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Assessing Multidimensional Poverty Index in Coastal Regions: Implications for the Makran Region of Iran*

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Abstract: The Global Multi-Dimensional Poverty Index (MPI) was developed in 2010 and used health, education and standard of living indicators to determine the incidence and intensity of poverty experienced by a population. While the MPI is a global index, the method is flexible and can be modified to best suit the environment or target groups. Coastal regions are one of the most critical areas that require modified MPI, since their complex structures are constantly subjected to natural and human changes that affect the living conditions of residents. What is lost in using the global MPI for poverty assessment in coastal communities is the lack of attention to contextual characteristics and, subsequently, missing various multi-aspect indicators in different natures and scales. This paper reviews the MPI and tries to expand the model based on the indicators of marine development approaches for the Makran coastal region as the case study. Overall, this review draws attention to social, natural, and financial capitals that have not conventionally been incorporated into the MPI model. According to the proposed model, although the Makran region has made slight progress in poverty reduction based on the general MPI index under the influence of development plans and various drivers during a ten-year period, it is severely impoverished in social, financial, and natural indicators presented by the expanded model. This difference shows the importance of using the developed model to enhance assessment accuracy and recommends a combination of five main poverty-related dimensions for poverty alleviation policies and evaluation processes in coastal regions.

Keywords: multi-dimensional poverty index, regional equity, regional planning, marine and coastal regions
JEL Codes: C15, I00, J1, R1

1. INTRODUCTION

The impact of development projects on poverty reduction is a topic that remains unresolved for planners and economists. However, it still holds significant importance in evaluating

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planning outcomes, both in terms of public interest and scientific research (Wratten, 1995; Mourmouris and Giaoutzi, 2006; Norman, 2010; Whitbread, 2012). An essentially positivistic epistemology continues to affect the poverty-alleviation policies and tends to dominate the conceptualization of the poverty term. In this view, the way that non-economic and spatial factors are considered is usually simplistic, and poverty, as a one-dimensional concept (Cornia, 2004), is defined by a low level of income (Galasso and Ravallion, 2005; Fransham, 2019). Hence, most poverty reduction theories have concentrated on quantitative changes, despite a critical thought that understanding other aspects of poverty depends on comparison with other regions in a territory and an equal commitment to multi-criteria analysis (Voogd, 1982; Godo et al., 2005; Caballero et al., 2009). As long as the concept of poverty is defined one-dimensionally, the methods of assessing the poverty reduction plans and policies will be one-dimensional too. Dominant quantitative analysis approaches such as Cost-Benefit Analysis (CBA) in a complex planning process never be able to represent the poor's interests (Londero, 1996; Snell, 2011; Whitbread, 2012).

On the other hand, development project impacts need to be seen as being influenced by dynamic and spatial factors (Robert et al., 2001; Faludi, 2000, 2003). The concept of social and spatial concerns has traditionally been ignored by mainstream economic approaches. A balance between qualitative and quantitative goals of development projects presents a challenge to traditional one-dimensional frameworks of projects' efficiency in poverty reduction. Over time, discovering or creating new models to evaluate development projects' impacts on poverty alleviation formed the core of regional studies that address spatial redistribution of poverty (Weiss, 2003; Vreeker and Nijkamp, 2006). In more recent years, traditional and dominant approaches and theories of poverty alleviation assessment, based largely on the famous CBA and utilitarianism models, have been replaced by a suite of models (Romer, 1986) and monitor multidimensional aspects of development projects (Hentschel and Seshagiri, 2000; Whitbread, 2012). These new approaches involve a wide array of factors and view poverty as a complex phenomenon. One of the most famous approaches to poverty measurement is the global multidimensional poverty index (MPI) which complements traditional monetary poverty assessment by analyzing the acute deprivations of people in three indicators, including health, education, and living standards (OPHI, 2020). Since OPHI and UNDP's Human Development Report Office designed MPI for analyzing multidimensional poverty in developing countries, they only consider some general dimensions. However, the potential dimensions that a measure of poverty might cover are broad (Alkire, 2008). As a result, it is important to tailor the concept of poverty and its criteria to the appropriate context, as there is no general concept that we can safely assume to hold for all countries at all times (Bellu and Liberati, 2005). This issue reveals the importance of conducting this study.

The present study aims to develop the MPI based on marine economic development approaches to provide a framework by which we can determine the extent of changes in the multidimensional poverty index of a coastal area affected by development activities. In this regard, the MPI's criteria are integrated with the livelihood-oriented approach of marine economic development plans and policies and cover broader dimensions of poverty. Since the model requires specific criteria on contexts, the case study in this paper is limited to the Makran coastal region, which is affected by the national economic development process

and is suffering from severe poverty in a coastal setting. This model is used to assess how the multidimensional poverty index of this region has changed during the ten years before and after the implementation of two consecutive national economic development plans. The Makran coastal region is located in the southeastern region of Iran, including coastal parts of Sistan and Baluchestan province and the southeastern region of Hormozgan province. Having a long coastal line (about 560 km), Iran could make ultimate use of its coastal and water resources. However, this region ranks first in the country in terms of deprivation (Islamic Consultative Assembly, 2004, 2010); thus, one of the major long-term goals of almost all national and regional economic development plans is to reduce the poverty rate in this coastal region (Islamic Consultative Assembly, 2010; Karimi et al., 2020). Therefore, providing this evaluation model can be useful for this case study and other similar coastal areas.

For this aim, the expansion of the multidimensional poverty index model has been done based on considering the marine development planning approaches and then calculating in a fuzzy system for the case study. The paper is structured as follows. The next section provides an overview of the case study, describing its current economic climate, livelihood, and population. The third section investigates some relevant concepts, literature, and research background. The fourth section determines methodology and data as well as their limitations. The fifth section discusses the results and findings. The final part concludes the output of the assessment model.

