Fuzzy sets theory and the Millennium Development Goals progress measurement in Cameroon

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Abstract: This paper uses the fuzzy set theory recently suggested by Cerioli and Zani (1990) and Dagum and Costa (2004) to derive a methodology to construct a Millennium Development Goals (MDGs) measurement index. Using the formulation of the index, it also derives the contribution of different attributes to the level of the progress being accomplished in achieving the MDGs. An empirical illustration, based on Cameroonian 2010 MDGs report, shows the usefulness of the procedure proposed in this paper.

Key Words: Fuzzy Set, Millennium Development Goals, Index, Cameroon.

JEL classification: C43, O20.

1. Introduction

The Millennium Development Goals (MDGs) represents a goal partnership that has grown from the commitments and targets established at the world summits of 1990s. Responding to the world's main development challenges and to the calls of civil societies, the MDGs is an acronym for millennium development goals and are a series of eight time-bound development goals that seek to address the issues of poverty, education, gender equality, health, the environment and global partnership for development, agreed by the international community to be achieved by the year 2015.

To make the goals as concrete as possible, eighteen global development targets and forty eight indicators (UN Statistic Millennium Development Indicators) accompanied the eight goals. National governments and the UN agencies undertake the task of monitoring and reporting on progress achieved under way, which is important to ensure strengthened accountability.

But most of the government report leads to a one by one Millennium Development indicator study and it becomes rapidly very difficult, due to the high number of indicators, to follow the analysis. The approach so used, prevents the possibility to directly compare, for instance, in the same country two regions or in the same continent, two countries, regarding to the MDGs global progress. Also, this approach hardly lends itself to a dynamic analysis. To remedy this fact, we propose that a composite MDG index should be elaborated and this constitutes the main goal of the present paper.

The objective of the paper is to develop a very simple methodology that can be used to construct a composite MDGs index. The composite index focuses on the aggregation of MDG indicators and the index can be used to assess a country, a group of countries or the regions in the same country, in terms of progress being accomplished in achieving the MDGs. The approach used to build the index is the fuzzy sets theory and it is closed to the Cerioli and Zani (1990) work while defining a non parametric poverty index. In the same context, the work of Dagum and Costa (2004) or more recently Mussard and Alperin (2008) could be consulted.

The outline of the article is organized into three sections in addition to the present introduction. In section 2, the theoretical formulation of the index is introduced. The index is obtained as a weighted average of a fuzzy subset function. As in section 3, the preceding results are implemented to analyze and compare the Cameroon's regions in terms of progress being realized in attaining the MDGs. Finally, the paper is concluded in section 4.

2. The MDGs Indicator Measurement: a fuzzy sets theory approach.

Let $C = \{c_1, c_2, \ldots, c_n\}$ be a group of n economic or geographical connected areas on which one needs to measure and compare the progress in attaining the MDGs at a given year. For example C is the African continent and c_i is an African country or C is any country in the world and c_i is one of the regions in the country.

Let $Ind = \{i_1, i_2, \ldots, i_m\}$ be the set of m statistical indicators selected to apprehend the MDGs. For simplicity, we suppose that i_j represents not only the jth indicator but also the jth goal or objective, defined on i_j and that will be reach in other to attain the considered MDG.

Let us call B a fuzzy subset of elements in $C = \{c_1, c_2, \ldots, c_n\}$ such that any element (country or region) $c_i \epsilon C$ presents some degree of realization to reach at least one of the m objectives. The degree of membership of the ith element $(i = 1, 2, \ldots, n)$ with respect to the jth indicator or objective $(j = 1, 2, \ldots, m)$ to the fuzzy subset B is defined as:

$$x_{ij} = \mu_B\big(i_j(c_i)\big) \ , 0 \leq x_{ij} \leq 1 \tag{1}$$

where x_{ij} states as follow :

- $x_{ij} = 0$ if the ith element has no realization in attaining the jth objective.
- $x_{ij} = 1$ if the ith element has fully reached the jth objective.
- $0 < x_{ij} < 1$ if the ith element has realized the jth objective with an intensity between 0 and 1.

For more precision on the definition of x_{ij}, we need to subdivide the socioeconomic indicators into two categories: the positive indicators and the negative indicators.

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- A statistic indicator is said to be positive, if it measures a desirable socioeconomic attribute. In this case, the objective based on it, leads to increase its value to the target.
- In the opposite, a negative indicator is one that concerns a non desirable socioeconomic attribute so that the basic objective is associated with the decrease of the indicator value.

For example, *net enrolment ratio in primary education; proportion of population with sustainable access to an improved water source,* are positive indicators.
While *HIV prevalence among pregnant women aged 15-24 years*; *Carbon dioxide emissions* are negative indicators.

The indicators will be treated separately according to their positive or negative character:

Formally speaking, if φ_{ij} represents the score of the ith element on the jth indicator and φ_j^{OMD} denotes the required level of the jth indicator to reach the MGDs corresponding objective.

