Characterization and typification of citrus production systems in the department of Meta

Caracterización y tipificación de los sistemas de producción citrícola en el departamento del Meta

José Alejandro Cleves-Leguízamo[1] and Alfredo Jarma-Orozco[2]

ABSTRACT

Agriculture is a co-evolutionary process between society and nature. Agroecology is an environmental science which focuses on ecosystem-culture and society-nature interactive systems, the effect of human intervention in the transformation of ecosystems. The central objects are agroecosystems and the units of study are production units. These production units are conceived of as agricultural systems and are found in the crossroads of multiple interactions between biophysical, socioeconomical, cultural, and production components, which must be analyzed with an integrated concept. In the present study, a characterization and typification of the citrus agroecosystems of the department of Meta were pursued (Colombia). The pertinence of implementing the methodology designed by the Latin-American Center for Rural Development (Centro Latinoamericano para el Desarrollo Rural-RIMISP) was evaluated, grouping the variables with a focus on an analysis of livelihoods. A survey and interview were defined as methods of collecting the primary information in the municipalities of Puerto López, Villavicencio, Granada, Lejanías, Guamal and San Martin, where 78.4% of the citrus area of the department is found. This study involved the selection and definition of the evaluation variables, validation and adjustment of said variables, collection of primary and secondary information, and the application of multivariate statistical analysis techniques to conform and characterize the recommendation domains or groups. The more important results indicated that it is possible to increase knowledge of the interrelations that exist between the different components of farm agroecosystems and their relationship with the principal agroecological structure. The existence of six agricultural groups or recommendation domains was established, with some productive characteristics very similar within the group but very heterogeneous to the outside of the group, with particular necessities.

Key words: cropping systems, production structure, farm surveys, agricultural statistics, *Citrus* sp.

RESUMEN

La agricultura es un proceso de coevolución entre las sociedades y la naturaleza, la agroecología es una ciencia ambiental, en donde se privilegia el estudio de las complejas interacciones ecosistema-cultura o sociedad-naturaleza; es el efecto de la intervención humana para transformar los ecosistemas, su objeto central y unidad de estudio son los agroecosistemas y la unidad productiva respectivamente. Estas unidades productivas conceptualmente se conciben como sistemas agropecuarios complejos, y se constituyen en el lugar donde se presentan múltiples interacciones entre los componentes biofísicos, socioeconómicos, culturales y productivos, los cuales deben ser analizados bajo un concepto integrador. En el presente trabajo, se avanzó en la tipificación y caracterización de los agroecosistemas citrícolas del departamento del Meta (Colombia); se evaluó la pertinencia de implementar la metodología diseñada por el Centro Latinoamericano para el Desarrollo Rural-RIMISP agrupando las variables con el enfoque análisis de medios de vida. Se definió la encuesta y la entrevista como medios de captura de información primaria, en los municipios de Puerto López, Villavicencio, Granada, Lejanías, Guamal y San Martin, donde se concentra el 78,4% del área citrícola del departamento. El trabajo investigativo comprendió la selección, definición de las variables a evaluar, validación y ajuste de las mismas, recolección de información primaria y secundaria, y la aplicación de técnicas de análisis estadístico de tipo multivariado para la conformación y caracterización de los grupos o dominios de recomendación. Los resultados más importantes indicaron que es posible ampliar el conocimiento de las interrelaciones que se presentan entre los diferentes componentes del agroecosistema finca y su relación con la estructura agroecológica principal. Se estableció que existen seis grupos de agricultores o dominios de recomendación, con unas características productivas muy semejantes al interior del grupo y muy heterogéneas al exterior de los grupos, con necesidades particulares.

Palabras clave: sistemas de cultivo, estructura de la producción, encuestas de fincas, estadísticas agrícolas, *Citrus* sp.

Received for publication: 18 January, 2014. Accepted for publication: 19 March, 2014.