2. OVERVIEW OF ECONOMY AND LIVELIHOOD OF THE MAKRAN COASTAL REGION

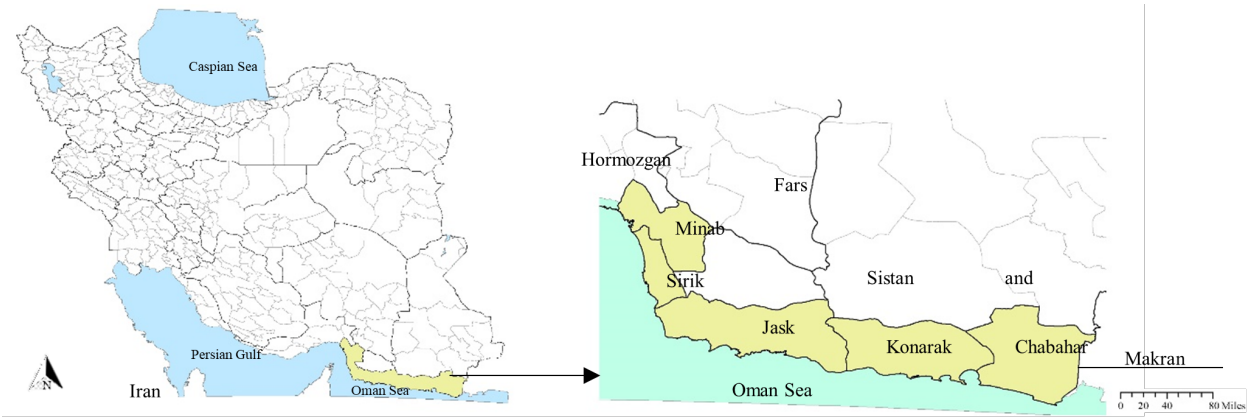
The coasts of Makran are considered one of the most important and strategic regions in the Middle East and Central Asia. The trend of the employment structure in macroeconomic sectors in the Makran region shows its multi-role economy with the dominance of the agricultural sector. In 1995, the region's economy played several roles with the dominance of the agricultural sector. In 2005, with the expansion of service and business activities, its role shifted slightly towards services. After ten years, in 2015, the region's economy shifted again to the agricultural sector due to the reduced diversity of activities in the region, a decrease in added value of some service sectors such as education, and an increase in the added value of the agricultural sector (Plan and Budget Organization, 2018).

Despite the potential and abundance of natural resources and strategic location, this region suffers from a high rate of deprivation, and the development of the region remains neglected so far. In 2015, the highest poverty rates in the country occurred in the provinces of Sistan and Baluchestan, Kerman, and Hormozgan, which were about 38.31%, 32.9%, and 22.08%, respectively (Parliamentary Research Center, 2016). According to the 2016 Population and Housing Census, 78% of residential units in this area were built with unsustainable materials (Statistical Center of Iran, 2016). In terms of housing, Chabahar and Jask have the highest number of slum dwellings, about 35%, and 23.2%, respectively. Furthermore, almost all rural areas of Makran do not have a water supply, and only half of the urban centers have access to the water network. In addition, the whole Makran region is deprived of gas supply networks.

The Makran region includes five counties (Figure 1). Firstly, Chabahar county, the easternmost county of Makran, is known as the development pole of the region. The economic structure of this county is divided into two main sections. The first is the partial development of this region with external investment, which is mainly carried out in the form of the development of the Chabahar commercial port. The second is the micro-scale economic activities of local communities to provide livelihoods. Obviously, industrial-commercial activities involve a small segment of the region's population in economic activities, as approximately 60% of the city's population lives in rural areas. Most of these industrial activities have links with the population and sectors outside the region, specifically with the capital. Among the rural population of this region, agricultural, horticultural, and herding activities are common.

Secondly, Konarak county is engaged in horticulture and agriculture. The county has commercial and industrial activities through the port of Konarak. There are also small-scale industrial workshops, such as boating industries. Thirdly, Jask county, with its main port as the second commercial port of Makran, is deprived of its economic advantages. The inhabitants of this area, about 70% of whom are villagers, are mainly engaged in fishing activities. Fourthly, Sirik county is also in a weak economic climate. This region also operates only based on small-scale fish and shrimp farming. Agricultural activities are rare, and there are no major commercial or industrial activities in this county. Lastly, situated in the western section of the Makran region is the county of Minab, which has partially facilitated agricultural and horticultural pursuits by virtue of possessing numerous rivers.

Figure 1: Location of Makran Region in Iran



In the history of Iranian planning, the Makran region does not have any integrated spatial development plan. The two eastern counties are part of the land management plan of Sistan and Baluchestan province, which was prepared in 2008. The three western counties are part of the land management plan of Hormozgan province in 2018, as well as the Integrated Coastal Zone Management (ICZM) plan of Hormozgan in 2019. Differences in the nature of these plans, the rate of progress in implementation, and the time of starting the plans can cast doubt on the outcome of the evaluation. So, the assessment of the multidimensional poverty index will be carried out for a ten-year period which includes the fourth and fifth Five-Year Economic, Social, and Cultural Development Plans. In other words, the purpose of this assessment is to evaluate changes in the multidimensional poverty index over a ten-year

period, which encompasses the fourth and fifth Five-Year Economic, Social, and Cultural Development Plans as development drivers. While these plans are referenced to justify the selected time frame, the evaluation will not assess the plans themselves.

After the 1979 Islamic Revolution, the government of Iran prepared and implemented a series of five-year development plans. Two of these plans are the Fourth and Fifth Five-Year Economic, Social, and Cultural Development Plan of the Islamic Republic of Iran [2005-2015] (Islamic Consultative Assembly, 2004, 2010). As the sixth five-year development plan is in progress, assessing the fourth and fifth ones, as the last completed plans, is more logical. Although these plans are provided on a national scale, they have regional impacts on regions by determining general development policies and macro development orientation as well as stimulating development drivers (Islamic Consultative Assembly, 2010).

