Original Research Article

PRINCIPAL COMPONENTS ANALYSIS FOR CHARACTERIZATION OF FARM PRODUCTION CORN ((*Zea mays*)) IN GUANARE MUNICIPALITY, PORTUGUESA STATE, VENEZUELA

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Abstract: In this paper presents a characterizations of farms and plots corn (*Zea mays*) , in order to interpret and grading this production systems in Guanare municipality of Portuguesa state in the winter cycle 2008, by Principal component analysis, for the which was selected a sample of 41 farms or plots, using information technical, socioeconomic, agroecological and institutional from of the records of producers the ASOGUANARE, SA association. In this regard, were considered twenty six (26) variables, of which were discarded sixteen (16) since show small variability. Over data matrix for ten variables was applied a principal components analysis (PCA) and statistical description. In this way, the PCA identified five (5) factors affecting corn production: size of farm or plot, cultivated area, limitations by equipment and machinery, limitations by labor and planting date. Similarly was observed a negative effect of the planting date (rainfall distribution) and limitations by equipment and machinery on yield. Finally, were identified and classified the 41 farms or plots into three groups discriminated mainly by the dimension or size of corn farm.

Introduction

Cereals and the corn specifically, is an agricultural product that is setting the trend in the national economy and in municipality Guanare in Venezuela, this is of great importance in national agricultural production. There is currently a high demand both nationally and internationally, for this reason we need to know the social, technical and economic factors of corn production and the relationship over the same productivity. In this sense, the study of different systems of agricultural production is of great importance to describe diversity of factors involved in production. Thus, the purpose in this paper is to describe and classify systems of maize production (*Zea mays*) in Guanare municipality using Principal Component Analysis (PCA).

Materials and Methods

Guanare municipality is located in northwestern Portuguese State and it is the political capital of state and the agricultural is the predominantly

economic activity. It covers an area of 2008 km2 or 200,800 ha; this represents the 13.21% of the surface. Economic activity is predominantly agricultural. In the agricultural landscape prevails the rice cultivation, corn, sugar cane, snuff, tomato, cassava, sorghum, sesame, cotton, among others, further livestock of meat and milk and pork breeding. In this research a 41 farms sample and plots planted to corn (*Zea mays*) in Guanare municipality, Portuguesa State, attached to the Producers Association of the Guanare municipality (ASOGUANARE, SA).

Technical, socio-economic, agro-ecological and institutional records from ASOGUANARE, SA were used in winter cycle in 2008, where the variables considered were: (1) Sector (2) Parish, (3) City, (4) Prea, (5) total area, (6) effective area (7) planting date (8) Yield by area (Kg/ha), (9) varieties, (10) land preparation (11) type of planting, (12) N power, (13) N rate (14) P power, (15) P dose, (16) K supply (17), K dose (18) NPK application (19) Limitations by pests, (20) limitations by disease (21) Limitations by weeds (22) Irrigation (23) limitations by equipment /machinery (24) constraints harvesters (25) Technical Assistance (26) hand labor. Of the 26 variables selected were discarded 16 variables, such as: (3) Municipality, (9) varieties, (10) Land preparation (11) Type of planting, (12) N Power, (13) N dose, (14) P power, (15) P doses (16) K supply (17), K dose, (18) the NPK application (19) limitations by pest (20) limitations by Disease (21) limitations by Weeds (22) Irrigation, (25) technical assistance, which for all producers (41) reported no variability. In the data matrix X, which is the number of observations vector X [ij], j = 1... p, where p represents the variable j to i observations. In this case the X matrix consists of observations "n" and variable "p", ie 43 x 10 variables selected farms. This matrix was analyzed with a statistical software, which allowed for a principal component analysis (PCA) based on the correlation matrix, with which it is determined: 1) eigenvalues and the proportion of explained variance, 2) matrix eigenvectors of the transformation matrix, 3) Correlation matrix between the original variables and the principal and 4 components) Projection units (farms) in the foreground two components (CP1*CP2). The number of principal components to included in the analysis were selected based on the Kaiser criterion, which includes only those components with greater than one (1) eigenvalues.

