Gross domestic product deficiencies as indicator of sustainable development. The case of Mexico

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Abstract

Since 1934, the Gross Domestic Product (GDP) has been considered as a valid indicator of progress, well-being and sustainable development. In economics, it has been the most relevant measuring indicator and the most widely used because international political-economic relations are based on it. In 2012, during the World Summit of Sustainable Development, Rio+20 the use of the GDP as a measure for development and prosperity was discussed and additional indicators for the GDP were proposed to measure natural wealth, social well-being and progress. The goal of this document is to prove deficiencies in using the GDP as the single indicator for sustainable development in Mexico. Different comparisons and analyses on sustainable development were performed in all states in the Mexican Republic.

The study was developed in two stages. In the first stage, only economic indicators were considered, analysing the contribution that each sector had on the GDP. On the second stage additional indicators related to all the dimensions of sustainable development; economic, social, environmental and institutional, were used.

The methodology is supported on the Diffuse Model of Subjective Preferences. The results show that in the case study, the GDP is not ideal as a single indicator of progress, well-being and sustainable development in an economy.

Introduction

Since 1934, the Gross Domestic Product (GDP) has been regarded as a valid indicator of progress, well-being and sustainable development; it has been the most relevant indicator to measure progress, the most widely used because political-economical international relations are based on it. Economic growth, measured through the GDP has been considered as the main goal of the political economy in a country since it is believed to increase employment and sustainable development in the regions. During the World Summit on Sustainable Development Rio+20 held in 2012, the use of the GDP as a measure for development and prosperity was discussed. Limitations were acknowledged as a measure for well-being and sustainable development, therefore complementary indicators were proposed to measure natural wealth, social well-being and progress. In this way countries could make decisions based on information that was closer to their reality as well as leverage the development of regions which in turn would allow them to move to an economy with stable levels of social well-being and sustainable development. Often, those involved in making important socioeconomic decisions are trapped in short term engagements. With studies supported in adequate management it is possible to make short and long terms objectives compatible, therefore moving towards a healthier economy with stable levels of social well-being and sustainable development.

The aim of this study is to prove deficiencies in using GDP as the single indicator of social development by analysing the case of all the states in the Mexican Republic. The process was carried out by comparing and analysing Sustainable Development in each state. The study was developed in two stages. In the first only economic indicators were used, analysing the contribution of each sector to the

GDP, while in the second, additional indicators associated with all dimensions of Sustainable Development; economy, social, environmental and institutional, were used.

The supporting methodology was the Diffuse Model of Subjective Preferences. The results proved that the GDP was not suitable as a sole indicator for progress in an economy's well-being and Sustainable Development.

The Gross Domestic Product

Since it was created, the GDP was used primarily as a tool for quantify an economy's production. Simon Kuznets, creator of the unified American accounting System, was the developer of the GDP in 1934, which became, since then the most used indicator to measure development and economic growth (Rikfin, Kuznets, Torre-Marín, 2005). In a simplified form, the GDP can be defined as the monetary sum of goods and services that are produced in a year in a specific geographical area. Its importance relies on the fact that it measures the level of production, which is one of the objectives of economic theory. The higher the GDP, the higher the production of goods and services, and therefore, higher level of well-being, development and progress. This is the reason why economic growth (on the GDP) has been related to development (Torre-Marín. 2005).

In order to establish the GDP, only goods and services destined for consumption and valued at market price were considered. Since the GDP reflects the movements of the market, products and services that are out the market were left out of the estimation and likewise, it did not include in its estimate environmental damage that resulted from economic activities and did not offer an appropriate valuation of the situation of the inhabitants. Considering the increasing inequalities growth in GDP does not necessarily mean that the population is better in economic terms and even less in terms of quality of life (Endara, 2013).

Nevertheless, GDP is a standard indicator widely used to measure and compare economic performance based on its own significance and also due to the influence that it has other important indicators such as employment and public accounts. It is common that conclusions about social wellbeing are drawn from this indicator because traditionally the availability of goods and services is associated with a higher quality of life (Endara, 2013).

The deficiencies of the GDP as indicator of sustainable development

GDP is the most used indicator to measure the success and evolution of any given economy. It has also become the more generally accepted indicator to make international comparisons between national economies. Nevertheless, the idea of using GDP to measure the level of production and well-being at the same time has created certain controversy. In 1934, S. Kuznets suggested that a country's well-being would hardly be inferred based on measuring of its production (Aguado, R., Martínez, J., 2011). Sustainable Development is another concept that has been related to the GDP, and has recently acquired relevance. It emerged in the nineteen-eighties because of voices alerting about the need to consider the planet's growth limits in an environment in which imbalances and its unsustainable character and the negative effects on the environment from dominant economic development models would result, in the short run, in natural resources depletion of the physical environment (Pinto, I., Gil-Lafuente, A.M., 2013).