Required data for the assessment study come from the official Statistical Yearbook of Iran (Plan and Budget Organization, nda) and the General Census of Population and Housing (Plan and Budget Organization, ndb), which are the only accessible official data resources in Iran. The region's overall population was 624,298 in 2005 and 745,244 in 2015, both of which are the population in this research divided per county (Statistical Center of Iran, 2006, 2016). Unlike the MPI model, which considers only individuals as a population, the developed model defines specific populations based on the nature of each criterion. So, required data is gathered per individual, household, and spatial parameters.

3. LITERATURE REVIEW

3.1. The Multi-Dimensional Poverty Concept

It is well-known that a low level of income is but one aspect of poverty and requires to be viewed in a broader context than income levels (Sen, 1998). Broader definitions encompass various aspects of social deprivation, including poor health and living conditions and limited rights in both political and social spheres (Watts, 1969; Weiss, 2003). More generally, Sen (1985) mentioned that poverty is the lack of capability to function in a given society (Sen et al., 1999). The World Bank has made a synthesis of the various positions: Poverty is the lack of, or the inability to achieve, a socially acceptable standard of living (World Bank, 2001). All of these definitions refer to poverty as a condition in which a reasonable standard of living is not achieved (Bellu and Liberati, 2005).

By expanding the definition of poverty, the methods of measuring poverty have shifted from indirect income-based uni-dimensional methods to direct multidimensional approaches (Sen, 1982; Bellu and Liberati, 2005). From 1990 onwards, several indexes have been introduced in order to assess human deprivation, such as Human Development Index (HDI) (UNDP International Poverty Centre, 2006), and Human Poverty Index (HPI) (Anand and Sen, 1997). However, all of these were slammed, since they do not capture many of the dimensions of a whole life, nor the necessary social conditions (UNDP International Poverty Centre, 2006). Finally, between 2009 and 2010, the Multi-Dimensional Poverty Index (MPI) was introduced as the latest index (Alkire et al., 2010; UNDP, 2010). The global MPI examines each person's deprivations across ten indicators in three equally weighted dimensions: health, education, and living standard (OPHI, 2018). It also offers high-resolution lens to

identify both who is poor and how they are poor (OPHI, 2020). While the MPI is a recent and commonly used method to measure poverty, it is not without limitations. One significant flaw is that the proposed indicators are assumed to be universal and applicable to all regions, regardless of their unique characteristics. Therefore, it is crucial to consider social, natural, and financial capital when using the MPI to measure poverty in a particular area. Failing to account for these factors may result in inaccurate or incomplete assessments of poverty levels.

3.2. Marine Economic Development and its Stance on Poverty Reduction

The tradition of coastal spatial planning was initially proposed to protect coastal areas' valuable resources and support local communities' social, economic, and welfare development. This tradition has been challenged over time by emerging issues and expectations for new management approaches (Adler, 2012). Generally, there are four identified approaches by which marine economic development is achieved, including oceans as natural capital, livelihoods, good business, and drivers of innovation (Neumann et al., 2012; Bueger, 2015; Silver et al., 2015; Voyer et al., 2017, 2018). Although sub-themes found in all four lenses may have existed within a single policy document, each document tended to prioritize or privilege one or two of the identified lenses (Voyer et al., 2017). The "Oceans as livelihoods" is the only approach by which marine economics development plans are directly applied for poverty alleviation (Australian National Centre for Ocean Resources & Security, nd; Krantz, 2001; Voyer et al., 2017), and this approach concludes five types of capital assets, including human, social, natural, physical, and financial capitals (Chambers and Conway, 1992; Scoones, 1998; Solesbury, 2003; Serrat, 2017; So, 2018).

3.3. Previous Research and Experience

The process of poverty assessment could play a vital role in reducing poverty and improving the lives of those currently living in poverty. By introducing MPI as the most common poverty assessment, United Nations Development Programme (UNDP) and Oxford Poverty and Human Development Initiative (OPHI) emphasize building national, regional, or even thematic multidimensional poverty assessment processes, especially in developing countries (OPHI, 2019). A growing number of policymakers are relying on localizing multidimensional poverty measurement to improve their understanding of poverty, allocate resources more effectively and improve poverty reduction plans. One of the first countries with an official national MPI is Mozambique (MPI-MZ) (MPPN, 2018). Three criteria were established to this end. The first step was to determine the relevance of each dimension and indicator to well-being based on the existing although the mdpiure and the experiences of other countries. The second criterion was the result of five workshops on multidimensional poverty, which took place in 2015 in collaboration with the United Nations Development Programme (UNDP) and the United Nations Children's Funds (UNICEF). The third criterion was the availability of information. This process identified 17 indicators grouped into three dimensions – education, health and determinants of health, and living standards. All the indicators for each dimension were also given equal weights and measured by the Alkire and Foster method (MPPN, 2018).

Since its inception, Nepal has built a national MPI to reflect national priorities and also permit international comparisons. The Government of Nepal took the path-breaking decision to use the global MPI as the basis for the design of its national MPI. However, the changes are minor. The new structure uses the same three original dimensions, ten indicators, the same weighting structure, and poverty cut-off. There are adjustments in five indicators: Nutrition, Child Mortality, Years of Schooling, Housing, and Assets. These improvements run in parallel with Nepal's aspirations. For instance, in the case of nutrition, previously, this indicator only considered nutritional deprivations based on children's weight for age. The new indicator now considers both underweight and stunting for children (Nepal Central Bureau of Statistics, 2021).

In 2021, in close consultation with various ministries, the Department of Census and Statistics (DCS) of Sri Lanka developed the first official National MPI for this country. With regard to this national MPI, a key population of interest for poverty is young children, whose deprivations in nutrition and cognitive development have lifelong effects. To further probe and support child poverty policies, DCS crafted an individual Child MPI for children aged 0-4, which includes exactly the same indicators as the National MPI, plus undernutrition and early childhood development. Sri Lanka's Child MPI is pioneering in being the first official measure of child poverty that links directly and precisely with the National MPI (Sri Lanka DCS, 2021).