- For a positive indicator j

$$x_{ij} = \begin{cases} 1 & if \ \varphi_{ij} \geq \varphi_j^{OMD} \\ \frac{\varphi_{ij}}{\varphi_j^{OMD}} & if \ \varphi_{ij} < \varphi_j^{OMD} \end{cases} \tag{2}$$

- For a negative indicator j

$$x_{ij} = \begin{cases} 1 & if \ \varphi_{ij} \leq \varphi_j^{OMD} \\ \frac{\varphi_j^{OMD}}{\varphi_{ij}} & if \ \varphi_{ij} > \varphi_j^{OMD} \end{cases} \tag{3}$$

It is worth noting that, in the case of negative indicator, x_{ij} is computed in the assumption that the objective is not to eradicate the evil, but to substantially reduce it. In particular this means that $\varphi_j^{OMD} > 0$

The degree of membership of the ith element of C to the fuzzy subset B is obtained simply as a weighted arithmetical average of x_{ij} $(j = 1,2, ... , m)$:

$$\mu_B(c_i) = \frac{\sum_{j=1}^{m} x_{ij} w_j}{\sum_{j=1}^{m} w_j} \qquad (4)$$

Where w_j is the weight attached to the jth indicator.

$\mu_B(c_i)$ gauges the intensity of MDGs accomplishment within the ith element c_i ; it defines the value of the index on c_i ; the following properties are straightforward:

- $\mu_B(c_i)=1$ if the MDGs are completely achieved in c_i.
- $0 < \mu_B(c_i) < 1$ if c_i has partially or totally reached some objectives but not all of them.

A Millennium Development Goal is apprehended as a subset of objectives which are themselves subsets of targets (related to indicators). It is well-known that the MDGs hold in eighteen targets and height goals. Let us denote by $G_k = \{i_1^k, i_2^k, ... , i_{n_k}^k\}$ the kth millennium development goal $(k = 1,2, ... ,8)$. (A similar reasoning may easily be done with the targets).

The degree of accomplishment of the kth millennium development goal in the whole country or in the continent is:

$$\mu_B(G_k) = \frac{\sum_{j=1}^{n_k} w_j^k \mu_B(i_j^k)}{\sum_{j=1}^{n_k} w_j^k} \qquad (5)$$

Where $\sum_{j=1}^{n_k} w_j^k$ is the weight assigned to G_k.

The overall MDGs index can be also obtained as:

$$\mu_B = \frac{\sum_{k=1}^{8} \mu_B(G_k) w^k}{\sum_{k=1}^{8} w^k} \qquad (6)$$

With $w^k = \sum_{j=1}^{n_k} w_j^k$, the weight of G_k .

Weighting the MDGs Indicators

The problem of weighting is always delicate in the construction of an aggregate index. It rarely has a unique solution and may lead to debate. Considering that the eight millennium goals have the same importance, we propose the equal weighting scheme, which

assigns $w^k = \frac{1}{8}$ as the relative weight to the kth millennium development goal $G_k = \{i_1^k, i_2^k, \dots, i_{n_k}^k\}$ ($k = 1, 2, \dots, 8$). A similar reasoning leads to take $w_j^k = \frac{1}{8n_k}$ as the relative weight of the indicator i_j^k.

Weighting the regions

The regions or countries are weighted by their populations. The relative weight of c_i is therefore equal $\frac{p(c_i)}{\sum_{i=1}^{n} p(c_i)}$.

One of the particularities of the process is that, it permits to gauge the degree of accomplishment of any objective in the whole country or in the continent:

$$\mu_B(i_j) = \frac{\sum_{i=1}^{n} x_{ij} p(c_i)}{\sum_{i=1}^{n} p(c_i)} \qquad (j = 1, 2, \dots, m) \tag{7}$$

Then, one can also obtain the MDGs index in the whole country or in the whole continent, represented here by the set $C = \{c_1, c_2, \dots, c_n\}$, as the weighted average of $\mu_B(i_j)$:

$$\mu_B = \frac{\sum_{j=1}^{m} \mu_B(i_j) w_j}{\sum_{j=1}^{m} w_j} \tag{8}$$

It is easy to see that, μ_B is also a weighted average of $\mu_B(c_i)$:

$$\mu_B = \frac{\sum_{i=1}^{n} \mu_B(c_i) p(c_i)}{\sum_{i=0}^{n} p(c_i)} \tag{9}$$

Regions and MDGs indicators Contributions

In the case of a country subdivided into n areas (or regions), it seems interesting to evaluate the contribution of areas, targets or indicators to the overall MDGs index. These contributions may be useful to identify areas and targets which are rich or poor regarding to MDGs accomplishment and to identify at the same time, the attributes being involved.

