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Understanding Manta's Multidimensional Poverty Using Administrative Records

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Abstract

The formulation of public policies aims to guide and direct activities at various levels of government to address situations affecting social sectors within a specific territory. To address these needs, this study proposes the development of an indicator to characterize the population of Manta using a multidimensional poverty index, consolidating data on the consumption of basic services, and accessibility to health and education services. Data analysis is crucial for supporting public sector operations and making informed decisions. This study conducts a comprehensive analysis of multidimen-sional poverty in Manta in 2019, using the multidimensional poverty index (MPI) based on the Alkire & Foster methodology, which measures depriva-tions in health, education, and living standards. The innovation of this work lies in using alternative administrative data to calculate the MPI, providing a more accurate and efficient measure for public policy decision-making aimed at poverty reduction. This study not only classifies Manta's sectors based on consumption behaviors and service accessibility but also offers an essential tool for improving the population's quality of life through effec-tive public policies based on precise data.

Keywords: *Multidimensional Poverty Index; Manta; Alkire & Foster Methodology; Administrative records; Basic services consumption.*

Introduction

The evaluation of poverty extends beyond mere economic measures to encompass a multidimensional understanding of deprivation and well-being. In this study, we delve into the nuanced landscape of poverty within the census sector of canton Manta, Ecuador. We aim to capture the intricate interplay of various factors that underlie poverty in this region, by adopting a multidimensional approach. Our investigation seeks to shed light on the diverse dimensions of poverty experienced by the population of Manta, providing insights for informed policy interventions and targeted development initiatives.

In this context, measurements of multidimensional poverty have been developed to establish a comprehensive view of the family's situation at a given time. The United Nations Development Programme (UNDP), for its 2010 Human Development Report, defined three dimensions upon which the Human Development Index (HDI) is calculated: life expectancy, access to knowledge, and adequate living conditions. However, it leaves it up to each government to define their own dimensions that better fit their situation (Hill and Adrangi, 1999)

Several poverty studies based on a Multidimensional Poverty Index (MPI) have been developed based on the work of professors Sabina Alkire and James Foster, who first proposed a multidimensional methodology for poverty measurement in 2007 (Alkire and Foster, 2011).

According to Sánchez, Maturana, and Manzano (2020) and Arrobo and Zamora (2017), researching multidimensional poverty helps vulnerable households' living conditions and the implementation of governmental policies or measures meant to close the poverty gap. The Multidimensional Poverty Peer Network was founded in 2013 to assist economies using the MPI in developing public policies aimed at eradicating poverty (Zambrano Yépez et al., 2023). The aim of this study is to use administrative records from Manta and apply the Alkire & Foster methodology to establish a Multidimensional Poverty Index. This would help to assess the impact of local and central governments on the provision of basic, healthcare and education services. Our study draws a particular emphasis on the use of administrative records

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regarding the consumption of basic services such as drinking water and electricity by families in Manta. To carry out this study, administrative data from the Manta Municipality, the Ministry of Public Health, and the Ministry of Education for the year 2019 are employed. This data was aggregated at the census sector level, which encompasses the total number of families accessing each of the basic services, as family-level data cannot be used due to Ecuadorian legal regulations. Additionally, demographic and infrastructure information related to education, health, and utilities was incorporated into the analysis.

Thus, three key dimensions were utilized: Standard of living, Health, and Education, incorporating a total of seven indicators. With this MPI constructed applying Alkire & Foster methodology, it becomes apparent that 53.9% of the census sectors in Manta are experiencing multidimensional poverty. We established a poverty threshold of 0.5 to calculate the MPI for the Manta sectors. Furthermore, it was observed that the identified impoverished sectors account for approximately 69.78% of the total deprivations considered in the calculation of the MPI. Lastly, when considering the headcount ratio multiplied by the intensity of poverty, which stands at 37.62%, it implies that a significant portion of census sectors are grappling with substantial deprivations in at least one dimension.

This article is organized as follows. Section 2 reviews the literature on the factor of the selected dimensions that influence poverty. Section 3 details the data and the methodology used. Section 4 discusses the results. Finally, Section 5 concludes.

Literature Review

As per Amartya Sen, poverty is defined as the inability of a person to lead a life that is meaningful and involves meeting basic requirements and making meaningful choices. This understanding of poverty implies that a person's ability to live a fulfilling life can be impacted by a variety of factors, from personal characteristics to environmental situations. External variables are equally crucial in establishing favorable conditions for the development of individual talents, even when individual attributes play a part in determining poverty (Sen, 1976).

Poverty has been extensively examined at the macro-level, revealing a multitude of factors across environmental, demographic, and socio-economic dimensions. Demographically, studies have associated poverty with indicators such as infant mortality, birth rate, population growth, urbanization and female labor force participation, and the percentage of indigenous populations (Palmer-Jones and Sen, 2006; Petrucci et al., 2004; Charles Leija, 2019). In the environmental sphere, soil quality, temperature, rainfall, and arable land availability have emerged as crucial determinants (Petrucci et al., 2004; Zambrano Yépez et al., 2023). Socio-economically, general infrastructure (Palmer-Jones and Sen, 2006), and accessibility to services significantly influence poverty. Pérez Akaki and Fonseca Soto (2017) further underscore how educational facility distribution can exacerbate poverty in certain income-segmented areas.

Moreover, ensuring universal access to basic services is important for fostering inclusive urban development (Vázquez Brust and Zambrano Barragán, 2020). Consequently, the substandard infrastructure in these impoverished areas perpetuates a cycle of poverty (Pérez Akaki and Fonseca Soto, 2017). The disparities in infrastructure deficiencies may stem from favoritism prevalent in developing nations, where economic resources are often funneled disproportionately into major urban centers, leaving smaller ones neglected (Amis and Kumar, 2000). Within this framework, existing literature indicates that local governments can influence to secure access to power and resources by defining local public policy (Bossuyt and Gould, 2000), thereby benefiting poverty areas. Indeed, numerous examples of local initiatives illustrate that the interventions of local authorities in slum areas can significantly enhance the living conditions of impoverished residents (Serageldin et al., 2006).

Education level, health status, and access to basic services are highlighted in the literature as important external variables (Medeiros et al., 2021; Moser and Felton, 2007; Muñoz et al., 2018). When it concerns education, for example, a person with high cognitive abilities might want to go to school, but if there are no schools in the area because of inaccessible roads (Petrucci et al., 2004), poor infrastructure for health and education, high

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rates of unemployment (Charles Leija, 2019), or expensive transportation, they will not be able to pursue their education under the right circumstances.