Due to consequences of economic growth created in both the environment and society, in 1987, the United Nations (UN) created the World Commission on Environment and Development (WCED), known as the Bruntland Commission. Its goal consisted on studying sustainable economic development, based on the first definition of sustainable development: "*the development that secures the needs of the present generation, without compromising that future generations will be able to ensure theirs*". Later on, in the 2005 UN World Summit on the environment the existence of the pillars that supported sustainable development were confirmed: economic dimension, environmental dimension and institutional dimension (Pinto, I., 2015; Pinto, I., Gil-Lafuente, A.M., 2013; Aguado, R., Martínez, J. 2011).

The main development of Support and Sustainable Development indicators started in the early 80s in Canada and in some countries in Europe, but were launched widely in the Earth's Summit to control the advance of the Agenda 21, the United Nation's Conference on the Environment and Development (Rio de Janeiro, June 1992). The Commission of Sustainable Development (CSD-In Spanish CDS) was created to monitor progress on sustainable development (Quiroga., 2001, 2007). Immediately,

the need to develop instruments to measure the progress towards sustainability became apparent, therefore, design and use of environmental sustainability and Sustainable Development became relevant.

Sustainable Development indicators can be described as a system of signals suitable to evaluate the progress of countries and regions towards Sustainable Development. The indicators are distinct tools that help in the design and evaluation of public policies, strengthening informed decisions and citizens' participation to bolster countries towards the Sustainable Development (ONU. 2012; Quiroga. 2007).

In the World Summit for Sustainable Development in Rio+20 held on June 19, 2012, the presidents, heads of state and representatives renewed their commitment in favor of Sustainable Development and the promotion of an economic, social and environmentally supportive future for the planet and for the current and future generations. The use of the GDP as a measure of development and prosperity, was also discussed. Its limits as a way to measure well-being and sustainable development were acknowledged, therefore proposals were made to incorporate additional indicators to the GDP to measure the natural wealth, the social well-being and the progress, among others the sustainable development indicators (ONU, 2012)

The main criticism to measuring Sustainable Development throughout the GDP has been that the indicator does not allow to evaluate the development in a comprehensive manner. The GDP is a validate tool to evaluate economic development in terms of money, but does not yield information regarding the impact of social and public policies and therefore about the quality of life. That is why some alternatives have been developed to evaluate development from economic, social and environmental perspectives.

Indicator Framework of the commission of sustainable development

In the document "Indicators of Sustainable Development: Guidelines and Methodologies", published by the UN in 2007, a third group of indicators for Sustainable Development were presented. Table 1 (ONU, 2007).

Model of Subjective Preferences

Numerous diffuse models have been developed through time. They have been applied in diverse areas, and can be divided in two groups: diffuse numerical models and non-numerical diffuse models. The Hamming Distance, developed by Richard Wesley Hamming in 1950; the theory of Expert Ones, introduced by Arnold Kaufmann in 1987, in the same year and the Model of Subjective Preference was proposed by R. Yager in 1988 are examples of the diffuse numerical models.

The Model of Subjective Preferences proposed an algorithm that organized physical or mental objects according to relevant characteristics. When it was possible to order a group of elements (objects) somehow, and this order of elements was found or established in another group according to a specific group of elements (different naturally, and normally) it was then possible to construct a scale with increasing and decreasing assessments. Optimized and sub-optimized were obtained without the need to use fundamental concepts (Gil-Aluja, J. 1999). This order was defined as: *"a grading of the preferences of physical or mental objects based on objective and subjective appreciations of their characteristics or singularities"*. One of the configurative elements of the order is given by the need to previously determine the characteristics, properties and/or singularities deserving appreciation. In practical terms, although not necessarily from a theoretical perspective, its number needs to be finite and susceptible to be numbered. These properties, characteristics and/or singularities will constitute the elements in a reference. Physical or mental objects subject to order in finite number in the practice, will be part of another referential group (Idem).

Once these two groups are established, the existence relationship between them is determined. Since the level of possession of all qualities or characteristics of the objects is not always expressed in an objective and precise way, the methodology of Subjective Preferences is used since it allows to store subjective and objective information simultaneously expressed in a precise and imprecise ways (Idem).

For further information on this model use the following references: Pinto, I. 2015; Keropyan, A. y Gil-Lafuente, A.M. (2013), Barcellos Paula, L. y Gil-Lafuente, A.M. (2010), Merigó, J. y Gil-Lafuente, A.M. (2012 y 2013), Vizuete Luciano, E. et.al., (2013), Hurtado, A. y Tinto Arandes, J. (2010), Kydland, F.E. et.al., (2011), Rico F. Marco A. y Tinco, J., (2010).

