty survey was applied to 128 households in three rural communities and a multidimensional poverty index was prepared with the Alkire and Foster methodology based on indicators of poverty. In the results, an index of 0.431 was found for a poverty line of 50%, the indicators that contributed to poverty in greater quantity were household equipment with 15.21% (number of electrical appliances) and 14.77% (automobile), of equal health forms with 7.76% (visit to the specialist doctor) and 6.49% (visit to the general practitioner), in terms of nutrition with 7.51% (protein), 6.3% (vegetables), and 5.1 (fruits). Likewise, a simulation of a public government intervention was carried out, for this the values of the poverty indicators with the greatest contribution to the index were adjusted and the poverty index was recalculated, with this it was possible to reduce the multidimensional poverty index to a value of 0.355. It was concluded that a

government intervention should be made to reallocate resources, so a scenario was proposed to reduce poverty.

Keywords: rural community, index poverty, health, Tepelmeme, ICT.

Resumo

A pobreza tem sido um problema mundial, o que no México ocorre com maior incidência nos estados do sul. O objetivo deste trabalho foi elaborar o índice multidimensional de pobreza com a inclusão de tecnologias de informação e comunicação para gerar uma intervenção pública, reduzir a pobreza e melhorar o bem-estar, com foco na saúde, nutrição, características de habitação, equipamentos de tecnologia de informação e comunicação, internet, redes sociais e saneamento. A investigação foi realizada no município de Tepelmeme Villa de Morelos, no estado de Oaxaca. Para fazer isso, uma pesquisa de pobreza foi aplicada a 128 famílias em três comunidades rurais e um índice de pobreza multidimensional foi preparado usando a metodologia de Alkire e Foster. Nos resultados, um índice de 0,431 foi encontrado para uma linha de pobreza de 50%. Os indicadores que mais contribuíram para a pobreza foram equipamentos domésticos (15,21% para o número de eletrodomésticos e 14,77% para o automóvel), saúde (7,76% para as visitas ao médico especialista e 6,49% para as visitas ao clínico geral) e nutrição (7,51% para proteínas, 6,3% para vegetais e 5,1% para frutas). Da mesma forma, foi realizada uma simulação de uma intervenção do governo público, para a qual foram ajustados os valores dos indicadores de pobreza com maior contribuição para o índice e o índice de pobreza foi recalculado. Com isso, o índice de pobreza multidimensional foi reduzido para o valor de 0,355. Concluiu-se que deveria ser feita uma intervenção governamental para realocar recursos, então foi proposto um cenário de redução da pobreza.

Palavras-chave: comunidade rural, índice de pobreza, saúde, Tepelmeme, TIC.

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Introduction

In Mexico, poverty is a historical problem that has been tried to address through national and international initiatives promoted by institutions such as the World Bank, the Economic Commission for Latin America and the Caribbean, and the United Nations (Aguilar- Estrada, Caamal-Cahuicho and Portillo-Vázquez, 2018a). A few years ago, the country defined three lines of well-being to locate the population with insufficient income: food poverty, poverty of capacities and patrimonial poverty (Aguilar Estrada et al., 2018b). However, since 2008, poverty has begun to be measured with a multidimensional method in charge of the National Council for the Evaluation of Social Development Policy, a body that - based on the information provided by the National Institute of Statistics and Geography - has carried out the multidimensional estimation of poverty 2008-2018. This information collected is very useful for the Mexican government, as it allows it to plan its interventions in terms of social development; In addition, the multidimensional aspect promoted by Mexico has been used at the international level for the construction of the 2030 Agenda in relation to poverty reduction (National Council for the Evaluation of Social Development Policy [Coneval], 2019).

In this regard, it is necessary to point out that the fight against poverty should be a priority, since the economic consequences generated by the current pandemic could increase it by approximately 8%. This means that in the last thirty years it would be the first that poverty increased considerably, which would further accentuate the suffering of the 10% of the world's population that already lives in extreme poverty, with difficulties in satisfying their basic needs of health, education, access to water and sanitation (United Nations, 2020). Therefore, this phenomenon must be measured in a multidimensional way, in terms of deficits of well-being attributes from minimally acceptable levels for different individuals in a society (Alkire, Apablaza, Chakravarty and Yalonetzky, 2017).

However, although Mexico was a world pioneer in the implementation of an official multidimensional poverty measurement system (Clausen, Vargas & Barrantes, 2019), it has not included the information and communication technologies (ICT) dimension, despite that since the 1990s ICTs have been recognized as facilitators of development and poverty reduction throughout the world (Becerril-Velasco, 2020).

For this reason, the main contribution of this research is to offer an index for rural communities that can use ICT, since technological advance has been constantly related to economic, political and social development, hence governments around the world have been

interested in promoting, to a greater or lesser extent, the adoption of technology (Becerril-Velasco, 2020).

The research presented was carried out in the municipality of Tepelmeme Villa de Morelos, Oaxaca, where three communities were studied. It is worth noting that in the state of Oaxaca the number of people living in poverty went from 2.8 million to 2.7 million between 2016-2018. This last figure, however, is higher than that reported in 2008, when 2.3 million people were living in poverty. Likewise, between 2016 and 2018, access to health services went from 15.9% to 16.3%, living spaces went from 26.3% to 25.1%, and access to food went from 31.4% to 27.9% (Coneval, 2019).

