

## SUSTAINABILITY POLICY FOR MANUFACTURING SECTOR. CASE OF TWO DEVELOPING COUNTRIES

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### Abstract

*In this research is made a comparative analysis between the public policies of Colombia and Mexico regarding global sustainable development and the control of the environmental impact caused by the manufacturing industry according to international agreements and guidelines of Objective 12 of the United Nations Agenda for Sustainable Development Goals (SDG). The aforementioned objective addresses aspects related to sustainable and economic growth and the promotion of innovation.*

*To reach the purpose of the paper a qualitative and descriptive research was performed, based on literature review of the main policies associated to the manufacturing sector. Then, policies related to energy, eco-innovation-sustainable innovation, corporate social responsibility and driven actions towards a green economy are studied.*

*As a result, there is a high orientation of public policy to short and medium term, that leads to weak linkages between industrial and social policies in spite of United Nations Agenda. Furthermore, it is concluded that government structures are not very consistent with general interests and the environment, moreover, it has different priorities to those of the industry in terms of innovation and sustainable production, and the persistent need to support policies with financial resources and human talent that promote their establishment.*

**Keywords:** sustainable innovation, sustainability policy, industrial policy, sustainable development goals, renewable energy

### 1. INTRODUCTION

According to the United Nations Industrial Development Organization - UNIDO a sustained increase in consumer demand will improve their welfare. Likewise, an increase in demand also turn into a larger offer of goods, that's means a huge production of goods that increases the profits and wages. Moreover, in the future, higher profits and wages will increase even more the demand of goods and therefore the production.

This process of economic growth demands the production of goods using intensively non-renewable natural resources and turn it unsustainable in the long term. Similarly, the production process requires large amounts of energy, that most of part come from sources of non-renewable and highly polluting that impact on climate change. In addition, the waste of the productive processes and the handling of goods at the end of their life cycle represent a big challenge that must be considered by governments, firms and consumers; it is under these worries that emerge the development of sustainable production and consumption [1].

The main theme of this work is focused on goal 12 of the Sustainable Development Goals- SDGs, which seeks to ensure consumption and sustainable production, in the approach of this SDG, the UN defines it as:

The efficient use of resources and energy, the construction of infrastructures that do not affect the environment, the improvement of access of basic services and the creation of green jobs, fairly remunerated and good working conditions. [2]

What it means as a reduction of environmental, economic and social costs. Its main goal is to increase production, with the use of less natural resources and raw materials, which will reduce the pollution. In other words, SDG 12 seeks to optimize the use of natural resources and raw materials in industries, in addition to have waste management plans specific to the production and management plan of final goods at the end of their life cycle. At the same time, it is necessary to sensitize all actors in the product life cycle, emphasizing both the producer and the consumer.

Among the main goals that it wants to achieve with this SDG, we can find [2]:

- Sustainable management and efficient use of natural resources
- Ecological management of chemical products and all waste along their life cycle
- Reduce the waste generation through prevention, reduction, recycling and reuse,
- Promote public purchase practices that are sustainable.
- Strengthen scientific and technological capacity around sustainable development

In this search for an eco-friendly goods production, it is difficult to monitor the environmental impact from the existing environmental indicators because they do not take into account the entire product life cycle [1].

For Ofstad, Westly, Bratelli, Norway & Miljøvern departementet (1994), sustainable consumption refers to the use of products and services to cover basic needs and improve the quality of life by decreasing the use of resources. For the companies mean, to introduce sustainable production and consumption processes to get a reduction in environmental, economic and social costs, as well as a reduction in raw material costs, increased security of supplies and progressing towards innovation processes and competitiveness of the company [3].

Sustainable (or green) production in the industry, requires rethink the manufacturing process and have an efficient waste management. It involves the remanufacturing and improvement of already made manufactures, through a low consumption of raw material and energy for their remanufacturing, which generates a positive environmental impact and a decrease in the production costs of the companies. The management must consider the responsibility that producers must assume of the waste (solid waste, water waste, hazardous waste and radioactive waste) that are generated by the production of goods. This management requires a decision-making towards better methods for the waste management that reduces the negative impacts on the environment [5].

The efforts of the countries to reach the Sustainable Development Goals are addressed to a number of policies and activities in different strategic sectors. However, industrial activity is a fundamental part of economic growth and therefore it has an important role in the eradication of poverty, the economic competitiveness and the protection of the environment, in order to achieve the welfare of society in countries with a strong industrial sector such as Colombia and Mexico.

