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## Determinants of the urban environmental quality: UEQI for colombian cities

*Determinantes de calidad ambiental urbana: ICAU para ciudades colombianas*

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### ABSTRACT

The present inquiry arises as a result of a constant search of problems that affect cities of the country, by the Hotbed of Investigation of Surcolombian Socioeconomic Studies HISSS, of the Surcolombiana University of Neiva (Colombia) -.In this way, we found those factors and actions that contribute to making Bogotá, Medellín, Barranquilla, Neiva, Tunja and Cúcuta, cities that the Ministry of Environment and Sustainable Development through the urban environmental quality indexes (UEQI) categorizes, at medium, low and very low levels. A methodology was developed that projects positivist and qualitative investigation, corresponding to a descriptive and explanatory study of the environmental sustainability of the cities is obtained from factors such as: public space; green areas; environmental pollution; mobility, public transport. The results obtained are of a relevant nature because they show old direct effects on the quality of life of the inhabitants, so that from them, alternative solutions are interpreted and proposed.

### RESUMEN

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**Palabras clave:**

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La presente indagación surge como resultado de una búsqueda constante de problemáticas que afectan a las ciudades del país, por parte del Semillero de Investigación de Estudios Socioeconómicos Surcolombiano –SIESS, de la Universidad Surcolombiana de Neiva (Colombia)-. En este sentido, la investigación identifica aquellos factores que hacen que las ciudades de Colombia presenten medios, bajos y muy bajos índices de calidad ambiental urbana (ICAU), a partir de que estas se categorizan a través de dicho índice por el Ministerio de Medio Ambiente y Desarrollo Sostenible. Se presentan los ICAU de las más representativas en cada nivel: Bogotá, Medellín, Barranquilla, Neiva, Tunja y Cúcuta, y se contrastan con indicadores económicos buscando relaciones entre ellos. La metodología utilizada se orienta por un enfoque de corte positivista y cualitativa, por lo que se obtiene un estudio descriptivo y explicativo de sostenibilidad ambiental de las ciudades desde factores como: espacio público; áreas verdes; contaminación ambiental; movilidad, transporte público. Los resultados obtenidos son de carácter relevante pues evidencian antiguas afectaciones directas para la calidad de vida de los habitantes, por lo que a partir de los mismos se interpretan y proponen alternativas de solución.

**1. Introduction**

The present investigation identifies the actions and factors that directly and indirectly influence the urban environmental quality of the selected cities: Bogotá, Medellín, Barranquilla, Neiva, Tunja and Cúcuta. For the above, it is taken into account that the Urban Environmental Quality Index (UEQI), which conforms to the legal and constitutional standards that have been established by the environmental authorities and Colombian territorial entities, tries to reflect the environmental sustainability of the cities faced with factors such as: “*The availability of public space; the quality and quantity of the green areas; environmental pollution; mobility and public transport*” [1]. In the previous sense, some projects have been developed that have served as orientation and/or stimulus for the development of the present investigation.

In the first place, the project “Design of a system of socio-environmental indicators for the capital district of Bogotá” was developed for the year 2004, based on the Master Plan for Environmental Management (MPEM), articulating the Pressure-State-Response (PSR) model that is part of it, to the extent that it entails supplying the socio-environmental indicators that constitute the key input for the construction of the model. In the words of the Plan: “... *they guide the application of instruments and resources to environmental management in all partial management scenarios. They can be stated as: Research, environmental education, participation and decentralization, institutional strengthening, inter-institutional coordination, control and surveillance, physical management.*” [2].

To a certain extent, at the University of Manizales in 2003 the project, “Indicators and Environmental Indices”, was presented and developed, which states that: “... *The measurement and assessment of impacts, aimed at an*

*appropriate environmental management, it has allowed the observation of recorded levels of contamination, for example, of physicochemical parameters, the analysis of the cause of them, and how they affect the socioeconomic conditions of the populations involved. The problem to define at what point or measure can you tell if it is an environmental impact or if it doesn't cause a significant damage to a community, has been addressed through the determination of permissible levels, regulations and laws by entities in charge of monitoring and environmental control*” [3].

Taking into account the previous antecedents, and as a result of a constant search of problems that are affecting the cities named above, it was arrived at the source constituted by the last reports that the UEQI has shown as an indicator that places the cities considered in specific ranges. And is that “*Unfortunately the effects and consequences of environmental pollution aren't few, because in addition to coming from a large number of sources exercised especially by humans, the results are evident in the weather conditions, animals and plants.*” [4].

Taking into account the above, in Colombia the environmental management and the quality of life of its inhabitants are evaluated through the urban environmental quality index, then, as a result of the problems presented previously, the research question arises, *What factors and variables determine the low urban environmental quality index in the cities of Bogotá, Medellín, Barranquilla, Neiva, Tunja and Cúcuta?*

In the present article it can be found structurally speaking, an introduction, the development of the article in which five themes and/or factors are addressed (for each city) starting with the economic, in second place we have the social ones, followed by the cultural ones, then we find the environmental and finally approximations

of possible solutions of the factors that prevent an eminent degree of urban environmental quality index in the selected cities. After the development there are the conclusions and finally the bibliography of the whole article.

## 2. Materials and methods

It's so in the research proposed a general objective "*Identify the factors and variables that determine the level of the urban environmental quality index of the cities of Bogotá, Medellín, Barranquilla, Neiva, Tunja and Cúcuta*", and five specific objectives: Establish the relationship between the economic characteristics of each city and the level of the urban environmental quality index; Determine the relationship between the social characteristics of each city and the level of the urban environmental quality index; Analyze the relationship between the cultural characteristics of each city and the level of the urban environmental quality index; Define the relationship between the environmental characteristics of each city and the level of the urban environmental quality index; Determine approximations of possible solutions of the factors that impede an eminent degree of urban environmental quality index in the selected cities.