Current research on multidimensional poverty in Iran is limited. Almost no research studies have focused on regional assessment, and most of the research studies focus on using the general MPI model on a national scale, regardless of what characteristics their settings have. The only difference between these studies is their time frames. In other words, researchers used this model as a tool to assess the general multidimensional poverty situation for specified time periods (Raghfar, 2015; Yoosefi et al., 2016; Fotros and Ghodsi, 2017). So, while some studies have assessed the MPI in Iran, none have addressed how general MPI's criteria could be developed or expanded based on specific circumstances of settings. This research focuses on coastal areas and tries to provide a regional MPI assessment framework for these regions.

4. METHODOLOGY AND DATA

4.1. Variable Selection and Processing

It is essential to tailor the concept of poverty and its criteria to the appropriate context because a general concept is unavailable to assume for all countries at all times (Bellu and Liberati, 2005). For assessing the impact of Makran's marine economic development on poverty, the general MPI is insufficient due to its incomplete overlap with indicators of sustainable livelihood approach as the main approach of the coastal development plans and policies (Figure 2). In terms of the setting, 'First nature' geographic characteristics, such as topography or proximity to the coast, play an essential role in the existence of spatial poverty (Bird et al., 2010a). Therefore, considering natural structure as the natural capital would be essential. Furthermore, due to the difference in ethnicity, race, religion, and culture (Bird et al., 2010b) of the Makran region, there is social exclusion and discrimination against

people living in this geographic area. As a result, social capital would be one of the most critical aspects of Makran local inhabitants' lives that should be determined to find an inclusive assessment model. Lastly, the relationship between financial capital and poverty is also important, as financial capital has both direct and indirect effects on poverty through its influence on various economic factors, such as income inequality, economic growth, and financial instability (de Haan et al., 2022). However, MPI does not incorporate financial capital as one of its assessment criteria.

The use of the five main capitals - social, financial, physical, human, and natural - as a framework for poverty assessment can provide a more comprehensive approach to poverty measurement. However, the exact criteria for each capital may need to be modified based on data availability and the unique context being assessed. Table 1 summarizes the modifications made to the criteria for each capital, highlighting the specific indicators to better capture poverty in Makran coastal region.

Figure 2: The Intersection of MPI and SLA's Criteria

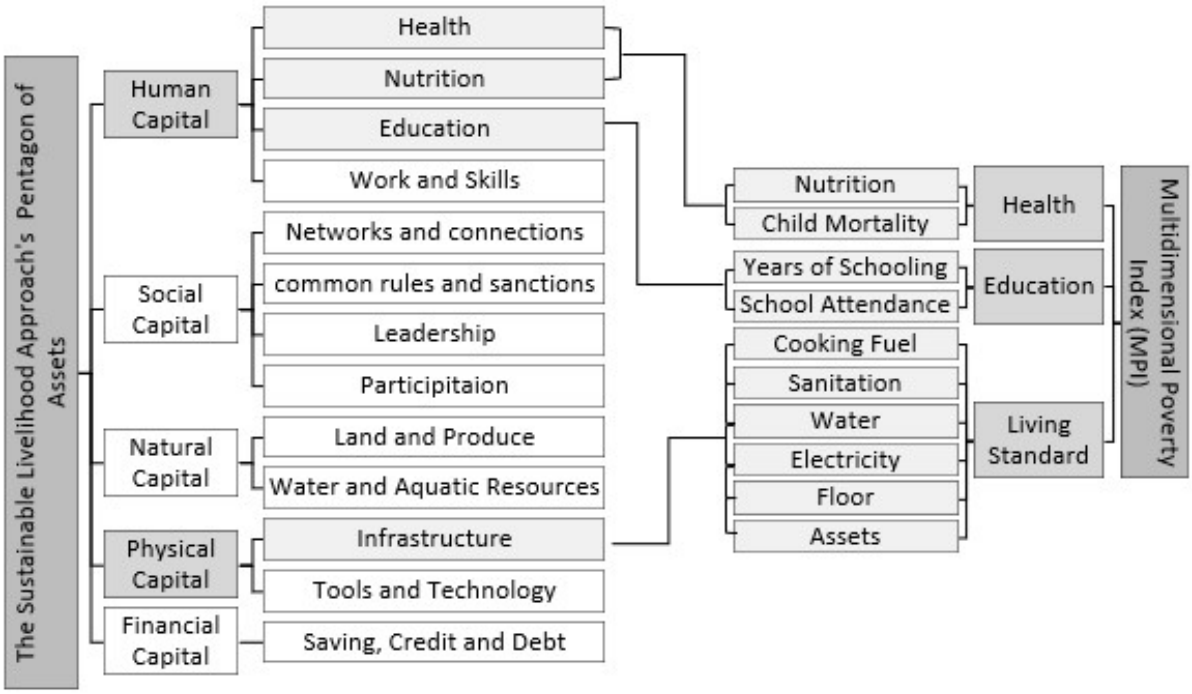


Table 1: Selected Variables Used in the Coastal MPI Model

Latent Variables	Manifest Variables	Indicators
Human Capital (HC)	Health (HC1)	Child Mortality (HC11) Have No Access to Health Insurance (HC12)
	Education (HC2)	Men's Illiteracy Rate (HC21) Women's Illiteracy Tate (HC22) Children 6 to 19 years Old Under 8 Literacy Grades (HC23)
	Work and Skills (HC3)	Men's Economic Participation Rate (HC31) Women's Economic Participation Rate (HC32) Unemployment Rate (HC33) Child Labor (HC34)
Social and Cultural Capital (SCC)	Institutions (SCC1)	Supply Needs Cooperative Society (SCC11) Transport Cooperative Society (SCC12) Agriculture Cooperative Society (SCC13)
	Social and Cultural Centers (SCC2)	Cinema and Theater (SCC21)
Natural Capital (NC)	Land and Produce (NC1)	Grassland (NC11) Desert (NC12)
Physical Capital (PC)	Housing (PC1)	Built-up Housing Area Less Than 50 Meters (PC11)- Substandard Building Materials (PC12) Asset (Housing) (PC13)
	Living Standards (PC2)	water (PC21) Urban Gas Supply (PC22) Electricity (PC23) Sanitation (PC24)
	Tools and Technology (PC3)	Fixed Phone Line (PC31)
Financial Capital (FC)	Income (FC1)	Average Yearly Income of a Rural Household (FC11) Average Yearly Income of an Urban Household (FC12)
	Banking (FC2)	Access to Banking Services (FC21)

