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# KNOWLEDGE MANAGEMENT AND ORGANIZATIONAL INNOVATION BASED ON THE GOVERNMENT-COMPANY-ACADEMY-PRODUCERS ALLIANCE TO REACTIVATE THE ROBUSTA COFFEE CHAIN, IN ECUADOR

Duicela-Guambi, Luis Alberto MSc[1],
Martínez-Soto, Moisés Enrique PhD[2],
Loor-Solórzano, Rey Gastón PhD[3],
Rodríguez-Monroy, Carlos PhD[4],
Morris-Diaz, Anne PhD[2]

[1]Escuela Superior Politécnica Agropecuaria de Manabí, Ecuador, Correo: lduicela@gmail.com
[2]Universidad de Zulia, Venezuela, Correo: moisesenriquemartinezsoto@fa.luz.edu.ve
[3]Instituto Nacional de Investigaciones Agropecuarias, Ecuador, Correo: rey.loor@iniap.gob.ec
[4]Universidad Politécnica de Madrid, España, Correo: crmonroy@etsii.upm.es

## ABSTRACT

The progress of the country and the welfare of the people depends on productivity, as an indicator of efficiency in the use of natural resources, capital and human talent. Ecuador is going through a deep crisis in the production of coffee where demand is much greater than supply with 1,560,000 bags of deficit, mainly of robusta coffee. In this scenario, eleven universities have formed the University Network of Coffee Research and Development (REDUCAFÉ), the cooperation agreements of the universities with the National Association of Coffee Exporters (ANECAFÉ) and the company Solubles Instantáneos C.A., collaborative agreements between companies, producer organizations, universities and the National Institute of Agricultural Research (INIAP) are managed to build sustainable coffee production. The university proposes to implement a knowledge management and organizational innovation model based on the "Government + Company + Academy + Producers" (GEAP) alliance, with the objective of taking advantage of the present and future value of the knowledge assets of the coffee chain and increase efficiency in the production, transformation and commercialization of coffee, in order to improve the living conditions of coffee farmers and contribute to the economic growth of Ecuador.

**Keywords:** Strategic alliance, productivity, technological efficiency, innovation, private companies.

## I INTRODUCTION

In the world 104 species of the Coffea genus have been identified [1], being the species: Robusta (Coffea canephora Pierre ex Froehner) and Arabica (Coffea arabica L.) the most important for Ecuadorians, in the orders: economic, social and environmental, in addition to the benefits for human health. Economically, coffee is a source of foreign exchange and income for the actors of the productive chains located in 23 of the 24 provinces of the country. In the social sphere, the productive coffee chains integrate peoples and ethnic groups, men and women, into a broad social fabric with a multisector impact. In the environmental field, coffee is grown in diverse soils and climates, mainly in agroforestry systems, helping to conserve natural resources. As for coffee and health, it has been proven that its consumption shows an inverse correlation with the risk of diabetes, liver damage and neurodegenerative diseases [2] [3].

The low production of coffee in Ecuador is the central problem of the coffee sector, attributed to causes such as low productivity, reduction of cultivated area, the prevalence of old coffee plantations and lack of credit (Figure 1). According to Monteros (2016), in 2016, the yield averages were: 0.48 t ha-1 in robusta and 0.22 t ha-1 in Arabic [4]. The impacts of low production are expressed in weak competitiveness, reduced exports and increased imports of raw materials for the industry from Vietnam, Brazil, Cote d'Ivoire, and Indonesia [5].

The low productivity of Ecuadorian coffee has as its causes: use of cultivars of unknown genetic origin, deficient management of soil and water, high incidence of pests, limited technologies for production systems and reduced dissemination of available technologies. The absence of technological innovations is a constant in primary production, recognizing that there are significant advances in soluble coffee processing technology.

According to Ponce, the Ministry of Agriculture (MAG), since 2011, has been carrying out the project "Reactivation of Coffee Cultivation", which must be redirected to encourage the cultivation of coffee, taking advantage of existing potential in suitable areas with irrigation availability, in the medium term, meet the demand of the national industry, eliminate imports of robusta coffee and be in tune with the dynamics of the international market [5]. According to the certificates of origin of the OIC-MAG [6], in 2007, total exports were 992,190 bags of 60 kilos, 95,625 bags of robusta, while, in 2017, total exports fell to 695,144 bags with only 26,932 bags of robusta (Table 1). The import of raw material for the instant coffee industry, in 2013 reached 1'377.630 bags of 60 kilos, mostly robusta. If the installed capacity for the export of coffee beans is 800,000 bags and for the production of instant coffee is 1'200,000 bags with an internal consumption of 200,000 bags, it means that the demand is around 2,200,000 bags [6].