Now, in the specific case of the municipality of Tepelmeme Villa de Morelos, 77.8% of the population is in a situation of poverty, 21.7% has deficiencies in terms of quality and housing spaces, 65.9% presents difficulties regarding basic services, 15.4% have deficiencies in access to health services, 83.6% lack access to social security, and 10.9% have problems related to food (Coneval, 2015).

Having explained the above, the objective of this work was to develop a multidimensional poverty index, with the inclusion of ICT, in a rural community that is in a situation of poverty in order to try to generate a public intervention that allows increasing well-being in health, nutrition, housing, ICT and sanitation. The intention is that with an adequate public intervention based on calculations of the multidimensional poverty index, this reality can be changed.

Poverty-related literature

Poverty in Mexico

Despite the efforts and policies to support Mexico, the country is still a nation of mostly poor people, since adequate standards of living are only guaranteed for 27.5% of the Mexican population. In fact, the population in poverty exceeds 2.3 times that considered the middle class (Teruel, Reyes, Minor and López, 2018). Furthermore, there is evidence that in the southern states of Mexico poverty levels are even higher (Campos Vázquez and Monroy-Gómez-Franco, 2016).

Although poverty extends to all countries in the world, its incidence is higher in rural areas (Chávez and Carrera, 2016). Rural poverty in Mexico arises mainly from the lack of access to basic services (Huerta Barrientos, Vera Morales and Vázquez González, 2018), so it is important to offer solutions that improve their conditions (Long, Hanlon and Pellegrin,

2018) . However, reality shows that these areas are at a disadvantage in terms of telecommunications infrastructure and applications, which restricts their possibilities to grow economically and socially (Roberts, Beel, Philip and Townsend, 2017). In this sense, the indicators of rural communities should be considered, since they play an important role for sustainability and rural development (Nguyen and Wells, 2018). In addition, when a certain municipality is helped, a domino effect is generated that benefits the neighboring towns (Leija and Saltillo, 2019). The ability to reduce poverty in Mexico, therefore, is related to the conditions of inequality, provision of public goods, productive structure and generation of formal jobs. (Campos Vázquez y Monroy-Gómez-Franco, 2016).

Multidimensional poverty

A person is in a situation of multidimensional poverty when the exercise of at least one of their rights for social development (food, health, education, housing, basic services and social security) is not guaranteed, and when their income is insufficient to acquire the goods and services it requires to satisfy its needs (Aguilar Estrada et al., 2018a).

In Pakistan, a multidimensional poverty study was conducted in rural areas; To do this, they associated living standards, agricultural and non-agricultural assets, and environmental indicators. Likewise, it was identified that 44% of households in rural areas live at the poorest levels, as they have to endure the lack of drinking water, inadequate sanitation facilities, poor housing conditions, contaminated energy sources and deprivation of economic resources (Padda and Hameed, 2018).

This is a situation that also affects some European countries, such as the United Kingdom, Hungary or Germany, although their particularities are different, hence it is difficult to establish cross-national comparisons. Therefore, the theoretical conceptualization of poverty must foresee spatial and sociocultural inequalities to adjust it to different regional and national contexts (Bernard, Contzen, Decker and Shucksmith, 2019). For example, rural household poverty in China is based on demographic characteristics, capital endowment variables, and geographic characteristics (capital variables include natural capital, physical capital, human capital, and financial capital, and are vital factors that affect farmers' poverty) (Liu, Wei, Xu, Li y Li, 2019).

Poverty in rural communities

The indigenous peoples of Latin America have a higher incidence of poverty due to the dispossession of their lands, which has resulted in lower levels of income, schooling, life expectancy and access to sanitation and drinking water (Economic Commission for America Latin America and the Caribbean [ECLAC], 2013). Due to the existence of so many variables, it is important to develop research on poverty that includes the following points: 1) life cycle of the evolution of poverty areas; 2) measurement of multidimensional regional poverty; 3) geographic identification of poverty and its types of area, as well as the spatio-temporal pattern; 4) dynamic simulation of poverty and its mechanism; 5) poverty mapping; 6) determination of the best geographic scale to combat poverty, anti-poverty measures, and 7) evaluation of the effectiveness of poverty reduction (Zhou y Liu, 2019).

Poverty and food

Mothers serve as guardians of the health of future generations; however, women's behavior is determined by individual knowledge and intentions, family and housing context, and community influences of poverty and rurality, as low-income rural mothers primarily benefit from multi-level support of nutrition education programs, community agencies and public policies that promote healthy nutrition and eating practices (Sano, Routh and Lanigan, 2019).

The key factors in food poverty are large household size, unemployment and low levels of initial education, hence well-articulated programs must be created that guarantee access to education, as well as well-paid job opportunities. (Eigbiremolen y Ogbuabor, 2018).

Poverty and ICT

Social media has created many opportunities for traders of non-timber forest products and has helped people to alleviate and lift themselves out of poverty. These technological resources may be informal or created by different NGOs or government agencies for the purpose of developing safety nets for practical and financial support, or to assist in the commercialization of products. An example of this in Mexico is the case of palm collectors, who voluntarily joined forces and obtained better prices from intermediaries to export said product to the United States and Europe. This shows that social networks can contribute to poverty reduction, since it allows producers to get fairer prices (Pullanikkatil, 2019).