Results and Discussion

Table 1 shows a statistical description of technical, socioeconomic and agro ecological variables from 41 farms production corn (*Zea mays*) in Guanare municipality, in winter cycle 2008, where one can observe a high variability (> 20%) with variation coefficients ranging from 21,8% to 88,03%. This high variability may explain the diversity associated with the management of maize production in the area. It is also important to note that on average you have parcels of 67,51 ha with 19,56 ha available for planting and an effective area of 18,66 ha. On the other hand we observed an average yield 3892,68 kg / ha.

Table 2 shows the correlation matrix, showing that there is a highly significant correlation (p <0,01) between effective hectares and the total area (ha), likewise, highly significant correlation (p <0,01) between total area with effective and cultivated area, also between cultivated area and effective area, it is therefore it justifies application of principal component analysis by matrix R method.

Table 1. Statistical description of technical, socioeconomic and agroecological variables from farms production corn (*Zea mays*) in Guanare municipality, winter cycle 2008.

Variable	Statistical		
	Mean ($\overline{X}$)	Standard deviation (S)	Variation Coefficient (%)
Total area	67,51	38,48	57,00
Cultivate area	22,22	19,56	88,03
Effective area	21,21	18,66	87,98
Yield (kg/ha)	3892,68	848,64	21,80

Table 2. Correlation matrix of technical, socioeconomic and agroecological variables from farms production corn (*Zea mays*) in Guanare municipality, winter cycle 2008.

Variable	Correlation coefficient and its significance			
	Total area (ha)	Cultivated area (ha)	Effective area (ha)	Yield (kg/ha)
Total area (ha)		0,59**	0,995**	-0,158 ns
Cultivated area (ha)			0,545**	-0,229 ns
Effective area (ha)				-0,132 ns
Yield (kg/ha)				

(**):$p \leq 0,01$ (ns):$p > 0,05$

Table 3 shows eigenvalues and the variance proportion of the three (3) first components from the data matrix of technical, socioeconomic and agroecological variables from 41 farm production corn (*Zea mays*) in Guanare municipality in the winter cycle 2008, thus showing that three components have eigenvalues greater than one and the cumulative variance is approximately 68,47%, by it can establish that dimensionality of canonical space in which are the 41 farms and fields which is size three (3).

Table 3. Eigenvalues and variance proportion from data matrix of technical, socioeconomic and agroecological variables from farms production corn (*Zea mays*) in Guanare municipality, winter cycle 2008.

Component	Eigenvalue	Variance proportion %	Cumulative variance %
1	2,88	32,09	32,09
2	1,93	21,44	53,53
3	1,34	14,93	68,47

Figure 1 shows a projection of 41 farms and plots in plane of the first two components (CP1 *CP2), where the analysis clearly shows three groups defined by variables associated with size of farm, where group one (G1) has an average total area of 14,66 hectares, group two (G2) 173,25 hectares, and group three (G3) of 128,67 hectares.
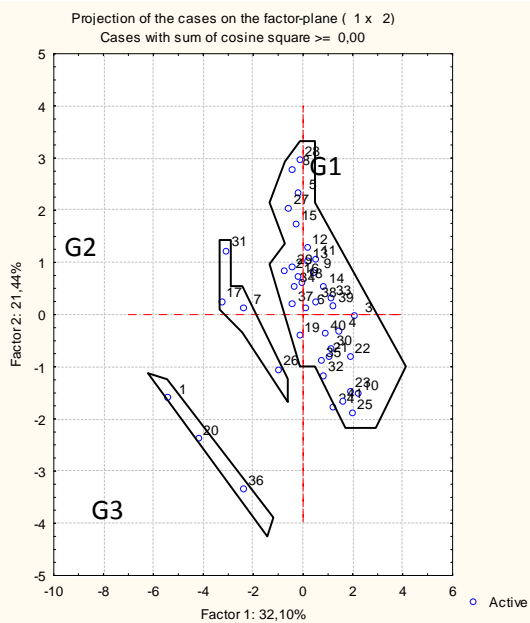

Figure 1. Projection of 41 farms used to grow corn farms in Guanare municipality in the plane of the first two components (CP1*CP2) of technical, socioeconomic and agroecological variables.