Likewise, a methodology is developed that guides a positivist and qualitative approach research that corresponds to a descriptive and explanatory study (in this way interpretations and comparisons will be carried out for the results). Initially there were sources such as: research results already referred, surveys conducted (In each of the cities named "*Urban Environmental Quality Survey-UEQS*", obtaining as sample: Bogotá (68), Medellín (68), Barranquilla (68), Neiva (57), Tunja (68), Cúcuta (68), taking into account a level of confidence of 90%, the surveys were conducted virtually in 2017), and information from government entities like the Ministry of Environment and Sustainable Development, mayorships and governorates of the selected cities, equally, data taken from DANE will be taken into account.

Regarding the places where the factors and actions that deteriorate the urban environmental quality of these cities have the greatest impact, it is intended to perceive the level of influence they have on the social, economic, environmental and cultural environment of the respective cities, from a statistical-qualitative analysis (Bearing in mind the Ministry of Environment and Sustainable Development is the one who validates the model through direct indicators: 1. Surface of green area per inhabitant; 2. Air quality; 3. Superficial water quality; 4. Percentage of urban protected areas included in the POT (acronym in Spanish) with the Environmental Management Plan

in execution; 5. Percentage of solid waste used; 6. Percentage of urban population exposed to noise above the permissible population linked to environmental education strategies; 7. Urban population located in areas of high threat; 8. Percentage of surface built with sustainability criteria.

And in this same line, there are indirect indicators:

1. Residential consumption of water per inhabitant;
2. Residential consumption of energy per inhabitant;
3. Quantity of solid waste per inhabitant disposed in landfill;
4. Percentage of urban protection land included in the POT with conflicts of land use;
5. Effective public space per inhabitant;
6. Percentage of length of alternative and massive transport systems) to make comparisons between them, and interpret and propose possible solutions to the factors that prevent a satisfactory degree of EUQI.

## 3. Development

It is important to know the economic environment in which each city is to be studied, inasmuch as, the economic activities that drive the economic development of cities generate positive and negative externalities in the environment. That's why the relationship between the economic characteristics of each city and the level of the urban environmental quality index is established through comparisons between economic variables such as GDP and some direct or indirect indicators (only present relevant data).

### a. Bogotá

According to the DANE, during 2015 Bogotá's GDP was estimated at \$ 138.443 million, and for the last quarter of the year it was close to \$ 35.285 million. The variation that occurred in the fourth quarter was the highest in 2015, showing an increase of 1,7%.

From this point of view, and understanding the city of Bogotá is the capital of the country, for 2015 it presented a EUQI of 50,9%, classifying itself as a medium environmental quality. It's interpreted, then, the increase of this index will impact the city economically since it strengthens the leisure industry contributing to the construction of a more favorable environment for its inhabitants. In this same line, to encourage trade, to develop efficient work in the different sectors of the city (construction, financial, service activity, commerce, transport, public services and industry) could be the effects of this increase; that is to say, a greater participation of these activities in the GDP will be obtained.

Likewise, it is essential to continue generating strategies to address the problem that persists in the environmental field of the Colombian capital, since it's still necessary to coordinate and correct several aspects that prevent the EUQI from increasing until it reaches a high classification.

### b. Medellín

On the other hand, the city of Medellín -which is the second most important city in the country for 2015 registered a EUQI of 55,5 %, the Colombian city with the best index despite being classified with a medium urban environmental quality. Looking to obtain a relationship between both cities, another indicator of economic type is used: unemployment. For the year 2015, in the capital city, the unemployment rate was 8,7 %, [5]. Meanwhile, for the city of Medellín an unemployment rate of 10,6 % was registered, [6]. The influence of aggregates such as the surface of green area per inhabitant can be observed: a space of 1,52 square meters per inhabitant for Medellín, this space being insufficient, [7]. The effect is evident in that this indicator favors physical activity, social integration and a better quality of life of the population. In this same line, another indirect effect can be seen in the indicator of effective public space per inhabitant, which shows sufficient or insufficient availability of public space susceptible to measuring the quantitative deficit of the public space of a permanent nature, [8]. The average value for this indicator in Bogotá is 3,9 m<sup>2</sup> per inhabitant [9], while for the city of Medellín the average of this indicator is 3.57 m<sup>2</sup> per inhabitant, [10]. It can be inferred that this indicator shows how unemployment affects it indirectly, since the effective public space is usually invaded by people who practice the informal economy, due to the high unemployment rates presented in both cities.

### c. Barranquilla

For Barranquilla, the sum of reports of direct and indirect indicators accumulates in 70,5 % of compliance, [1]. However, for example, in variables such as residential consumption of energy per inhabitant and surface constructed with sustainability criteria, there were inconsistencies in the calculations and the basic information. To this is added the concern of indicators that either do not present a report or are invalid or have a zero rating; as a sample of these inconsistencies there are indicators such as percentage of surface constructed with sustainability criteria, percentage of urban population exposed to noise above permissible (diurnal) levels. Of the foregoing, the EUQI was located in a low quality

range for the year 2015, thanks to the very low and low qualification that had above all the indirect indicators.

### d. Neiva

The situation is not far from resembling the Barranquilla case. For the year 2015, it showed a EUQI of 33,7 from 13 of the 15 indicators, "highlighting the report of all indirect indicators" [11]. Only 2 of the direct indicators, urban green area per inhabitant and air quality, presented high qualification. The impacts on quality are derived from the low ratings of the "percentage of urban population (microcenter) exposed to noise above permissible levels, both in daytime (58,56 %) and at night time (84,06 %) and the percentage of urban population located in high-threat areas (8,04 %)." [11].

