

# Food Security Measurement Model Proposed for Colombia Based on the Dimension of Access for Public Policies

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## Abstract

The departmental and municipal governments have the responsibility to measure the food degree security in the area through indicators adjusted to the information of each region, taking into consideration their sociodemographic variables and customs. This article proposes an indicator for measuring the food degree insecurity from self-sufficiency and food stability, without neglecting to consider the region conditions and customs that allows adequate policies and processes management by the departmental and municipal governments of the country.

**Keywords:** Food security, dimensions, Measurement indicators, public policies

## I. INTRODUCTION

The food access is essential for human life and constitutes an basic element for the full development of people and an fundamental basis for a life quality, it is in this sense that the "Food Security" concept was born for several years. This conception has been widely used over decades in different countries and by different organizations such as the Food and Agriculture Organization of the United Nations - FAO - to refer about the access to food by the population worldwide.

The food security measurement is widely studied by different organizations and countries concerned about "hunger" worldwide. For example, in 2007, the United States Agency for International Development - USAID, published a Guide to Indicators, called HFIAS - Household Food Insecurity Access Scale (USAID, 2007). Subsequently, taking into account the need to establish indicators that would make it possible to measure the other food security dimensions, by 2011, the Committee on World Food Security (CFS) established a "Round Table on Measuring Hunger" with the purpose of giving importance to the need to find "optimal" indicators that allow monitoring (CFS, 2011).

However, it is not enough to have food security, but also, as how it is established (Martínez & Palma, 2014), it become necessary to look at the problem by adapting it to the social and cultural diets and nutrition characteristics of each country. To achieve this there is a National Food and Nutrition Security Policy 2012 - 2019 - PSAN - implemented in 2013 by the Intersectoral Commission for Food and Nutrition Security (CISAN) (CONPES 113, 2008) in Colombia.

But this operational structure has not been enough in Colombia. Some probable causes of this food failure security policy lie in aspects, not only economic and corruption, but also in the eagerness of specialize the field with the objective of an agro industrial development that introduces Colombian agriculture in global markets, positioning the food production in the commercial competition, creating the need to feed themselves in the population. This research objective is to propose an indicator for measuring the food degree insecurity from self-sufficiency and food stability, considering the region conditions and customs that allows managing the policies and processes that follows according to the measured food degree safety in every region.

## II. THEORETICAL FRAMEWORK

Food security was defined at the World Food Summit in 1974 in these words "... that there are sufficient global stocks of basic foods at all times ... to maintain a constant expansion of consumption ... and to counteract fluctuations in production and prices" (FAO 1974) This definition denotes its preponderance towards the inexhaustible supply of basic foods necessary for human subsistence. However, the problem of sufficient food supply was compounded by a variable of greater control and greater weight: "access"; and that is why in 1983 the FAO analysis focused on access to food and the balance between demand and food supply, reaching the following definition: "... ensure that all people have at all times physical and economic access to the basic foods they need." (FAO 1983). This same importance to food security is given by Amartya Sen (1982) cited by Martínez (2016) who assures that hunger exists in a region according to food access, its distribution, as well as the vision of food as right.

Since the previous concept focuses on "access" to food, since 1996, the International Peasant Movement "La Via Campesina" launched the concept of "Food Sovereignty" (La Via Campesina, 2011), defining it as the way of: "organizing food production and consumption according to the needs of local communities, giving priority to local domestic production and consumption..." (Guareschi et al., 2014). Other authors such as Silvia Pérez (2010), affirm that the food concept security is based on an approach from consumption, while that of Food Sovereignty is oriented towards production. (Pérez-Vitoria, 2010).

