POPULAR AND SOLIDARITY ECONOMY ENTERPRISES: COST OPTIMIZATION THROUGH LINEAR PROGRAMMING

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Abstract
Purpose: The main objective was to design a linear programming model for cost optimization of popular and solidarity economy entrepreneurships, in addition to propose the job order costing as an effective tool for determining the cost production.
Methodology: The research method was of a logical deductive type, using a mixed approach, with a correlational level. A linear programming model was designed to minimize the production cost. A job order was designed, that includes the components of cost production and operating expenses and was applied to 20 enterprises determining the price in terms of job order costing.
Findings
Spearman's correlation test shows a coefficient equivalent to 0.484, reflecting an average positive correlation between job costing and cost optimization. The application of the linear programming model contributed to the minimization of cost production, while the designed production order allowed to determine the distribution of the cost in each venture, constituting a guide for the calculation of the production cost of future ventures.
Originality/value
This research contributes significantly to entrepreneurs and small businesses, providing a model for cost optimization. The designed production order allows setting the price with an adequate profit margin, registering direct material costs, direct labor and general costs; which are transferred to the model oriented to the minimization of the cost of production.
Keywords: cost of production, job order, enterprise, optimization, linear programming, minimized.
JEL classification: D24, M13, M41.

1.   INTRODUCTION

The Constitution of theRepublic of Ecuador, since 2008, defines the economic system as social and solidary; recognizes the human being as subject and end; tends to a dynamic and balanced relationship between society, State and market, in harmony with nature; with the objective of guaranteeing the production and reproduction of the material and immaterial conditions that enable good living.(Constitution, 2008)

Based on Art.1. From the law of Popular and Solidarity Economy, EPS ventures are born, there are more than 8,400 organizations registered in the Superintendence of Popular and Solidarity Economy (SEPS) in 2018. (MALE, 2018) For the purposes of this research, 20 enterprises from the province of Chimborazo-Ecuador, an eminently agricultural province with a variety of crops such as cereals, legumes and tubers, were considered. The cost of production in the EPS enterprises of the province is calculated without using systems for determining the cost. The main objective is to provide guidance for the calculation of the cost of production through the analysis of the costs and expenses involved in the process, proposing the system of costs by production orders as a tool for the determination of the total cost. The research method used is logical deductive, mixed approach, descriptive research level, (GAD Chimborazo, 2022)being non-experimental-transversal. The results obtained determine that labor is the element least considered by entrepreneurs in the production process while the Spearman correlation coefficient = 0.484 reflects an average positive correlation between the research variables.

2.   THEORETICAL FRAMEWORK

Organic Law of Popular and Solidarity Economy (LOEPS)

For the purposes of the LOEPS, popular and solidarity economy is understood as the form of economic organization, where its members, individually or collectively, organize and develop processes of production, exchange, marketing, financing and consumption of goods and services, to satisfy needs and generate income, based on relations of solidarity, cooperation and reciprocity, privileging work and the human being as the subject and purpose of their activity. oriented to good living, in harmony with nature, over appropriation, profit and capital accumulation. The purpose of this law is(LOEPS, 2011)

 to achieve the following aspects(LOEPS, 2011) :

a) rrecognize, promote and strengthen the Popular and Solidarity Economy in its exercise and relationship with the other sectors of the economy and in the State;

b) topromote the practices of the popular economy developed in communes, communities, peoples, nationalities, and in their productive economic units to achieve Sumak Kawsay (Good Living);

c) andestablish a common legal framework for natural and legal persons that make up the Popular and Solidarity Economy;

d) Torestore the rights, obligations and benefits of persons and organizations subject to this Law.(Vega, 2017)

The initialprinciplesof the EPS organizations and the popular and solidarity financial sector (SFPS) are as follows (SEPS, 2022):

• Thesearch for good living and the common good.

• Thepriority of labour over capital and of collective interests over individual interests.

• Fair trade and ethical and responsible consumption.

• Gender equality.

• Therespect for cultural identity.

• Lto self-management.

• Social and environmental responsibility, solidarity, accountability.

• Equitable and solidary distribution of surpluses.

Ecuador has considered the popular and solidarity economy (EPS) as one of the best techniques to meet the economic needs of society, establishing it as an alternative economic model in the country. This has allowed the creation of enterprises, creating economy and generating new sources of work for the inhabitants.(Boza, Campoverde, & Ávila, 2021)

Sole proprietorships, family and domestic ventures

They are persons or groups of persons who carry out economic activities of production, commercialization of goods or provision of services on a small scale carried out by self-employed workers or small family nuclei, organized as de facto companies in order to satisfy needs, from the generation of income and exchange of goods and services (Valenzuela, 2012). Forthis, they generate work and employment among their members.(LOEPS, 2011)

In accordance with the above, for the application of the cost system by production orders, the 20 EPS enterprises in the province of Chimborazo-Ecuador have been grouped according to the activity they carry out, in order to perform an analysis of the cost of production in similar ventures (Table 1).

Table 1. EPS ventures in the Province of Chimborazo.

No.	EPS VENTURES	ACTIVITY
1	Yoly Arts (scale characters).	
2	ARNEV tinsmith (handmade key chains).	CRAFTS
3	Marthita Treasures (handmade jewelry).	
4	Ancestral Food (granola, nuts).	FOODS

5	Association of agro-industrial producers "El Nevadito".	
6	AROMA AND TRADITION (coffee substitute)	
7	La Reina Miel (propolis, honey carmelos).	
8	Sicalpa organic production farm.	
9	Fish Puma Miranda.	
10	Agricultural production "Agro PeGuarita".	
11	Agricultural production: potato.	AGRICULTURAL PRODUCTS
12	Agricultural production: carrot.	
13	Agricultural production "Doña Susana".	
14	LABI (ASOPROIL Biosupplies Laboratory).	
15	Footwear "Paso Fino".	
16	Garcés cloth hats.	FACTORY
17	Handmade garments "ARTEKA".	
18	Sewing workshop "Agujitas".	
19	Antiseptic products "ALCA QUIM".	SEVERAL
20	Alternative therapies "NATUVITAL".	