In the Ecuadorian context, Petrucci et al. (2004) examined the dynamics of household poverty using data from the 1995 Survey on Life Conditions. Their study highlighted the importance of environmental elements such as access to irrigation systems and roads, emphasizing their impact on impoverished households. Notably, insights gleaned from the article on Zambrano Yépez et al. (2023) further enrich this understanding. Previous research on poverty in Ecuador, including studies conducted by Farrow et al. (2005) and Jiménez and Alvarado (2018), primarily relied on Census Data, which is constrained by its availability only every ten years. In contrast, our study utilizes administrative records, providing annual updates. By utilizing data from 2019, capturing pre-pandemic conditions, we sourced variables from various sources. Our analysis encompasses various factors, such as socioeconomic attributes, educational and healthcare facilities, and the availability of basic services within the canton of Manta. As a result, we incorporate insights derived from administrative records specific to Manta, offering an additional perspective on multidimensional poverty.

The National Statistical and Census Institute of Ecuador (INEC) developed a multidimensional poverty indicator with four dimensions and twelve indicators, based on Alkire & Foster methodology. This initiative aligns Ecuador with countries adopting a multidimensional approach to assess poverty, in accordance with the Sustainable Development Goals (SDGs) promoted by the United Nations. This indicator represents the proportion of people living in households experiencing deprivations in at least one third of the weighted indicators (K >= 33.3%) (INEC, 2023b).

Another multidimensional poverty index used in Ecuador, as well as in other countries, is the Unsatisfied Basic Needs Index (UBNI). According to the INEC, the UBNI is a measure of multidimensional poverty developed in the 1980's by the Economic Commission for Latin America and the Caribbean (ECLAC). The method encompasses dimensions, with indicators within each dimension measuring deprivations that includes non-monetary criteria like access to basic education, housing conditions, access to basic services, all of which are indicators of household deprivation (INEC, 2023a).

As of December 2023, Ecuador reported an income poverty rate of 26%. Notably, poverty is more pronounced in rural areas, where it stands at 42.2%, compared to 18.4% in urban regions. Moreover, poverty rates based on unsatisfied basic needs (UBN) and multidimensional measures were 30.8% and 37.3%, respectively. Similarly, rural areas experience higher poverty rates based on both UBN (52%) and multidimensional measures (67.9%) compared to urban areas, with rates of 21% and 23%, respectively (INEC, 2024). These disparities in poverty metrics suggest that poverty encompasses more than just income inadequacies; it reflects limited opportunities for socioeconomic advancement, attributed to factors like inadequate access to education and healthcare (Sen, 1976). Poverty tends to concentrate in regions underserved by government interventions (Delgado Narro, 2020). In Ecuador, the bias toward major cities has contributed to their development at the expense of less developed areas. Although national budget allocations now consider poverty incidence, local governments in high-poverty areas face operational challenges due to limited capacity. Notably, there exists a negative correlation (-0.21) between poverty and the operational capacity index of local governments.

Study Context: Manta, Ecuador - "The Gateway to the Pacific"

Manta, in Ecuador's Manabí province, as an emerging urban center known for its vibrant fishing, commercial, and tourism sectors, making it a top destination. Despite significant economic progress, there's a need to examine its sustainability. Severely impacted by the 2016 earthquake, Manta is still recovering but remains a vital city for Ecuador. Known as "The Gateway to the Pacific," it boasts a major fishing port and thriving businesses, notably in fishing, real estate, tourism, and import-export, with its tuna sector alone contributing 70% to the national GDP (Zambrano Yépez et al., 2023).

According to the 2022 Population and Housing Census, there are 271145 inhabitants, 18.94% of the province's population, making it the second most populous city in Manabí province, with 48% being men and 52% being women. The population is predominantly concentrated in the urban area, accounting for 95%,

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while the remaining 5% reside in rural area. There are two rural and five urban parishes in Manta (Zambrano Yépez et al., 2023).

Despite Manta's abundant productive potential, its benefits are not equally distributed among the entire population. This is evident from data in the INEC Economic Census by 2010, which highlights deficiencies in services such as potable water supply, sanitation and sewage systems, public security, among others. These deficiencies contribute to issues of poverty and social inequality (Sabando et al., 2018). Economic growth indicators do not translate into social development parameters. For example, while the public sewage system serves more than 50% of the urban population, marginalized urban and rural areas lack this service. Similarly, although the public potable water network is installed in approximately 81.58% of urban households, not all families receive a reliable supply of water, relying instead on alternative sources like water trucks, shallow wells, or natural springs. The same disparity is seen in the public lighting network, which is insufficient in rural areas, highlighting issues of inequality among the population (GAD Manta, 2021; Sabando et al., 2018).

According to the UBN index based on data from the 2010 Population and Housing Census, 99% of people living in the rural areas and 53% of those living in the urban areas of the canton of Manta are considered poor. The overall poverty rate by UBN in the canton reaches 55%. This measurement and distribution of poverty provide a socio-spatial characterization of the canton, indicating that people in rural areas have significantly lower living conditions compared to those in urban areas (GAD Manta, 2022).

The 2021 Social Register shows that the Canton of Manta has a 20% of families in poverty out of total surveyed families. It provides socioeconomic and demographic information on poor and extremely poor populations, focusing on those in the two lowest deciles of per capita consumption and collecting data on marginalized areas identified by the Unsatisfied Basic Needs (UBN) index.

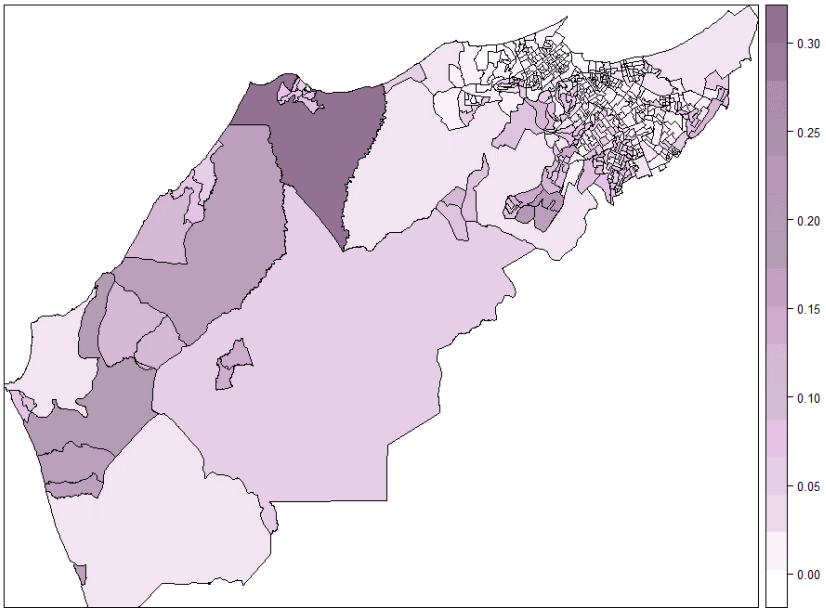

Figure 1. Distribution of the percentage of poor people of Manta, according to Social Register Index, per census sector

Source: Social Register Database, 2019

Methods

Numerous studies on poverty have utilized the Multidimensional Poverty Index (MPI), which is based on the pioneering work of professors Sabina Alkire and James Foster. This methodology requires selecting

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weights for different dimensions and indicators, which are used to construct the MPI. These weights should align with the overall objectives of the measure that reflect the importance of various aspects of poverty and the method of data collection. Normative techniques are employed to establish weights based on value judgments, and it is essential that these weights are well justified and be thoroughly discussed and analyzed in advance to ensure that the resulting poverty index is both accepted and useful (Alkire and Foster, 2011; Alkire et al., 2015).