4.2. Methodology

The MPI's mathematical structure corresponds to one family member of multidimensional poverty measures proposed by Alkire and Foster (AF), the M_0 or Adjusted Headcount Ratio. The AF method counts overlapping or simultaneous deprivations experienced by a person or household in multiple indicators of poverty to determine whether someone or their household is poor. The indicators may be equally weighted or have different weights, and it is a flexible approach that can be adapted to a variety of situations by selecting different dimensions, poverty indicators within each dimension, and poverty cut-off values (Alkire and Foster, 2011). Constructing this measure entails the following steps.

Let n represent the number of persons, and let $d \geq 2$ be the number of dimensions under consideration. Dimensions might relate to health, education, work, living standards, or empowerment. Let $y = [y_{ij}]$ denote the $n \times d$ matrix of achievements, where the typical entry $y_{ij} \geq 0$ is the achievement of individual $i = 1, 2, \ldots, n$ in dimension $j = 1, 2, \ldots, d$. Each row vector y_i lists individual i's achievements, while each column vector y_{*j} gives the distribution of dimension j achievements across the set of individuals. In what follows, we assume that d is fixed and given, while n is allowed to range across all positive integers, allowing poverty comparisons across populations of different sizes. Thus the domain of matrices under consideration is given by $Y = \{y \in R^n : n \geq 1\}$. For concreteness, we have assumed that individual achievements can be any non-negative real number; our approach can easily accommodate larger or smaller domains where appropriate. Let $Z_j > 0$ denote the cut-off below which a person is considered to be deprived in dimension j, and let z be the row vector of deprivation cut-offs (Alkire and Foster, 2011, p.477).

In the identification function $\rho : R^d_+ \times R^d_{++} \to \{0, 1\}$, which maps from person i's achievement vector $y_i \in R^d_+$ and cut-off vector $z \in R^d_{++}$ to an indicator variable in such a way that $\rho(y_i; z) = 1$ if the person i is poor and $\rho(y_i; z) = 0$ if a person i is not poor. Applying ρ to each individual achievement vector in y yields the set $Z \subseteq \{1, \ldots, n\}$ of persons who are poor in y given z (Ibid).

For any given y, let $g^0 = [g^0_{ij}]$ denote the 0-1 matrix of deprivations associated with y, whose typical element g^0_{ij} is defined by $g^0_{ij} = 1$ when $y_{ij} < z_j$, while $g^0_{ij} = 0$ otherwise. Clearly, g^0 is an $n \times d$ matrix whose ijth entry is 1 when the person i is deprived in the jth dimension, and 0 when the person is not. The ith row vector of g^0, denoted g^0_i, is person i's deprivation vector. From the matrix g^0 we can construct a column vector c of deprivation counts, whose ith entry $c_i = |g^0_i|$ represents the number of deprivations suffered by person I (Ibid).

For identifying the poor, a natural alternative is applied, which uses an intermediate cut-off level for c_i that lies somewhere between the two extremes of *1* and *d*. For $k = 1, \ldots, d$, let ρ_k be the identification method defined by $\rho_k(y_i; z) = 1$ whenever $c_i \geq k$, and $\rho_k(y_i; z) = 0$ whenever $c_i < k$. In other words, ρ_k identifies person i as poor when the number of dimensions in which i is deprived is at least k (Ibid).

The next step is to identify the percentage of the poor. The headcount ratio $H = H(y; z)$ is defined by $H = q/n$, where $q = q(y; z) = \sum_i^n = 1\rho_k(y_i, z)$ is the number of persons in the set Z_k, and hence the number of the poor identified using the dual cut-off approach. To identify average deprivation share, define the *censored vector of deprivation counts* $c(k)$ by $c_i(k) = \rho_k(y_i; z)c_i$ for $i = 1, \ldots, n$. Notice that $c_i(k)/d$ represents the share of possible deprivations experienced by a poor person, and hence the average deprivation share across the poor is given by $A = |c(k)|/(qd)$. The adjusted headcount ratio is given by $M_0 = H \times A = \mu(g_0(k))$ (Ibid).

The Alkire and Foster calculation structure is based on binary logic of zero and one, which is a two-valued formal logic and defines people as either poor (value is equal to 1) or not poor (value is equal to 0). For assessing the MPI in a region, using a binary logic of zero and one is unrealistic due to its scale, available data, and differences in the nature of variables. So, shifting from binary logic to fuzzy logic is essential to evaluate the percentage of poverty in a region. In this way, the poverty situation of the region is shown as a percentage in the ratio of the number of poor to the total population of the region.

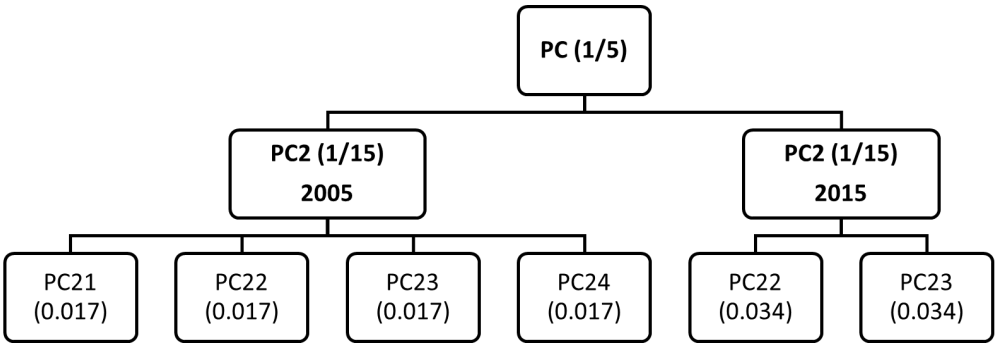
4.3. Data

4.3.1. Variables' and Indicators' Weights and Treatment of Missing Data

In the MPI, weights are equally distributed across dimensions (1/3 each) and within dimensions across indicators (Alkire and Foster, 2011). However, as the developed MPI has five latent variables, weights are equally distributed across dimensions (1/5 each) and within dimensions across indicators. However, indicators are not necessarily weighted equally in some circumstances. To be more specific, if there was missing information for just one year (2005 or 2015), we use the available information to show the deprivation status in the related year; and in order to prevent potential bias, the unavailable indicators' weights would be