### e. Tunja

For the case of Tunja, which has a green area per capita with 3,50 m<sup>2</sup>/hab.; the percentage of solid waste used was 7,34 %, and population located in areas of high threat of 6,33 %. At the same time, with very low ratings (0), there is the surface water quality, [7]. However, in analyzing its economy it is evident that for the period 2002-2014, the GDP of Boyacá showed a higher growth above the national in the years 2007 (12,9 %) and 2011 (9,4 %) and the groups of spending with greater participation were food (10,1 %) and education (5,4 %). This generates indications of a possible development of sound policies aimed at improvements in education that are articulated for sustainable development.

### f. Cúcuta

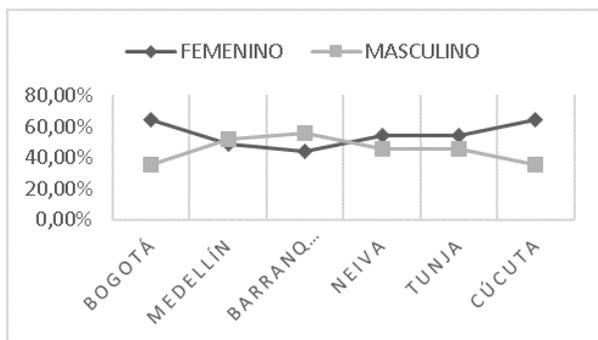
Cúcuta, unfortunately, is at a disadvantage compared with the rest of the cities analyzed by the UEQI, through which is classified as a city with a range of urban environmental quality very low – 6,5 with score lower than 20 points. This is due to the fact that the 100 % of the direct indicators reported, 5 obtained qualification very low (0), a situation that significantly affects the final result of the UEQI and 5 were not reported, [1]. At the same time, it does not have urban protected areas, the rates of participation in education and environmental management are very low (2,6 per thousand inhabitants in both cases). This could be related to the national GDP growth of Cúcuta, which showed a reduction of 1,3 percentage points compared to the year 2016, due in large part to the decrease in the oil sector revenues, and the increase in inflation at prices Constants in the 2015, [12]; And the water level deficit in the department.

Social is that belonging or relative to society. Remember that society is understood as the set of individuals who share the same culture and who interact with each other to form a community. In this sense, the social can give a sense of belonging because it implies something that is shared at the community level. For example, the notion of social coexistence refers to the way in which the members of a society coexist, [13]. For this reason, the relationship between the social characteristics of each city and the level of the urban environmental quality index is determined, through the following Figures 1, 2, 3 and 4. Emerge as a result of the applied survey (already explained in the methodology).

The survey that was applied in the city of Bogotá “Urban Environmental Quality Survey- UEQS” to know the perception of its citizens against the environmental quality that presents the capital of the country, shows that for the population polled is very important the Preservation of the environment (72,1%) and only 1,4% consider this factor unimportant (Figure 2), of which 64,7% are women and 35,3% men (Figure 1). However, although environmental pollution is a problem with a growing and shocking behavior, only 58,8% are informed of the high level of pollution that the city presents compared to 41,2% that is unaware (Figure 3). In addition, approximately 30% of respondents have knowledge of the UEQI (Figure 4).

According to the results of the application of the UEQS made to the city of Medellin, 51,5% of the total number of people who answered the survey belongs to the masculine gender and 48,5% female gender (Figure 1). On the other hand, 85,3% report that it is very important to take care of the environment, likewise, 14,7% shows the importance of caring for the environment (Figure 2). The 66,2% are informed about the high level of contamination that presents the city, while the 33,8%

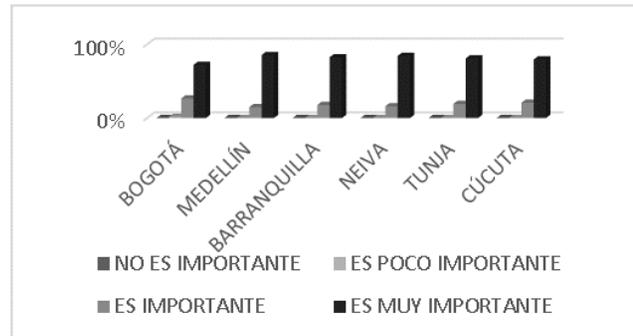
Figure 1: Gender in Selected Cities (%).



Source: own.

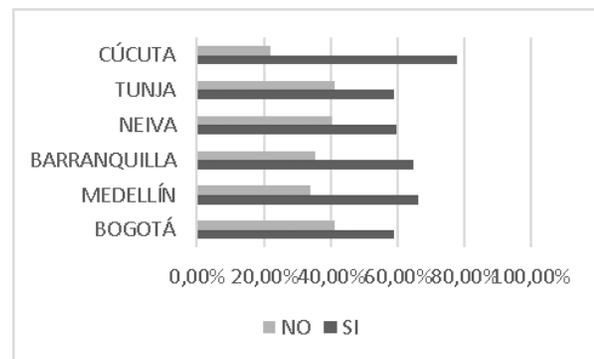
said the opposite (Figure 3). With 82,4% arises that the people surveyed didn't know was the UEQI urban environmental quality index and just 17,6% if they knew it (Figure 4).

Figure 2: Importance of the Environment for citizens.