In line with this methodology, the adaptability in design enables the customization of measures at either the national or subnational level to mirror the predominant priorities or standards related to poverty. The rationale behind the utilization of diverse weights in developing an MPI is as follows:

In this way, poverty cutoffs were established for allowing people to choose not to participate, if they so desire, but also attempts to identify those who are deprived because of forced deprivations. This method lowers identification errors, allowing those who would want to abstain from avoiding being labeled as impoverished and lowering the possibility of incorrect data labeling someone as impoverished. It has been shown that among the impoverished, higher numbers of deprivations are correlated with higher degrees of poverty.

When a measure is released, it may be the result of a high-level normative assessment that its distribution will likely improve welfare more than its withholding. A thorough comprehension of the existing situation frequently informs this decision. Specific decisions in measurement design, such as the choice of measurements, weights, and poverty cutoffs, are, at a minimum, guided by value judgments. Measures can be customized to reflect current objectives or conventions about poverty because measurement designs are inherently flexible.

In assessing progress over the short- or medium-term, relative weights can indicate how important it is to address deprivations first. For example, because education is so important, a region with high levels of educational attainment but inadequate road infrastructure may emphasize education in long-term poverty measures, yet participatory planning efforts may give road infrastructure a higher priority to address immediate needs.

In this study, the following variables are used that contain amenity-related variables, and utility consumption-related variables (see details in Table 1).

Table 1. Description of variables and information sources

Variable name	Variable description	Information source
Amenity Central government related variables		
Education centers	Number of education centers per census sector	Ministry of Education of Ecuador (MINEDUC)
Health centers	Number of health centers per census sector	Ministry of Public Health of Ecuador (MSP)
Amenity Local government related variables		
Sewerage	Access to sewage system	Municipality of Manta
Public transportation	Access to public transportation	Municipality of Manta
Waste collection	Access to waste collection	Municipality of Manta
Utility Consumption related variables		
Consumption of potable water	Average consumption of potable water per family per census sector. A water meter per family is assumed.	Municipality of Manta
Consumption of electricity	Average consumption of electricity per family per census sector. An electricity meter per family is assumed.	Municipality of Manta

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Selection of dimensions and indicators

Several dimensions and indicators are susceptible to be used, as some aim to verify the fulfillment of human rights in a locality. For example, for 2018, at least five out of ten indicators of the Global MPI were aligned with the achievement of the Sustainable Development Goals (SDGs) of the United Nations' 2030 agenda. According to Alkire and Foster (2011), the weighting of dimensions and indicators can be equal, reflecting the same weights based on implemented public policies, or different, as some countries determine differently.

In this sense, to construct the multidimensional poverty indicator for the census sector in Manta, three dimensions were employed: standard of living, health, and education, applying the dimensions proposed for calculating the Human Development Index (HDI) developed by the UNDP (2010).

The first dimension comprises seven variables, two of which are numerical, and the remaining five are binary. Conversely, the dimensions of Health and Education were each represented by a single indicator: the number of health centers and the number of educational centers, respectively (Table 2).

Table 2. Dimensions and indicators

Dimension	Indicator	Data Indicator Type
Standard of living	Average consumption of potable water	Numerical
	Average consumption of electricity	Numerical
	Access to public transportation	Binary (0: no; 1: yes)
	Access to waste collection	Binary (0: no; 1: yes)
	Access to sewage system	Binary (0: no; 1: yes)
Health	Number of health centers	Binary (0: no; 1: yes)
Education	Number of educational centers	Binary (0: no; 1: yes)

A recoding of the numerical variables into binary ones was done for the indicators related to health and education. This was done to convert numbers into presence indicators and more precisely record the availability of health and educational services. This was justified since, in the case of health, most of the data points were concentrated at 0 or 1. Similarly, in the case of education, there were outliers in about 2.88% of the data, suggesting that certain census sector had more than one educational facility.

Structure of weighting of dimensions and indicators

Under this approach the dimension of Standard of living has a greater weight due to the presence of indicators related to basic services such as access to drinking water, electricity, sewerage, public transport and garbage collection. These services are critical to poverty reduction in a census sector, as they continuously influence the quality of life of its inhabitants. Therefore, giving greater importance to this dimension reflects the importance of ensuring access to these services as part of efforts to address multidimensional poverty.

Hence, the weighting of indicators was re-adjusted, which is to give a differentiated weight to indicators of average water and electricity consumption, by considering them as essential components of the basic services that determine living conditions, as opposed to services such as transport and garbage collection, which are fewer primary services, so they have a lower weighting.

For the other indicators, they will be equitably weighed as indicated below. In Table 3 the percentage participation of each indicator is shown.

Table 3. Percentage of participation of each indicator

Dimension	Indicator and Description	Weight	Weight

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		Indicator	Dimension
Standard of living	Average drinking water consumption in cubic meters per water meter. A water meter per family is assumed.	21.43%	71.43%
	Average electric light consumption in KwH per electricity meter. An electricity meter per family is assumed.	21.34%	
	Public transportation service	7.14%	
	Waste collection service provided by the municipality	7.14%	
	Sewerage network service provided by the municipality	14.29%	
Health	Presence of health centers (MSP)[1]	14.29%	14.29%
Education	Presence of educational centers (MINEDUC)[2]	14.29%	14.29%

[1] MSP - Ministerio de Salud Pública de Ecuador (Ministry of Public Health of Ecuador)

[2] MINEDUC – Ministerio de Educación Ecuador (Ministry of Education of Ecuador)

Deprivation thresholds

Alkire-Foster's methodology refers to the existence of "two levels of thresholds" one threshing point for each indicator (to determine whether the identification unit is private or not in every indicator) and one poverty line (to establish whether the identifying unit is multidimensional poor) (Alkire and Foster, 2011).

To determine the deprivation threshold in indicators, it is considered that, in the dichotomic variables, the deprivation of service is met in those indicators where the responses indicate the absence of a service.