TOPIC	SUB-TOPIC	INDICATOR
Poverty	Income	Percentage of people living under poverty conditions
	Inequality	Relationship of national income, from the highest to the lowest
	Sanity	People with availability to service of improved sanity
	Purified water	Population with access to clean water
	Access to energy	Percentage of housing without electricity nor energy
	Life conditions	Population who live in suburbs and slums
Government	Corruption	Percentage of the population that has bribed someone
	Crime	Number of murders in each 100,000 people
Health	Mortality	Mortality rank under 5 years
		Lifespan when they are born
	Provision of health	Percentage of the population with access to primary healthcare
		Immunization against diseases and infections for children
	Nutritional condition	Nutritional condition for kids
	State of health and risk	Average of mortality of the main diseases such as VIH, malaria and tuberculosis
Education	Level of education	Total average of inscriptions to the last grade school in elementary school
		Total average of inscriptions in elementary school
		Average of literate adults
Demography	Population	Average growth of the population
		Relation of dependency
Natural disasters	Vulnerability to natural disasters	Percentage of the population living near risky areas for disaster
Atmosphere	Weather change	Emissions of carbon dioxide
	Reduction of the ozone layer	Consumption of substances which damage the ozone layer
	Air quality	Concentration of atmospheric pollution in urban areas
Land	Agriculture	Permanent area to grow and prepare land
	Woods	Proportion of land covered by forests
Oceans, seas and coasts	Coastal area	Average of people living near the coast
	Fishing	Proportion of fish quantity found in the secure biological limits
	Marine environment	Proportion of the protected maritime area
Sweet water	Quantity of water	Proportion of total use of water
		Frequent use of water for the economic activity
	Quality of water	Dirty water with human waste
Biodiversity	Ecosystem	Average of territory protected, total of ecological regions
	Species	Change of status of threatened species
Economic Development	Macroeconomic results	Per Capita GDP / Participation in the investment of the GDP
	Public finance supportive Employment	Debt and relationship with GDP
	Employment	Employment and relationship-population
		Work costs per unit and work productivity
		Participation of women in the paid employment without consideration of the agricultural area
	Technology Information and communication	Users of internet per each 100 people
	Investigation and development	Total indicator about R and D as proportion of the GDP
	Tourism	Contribution of the tourism to the GDP
Global economic development	Commerce	Deficit in current account as percentage of the GDP
	External finance	Official assistance to develop (ODA) given or received as percentage of the GNI
Consumption and patterns of production	Consumption of materials	Consumption of materials in the economy
	Use of energy	Annual consume of energy and per economic activity
		Total intensity of the use of energy and per economic activity
	Production of waste and process	Production of dangerous waste
		Treatment and elimination of waste
	Transportation	Distribution and way of people's transportation

Source: Developed by authors with data from Sustainable Development guidelines and methodologies
Table 1. Social Development Indicators CSD

Analysis results: Economic Dimension

The case study that was presented analyses all the states of the Mexican Republic. Data was obtained from publications issued by the National Institute of Statistics and Geography (INEGI), which is an autonomous agency of the Mexican government, coordinating the National Statistical Information System and Geographic of the country.

The results of applying the methodology of Subjective Preferences Indicators are presented in the Economic Dimension. The model of Subjective Preferences includes the contribution of each economic

sector in all the states of the Mexican Republic towards the GDP establishing a process of normalized comparison that will later be affected vector that is representative of the normalized preferences of economic activities in each state. It is in this last vector that the subjective strand of the model rests; it is dependent on the existing priorities, and it is weighted in larger or smaller measure the relative importance of an economic activity over the rest. For further information about the development of methodology of Subjective Preferences in this group of indicators, see (Pinto, 2015)

Two finite groups were defined for the analysis, the group of objects and the group of characteristics that determined the decision. The 31 states and Mexico City were considered as the group of objects that make up the Mexican Republic while the group of indicators of the GDP established in basic values of each economic unit was used as the group of determinant characteristics of the decision. Both groups are analyzed in Table 2.