Similarly, for rural communities that carry out agricultural activities, the use of ICTs is increasingly necessary, since they can gather useful information for their crops (Mittal and Mehar, 2016). In this sense, they can review the drought forecast and join forces to promote policies that encourage investment in water supply programs (Liu, Wenxin, Zhao and Xu, 2018).

Digitization and automation, on the other hand, can significantly improve the lives of farmers and workers, and can generate new job opportunities in the digital agriculture sector. For this, however, actions must also be taken in terms of technological training (Rotz et al., 2019). In short, access to these resources will not make sense if people are not able to get the most out of them, so it is necessary to promote the development of certain digital skills that allow doing so (Van Dijk, 2017).

In accordance with this idea, the Mexican State has made a great effort to strengthen the telecommunications sector and open access to ICT. In addition, ICTs are beginning to be implemented in the policies to combat poverty in Mexico, although it is worth noting that these initiatives have yet to reach the labor market so that the poor can increase their economy with ICTs (Becerril-Velasco, 2019).

Despite the economic benefits that ICTs offer, it is quite a challenge to strengthen rural infrastructure and communication networks to reduce information asymmetries and improve farmers' access to markets, through e-commerce and trading platforms. The geographic and cultural gap must be overcome to unite producers and consumers in a virtual space and collaborative technical assistance. In short, it is necessary to join forces with non-governmental organizations, the private sector and research institutions to guarantee the sustainability of small producers in rural areas. (Hissa *et al*., 2019).

Method

The research was carried out in 2018 in 128 households (out of a population of 318 households) in the municipality of Tepelmeme Villa de Morelos, Oaxaca, specifically in three rural communities: La Unión, Las Flores and Tepelmeme. Similarly, profiles were created for each household, which were to select the study communities and that the home was permanently inhabited by the occupants. To elaborate the multidimensional poverty index, the methodology of Alkire and Foster (2011) was used, which consisted of the following steps, which are presented in the form of sections throughout the text.

Select dimensions, measures and weights

Association tests were performed by the Cramer's V measure and redundancy by Ro's test for the interrelation of all the variables of the survey; subsequently, seven dimensions were taken: health, household equipment, nutrition, sanitation, use of the internet, ICT and housing. Each dimension includes indicators that are described in Table 1, while their relationship is presented in Figure 1. Similarly, weights were established for each dimension and indicator. The sum of these weights added equal to one (equation 1), which normalizes the weights of the indicators.

$\Sigma_j p_j = 1$ **(1)**

Set deprivation limits

The deficiency limit was established for each indicator, which is shown in Table 1 (description column).

Establish a multidimensional poverty line to identify who is poor

A matrix was prepared with the indicators in Table 1. Those who exceeded the deficiency limit per indicator were assigned a value of 1 (the rest were assigned a value of 0); this in order to quantify poverty levels by indicator and dimension.

Calculate the multidimensional poverty percentage (H), the intensity (A) and the multidimensional poverty index (IMP)

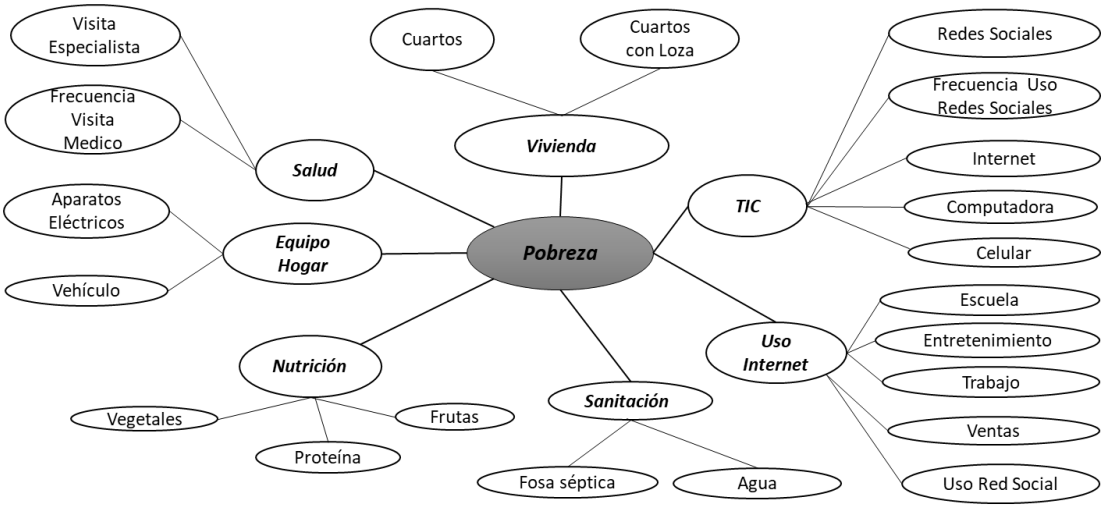
The corresponding calculations were made for the incidence of poverty or the percentage of multidimensional poverty (H), as well as the intensity (A) - how poor the poor are - and the multidimensional poverty index (IMP), which is presented in equation 2.

$IMP = H * A$ **(2)**

Subsequently, a disaggregation by community was made. The calculations were carried out in Stata software (version 14.0). Some code routines were provided at the summer school of the Oxford Poverty and Human Development Initiative (OPHI), an economic policy and research center within the Oxford Department of International Development at the University of Oxford. This center is run by Sabina Alkire (Oxford Poverty% Human

Development Initiative [OPHI], 2020). Figure 1 shows the relationship of variables in a diagram of uses, later these variables are described in table 1, accompanied by the weight assigned to each one for the corresponding calculations.