The manufacturing industry plays an important role in both countries, the industrial gross domestic product (GDP) represents 32.8% of the total GDP of Colombia and 32.6% of Mexico. For Colombia, the sectors of petroleum derivatives, chemical products, and food and beverage production represent 42.5% of the total of manufacturing sector [6], which represents a lower concentration and less dependence on a few activities compared to Mexico, where the automotive industry, food production, chemical products and petroleum products represent 68% of the total of the industry [7].

According to the previous concepts, we want to analyze the public policies that impact on the manufacturing industry in two developing countries: Colombia and Mexico and that contribute to the creation of a sustainable economy. The analysis allows us to identify elements that contribute to the

awareness of the actors of society about the need for cultural change towards sustainable production and consumption, as a contribution to sustainable development.

To achieve the objective proposed in this document, the methodological elements used in the research are presented in the following section. Then, we present the main results related to public policies taken in both countries regarding sustainability in the framework of international agreements. The section 4 presents the analysis of sustainability policies and the role of industries to finally present some conclusions.

## **2. MATERIALS AND METHOD**

A qualitative and descriptive research was performed, based on literature review of the main policies associated to the manufacturing sector. Then, policies related to energy, eco-innovation-sustainable innovation, corporate social responsibility and driven actions towards a green economy are studied.

A search was made of the laws and policies in search of sustainability or care of the environment, in the newspapers of official publications of the legislative apparatus of Colombia and Mexico. After obtaining about 15 results for Colombia and 10 for Mexico, the list was cleaned by reading the laws and recognizing which of these had a direct impact with the industry and that respond to the SDG 12 of sustainable production and consumption, to finally analyze in depth 6 policies for the Colombian case and 3 for the Mexican.

As a second step, a documentary review of research articles was made in the Science Direct database of the following terms (Sustainable development policy AND Colombia OR Mexico), (Industry analysis AND Colombia OR Mexico), limiting the search to (environmental analysis AND Colombia OR Mexico).

In the first search for Colombia, 2,971 documents were obtained and for Mexico, 10,537. A filter was applied to only the research articles between 2015-2018, obtaining 768 results for Colombia and 1,978 for Mexico. Finally, a reading of the abstract was made, which showed whether the article was directly related to the topic to be discussed and whether it analyzed the roles of both the government and the industry, which a total of 46 articles were obtained for analysis.

## **3. RESULTS**

### *3.1 International agreements in the framework of sustainability*

Colombia and Mexico have sought the signature of multiple free trade agreements with several countries. Colombia has agreements with El Salvador, Guatemala and Honduras, Andean Community (CAN), Caribbean Community (CARICOM), (Common Market of the South) MERCOSUR, Chile, European Free Trade Association (EFTA), Canada, United States, Cuba, European Union, Pacific Alliance, Korea, Costa Rica, Mexico, Venezuela. For its part, Mexico has the following agreements: North American Free Trade Agreement (NAFTA), European Union, Iceland, Liechtenstein, Norway and Switzerland, Uruguay, Japan, Transpacific Agreement, Panama, Pacific Alliance.

In a brief analysis of the free trade agreements signed by Colombia, it is found that agreements that are clearly mentioned the environmental are only 4 of the 15 trade agreements, and the ambition of the country in environmental matters is limited. It highlights the great importance that environmental protection and development takes in the agreements with the European Union and the United States. At the same time, it should be mentioned that for the agreements with Canada and Chile, the environment is mentioned very narrowly and makes very general references to its protection.

It should be said that in the four trade agreements, emphasis is placed on the sovereignty of each country in terms of its natural resources and legislation to protect it, the importance that trade between the parties does not affect or limit the development of the environment, the importance of education focused on the environment and finally of citizen participation in legislation and protection.

It should be noted that agreements made with the European Union, the United States and Canada also emphasize labor protection, their rights and their development.

As for the situation in Mexico, there is a lag in the guidelines that can be found into the free trade agreements signed by the country, one of the main reasons that can be found for this situation, is the antiquity in the signing of the current commercial agreements. However, in the renegotiation processes of some of the agreements, environmental and sustainability issues are being discussed to be implemented in future reforms to them.

Table 1 shows the public policies that both countries have formulated in response to the SDGs. The Colombian government has made multiple laws that seek to cover all aspects raised by the SDGs, likewise it highlights the great development that SDG 12 has had: Production and Sustainable Consumption with 7 laws that aim to give a national development to this issue. In the Mexican case there is less development of laws, since they provide general guidelines with which each state that makes up the country develops and adopts public policies to comply with the laws. Thus, the central government created the previous laws in compliance with international agreements and concerns on environment and sustainability, and recently have undergone reforms and updates to better respond to the modern challenges represented by the SDG.