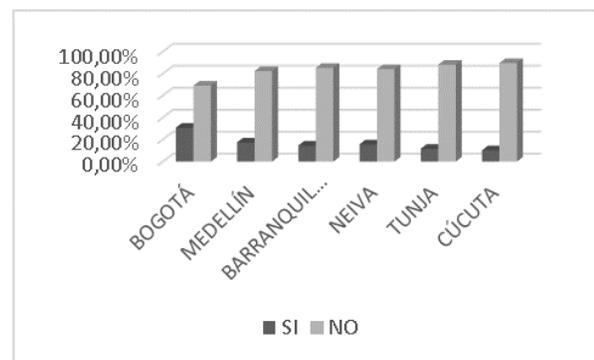
Source: own.

Figure 3: Are Citizens Informed Near Pollution Levels?



Source: own.

Figure 4: Knowledge of the UEQI by the Citizen.



Source: own.

In the survey conducted in Barranquilla, it can be observed that, of 68 responses, 55,9% (Figure 1) corresponded to the male gender. Regarding the importance of taking care of the environment, 82,4% (Figure 2) considers it very important. This high

percentage could possibly be related to the fact that more than 60 % (Figure 3) of the respondents are informed of the high level of pollution in the city, as well as the knowledge of the UEQI where only 14,7 % (Figure 4) was informed of the index.

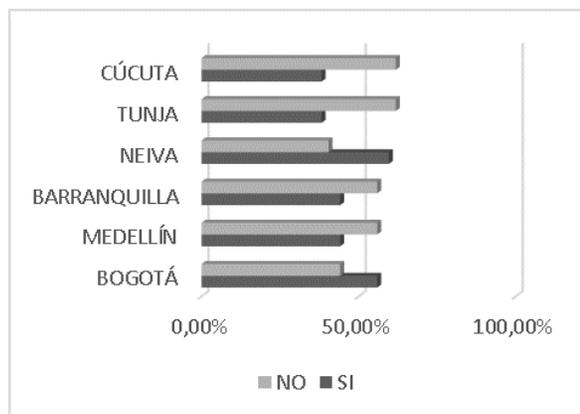
In the survey realized in the city of Neiva, in where we obtained 57 inquiries, observes that 45, 60 % corresponded to the masculine gender and 54,40 % to the feminine gender (Figure 1). In regard to the importance of the environment for the citizens, 84,20 % (Figure 2) considers it very important, and this percentage can be clearly related with the fact that 59,60 % (Figure 3) of the respondents, are informed about the pollution in the city, but on the other hand we obtained that only 15,80 % has knowledge of the Index of Environmental Quality Urbana (Figure 4).

In the case of the city of Tunja, the EUQS was applied and of the total of 68 surveys carried out, 54,4 % of the respondents are female and 45,6 % are male (Figure 1). In the estimated sample, 80,9 % of the surveyed population is very important to take care of the environment. And for 19,1 % of the surveyed population it is important (Figure 2). Of the people surveyed is 58,8 % if it is aware of the high level of pollution in the city of Tunja, and 41,2 % of respondents aren't reported (Figure 3). In this same vein, was obtained that 88,2 % of the population surveyed doesn't know about the UEQI, and 11,8 % if known (Figure 4).

In the city of Cúcuta, the UEQS was applied; 68 surveys where 35,3 % of the surveyed population were men and 64,7 % were women (Figure 1). Now, 75,4 % of the surveyed population expressed that it is very important to take care of the environment (Figure 2). In addition, 77,9 % of the people surveyed expressed that they are informed of the pollution level of the city, while 22,1 % aren't (Figure 3); however, only 10,3 % of the population knows and has knowledge about the UEQI, compared to a higher percentage of 89,7 % which has no knowledge (Figure 4).

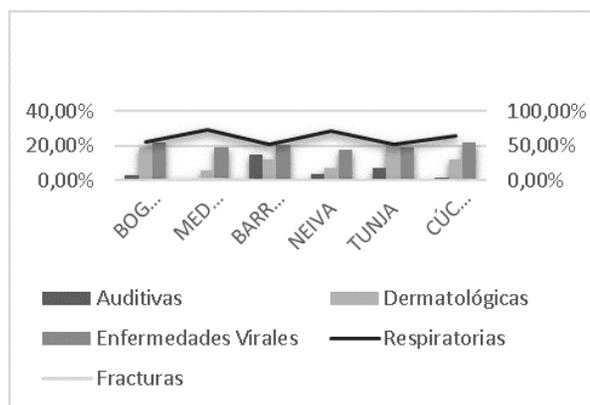
In the UEQS applied for the city of Bogotá is considered that the respiratory diseases in the capital (Figure 6), are the main condition caused by environmental pollution (55,9 %), followed by viral diseases (22,1 %), which is mainly derived from the accumulation of waste in the water sources (61,8 %) and pathogens - bacteria, viruses, protozoa, parasites - (25 %) (Figure 8).

Figure 5: Full Knowledge about the Types of Environmental Pollution and its Consequences.



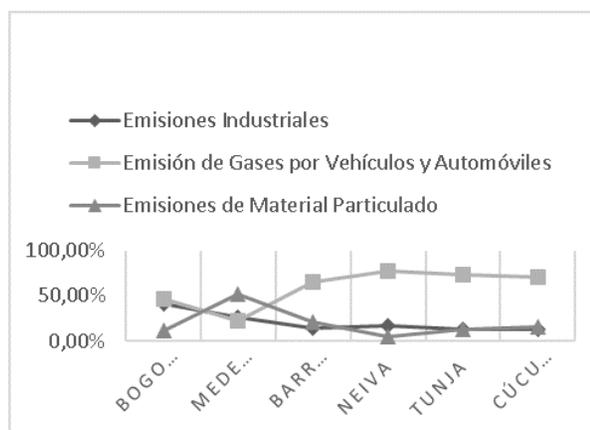
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Figure 6: Conditions as a Consequence of Environmental Pollution.