Source: own elaboration based on . (Hail & Rodriguez, 2022)

* Information provided by the Ministryof Economic and Social Inclusion.

For the application of the system of costs by production orders it is necessary to introduce some concepts:

Cost of production

They are the costs that are generated in the process of transforming raw materials into finished products. Another definition mentions that production costs are those that intervene in the manufacture of a product, are generated within the productive or manufacturing area and are known as cost elements that are: the Direct Raw Material (MPD), Direct Labor (MOD) and Indirect Production Costs (CIP).(Garcia J., 2008)(López & Gómez, 2018)

Elements of the cost of production

The cost of production is made up of the direct raw material, direct labor and indirect costs involved in the production process as shown in Figure 1.
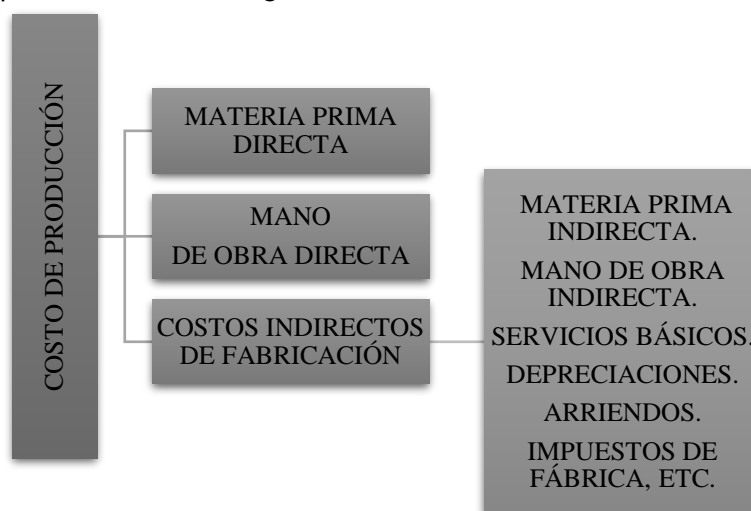

Figure 1. Elements of the cost of production

Source: own elaboration based on . (Chiliquinga & Vallejos, 2017)

Direct raw material

It constitutes the main element in the production process. They are all the materials that can be identified quantitatively within the product and whose amount is considerable.(Rojas, 2007)

Indirect raw material

They are all those that are not direct materials, even if they are involved in the manufacture of a product. Examples are the glue used to glue furniture and the rivets used to assemble a car. Indirect materials are considered part of indirect manufacturing costs.(Lasso, 2013)

Direct labor

Direct labour is the wages of workers for as long as they are involved in the work of processing or modifying raw materials or direct materials used in the manufacture of products and identifiable with an individually determined production batch or production order or with a specific production process.(Ramírez, García , & Pantoja, 2010)

- Indirect Work Hand (MOI)

They are the wages, benefits and obligations to which all workers and employees of the factory give rise, whose activity cannot be fully identified or quantified with the finished products. (Eras, Burgos, & Lalangui, 2015)

Indirect manufacturing costs

Indirect manufacturing costs (CIF) include all production costs that are not categorized as direct materials, nor as direct labor. Among them we can mention the following:(Rojas, 2007)

•Indirect labour

•Indirect material

•Heating, light and energy for the plant

•Lease of the factory building

• Depreciation of the buildings where the plant stands

•Machinery and equipment

•Fuel

•Utilities of the production plant

•Maintenance

•Cleaning of the production plant

•Production plant surveillance service

Operational expenses

They are those expenses involved in the production process, being mainly those presented in figure 2.

GASTOS ADMINISTRATIVOS	GASTOS FINANCIEROS	GASTOS DE VENTA
•Sueldos del personal administrativo. •Gastos en útiles de oficina, papelería. •Suministros de limpieza, útiles de aseo.	•Intereses por préstamos en entidades financieras. •Comisiones por emisiones de cheques. •Comisiones por transferencias bancarias, etc.	•Gastos de publicidad. •Sueldos, comisiones a vendedores. • Gastos de distribución y comercialización, etc.

Figure 2. Operational expenses

Source: own elaboration based on (López & Gómez, 2018).

Total cost

It is obtained by adding the cost of production plus operating expenses (Figure 3).

Figure 3. Shaping the total cost

Source: own elaboration based on .(Garcia J., 2008)

Prime cost: According to the sum of the direct elements involved in the preparation of the articles(Garcia J., 2008):

Direct raw material + direct labor = Prime cost

Cost of transformation or conversion: It is the sum of the elements involved in the transformation of direct raw materials into finished products. (Garcia J., 2008)

