

Socioeconomic stratification of the producing municipalities of coffee in Oaxaca integrated to the Crusade against the Hunger

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Abstract

Risks faced by coffee, such as problems in cultivation, production processes and price volatility, endanger the well-being of producers. To examine the problems of the coffee sector is required to approach it from a holistic approach and relate to various causes that may be inter-related. 5 as results main components explaining the cumulative variance of the variables in 74.29% were generated. the first two components accumulate 47.20% of the variability generated five layers for each of them are described. Oaxaca state maintains an important potential productive value (cultural) that must be valued in coffee producing areas framed in the crusade against hunger. It is therefore necessary to generate synergies between the triple helix (producers, government, business) generating scientific innovation, infrastructure and increasing human capital to support better public policies that achieve more value added to the coffee chain in underserved areas.

Coffee, Analysis of Principal Components, Marginalization, Public Politics

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1. Introduction

In the Mexican Republic, sixteen states produce coffee. Coffee production is concentrated in the states of Chiapas, Veracruz and Oaxaca, with more than 75 percent of producers, area sown and production volumes (Robles, 2011). In Oaxaca, where coffee plantations cover 24% of the total agricultural area of the state. The great paradox of coffee production in Oaxaca, is that although this contributes significantly to the entry of foreign currency to the country, practically a large number of coffee families live in extreme poverty (Avalos-Sartorio and Becerra, 1999).

The objective of this work was to investigate the characteristics of coffee producing municipalities in Oaxaca integrated into the Crusade Against Hunger, where socioeconomic, productive and marginalization aspects are related to establish strata of localities and locate lines of work in the design and implementation of public policies of the value chain. To do this, databases were used from the National Population Council (CONAPO), National Council for the Evaluation of Social Development Policy (CONEVAL), Food and Agriculture System of the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SIAP-SAGARPA.) and Secretary of Social Development (SEDESOL).

The methodology of Principal Component Analysis (PCA) was used to generate new uncorrelated variables from 15 variables on productive, socioeconomic and marginal aspects. Subsequently, the analyzed municipalities were stratified in homogeneous groups and heterogeneous among them.

3. Materials and Methods

The SIAP-SAGARPA, CONEVAL, SEDESOL and CONAPO databases were used to establish the stratification of the coffee producing municipalities in Oaxaca incorporated into the Crusade against Hunger. In the analysis of the information, 15 variables were related (see Table 1) that were selected according to socioeconomic conditions, productive characteristics of coffee and poverty. It is important to note that there are other variables that are also important and influential in the competitiveness of the coffee value chain; among them, there are the climatological ones that will be addressed in a later study.

PPA	Percentage of population of 15 years or more illiterate	PPL	Percentage of population in localities with less than 5000 inhabitants
PVH	Percentage of homes with some level of overcrowding	PRO	Production (Ton)
POE	Percentage of occupants in dwellings without electric power	REN	Performance (Ton / Ha)
PPP	Percentage of population aged 15 and over without full primary education	VPR	Production Value (Thousands of Pesos)
PP2	Percentage of employed population with income of up to 2 minimum wages	SCO	Sup. Harvested (Ha)
POA	Percentage of occupants in dwellings without piped water	SSE	Sup. Sown (Ha)
POD	Percentage of occupants in dwellings without drainage or toilet	GIN	Gini 2010
		PMU	Municipal Poverty 2010

Table 1 Variables socioeconómicas, productivas y ambientales de estudio

Continuing with the analysis of productive characteristics and marginality, in the Oaxacan coffee producing municipalities integrated into the crusade against hunger, the use of the Principal Component Analysis (PCA) methodology was considered with the purpose of generating new variables of components (eigenvalues - eigenvalues of each component) that summarize the characteristics of the studied problem of the original data set. The ACP reduces the dimensionality of the phenomenon by generating a baseline analysis of the original database and provides more information about the problem (Pla, 1986).

The purpose of generating new indicators, which relate various variables in 5 components, is based on a better contextualisation of problems in a holistic way, in the face of structural problems in the coffee sector. Once the components were obtained, we proceeded to stratify the first component obtained from the selected variables of coffee producing municipalities according to the productive, marginalization and socioeconomic characteristics of the municipality with the technique of Dalenius and Hodges (1959).

This tool helps reduce information by generating strata of municipalities in groups that are more homogeneous among themselves and more heterogeneous among them, considering minimizing the variance of the data under study. The results are intended to organize strata that guide the needs for the best design and implementation of public policies.