- The absolute contribution of the jth indicator to the level of MDGs index within the ith region c_i is :

$$CTR_j(c_i) = \frac{x_{ij} w_j}{\sum_{j=1}^{m} w_j} \tag{10}$$

The relative contribution is : $ctr_j(c_i) = \dfrac{x_{ij}w_j}{\mu_B(c_i)\sum_{j=1}^{m} w_j}$

- Inversely, the absolute contribution of the ith region c_i to the attainment of the jth objective is :

$$CTR_i(i_j) = \frac{x_{ij}p(c_i)}{\sum_{i=1}^{n} p(c_i)} \tag{11}$$

And its relative contribution is: $ctr_i(i_j) = \dfrac{x_{ij}p(c_i)}{\mu_B(i_j)\sum_{i=1}^{n} p(c_i)}$

- The absolute contribution of the ith region c_i to the overall MDGs index is:

$$CTR_{\mu_B}(c_i) = \frac{\mu_B(c_i)p(c_i)}{\sum_{i=1}^{n} p(c_i)} \tag{13}$$

And its relative contribution is: $ctr_{\mu_B}(c_i) = \dfrac{\mu_B(c_i)p(c_i)}{\mu_B\sum_{i=1}^{n} p(c_i)}$

- The contribution of the jth indicator to the overall MDGs index is:

$$CTR_{\mu_B}(i_j) = \frac{\mu_B(i_j)w_j}{\sum_{j=1}^{m} w_j} \tag{14}$$

And its relative contribution is:

$$ctr_{\mu_B}(i_j) = \frac{\mu_B(i_j)w_j}{\mu_B\sum_{j=1}^{m} w_j}$$

- In the same way, the contribution of the kth millennium development goal to the level of MDGs index within the ith region c_i is :

$$CTR_i(G_k) = \frac{\mu_B^k(c_i)w^k}{\sum_{l=1}^{8} w^l} \tag{15}$$

With $\mu_B^k(c_i) = \dfrac{\sum_{j=1}^{n_k} x_{ij} w_j^k}{\sum_{j=1}^{n_k} w_j^k}$

and the corresponding relative contribution is: $ctr_i(G_k) = \dfrac{\mu_B^k(c_i) w^k}{\mu_B(c_i) \sum_{l=1}^{8} w^l}$

3. A case Study : Cameroon

While ratifying the Millennium Declaration in 2000 in the course of 2000 as well as 188 other states, Cameroon has marked its commitment to the need to achieve the MDGs by 2015. This section presents results of the MDGs indicator for Cameroon in year 2010. The data are drawing from the 2010 MDGs national report of the country. As it is often the case in African countries, there are a number of missing indicators and the objectives have been contextualized. But one of the reasons that can justify the choice of the country is that, data are broken down into the ten geographical regions: Adamaoua (AD), Centre (CE), East (EST) Far-North (EN), Littoral (LT), North (NO), North-West (NW), West (OU), South (SU), South-West (SW) , and the two biggest towns: Yaoundé (YD), Douala (DL). These twelve geographical areas constitute the set $C = \{c_1, c_2, \ldots, c_n\}$. Only twenty indicators have been observed by the Cameroon 2010 report; some of them are officially assigned to a quantitative target. When the value of the target is not specified, a target level is affected based on others similar African countries report. Details of this purpose and the subdivision of the indicators between the height Goals are presented in column (1) and (2) of Table A1 in annex. Also, Table A1 gives details on the computations of the results with respect to the various indicators.

How regions contribute to the overall level of MDGs achievement.

Table 1 presents results on MDGs progress index within the twelve Cameroonian regions. In order to measure the effect of the weight on the index, we compute regional index and evaluate the relative contributions of regions (column (3) and (4)). The statistics displayed in the table unambiguously imply that the two biggest towns (Douala and Yaoundé) are the leading regions in MDG accomplishment in Cameroon. They are closely followed by Littoral and West regions. However, the West region contributes the most, due to its high population, to the global MDGs progress in Cameroon. Globally speaking, the MDGs accomplishment

level is modest; the country is barely in midstream (global or national index= 0.60) and needs to make more effort in order to attaining[1] the MDGs in 2015.

Tableau 1 : MDG **progress Index within Cameroonian regions in 2010**

REGION	Population $p(c_i)$	MDG Progress index μ_B	Relative Contributions $ctr\mu_B$ %
Yaoundé	1481661	0.75	9.99
Douala	1798737	0.77	12.47
Adamaoua	859032	0.47	3.62
Centre	1487600	0.63	8.35
East	896381	0.49	3.95
Far North	3230706	0.42	12.07
Littoral	815707	0.71	5.18
North	1456618	0.47	6.10
North-West	2184928	0.63	12.30
West	2353000	0.68	14.41
South	634937	0.60	3.40
South-West	1475293	0.62	8.16
Total	**18674600**	**Global Index= 0.60**	100.00

**Sources**: NIS, 2010, Calculations by the authors

The relative contribution of each region at the national level of achievement is the ratio of the overall index of level of achievement of MDGs in the region weighted by the population of the region. It corresponds to the region's share in the Global Index. This reflects the fact that the contribution combines both, the level of achievement of the MDGs and the importance of the population in the region. From this perspective, if two regions have the same level of achievement of the MDGs, the most popular one will contribute most to the achievement of the MDGs in the country.