[1] Faculty Sectional Duitama, Universidad Pedagógica y Tecnológica de Colombia (UPTC). Duitama (Colombia). clevesalejandro@yahoo.com
[2] Faculty of Agricultural Sciences, Universidad de Córdoba. Monteria (Colombia).

Introduction

In recent decades, the focus on production systems has grown in importance as a tool for the characterization of productive processes and rational planning of labor, research and continuing education (Miranda *et al*., 2012). A production system is a collection of activities that a group of people organizes, directs, and carries out in accordance with their objectives, culture, and resources, implementing practices with respect to the environment where they are located (Duarte, 1990). The relevance of the ecosystem-culture interaction has proven itself, considering the latter as an adaptation strategy implemented by humans in order to meet their social needs, such as food, clothing, and industry (Ángel, 1996).

Citrus originated in the subtropics and have developed well in the region called the "citrus belt", found between 25° and 40° latitude, north and south, even though the tropics offer good production. Flowering and production are markedly stimulated by environmental factors and temperatures in subtropical conditions and water stress under tropical conditions (Aguilar *et al.,* 2010). In Colombia, they are grown from sea-level up to 2,000 m a.s.l. It is the most cultivated group of fruits and occupies the second largest area after the banana, with 62,409 ha (Orduz and Mateus, 2012).

One of the biggest challenges faced by researchers and continuing education teachers in promoting sustainable agricultural development is designing programs that are adjusted to the conditions of producers (Jänicke and Klaus, 2006). Historically, designed policies have tackled agricultural problems independently and without any connection; no efforts have been made to identify the interrelations between the availability of resources, developmental practices, and the environmental damage caused by said practices. Knowledge of these interactions is useful for the design of rational management strategies and the sustainability of the available natural resources (Escobar and Berdegué, 1990; Larrea *et al.,* 1998) and the basic requirement for their adequate diagnosis of the availability of excellent quality information based on a suitable collection methodology that starts with the selection of the objet population of the study and the classification factors in accordance with the established hypothesis (García and Calle, 1998).

Cabrera *et al.* (2004) indicated that characterization and typification studies on agroecosystems must have eight stages: i) describe the population; ii) selection of the simple collection tool and its construction; iii) processing of the information; iv) review and selection of variables; v) application of multivariate statistical techniques; vi) determination of types or subsystems; vii) description of types or groups; viii) validation of typology.

Agroecology studies the structure and functioning of agroecosystems from the point of views of cultural and ecological interactions (León and Altieri, 2010). Agroecosystems are subsystems of farms (Hart, 1985) with a focus on interactions on the farm (upper agroecosystem) and the lots (lower agroecosystem) (León, 2012). The term principal agroecological structure (PAS) is an evolutionary concept that defines the integration of farms as well as their interconnection and interaction with the agroecosystem, the landscape, and society. The PAS is related to communication, connectivity, and functions that are called functional biodiversity. The level of interconnectivity of the farm with the principal ecological structure of the landscape (support infrastructure) can offer higher possibilities for climatic and biological regulation and management in comparison with farms where the PAS is simple or disarticulated (León, 2010).

There are no exact reference data for the area sown with citrus in Meta; however, the Ministerio de Agricultura y Desarrollo Rural of Colombia estimates this area at between 8,500 and 10,104 ha (MADR, 2006) and the Secretaría de Agricultura the department of Meta (Gobernación del Meta, 2012), reported area statistics (4,767 ha) for seven municipalities with an average yield of 23.5 t ha^{-1}. These production areas are characterized by the utilized technology, which has a large empirical component, by erratic production, by high production costs and by the eventual environmental damage that will be caused by the excessive use of pesticides. Production is geared toward fresh consumption. The excessive offering during harvests lowers prices. No postharvest process exists (Cleves *et al.,* 2012).