Direct labor + Manufacturing indirect costs = Conversion cost

Cost systems

As mentioned, two main systems are known, clearly defined: the system of costs by batches or production orders and the system of costs by processes, from which the other existing costing systems are derived, whose design and implementation depends among other factors on the characteristics of production, business organization and / or functional, of the processes to be executed, of the time established for the costing of the products and of the procedures defined for the accumulation, allocation and integration of these costs to the final products. Figure 6 shows the main characteristics of cost systems.(Ramírez, García , & Pantoja, 2010)
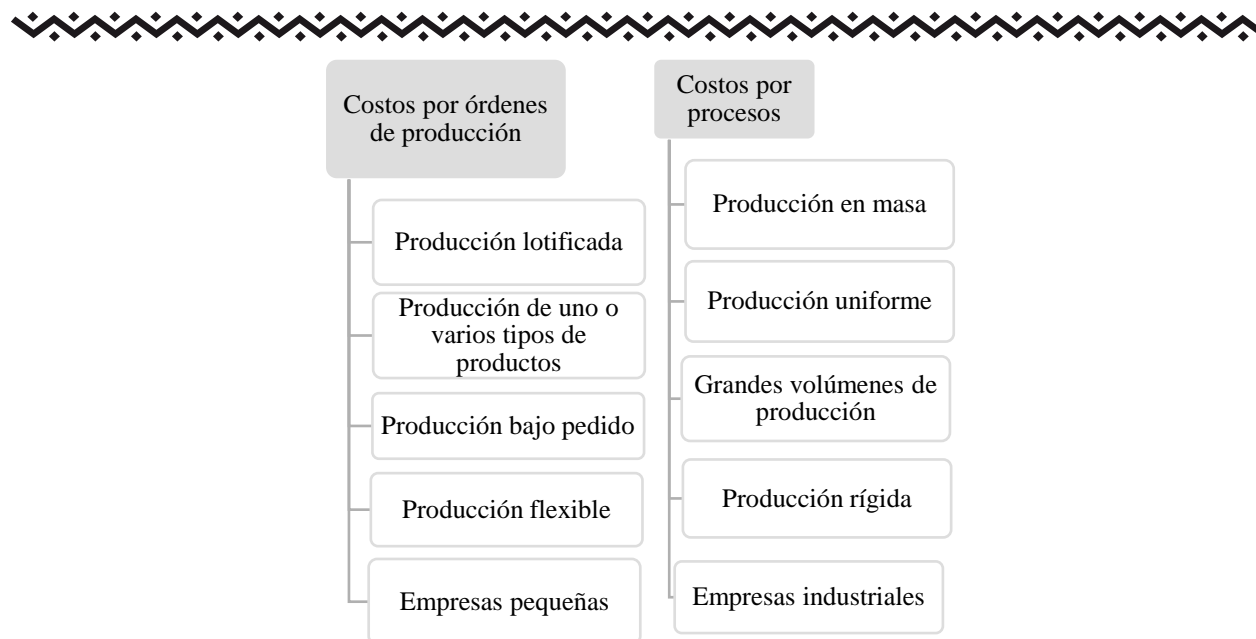
Costos por órdenes de producción	Costos por procesos
Producción lotificada	Producción en masa
Producción de uno o varios tipos de productos	Producción uniforme
Producción bajo pedido	Grandes volúmenes de producción
Producción flexible	Producción rígida
Empresas pequeñas	Empresas industriales

Figure 4. Characteristics of cost systems

Source: own elaboration based on .(Ramírez, García , & Pantoja, 2010)

In the case of EPS ventures, the system of costs by production orders is the most convenient for determining the cost, considering that these are small enterprises whose production is of the lotified type.

Cost system for production orders

It is a system in which processing companies accumulate the costs incurred or used in the period; with the purpose of determining the total and unit cost of production, in addition to having the necessary information with the preparation of the work or production order, for each order or work accepted; for the recording of operations related to the manufacture of articles.(López & Gómez, 2018)

Characteristics of the cost system by production orders

In the system of costs by production orders the following characteristics are distinguished:(Ramírez, García , & Pantoja, 2010)

• Production costs are caused, accrued and allocated per batch.
• Each batch can be completely different from the others.
• The records and controls of the resources consumed and the costs caused in the elaboration of each batch, are kept in the document known as "production order".
• The unit cost is calculated for the set of products that make up each batch.
• The unit cost is known from the moment the elaboration of the respective lot is concluded.

Productiondesign

The production order is a document that allows to calculate the cost of production of a batch of products of similar characteristics, by adding the costs and expenses involved in the production process. Figure 5 shows the format designed to determine the cost of production of EPS enterprises in the province of Chimborazo. Because there are different products and services, work order costing systems accumulate costs separately for each product or service. (Horngren, Srikant, &; Rajan, 2012)

PRODUCTION ORDER N°_____	
ENTERPRISE:_____	
CUSTOMER:	PRODUCT:
PRODUCTION START DATE:	SPECS:
FEECHA END PRODUCTION:	UNITS PRODUCED:
PRODUCTION COST	

DIRECT RAW MATERIAL (MPD)				
QUANTITY	UNIT OF MEASUREMENT	DESCRIPTION	UNIT COST	TOTAL COST
DIRECT RAW MATERIAL COST				$ -
DIRECT LABOR (MOD)				
CHARGE	HOURS EMPLOYED	UNIFIED BASIC SALARY	COST PER HOUR	TOTAL COST
DIRECT LABOR COST				$ -
INDIRECT MANUFACTURING COSTS (CIF)				
QUANTITY	UNIT OF MEASUREMENT	DESCRIPTION	UNIT COST	TOTAL COST
INDIRECT MANUFACTURING COSTS				$ -
COST OF PRODUCTION (MPD+MOD+CIF)				$ -
OPERATIONAL EXPENSES				
ADMINISTRATIVE EXPENDITURE (GA)				
QUANTITY	UNIT OF MEASUREMENT	DESCRIPTION	UNIT COST	TOTAL COST
TOTAL ADMINISTRATIVE EXPENDITURE				$ -
FINANCIAL EXPENSES (GF)				
QUANTITY	UNIT OF MEASUREMENT	DESCRIPTION	UNIT COST	TOTAL COST
TOTAL FINANCIAL EXPENSES				$ -
SELLING EXPENSES (GV)				
QUANTITY	UNIT OF MEASUREMENT	DESCRIPTION	UNIT COST	COST
TOTAL SELLING EXPENSES				$ -
TOTAL OPERATING EXPENSES (GA + GF + GV)				$ -
UNIT COST OF PRODUCTION				
DIRECT RAW MATERIAL COST				$ -