Objects

Mexican Republic Regions	
P1	Aguascalientes
P2	Baja California
P3	Baja California Sur
P4	Campeche
P5	Coahuila de Zaragoza
P6	Colima
P7	Chiapas
P8	Chihuahua
P9	Distrito Federal
P10	Durango
P11	Guanajuato
P12	Guerrero
P13	Hidalgo
P14	Jalisco
P15	México
P16	Michoacán de Ocampo
P17	Morelos
P18	Nayarit
P19	Nuevo León
P20	Oaxaca
P21	Puebla
P22	Querétaro
P23	Quintana Roo
P24	San Luis Potosí
P25	Sinaloa
P26	Sonora
P27	Tabasco
P28	Tamaulipas
P29	Tlaxcala
P30	Veracruz de Ignacio de la llave
P31	Yucatán
P32	Zacatecas

Characteristics

Indicators of GDP in basic values in each of the economic units	
C1	Agriculture, farming, wood resources, fishing and hunting
C2	Mining
C3	Electricity, water, gas supplies, consumers' final products
C4	Construction
C5	Food industry, drinks and tobacco
C6	Textiles, clothing and leather clothes
C7	Wood industry
C8	Paper industry, printing and related companies
C9	Oil products, charcoal, chemistry products, plastic and nylon
C10	Manufacturing of products with no metallic minerals
C11	Steel industry
C12	Machines and equipment
C13	Furniture manufacturing and related products
C14	Other manufacturing companies
C15	Commerce
C16	Transportation, mail and storage
C17	Information massive ways
C18	Finance services and insurance
C19	Housing services and rents
C20	Professional services, technical and scientific
C21	Education service
C22	Health service and social assistance
C23	Culture, sports and leisure services
C24	Room booking, food and drink preparations
C25	Other services except government activities
C26	Government activities

Source: Developed by authors based on information from the INEGI [INEGI, 2014]

Table 2. Group of objects and characteristics

Data of the study. Graphic 1 concentrates the information of the Mexican Republic for each of the basic values indicators of the GDP for each economic unit (to analyze the full data set see: (Pinto, I., 2015).

Graphic 1. Information Concentration

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18
C1	5739428	10648689	2835334	3380938	11122985	3748123	18729543	22377383	1202972	15856081	18222202	9536580	8493014	40221802	16649572	31569195	4060842	6267168
C2	1345169	646227	2156210	4.84E+08	13007630	922269	14997468	5724654	83411	8377995	1468929	2607564	1725752	2208693	4508620	1459660	364847	174296
C3	553773	6347859	1328562	593027	4778950	1985122	7126691	5232325	9197319	2003940	3884719	5509416	3162940	5150685	11356863	2885182	1448071	1516868
C4	11613035	32755458	13676846	28713828	25931358	5412393	13667697	25960224	82701404	9840489	29352530	10007968	14022261	41126885	67051907	16591024	11301774	10813457
C5	10012608	13526856	1774730	1820514	12843957	2750103	10523182	12121175	54340433	18669692	37286751	6536730	15519907	68276357	1.01E+08	13134658	6054963	3522902
C6	2851031	1414775	35244	665306	6951131	52883	264786	1816404	15348906	1000159	17044283	274010	4029698	6884227	12492044	1166337	1775705	258538
C7	72515	510190	3159	112672	95313	85305	191017	7550719	617603	2420628	97805	455647	117243	910772	922421	2568042	35624	104293
C8	241038	3463555	21002	19872	2327185	27496	222104	1724181	11436020	1014432	2343631	57239	191554	3760406	13766022	1129478	379791	31933
C9	1579432	3006297	32703	164055	7094779	115752	5373545	2625128	76724665	536196	18824040	112215	15489359	21175434	53884258	1910953	12716976	719571
C10	2124482	2694487	212527	118323	7928499	2206358	207344	5220449	2911070	629997	5061085	846383	11064044	8083286	10457264	1865360	3002714	113143
C11	850216	6053364	67656	85677	28839345	157474	116305	3071641	28990837	1599194	6483583	2798955	991974	12129719	21573768	12031988	922346	681328
C12	18547046	26700258	5745	21	40358649	138048	388094	44013297	18593648	2603940	37253332	52324	3405255	34373036	51990119	558227	4857306	254844
C13	231636	1573704	18166	20907	553982	61161	93248	1034756	3725535	574750	342532	71186	131697	3822653	3594885	367397	65973	30755

Table 3 shows the final vector with the weight of sustainability for each state of the Mexican Republic is descending order.