Key information to understand the importance of coffee is the entry of foreign exchange for exports (Figure 2), which generated in 2012 $ 198 million and in 2017 it was reduced to $ 101 million. Robusta coffee exports in grain, in 2012, generated foreign currency for $ 50.6 million and in 2017 only $ 3 million [6].

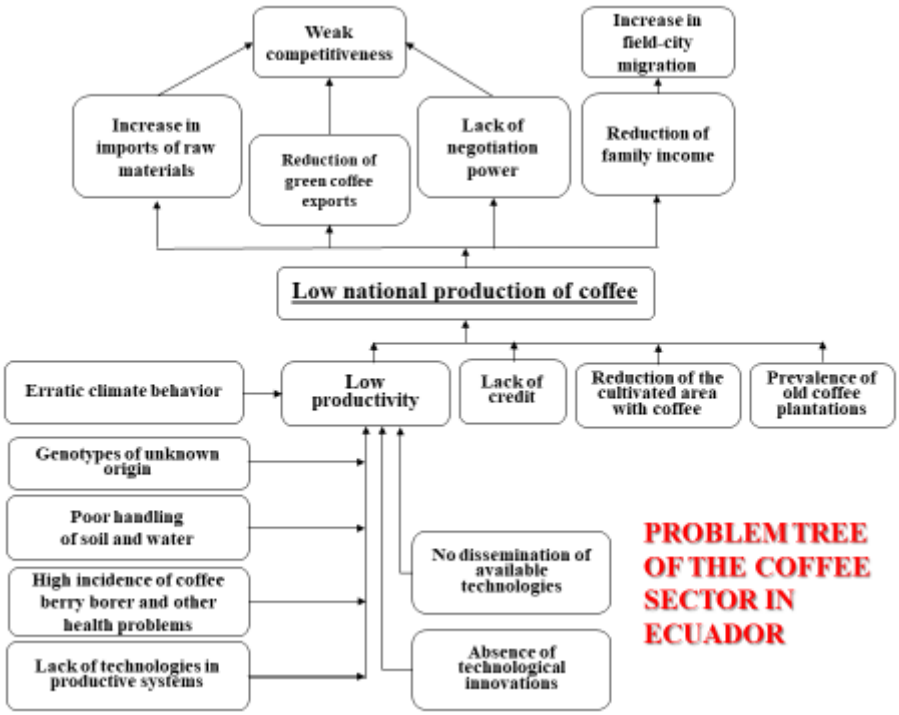


Figure 1. Problem tree of the coffee sector in Ecuador

**Coffee exports from Ecuador: 2007-2018**
(60 kg bags)

| Year | Arabica Coffee | Robusta Coffee | Industrialized coffee | Total bags (60 kg) |
|---|---|---|---|---|
| 2007 | 147.376 | 95.625 | 749.189 | 992.190 |
| 2008 | 59.575 | 65.895 | 748.609 | 874.079 |
| 2009 | 136.064 | 300.015 | 690.643 | 1.126.722 |
| 2010 | 184.398 | 210.903 | 806.048 | 1.201.350 |
| 2011 | 199.438 | 407.789 | 939.112 | 1.546.338 |
| 2012 | 114.181 | 359.312 | 1.097.452 | 1.570.944 |
| 2013 | 78.587 | 122.656 | 1.060.447 | 1.261.691 |
| 2014 | 63.592 | 87.468 | 980.579 | 1.131.638 |
| 2015 | 58.974 | 46.728 | 764.268 | 869.970 |
| 2016 | 64.122 | 20.247 | 836.804 | 921.174 |
| 2017 | 52.944 | 26.932 | 615.269 | 695.144 |
| 2018 | 18.047 | 55.186 | 409.466 | 482.700 |

**Source**: International Coffee Organization, Certificates

Table 1. Evolution of coffee exports: 2007- 2017 [6]