According to the FAO (Balbi, 2010), the Food Security concept emphasizes the problems of household access, because even if

a country has high production, its population may suffer from food security and nutrition problems. In this way, FAO arrives at a broad concept of food security that has 4 pillars: availability, stability, access, and utilization. To measure food security in

Colombia, OSAN takes the indicators in Table 1 proposed by experts on the subject to evaluate the availability of food proposed by Machado & Pinzón (2016). These are:

**Table 1: Food availability indicators**

Indicator name	Description	Operational definition	Disaggregation level
Food availability	Offer available for the domestic market Results in thousands of metric tons	Results in thousands of metric tons $DA = PA + IA - ExA - CE$  DA: availability of priority foods (t) PA: Production of priority foods (t) ExA: Priority Food Exports CE: Changes in Priority Food Stocks (t)	National
Food self-sufficiency coefficient	It establishes the degree that the national market is supplied with the internal supply (national production). If the indicator is equal to 1 the country is self-sufficient, as it moves away from 1 it is losing self-sufficiency and if it is greater than 1 it produces more than it consumes and exports.	$CA = PA / DA$  CA: coefficient of self-sufficiency PA: volume of priority food production (t) DA: volume of availability of priority foods	National
Food dependency coefficient	It shows to what extent the availability of food depends on imports with the availability of priority foods. If it is equal to 1, the country is totally dependent on imports, if it is less and tends to decrease, the country still retains some food independence, when it is equal to 0, the country is 100% self-sufficient	$CD = IM / DA$	National
Per capita production of priority foods	It is defined as the relationship between production and the total number of inhabitants. Its trend over time shows the ability of a country to strive for food production in relation to demographic change. $PC = PA / PT$ Regional	$PC = PA / PT$	Regional

Source: (Machado & Pinzón, 2016).

The availability is determined by: the productive structure, however, this structure must be delimited to those foods that are critical in the analysis of food safety, that is why, in the Analysis of the availability of food of the Observatory of Safety Food and Nutrition of Colombia, only foods prioritized by the Inter-sectoral Commission for Food and Nutritional Security during the period 2007 - 2009 are taken into account, which is:

**Table 2: Foods prioritized by the Inter-sectoral Commission for Food and Nutrition Security during the period 2007 - 2009.**

Food group	Priority foods
Cereals	Rice, Corn and Wheat
Fruits	Orange, guava, banana, tree tomato, blackberry, mango and papaya
Vegetables	Tomato, onion, carrot, beans, squash, spinach and broccoli

Dairy	Milk and Cheese
Meat	Beef, pork, chicken and fish and organ meats (liver and kidney)
Egg	Chicken eggs
Legumes	Beans, lentils, peas
Suggars	Suggar and sugarcane
Tubers and Bananas	Potato, cassava and plantain
Oil	Vegetal Oil
Chocolate	Chocolate

Source: OSAN 2009

An adequate measurement of each dimension will allow the establishment of programs and policies that lead to mitigating the risks of food insecurity. Some of these policies are pointed out by authors such as Cuellar (2011) who established for ECLAC, a typology of food security programs for each dimension shown in Table 3.

Table 3: Typology of public policy programs by dimensions

Public policy instrument	Classification	Program	Dimensión it points
Fiscal transfer	Type I	Production subsidies (direct, input, among others)	Availability
	Type II.	Cash transfers to consumers, conditional and unconditional.	
	Type III	Food marketing at prices below market prices	Access
	Type IV	Transfers in kind to consumers in such a way that the food or nutrient is transferred to the beneficiary.	Use (nutritional dimension)
Provision of public goods	Type I-A	Technical assistance for production. They complement Type I.	Availability
	Type IV-A	Access to health, education and hygiene services	Access

Source: (Cuellar, 2011)

#### IV. RESULT

The following food security indicators are proposed below, taking into consideration mainly the prioritized foods in Colombia to measure Food Security (Table 2), the population variables, the crops in the region, the availability degree of food due to production in the region. The food that reaches this market either from other places or by imports and those that go out to supply other regions or by exports:

##### i. Indicator of food sufficiency

According to FAO (2006), the definition of food security, the supply, and demand of food can be given in three ways: local production, imports, or food aid. Although authors such as (Martínez Salvador, 2016) give greater importance to “self-sufficiency”, it will not necessarily be of greater relevance for food security when the regional level is analyzed, for example, the Food production varies for each department with different thermal floors in countries like Colombia, which means that it will not be the same food from the center of the country as on the Caribbean coast. That is why, without limiting it, an indicator for measuring the food sufficiency is proposed with the food amount that comes from other central markets (including that imported from other countries), the food amount that leaves towards other central markets to supply other regions, and also the food amount that goes out for export and all this related to the total population of the region under study.