It highlights the differences between Colombia and Mexico in terms of their governmental organization, on the one hand Colombia, which is a centralist republic, for which the national government is the entity responsible for formulating the laws and policies of all its territory and it is the responsible for adopting these policies in the territories. On the other hand, Mexico, it is a federal republic, for which the central government dictates the laws and some guidelines, but it is the federal governments that make the formulation and implementation of the different necessary policies and attending to their own needs; for this, it makes the analysis of the Mexican situation somewhat difficult to do it.

### *3.2 Public policies towards sustainability in Colombia and Mexico*

In the literature review positive and negative aspects were found in the policies described above regarding sustainable development and especially the environmental impact of the industry (Table 2 and 3).

A study conducted by Hoogesteger and Wester (2017) in Guanajuato, Mexico, shows the uncontrolled exploitation of groundwater due to private concessions of these, but it also proves the lack of coordination between bureaucratic levels, society and the market, and despite the fact that new technologies have been stimulated and implemented in search of the efficiency of water use, consumption figures have not shown an improvement.

Regarding sustainable production, Mexico also encourages the use of renewable energy through its energy transition law. This new law and the slow adoption of new technologies in the generation of energy, highlight an increase in the use of non-renewable sources. The use of natural gas increased between 2014 and 2017 from 40% to 57% of the total of the fuels used for generation; additionally, an increase of 8% to 11.1% in the use of coal, only 12.9% of the energy is from hydroelectric sources and 3% from other renewable sources. Among the possible causes of these figures are the subsidies to fossil fuels [9].

**Table 1.** Public policies of Colombia and Mexico in response to the Sustainable Development Goals

| <b>COLOMBIA</b>                                                                                                           |       |       |       |        |        |
|---------------------------------------------------------------------------------------------------------------------------|-------|-------|-------|--------|--------|
| Policies                                                                                                                  | SDG 7 | SDG 8 | SDG 9 | SDG 12 | SDG 13 |
| National Environmental Policy for the Sustainable Development of the Oceanic Spaces and Insular Coastal Zones of Colombia |       | X     | X     | X      | X      |
| Environmental Education Policy                                                                                            |       |       | X     | X      | X      |
| Cleaner Production Policy                                                                                                 | X     | X     | X     | X      |        |
| Prevention and Control of Air Pollution Policy                                                                            | X     |       |       |        |        |
| Water Resources Management Policy                                                                                         |       |       | X     | X      | X      |
| National Policy on Production and Sustainable Consumption                                                                 |       | X     | X     | X      |        |
| Integral Management of Solid Residues Policy                                                                              |       |       | X     | X      | X      |
| National Green Businesses Plan                                                                                            |       | X     |       | X      |        |
| Renewable Energy Policy                                                                                                   | X     |       |       |        |        |
| <b>MEXICO</b>                                                                                                             |       |       |       |        |        |
| Policies                                                                                                                  | SDG 7 | SDG 8 | SDG 9 | SDG 12 | SDG 13 |
| Energy transition law                                                                                                     | X     |       | X     |        |        |
| General Law of Ecological Balance and Environmental Protection                                                            |       | X     |       | X      | X      |
| National Water Law                                                                                                        | X     |       | X     |        | X      |
| General Law for the Prevention and Integral Management of Waste                                                           |       |       | X     | X      | X      |
| National Strategy for Sustainable Production and Consumption                                                              |       | X     |       | X      |        |

Source: based on official publications from Colombia and Mexico.

In the Mexican case, there is a discussion around green taxes. The establishment of carbon taxes in Mexico has generated corporate unrest since they say that these taxes only benefit the state's income instead incentives, which finally affect their competitiveness [10].

In the Colombian case, the implementation of biofuels is highlighted as a positive measure, which created a strong market for this new product with similar characteristics to that of traditional fuels with almost an inelastic demand [11]. However, the higher consumption of biofuels also generates a pressure on production, which can show negative effects on the use of soils. Gómez-Navarro & Ribó-Pérez (2018) highlights the need to carry out the promotion of green products, which encourages changes within companies, research and coordination of private companies, research centers and universities around new technologies.