DIRECT LABOR COST	$ -
INDIRECT MANUFACTURING COSTS	$ -
OPERATIONAL EXPENSES	$ -
TOTAL COST (PRODUCTION COST + OPERATING EXPENSES)	$ -
UNITS PRODUCED	
UNIT COST OF PRODUCTION (TOTAL COST / UNITS PRODUCED)	$ -

Figure 5. Production order
Source: own elaboration based on .(Jimenez, 2010)

3.   METHODOLOGY

The research method used is logical deductive, deduction being a process that begins with general ideas and moves on to particular cases. As mentioned (Baena, 2017)(Hernández, Fernández, & Baptista, 2014) by medinate, the mixed approach and the use of quantitative and qualitative methods complemented the analysis developed. According to quantitative research, it consists of contrasting hypotheses from the probabilistic point of view and, if they are accepted and demonstrated in different circumstances, from them to elaborate general theories. (Guerrero, 2015) In this particular case, the quantitative analysis of all the elements that are part of the cost of production in the EPS ventures allowed to know the distribution of the cost of each enterprise according to the activity to which they are dedicated, on the other hand, a likert scale survey was applied to collect information on the two study variables. The results obtained were tabulated in the statistical software SPSS in order to determine the association between the independent variable: determination of the cost by production orders and the dependent variable: optimization of the cost-profitability of the EPS ventures. (Perez, 2021)

The qualitative analysis was developed through a descriptive situational diagnosis, which is based on the social action of the researcher who, when immersed in the scenario, is obliged to sustain a set of interactions with the actors involved, in their situational context. Direct observation of the production process of each of the EPS ventures, open interviews with entrepreneurs to collect information on the (Yuni &; Urbano, 2006)cost of all elements involved in production, review of accounting documents, direct observation, discussion groups, evaluation of learning experiences and direct interaction with the community , were some of the techniques used.

3.1.   Level of research

The descriptive-correlational level was used, since it is intended to determine the association between the independent variable: determination of the cost by production orders, and the dependent variable: optimization of the cost of production and profitability in EPS ventures.

3.2.   Research Design

The design is non-experimental-transversal, which describes the relationship between two or more categories, concepts or variables at a given time, either in correlational terms, or depending on the cause-effect relationship.(Hernández Sampieri, 2018)

3.3.   Research hypothesis

For the development of the research raises the null hypothesis (H_0) and alternative hypothesis (H_1), constituting these hypotheses in tentative explanations of the phenomenon investigated or presumed statements of the relationship between two or more variables.(Ezpinoza Freire, 2018)

H_0: the determination of the cost by production orders is not related to the optimization of the cost and profitability of the EPS ventures.

H_1: the determination of the cost by production orders is related to the optimization of the cost and profitability of EPS ventures.

Dependent variable: determination of cost by production orders
Dependent variable: optimization of the cost and profitability of EPS ventures
As mentioned, hypotheses must be susceptible to verification through the use of procedures, methods, and techniques that are affordable, since this must be clearly demonstrated or refuted at the end of the investigation. (Garcia J., 2016) By means of the Chi quadradro statistical test, which allows to evaluate hypotheses about the relationship between two categorical variables, it was possible to determine the association between the dependent and independent variables to later measure the intensity of the association through the Spearman correlation coefficient, which varies from +1.0 to - 1.0 and is interpreted as a sample correlation coefficient, in that the positive value close to 1.0 indicates a strong relationship between the ranges: if one range grows the other grows. Correlations by ranges close to -1.0 indicate a strong but negative relationship between the ranges: when one range grows the other decreases.(Hernández Sampieri, 2018)(Anderson , Sweeney, & Williams, 2008)

3.4.   Formulation of the optimization model
Linear programming models aim to optimize (minimize or maximize) a linear function, called objective function, whose variables are subject to constraints expressed by a system of equations or inequalities, which lead to decision-making about their impacts in any case study. In this research, the objective was to minimize production costs, considering variables such as direct raw material (MP D), direct labor (MOD), indirect manufacturing costs (CIF) and the units to be produced. Consequently, the following linear programming model was developed:

Objective function:

$$Min\ (Z) = \sum_{i=1}^{n} C_i MPD_i + \sum_{i=1}^{m} h_i\ MOD_i + \sum_{i=1}^{p} D_i\ CIF_i$$

Where:
Z = cost of production
C_i = quantity of direct raw material i
h_i = number of hours devoted to activity i of the production order
D_i = quantity of the indirect manufacturing cost type i
MPD_i = direct raw material cost $_i$
MOD_i = direct labour cost of activity i
CIF_i = type of indirect manufacturing cost i
N = units to be produced in production order j
x_j = raw material stock for production order j
TP_J = Time in hours for production order j
Restrictions:
For the amount of raw material used in production:

$$\sum_{i=1}^{n} C_i MPD_i \leq\ x_j$$

For the number of hours spent on production:

$$\sum_{i=1}^{m} h_i \leq tp_j$$

 Non-explicit restrictions**:**
$$MPD,\ MOD,\ CIF,\ are\ non\text{-}negative$$

4.   RESULTS
4.1.   Distribution of the cost of production of handicraft enterprises
Figure 6 shows the distribution of the cost of production of enterprises in the area of handicrafts, in which the raw material represents between 37% and56% of the total cost, followed by the cost of