4. Results and discussion

According to the statistics of the SEDESOL, 1,012 municipalities are contemplated in the crusade relation against hunger. Among the main entities that have localities in these characteristics are:

Oaxaca which concentrates 28.8% (291 municipalities), Chiapas (6.9%, 97), Veracruz (8.4%, 85), Guerrero (7.6%, 77), Mexico (6.5%, 66), Puebla (6.3%, 64) and Michoacán (5.0%, 51). Of the total of municipalities in Oaxaca in the crusade against hunger, 42.6% (124) has a presence in coffee production, which demonstrates the direct relationship between rural municipalities with high marginalization and coffee crops as an important association. Of the 124 municipalities producing coffee in the crusade against hunger, 25.8% (32) have less than 2,500 inhabitants where they would be considered rural (according to the 2010 INEGI census), and 74.2% (92) are urban.

Table 2 shows the importance of the Costa Region in the planting of coffee with more hectares, mainly in Pochutla (32,138 hectares), which is also where the highest crop losses occur. It is important to note that the yield (ton / ha) is higher in the plantations located in the Sierra Norte region with 1.70 ton / ha, on average. Of course, there are soil conditions (soil and relative humidity of the environment) and climatology that significantly influence the productivity of coffee, which would be a work of further study to analyze. In rural areas, the average yield is 1.22 ton / ha while in urban areas they reached 0.99 ton / ha. The characteristics of coffee cultivation require more analysis according to the varieties in urban areas or producers without marginalization.

Region		Sur. Sown (Ha)	Sur. Harvested (Ha)	Average yield (Ton / Ha)
Cañada Region	4to Distrito: Teotitlán	16,380	16,315	0.85
	5to Distrito: Cuicatlán	4,417	4,402	0.77
	Total	20,798	20,718	0.82
Coast region	21er Distrito: Jamiltepec	1,871	1,786	0.45
	22do Distrito: Juquila	10,339	10,159	0.36
	30mo Distrito: Pochutla	32,138	30,178	0.41
	Total	44,348	42,123	0.41

Isthmus Region	28vo Distrito: Tehuantepec	6,068	6,068	0.80
	29no Distrito: Juchitán	2,785	2,785	1.38
	Total	8,853	8,853	1.03
Mixtec Region	16to Distrito: Tlaxiaco	1,040	1,040	1.14
	Total	1,040	1,040	1.14
Papaloapam Region	6to Distrito: Tuxtepec	6,608	6,054	1.25
	7mo Distrito: Choapam	4,666	4,509	1.22
	Total	11,274	10,563	1.24
Sierra Norte Region	12do Distrito: Ixtlán	766	766	1.80
	13er Distrito: Villa Alta	2,186	2,186	1.78
	14to Distrito: Mixe	11,843	11,603	1.63
	Total	14,795	14,555	1.70
South Sierra Region	15to Distrito: Putla	7,155	7,155	1.09
	23er Distrito: Sola De Vega	563	532	1.53
	26to Distrito: Miahuatlán	6,836	6,835	1.42
	27mo Distrito: Yautepec	1,498	1,498	1.39
	Total	16,052	16,020	1.34

Table 2 Statisticians of the productive variables of the coffee of the municipalities in the crusade against hunger (2015)

Source: Prepared by the authors with data from SIAP-SAGARPA (2015), SEDESOL (2015))

The planted area and coffee production in the state of Oaxaca is differentiated by several regions (Cañada, Costa, Isthmus, Mixteca, Papaloapam, Sierra Norte, Sierra Sur) and classified into districts. As for production, the Mixe district accounted for 18.4% of the state total in 2015, followed by Teotitlán (13.4%) and Pochutla (12.1%). 51.61% of the municipalities producing coffee in the crusade against hunger are classified with high degree of marginalization (IMG) (64 municipalities), 47.58 with a very high IMG (59) and only 0.80% with low IMG (1). The highest coffee yield is located in the municipality with low IMG, in contrast, municipalities with very high IMG have the lowest yields (0.97 ton / ha).

This reality reinforces that socioeconomic differences have a relationship with the scope of productivity capacities of the sector.