broken down by other available indicators of the same dimension. For instance, there is no data for PC21 and PC24 in 2015; however, these two indicators are calculated for the year 2005. In order to prevent calculation biases, the manifest variable of PC2 (with 1/15 weight) would have four 0.017 weighted indicators for the 2005 calculation and two 0.034 weighted indicators for the 2015 calculation (Figure 3). The total weight of the indicators of both years is equal to the weight of the manifest variable, which could prevent any calculation bias.

Figure 3: Breaking Down PC2's Indicator's Weight



4.3.2. Statistical Population and Treatment of Indicators With Non-applicable Population

In the general model of MPI, the calculation is based on individual data gathered with questionnaires. In this research, the aim is to assess the poverty of the whole region, so the information of criteria is calculated on the scale of the counties or the whole of the Makran regions by using annual statistical data. It means that although the general MPI categorized individuals as poor (1) or non-poor (0) people, a fuzzy calculation is used for the Makran region by which the percentage of poverty for each criterion is determined in every sub-region. In this way, we can recognize, for example, to what extent people are suffering from a lack of sanitation in this region. For calculating the percentage of poverty, the region's individual and household populations are used as the population in both 2005 and 2015 for each county (table 2). For indicators that are not related to the population, such as having access to banking services or the indicators of natural capital, the percentage of poverty incidence is calculated based on per capita or the percentage of total units.

Table 2: Population of the Makran Region

Population	Chabahar		Konarak		Jask		Sirik + Minab	Sirik	Minab
	2005	2015	2005	2015	2005	2015	2005	2015	2015
Individual	216681	283204	71063	98212	78693	58884	257831	45723	259221
Household	41591	68147	14312	23600	16715	15211	50555	11304	68906

4.3.3. Poverty Cut-Off

The poverty cut-off k reflects the share of weighted indicators in which a person must be deprived in order to be considered multi-dimensionally poor. If the household is deprived in one or more dimensions, it should be among the poor. In other words, if a household is deprived of one-fifth of its weight indicators, it is considered a multidimensional poor. Therefore, according to AF's method, the value of k could be 0.20 in this study, as there are five latent variables in the developed MPI. As a result, k requires the poor to be deprived in 20 percent of the weighted indicators to be considered multi-dimensionally poor. When there are one or more missing indicators, the other indicators present in the dimensions receive a higher weight.

5. RESULTS

5.1. Incidence of Multi-Dimensional Poverty

The developed MPI considers the percentage of deprivation in each indicator for every county. In other words, although the MPI determines an individual 100% (or 0%) poor in the indicators ("0%" indicates no deprivation in that indicator, while "100%" indicates deprivation in that indicator.), here, we set the percentage of family or individual deprivation per county (Table 3). For example, 33 percent of men who are living in Chabahar County are ilalthough the e. So, the incidence (or headcount) of HC21 would be 33%.

5.2. The Intensity of Multi-dimensional Poverty

The following table demonstrates the deprivation scores of all five capitals in 2005 and 2015. Based on the numbers and weights of the indicators, the intensity of multidimensional poverty (IMP) is calculated per county. Regarding the incidence of poverty, all counties have a higher rate than the poverty cut-off (0.20). It means that the whole region suffers from multidimensional poverty even after implementing two five-year development plans (Table 4).

During the ten years and with the implementation of two plans, the Makran region had very severe poverty in terms of social capital, the rate of which has remained constant and has not progressed during this time. The different lifestyles of the Makran residents compared to other regions of Iran, the lack of non-governmental organizations and social institutions, the method of top-down planning, and the minimal participation of citizens during the two development projects indicate the high rate of social poverty in this region.

In the second priority, the region's natural capital has a high poverty rate, and the stability of this index over ten years shows the small impact of planners and policies on natural poverty reduction. The third priority is physical capital. Over ten years, the impact of development plans on reducing physical capital poverty was almost zero in this region. The fourth priority is human capital. Its poverty rate is less than 0.4. With the implementation of two development plans, the rate of human poverty in the region, especially the three counties of Konarak, Chabahar, and Jask, has slightly decreased and becomes close to the