The analysis of the contributions of regions (on graphic 1 below) to the overall level of achievement of the MDGs in the country shows that the regions that contributes the most in the achievement of the MDGs are respectively the West (13.0%), Douala (12.5%), the Far North (12.1%). The West region and Douala present not only a high level of achievement of the MDGs but also a large population size, while the Far North region influences the overall

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[1] It would have been attractive to consider a dynamic analysis in order to evaluate the change in the index value over the time. But this was not possible due to non availability of other Cameroonian MDGs reports with regions investigations.

index trough its population size mainly. Adamaoua and East are the both regions that contribute less to the overall level of achievement of the MDGs in the country.

Graphic 1: contribution of the regions to the global level of the MDGs index
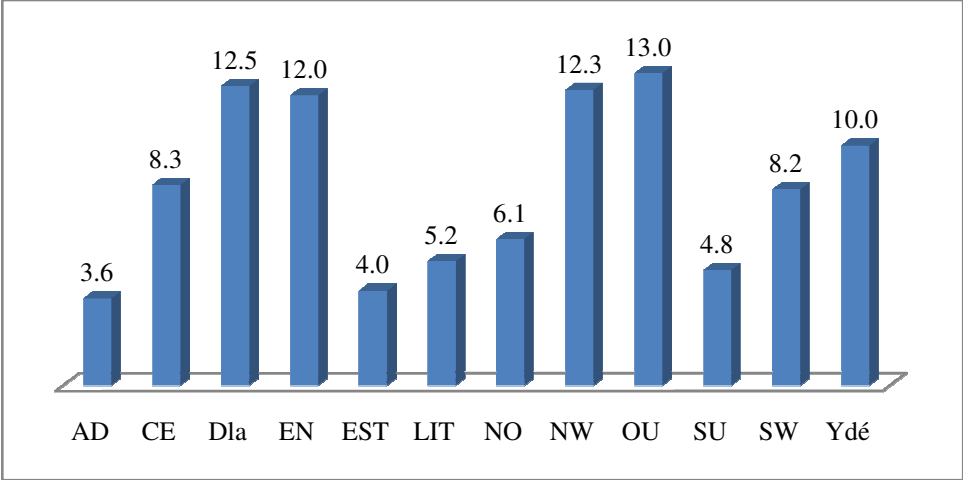
As a set of eight objectives, progress towards the MDGs can be assessed with more detail, by reviewing progress for each goal. The following section provides an analysis based on this approach.

How the eight goals contribute to the overall level of MDGs achievement.

Table 2 below shows more pronounced efforts to goals 2 (*Achieve universal primary education for all*) and 3 (*promote gender equality and empower women*). The values of their corresponding index are respectively 0.81 and 0.73. In opposite, we note that the goal 8 (*Develop a global partnership for development*) contributes least to the overall index as its relative contribution is 7.57%. Furthermore, the level of this goal is due essentially to the development of mobile phone sector (see table A1 in annex), dominated by two multinationals providers that are MTN[2] and Orange[3]. Also, the very low level (0.46) in attending the goal 7 (*ensure Environmental Sustainability*) reflects the intensity of effort that is needed in this area where the corresponding objectives seem significantly compromised.

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[2] Mobile Telephone Networks (South Africa firm).
[3] French firm.

Table 2: MDG Progress index in 2010

MDG	MDG Progress index $\mu_B(O_k)$	Relative Contributions to the global level of the index ctr_{μ_B} %
G1. Eradicate extreme poverty and hunger	0.65	13.59
G2. Achieve Universal Primary Education	0.81	16.94
G3. Promote Gender Equality and Empower Women	0.73	15.35
G4. Reduce Child Mortality	0.57	11.91
G5. Improve Maternal Health	0.64	13.41
G6. Combat HIV_AIDS, Malaria, and Other Diseases	0.55	11.51
G7. Ensure Environmental Sustainability	0.46	9.74
G8. Develop a global partnership for development	0.36	7.57
TOTAL	**Global Index= 0.60**	100

Sources: NIS, 2010, Calculations by the authors

The graphic 2 below, clearly illustrates the disparity in levels of achievement of the eight MDGs in Cameroon. As we have noted above, Goal 2 (*achieve universal primary education for all*) is the leader with an achievement rate of 81%. This good performance could be explained by the targeted policy of the Government to improve access to schools, particularly through free primary education. Nevertheless, such a performance hides important discrepancies, both in terms of infrastructure (classrooms) and human resources (teachers) between rural and urban areas.