Figura 1. Variables para medir la pobreza en comunidades rurales



Fuente: Elaboración propia

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Tabla 1. Dimensiones e indicadores de pobreza

Dimensión	Indicador	Descripción	Peso
Salud (10 %)	Visita al médico general (hdFrViMed)	Un hogar tiene la carencia de visitar al médico general cuando los integrantes de la familia nunca lo visitan o lo visitan una vez al año.	5 %
	Visita al médico especialista (hdVisespc)	Un hogar tiene la carencia de visitar al médico especialista cuando nunca lo visitan, aunque lo necesiten por alguna enfermedad.	5 %
Equipo en el hogar (20 %)	Aparatos eléctricos (hdApaElec)	Un hogar tiene la carencia en aparatos eléctricos si cuenta con menos de tres.	10 %
	Vehículo (hdCar)	Un hogar tiene la carencia de vehículo si no tiene uno para transportarse.	10 %
Nutrición (20 %)	Proteína (hdProteina)	Un hogar tiene la carencia de proteína si los integrantes comen huevo menos de cuatro veces a la semana, o comen carne menos de tres veces a la semana, o comen pollo menos de tres veces a la semana o comen pescado menos de tres veces a la semana.	6.6 %
	Vegetales (hdvegetales)	Un hogar tiene la carencia de vegetales si los integrantes los comen menos de cinco veces a la semana	6.6 %
	Frutas (hdFrutas)	Un hogar tiene la carencia en frutas si los integrantes las comen menos de cuatro veces a la semana.	6.6 %
Características de la vivienda (10 %)	Habitaciones para dormir (hdHabit)	Un hogar tiene la carencia en habitaciones utilizadas para dormir si cuenta con menos de tres.	5 %
	Habitaciones con techo de loza (hdHabTecho)	Un hogar tiene la carencia en habitaciones de techo con loza si no tiene ningún cuarto techado con loza.	5 %
Hogares con equipo de TIC, acceso a internet y a las redes sociales (15 %)	Red social (hdRedSoc)	Un hogar tiene la carencia de redes sociales si los integrantes no tienen redes sociales y tienen edad para usarlas.	3 %
	Frecuencia de uso de la red social (hdFrecUsRS)	Un hogar tiene la carencia en redes sociales si las usan menos de tres veces por semana.	3 %
	Internet (hdInternet)	Un hogar tiene la carencia de internet si no cuenta ese servicio.	3 %
	Computadora (hdPC)	Un hogar tiene la carencia de computadora si no cuenta con dicho recurso.	3 %
	Teléfono celular (hdCelular)	Un hogar tiene la carencia de teléfono móvil si no cuenta con ese dispositivo.	3 %
Uso de internet (15 %)	Internet para la escuela (hdIntEscue)	Un hogar presenta esta carencia si no usa internet para la escuela.	3 %
	Internet para el entretenimiento (hdIntEntrm)	Un hogar tiene esta carencia si no usa el internet para el entretenimiento.	3 %
	Internet para el trabajo (hdIntTrab)	Un hogar tiene esta carencia si no usa el internet para el trabajo.	3 %
	Internet para las redes sociales (hdDatUsoRS)	Un hogar tiene esta carencia si no usa internet para las redes sociales.	3 %
	Internet para vender productos (hdDatVentas)	Un hogar tiene esta carencia si no usa el internet para vender productos artesanales.	3 %
Sanitación (10 %)	Agua HdAgua	Un hogar tiene esta carencia si no cuenta con agua en su casa.	5 %
	Fosa séptica hdFosaSep	Un hogar presenta esta carencia si no cuenta con fosa séptica.	5 %

Fuente: Elaboración propia

In addition, a scenario was outlined taking into account whether there was a public policy intervention; For this, new weights were reassigned to the dimensions and indicators, which is presented in Table 2.

Tabla 2. Reasignación de ponderaciones a las dimensiones e indicadores

Dimensión	**Indicador**	**Peso**
Salud (12 %)	Visita al médico general (hdFrViMed)	6 %
	Visita al médico especialista (hdVisespc)	6 %
Equipo en el hogar (25 %)	Aparatos eléctricos (hdApaElec)	12.5 %
	Vehículo (hdCar)	12.5 %
Nutrición (21 %)	Proteína (hdProteina)	7 %
	Vegetales (hdvegetales)	7 %
	Frutas (hdFrutas)	7 %
Características de la vivienda (12 %)	Habitaciones para dormir (hdHabit)	6 %
	Habitaciones con techo de loza (hdHabTecho)	6 %
Hogares con equipo de TIC, acceso a internet y a las redes sociales (5 %)	Red social (hdRedSoc)	1 %
	Frecuencia de uso de la red social (hdFrecUsRS)	1 %
	Internet (hdInternet)	1 %
	Computadora (hdPC)	1 %
	Teléfono celular (hdCelular)	1 %
Uso de internet (15 %)	Internet para la escuela (hdIntEscue)	3 %
	Internet para el entretenimiento (hdIntEntrm)	3 %
	Internet para el trabajo (hdIntTrab)	3 %
	Internet para las redes sociales (hdDatUsoRS)	3 %
	Internet para vender productos hdDatVentas	3 %
Sanitación (10 %)	Agua hdAgua	5 %
	Fosa séptica hdFosaSep	5 %

Fuente: Elaboración propia

The hypothesis proposed was the following: a multidimensional poverty index is an indicator that works as a measure to compare poverty indicators.