Table 4 shows principal components analysis, where the first component is the highest with 32,09% variance and therefore greater explanatory power of data and likewise were observed positive values in proportions more or less similar to those variables that together reflect the size, scale, size or surface of the 41 farms and plots, total area (ha), effective area (ha) and cultivated area (ha), on the other hand the second component shows a relationship between variables associated with limitations in this case limited by crop and labor, and the third component shows three variables highly correlated such as planting date, yield (kg / ha) and limitations on equipment and machinery, there you can see positive values for planting date and limitations on equipment and machinery, and the negative effect that these have on yield (kg / ha).

Table 4. Principal components analysis on the matrix rotated (varimax).

Variable	Component		
	1	2	3
Location	-0,123	-0,528	-0,008
Total area	0,690	0,404	0,068
Cultivated area	0,974	0,003	0,034
Effetive area	0,965	-0,035	0,025
Planting date	-0,313	-0,109	0,745
Yield (kg/ha)	-0,161	-0,107	-0,864
limitations by equipment and machinery	0,214	0,278	0,596
limited by crop	-0,177	0,837	0,017
limited by labor	0,185	0,765	0,249

Table 5 shows a classification and characterization of the 41 farms corn producers of Guanare in municipality, showing that the group one (G1) and three (G3) have the higher yields with an average of 3800 and 3900 kg / ha respectively, however, these two groups differ in total area, since the plots from group G1 have a average of 14,66 hectares and the farms from the group G3 with an average of 128,67 hectares.

On the other hand the group two (G2) is characterized by the lowest yield (3300 kg / ha) with an average surface of 173,25 ha, the group two (G2) showed the lowest yield compared with the group one and three (G1 and G3), this may be related to climatic factors, or the fact that there are farms grouped whose main activity is the cultivation of corn to the animal production or other crops.

Table 5. Classification and characterization of 41 corn-producing farms in Guanare municipality winter cycle in 2008, based on the first three principal components.

Group	Mean			
	Total area (ha)	Cultivated area (ha)	Effective (ha)	areaYield (kg/ha)
G1 (82,9 %)	14,66	11,24	10,79	3964,71
G2 (9,7 %)	173,25	38,75	35,75	3300
G3 (7,3 %)	128,67	88,33	85	3866,67

The classification and characterization of the corn crop management on 41 farms in Guanare municipality in the cycle of winter 2008, showing that most of the producers of group one (G1) initiated the period sown in may and only 8,82% performed sowing in the month of June, so it can be seen in this group a 35,29% of farms had limitations by equipment and machinery and 41,17% with harvest limitations and own labor. In group two (G2) shows that farmers started planting in May, they had no limitations on equipment and machinery; however, 25% reported limitations per crop with 75% of the labor own work. Finally, group three (G3) was characterized by start planting the first 15 days of May, this group did not provide limitations for equipment and machinery, but a percentage of producers relatively high (66,67%) had limitations for crop and also labor was itself.

Conclusions

The principal component analysis (PCA) identified five factors that have greatest impact on maize production in 41 farms or parcels in Guanare municipality in the winter cycle 2008, these were: size of the farm or plot, limitations by equipment and machinery, limitations by harvest, limitations for labor and planting date.

Was observed the negative effect of the planting date and factors as limitations by machinery and equipment over performance. The PCA allowed to identify or classify 41 farms or plots in three clearly defined groups and discriminating against primarily by the extent or size of the farm or plot. was observed that groups one and three (G1 and G3), whose main activity is corn production were those who reported higher yields. PCA is a powerful tool that permits identification of factors involved in production systems, in addition to their classification into homogeneous subgroups based on factors that allow their discrimination. Also, it Advisable have a control that allows to association of producers (ASOGUANARE S.A) measure those factors such as source of fertilizer and quantity, limitations by pests, diseases and weeds to be included in future research.

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