Table 3: Incidence of Multi-Dimensional Poverty, 2005 and 2015

Latent Variables	Manifest Variables	Indicators	2005				2015				
			Makran Region								
			Sistan and Baluchistan Province		Hormozgan Province		Sistan and Baluchistan Province		Hormozgan Province		
			Chabahar	Konarak	Jask	Sirik + Minab	Chabahar	Konarak	Jask	Sirik	Minab
HC	**HC1**	**HC11**	**0.20%**	**0.10%**	**0.30%**	**0.20%**	**0.20%**	**0.10%**	**0.20%**	**0.20%**	**0.20%**
		HC12	8%	N/A	49%	88%	2.60%	32%	N/A	91%	74%
	HC2	**HC21**	**33%**	**30%**	**31%**	**18%**	**26%**	**19%**	**20%**	**12%**	**12%**
		HC22	50%	51%	45%	26%	38%	35%	29%	20%	20%
		HC23	**27%**	**31%**	**21%**	**10%**	**23%**	**19%**	**16%**	**5%**	**15%**
	HC3	HC31	41%	31%	42%	43%	44%	30%	45%	45%	38%
		HC32	**92%**	**83%**	**94%**	**90%**	**87%**	**84%**	**84%**	**82%**	**88%**
		HC33	33%	17%	29%	16%	14%	10%	12%	15%	12%
		HC34	**2%**	**6%**	**1%**	**2%**	**1%**	**2%**	**1%**	**0.10%**	**1%**
SCC	SCC1	SCC11	71%	70%	71%	71%	68%	68%	67%	67%	68%
		SCC12	**86%**	**85%**	**86%**	**86%**	**83%**	**83%**	**82%**	**82%**	**83%**
		SCC13	63%	62%	63%	63%	74%	74%	73%	73%	74%
	SCC2	**SCC21**	**26%**	**100%**	**100%**	**100%**	**45%**	**100%**	**100%**	**100%**	**59%**
NC	NC1	NC11	89%	89%	94%	94%	89%	89%	95%	95%	94%
		NC12	**33%**	**27%**	**22%**	**22%**	**27%**	**27%**	**22%**	**22%**	**22%**
PC	PC1	PC11	43%	26%	24%	15%	34%	33%	24%	7%	9%
		PC12	**87%**	**78%**	**85%**	**93%**	**72%**	**65%**	**75%**	**87%**	**83%**
		PC13	29%	30%	22%	22%	34%	30%	31%	21%	23%
	PC2	**PC21**	**81%**	**48%**	**32%**	**6%**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
		PC22	100%	100%	100%	100%	100%	100%	100%	100%	100%
		PC23	**39%**	**52%**	**60%**	**5%**	**15%**	**23%**	**12%**	**11%**	**0.50%**
		PC24	64%	53%	60%	62%	N/A	N/A	N/A	N/A	N/A
	PC3	**PC31**	**37%**	**100%**	**68%**	**33%**	**73%**	**100%**	**43%**	**18%**	**37%**
FC	FC1	FC11	30%	30%	0%	0%	50%	50%	14%	14%	14%
		FC12	**30%**	**30%**	**0%**	**0%**	**26%**	**26%**	**3%**	**3%**	**3%**
	FC2	FC21	51%	54%	43%	37%	41%	75%	38%	47%	67%

Source: Statistical Center of Iran (2006, 2016)

Table 4: The Intensity of Multi-Dimensional Poverty

Latent Variables	Makran Region Deprivation Score								
	Sistan and Baluchistan Province						Hormozgan Province		
	Chabahar		Konarak		Jask		Sirik + Minab	Sirik	Minab
	2005	2015	2005	2015	2005	2015	2005	2015	
HC	**0.318**	**0.262**	**0.311**	**0.257**	**0.347**	**0.259**	**0.326**	**0.3**	**0.289**
SCC	0.614	0.673	0.797	0.811	0.798	0.809	0.799	0.804	0.708
NC	**0.616**	**0.581**	**0.583**	**0.581**	**0.585**	**0.585**	**0.585**	**0.585**	**0.585**
PC	0.6	0.546	0.38	0.585	0.563	0.475	0.42	0.406	0.42
FC	**0.37**	**0.39**	**0.38**	**0.503**	**0.143**	**0.183**	**0.123**	**0.213**	**0.28**
Intensity of Multi-Dimensional Poverty	0.479	0.444	0.494	0.489	0.478	0.429	0.424	0.423	0.415

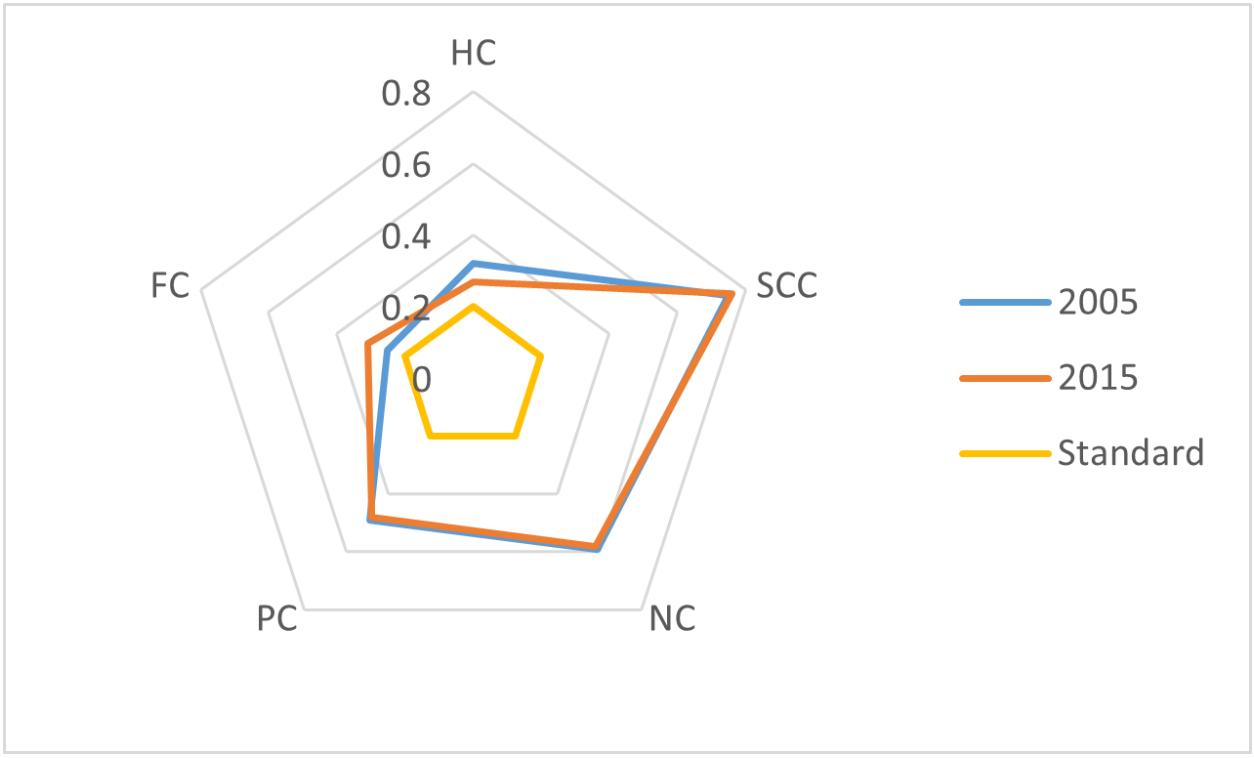
poverty cut-off. However, the growth rate of this index is very low, which shows that plans' policies have been implemented with low efficiency.