Waste collection is an essential service whose absence has a significant impact on the health and well-being of families, especially in the poorest areas. The literature on health emphasizes that the lack of resources and services such as garbage collection amplifies deprivation in disadvantaged neighborhoods, contributing to unhealthy living conditions. Environmental injustice also plays an important role, as poor areas are more likely to have environmental health threats, such as landfill sites. Lack of home garbage collection not only increases the risk of disease, but also perpetuates the cycle of poverty and marginalization of these communities (Angulo et al., 2016).

The deprivation of transport occurs when the census sector lacks this service, because it is important to supporting economic growth, creating jobs and connecting people with essential services, such as healthcare or education (World Bank, 2023).

The privatization of the sewerage service occurs when the sector lacks it. It is a basic human right and necessity for everyone to have access to proper sanitation. Ensuring everyone has access would have an important effect on lowering disease and mortality rates, especially among children (UNICEF, 2023).

Those sectors that have not educational centers are considered deprived, because education promotes equality between people and build stronger communities in cities. Education is important for building professional capacity (UNESCO, 2022).

The provision of healthcare is widely recognized as a basic human right essential for safeguarding the well-being and safety of communities, underscoring the pivotal role of health services in both society and the economy. Central to the delivery of healthcare are healthcare professionals, without whom healthcare provision would be impossible. To tackle the global shortage of health workers and ensure fair access to high-quality healthcare services, it is essential to offer healthcare professionals suitable working conditions and employment opportunities (ILO, 2023). Furthermore, a society with deficiencies in access to and availability of healthcare services hinders the development of work, economy, and education sectors, leading to a stagnation in the well-being of the population and an increase in poverty. In this sense, the absence of a primary healthcare facility or unit, a sector is considered deprived.

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In relation to the numeric variables of average consumption of potable water and electricity, the quintile technique is employed to determine the deprivation threshold. This methodology divides the data into five equal groups, using the second quintile as a reference in this case. This practice is commonly used and is based on the analysis of data distribution, allowing the identification of sectors that may be particularly disadvantaged or vulnerable, as well as those at risk of deprivation, even if they do not reach the strict threshold of the first quintile.

The deprivation thresholds per indicator are shown in Table 4.

Table 4. Deprivation thresholds per indicator

Dimension	Indicator	Deprivation Threshold
Standard of living	Average drinking water consumption in cubic meters per water meter. A water meter per family is assumed.	10.61 cubic meters
	Average electric light consumption in KwH per electricity meter. An electricity meter per family is assumed.	16476 KwH
	Public transportation service	1 = Presence
	Waste collection service provided by the municipality	1 = Presence
	Sewerage network service provided by the municipality	1 = Presence
Health	Presence of health centers (MSP)	1 = Presence
Education	Presence of educational centers (MINEDUC)	1 = Presence

Poverty threshold

Most MPIs use an intermediate criterion that identifies as poor those units that are deprived in a complete dimension or, alternatively, deprived in strictly more than one dimension. The recommendation is that, based on the combination of statistical criteria and subjective poverty assessments, a threshold of 1/3 is selected (Santos, 2019).

Considering the UBN Index for Manta, the following data is presented in Table 5.

Table 5. Tabulated poverty by Unsatisfied Basic Needs Index.

Population			Percentage		
Non Poor	**Poor**	**Total**	**Non Poor**	**Poor**	**Total**
100963	122800	223763	45.1%	54.9%	100.0%

Source: National Statistical and Census Institute (INEC, 2023a)

The selection of the poverty threshold of 0.5 for calculating the Multidimensional Poverty Index (MPI) in the sectors of Manta is grounded in the Table 5, derived from the tabulated poverty of the 2010 Census, indicate that around 54.9% of the population of Manta is classified as poor. By using a threshold of 0.5, it is found that 53.9% of the census sectors are considered poor. Furthermore, several tests were conducted with other thresholds, which yielded extreme and restrictive results, as evidenced in Figure 2.

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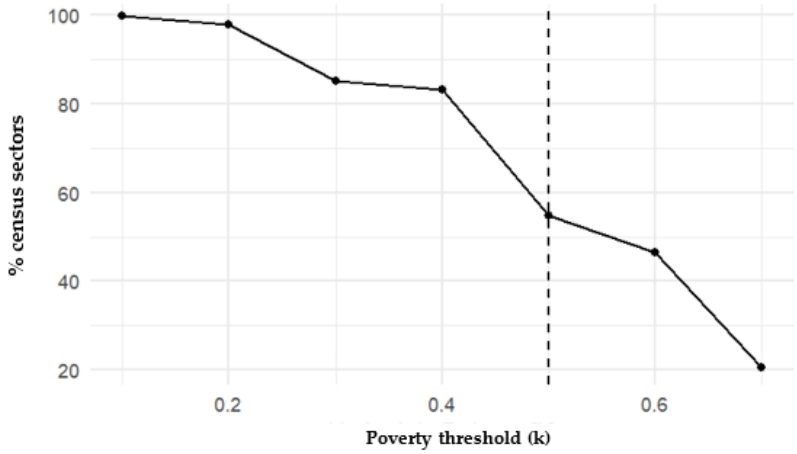

Figure 2. Percentage of census sectors classified as poor for different poverty thresholds (k).

Calculation of the indicator

Once the dimensions, indicators, weights and deprivation thresholds are defined, the calculation of the MPI proceeds. The construction of an MPI, using the Alkire and Foster methodology, is based on the measurement M_0, also called the *adjusted count rate* (Alkire and Foster 2011). The following description is taken from Santos and Villatoro (2016) and Santos (2019).

Let $xij \in \mathbb{R}+$ be the achievement of each person $i = 1, \ldots, n$ in each indicator $j = 1, \ldots, d$, and let zj be the deprivation cut-off of indicator j. A person is deprived in this indicator if their achievement falls below the deprivation threshold. Formally, deprivation is defined as $g_{ij}^0 = 1$ when $xij < z$j and $g_{ij}^0 = 0$ otherwise. Each person's deprivation is weighted by the indicator weight, given by wj, such that $\Sigma j\ wj = 1$. From this, a deprivation score is computed for each person, defined as the weighted sum of deprivations $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$. Then, using this deprivation score, the poor are identified using a second cut-off, the poverty threshold denoted by k, which represents the minimum proportion of deprivations a person must experience to be identified as poor. That is, someone is poor when $ci \geq k$.

The deprivations of those who are not identified as poor are then ignored; technically, they are censored. Formally, censored deprivations are defined as $g_{ij}^0(k) = g_{ij}^0$ when $ci \geq k$ and $g_{ij}^0(k) = 0$ otherwise. Similarly, the censored deprivation score is defined as $ci\ (k) = \sum_{j=1}^{d} w_j g_{ij}^0$.