Identificator	*Estate of the Mexican Republic*	*Obtained value*
R9	Distrito Federal	0.1952
R15	Estado de México	0.0977
R19	Nuevo León	0.0802
R14	Jalisco	0.0633
R11	Guanajuato	0.0457
R8	Chihuahua	0.0444
R30	Veracruz	0.0397
R2	Baja California	0.0344
R21	Puebla	0.0336
R5	Coahuila de Z.	0.0309
R28	Tamaulipas	0.0268
R16	Michoacán	0.0256
R26	Sonora	0.0239
R4	Campeche	0.0230
R24	San Luis Potosí	0.0206
R22	Querétaro	0.0195
R27	Tabasco	0.0188
R25	Sinaloa	0.0185
R13	Hidalgo	0.0167
R20	Oaxaca	0.0161
R23	Quintana Roo	0.0157
R7	Chiapas	0.0154
R10	Durango	0.0149
R12	Guerrero	0.0142
R31	Yucatán	0.0136
R17	Morelos	0.0117
R1	Aguascalientes	0.0111
R32	Zacatecas	0.0067
R29	Tlaxcala	0.0062
R3	Baja California Sur	0.0057
R18	Nayarit	0.0052
R6	Colima	0.0051

Table 3. Weighted Sustainability, Economic Dimension

Results Analysis in all Dimensions

The results from the use of the methodology of Subjective Preferences in all the dimensions of Sustainable Development: economic, social, environment and institutional are presented. For further information regarding the development of the Subjective Preferences methodology in this group of indicators, see (Pinto, I 2015).

1. The group of objects includes the 31 states of the Mexican Republic and Mexico City, while the group of determining characteristics of the decision includes indicators related with all the dimensions of the supportive development. Both groups are presented in the Table 4
2. Data presented is the same as shown in Graphic 1
3. Table 5 shows the final vector with the weighted sustainability for each state in the Mexican Republic. Results are ordered in a descendent pattern.

Objects

Regions of the Mexican Republic	
P1	Aguascalientes
P2	Baja California
P3	Baja California Sur
P4	Campeche
P5	Coahuila de Zaragoza
P6	Colima
P7	Chiapas
P8	Chihuahua
P9	Distrito Federal
P10	Durango
P11	Guanajuato
P12	Guerrero
P13	Hidalgo
P14	Jalisco
P15	México
P16	Michoacán de Ocampo
P17	Morelos
P18	Nayarit
P19	Nuevo León
P20	Oaxaca
P21	Puebla
P22	Querétaro
P23	Quintana Roo
P24	San Luis Potosí
P25	Sinaloa
P26	Sonora
P27	Tabasco
P28	Tamaulipas
P29P	Tlaxcala
30	Veracruz de Ignacio de la llave
P31	Yucatán
P32	Zacatecas

Characteristics

Identificator	*Indicators Sustainable Development*
C1	Average of total grow
C2	Average of global pregnancy
C3	Average of global pregnancy in adolescence between 15 to 19
C4	Total average of mortality
C5	Life expectancy when born (years)
C6	Average housing size
C7	Average housing with water supply
C8	Total average of illiterate people
C9	People over 18 years old or more with professional studies
C10	People over 18 years old with post grade (number of people)
C11	Population with average of schooling over 15 years old or more
C12	Total average of unemployment
C13	Land surface with reforestation (hectares)
C14	Average of poverty
C15	Average of people vulnerable with lack of social facts
C16	Average of people vulnerable by their income
C17	Average of people with education outback
C18	Coefficient of Gini
C19	GDP (millions of pesos)
C20	Average of houses with electricity
C21	Surgery rooms per every 100,000 habitants
C22	Average of children mortality
C23	Medic units per each 100,000 habitants

Table 4. Group of objects and characteristics

Identificator	*State of the Mexican Republic*	*Obtained value*
R9	Distrito Federal	0.05052
R15	Estado de México	0.03944
R14	Jalisco	0.03776
R19	Nuevo León	0.03674
R5	Coahuila de Zaragoza	0.03428
R30	Veracruz de I.	0.03361
R6	Colima	0.03299
R31	Yucatán	0.03201
R17	Morelos	0.03162
R27	Tabasco	0.03113
R29	Tlaxcala	0.03113
R21	Puebla	0.03102
R11	Guanajuato	0.03083
R25	Sinaloa	0.03080
R24	San Luis Potosí	0.03044
R16	Michoacán de O.	0.02985
R23	Quintana Roo	0.02969
R4	Campeche	0.02965
R32	Zacatecas	0.02947
R2	Baja California	0.02942
R1	Aguascalientes	0.02934
R3	Baja California Sur	0.02882
R26	Sonora	0.02874
R28	Tamaulipas	0.02874
R22	Querétaro	0.02866
R18	Nayarit	0.02830
R13	Hidalgo	0.02820
R8	Chihuahua	0.02801
R7	Chiapas	0.02743
R20	Oaxaca	0.02703
R10	Durango	0.02661
R12	Guerrero	0.02543

Table 5. Ranking of support, all the dimensions

Discussion of results

The analysis of results was performed by comparing the results obtained from Table 3 and those from Table 5. This information is presented in Tables 6 and 7. The position of the economic dimension based on their relative weight with regards to the position of the state, considering all the dimensions of Sustainable Development is presented.