labor which in turn is between 37% and 46%. The CIF represent between 1% and 26%, being mainly among these, the costs of packaging and distribution.
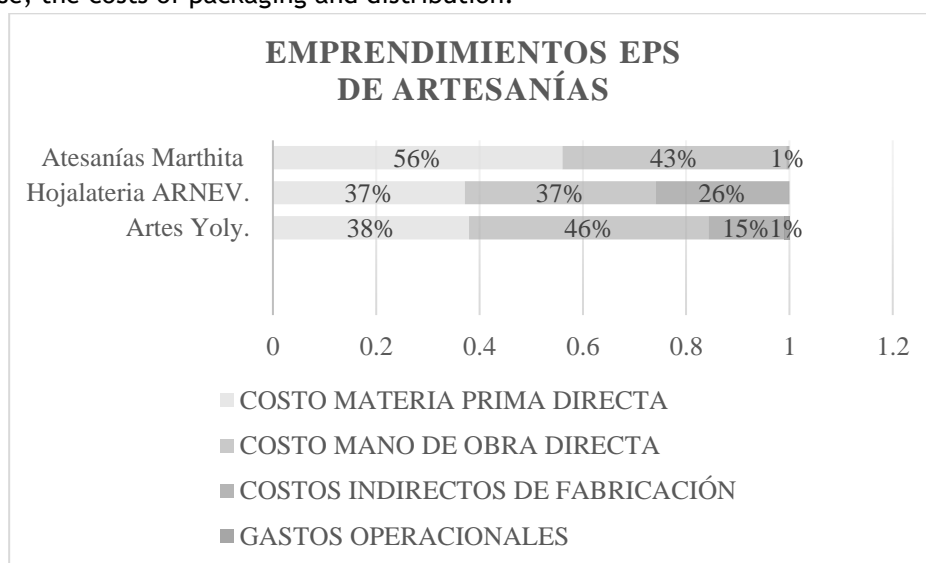
EMPRENDIMIENTOS EPS DE ARTESANÍAS

Atesanías Marthita	56% 43% 1%
Hojalateria ARNEV.	37% 37% 26%
Artes Yoly.	38% 46% 15% 1%

- COSTO MATERIA PRIMA DIRECTA
- COSTO MANO DE OBRA DIRECTA
- COSTOS INDIRECTOS DE FABRICACIÓN
- GASTOS OPERACIONALES

Figure 6. Distribution of the production cost of handicraft enterprises.
Source: authors.

4.2.   Distribution of the cost of production of food enterprises

In most ventures of this classification, the raw material is the most representative element, covering up to 96% of the total cost of production, unlike the venture "La Reina Miel" in which the raw material represents 5%, as they are products made from honey produced by bees. The cost of labor varies depending on whether or not it is considered by entrepreneurs, the highest cost being 62% corresponding to the "Piscícola Puma Miranda"; unlike the cost equivalent to 0% of the "Sicalpa Organic Production Farm" which does not consider labor among its costs, because the owner contributes with this element. As for the CIF, all the enterprises in the area consider this element, covering between 3% and 31% of the total cost of production, being the CIF costs related to the indirect raw material, transportation of the raw material, payment of rent, payment of basic services, packaging and labels of the products. Regarding operating expenses, only the ventures "El Nevadito" and "La Reina Miel" incur selling expenses, these being 10% and 13% respectively (Figure 7).
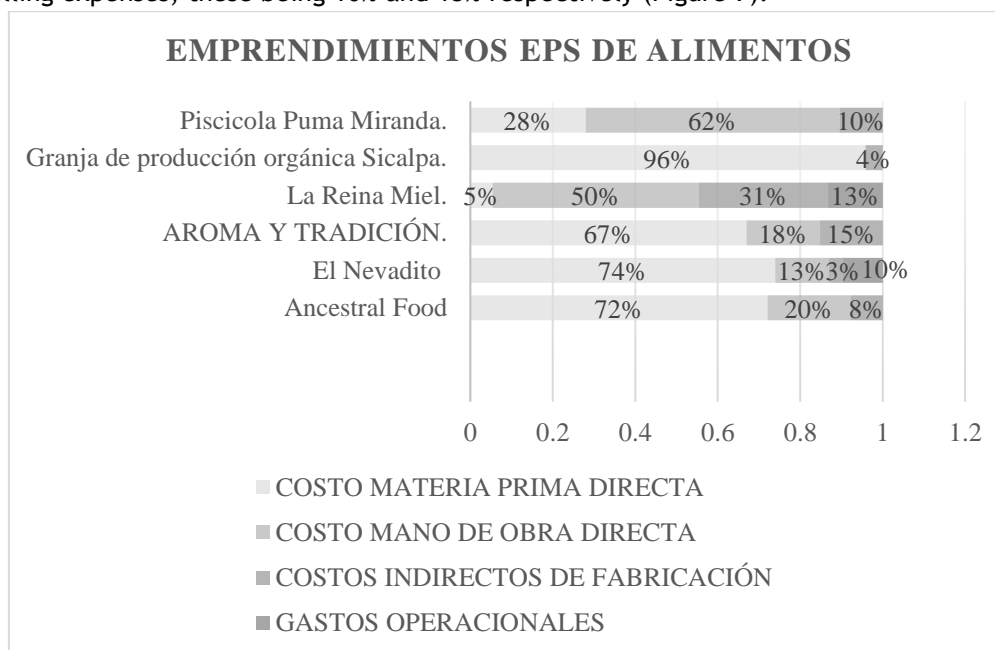
EMPRENDIMIENTOS EPS DE ALIMENTOS

Piscicola Puma Miranda.	28% 62% 10%
Granja de producción orgánica Sicalpa.	96% 4%
La Reina Miel.	5% 50% 31% 13%
AROMA Y TRADICIÓN.	67% 18% 15%
El Nevadito	74% 13% 3% 10%
Ancestral Food	72% 20% 8%

- COSTO MATERIA PRIMA DIRECTA
- COSTO MANO DE OBRA DIRECTA
- COSTOS INDIRECTOS DE FABRICACIÓN
- GASTOS OPERACIONALES

Figure 7. Distribution of the cost of production of food enterprises.
Source: authors.