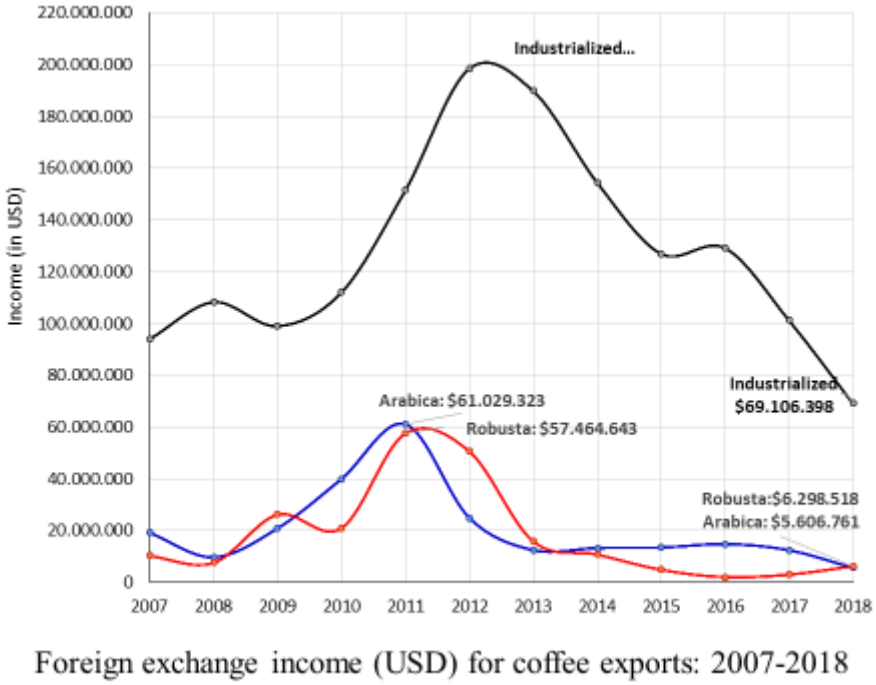


Figure 2. Foreign exchange income for coffee exports: 2007-2017 [6]

In this scenario, a knowledge management model is proposed, defined as an organizational strategy that, based on an innovative environment and the use of Information and Communication Technologies (ICT), can develop capacities to originate, store, transfer, apply and protect organizational knowledge, in order to increase the competitiveness and sustainability of organizations or companies [7]. Martínez-Soto [7] notes that in the 21st century, the competitiveness and sustainability of organizations is based on knowledge assets and their management (CG), which represents a strategy that contributes to improving the performance and performance of the supply chains of the agro-food industry in general and of coffee in particular.

Likewise, according to the Oslo Manual, in a review of UNED [8], innovation is understood as the conception and implementation of significant changes in a product or process, in marketing or in an organization with the purpose of improving the production results of goods or services. Innovative changes are made through the application of new knowledge. Innovation activities include all the scientific, technological, organizational, financial and commercial actions that lead to innovation.

In this sense, among the different types of innovation, there is organizational innovation which is defined as changes in the practices and procedures of companies, changes in the workplace, in external relations, as well as the application of decisions strategies with the purpose of improving results by improving productivity or reducing internal transaction costs for customers and suppliers.

The update in knowledge management also enters into this type of innovation, as does the introduction of management systems for production, supply and quality management operations. Likewise, innovations in the organization are considered to be variations in relations with customers and suppliers, including research centers and the integration of suppliers or subcontracting of activities. Such is the case of this dissertation which aims to prospectively analyze how knowledge management and organizational innovation can help reactivate the robusta coffee production chain, through the government-company-academy-producers' alliance, in Ecuador. The final purpose of this strategy is to contribute significantly to reducing the gap or deficit between supply and demand, generating a positive trade balance in the coffee production chain in Ecuador.

## II. DEVELOPMENT OF THE KNOWLEDGE AND INNOVATION MANAGEMENT MODEL

### 2.1. OBJECTIVE OF THE MODEL

The tree of objectives of the coffee sector (Figure 3) allows identifying as a central objective "increase national production" to replace imports of raw material for industry, increase exports of coffee beans, improve bargaining power, increase revenue economic activities and strengthen competitiveness. The objective of the proposed organizational management and innovation model is to contribute to greater technological efficiency in production and transformation, to improving the living conditions of coffee farmers and to the economic growth of the country.