Table 3 shows 5 eigenvalues that show the percentage of variance explained by each one of them in the information set. The characteristic value associated with the first component summarizes 25.36% and the second 21.83%. The five components in the model explain 74.29% of the total variability of the information. On the other hand, with an approximate Chi-square value of 1.824.5 and 105 degrees of freedom and a significance of $p = 0.000$ it is evident that it is not an identity matrix and the ACP study can be carried out with the variables established in the table 1; in addition, the value of Kaiser-Mayer-Olkin (KMO) corresponds to 0.7 and therefore the model can be considered as acceptable

Comp	Initial eigenvalues			Sums of saturations to the square of the extraction			Sum of the saturations to the square of the rotation		
	Total	% de la variación	% acumulado	Total	% de la variación	% acumulado	Total	% de la variación	% acumulado
1	3.805	25.364	25.364	3.805	25.364	25.364	3.700	24.666	24.666
2	3.276	21.838	47.202	3.276	21.838	47.202	2.261	15.074	39.739
3	1.775	11.832	59.034	1.775	11.832	59.034	2.143	14.286	54.025
4	1.151	7.675	66.709	1.151	7.675	66.709	1.578	10.520	64.545
5	1.137	7.583	74.292	1.137	7.583	74.292	1.462	9.747	74.292

Table 3 Total explained variance of the main components
Source: Extraction method: Principal Components Analysis

Subsequently, we proceeded to correlate the five components with the variables of the municipal coffee producers of Oaxaca, which are also considered in the crusade against hunger. These are grouped with the independent variables (components) and according to their correlations in each of them.

Table 4 shows the correlations between the variables under study and the five main components generated. When the associations between the variables are made, five very well defined groups are obtained. According to their classification the strata can be named as follows:

- CP1 "Municipal coffee production of the municipalities in Oaxaca in the crusade against hunger".
- CP2 "Poverty and marginality".
- CP3 "Illiteracy and low income".
- CP4 "Productive performance versus housing with energy and overcrowding".
- CP5 "Housing characteristics (water and energy)".

Typology	Variable	Component	
		CP1	CP2
Percentage of population of 15 years or more illiterate	Pearson correlation	0.05	.188*
Percentage of population aged 15 and over without full primary education	Pearson correlation	0.00	.375**
Percentage of occupants in dwellings without drainage or toilet	Pearson correlation	-.251**	-0.09
Percentage of occupants in dwellings without electric power	Pearson correlation	.311**	.426**
Percentage of occupants in dwellings without piped water	Pearson correlation	.236**	0.02
Percentage of homes with some level of overcrowding	Pearson correlation	0.04	.605**
Percentage of population in localities with less than 5000 hab.	Pearson correlation	0.02	.591**
Percentage of employed population with income of up to 2 SM	Pearson correlation	-0.14	-0.05
Sup. Sown (Ha)	Pearson correlation	.920**	-0.02
Sup. Harvested (Ha)	Pearson correlation	.926**	-0.02
Production (Ton)	Pearson correlation	.925**	-0.08
Performance (Ton / Ha)	Pearson correlation	0.01	-0.04
Production Value (Thousands of Pesos)	Pearson correlation	.919**	-0.09
Gini 2010	Pearson correlation	0.16	-.765**

Municipal Poverty 2010	Pearson correlation	-0.17	.759**	
Typology	Variable	Componente		
		CP3	CP4	CP5
Percentage of population of 15 years or more illiterate	Pearson correlation	.870**	-0.15	0.08
Percentage of population aged 15 and over without full primary education	Pearson correlation	.845**	-0.08	-0.06
Percentage of occupants in dwellings without drainage or toilet	Pearson correlation	-.294**	-.200*	.587**
Percentage of occupants in dwellings without electric power	Pearson correlation	-0.04	-.295**	.510**
Percentage of occupants in dwellings without piped water	Pearson correlation	.232**	0.01	.727**
Percentage of homes with some level of overcrowding	Pearson correlation	0.09	-.249**	.307**
Percentage of population in localities with less than 5000 hab.	Pearson correlation	-0.05	.476**	-0.08
Percentage of employed population with income of up to 2 SM	Pearson correlation	.478**	.271**	.438**
Sup. Sown (Ha)	Pearson correlation	-0.03	-.277**	0.02
Sup. Harvested (Ha)	Pearson correlation	-0.02	-.265**	0.02
Production (Ton)	Pearson correlation	0.01	.256**	0.04
Performance (Ton / Ha)	Pearson correlation	-0.10	.879**	-0.10
Production Value (Thousands of Pesos)	Pearson correlation	0.01	.259**	0.05
Gini 2010	Pearson correlation	-.444**	0.04	0.05
Municipal Poverty 2010	Pearson correlation	.287**	0.08	-0.10

** The correlation is significant at the 0.01 level (bilateral).

*. The correlation is significant at the 0.05 level (bilateral).

Table 4 Pearson's correlation coefficient with the Component Matrix

Source: Own elaboration with the methodology of Principal Components in SPSS

The first component (CP1) is highly correlated at the 0.01 level (bilateral) with the productive variables of coffee (planted area (ha), harvested area (ha), production (ton) and production value (thousands of pesos)); for what could be considered as "Municipal production of coffee of the municipalities in Oaxaca in the crusade against hunger." On the contrary, it presents a negative relationship with the percentage of occupants in dwellings without drainage or toilet.