Once multidimensionally poor individuals have been identified, the M0 measure combines two fundamental sub-indices: the proportion of people who are multidimensionally poor (also called poverty incidence) and the intensity of their poverty or the (weighted) average of deprivations among the poor. Formally, the proportion of poor people is given by $H = q/n$, where q is the number of individuals identified as poor. The intensity of poverty is given by $A = \sum_{i=1}^{n} c_i(k)/q$. The MPI, like the M0, is the product of these two sub-indices:

$$MPI = M_0 = H \times A = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{d} w_j g_{ij}^0(k), \quad (1)$$

Results

The Alkire Foster methodology is quite flexible as it proposes the construction of the indicator through the weighting of dimensions and indicators, as well as the assignment of deprivation thresholds by the researcher. Therefore, it must be theoretically substantiated. To validate this approach through testing, the

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non-parametric Wilcoxon rank-sum test, also known as the Mann-Whitney U test, was conducted. This test is used to compare the medians of two independent samples, particularly when the variable of interest, in this case the number of individuals, does not follow a normal distribution. In this context, the test was applied to determine if there are differences between the medians of individuals in poor and non-poor sectors, for which the following hypotheses are established:

$$H_0: \text{Median of Group 1} = \text{Median of Group 2} \quad (2)$$

$$H_1: \text{Median of Group 1} \neq \text{Median of Group 2} \quad (3)$$

The result was a p-value of 7.054e-06, which is very small compared to an alpha of 0.05, suggesting that there is a significant difference between the medians of the two groups. Therefore, it is concluded that the indicator shows a difference between poor and non-poor sectors in terms of the number of individuals.

Hence, according to previous results and with the explained methodology, it is observed that 53.9% of census sectors are in a situation of multidimensional poverty in Manta. (Figure 3)

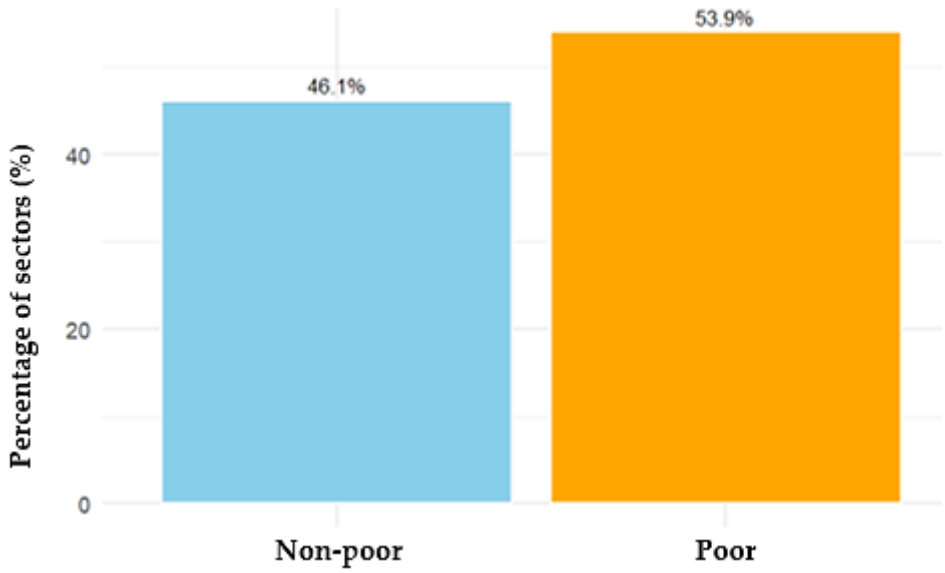

Figure 3. Percentage of census sectors classified as poor and non-poor

Regarding the intensity of poverty, represented by A = 69.78%, it indicates that the identified poor sectors experience approximately 69.78% of the total deprivations considered in the calculation of the multidimensional poverty index. Finally, considering the headcount ratio multiplied by the intensity of poverty, the adjusted headcount ratio, M0, which is 37.62%, suggests that a significant portion of census sector faces significant deprivations in at least one dimension, considering the seven indicators analyzed.

Below, the Figure 4 shows the contribution of each indicator to the MPI, it is visualized in a bar chart, highlighting the significance of each case. The contribution of each indicator to the Multidimensional Poverty Index (MPI) was assessed to understand its significance in capturing poverty dimensions. Results revealed that indicators related to education and health had a substantial contribution to the MPI, indicating their importance in identifying poverty levels within the studied population. Additionally, the consumption of basic services accounted for nearly 15% of the MPI, indicating citizens' behavior regarding their use of residential

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water and electricity services, which impacts the measurement of multidimensional poverty. This finding is noteworthy as it is derived from administrative records of service-providing companies, as indicated by Anderson et al. (2017).

One significant result is that access to sewerage, waste disposal, and public transportation, which collectively represent 23% of the MPI, underscores the role of municipal service infrastructure in calculating multidimensional poverty measures. This finding aligns with Medeiros' assertion in their article that everything contributed by the local government affects poverty reduction in the locality Medeiros et al. (2021).

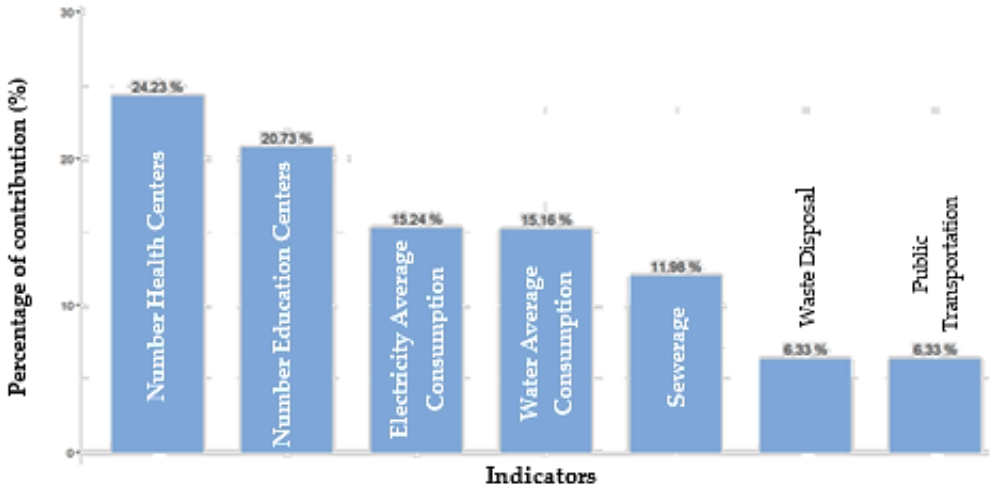

Figure 4. Contribution of each indicator to the MPI

Figure 5A reveals the distribution of deprivations by sector (rural, urban, urban-rural) across three levels of deprivation (5, 6, and 7), which represents 39% out of total Manta's sectors. Urban areas overwhelmingly domine in all categories, particularly with 5 and 6 deprivations, where they represent 97.25% and 94.03% respectively out of the total sectors. Rural areas have a higher proportion of 7 deprivations (15.38%) compared to 5 and 6 (1.83% and 5.97%), while urban-rural sectors show minimal representation, with no sectors reported for 6 deprivations but small percentages for 5 and 7 deprivations (0.92% and 7.69%).