The development of the citrus sector in the country depends on the specialization of the regional offering following the pattern of competitive and comparative advantages in a clustered form, as seen in Meta (Caicedo, 2004). The pluviometric regime is monomodal; the rainy season is from March to November. The average annual precipitation oscillates between 2,500 and 3,800 mm. The temperature (±26°C) is constant throughout the day, year-round (Davies and Albrigo, 1994). 4,930 heat units/year are seen (Orduz and Avella, 2008). The soils are deep with a clay loam texture, classified as class IV and are recommended for citrus (Orduz and Baquero, 2003); these low tropic climatic conditions correspond to the vegetative formation of a tropical moist forest mt-f (IGAC, 2004).

Considering the cultural and ecological relationships that are found, the productive processes must be taken in a holistic and environmental view in order to understand the totality of the system, and not just partially; the present study aimed to characterize and typify the citrus production systems in the department of Meta, Colombia.

Materials and methods

This study was carried out in the second semester of 2012 in the municipalities of Lejanías, Villavicencio, Guamal, Granada and Puerto López, which constitute 78.4% of the citrus production of Meta. Utilizing different sources of primary information, 51 lots were selected and isolated, covering an area of 650.8 ha, equivalent to 11.88% of the total cultivated surface in the department of Meta.

Compilation of information

By reviewing primary and secondary sources, general information on the production zones was compiled, such as the varieties, volumes, area, etc., through the use of surveys and interviews. Afterwards, a conceptual framework was created to determine the particular characteristics of the productive units, following the proposal of García and Ramírez (2011). With the goal of facilitating an understanding of the numerous factors that determine the different production systems (Alwang *et al.,* 2005; Bermúdez, 2008; Mora *et al.,* 2011), the variables were selected and grouped in indices composed of capital, as indicated in Tab. 1.

For the determination of the variables: PAS, sanitation evaluation of the cultivation and definition of the production systems, rounds were carried out in the field, compiling this information in formats specifically designed for this task; rounds were also carried out in the field with functionaries of the Meta region ICA, conducting pilot tests for the validation of the survey's relevance.

Data processing

An Excel® (Microsoft Corporation, Washington DF) archive base was constructed which was analyzed using multivariate analysis. In order to reduce the dimensionality of the database, the categorical variables used in the qualitative-type description were purified. Some qualitative-type variables were transformed into quantitative ones through the introduction of categories. In total, 26 quantitative variables were defined, which were used for the descriptive statistical analysis, using version 9.0 of the Statistix program (Analytical Software, Tallahassee, FL), which calculated means, standard deviation, and coefficients of variation. With the retained variables, the correlation analysis was carried out; conducting the calculation of the correlation matrix with the respective degrees of association.

Based on the correlation matrix, the analysis of principal components (APC) was carried out, determining in each the value, variance percentage, and accumulated variance. Using the licensed software IBM SPSS Statics (IBM, Armonk, NY), the grouping of the farms was graphed based on the second and third most significant components.

In each of the primary vectors or synthetic variables that retained 72.2% of the accumulated variance of the data, the significant variables were selected, which were used for the cluster analysis (CA). In order to determine the Euclidian distance, the grouping or algorithmic Ward method was

TABLE 1. Differentiating criteria of the selected and evaluated variables.

System components	Criteria	Variables
Natural capital	Biodiversity	Farm area. Area sown with citrus. Production system. PAS configuration. Productivity, Production preference. Phytosanitation. Limitations. Vegetative material.
	Water resource	Availability. Source. Irrigation system type.
	Soil	Cover, Diagnostics. Weed control. Fertilizer type.
	Climate	Climatic variations. Adjustments to the productive system. Prognosis.
		Availability of Climatic information. Relationship with pathogens.
		Use of bio-indicators.
Human capital	Work force	Availability. Training. Health services. Health status.
		Level of agrochemical protection. Consideration of the effect of pesticides. Experience. Type of records. Recording keeping.
		Relationship with the land ownership. Relationship with the administration of the lot. Protection. Education. Principal activity. Land ownership.
Social capital	Organization	Associations. Technical assistance. Type of technical assistance. Offering of the technical assistance. Perspectives. Delivery of Administrative Services. Infrastructure level.
Physical capital	Infrastructure	House area.
Economic capital	Resources	Saving capacity. Available credit. Profitability. Destination of the production. Revenue Source. Level of the potential revenue of the activity.

used, which produces the maximization of the homogeneity between the compact groups of a similar size, calculating the distance as a measurement of similarity (a lesser distance indicating high similarity). For the standardization of the variables, the "zeta" normal table was used. Thereby, the quantity of the production system groups that represented the problematic existence was defined. The results were graphed in a dendrogram. Finally, the description of the six groups or recommendation domains that were obtained was carried out, followed by verification.