Identificator	*States of the Mexican Republic*	*Evaluation Economic Dimension*	*Evaluation all Dimensions*
R9	Distrito Federal	0.1952	0.05052
R15	Estado de México	0.0977	0.03944
R19	Nuevo León	0.0802	0.03674
R14	Jalisco	0.0633	0.03776
R11	Guanajuato	0.0457	0.03083
R8	Chihuahua	0.0444	0.02801
R30	Veracruz	0.0397	0.03361
R2	Baja California	0.0344	0.02942
R21	Puebla	0.0336	0.03102
R5	Coahuila de Z.	0.0309	0.03428
R28	Tamaulipas	0.0268	0.02874
R16	Michoacán	0.0256	0.02985
R26	Sonora	0.0239	0.02874
R4	Campeche	0.0230	0.02965
R24	San Luis Potosí	0.0206	0.03044
R22	Querétaro	0.0195	0.02866
R27	Tabasco	0.0188	0.03113
R25	Sinaloa	0.0185	0.03080
R13	Hidalgo	0.0167	0.02820
R20	Oaxaca	0.0161	0.02703
R23	Quintana Roo	0.0157	0.02969
R7	Chiapas	0.0154	0.02743
R10	Durango	0.0149	0.02661
R12	Guerrero	0.0142	0.02543
R31	Yucatán	0.0136	0.03201
R17	Morelos	0.0117	0.03162
R1	Aguascalientes	0.0111	0.02934
R32	Zacatecas	0.0067	0.02947
R29	Tlaxcala	0.0062	0.03113
R3	Baja California Sur	0.0057	0.02882
R18	Nayarit	0.0052	0.02830
R6	Colima	0.0051	0.03299

Table 6. Economic Dimension versus all the dimensions of Supportive Development

Identificator	*Estate of the Mexican Republic*	*Position Economic Dimension*	*Position all Dimensions*
R9	Distrito Federal	1	1
R15	Estado de México	2	2
R19	Nuevo León	3	4
R14	Jalisco	4	3
R11	Guanajuato	5	13
R8	Chihuahua	6	28
R30	Veracruz	7	6
R2	Baja California	8	20
R21	Puebla	9	12
R5	Coahuila de Z.	10	5
R28	Tamaulipas	11	24
R16	Michoacán	12	16
R26	Sonora	13	23
R4	Campeche	14	18
R24	San Luis Potosí	15	15
R22	Querétaro	16	25
R27	Tabasco	17	10
R25	Sinaloa	18	14
R13	Hidalgo	19	27
R20	Oaxaca	20	30
R23	Quintana Roo	21	17
R7	Chiapas	22	29
R10	Durango	23	31
R12	Guerrero	24	32
R31	Yucatán	25	8
R17	Morelos	26	9
R1	Aguascalientes	27	21
R32	Zacatecas	28	19
R29	Tlaxcala	29	11
R3	Baja California Sur	30	22
R18	Nayarit	31	26
R6	Colima	32	7

Table 7. Weighted Economic Dimension against all the Sustainable Development Dimensions

Certain states were specifically relevant for the analysis. The state which occupied the last position in the economic dimension was Colima, and the state which was placed last in all dimensions was Guerrero. Data from Table 7, column 3 show Colima in position 32, nevertheless further analysis shown in column 4 placed the state in the 7th position, climbing twenty-five positions. At the same time, in the economic dimension, Guerrero was in the 24th position, and in further analysis it was in the 32nd position, descending eight positions.

Table 8 shows the analysis of both states with respect to the 10 indicators that have more weight.

Characteristics	*Colima %*	*Guerrero %*
C18: Coefficient of Gini	0.445	0.533
C14: Percentage of poor people	34.4	69.7
C15: Percentage of the vulnerable population per social lack	31.7	21.7
C1: Rank of total growth	1.8	0.9
C22: Rank of children mortality	12.2	16.4
C2: Global rank of fecundity	2.35	2.91
C16: Percentage of vulnerable population by income	6.3	2.3
C8: Percentage of total illiterate people	5.13	16.68
C17: Percentage with education outback	18.8	26.8
C3: Fecundity rank in adolescents between 15 and 19 years old	44.53	69.18

Table 8. All dimensions Colima-Guerrero

Table 8 shows the analysis of both states with respect to the 10 indicators that have more weight.

From Table 8, it is possible to clearly observe that Colima has a higher Sustainable Development level than Guerrero in items C18, C14, C22, C2, C8, C17, and C3. The rankings associated to the state of Colima, and shown in Table 6 was 0.03299, while in the state of Guerrero it was 0.02543. This helps explain that the well-being of the population in Colima is considerably better than that in the state of Guerrero.