The second component (CP2) is positively associated and the level 0.01 (bilateral) is significant with the percentage of dwellings with some level of overcrowding, percentage of population in localities with less than 5 000 inhabitants, municipal poverty 2010, which is I would call it "illiteracy and low income." In contrast, it presents a negative relationship with the Gini index. It should be noted that the highest inequality expressed in the Gini index is found in the municipalities with high levels of marginalization that average in 0.5664, in contrast, coffee producing municipalities with very high levels of marginalization have an average inequality of 0.5217 .

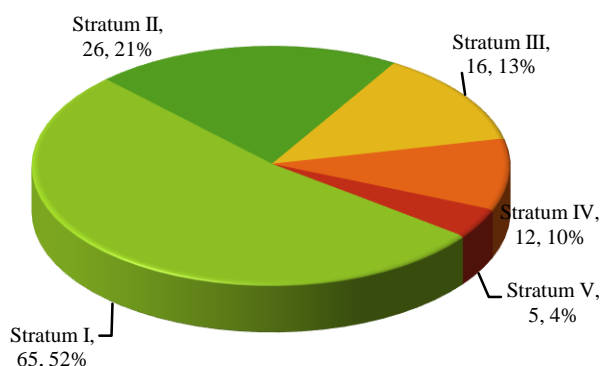
The third component (CP3) has a positive relationship between the percentage of the population of 15 years or more illiterate living in coffee producing regions in Oaxaca, percentage of population aged 15 years or older without full primary and percentage of employed population with income from Up to 2 minimum wages. In contrast, it presents a negative relationship with the percentage of occupants in dwellings without drainage or toilet and Gini index. This component may represent "Illiteracy and low income". The fourth component (CP4) presents a positive and significant relationship at the 0.01 level (bilateral) with the yield of coffee production; on the contrary, it has a negative relationship with the percentage of occupants in dwellings without drainage or toilet, harvested area (ha).

Percentage of occupants in dwellings without electric power and the percentage of dwellings with some level of overcrowding. This component could be considered as "productive performance versus housing with energy and overcrowding"; that is, the greater the production, the fewer problems related to housing services. Finally, CP5 is positively related to housing characteristics in water and energy.

Given that CP1 and CP2 collectively concentrate 47.20% of the variability of the information set, the two components obtained from the model will be considered for the analysis by means of the regression and standardization technique. In addition, the stratification of coffee producing municipalities according to the productive characteristics, marginalization and poverty of coffee was carried out using the technique of Dalenius and Hodges (1959). With this, the variance of the classes established on the territorial information of the coffee producing municipalities in Oaxaca (in the crusade against hunger) will be minimized, generating heterogeneous groups among them and homogeneous among themselves. The strata would focus the design of sectoral public policies for the coffee value chain and socioeconomic conditions of the local inhabitants' producers.

Once the strata were obtained, the first two components generated in the ACP model were linearly combined. For the first case, the standardized values of CP1 fluctuated between the values of -1,281 and 3,527. Applying the stratification of Dalenius and Hodges, the strata were segmented into the following interval limits of the first component: I. (-1.281, -0.319), II (-0.320, 0.161], III. (0.162, 1.123), IV (1,124, 2,565) and V. (2,566, 3,527) (Graph 1).

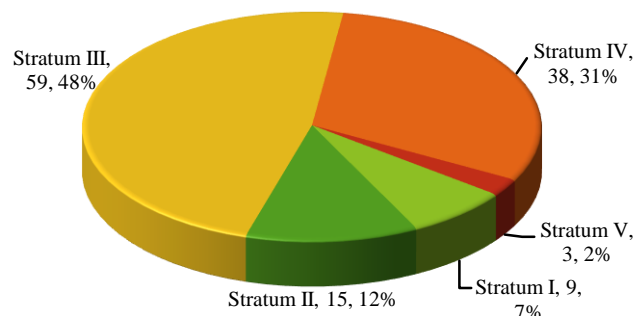
Thus, each municipality producing coffee in Oaxaca in the crusade against hunger is grouped under homogeneous conditions of the productive situation, marginalization and municipal poverty. In the first stratum, there are 65 municipalities that represent 52% of the group analyzed with CP1, stratum II (26) represents 21%, stratum III (16) 13%, stratum IV (12) 10% and stratum V (5) 4%.