Loosely speaking, graphic 2 reveals four different levels of achievement from the comparison of those eight MDGs. The first level, represented by lowest MDGs achievement is represented by goal 8 (*Develop a global partnership for development*) and goal 7 (*Ensure environmental sustainability*). The second level of achievement on the MDGs represented by goal 6 (*Combat HIV / AIDS, malaria and other*) and goal 4 (*Reducing the mortality of children under 5 years*) with achievement level which are close below the value of national index (0.60). Then comes the third level represented by goal 1 (*Eradicate extreme poverty and hunger*), goal 5 (*Improve maternal health*) and goal 3 (*Promote gender equality*) with achievement level which above the value of national index. And finally the fifth level, only formed by goal 2 (*Achieve universal Primary Education*), with an index value which is very close to 1.

Graphic 2: Levels of the MDGs in 2010

Goal	Value
G8. Develop a global partnership for development	0.36
G7. Ensure Environmental Sustainability	0.46
G6. Combat HIV_AIDS, Malaria, and Other Diseases	0.55
G4. Reduce Child Mortality	0.57
G5. Improve Maternal Health	0.64
G1. Eradicate extreme poverty and hunger	0.65
G3. Promote Gender Equality and Empower Women	0.73
G2. Achieve Universal Primary Education	0.81
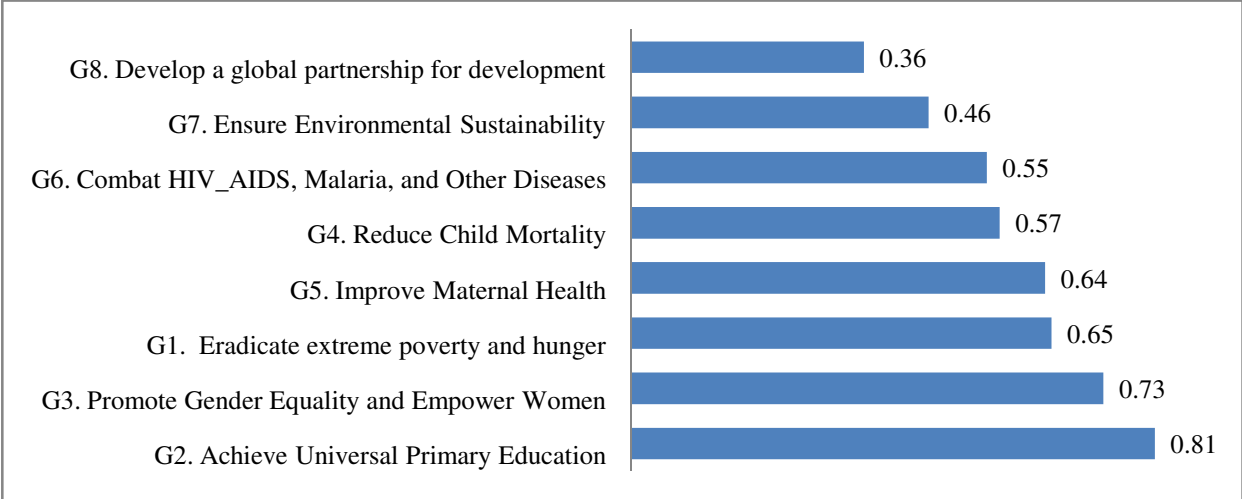
Sources: By the authors

Levels of MDGs achievement in different regions

This section proposes to examine for each region the level of achievement of all the eight goals. For this purpose, the following Table 3, on the extent of progress of MDGs in different regions, is used. A good analysis of the table requires an appropriate method of synthesis. However, some lessons can be directly learned. Almost all of the eight MDGs goals have their maximum level of achievement in Douala and Yaoundé; except the goal G6 which is characterized by high levels of achievement rather in areas where the overall index is relatively low as the North, Far north and the East regions. It is also interesting to note that the objective G5 rather peaked in Yaoundé and the West.

Note that, the first three Goals G2, G3 and G1 are leading in almost all regions; except in three regions Adamaoua, Extreme-North and North which are the last regions regarding to the MDGs Global achievement. The three regions, which constitute the so called *Great North Region* in Cameroon, are particular characterized by a high level of Goal G6 (*Combat HIV_AIDS, Malaria, and Others Diseases*). It is also important to note that, the very low performance of Goals G7 and G8 is due to the fact that the two biggest towns Yaoundé and Douala are the only regions in which these Goals have started to be implemented.