Results

Table 3 presents the aggregate measures of incidence and intensity according to the percentage of the poverty line, as well as the multidimensional poverty index. Similarly, Table 4 shows one-dimensional poverty, multidimensional poverty and the percentage of contribution to multidimensional poverty.

Tabla 3. Pobreza unidimensional

Línea de pobreza (k)	**Incidencia (H) %**	**Intensidad (A) %**	**Índice multidimensional de pobreza (IMP)**
10 %	99.19 %	55.29 %	0.548
20 %	98.39 %	55.97 %	0.551
30 %	87.71 %	55.67 %	0.488
40 %	73.44 %	64.69 %	0.475
50 %	63.43 %	67.99 %	0.431
60 %	43.91 %	67.98 %	0.299
70 %	26.52 %	73.51 %	0.195
80 %	10.16 %	86.68 %	0.088
90 %	4.30 %	91.06 %	0.039
100 %	0.00 %	NA	0.000

Fuente: Elaboración propia

Tabla 4. Pobreza multidimensional y porcentaje de contribución a la pobreza

Dimensión	Indicador	Pobreza unidimensional (%)	Pobreza multidimensional (%)	Contribución al índice multidimensional de pobreza (%)
Salud	HdFrViMed	69.8	32.72	6.49
	HdVisespc	77.33	39.15	7.76
Equipo en el hogar	hdApaElec	55.4	38.35	15.21
	HdCar	68.53	37.26	14.77
Nutrición	hdProteina	60.12	28.42	7.51
	hdvegetales	36.11	23.83	6.3
	hdFrutas	32.61	19.29	5.1
Características de la vivienda	HdHabit	50.62	30.31	6.01
	hdHabTecho	26	20.66	4.1
Hogares con equipo de TIC, acceso a internet y a las redes sociales	HdRedSoc	60.93	37.26	1.48
	HdFrecUsRS	64.14	37.26	1.48
	HdInternet	96.79	40.76	1.62
	HdPC	80.49	40.76	1.62
	hdCelular	21.32	14.42	0.57
Uso de internet	HdIntEscuela	93.58	40.76	3.23
	HdIntEntrm	80.49	37.54	2.98
	HdIntTrab	95.18	40.76	3.23
	HdDatUsoRS	73.26	38.35	3.04
	hdDatVentas	91.97	40.76	3.23
Sanitación	HdAgua	21.29	15.38	3.05
	hdFosaSep	8.56	6.15	1.22

Fuente: Elaboración propia

Table 5 shows the population, incidence, intensity and multidimensional poverty index by community; To do this, the k value of the poverty line was set equal to 50%, in such a way that a new value for the index is appreciated and it is perceived that the community of La Unión is the one most affected by poverty. Likewise, table 6 shows the percentage of contribution to poverty by region.

Tabla 5. Índice multidimensional de pobreza por comunidad

Comunidad	Población %	Incidencia % (H)	Intensidad % (A)	Índice multidimensional de pobreza (IMP)
La Unión	8.81	87.50	64.00	0.56
Las Flores	9.43	27.78	66.00	0.18
Tepelmeme	81.76	37.25	60.98	0.23
Municipal	100	40.76	61.87	0.25

Fuente: Elaboración propia

Tabla 6. Porcentaje de contribución por región

Indicador	Las Flores	Tepelmeme	La Unión	Municipal
hdFrViMed	6.06	6.47	6.70	6.49
hdVisespc	7.58	7.77	7.81	7.76
hdApaElec	15.15	15.10	15.63	15.21
hdCar	15.15	15.10	13.39	14.77
hdProteina	8.08	7.48	7.44	7.51
hdvegetales	10.10	6.04	5.95	6.30
hdFrutas	6.06	5.18	4.46	5.10
hdHabit	4.55	6.26	5.58	6.01
hd HabTecho	1.52	4.53	3.35	4.10
hdRedSoc	1.52	1.51	1.34	1.48
hdFrecUsRS	1.52	1.51	1.34	1.48
hdInternet	1.52	1.64	1.56	1.62
hdPC	1.52	1.64	1.56	1.62
hdCelular	1.52	0.52	0.45	0.57
hdIntEscuela	3.03	3.28	3.13	3.23
hdIntEntrm	3.03	2.93	3.13	2.98
hdIntTrab	3.03	3.28	3.13	3.23
hdDatUsoRS	3.03	3.02	3.13	3.04
hdDatVentas	3.03	3.28	3.13	3.23
hdAguar	0.00	2.37	6.70	3.05
hdFosaSep	3.03	1.08	1.12	1.22