Results

Table 2 presents the coefficients of variation, standard deviation, and means of the evaluated variables.

It was observed that the variables were effectively contributing to the differentiation of the productive units, some with more intensity than others. The variables with a high coefficient of variation were: farm area (282.87%); cultivated citrus area (211.93%); record keeping (177.73%), productivity (108.75%); total revenue (102.82%), level of protection in the control of pathogens (77.822%), record type (65.397%); and offering of technical assistance (64.005%).

Although the review indicated that it would be necessary to discard the variables with a coefficient of variance under 40%, the decision was made to continue the multivariate analysis with all the variable (independent of their discriminatory power), the reasoning was that a significant number of original variable had been previously isolated and it was desirable to rely on a high quantity of information, in accordance with Bermúdez (2008) who reported that the utilized variables must have characteristics such as sensitivity for the detection of differences, ability to integrate system components and ease of measurement and interpretation.

Correlation matrix of variables (CMV)

The analysis of the correlation matrix of the retained variables indicated a correlation (highly explicative) between the farm area sown with citrus and the PAS, which demonstrated that a productive unit that has a reserve area potentialized the connectivity between the lower and upper ecosystems and between these and the landscape. An identical relationship was seen between the productivity and the records, demonstrating that the administrative organization is associated with the exploitation of the resources; the same occurred between the profitability and productivity variables.

TABLE 2. Means, standard deviation, and coefficients of variation of the evaluated variables of the citrus production systems of Meta.

Variable	Mean	SD	CV	Minimum	Maximum
Citrus area	12.653	26.815	211.93	1.0000	120.00
Principal activity	0.8235	0.4339	52.683	0.0000	2.0000
House area	106.90	64.075	59.938	0.0000	350.00
Farm area	20.692	58.532	282.87	1.0000	365.00
Weed control	1.7255	0.8962	51.938	1.0000	3.0000
Organic matter availability	2.8039	0.5664	20.200	1.0000	3.0000
Principal agroecological structure	2.2353	1.0879	48.669	1.0000	4.0000
Crop age	9.5490	5.7422	60.134	3.0000	30.000
Education level	1.1765	0.4777	40.608	1.0000	3.0000
Experience	2.6667	0.6831	25.617	1.0000	3.0000
Use of agrochemicals	2.0588	0.5801	28.174	1.0000	4.0000
Farm	26.000	14.866	57.177	1.0000	51.000
Water source	1.7059	0.5018	29.414	1.0000	3.0000
Infrastructure	2.6275	1.0190	38.784	1.0000	4.0000
Total revenue	3.944^{E+07}	4.055^{E+07}	102.82	1.313^{E+06}	2.466^{E+08}
Prospective	2.5882	1.0035	38.772	1.0000	4.0000
Number of lots	2.0196	0.9485	46.963	1.0000	5.0000
Productivity	8.1761	8.8916	108.75	0.2000	46.970
Fumigation protection	1.0980	0.8545	77.822	0.0000	3.0000
Technical assistance	2.0588	1.3178	64.005	1.0000	4.0000
Bookkeeping records	1.5098	0.9874	65.397	1.0000	4.0000
Profitability	2.6667	0.8869	33.260	1.0000	4.0000
Phytosanitation	2.2941	0.8554	37.288	1.0000	4.0000
Land ownership	2.8431	0.4636	16.305	1.0000	3.0000
Record type	0.3725	0.6621	177.73	0.0000	2.0000
Type of technical assistance	1.1961	0.5299	44.302	1.0000	3.0000

SE, standard error; CV, coefficient of variation.