Overall, urban sectors account for 94.71% of all deprivations, highlighting a significant concentration of deprivation in urban settings. This suggests that targeted policies and interventions are particularly needed in urban areas to address the high levels of deprivation. In contrast, rural and urban-rural areas, though less represented, also require attention, especially in addressing higher-level deprivations in rural sectors.

Figure 5B shows the distribution of deprivations across Rural, Urban, and Urban-Rural areas for three deprivation levels (5, 6, and 7). Urban areas predominantly suffer from 5 deprivations (94%) and have significant 6 deprivations (35%), while only 6% experience 7 deprivations. Rural areas are mostly affected by 6 deprivations (50%), with minimal impact on 5 and 7 deprivations (25% each). Urban-Rural areas are equally split between 5 and 7 deprivations (50% each), with no 6 deprivations. This indicates the need for tailored interventions: urban areas need focus on reducing 5 deprivations, rural areas on 6 deprivations, and urban-rural areas on both extremes.

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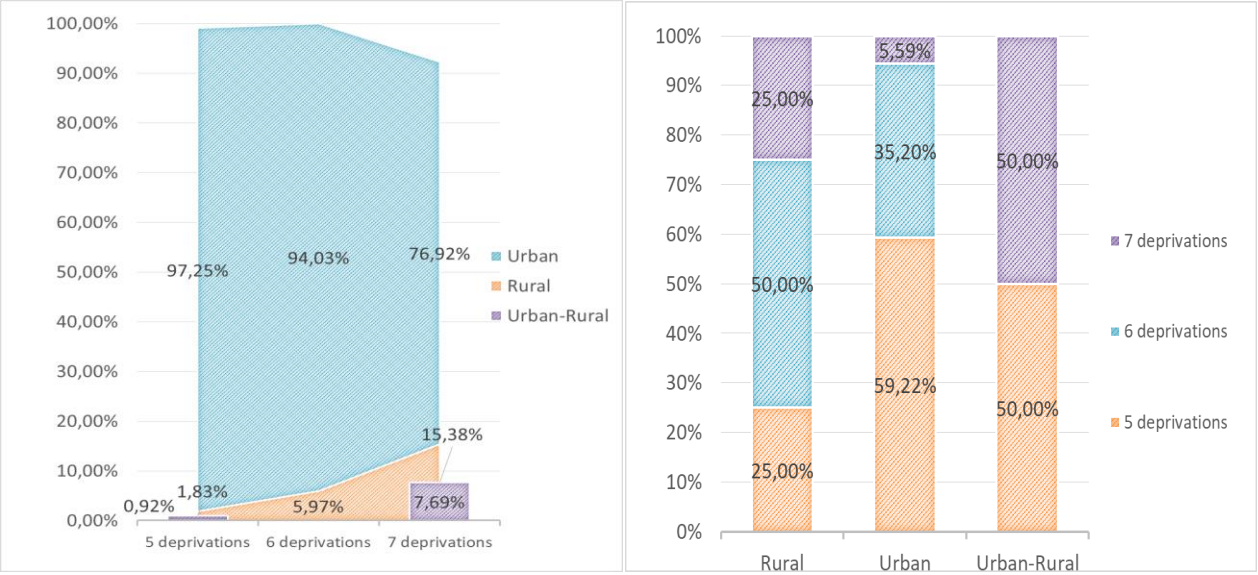

Figure 5. (A) Distribution of deprivations; (B) Distribution by area

Figures 6 shows the distribution of various public service and infrastructure indicators across the census sectors. Out of 486 sectors, 50% lack access to garbage collection and public transportation, indicating that half of the population does not have basic waste management and mobility services. Sewer access is unavailable to 47% of the sectors, slightly less than half, suggesting a need for improvement in sanitation infrastructure. The average consumption of potable water and electricity is reported to be below the service limits (10 m3 and 16,000 kWh) in 40% of the sectors, highlighting a moderate level of access to these essential services or limited availability of these resources.

Additionally, the absence of health and educational centers is quite high, with 96% of the sectors lacking health centers and 82% without educational institutions, underscoring a significant deficiency in essential infrastructure for health and education in these sectors. This may also be due to the location of health and education centers depending on policies defined by the respective ministries. This scenario suggests a need for intervention to establish and improve access to these services in the affected areas, as the lack of health and educational centers can have long-term negative consequences on the community's well-being and development.

However, the lower percentages in other services such as garbage collection, transportation, and sewer access indicate specific areas needing targeted interventions to improve the overall quality of life in these sectors.

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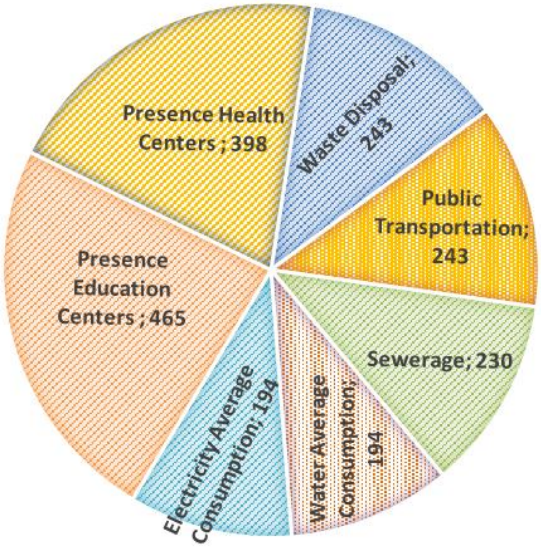

Figure 6. Distribution of sectors with deprivations in the indicators

Figure 7 illustrates the number of sectors that lack various public services and infrastructure in rural, urban, and urban-rural areas, along with the corresponding percentages. Urban sectors exhibit significant gaps in waste disposal and public transportation services, with 235 out of 486 sectors (48.4%) lacking these services, compared to only 7 sectors (1.4%) in rural areas and 1 sector (0.2%) in urban-rural areas. Sewerage is absent in 213 urban sectors (43.8%), 14 rural sectors (2.9%), and 3 urban-rural sectors (0.6%). Similarly, 178 urban sectors (36.6%) lack adequate water consumption, compared to 13 rural (2.7%) and 3 urban-rural sectors (0.6%). Electricity consumption deficiencies are found in 182 urban sectors (37.4%), 9 rural sectors (1.9%), and 3 urban-rural sectors (0.6%). A staggering 450 urban sectors (92.6%) lack educational centers, with rural (12 sectors or 2.5%) and urban-rural (3 sectors or 0.6%) also showing deficiencies. Health centers are absent in 391 urban sectors (80.5%), while rural areas have 5 sectors (1.0%) and urban-rural areas have 2 sectors (0.4%) without these facilities. This data highlights significant disparities in access to essential services and infrastructure, particularly in urban areas, indicating a critical need for targeted interventions to improve service availability in underserved sectors.