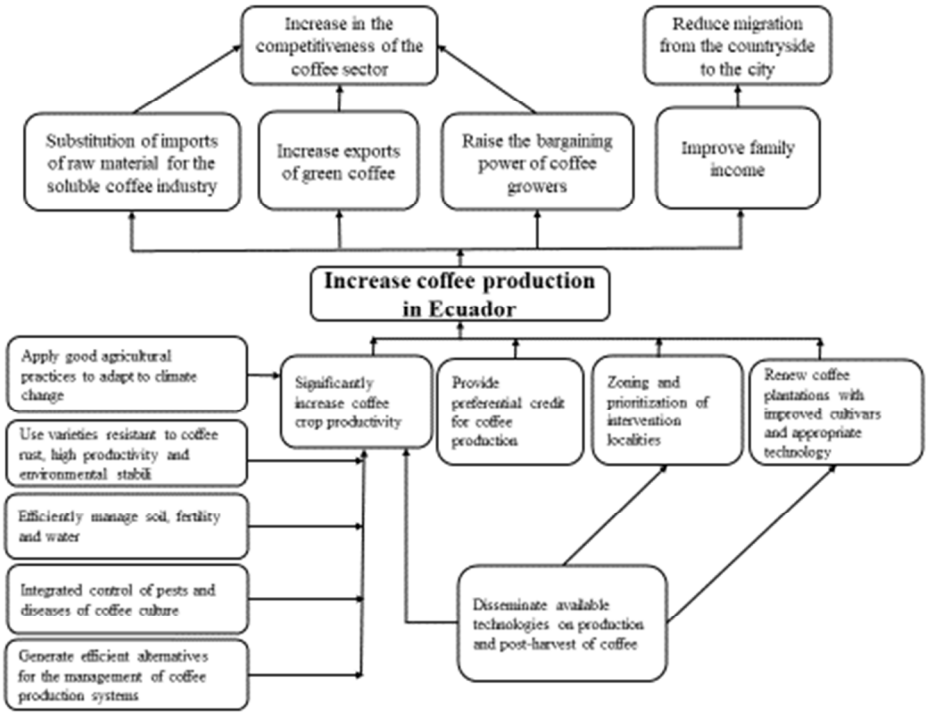


**Figure 3.** Objective tree of the coffee sector in Ecuador **Source:** Authors

## 2.2. ORIGIN AND GENETICS OF ROBUSTA COFFEE

Robusta coffee (C. canephora) was discovered in Africa, at the end of the 19th century, in Equatorial Guinea and the Congo. It was introduced to Southeast Asia in 1900, to Java in 1901 and then to other tropical areas of the world. The species C. canephora is classified into three groups: Congolensis (Originating in the Congo), Guinensis (Originating in Equatorial Guinea) and Kouilou (Conilón) [9]. In America, there is no Guinensis coffee.

In Ecuador, the robust variety was introduced in 1951 from Costa Rica (Tropical Agricultural Research and Higher Education Center-CATIE); Nestlé, in the 1990s, introduced robusta genotypes from different origins; later ELCAFÉ introduced robust from Vietnam, Indonesia, Uganda, and Brazil, including the Conilón [10].

In robusta coffee, a cross-pollinated species, the selection of "clone heads", cloning and use of clonal plants has been the recommended strategy to encourage cultivation. As an alternative strategy, the formation and use of F1 hybrids are recommended from the "selection of clones" [10].

## 2.3. ACTORS OF THE COFFEE CHAIN

The coffee growers have historically shown a weak socio-organizational level, being unionized in cooperatives, corporations, agricultural centers, communes and associations, only 10% [11]. The exporters are members of ANECAFÉ, an organization that organizes the "Golden Cup" contests, in Arabica and robusta [6].

In circumstances of production crisis, producers should be considered as the central axis of any intervention (Figure 4). Intermediaries, bean coffee exporters, roast and ground coffee processing companies and soluble coffee industries depend on the production contingencies, articulated to the institutions responsible for implementing them. All the actors are aligned to public policy, complying with control regulations, motivating opportunities to access markets.