Graph 1 Municipal stratification of coffee production in CP1

Source: Own elaboration, based on the indicators with the first component

The second component (CP2) related to the poverty and marginality of coffee producing municipalities in Oaxaca (in the crusade against hunger) the limits fluctuated in: I. (-3.176, -1.611], II. (-1.612, -0.568], III. (-0.569, 0.475], IV. (0.476, 1.519] and V. (1.520, 2.040] (graph 2). The Stratum I of CP2 concentrates 9 territorial coffee producing municipalities that represent 7% of the total (124), Stratum II (15) represents 12%, Stratum III (59) 48%, Stratum IV (38) 31% and Stratum V (3) 2%.



Graph 2 Stratification of the characteristics of poverty and marginality in the coffee municipalities in the CP2

Source: Own elaboration, based on indicators with the second component of the ACP

Table 5 and 6 show the Stratum generated for both the first component (CP1) and the second component (CP2) and their relationships with the variables described in table 1.

	Component 01		
Degree of Marginalization	Stratum04	Stratum05	Total
Very high			
Percentage of population of 15 years or more illiterate	24.05	30.62	28.16
Percentage of population aged 15 and over without full primary education	48.94	49.30	48.80
Percentage of occupants in dwellings without drainage or toilet	0.52	1.73	2.39
Percentage of occupants in dwellings without electric power	11.04	12.42	6.99
Percentage of occupants in dwellings without piped water	16.69	39.74	18.44
Percentage of homes with some level of overcrowding	50.72	58.70	53.74
Percentage of occupants in dwellings with dirt floors	30.15	41.61	23.98

Percentage of employed population with income of up to 2 minimum wages	60.14	74.41	70.87
Performance (Ton / Ha)	1.01	0.67	0.97
PMR (\$ / Ton)	3,935.75	4,167.33	3,889.84

Table 5 Characteristics of the CP1 with IMG Stratum Very high

Source: Own elaboration with data from SIAP-SAGARPA (2011) and CONEVAL (2015)

Degree of Marginalization Very high	Component 02					Total
	Stratum 01	Stratum 02	Stratum 03	Stratum 04	Stratum 05	
Percentage of population of 15 years or more illiterate	31.19	27.74	27.98	28.37	26.12	31.19
Percentage of population aged 15 and over without full primary education	44.45	46.58	47.56	50.40	43.38	44.45
Percentage of occupants in dwellings without drainage or toilet	1.14	0.87	3.35	1.97	1.33	1.14
Percentage of occupants in dwellings without electric power	3.69	3.09	5.67	8.03	12.79	3.69
Percentage of occupants in dwellings without piped water	31.81	15.79	20.56	17.75	3.11	31.81
Percentage of homes with some level of overcrowding	52.66	42.14	50.13	57.31	56.04	52.66
Percentage of occupants in dwellings with dirt floors	28.10	27.38	20.45	25.84	26.82	28.10

Percentage of employed population with income of up to 2 minimum wages	71.13	83.19	73.59	69.23	47.79	71.13
Performance (Ton / Ha)	0.80	0.93	1.00	0.93	1.48	0.80
PMR (\$ / Ton)	4,388.30	4,252.15	3,959.38	3,815.21	3,488.93	4,388.30

Table 6 Features of CP2 with IMG Stratum Very high

Source: Own elaboration with data from SIAP-SAGARPA (2011) and CONEVAL (2015)

5. Conclusions

Of the 2,458 that exist in the country, the state of Oaxaca is the main entity with municipalities in the Cruzada Contra el Hambre (291), concentrating 28.8% of the country's total. Of this total, 124 municipalities have coffee activity mainly inhabited with levels of high and very high marginalization; 25.8% (32) have less than 2,500 inhabitants (rural), and 74.2% (92) are urban. The value of coffee production in rural municipalities represents around 40% of the total value of total agrifood production, and in the case of urban municipalities, 24%.

For practical purposes, the components for the analysis were considered since they incorporate about 50% of the variability of the information that explains the municipal coffee production of the municipalities in Oaxaca in the crusade against hunger, as well as poverty and marginality respectively. The third component is related to illiteracy and low income, the fourth with productive performance versus housing with energy and overcrowding, and the last one with housing characteristics (water and energy).

The yields and productions of coffee in the municipalities of the crusade against hunger in Oaxaca do not behave equally between rural and urban regions. This situation is positively related to the socioeconomic situation and marginality in which the inhabitants of the value chain live.

There are other important factors such as environmental, pedological, safety, quality and socialization networks of technological packages that will be addressed in a post-erior study. The producing municipalities must incorporate public policy actions that involve innovations in the production and marketing processes in order to add value to the final product to the consumer.

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