The financial capital poverty condition in the Makran region is the second favorable dimension of multidimensional poverty. However, after ten years, this index has also declined slightly in most counties, indicating an increase in financial capital poverty. The counties of Konarak and Chabahar were exposed to financial poverty in both 2005 and 2015, with an index of more than 0.4. The three counties of Jask, Sirik, and Minab, with an MPI rate of about 0.12, did not have financial poverty in 2005, and after ten years, this index reached the poverty cut-off rate, although, despite this slight decline, they can still not be

called financially poor. This shows the importance of using the coastal MPI for measuring plans' effects. In other words, if evaluated only from a financial point of view, with the implementation of development policies in the ten years, some areas of the Makran region will not be included in the group of impoverished areas. In comparison, the same areas in other dimensions of development, such as social, institutional, physical, and human dimensions are completely in poverty. Therefore, one-dimensional or income-based evaluation can increase the probability of errors.

The following diagram demonstrates the multidimensional poverty index of the Makran region in the form of radar charts (Figure 4). The farther the lines of the graphs' curves from the center of the graph, the more unfavorable the poverty condition. It seems that although the region's general condition in two indicators of human and financial capital is close to the poverty cut-off rate, multidimensional poverty prevails in the whole region, which is more severe in dimensions such as social, natural, and physical capital, respectively. The slight difference between the curve intervals of the graphs shows that the implementation of development plans is almost ineffective in improving the social, natural, and physical dimensions; it has a slight decline in the human capital poverty rate and even increases the financial capital poverty in the Makran coastal region.

Figure 4: The MPI Radar Chart of the Makran Region



The intensity of multidimensional poverty in the Makran region, calculated from the average poverty intensity of each county, is equal to 0.469 for 2005 and 0.440 for 2015 (table 5). Based on the AF method, the multidimensional poverty index is obtained by multiplying the incidence and intensity of poverty. As the incidence of poverty in the Makran region is 1, the MPI score is equal to the poverty intensity. From 2005 to 2015, the MPI score has

fallen by just 6 percent, from 0.469 to 0.440, which is very small over ten years.

Table 5: The Multi-Dimensional Poverty Index of the Makran Region

Year	Poverty Incidence (H)	Poverty Intensity (A)	MPI Score (H*A)
2005	1	0.469	0.469
2015	1	0.44	0.44
Poverty Cut-Off:	-	-	0.2

6. CONCLUDING REMARKS

The global Multidimensional Poverty Index is an international measure of acute multidimensional poverty covering over 100 developing countries. The MPI assesses poverty at the individual level by using ten general indicators. These simplification-permits comparisons across countries and world regions and within countries by ethnic group, urban or rural area, subnational region, and age group, as well as other key household and community characteristics (OPHI, 2018). However, UNDP and OPHI emphasize the need to build national and regional multidimensional poverty index or even develop the MPI based on specific target groups such as children, especially in developing countries. In this regard, this paper has focused on coastal regions and tried to develop a special MPI for assessing multidimensional poverty in coastal communities. For this aim, MPI's criteria were matched to the sustainable livelihood approach's criteria which relies on the "oceans as livelihoods" coastal planning approach. The developed model included five main poverty-related dimensions and was run for the Makran region.

This developed model has three major differences from the global one in assessing multidimensional poverty in the case study. One is that although the general MPI assesses poverty at the individual level, the developed MPI assesses poverty at the regional level and considers Makran's spatial structures. In this way, financial, social, and natural dimensions were added to the model, each of which required a specific population. Although the region has improved slightly in human and physical aspects as two common global dimensions, the poverty level has also worsened in financial, social, and natural dimensions, even up to 23 percent from 0.254 to 0.331 for financial capital. In other words, even though the general MPI shows slight progress in poverty alleviation, the developed model shows a reverse trend in reducing poverty. This difference shows the importance of using the developed model to enhance assessment accuracy.

Second, due to the simplicity of global MPI, many nations use its common framework to assess multidimensional poverty. In a step forward, the general MPI is modified to be used as a national evaluation framework, and some countries have the experience of developing the general model to have a localized one. Moreover, in the only case of Sri Lanka that crafted an individual Child MPI for children as a key population, the general MPI is modified for a specific target group. Here, the developed model focuses on the coastal environment as

a specific geographical region. This hybrid model was synthesized based on the livelihood-related marine and coastal planning approach and the general criteria of the global MPI to be matched to the characteristics of coastal environments.

Thirdly, the general MPI assesses poverty at an individual level and uses different calculation systems to determine whether a person is poor or not, and the Alkire and Foster calculation method is the most common one. However, the developed MPI assesses poverty at the regional level with regard to spatial structures, and it would be unrealistic to find a region absolutely poor or not poor in a specific dimension. Therefore, fuzzy logic is used to calculate poverty in the developed MPI model instead of using the binary logic of zero and one, which is a two-valued formal logic in the Alkire and Forster method. In this way, the percentage of the population who are suffering from poverty in each criterion was calculated and showed to what extent the region is poor in each of the five dimensions, which makes the multidimensional poverty assessment more accurate, realistic, and applicable.

Overall, this study demonstrates the necessity of developing an MPI framework for poverty assessment in coastal regions. Multidimensional poverty assessment requires comprehensive and context-oriented viewpoints as well as readily accessible information to provide an accurate assessment. In coastal areas in which complex structures are constantly subjected to natural and human changes and affect the living conditions of residents, the developed model offers a promising opportunity to recognize, analyze, and alleviate multidimensional poverty.

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