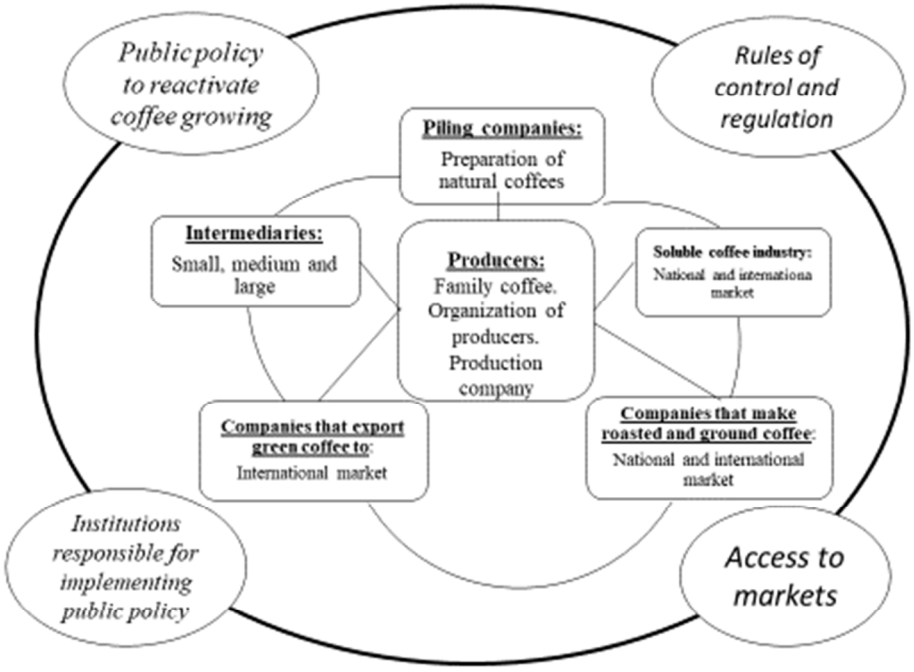


**Figure 4.** Relations between actors of the coffee production chain in Ecuador

## 2.4. KNOWLEDGE AND INNOVATION MANAGEMENT: GOVERNMENT-COMPANY-ACADEMY-PRODUCERS MODEL

Knowledge management is defined as a discipline that has the purpose of improving the performance of individuals and organizations; as well as maintain and take advantage of the present and future value of knowledge assets [12]. In coffee growing, knowledge is accumulated in the habits and experiences of the actors of the chain, at the individual and collective levels, where only a tiny part is systematized in scientific and technical publications. In this context, it is proposed to formulate and implement a knowledge management strategy to develop, acquire, store, transfer and apply knowledge; promote Research + Development + Innovation in the coffee chain; reduce time in R & D & I processes, improve technologies and reduce costs associated with the repetition of errors [13].

## VALUATION OF FAVORABLE IMPACTS OF THE MODEL

The effects and impacts of the application of the model must be evaluated in all the links of the chain, from the perspective of strengthening strengths, taking advantage of

opportunities, facing threats and overcoming weaknesses. This assessment can be carried out before and after the application of the model, with emphasis on coffee communities and companies.

The assessment of coffee production systems can be done through multicriteria analysis or sustainability index, weighing indicators and sub-indicators, measuring them with an ordinal scale of 1 to 10, in the dimensions: economic, socio-cultural and environmental [14] [15]. The assessment of sustainability indices of farms (IS) is done with the criterion "greater is better".

$$IS = \frac{1}{3} \sum (ie + isc + ia)$$

Where:

IS: Sustainability index of the coffee farm, valued on an ordinal scale of 1 to 10

ie: Economic sustainability index

isc: Socio-cultural sustainability index

ia: Environmental sustainability index [15].

**Decision rule**: For a coffee plantation (or several related farms) to be considered sustainable, IS ≥7.0 and no partial index is less than 7.0.

## III. EXPECTED RESULTS WITH THE APPLICATION OF THE MODEL

The proposed model aims to achieve favorable results in the improvement of the productivity of robusta coffee, in the deepening of the alliance of actors in the coffee chain and the development of a new model of knowledge management and organizational innovation.

### 3.1. IMPROVING THE PRODUCTIVITY OF ROBUSTA COFFEE

The economic well-being of the country depends on productivity, which is an indicator of efficiency in the use of natural resources, capital and human talent. In coffee production, the productivity or yield of the farm is valued in kilos ha-1, quintals ha-1 or tons ha-1. The productivity of coffee plantations depends on three factors: genetic, environment and management (Figure 5).

Genetic factor: cultivars

The genetic factor refers to cultivars, clones or hybrids, used to renew coffee plantations or new plantings. In Ecuador, AGROCALIDAD recommends using the clones: NP-2024, NP-3013, NP-3056, CON-ERB-01, COF-06 and COF-05 [16]. Instant Solubles C.A. has selected the clones CGS-2-P10, GCNU-1-P20, JMR-8-P15, JCL-6-P12, ACR-2-P17, CRT-2-P02 and CRT-20-P07 [17] [18] There are selections from Nestlé and

Robustasa [10], from the University of the Santa Elena Peninsula [19] and the Pichilingue Tropical Experimental Station [20]. INIAP reports new selections: COF-004-P15, NP-2024-P10, COF-003-P15 and NP-4024-P04 [21]. COFENAC and Dublinsa selected: CONERB 01-P17, COF 02-P15-17, COF 04-P18, CONETP 01-P11, COF 05-P02, NP 4024-P15, COF 06 P3-15-17 and COF 01-P2 -4 [10].

An alternative is the use of hybrids derived from clones, where prior to their formation it is required to know the genetic compatibility of the parents. Dublinsa through this procedure developed the hybrid ECUROBUSTA 01, cultivar adapted to the dry tropics of the Santa Elena Peninsula and Guayas [176].

**Environment: agro-ecological aptitude**

The coffee environment involves the biotic and abiotic components. In the biotic, the coffee plantation is a space of high biological diversity where there are abundant weeds, shrubs and trees, plague and beneficial insects, rodents, birds, earthworms, mollusks and microorganisms, among others. In the abiotic, climatic elements are involved (precipitation, heliophany, temperature, among others), agricultural land and altitude, longitude, latitude, and landscape.