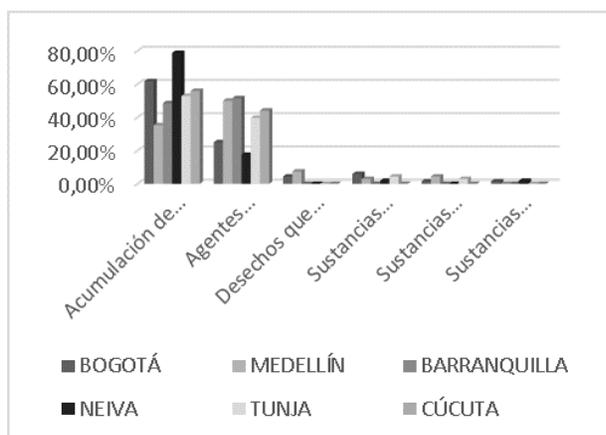
Source: own.

Figure 7: Main Action and/or Factor that Affects the Environmental Quality in the Air of Cities



Source: own.

**Figure 8:** Main Action and / or Factor that Affects the Quality of Water in Cities.



Source: own.

For the UEQS applied in the city of Medellín highlights that 73,5% of the total number of respondents categorized the conditions-respiratory as one of the major conditions resulting from pollution of the environment (Figure 6). The main action and/or factor affecting environmental quality in the air for the city, It is 51,5% particulate emissions (Figure 7). The environmental quality of water, the main action and/or factor that the affect is represented by pathogens (Bacteria, viruses, protozoa, parasites that enter the water from organic waste.) with a percentage of 50% and by debris in the water sources with a 35,3% (Figure 8).

For the UEQS applied in the city of Barranquilla it is observed that now, the majority of respondents (54%) do not know the types of environmental pollution or its consequences (Figure 5), they have knowledge of conditions (Figure 6) as respiratory contamination (52,9%), followed by viral diseases (20,6%). They also consider the emission of gases by vehicles and automobiles (64,7%) the main action that affects air quality (Figure 7) and the main water condition (Figure 8) are the pathogens (51,5%) such as bacteria, viruses, protozoa, parasites. On the other hand, in the EUQS applied in Neiva, 59,60% of the respondents has knowledge of the types of environmental pollution and the consequences by which faces the city (Figure 5); the conditions (Figure 6) that more recognise, because of the situation are the viral illnesses with 17,50%. The citizens consider that the main action that affects the environmental quality in the air of Neiva (Figure 7), is the broadcast of gases by vehicles and cars (77,20%) and the main factor that affects the quality in the water

(Figure 8) is the accumulation of wastes in the hidrics sources (78,90%).

For 61,8% of citizens surveyed by the UEQS in Tunja, they don't have knowledge nor of the types of environmental pollution that is nor its consequences, 38,2% owns it (Figure 5). In the opinion of the people, identifies that 52,9% of the consequences caused by the contamination are respiratory, this being the greatest consequence in the city (Figure 6). The main action affecting environmental quality in the air for the city of Tunja the emission of Gases by vehicles and automobiles is with a 73,5% (Figure 7). 52,9% of the citizens who participated in the survey think that, the accumulation of waste in the water sources is the main action affecting the environmental quality of water in Tunja (Figure 8).

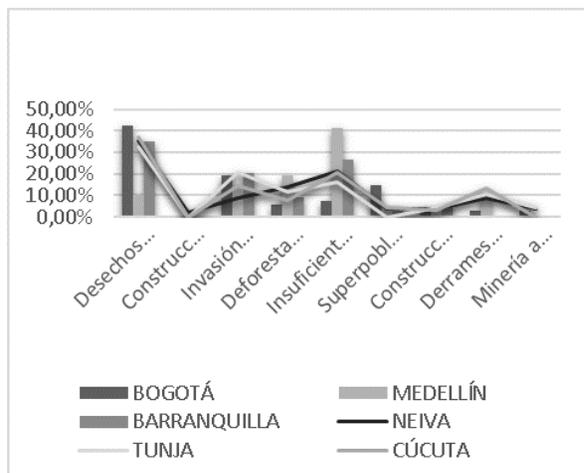
Likewise, only 38,2% of the population surveyed by the UEQS in Cucuta, has full knowledge of the types of environmental pollution and its consequences, while the remaining 61,8%, which is a much larger figure where it is recognized that the issue is not known (Figure 5). Similarly, in the opinion of respondents, 64,7% responded that the respiratory condition is the greatest consequence of environmental pollution in the city (Figure 6). It can also be seen that 70,6% of the population surveyed thinks that the emission of gases by vehicles and automobiles is the main action and/or factor that affects the environmental quality in the air for the city (Figure 7). On the other hand, 55,9% believed that the accumulation of waste in water sources is the main action and/or factor that affects the environmental quality of the city (Figure 8).

The UEQS applied in Bogotá reflects many of the conditions caused by environmental pollution may have its origin in the accumulation of waste of elements in the streets (42,6%), the invasion of public space (19,1%), overpopulation (14,7%) and the Deforestation (5,9%) (Figure 9). But, only 75% recognise their participation in actions that indicate the low environmental quality of the city (Figure 10). For its part, the actions to counteract the environmental problems are headed by the recycling (35,3%), reuse (30,9) and the reduction of the consumption of polluting products (26,5%) (Figure 11). Finally, people have an interest in the regular environment (38,59%), bad (35,3%), very bad (14,7%), good (10,3%) and very good (1,5%) (Figure 13).