A relevant question arises: Why is the state of Colima ranked in the last position in the analysis of economic indicators? The answer is found in this study because only information related to the GDP was considered without including relevant issues such as the geographic size of the state or its population. In the model the higher the contribution in indicators with higher weight, the higher the sustainable development in the state. Additionally the GDP by itself is not an indicator that represent population well-being, therefore, other factors need to be considered such as the ones proposed during this analysis.

In the same way, the states of Chihuahua and Coahuila de Zaragoza were analyzed. In Table 7, Column 3 Chihuahua was located in the 6th position and in the last analysis, Column 4 of Table 7, it was found in the 28th position, falling twentytwo positions. On the other hand, in Table 7, Column 3, Coahuila de Zaragoza was located in the 10th position and in Column 4 of the Table 7 it occupied the 5th position, climbing five positions.

Table 9 shows the analysis of both states with respect of the ten indicators with more weight.

Characteristics	*Chihuahua*	*Coahuila de Z.*
C18: Coefficient of Gini	0.5	0.464
C14: Percentage of poor people	35.3	27.9
C15: Percentage of the vulnerable population per social lack	27.4	24.4
C1: Rank of total growth	1.1	1.8
C22: Rank of children mortality	14.7	9.5
C2: Global rank of fecundity	2.53	2.43
C16: Percentage of vulnerable population by income	10.7	12.7
C8: Percentage of total illiterate people	3.66	2.63
C17: Percentage with education outback	16.1	12.5
C3: Fecundity rank in adolescents between 15 and 19 years old	72.47	72.67

Table 9. All the dimensions Chihuahua-Coahuila of Zaragoza

In Table 9 it can be observed that Coahuila de Zaragoza has a higher Sustainable Development ranking than Chihuahua in indicators C18, C14, C22, C2, C8 and C17. The evaluation associated to the state of Coahuila de Zaragoza and shown in Table 6 is about 0.03428 while in Chihuahua it is 0.02801. Therefore, the well-being of the population of Chihuahua is considerably higher than in the state of Chihuahua.

Conclusions

The analysis performed through the study of all the states in the Mexican Republic show that the Gross Domestic Product (GDP) alone is not an indicator that shows the sustainability of a region, on the contrary, it has been demonstrated that there are several deficiencies with this indicator, therefor it cannot be considered as a generator of progress, well-being and sustainable development. It is therefore required to consider additional indicators to support sustainable development in a region.

Bibliography

Aguado, R., Martínez, J. (2011). Una propuesta alternativa al Producto Interior Bruto como indicador de sostenibilidad y desarrollo bajo el prisma del pensamiento social cristiano (An alternative proposal to the Gross Domestic Product as an indicator of sustainability and development under the prism of Christian social thought). *Revista de Fomento Social 66,* pp. 219-249. ISSN: 00156043.

Endara, G. (2013). La compleja medición del bienestar - ¿por qué el PIB no es un indicador adecuado, qué alternativas existen y qué tan viable es su aplicación? (The complex measurement of well-being - why GDP is not an adequate indicator, what alternatives exist and how viable is its application?). *Friedrich Ebert Stiftung Sustainability.* Consultado en http://www.fes-sustainability.org/de/node/370, el 29/09/2015.

Gil-Aluja, J. (1999). *Elementos para una Teoría de la Decisión en la Incertidumbre (Elements for a Theory of Decision in Uncertainty).* Editorial Milladoiro, España.

Gil-Aluja, J., Merigó, J., Gil-Lafuente, A. (2011). Decision making with the induced generalized adequacy coefficient. *Appl. Comput. Math. V, 10, N. 2.*, pp. 321-339.

Gil-Aluja, J., Merigó, J., Gil-Lafuente, A. (2011). A new aggregation method for strategic decisión making and its application in assigment theory. *African Journal of Business Management. Vol. 5 (11) 4, (ISSN-1993.8233)* pp. 4033-4043.

Gil-Aluja, J., Merigó, J., Gil-Lafuente, A. (2011). Using homogeneous groupings in portfolio managament. *Expert Systems with Applications. An International Journal. Vol. 38, Issue 9, (ISSN-0957-4174)* pag. 10950-10958.

Gil-Aluja, J., Merigó, J., Gil-Lafuente, A. (2011). Soft Computing Techniques for Decision Making with Induced Aggregation Operators. *Information. An International Interdisciplinary Journal. Vol. 14 nº 6, (ISSN 1343-4500)* pp. 2019-2039.