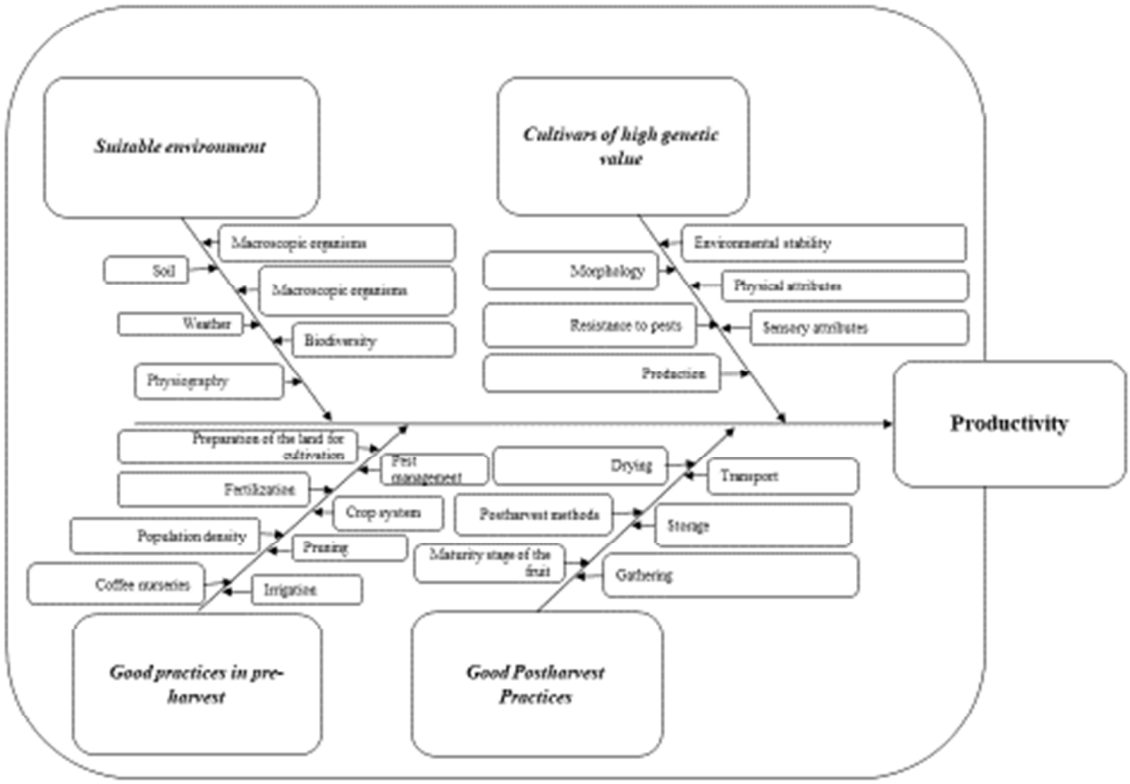


Figure 5. Cause-effect diagram of the elements and determinants of coffee plantation productivity

### 3.2. DEEPENING THE ALLIANCE OF ACTORS IN THE AGRICULTURAL CHAIN OF COFFEE

Organizational innovation takes into account changes within companies, institutions or groups of companies and institutions. It can occur through the development of new organizational practices, new forms of organization and how organizations adopt innovation or simply new organizational processes or new organizational structures that were previously not associated or did not exist [22]. Such is the case of the coffee production chain and the proposed model that integrates academia, companies, government sector entities and coffee producers.

**Academia: Public universities that make up the REDUCAFÉ**

In 2015, the University Network for Coffee Research and Development (REDUCAFÉ) was formed, to which the following eleven universities working in coffee research have been integrated: Southern State University of Manabí-UNESUM, State University of Bolívar-UEB, Technical University of Babahoyo-UTB, Technical University of Esmeraldas "Luis Vargas Torres" -UTELVT, Technical University of Cotopaxi-UTC, University of the Peninsula of Santa Elena-UPSE, Agricultural Polytechnic School of Manabí-ESPAM, Laica University "Eloy Alfaro de Manabí" -ULEAM, State University of Amazonas-UEA, State Technical University of Quevedo-UTEQ and Technical University of Manabí-UTM.