4.3.   Distribution of the cost of production of agricultural commodity ventures

The cost of raw materials in the "Agro PeGuarita" enterprise represents 83% of the total cost of production, citing the purchase of seeds for agricultural production. In the venture "Agricultural production: potato" the cost of raw material corresponds to 25% of the total cost; in "LABI" (ASOPROIL Bioinput Laboratory) at 22%, in the ventures "Agricultural production: carrot" and "Agricultural production "Doña Susana" corresponds to 18% of the cost of production (see figure 8). With regard to labor, there are entrepreneurs who do not consider this cost because they are the ones who contribute with this element. With regard to the venture "Agricultural production "Doña Susana" the cost of labor represents 66%, in the ventures "LABI" (Laboratory of bioinputs ASOPROIL)" and "Agricultural production: potato" labor represents 54% of the total cost of production, in the "Agricultural production: carrot" labor corresponds to 37%, while in the "Agro PeGuarita" enterprise, labor represents only 7% of the total cost of production. The frequent CIFs in this classification correspond to the payment of irrigation water, purchase of raffia sacks for product packaging, purchase of fertilizers and indirect materials in the case of the bioinput laboratory. In this way, the CIF of "Agricultural production: carrot" amount to 45%, in the "Agricultural production "Doña Susana" correspond to 17% and in "LABI" (Laboratory of bioinputs ASOPROIL) the indirect costs represent 15% of the cost of production, in the ventures "Agricultural production: potato" and "Agro PeGuarita" the indirect costs of manufacturing correspond to 10% and 8% respectively. As for operational expenses, "LABI" (ASOPROIL Bioinputs Laboratory) incurs administrative expenses such as: payment of rent and basic services of its establishment, equivalent to 9% of its total cost of production, the other ventures incur sales expenses such as transportation for the commercialization of the products, which in the venture "Agricultural Production" amount to 10% and in "Agro PeGuarita" represent only 2% of the total cost of production.
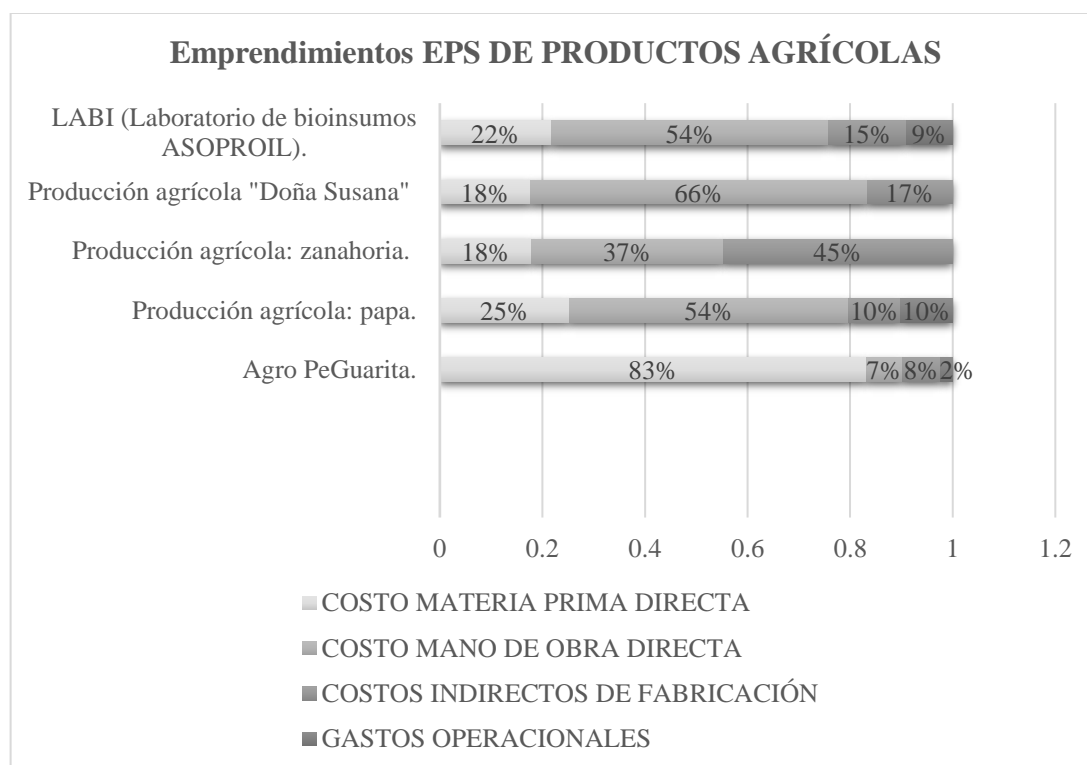

Figure 8. Distribution of the cost of production of agricultural product ventures.
Source: authors.