There was no significant relationship between the cultivated citrus area and the availability of manual labor, which was explained by the fact that agroindustrial lots are worked by families. The same tendency was seen in the municipalities where oil exploration and production are carried out. Likewise, there was no relationship between the sanitation level of the crops and the type of technical assistance, worrisome due to the fact that technology transference is offered at 82.5% by the commercial organizations, supply warehouses, and intermediaries, which affect the activities of suppliers and purchasing of the production.

Principal component analysis (PCA)

The results indicated that the eight primary principal components (compound or synthetic variables) explained 77.2% of the variance accumulated in the data. These were retained for the later analysis of conglomerates (AC). The results are presented in Tab. 3, also known as the contingency table.

TABLE 3. Accumulated variances of the synthetic variables of the multivariate analysis of the citrus production of the department of Meta.

Vectors	Eigenvalues	Variance percentage	Cumulative variance percentage
1	7.08165	28.3	28.3
2	2.67543	10.7	39.0
3	2.23684	8.9	48.0
4	1.96151	7.8	55.8
5	1.73770	7.0	62.8
6	1.44001	5.8	68.5
7	1.15847	4.6	73.2
8	1.01753	4.1	77.2

In each vector (CP), the variables (factors) with higher representativeness within the same were selected (variables with high weight/component), selecting 16 variables, which are indicated in Tab. 4.

TABLE 4. Extracted variables/citrus characterization vector of the department of Meta.

Vector	Variables
1	Cultivated citrus area, farm area, productivity
2	House area, level of education
3	Principal activity, agricultural experience, technical assistance supply
4	Land ownership type
5	Water source, type of technical assistance
6	Type of weed control, fumigation protection
7	Principal agroecological structure, fertilizer type
8	Availability of manual labor

Analysis of conglomerates (AC)

From the principal components analysis, the more significant variables were selected. Afterwards, a multivariate cluster analysis of the hierarchical nature was carried out, comparative, with which the data maximizing the homogeneity between the groups of the productive units were classified, at the same time the heterogeneity was maximized.

Of the variables, 50% came from compound indices of a capital nature, 31.5% of a human nature, 12.5% of a social-capital nature, and 6.25% of a physical-capital nature. The groupings in the economical capital index were not significant in the typification process.

With the relationship with the technical assistance, only 41.75% of the farmers stated that they had received some type of technical assistance, which coincides with the low level of protection in the applications for phytosanitary control (54.73%). The phytosanitation problems gain influence every day. The principal phytosanitation limitations were pests 56.31% (white mites) and black spot. The use of chemical controls is indiscriminate; the environmental repercussions have not yet been evaluated and, therefore, must be determined in subsequent studies. On the other hand, the education level was low, with 83.12% of those interviewed with an incomplete primary education.

Dendrogram

In order to determine the association or similarity measurement, the concept of Euclidian distance was used, based on the Ward method, according to which, at a shorter distance between the productive units, there was higher similarity and, therefore, they came from the same group. For the differences (greater distance), this analysis clearly indentified six groups or recommendation domains, each one with particular characteristics, which are described below (Fig. 1).

Description of the groups

The description of the conforming groups was carried out through the calculation of the descriptive statistics of the original variables/group. The particular characteristics of the production systems were indicated, along with the principal differences between the groups. The selected variables indicated the characteristics that differentiated the production systems (variability between the groups). The grouping was validated with field observations and the results were fitted to the actual conditions of the citrus systems in the different production zones. The formed groups had the following characteristics:

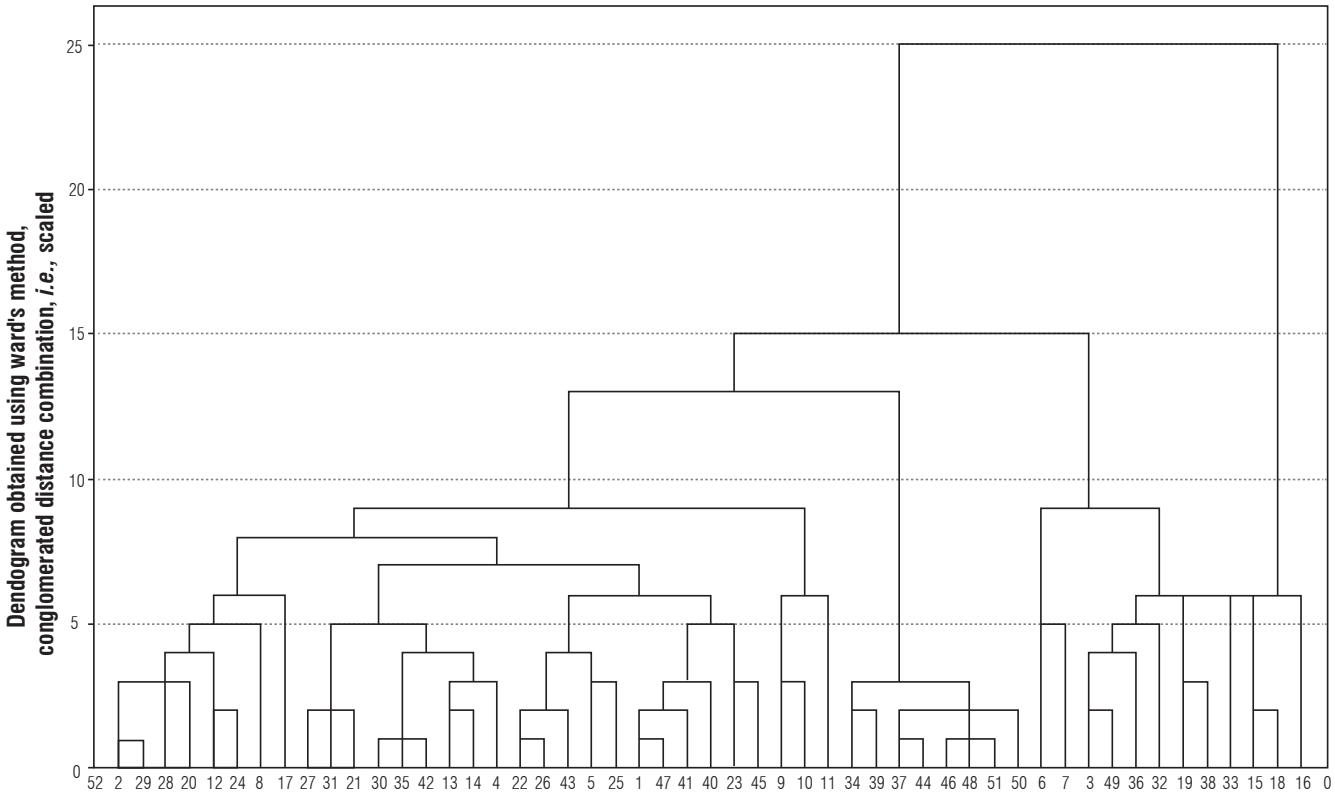

FIGURE 1. Conformation of the groups or recommendation domains in citrus production systems in the department of Meta.

Group 1

Contained 8 farms: 2, 8, 12, 17, 20, 24, 28 and 29. Corresponded to 15.68% of the farms, 90% were found in the municipality of Lejanías. Lots with an average area of 6.33 ha, characterized by a low or nonexistent principal agroecological structure, due to the fact that the lots use monocultivation, with intense cultivation; preference for the tangelo crop (*Citrus reticulata* × *Citrus paradisi*) and sweet orange (*Citrus sinensis*), deficient phytosanitation management level, very low education level (incomplete primary), absence of associations, no technical assistance, receive indications from the sellers of supplies, low productivity and revenue, availability of manual labor is exclusively familiar.