On the other hand, for the UEQS applied in Medellín, the quality of the soil is mainly affected by the Insuficientes green areas of the city, as a result introducing a percentage 41,2%; at the same time deforestation It is another factor that affects the quality

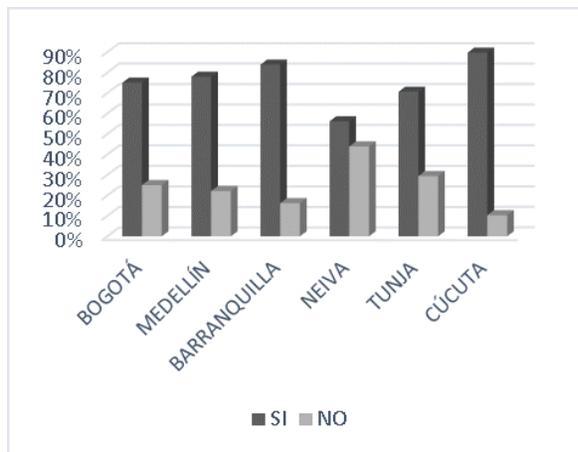
of the soil with a percentage of 19,1% (Figure 9). Within the main action that makes people in the city to improve environmental quality, is recycling with 30,9%, then reuse represented by a 29,4%, also is to reduce the consumption of polluting products with 29,4%, cataloging with 10,3% that no action is performed (Figure 11).

**Figure 9:** Main Action and/or Factor that Affects the Environmental Quality in the Land of Cities.



Source: own.

**Figure 10:** Participation of Citizens in Actions that Affect the Low Quality of Cities.

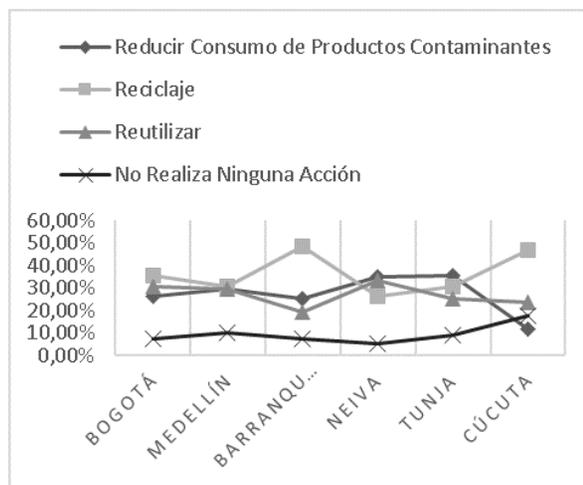


Source: own.

In the case of the UEQS in Barranquilla, in relation to the quality of the soil (Figure 9), are the debris of elements in the streets (35,3%), insufficient green areas (26,5%) and invasion of public space (20,6%) the main affections. This situation is reflected because 83% of citizens have participated in actions that indicate the low environmental quality of the city (Figure 10), even

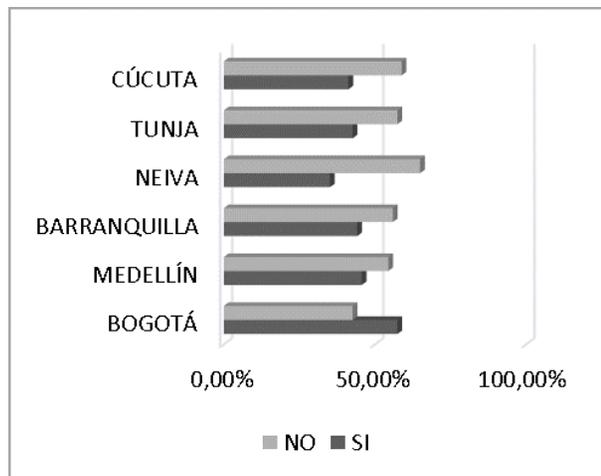
if they opt for recycling (48,5%) as the main action to improve the quality of the environment (Figure 11). The data also show that there is no knowledge (56%) of any entity that deals with environmental problems (Figure 12). Finally, 54,40% consider the level of interest in the environment very bad (Figure 13).

**Figure 11:** Main Action Performed by Citizens to Improve Environmental Quality in Respective Cities.



Source: own.

**Figure 12:** Knowledge on the part of the Citizen about any Environmental Entity Responsible for the Present Problematic.

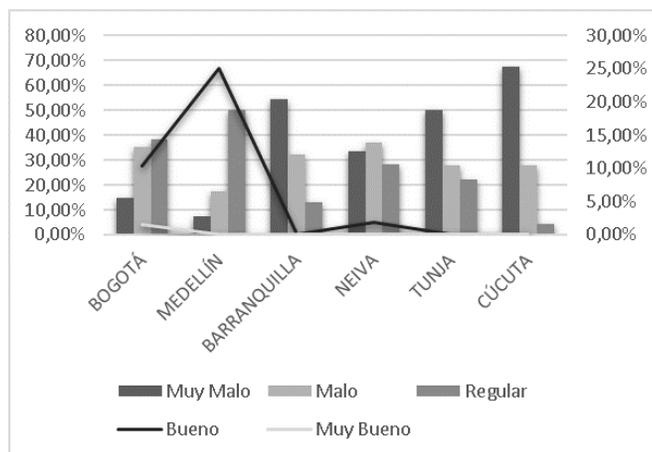


Source: own.

For the EUQS in Neiva, with relation to the factor that affects the quality of the soil (Figure 9), the insufficient green zones (21,10%) and the deforestation (14%) are the main conditions. And this situation sees justified with the fact that 56% of the citizens has been participate in the actions that influence in the low

environmental quality (Figure 10). However, the citizens take like main action of improvement the fact to reduce the consumption of products contaminants, represented in 35,1% (Figure 11). Besides the survey launches a percentage of 64,90% in the fact that the citizens of Neiva don't have knowledge of entities commissioned of the problematic environmental (Figure 12). Finally, during the period of 2014-2016 the level of interest of the citizens by the environment considered bad with 36,80% and only 1,80% being well (Figure 13).