Gil-Aluja, J., Gil-Lafuente, A., Klimova, A. (2009). M-Attributes Algorithm for the Selection of a Company to be Affected by a Public Offering. *International Journal of Uncertainty, Fuzziness and Knowledge – Based Systems. Vol. 17. Nº 3.* p. 333-343.

Gil–Lafuente, A. (2005). *Fuzzy Logic in Financial Analysis*. Springer, Berlin.

Gil-Lafuente, A. (2013). Errores recurrentes en el origen de la crisis y nuevas bases para el bienestar social sostenible (Recurring errors in the origin of the crisis and new bases for sustainable social welfare). *Discurso de ingreso en la Real Academia de Ciencias Económicas y Financieras, como Académica de Número*. Barcelona.

Gil-Lafuente, A., Barcellos de Paula, L. (2013). Determining the Composition of a Portfolio Management from a Grupings Model. *International Journal of Uncertainty, Fuzziness and Knowledge – Based Systems. Vol. 21,* Online ISSN: 1793-6411.

INEGI, Instituto Nacional de Estadística y Geografía. *México en Cifras (Mexico in numbers).* Disponible en: http://www.inegi.org.mx/

INEGI, Instituto Nacional de Estadística y Geografía, (2010). *Sistema de Cuentas Nacionales de México. Producto Interno Bruto por Entidad Federativa, 2005-2009 (System of National Accounts of Mexico. Gross Domestic Product by Federal Entity 2005-2009).*

ONU (2012). *Desarrollo sostenible: ejecución del Programa 21 y del Plan para su ulterior ejecución, y aplicación de los resultados de la Cumbre Mundial sobre el Desarrollo Sostenible y la Conferencia de las Naciones Unidas sobre el Desarrollo Sostenible (Sustainable development: implementation of Agenda 21 and the Plan for its further implementation, and implementation of the outcomes of the World Summit on Sustainable Development and the United Nations Conference on Sustainable Development).* Sexagésimo séptimo período de sesiones.

ONU. (2015). *Indicators of Sustainable Development. Guidelines and Methodologies.* Third Edition. Consultado en : http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf.

Pinto, I., (2015). *Modelo difuso de gestión para potencializar el desarrollo de regiones como contribución al Desarrollo Sostenible (Diffuse management model to potentiate the development of regions as a contribution to Sustainable Development).*

Tesis para obtener el grado de Doctor en Planeación Estratégica y Dirección de Tecnología. Universidad Popular Autónoma del Estado de Puebla, México.

Pinto, I., Gil-Lafuente, A., Sánchez, G. (2018). Pichat´s Algorithm for the Sustainable Regional Analysis Management: Case Study of Mexico. *Studies in Systems Decision and Control 125*.

Pinto, I., Gil-Lafuente, A., Malcón, C. (2017). Potenciar el desarrollo de regiones a partir de modelos difusos (Enhance the development of regions from diffuse models). *Estrategias de Innovación para el Desarrollo Empresarial*. Ilustre Academia Iberoamericana de Doctores, pp. 1923-1937.

Quiroga. R., (2001). *Indicadores de sostenibilidad ambiental y de desarrollo sostenible: estado del arte y perspectivas (Indicators of environmental sustainability and sustainable development: state of the art and perspectives)*. Serie Manuales CEPAL No. 16. Consultado en http://repositorio.cepal.org/handle/11362/5570.

Quiroga. R., (2007). *Indicadores ambientales y de desarrollo sostenible : avances para América Latina y el Caribe (Environmental and sustainable development indicators: progress for Latin America and the Caribbean)*. Serie Manuales CEPAL No. 55. Consultado en :
http://www.cepal.org/deype/publicaciones/xml/4/34394/lcl2771e.pdf.

Rikfin, J. *La edad de la empatía (The age of empathy)*. Paídos. ISBN 978-84-493-2356-0, p. 539

Torre-Marín, G. (2005). *Desarrollo Sostenible (Sustainable Development)*. Ediciones UPC.

Kaufmann, A., Gil Aluja, J., Terceño, A. (1994). *Matemáticas para la economía y la gestión de empresas (Mathematics for the economy and business management*). Ed. Foro Científico, Barcelona.

Kaufmann, A., Gil Aluja, J. 1992. *Técnicas de gestión de empresas (provisiones, decisiones y estrategias) (Business management techniques (provisions, decisions and strategies)*. Ed. Pirámide. Madrid.

Kaufmann, A., Gil Aluja, J., 1993. *Técnicas especiales para la gestión de expertos* (*Special techniques for the management of experts)*. Ed. Milladoiro Santiago de Compostela.

Kuztnets, S. (1962). *How to Be Happy*. Financial Times Weekend.