Group 2

Contained 9 farms: 4, 13, 14, 21, 27, 30, 31, 35 and 42. Corresponded to 17.64 % of the productive units, located in the municipality of Lejanías (95%). Lots with an average area of 2.3 ha. Average availability of infrastructure, medium and upper education levels (bachelors, technical), technical assistance has never been received; the level of protection in the chemical control practices is zero, without administrative organization, the principal agroecological structure is low, a high level of articulation between the agroecosystems (upper and lower) was observed and was reflected in a regular phytosanitary evaluation of the crops, considered to be affected by the climatic variations that have occurred in recent years.

Group 3

Contained 11 farms: 1, 5, 22, 23, 25, 26, 40, 41, 43, 45, and 47. Corresponded to 21.56% of the lots, 100% located in the municipality of Lejanías, with an average area of 9.6 ha. The infrastructure is high, tangelo, 'Arrayana' mandarin (*Citrus reticulata*) and sweet orange are cultivated, use of dwarfing patterns, 60% are articulated with some type of association and receive or have received technical assistance from an agricultural expert; despite the above, the use of protection in the application of agrochemicals is low, vast experience in the management of the crop, proprietors with direct administration of their lots, the principal agroecological structure is nonexistent in 40% of the lots and low in 60% of the lots, 50% have the ability to save and 40% have credit available, never have received climatic information, relationship between high temperatures and the occurrence of pathogens, principally mites.

Group 4

Contained 3 farms: 9, 10 and 11. Corresponded to 5.88% of the farms, 100% located in the municipality of Puerto López-Villavicencio; agroindustrial farms, with an average

area of 117.33 ha, one solid logistical, administrative, technical, financial infrastructure with significant articulation with specialized markets, processed climatological information and incorporated in the phytosanitary management, gallery forests, high principal agroecological structure, without phytosanitary limitations, investment in their own nurseries, which guarantee an adequate quality in the propagation material, presented the highest productivity and profitability, administration handled by Agronomic Engineers who report to the investors, quality assurance processes being developed.

Group 5

Contained 8 farms: 34, 37, 39, 44, 46, 48, 50 and 51. Corresponded to 15.68% of the lots, located in Granada and Lejanías, mostly young crops (5 years), average area 4.25 ha. The renewal is fundamentally with tangelo (*Citrus reticulata* × *Citrus paradisi*) with dwarfing patterns, 'Flying Dragons' and sweet orange (*Citrus sinensis*), the available infrastructure level is low. The level of education is low (incomplete primary), the experience is intermediate (between 5-10 years), no type of technical assistance has been received, the level of protection in the application of agrochemicals is low, likewise for the productivity (the crops are reaching physiological maturity), no organizational articulation, no saving capacity, no credit, climatological information has not been received.

Group 6

Contained 12 productive units: 3, 6, 7, 15, 16, 18, 19, 32, 33, 36, 38 and 49. Corresponded to 23.52% of the cultivation, located in Guamal and Lejanías, with an average area of 6.79 ha. The average cultivation age is 16 years, the technical assistance is provided by commercial organizations, there are associations for other crops (legumes and cacao), there is a medium principal agroecological structure, climatological information has been received by television. The farmers of Guamal are changing activities, deciding to focus more on touristic work; in this municipality, there are a lot of oil extraction activities, the cultivation is mostly sweet oranges, lime and mandarins.

Discussion

The present study is the second one to be carried out in Colombia for the typification of citrus production; the first one was done by Pulido *et al.* (2009), both recognize the importance of surveys for obtaining quality information.

In accordance with the results of Escobar and Berdegué (1990) and García and Calle (1998), who indicated that typification is the establishment and construction of possible types of producers (grouped) based on their characteristics, this study complied with said expectations; in accordance with the studies Mora *et al.* (2011), verifying that the grouping of the variables in the study of "Livelihood Indices" was a suitable methodology for clearly differentiating six types of producers. In this process, the systematic focus was definitive, as established by Mantilla *et al.* (2000) because, as indicated by Pulido *et al.* (2009); García and Calle (1998); and Ríos *et al.* (2004), the conceptual organization of the diversity that exists in the lots is facilitated, defining the interactions of the variables, and, finally, proposing (according to the priorities) future management alternatives (Escobar and Berdegué, 1990).