Fuente: Elaboración propia

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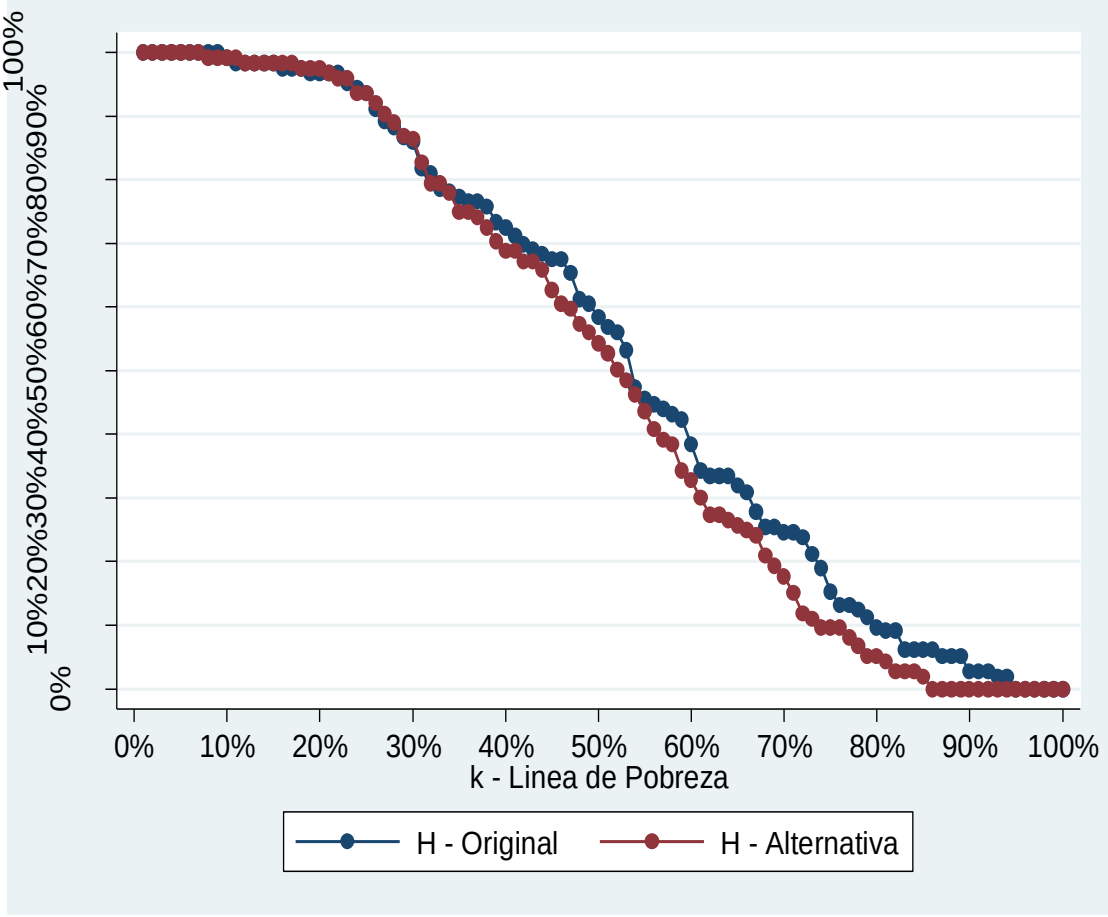
Public policy intervention

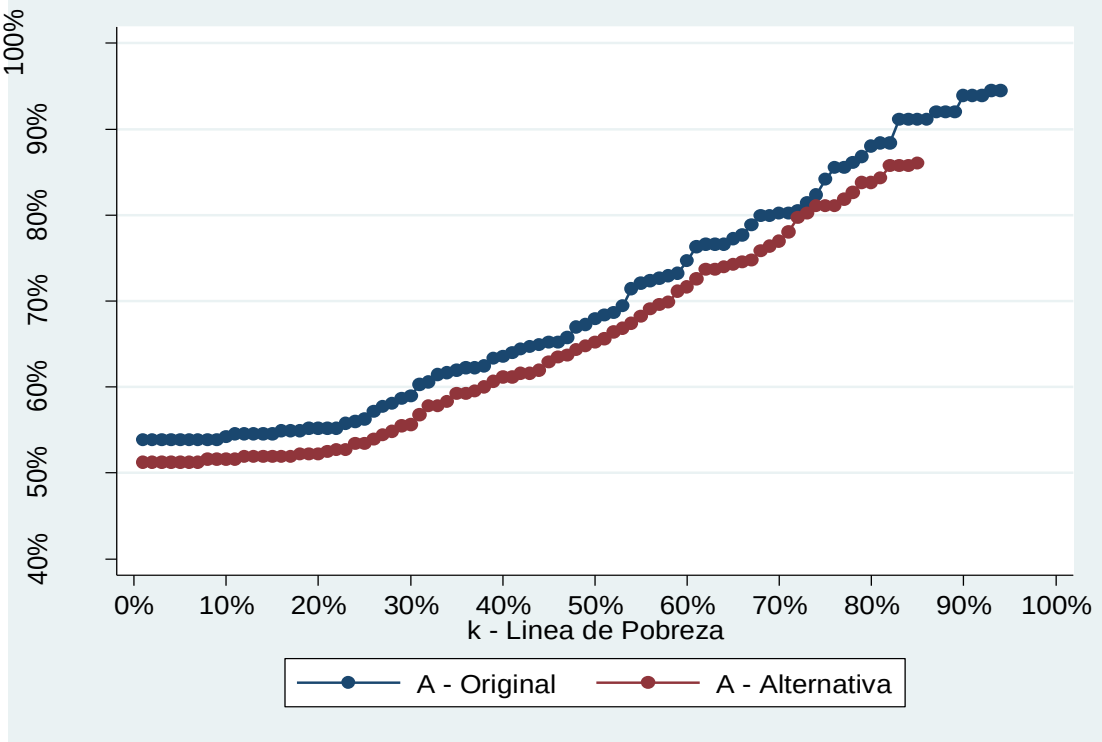
It is proposed that the government carry out an intervention and reallocate its budget (as indicated in Table 2) for the indicators with the highest poverty rates. In accordance with this idea, a reassignment was carried out giving a greater weighting to the dimensions of health, home equipment, nutrition, characteristics of the home, and a lower weighting to ICT and the internet. Once this was done, all the calculations were carried out again, which would reduce poverty if carried out. For this reason, figures 2 and 3 show comparisons of the incidence and intensity of poverty with original values and with values of public intervention; Likewise, Figure 4 shows the multidimensional poverty index, which is lower with said intervention.