4.4.   Distribution of the cost of production of manufacturing ventures

With regard to the cost of raw materials, it is evident that the footwear venture "Paso Fino" corresponds to 73% of the total cost of production, in the "Sombreros Garcés" venture it represents 65%, in "Agujitas" the cost of raw material reaches 40%, and in the "ARTEKA" entrepreneurship the

raw material corresponds to 27% of the total cost of production (see figure 9). The cost of labor is relatively low, because most entrepreneurs contribute with this element without hiring any personnel, finding the cost of labor distributed as follows: "ARTEKA" 28%, "Sombreros Garcés" 21%, footwear "Paso Fino" 15%, "Agujitas" 5%.

The most common indirect costs in the production process of the enterprises of the manufacturing area correspond to the payment of basic services, packaging and labels of the products and indirect materials used in the production, in this way in the enterprise "Agujitas" the CIF represent 43% of the total cost, in "ARTEKA" they represent 30%, in footwear "Paso Fino" the indirect costs correspond to 10% and in the venture "Sombreros Garcés" they represent 4% of the total cost. All enterprises in the manufacturing area consider operating expenses in their production process, being distributed as follows: "ARTEKA" 15%, "Agujitas" 11%, "Sombreros Garcés" 10%, footwear "Paso Fino" 2%.
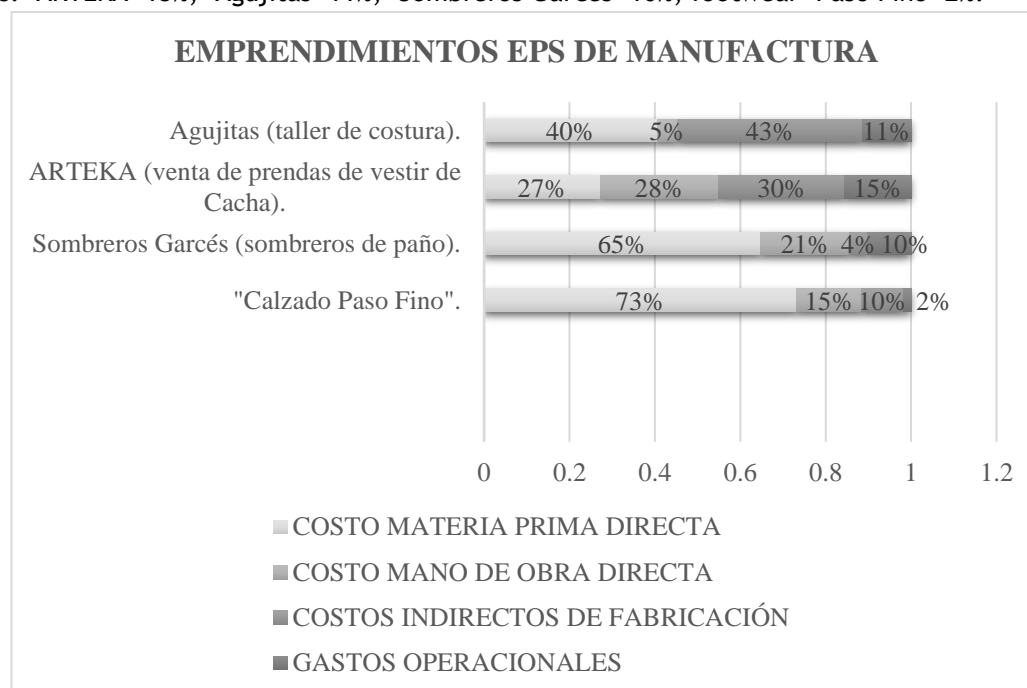

Figure 9. Distribution of the cost of production of manufacturing ventures.

Source: authors.

4.5.   Distribution of the cost of production of various ventures

The enterprises within this classification correspond to two different activities, the enterprise "ALCA QUIM" dedicated to the production of floor disinfectants, with a raw material cost corresponds to 19% of the total cost and the "NATUVITAL" enterprise dedicated to bridging relaxing massage services with a raw material cost equivalent to 40% of the total cost of production, considering in the latter as raw material several essences and oils with natural aromas used to provide the service (Figure 10). The cost of direct labor in the "ALCA QUIM" enterprise corresponds to 67% of the total cost, this being the most representative cost in its production process. As for "NATUVITAL" labor represents 18% of the total cost of production, because only the cost of labor of the person providing the service during the duration of the service is considered.

The CIFs correspond to costs related to the indirect raw material, in the case of "FTAA QUIM" to the containers, labels, flavorings and colorants for the product, representing this cost 14% of the total cost. As for the indirect costs of "NATUVITAL", they correspond to 6% of its total cost of production, being within these the payment of rent and the payment of basic services. Only the enterprise "NATUVITAL" incurs operating expenses, precisely selling expenses corresponding to the payment of advertising on the Internet, representing this amount 35% of the total cost of production.
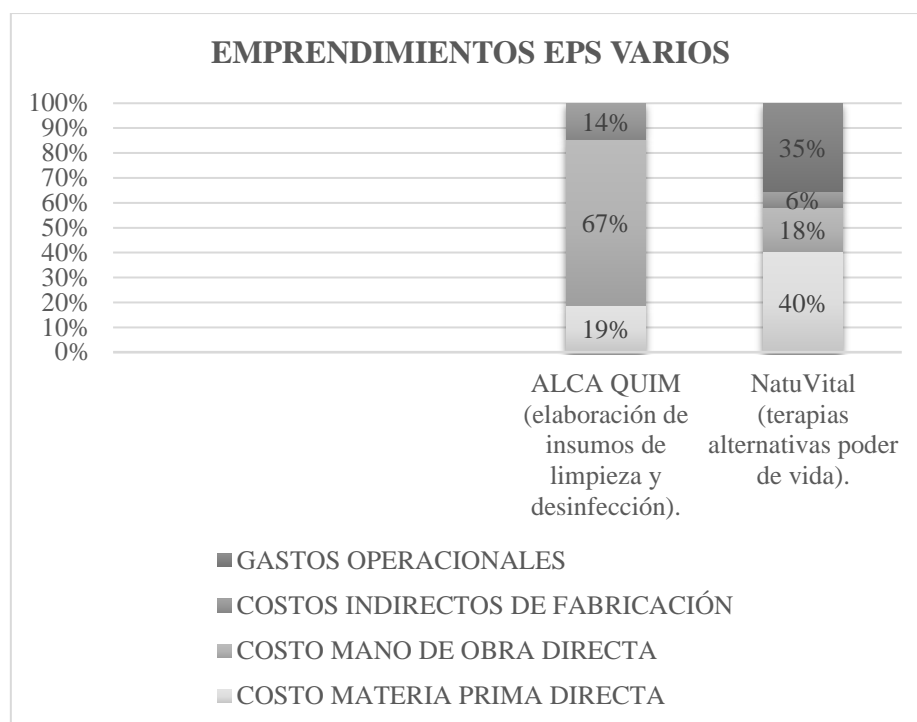
Figure 10. Distribution of the cost of production of various ventures.