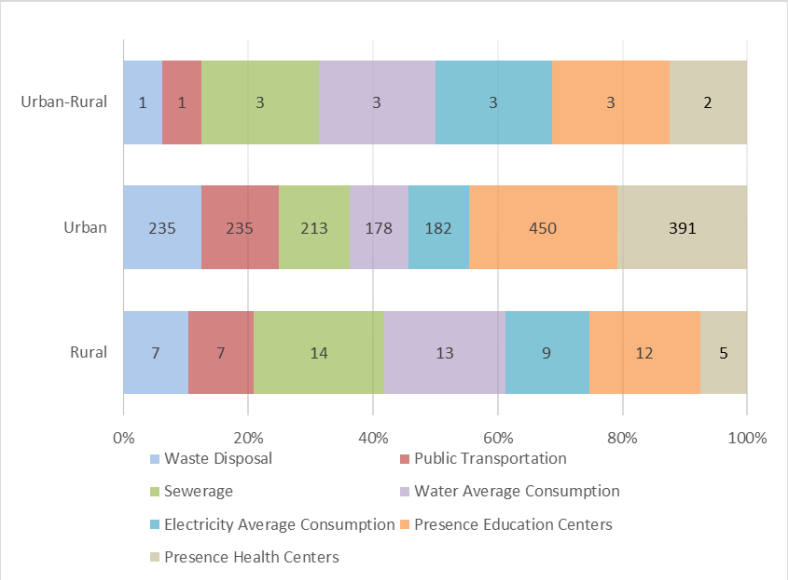

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Figure 7. Distribution of sectors with deprivations in the indicators by area

Figure 8 shows a spatial representation of the multidimensional poverty index (MPI) calculated in the census sectors of Manta. The blue colors indicate a lower poverty rate, while the orange colors indicate higher poverty rates.

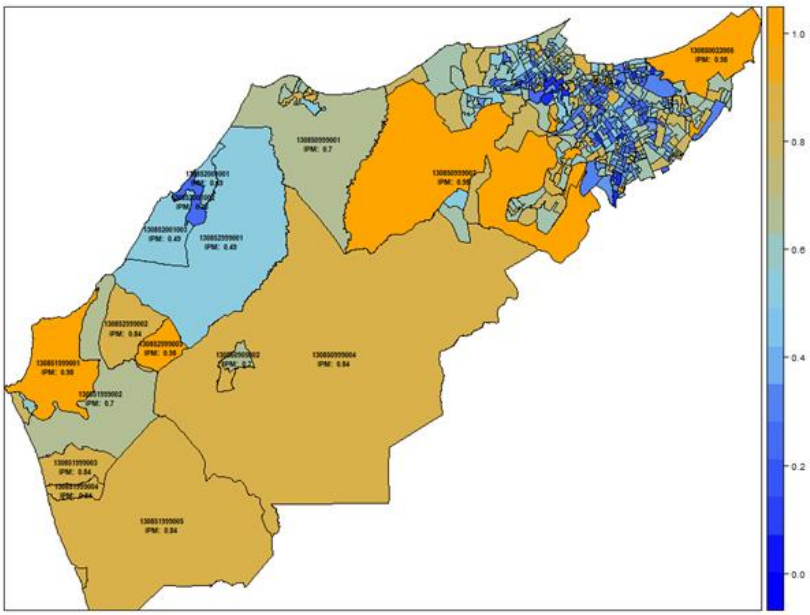

Figure 8. Distribution of sectors by MPI calculated

The following is an analysis of the map:

- Urban and Rural Distribution: The highest concentration of sectors is in the urban area of Manta, which is evident by the density of subdivisions in the northeastern part of the map. Rural areas, represented by larger and less subdivided sectors, are mainly located in the western and southern regions of the map;

- Poverty Patterns: The non-poverty areas (blue) are mainly located in the northeast, which coincides with the most densely populated urban areas. This suggests that urban areas have better indicators of multidimensional well-being based on the administrative records used, possibly due to improved access to basic services, municipal infrastructure, access to education and health. The poorest areas (orange) are scattered across rural areas and some peripheral areas of the city. The larger sectors in the west and south of the map show high MPI, indicating that these regions face greater challenges in terms of multidimensional poverty, which may be due to lower provision of municipal public services, fewer educational and health centers, or lower consumption of water or electricity services;

- Contrasts and Clusters: A noticeable contrast is observed between urban and rural sectors. While urban areas have lower rates of poverty, rural areas have higher rates. High poverty clusters exist in rural and some peripheral areas of the city, which may indicate inequalities in the distribution of resources and services.

When comparing MPI results (Figure 8) with those of the Social Register (Figure 1), both maps represent the poverty situation in the census sectors of Manta, but use different methodologies and data for their calculation. The Multidimensional Poverty Index (MPI) and the Social Register offer two complementary perspectives on poverty.

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The MPI uses administrative records from all sectors, providing a comprehensive view of poverty. It includes a combination of indicators of education, health, access to basic services and living conditions. The Social Register prioritizes sectors with unsatisfied basic needs (NBI) ≥ 50%, focusing on more vulnerable areas, with a focus on prioritizing poorer sectors, which may not be universal. Both methodologies consistently identify areas with high poverty in the west and southwest of Manta. This reinforces the need for focused interventions in these areas.

In short, although the two maps use different methodologies and approaches, both are useful to understanding and addressing poverty in Manta. Integrating the findings of both can provide a solid basis for planning and implementing effective public policies.

Discussion

The aim of this study was to use the administrative records from Manta and apply the Alkire & Foster method in order to create and validate a Multidimensional Poverty Index (MPI). We identified data sources, relevant dimensions, inference techniques, in addition to how the multidimensional poverty indicator could help public decision-making. The proposed MPI was validated by the results, making it useful for formulating policies. A multidimensional poverty measure for census sectors of Manta was attained through alternative data sources and appropriate techniques.