Similarly, as indicated by Moreno (2011), it was possible to confirm that this methodology was also useful for evaluating the performance of the producers within their environments, identifying strengths, possibilities, and limitations.

Among the latter, it was possible to determine the absence of technical assistance as the greatest failure, among other circumstances that manifested in the field with a disproportionate use of chemical supplies. In the postharvest, the situation was equally limiting, 61.7% of the producers did not use any type of transformation; therefore, the generation of the aggregated value was also zero. The commercialization process was done by intermediaries who also handle the assistance process. Only one producer possessed his own commercialization channel. 63.11% of the production volume is commercialized in Bogota, 29.13% is distributed in the region and 7.77% is sold locally. Exports are zero. Commercial articulation is nonexistent, 47.57% of the citrus producers do not have the capacity to save, 48.57% do not fulfill the requirements of banks to have credit. The level of commercial organization is incipient; only 7.8% of the productive units have some type of organizational and functional scheme that is common to any agribusiness; if this situation was broader, without a doubt, the situation of the producers would improve significantly with the standardization of the production and commercialization parameters. It is important to note that 75% of the highly technological producers are located in the municipality of Puerto López-Villavicencio, characterized by having links with specialized markets, maintaining systematic records, interpreting and processing climatological information, external consultants, and higher productivity.

In the studies of Orduz and Avella (2008), it was found that the principal weakness of citrus cultivation was a dependence on just one variety/crop species; this situation has

not been changed in the last five years and was confirmed in the present study, finding that the species with the larger cultivation areas were sweet orange (45.69%), tangelo (22.43%) and 'Arrayana' mandarin (14.59).

It was found that the most used pattern independent of the species was 'Cleopatra' (82.5%) and, in accordance with Orduz (2012) it is not suitable due to its high behavior which reduces the number of trees/ha, impedes the entrance of production, presents an erratic behavior and affects the quality of the fruits.

On the other hand, Mateus *et al.* (2010) indicated that the cultivated area of tangelo (*Citrus reticulata* × *Citrus paradisi*) has doubled in just 2 years, this tendency was verified principally in the municipality of Lejanías, where a growth in interest for the cultivation of this species with a flying dragon dwarfing pattern was confirmed, the waiting list for nurseries is very long.

It is important to note that the first typification study in the citrus sector was carried out by Pulido *et al*. (2009) in the department of Casanare, finding that the average cultivation area was only 5 ha; mostly, the farmers have increased livestock and limited the cultivated area.

This study confirmed that, in the department of Meta, the producers prefer agricultural activities, 77.67% demonstrated a long history with their lots, with a dedication of more than 10 years, 89.32% are proprietors, 90.19% directly administer their lot, the soil quality is better and a marked presence of vendors is seen, who guarantee the purchase of the harvests.

Conclusions

The methodology proposed by the International Network of Production System Research Methodology, Red Internacional de Metodología de Investigación de Sistemas de Producción (RIMISP), based on the multivariate analysis technique, proved to be a useful tool in the classification and typification process for production units, in this case citrus production, which allowed for grouping the producers by their characteristics of homogeneity and, at the same time, discriminate differences between the six defined groups. This, without a doubt, will contribute to the efficient and strategic planning for the citrus sector of the department of Meta, although further similar studies are recommended for other citrus producing areas of the country.

As a function of their productivity and area, 24% of the farms are entrepreneurial in nature, characterized by high productivity, suitable phytosanitation conditions, analysis of climatological information, high principal agroecological structure, use of ecosystems (gallery forests) that encourage biodiversity, and high connectivity between upper and lower agroecosystems and those of the landscape (functional biodiversity). These productive units in their totality are located in the municipality of Puerto López.

On the other hand, 76% of the farms practice rural economics, have a principally agricultural activity and use this for their subsistence. The organizational level requires a better institutional accompaniment.

The climatic variations that have occurred in the last five years have significantly affected producers in terms of obtained quality and volume.

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