**Figure 13:** Level of Interest of Citizens for the Environment Within. The Respective Cities between the years 2014 – 2016.



Source: own.

In Tunja, the biggest factor that affects the quality of the soil are wastes of elements in the streets in the opinion of the respondents with a 32,4% (Figure 9). Similarly, it was found that 70,6% of citizens it says if you have been involved actions that affect the low environmental quality and 29,4% not (Figure 10). It's also determined that the main action to improve environmental quality according to respondents is to reduce the consumption of polluting products with a percentage of 35,3% (Figure 11). Must be borne in mind that only 57,4 percent of the respondents don't know no entity dealing with the presented problematic and 42,6% If you have knowledge of any (Figure 12). Finally, it was obtained that the interest of the people was very bad with a 50%, bad with 27,9% of the opinion, and regular with 22,1% of interest according to the opinion of the respondents (Figure 13).

Finally, the applied UEQS for the city of Cucuta, 36,8% of the population believed that the waste of elements in the streets are the main action and/or factor that affects the environmental quality in the soil for the city (Figure 9). At the same time, 89,7% of

the population considers that it has been involved in the actions that affect the low environmental quality of the city while the 10,3% feel the opposite (Figure 10). Likewise, recycling with a 47,1% share is the main action that the surveyed population makes to improve environmental quality (Figure 11). Similarly, it is observed that 58,8% of respondents know of a public or private entity to deal with the problem, while 41,2% do not know (Figure 12). Finally, 67,6% of people described the level of people's interest in the environment within the city in the years 2014 – 2016 as very bad (Figure 13).

It's important to strengthen the cultural environment in which each city is to study since, a good culture in the citizenry stimulates and promotes a good performance and/or urban- environmental development in the respective cities. This is why the relationship between the cultural characteristics of each city and the level of the urban Environmental Quality Index is analyzed.

#### g. Bogotá

The last few years have not been the best for the maintenance of life and nature in the city of Bogotá. Climate variations and the intensification of rain and dry events have shown the vulnerability of the Bogotá Savannah and the city's territory to droughts and floods and have made clear the absence of a coherent and long-term environmental policy Scope and serious contingency plans to respond to the increasingly severe conditions that will have to be faced in the coming years, [14].

Now, the recycling culture has had a positive impact on citizens because it has provided solutions to various cultural and economic problems, the zero garbage program gives future generations the opportunity to live in a less and offers the region employment opportunities to approximately 20.000 people; It also strengthens the productive processes of the city and the generation of sustainable culture, [15]. However, this does not mitigate all damage, Bogotá produces 6.200 tons per day of solid waste, of which 5.400 reach Doña Juana Landfill, an average of 800 tons per day are reintegrated into the production chain thanks to the work of about 15.000 families of Recyclers.

#### h. Medellín

It should be noted that Medellín, in the classification of UEQI had an average score of 55,5% higher than Bogotá [7], however, it is in the average classification. This indicates that it should reflect and improve cultural

aspects that can positively impact the city. According to the UEQI, it is expressed that for every 1.000 inhabitants 30,3 become aware and participate in environmental management. With the above, the projections carried out by the local administrations of Medellín, from the year 2005 to 2020, it can be seen that there is an increase in the trend in the constant population of 2.499.080 inhabitants in the year 2005 to 2.933.094 for the year 2020.

#### **i. Barranquilla**

According to the Ministry of Education, weaknesses have been demonstrated in the institutional PRAES of the district of Barranquilla, since the context of the projects are developed from a unidisciplinary vision (from the natural sciences) where the contents in its Majority are markedly biotic but very little is involved in the economic, social, political and cultural aspects that should be evidenced within an environmental education project, [16]. The above, evidence the little environmental culture that has developed in Barranquilla.

#### **j. Neiva**

In the case of Neiva, it's in a process of generating environmental culture; According to the Ministry of Environment and Sustainable development Neiva obtained a percentage of 35,6 or low environmental quality. According to the UEQI, it is indicated that for every 1.000 inhabitants 105 become aware and participate in environmental management, [7].

#### **k. Tunja**

In the case of Tunja, we are in the process of generating environmental culture; according to the Ministry of Environment and Sustainable development, the city obtained a percentage of 35,5 low environmental qualities. In terms of environmental quality, Tunja is located in the low range. The above because only one (1) of the direct indicators reported obtained very good qualification (1): Urban population linked to environmental education strategies (54,29 inhabitants per thousand), [7].

#### **l. Cúcuta**

In the case of Cucuta, the environmental culture isn't entrenched; in addition to this, it doesn't even have educational systems that promote it. Therefore, according to the classification of the UEQI, Cucuta obtained a score of 6,5 % i.e.: very low environmental

quality. In terms of environmental quality, Cucuta is located in the very low range. According to the UEQI, it is expressed that for every 1.000 inhabitants 2,6 become aware and is involved in environmental management, [7].

The conditions (physical, economic, cultural, etc.) of a place, a group or a time are also known as environment [17]. This is why the relationship between the environmental characteristics of each city and the level of the urban Environmental Quality index is defined below.

#### **m. Bogotá**

In the Colombian capital environmental characteristics are presented as: 74% of urban protected areas included in the OTP from 2013 to 2015, Plan of environmental management in Transmilenio stations comply with 75 % (PM 10) air quality represents 6 % of the index (lengths of alternative systems of transport, effective public space per inhabitant), 17 % urban protected areas included in the OTP with environmental management in the 0% implementation plan public per capita space, 18 % of the index, (freeloaders solid waste), [7].