Source: authors.

4.6.   Hypothesis testing

The hypothesis test was developed using the SPSS statistical software, making use of the Chi square test to determine the association between the study variables. A significance level of 0.05 was considered, which implies that the researcher has 95% confidence to generalize without making mistakes and only 5% against. In terms of probability, 0.95 and 0.05, respectively; Both add up to unity. This level is the most common in social sciences.(Hernández, Fernández, & Baptista, 2014)

The results of the applied statistic (Figure 11) show a significance value equal to 0.061 > 0.05 that according to the hypothesis contrast decision rule indicates the rejection of the alternative hypothesis and the acceptance of the null hypothesis, however, given the 66.7% of the expected count in the contingency table (Figure 12) the chi-square test is inconsistent so the significance value of the likelihood ratio and being equal to 0.041 < 0.05 the alternative hypothesis H_1 is accepted, concluding that the determination of the cost by production orders is related to the optimization of the cost and profitability of the EPS ventures.

Chi-square test			
	Value	Gl	Asymptotic significance (bilateral)
Pearson's chi-square	5,604[a]	2	,061
Likelihood ratio	6,409	2	,041
Linear by linear association	4,894	1	,027
Number of valid cases	20		
A. 4 cells (66.7%) have expected a count less than 5. The minimum expected count is .70.			

Figure 11. Chi-square test results.

Source: SPSS statistical software

Figure 12 shows the categorical data in terms of frequency and the relationship between the independent and dependent variable.

Cross table Cost system by production orders* Optimization of the cost of production and profitability of EPS ventures.

			Optimization of the cost of production and profitability of EPS ventures		
			I AGREE	TOTALLY AGREE	Total
Cost system for production orders	NEUTRAL	Recount	2	0	2
		Expected count	,7	1,3	2,0
		% within Optimization-profitability ventures EPS	28,6%	0,0%	10,0%
	I AGREE	Recount	4	6	10
		Expected count	3,5	6,5	10,0
		% within Optimization-profitability ventures EPS	57,1%	46,2%	50,0%
	TOTALLY AGREE	Recount	1	7	8
		Expected count	2,8	5,2	8,0
		% within Optimization-profitability ventures EPS	14,3%	53,8%	40,0%
Total		Recount	7	13	20
		Expected count	7,0	13,0	20,0
		% within Optimization-profitability ventures EPS	100,0%	100,0%	100,0%

Figure 12. Contingency table.

Source: SPSS statistical software

To know the level of association between the research variables, the Spearman correlation test was performed, in the results a correlation coefficient = 0.484 was obtained, which determines an average positive correlation. Being Spearman's Rho statistic correlation test and hypothesis test at the same time, the significance value = 0.031 (Hernández, Fernández, & Baptista, 2014)< 0.05, ratifies the acceptance of the alternative hypothesis H_1: the determination of the cost per production orders is related to the optimization of the cost and profitability of EPS ventures (Figure 13).

		Correlations		
			Cost system for production orders	Optimization of the cost of production and profitability of EPS ventures
Rho de Spearman	Cost system for production orders	Correlation coefficient	1,000	,484[*]
		Sig. (bilateral)	.	,031
		N	20	20

Optimization of the cost of production and profitability of EPS ventures	Correlation coefficient	,484*	1,000
	Sig. (bilateral)	,031	.
	N	20	20

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

Figure 13. Results of Spearman's Rho correlation test.
Source: SPSS statistical software

5.   CONCLUSIONS

In the present research, 20 EPS enterprises from the province of Chimborazo-Ecuador were considered, grouped for study purposes in four areas: food, agricultural products, manufacturing and several. Through the results obtained, it was determined that entrepreneurs do not use systems for determining costing, which results in pricing based on competition and low profit margins.

In order to optimize the cost of production and generate profitability, the production order was designed, a document that allowed calculating the cost of production of each batch of products, knowing the distribution of the cost, determining the unit cost of production and facilitating the setting of the price with a profit margin of 40%, established by the entrepreneur.

The statistical tests of Chi square and Spearman's Rho correlation coefficient affirmed the alternative research hypothesis, concluding that the determination of the cost by production orders is related to the optimization of the cost and profitability of EPS ventures. The results of this research validate the usefulness of the application of established cost systems, taking as a guide the system of costs by production orders and the use of the production order model proposed in this document, which aims to contribute to the optimization of the cost of production of EPS ventures, gererar a more profitable business, and constitute a guide for the entrepreneur.

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