The selection of dimensions and indicators for constructing the MPI was one critical point that affected the results and nature of the analysis. Various dimensions of poverty in Manta were captured by using administrative records as a secondary source. Education emerged as a significant dimension indicated by such factors as availability of schools and their quality. Areas with fewer educational centers tend to be more deprived; thus, there is need for government policies aimed at improving access to education and its quality. (Berner and Van Hemelryck, 2020; Castillo and Jácome, 2015).

Another important element to be considered is health, which had indicators such as the existence of health centers and the availability of medical services. Previous studies have found that people living in areas with fewer health facilities tend to suffer more compared to those who are in areas with many such facilities. This is because access to healthcare services increases one's quality of life as well as economic opportunities. (Mideros, 2012).

It was found that average consumption of basic services is one of the key indicators, where the consumption of good quality water and energy is recognized as a significant dimension. There is a link between low consumption of basic services and poverty (Mideros, 2012). As such, this calls for public policies including subsidies and infrastructural developments so as to ensure adequate access to these services.

Another dimension that emerged as significant is the having access to adequate sanitation and waste disposal systems. Public health and poverty are directly influenced by sanitation infrastructure (Medeiros et al., 2021). Areas that have a poor sanitation and waste disposal system are more deprived than others. Therefore, to reduce multidimensional poverty, there is need for improvements of these services in form of public policy changes.

The availability and quality of municipal services, such as public transportation and access to community facilities, are also important indicators. Areas with better municipal infrastructure have lower levels of poverty, consistent with existing literature that emphasizes the importance of municipal investment in infrastructure for poverty reduction (Medeiros et al., 2021).

Indicators related to education and health had a substantial contribution to the MPI, indicating their importance in identifying poverty levels. The consumption of basic services was also a relevant indicator, representing 15% of the MPI. This finding aligns with previous studies, such as Mideros (2012), which considers basic services an important variable for defining public policies for poverty reduction.

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Administrative records offer several advantages for constructing a multidimensional poverty index. They are typically more precise and updated more frequently than traditional survey data, enabling a timelier evaluation of poverty conditions. Covering a larger portion of the population, these records provide a comprehensive and representative view of poverty across various geographic areas (Berner and Van Hemelryck, 2020). Additionally, using administrative data reduces the costs associated with primary data collection, making it a more sustainable approach (Anderson et al,. 2017; Vizuete-Salazar et al., 2019). This method also allows for the detection of specific deprivations in different dimensions, aiding policymakers in designing more targeted and effective interventions (Alkire and Foster, 2011).

Integrating administrative records into poverty measurement enhances data precision and facilitates a more adaptive policy response. Unlike traditional methods such as household surveys, administrative records can be updated more frequently and at a lower cost, improving measurement accuracy and allowing for a more dynamic approach to policy development. This integration can complement survey data, providing a comprehensive view and demonstrating the economic feasibility of using administrative records.

Moreover, administrative records can improve transparency and accountability in public management by offering up to date and detailed reports on poverty and interventions, thus maintaining public trust. They also enable continuous monitoring of socio-economic conditions, supporting real-time policy adjustments and the creation of early warning systems to address emerging vulnerabilities. This approach enhances citizen participation by making data more accessible and understandable, empowering public engagement in policy development and evaluation.

However, the use of administrative records also presents challenges. The quality of these records can vary, which may affect the accuracy of poverty indicators. Implementing mechanisms to ensure data quality and consistency is crucial. Additionally, access to administrative records may be restricted due to privacy and data security policies, necessitating appropriate agreements and protocols to ensure responsible data access and use. Integrating and analyzing large volumes of administrative data require advanced technical capabilities and adequate resources, making it essential to have trained teams and appropriate tools.

While administrative records cover a large portion of the population, certain groups, such as displaced or informal populations, may not be adequately represented. Therefore, considering complementary methods to capture information about these groups is important. Despite the positive research results, it is essential to acknowledge and discuss the limitations and challenges associated with using administrative records. This includes addressing ethical considerations, such as protecting individuals' privacy, ensuring data security, and obtaining informed consent. A robust ethical discussion ensures that the proposed approach is not only effective but also responsible and respectful of individual rights, and identifies areas for future improvements and studies.

Conclusions

Flexibility is the main characteristic of the Alkire Foster methodology which allows one to create a multidimensional poverty indicator by assigning weights to dimensions and indicators while setting deprivation thresholds. The Wilcoxon rank-sum test was applied for validation, and it showed that there are significant differences in median values between the poor and non-poor sectors with a p-value of 7.054e-06. This confirms the reliability of the method in poverty level differentiation and hence supports its theoretical basis.

The study showed that 53.9% of census sectors in Manta are multidimensionally poor. The intensity of poverty is represented by 69.78% deprivations indicating that limited poor sectors experience a higher percentage of total exclusions being considered in the computation of MPI. Given this high extent of deprivation, comprehensive strategies for poverty alleviation should be adopted in such places urgently.

Poverty has been captured by this analysis as a multidimensional phenomenon using the Multidimensional Poverty Index (MPI). Education and health indicators were found to contribute significantly to the index indicating their critical role in identifying levels of poverty. Furthermore, checking municipal service

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infrastructure collectively accounted for 23% of MPI; access to sewerage networks, waste disposal systems and public transport facilities. In this regard, local government services have probabilistic power over poverty alleviation decisions made today by politicians.

In terms of deprivation levels there were evident disparities after carrying out a spatial analysis. The urban sectors were shown to suffer most from deprivation compared to the rural ones. For example, in terms of aspects with 5 and 6 deprivations, they accounted for 94.71% in the cities alone. On the other hand, areas characterized by 7 (15.38%) usually occur more in the rural parts than in the cities. This implies that in cities that are experiencing much deprivation as stated above, specific policies and interventions should be made rather than dealing with all regions at once; addressing those deprivations that are higher require focus on rural and peri-urban areas' attention. Integration of the Multidimensional Poverty Index (MPI)'s findings alongside those from Social Register provide an efficient basis for planning and implementing public policies intended for fighting against poverty within these regions considering their consistent identification of high poverty zones located within western as well as southwestern parts of Manta.

Our research indicates that it is crucial to consider multi-dimensionality of poverty when developing poverty measuring techniques. This implies the adoption of Alkire-Foster methodology by policymakers in order to gauge diverse dimensions of poverty in a community. The cost effective use of administrative records when measuring poverty reveals the necessity for investment in data infrastructure and capacity building. Hence, governments and other policy makers should focus on establishing data collection systems that will enable them to make decisions based on evidence in regard to reducing poverty levels.

Progressively, efforts should be made towards improving transparency and accountability in poverty measurements. Additionally, stakeholder involvement and participatory approaches can help develop reliable indicators of poverty leading to targeted interventions.

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