Figura 2. Comparación de incidencia de la pobreza



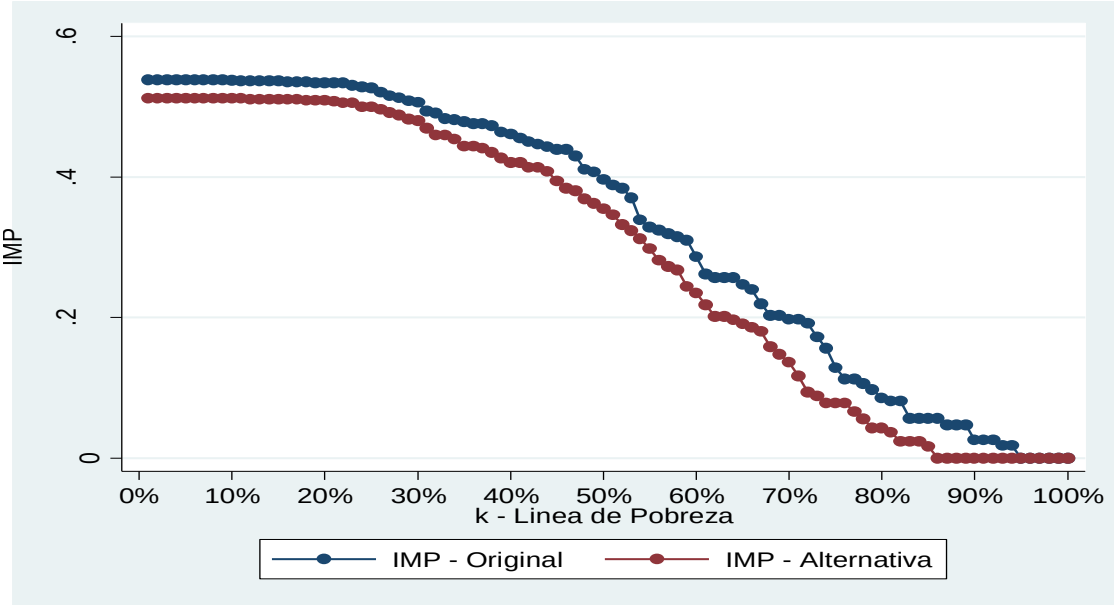
Fuente: Elaboración propia

Figura 3. Comparación de intensidad de la pobreza



Fuente: Elaboración propia

Figura 4. Comparación del índice multidimensional de pobreza



Fuente: Elaboración propia

Discussion

The results found that the multidimensional poverty index of the municipality of Tepelmeme Villa de Morelos in the state of Oaxaca had an average value of 0.431 (k = 50%), which is high compared to that reported by the world poverty index (Alkire, Kanagaratnam and Suppa, 2019). However, it is worth noting that there are some variants, since in this case 21 indicators were considered, including ICT. On the other hand, by standardization, 10 indicators are considered in the world poverty index. Even so, the important thing is to have a metric to be able to make comparisons.

Initially, Table 4 shows the one-dimensional poverty index —that is, the percentages of poverty for each indicator—, and it is perceived that the worst in the municipality has to do with the internet in households, as well as its use at school, at work and in sales, although health aspects are also highlighted. On the other hand, when using the Alkire and Foster methodology (Alkire and Foster, 2011), the poverty indicators have another behavior, since their evaluation is carried out in a multidimensional way. In this sense, the percentages decrease by almost half; For example, in the case of the internet, it was 96.79% in a unidimensional way, while in a multidimensional way it was 40.76%.

In the same table 4 the column of contribution to the multidimensional poverty index is given in percentages. This is where it is necessary to analyze which are the indicators that affect the index the most (in fact, other important indicators were found; see the red and orange colors in the table). In summary, it can be seen that the most serious thing is the home equipment (number of electrical appliances and automobile), in addition to health (frequency of visits to the general practitioner and specialist doctor), as well as nutrition or food (protein, vegetables and fruits), in addition to the characteristics of the home (number of sleeping rooms and rooms with tile roofs). The rest of the ICT indicators do not affect the index, while the use of the internet remains in a state of alert, but it is not serious.

Table 5 shows the population, incidence, intensity and multidimensional poverty index by community. It is observed that the most affected community is La Unión, since it has the highest rate, while the least affected is Las Flores. Likewise, Table 6 shows the contribution to the index by region or community. For the Las Flores region, the most serious problem is the equipment in the home (number of electrical appliances and cars), followed by food (vegetables) and then health (visit to the specialist doctor). For the Tepelmeme region the most serious is the equipment in the home (number of electrical appliances and automobile), then health (visit to the general practitioner and specialist) and food in terms of

protein (it also has alerts for vegetable deficiencies and lack of rooms to sleep). In the case of the La Unión region, the patterns of the indicators are similar, since the most serious thing is in the equipment at home, health, food and the lack of rooms to sleep.