An example of the aforementioned can be found in the chemical industry, which represents the second and third most important sector in the manufacturing industry for Colombia and Mexico respectively. This industry is one of the ones that contribute the most to generating negative impacts on the environment, mainly due to the use of non-renewable raw materials and the inefficient use of energy

[13]. This leads to an excessive generation of waste and emissions into the atmosphere, especially carbon dioxide, which contributes to global warming and climate change.

Research and technological development have made it possible to treat carbon dioxide not as a waste but as an alternative chemical raw material for the synthesis of fuels and the manufacture of chemical products that were previously extracted from the oil sector, which reduces dependence on the oil derivative industries [13].

Thus, it is possible to demonstrate a positive relationship between innovation and sustainability and its long-term benefits. Industries must consider the importance of investments in education, infrastructure, and technological research in order to improve their processes and contribute to the development of green innovations. It is also important that they develop highly complex relationships with universities and technological development centers for the development of innovations, and thus contribute to the reduction of barriers such as the administrations of universities, the lack of support for research projects, lack of economic resources and institutional culture [14].

According to Huang, Hu, Liu, Yu & Yu (2016), the establishment of a clear stable regulatory framework and social pressure on the part of consumers are determining factors in the development and adoption of green innovations within industries. In developing countries, state regulations are the biggest drivers of green innovations, the incidence of consumers is lower because of low environmental awareness.

Likewise, society must focus its efforts on promoting green education and promoting sustainable consumption. Additionally, developing countries' governments must establish stricter regulations and green taxes to encourage companies to adopt sustainability measures in their processes [16], focus their efforts on education and raise awareness among companies' top managers in order to encourage green innovation [17] [15]. Finally, Huang et al. (2016) highlight the importance that companies create support and cooperation networks towards the adoption of green innovation. Tables 2 and 3 identify the positive and negative aspects of the public policies proposed in this section.

#### **4. DISCUSSION**

One of the main drawbacks when designing a public policy is the availability of information, which is the case for the formulation and implementation of sustainable development laws in Mexico, as well as the low interest of the different actors involved in participation and coordination for decision making, which are taken by a small group with high bargaining power, leaving out smaller groups [10].

In Colombia, it is identified public policies that promote sustainable production, the consumption of renewable energies and the efficient management of waste, however, a lack is the creation of financing mechanisms and the promotion of investment in this field. From an economic point of view, the policy should create economic incentives related to taxes, grace periods, debt forgiveness, reduction of tariffs on the import machinery through which they allow a more active participation of markets in sustainable development [18].

Financial mechanisms are a key factor that directly drives or prevents the production, consumption and sustainable innovation of industries. For example, there are the highest biofuels prices established by the government compared to traditional fuels which does not encourage the improvement of the sector's productivity and create an impossibility of competition in a free market. The public price regulation policy would promote the research and development of new technologies related to the production process of biofuels, in addition to promoting the intensive use of the existing land for this industry, limiting its effects on new lands to avoid the affectation of forests and the reduction of arable agricultural areas [11].

**Table 2.** Positive and negative aspects of Colombia's public policies in response to the Sustainable Development Goals

| Aspects                                | Positive                                                              | Negative                                                                          |
|----------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Infrastructure                         | Emphasis is placed on the improvement of infrastructure               | Facilitate the importation of machinery                                           |
|                                        | Creation of new financing mechanisms                                  | Lack of Green Funding                                                             |
|                                        |                                                                       | Financial Instability                                                             |
|                                        |                                                                       | Need to improve economic incentives                                               |
| Clean energies                         | Stimulus towards clean energies                                       | Lack of incentives for the implementation of clean energies                       |
|                                        | Focus on non-interconnected areas                                     | The costs in investments in clean energy are higher than other countries          |
|                                        | Some economic incentives towards the implementation of clean energies | Difficulty in acquiring new technologies                                          |
|                                        |                                                                       | Lack of coordination between the public and private sectors, research centers     |
|                                        |                                                                       | Impossibility to sell your surplus                                                |
|                                        |                                                                       | One-time fee, which prevents the use of certain more expensive technologies       |
|                                        |                                                                       | Medium and short-term activities are prioritized                                  |
|                                        |                                                                       | Promotion of green products, which would stimulate the adoption of clean energies |
|                                        |                                                                       | Preference bias of the population towards some types of clean energies            |
|                                        |                                                                       | Difficulties in granting licenses                                                 |
| Production and Sustainable Consumption |                                                                       | Financial barriers (access to credit, interest rates and inflation)               |
|                                        | Substitution of fuels (biofuels)                                      | Pressure on the use of land for biofuels generation                               |
|                                        | Prohibition of high sulfur fuels                                      | Regulated prices in biofuels that discourages competition                         |
|                                        | Encouragement of energy efficiency                                    | The intensive use of land already cultivated should be promoted                   |
|                                        |                                                                       | Lack of ambition in the policy approach                                           |
|                                        |                                                                       | Companies only seek to comply with the minimum standards                          |