Table 3: Relative contributions of MDG to the level of accomplishment within regions

	G1	G2	G3	G4	G5	G6	G7	G8	Total
Ydé	77.60	94.80	87.11	62.77	96.50	50.63	94.50	36.95	**9.99**
Dla	78.73	94.17	86.43	78.77	93.60	52.06	95.59	38.40	**12.47**
AD	55.68	60.77	42.50	52.47	40.90	52.88	34.33	36.48	**3.62**
CE	68.55	95.17	81.11	58.75	71.90	49.88	42.50	32.53	**8.35**
EST	56.15	72.90	73.86	44.36	27.50	56.43	26.12	35.58	**3.95**
EN	51.17	50.67	50.75	43.63	19.40	60.48	24.69	32.31	**12.07**
LIT	73.98	94.30	86.18	63.37	92.10	52.06	61.34	42.23	**5.18**
NO	51.79	59.70	48.75	44.38	29.30	83.71	22.85	32.87	**6.10**
NW	60.90	89.37	77.82	70.57	79.70	47.11	40.74	35.75	**12.30**
OU	77.19	94.57	88.29	56.13	94.70	56.22	38.96	39.70	**14.41**
SU	67.81	93.77	90.29	50.95	57.90	37.49	42.81	36.94	**3.40**
SW	64.95	92.13	81.29	53.36	69.60	46.22	46.60	38.91	**8.16**
Total	**13.59**	**16.94**	**15.35**	**11.91**	**13.41**	**11.51**	**9.74**	**7.57**	**100.00**

Link between MDGs achievement and other socioeconomic factors

The correlation matrix and the correlation circle below allow respectively to have a quantitative measure of the relationship between levels of achievement of the MDGs, poverty, and population, and a graphical illustration of these links. The process also provides information on opportunities to capture the eight dimensions of the MDGs by a reduced number of factors. It follows that:

- the eight MDGs are highly positively correlated with each other in Cameroon. The objective of the G6 case appears singular and is negatively correlated with all others. This objective is therefore an atypical behavior that requires special attention ;
- the level of achievement of the MDGs is strongly correlated with income poverty. This could mean that it is in areas where poverty is most severe that the MDGs are the least achieved. Thus, reducing poverty and achieving the MDGs constitute the same event in Cameroon. However, AIDS, malaria and other infectious diseases should be a complementary strategy to that of poverty reduction;
- it should also be noted that there is a particularly strong link between the objective G1 and G5. This observation suggests that the reduction of extreme poverty and hunger contribute significantly to the improvement of maternal health in Cameroon;
- the population size seems to slightly influence the level of achievement of the MDGs with correlation coefficients ranging between -0.03 and 0.22. However, the size of a

population gives an idea of the mass of needs and an overview of the need to deploy actions of its inhabitants.

<u>Table 4 : Correlation matrix</u>

	MDGs	PV	G1	G2	G3	G4	G5	G6	G7	G8	POP
MDGs	1.00										
PV	-0.90	1.00									
G1	0.96	-0.92	1.00								
G2	0.90	-0.80	0.87	1.00							
G3	0.84	-0.78	0.84	0.95	1.00						
G4	0.83	-0.66	0.70	0.66	0.55	1.00					
G5	0.97	-0.82	0.93	0.89	0.79	0.82	1.00				
G6	-0.46	0.51	-0.47	-0.64	-0.63	-0.40	-0.46	1.00			
G7	0.86	-0.90	0.81	0.62	0.58	0.78	0.76	-0.35	1.00		
G8	0.65	-0.63	0.67	0.59	0.58	0.45	0.67	-0.41	0.48	1.00	
POP	-0.02	0.06	-0.03	-0.07	-0.05	0.01	-0.01	0.07	-0.03	-0.09	1.00

Sources : NIS, 2010, Calculations by the authors

The correlation circle below graphically summarizes the links between the levels of the MDGs in different regions. To refine our analysis, we have also included the level of poverty. It is noted that addressing the issue of achieving the MDGs amounts to address the root causes of poverty. Indeed health, maternal and education are vital elements in improving conditions of daily life of people gathered in the objectives G1, G2, G3, G4, G5, G7, G8.

*<u>Graphic 3:</u>* Correlation between MDGs and other socioeconomic factors
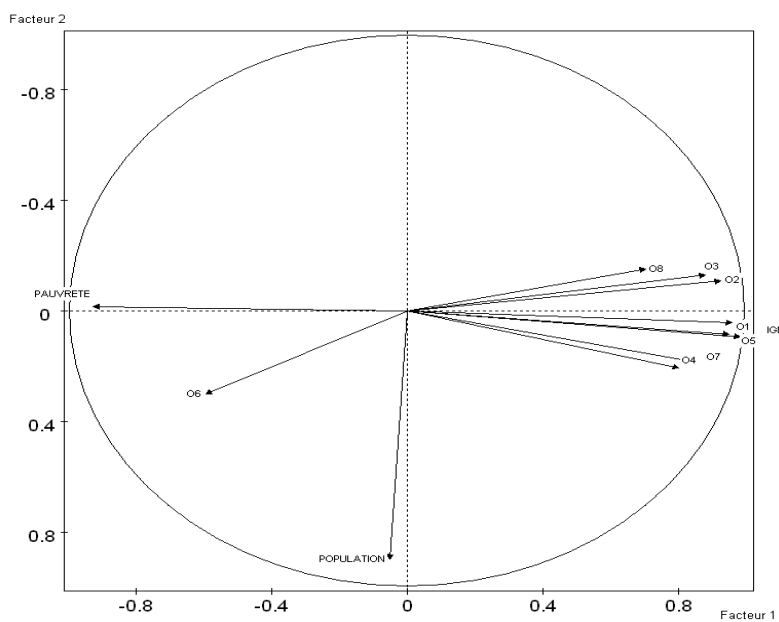
It appears from our analysis that the level of poverty is strongly negatively correlated with levels reached seven of the eight goals. Therefore, any strategy to reduce the poverty level would help boosting the path towards achieving the MDGs.