With the data presented in tables 4 and 5, a public policy intervention was proposed. To do this, a reassignment of the weights to the indicators was carried out, which made it possible to reduce the incidence, intensity and multidimensional poverty index. In this sense, it is important that both the state government and the municipal government reallocate their budget items related to the variables with the highest percentage of contribution to the poverty index (household equipment, health and food) to reduce the poverty.

These reassignments must be carried out with quality, that is, there must be efficiency in the distribution of resources, for which it must have personnel trained in health, social and study programs, since these actions can reduce poverty in this area. municipality, as well as in others nearby (Leija and Saltillo, 2019; Sano et al., 2019; Zhou and Liu, 2019).

On the other hand, it is worth noting that one of the indicators that affect the poverty index in the municipality of Tepelmeme Villa de Morelos is the equipment in the home. For this reason, the government can coordinate with the World Bank some action within the framework of the Rural Finance Expansion Project to help the credit system in areas where the presence of traditional banks is scarce or non-existent. In this regard, it is important to mention that more than 150,000 loans have been granted and credit has been expanded for small-scale rural enterprises, with special emphasis on women and marginalized areas. (Banco Mundial, 2019).

On the other hand, the use of the internet in the municipality should not be neglected, because - although it does not contribute to poverty a percentage greater than 3.23% - it does present alerts; Furthermore, it must be remembered that the internet is a trigger for the digital economy (Mittal and Mehar, 2016). In effect, ICTs help the acquisition of materials (Pullanikkatil, 2019), as well as to review the weather forecasts for agricultural activities, which allows taking preventive measures for a better harvest (Liu et al., 2018).

In 2016 and 2018 an improvement was observed in Oaxaca, mainly in terms of access to basic services; for example, more people have access to piped water within the land and to electricity (Coneval, 2019). However, other priorities such as health and nutrition need to be addressed (Eigbiremolen and Ogbuabor, 2018; Sano et al., 2019).

In short, with the creation of the multidimensional poverty index, more effective actions can be taken (Padda and Hameed, 2018) according to the regions most in need

(Bernard et al., 2019). However, as stated above, these policies must be clear and focused on both providers and recipients of the resource.

Likewise, it is pertinent to indicate that this study can be replicated to optimize the intervention of public policies in municipalities with similar characteristics, although it should be emphasized that in order to see the efficiency of the municipality's management by uses and customs, it is necessary to monitor to short-term poverty indicators in order to measure the efficiency of management. For this reason, it is considered pertinent to investigate more about the efficiency of policies, since the present study only aimed to create an index for the generation of public policy to reduce poverty.

Finally, the limitations of this research are found in the classification by gender and age groups, since this requires extending the research to poverty of the population, and not of households. The strength of this study, on the other hand, is that it has a metric for households in a municipality considered rural by the number of inhabitants. The areas of weakness were not speaking including social cohesion, since in these places many meetings with friends are used, as well as the lack of indicators of educational lag. Another weakness is that by analyzing only the aforementioned municipality of Tepelmeme with its two communities (La Unión and Las Flores), the results are not representative at the national level. Even so, the conclusions can be extended to other nearby municipalities with similar social and economic characteristics.

Conclusions

The multidimensional poverty index in the municipality of Tepelmeme Villa de Morelos is a measure that includes the incidence and intensity of poverty both in the municipal seat and in two communities (La Unión and Las Flores). This can be used to analyze the percentage of poverty by indicator in a multidimensional way, as well as to examine the percentage of contribution to the poverty index of each indicator, which invites us to take measures in the field by a municipal management that must follow standards of effectiveness and efficiency.

In general, according to the data collected, it can be concluded that the indicators that most influence poverty are the lack of equipment in the home (number of electrical appliances with 15.21% and automobile with 14.77%), health deficiencies (visit to the specialist doctor with 7.76%) and the lack of nutrition (protein with 7.51%). Similarly, the lack of access to health in terms of the frequency of visits to the general practitioner (6.49%),

nutrition in terms of vegetables (6.3%) and rooms to sleep (6.01%). The rest of the indicators were less than 5%.

Finally, the indicators of the dimension Households with ICT equipment, access to the internet and social networks were those with the lowest percentages of contribution to the multidimensional poverty index. Likewise, the Internet use dimension presents indicators with a low contribution percentage to the index of 3% on average. Therefore, an adjustment was made in the weightings of the indicators to simulate a scenario of government intervention, thereby reducing the incidence, intensity and multidimensional poverty index.

Future Research Lines

It is urged to continue with research on the weighting of Households with ICT equipment, access to the internet and social networks, because in accordance with the literature of international organizations such as the United Nations (UN) and the Organization for Economic Cooperation and Development (OECD), have placed great emphasis on the fact that technological development is essential for economic development, therefore it is interesting to analyze the factors that make the results in this research have a lower impact.

Likewise, it is important to continue with research on the impact of ICTs on poverty, segmenting the samples by gender or age. Readers are encouraged to make use of the Alkire and Foster technique to create different poverty impact indices. However, it is also of great interest to measure the impact of public policies on poverty, using the same methodology as Alkire and Foster.

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