The REDUCAFÉ is covered by the Political Constitution: Article 350 .- "The higher education system aims at academic and professional education with a scientific and humanistic vision; scientific and technological research; innovation, promotion, development and dissemination of knowledge and cultures; the construction of solutions for the problems of the country, in relation to the objectives of the development regime "; as well as, in the Organic Law of Higher Education, Article 8 .- among the purposes of Higher Education, literal f) states: "Encourage and implement research programs of a scientific, technological and pedagogical nature that contribute to the improvement and protection of the environment and promote national sustainable development. "

According to Oberto, in Mexico, the university sector is oriented with an innovative proposal towards the promotion of a culture of management of innovation and technology among entrepreneurs, the systematic development of this field of knowledge, the training of specialists in the field and the implementation of appropriate management models for companies [23].

**Companies:** Associated in the ANECAFE or non-unionized

**National Association of Coffee Exporters (ANECAFÉ):** Private company

In May 1983, the ANECAFÉ was constituted, as a civil and private entity, with a social purpose, non-profit, that is apolitical and does not participate in religious matters. This guild groups exporters of instant coffee and coffee beans. In 2017, the coffee exporting companies were: ELCAFÉ CA, Benavides Termal José Luis, Kolnetsa SA,

Solubles Instantáneos CA, Belcet SA, Kave Café SA, FAPECAFÉS, QUEVEDOCACAO SA, Piladora SOL DE ORIENTE SA, Cando Crucerira Valeria Lorena, PROCAFÉ, CAFECOM SA, GRUPO SALINAS, PEORIA SA, GALLETTI SA, DUBLINSA SA, Hacienda La Papaya Halapa Cía. Ltda., Jiménez Lozano Roberto Vinicio and Paredes Navas Fabricio Xavier [6].

The companies that contribute in a particular way in research are SICA and Dublinsa S.A.

Solubles Instantáneos C.A.- Company founded in 1960, directed by Mr. Jorge Salcedo Benítez, that since its creation maintains a technology leadership in the soluble coffee market. It has cooperation agreements with the following universities: ESPAM, UTB, UEB, UTC, ULEAM, and UTELVT.

Dublinsa SA-Company dedicated to the production of robusta coffee, cocoa and other agricultural and forestry crops, chaired by Mr. Freddy Bustamante Morán, owner of the Robusta Coffee Research Center (Isidro Ayora canton, Guayas province) where the ECUROBUSTA hybrid was developed 01 [10].

**Entities of the governmental sector:** Government

Ministry of Agriculture and Livestock (MAG) - Governing body of the agro-productive policy. It promotes the "Minga agropecuaria" that includes nine axes of action: Access to markets, kits and supplies, provision of irrigation, scrap/mechanization, credit, insurance, technical assistance, associativity and legalization of land [24]. Since 2011, it has executed the "Reactivation of Coffee Cultivation" Project [25], which, according to Ponce and collaborators, must be reoriented to encourage the cultivation of robusta coffee [5].

Ministry of Industries and Productivity (MIPRO) - Governing body of industry development, in its policy points as key elements for industrial development: investment, productivity, quality, innovation, and markets [26].

**BANECUADOR** - Public entity that finances individual, family, associative, communal and small and medium enterprises-SME productive units [27].

**Corporación Financiera Nacional (CFN)** - Entity that grants credit for economic activities aligned to public policies, seeking to maximize the positive impacts in productive chains, employment, national component, exports, productivity, investment, innovation, entrepreneurship and market [28].

**National Institute of Agricultural Research (INIAP)** - Agency in charge of agricultural research in areas of interest such as coffee; Its purpose is: "To promote scientific research, generation, innovation, validation and dissemination of technologies in the agricultural sector, and forest production, within the scope of its competencies" (Article 1, INIAP's Constitutive Law-reformed in 2015). The Coffee and Cocoa Program of INIAP carries out coffee research projects in several localities of the country.

**Decentralized Autonomous Governments (GADs)** - Article 238 of the Constitution of the Republic of Ecuador establishes as GADs the parochial boards, cantonal councils, and provincial councils, which enjoy political, administrative and financial autonomy.

**Coffee producers:** They are the owners of the coffee farms that can be of the following types: family, community, associative or business. Robusta producers are distributed in 11 provinces of Ecuador: Esmeraldas, Santo Domingo, Los Rios, Cotopaxi, Bolívar, Guayas, Santa Elena, Orellana, Sucumbíos, Napo and Pastaza. Several people grow coffee: Kichwas, Shwaras, Secoyas, Montubios, Negros and Tsáchilas [10].

### 3.3. CONSTRUCTION OF A KNOWLEDGE MANAGEMENT AND ORGANIZATIONAL INNOVATION MODEL IN THE COFFEE SECTOR

To manage knowledge and technology at the company level, Nieto-Potes recommends the model called: "tripod of knowledge management and innovation: public sector + private company + academia", which can be enhanced as a unit that produces information and knowledge [ 29]. This model, in the situation of crisis of coffee production, the prevalence of small producers and the high number of coffee production units (CPU), is insufficient in relation to the needs raised. In this sense, an alternative model based on the alliance is proposed: Government + Company + Academy + Producers.