However, general positioning of the level of achievement of the objective G6, shows that it is positively correlated with poverty rates, thereby indicating that regions with a high level of achievement for this objective are most of the time regions where the level of poverty is also high.

Therefore, the behavior that the administration sector would adopt in different situations during the formulation of economic policies in favor of poverty reduction is indicative of the level of commitment to the achievement of the Millennium Development Goals.

Graphic 4: Proximity of regions relatively to MDGs achievement, 2010
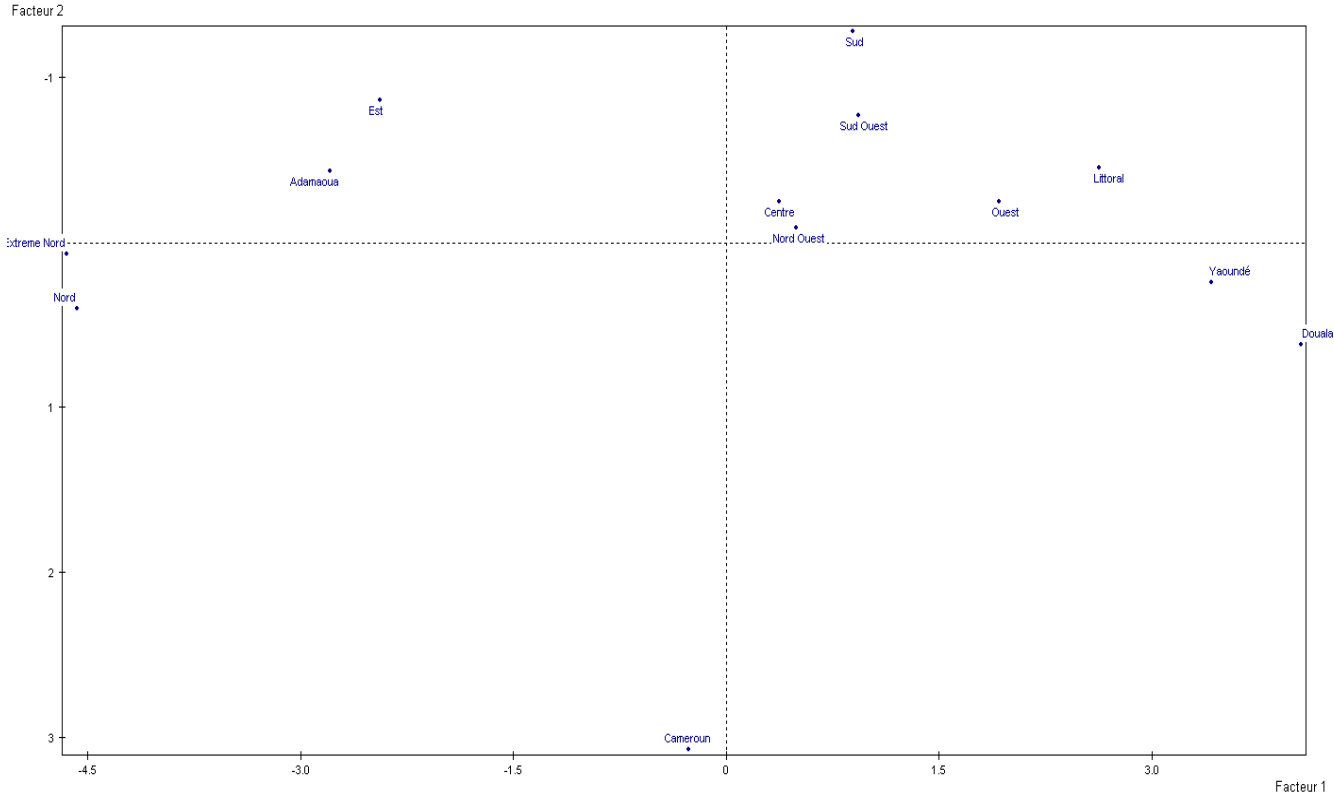
Graphic 4 illustrates the similarities and dissimilarities of the regions relative to their level of achievement of MDGs. Several observations can be derived from this chart:
- from the left to the right in the graphic 4, we are going to region with low MDGs level to those with the highest levels.