The relationship that is taken with the UEQI coincides with the work done so far, lacking better management. However, he is preparing the community to qualify for environmental issues as for example the one done by NES within the Ministry of environment in the period of 2015, training directors sustainable development and regional autonomous corporations.

#### **n. Medellín**

With regard to UEQI, which most affects the Medellín index are not used with 12 % - very low waste problems in the index. Accordingly, should involve the community at work more in the environmental areas and enable them to work properly. The relationship that exists in the UEQI regarding the characteristics described in this study was that the transportation system have opportunities for innovative and environmentally friendly ideas with nature, which would generate a more consistent rate and not as under; IE: you have to continue working so that there are more projects that save energy and do not contaminate the air, [7].

#### **o. Barranquilla**

Presents environmental characteristics, such as: the percentage of alternative systems of transport (13,64)

12% rate, urban population (solid waste disposed in landfill (0,93 Kg/inhabitant-day), surface water quality (qualification of the TIC mesh)) 12%. Urban protected areas included in the OTP (2013-2015) with 0% environmental management plan, percentage of solid waste used on the generated total (0,13%), urban population that participates in environmental management is 35%, presents urban population exposed to noise, air quality (PM10), the air quality of the (PM 2,5), not has surface green area, reported invalid: surface built with sustainability criteria, [7].

For 29% according to the UEQI invalid indicators, can be seen in that it does not have many alternative transportation systems, only one, the mass transit system. These systems, such as electric cars, would facilitate welfare and not only save gasoline, but also contribute to the maximum reduction in pollution, it is necessary to involve both the government and the community to be trained in environmental programs not only generating an index of better urban environmental quality, but allowing solid waste to be exploited.

#### **p. Neiva**

The industrial activities in Neiva are one of the main causes of environmental deterioration of the city, which result in an increase in waste that is not properly managed cause a great environmental impact, polluting the soil, air and water; this is reflected in the absence of information that would facilitate the obtaining of values that would allow to measure the degree of affectation that the industrial processes cause on the environment in the urban zone of the municipality of Neiva [18]. It is for this reason that Neiva is classified according to the Ministry of Environment and Sustainable development is one of the cities with low environmental quality indices.

#### **q. Tunja**

One of the problems that is most evident in Tunja is the environmental pollution that influences, not only in the city but also in the preservation of the natural resources that are indispensable for the human being. All this because of the carelessness in which the city is located and the misuse that is given to natural resources.

#### **r. Cúcuta**

Bathed by the rivers Pamplonita and Zulia, the problem surrounding the mining of the department Norte de Santander is fundamentally based on the existence of illegality in mining operations, the scarce technology and the scarce contribution and accompaniment of the

authority mining for the centralization of administrative procedures in the issuing of titles and mining records, [19]. Therefore, it can be shown that the city of Cucuta has unfavorable environmental characteristics and is for this reason that it is with a very low environmental quality index.

Taking into account the initially exposed problems and analyses found in different aspects such as, economic, social, cultural and environmental, is by them which then determine estimates of possible solutions of factors that impede an eminent degree of urban environmental quality index in selected cities (Bogotá, Medellín, Barranquilla, Neiva, Tunja and Cúcuta).

Given that Bogotá and Medellín are known to grow economically by its broad industry level, the towns of Kennedy and Puente Aranda in Bogotá, as more contaminated by particulate matter areas considered, [20]. With respect to Medellín, in March 2016 a wave of pollution originated since it was 1.200.000 vehicles circulating, [21]. As possible measures to mitigate the environmental problems may intensify the operational control and surveillance to vehicle load, urban, InterCity transportation and factories, It generated emissions into the atmosphere of the capital as well as promoting mobility, bikeway networks and road networks. On the other hand, Neiva has high proliferation of public establishments, [22].

With respect to Barranquilla, since 2007 is unknown air quality since it does not have an air quality monitoring system, especially as main problem of water resources pollution and noise pollution, [23]. It is therefore proposed as measures to mitigate the low rates of urban environmental quality strengthening of national, departmental programs, collection of waste and recycling in the water sources of cities, as well, provide relevant information to residents the effects produced by the poor management of solid waste in water sources, above all, the quarries located along the road to the sea, as Caribbean cement, quarries Ochoa and quarries Barranquilla.

Now, given the major problems environmental of Cucuta as the uncontrolled logging in the forest reserve of the Catatumbo, the accelerated population growth, road infrastructure, among others [24], are proposed as possible solutions: set strengthening the community in the national forestry development and implementation plan focused, sustainable forest management in zoning, conservation and restoration of ecosystems, the management and exploitation of forest ecosystems, [25].

Finally, for pollution of water sources, especially of the Chicamocha River Tunja dumping without control of different residential areas nearby, we recommend the implementation of collective learning comprehensive management of resources is articulate where the participation of all sectors and actors associated with each resource, water sources, ecosystems, for its proper administration.

#### 4. Conclusions

- a. The cultural characteristics of each city analyzed have an important impact on the environmental characteristics of each region, that is to say that the cities where there is a culture on the protection of the green zones is observed that there is an index of Environmental quality a little higher with respect to cities where they do not encourage environmental culture.
- b. Barranquilla reported a low quality UEQI for 2015, mainly represented by shortcomings such as: Very low values of indirect indicators, additionally, by indicators whose reports were invalid or obtained a score equal to zero.
- c. For the city of Medellin, the emissions of particulate matter (most selected factor in the survey, Figure 7), they cause respiratory and viral diseases among others. Also evidenced the lack of interest of people to solve this problem.
- d. The behavior of the economy in Cúcuta and the perception of its citizens on the environmental situation by which traverses the city, are evidence of the stagnation in the field of sustainable development that is based on the lack of systems of monitoring and follow-up for the preservation of resources and the achievement of projections in the short and long term.

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