A specific product that is produced in the region, plus what enters from other markets less what leaves to other markets, all of this must be sufficient for the entire population nutritious diet and must be greater or equal than to the food consumption in the studied region.

$$ISuf_i = \frac{a_i + b_i - c_i}{T}$$

Where,

$a_i$  = Quantity in food tons  $i$  produced in the region in one year. If it is not cultivated or produced, it becomes zero.

$b_i$  = Amount in food tons  $i$  imported and/or brought from other regions in a year.

$c_i$  = Quantity in food tons  $i$  exported or taken to other regions in a year.

$T$  = The Size population in the region under study The “ $i$ ” is specified for each of the foods in the prioritized foods table for Colombia (Table 2).

To determine whether or not there is food insecurity, the variable of the total population consumption of each food “ $i$ ” in units of measurement Ton/year must be known. Thus, a first restriction is established for a measurement model at the regional level. For example, suppose that the variable “ $i$ ” is rice food and we are evaluating food security in the Department of Córdoba, where according to an editorial, the inhabitants of the Caribbean Coast are the ones who eat rice the most, approximately, with a per capita consumption of 70 kilograms

per year, almost double the national average. So, the Department restriction for this variable would be:

$$\frac{a_i + b_i - c_i}{T} \geq 0,7 \text{ TON}$$

$a_i$  = Amount in rice tons that is grown in the Department or region under study.

$b_i$  = Amount in rice tons imported and / or brought from other regions in the year.

$c_i$  = Quantity in rice tons that is exported and/or taken to other regions in a year.

$T$  = The size population of the Department or region under study.

### ii. Stability indicator

Even though several authors base the stability component on meteorological factors, this research proposal is given for the consultations and the information available in Colombia. It proposes this measure as the crop probability losses or crop substitution, which makes it decrease the availability of a particular food  $i$ . This probability can be calculated with the historical data reported by the agriculture secretariats of each department through Agronet.

Then, Stability would be measured with a loss factor  $\rho$  and it would apply only to cultivated foods:

$\rho_i$  = Harvest loss or crop replacement  $i$ .

To the sum of the self-sufficiency the entire group indicator of prioritized foods (36 in total), with the stability indicator, we will call it: ICSA Food Security Coverage Index:

$$ICSA = \frac{\sum_{i=1}^n (a_i - \rho a_i) + b_i - c_i}{T}$$

### iii) Autonomy

It will be measured as the percentage of what is produced in the region of each food  $i$ , over the minimum consumption required for the population.

$$Aut = \frac{a_i}{CT_i}$$

Where,

$a_i$  = Quantity in food tons  $i$  produced in the region in one year

$CT_i$  = Total population food consumption  $i$  in the year

Finally, sustainability will be measured according to the population growth rate of the region and therefore the increase in food consumption. It appears that the dataset used, CICIDS2017, is well suited for DT algorithm and its derivatives, such as BT and random forest.

## V. CONCLUSION

Colombia has made progress in measuring food insecurity as established by the National Food and Nutrition Security Policy 2012 - 2019 - PSAN - implemented in 2013 by the Intersectoral Commission for Food and Nutrition Security (CISAN), in compliance with the established in CONPES 113 of 2008 and to date the results have been satisfactory.

As a result of this policy, each departmental government has been implementing policies in every dimension of food security, related to the means economic dimension, life quality and well-being, and the food quality and safety; And although the results at the national level have been satisfactory, the measurements made do not contemplate all the dimensions recognized up to know that makeup food security: availability, sufficiency, access, stability, autonomy, sustainability.

For this, an indicator is proposed in this research from the access dimension that contemplates sufficiency and stability, in addition, the prioritized foods for Colombia are recognized and taken into account, which allows analyzing food safety in a more "regional" way. In fact, the proposal is to establish prioritized food for each Department chart, considering that some foods are not necessarily consumed in all country regions, or in the same proportions according to customs. The example of rice was given, which is consumed twice as much on the Caribbean Coast as is consumed in the interior of the country.

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