|  |  |                                                              |
|--|--|--------------------------------------------------------------|
|  |  | Barriers to innovation                                       |
|  |  | Cultural barriers                                            |
|  |  | Barriers to governance                                       |
|  |  | Lack of resources towards research                           |
|  |  | Universities limit their dissemination to a very small group |
|  |  | Lack of clear regulatory framework                           |
|  |  | Lack of social pressure                                      |
|  |  | Consumers have less environmental awareness                  |
|  |  | Missing sensitize business leaders                           |

The promotion of sustainable production and consumption has begun to be successful in the countries. There is evidence of the generation of new business opportunities thanks to the promotion of sustainable development and possible new industries to strengthen it [19]. However, for the Colombian and Mexican case, three major barriers to sustainable development can be detected: barriers to innovation, cultural barriers and barriers in the governance of the productive and educational sectors.

**Table 3.** Positive and negative aspects of Mexico's public policies in response to the Sustainable Development Goals

| Aspects            | Positive                                              | Negative                                                                                                      |
|--------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Policy Formulation | Implementation of political integrity in its laws     | Absence of most actors in the policies formulation                                                            |
|                    | It has a lot of information                           | Most of the information is outdated                                                                           |
|                    | Indicators to assess ecosystems and define strategies | Decisions are made by a small group with high bargaining power                                                |
| Water Management   | The efficient use of water has been encouraged        | Uncontrolled exploitation of groundwater                                                                      |
|                    |                                                       | Delay in corrective actions                                                                                   |
|                    |                                                       | Lack of coordination between government actors and society                                                    |
|                    |                                                       | Recurrent amnesties for those who misuse water, which generates a disincentive to compliance with regulations |
| Clean energies     | Stimulus towards clean energies                       | Lack of promotion of energy efficiency                                                                        |
|                    |                                                       | Lack of investment in energy transport                                                                        |
|                    |                                                       | Intensive use of fossil fuels for power generation                                                            |
|                    |                                                       | Subsidies to fossil fuels                                                                                     |

|                                        |                               |                                                              |
|----------------------------------------|-------------------------------|--------------------------------------------------------------|
|                                        |                               | Intermittent research on clean energy                        |
| Production and Sustainable Consumption | Implementation of green taxes | Barriers to innovation                                       |
|                                        |                               | Cultural barriers                                            |
|                                        |                               | Barriers to governance                                       |
|                                        |                               | Lack of resources towards research                           |
|                                        |                               | Universities limit their dissemination to a very small group |
|                                        |                               | Lack of clear regulatory framework                           |
|                                        |                               | Lack of social pressure                                      |
|                                        |                               | Consumers have less environmental awareness                  |
|                                        |                               | Missing sensitize business leaders                           |

The role of the university towards industry's innovation is constrained by the very purpose of its research, as the results of research are almost exclusively limited to specialized journals without widespread dissemination for all audiences and, consequently, its influence in the formulation of policies on climate change. Academic publications related to sustainable production and consumption in Colombia and Mexico are few; the awareness of sustainability within the academic and business communities is necessary to achieve the effective development of clean production, green innovations, and change in consumption habits that allow the transformation into a sustainable industry.

## 5. CONCLUSIONS

The legislative and political approach in the world and within countries is beginning to show its first results, however, the adoption of sustainable development in Colombia and Mexico has not been obstacles free. There are problems of incentives towards the adoption of sustainability measures in industries, especially economic incentives with greater coverage. There is a need for access to credits and better financial conditions. The lack of coordination and alignment of goals between government, academia and the industrial sector limits research, development and the creation of sustainable innovations that contribute to the achievement of sustainable development objectives.

Similarly, a strengthening of state apparatus is needed, as well as the imposition of clear measures and sanctions that promote sustainable development in all economic areas. However, a key player in the promotion of sustainable development is the university, both for the development of research as well as for training and education of the population. With the help of industries, the government must promote the development of all types of innovation that contribute to the sustainability of the countries.

Likewise, communities must be aware of their role in sustainable development. The importance of the social pressures that the community can exert towards the industries and the government for the development and adoption of sustainability within the countries is demonstrated.

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