To face the lack of coordination, the lack of incentives, the confusing prioritization of actions and the fragmentation of resources, requires an efficient institutional framework that has the potential to become a positive force, capable of inducing innovation and training processes of talents [30]. The integrating concept must begin with the articulation of the parish governments, prioritizing the territories with the greatest agro-ecological aptitude and valuing the socio-economic aspects. Inclusive innovation processes will have relevance and social acceptance when the actors assume the responsibility of contributing to the search for solutions to the coffee problem and coffee growers innovate processes to overcome technical, productive and social adversities [31]. The insertion into the knowledge society, according to Aguilar and Ruiz, with whom it is fully agreed, begins with the search for the improvement of the living conditions of coffee growers, education, food, health and recreation [32].

The integration of the company Solubles Instantáneos C.A. as a strategic partner of several universities, the articulation of university-INIAP projects, the alliance of local governments and exporters, the golden cup contests, the SICA-producers' agreement to promote the cultivation of robusta coffee in the Santa Elena Peninsula, among other actions, they conform the expression of the first steps towards the implementation of the GEAP model.

Based on the cited references, realities that appear and reflections, in Figure 6, the GEAP Model is presented, as a graphic representation of the ideas developed in this prospective analysis, in the perspective of expanding the access of the coffee

production chain to the drafting, management and innovation of producers and other actors in the coffee chain, concordance with public policies, compliance with current regulations and the support of international cooperation, in scientific terms. Technological, financial and institutional.

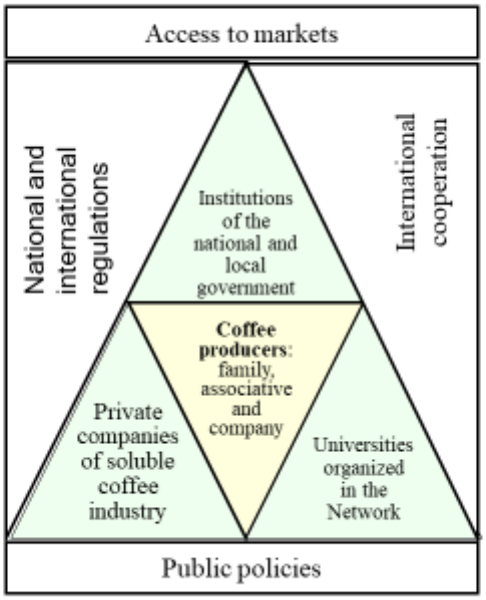


**Figure 6**. GEAP model for coffee technology knowledge and innovation management: Government + Private Company + Academy + Producers

In Ecuador, knowledge management and organizational innovation can contribute significantly to the reactivation of the coffee production chain, based on the government-company-academy-producers' alliance. The coffee growers must have a leading role and become the central axis of the production process, articulated to the collectors, craftsmen and industrialists who transform into ground and soluble coffee, merchants, exporters, coffee shops and other related actors in order to increase efficiency in the production, transformation and marketing of coffee, improve the living conditions of coffee farmers and contribute to the economic growth of Ecuador.

## IV. PERSPECTIVES: BY WAY OF CONCLUSIONS

The GEAP Model and its application in coffee growing, with emphasis on the robusta coffee production chain, has the following perspectives:

1. Knowledge management and organizational innovation will contribute significantly to the reactivation of the coffee production chain, based on the proactive "government-company-academy-producers" alliance in Ecuador, defined as a GEAP model.

2. The low national production, a determining factor of the reduced competitiveness of Ecuadorian coffee in the global market, constitutes the problem to be solved, creating a scenario where coffee growers have a leading role, in the central axis of the production process and transformation, articulated to the collectors, artisans and industrialists of ground and soluble coffee, merchants, exporters, coffee shops and other actors.

3. The articulation of the actors will have its full expression in the planning, execution, and evaluation of the programs and projects of research, development and innovation, adopting and cultivating varieties of high genetic value in suitable environments and the application of good pre-harvest practices. and post-harvest, as well as the management for access to markets, mainly to the differentiated ones.

4. The proposal will seek to take advantage of the present and future value of the knowledge assets of the coffee chain and contribute to a greater efficiency in the production, transformation and commercialization of robusta coffee, increase efficiency in the production, transformation and commercialization of coffee, improve the living conditions of coffee farmers and contribute to the economic growth of Ecuador.

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