-   the preceding analysis of the correlations shows that this direction of movement is exactly that of the decreasing level of income poverty rate, that is to say that regions farther to the left of the graph are those which rates of poverty are the highest in the country. This confirms the fact that poverty is at the center of the MDGs in Cameroon.

4- **Conclusion:**

The present paper has proposed a methodology that can be used to construct an aggregate index to analyze progress being accomplished in achieving the MDGs. From the onset it was assumed that the formulation of the index could be summarized in a single expression without complicated terms. The approach used is similar to the one used by Dagum and Costa (2004) when defining a poverty index and it is based on fuzzy set theory. Thus our result constitutes value added to help in strategic policies regarding to the MDGs global progress and MDGs comparison. The method seems very simple; it is tractable and applicable in empirical and policy work as we have illustrated in Section 3 by analyzing Cameroonian MDGs progress level in 2007.

This empirical work has revealed that, national level of MDGs achievement is 0.60. This index value shows that policy makers need to make more effort in order to attain the MDGs in 2015. On the other hand, we have shown that, the two biggest towns in Cameroon, say Douala and Yaoundé, followed by the West region, contribute the most in the overall MDGs progress level. It is also made obvious that, the so called Great North Region in Cameroon is the last county in terms of MDGs attainment.

Moreover the study has also shown the differences in levels of achievement for each objective. In fact, MDG 8 "Global Partnership for Development" has the lowest level of achievement (36%) opposite to the MDG 2 on universal primary education (81%). One reflecting the low impact of partnership on improving the living conditions of populations and the other the reach of public efforts on ease of access to primary school including free thereof.

Then, we became interested in the interdependencies between regions and between goals and objectives and other socioeconomic factors. It emerged that the issue of poverty is central to the issue of MDGs in Cameroon. Certainly, a direct strategy for poverty reduction needs to be developed but at the same time, special attention should be paid to the health sector including

maternal health, which has a downward trend and the major endemic diseases such as HIV / AIDS, Malaria because they tend to develop in areas where poverty begins to decrease.

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ANNEX : Table A1	National score 2007	MDG target 2015	MDG Progress index
G1. **Eradicate extreme poverty and hunger**			**0,65**
I.11 Proportion of population below the poverty line	39.9	25.1	0.67
I.12 share of the poorest fifth	6.4	15	0.54
I.13 employment rate	75.1	96	0.78
I.14 Prevalence of underweight children under five years of age	19.3	8	0.61
G2. Achieve Universal Primary Education			**0.81**
I.21 Net enrolment ratio in primary education	75.5	100	0.78
I.22 literacy rate	83.1	100	0.82
I.23 net enrollment rate	79.8	100	0.82
G3. Promote Gender Equality and Empower Women			**0.73**
I.31 Ratio of girls to boys in primary education	0.95	1	0.93
I.32 Ratio of girls to boys in secondary education	0.86	1	0.81
I.33 women represented in the national assembly	0.14	0.35	0.35
I.34 literacy rate for women aged 15-24 compared with men	0.87	1	0.85
G4. Reduce Child Mortality			**0.57**
I.41 Under-five mortality rate	144	75.8	0.60
I.42 Infant mortality rate	74	21.7	0.30
I.43 Proportion of 1 year-old children immunized against measles	78.8	100	0.81
G5. Improve Maternal Health			**0.64**
I.51 Proportion of births attended by skilled health personnel	58.9	100	0.64
G6. Combat HIV_AIDS, Malaria, and Other Diseases			**0.55**
I.61 Seropositivity rate of pregnant women	6.7	5	0.76
I.62 percentage of seropositive women eligible for antiretroviral therapy	53	100	0.51
I.63 Prevalence of malaria among target groups (pregnant women and children 0 to 5 years)	15	5	0.37
G7. Ensure Environmental Sustainability			**0.46**
I.71 Proportion of population with access to improved house	25.5	75	0.34
I.72 Proportion of population with sustainable access to an improved water source	43.9	75	0.56
I.73 Proportion of population with access to improved sanitation	31.7	75	0.42
I.74 Proportion of population using solid fuels	82.9	42.2	0.54
G8. Develop a global partnership for development			**0.36**
I.81 Telephone lines per 100 people	1	25	0.01
I.82 Mobile cellular subscriptions per 100 people	17.1	50	0.34
I.83 Number of computer per 100 people	0.6	25	0.02
I.84 Rate of underemployment	84.3	50	0.60
I.85 unemployment rate for 15-24 year olds	4.5	4	0.83
TOTAL			**0.60**

Sources: NIS, 2008, Calculations by the authors