

Applying *La Prospective* to Long-Term Planning of the Local Arrangement of Gems, Jewelry, Mineral Crafts and Tourism in the Municipality of Cristalina/Brazil

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The Cristalina 2040 Project aims to develop the prospective process for the sustainable development of the local Productive Cluster of Gems, Jewelry, Mineral Crafts, and Tourism in the Municipality of Cristalina, State of Goiás, Brazil. The prospective process allows for long-term planning and strategy formulation, adapting resources to face adversities and opportunities. Six steps, based on the developments of Berger (1958), Giget (1989), Godet (2001a, 2001b), De Jouvenel (2010), Aulicino (2006), and Aulicino & Fischmann (2020), were carried out: situational analysis, structural analysis, competency trees, morphological analysis, scenario building, and evaluation of the prospective process through results and impacts. The strategy implementation is ongoing and includes the following results: (i) Organization of the local mineral Productive Cluster Network (PCN); (ii) Enrich the mindset of interested parties with knowledge about the Prospective Process for Mineral-Based PCNs through a training-action process; (iii) Workshops for sharing ideas, future scenarios, and action creation; (iv) Appropriation by civil society of knowledge about the construction of scenarios that facilitate the achievement of the desired future scenario; (v) Involvement and support of public authorities; (vi) Documentation and reports for accountability purposes; (vii) Dissemination of the project through an E-book on the Prospective Process; (viii) 19.5% of actions (15 out of a total of 77 strategic actions proposed) in implementation; and (ix) Economic, social, and environmental impacts being annually evaluated (last consolidated results by December 2023).

Keywords: *Prospective process, long-term planning, appropriation, governance, Local Productive Arrangement, scenarios, building the future.*

Introduction

A partnership between the Association of Artisans of Cristalina de Goiás (AAC) and the Brazilian Institute of Information in Science and Technology (IBICT) resulted in the application of a prospective process for building future scenarios for the Local Productive Arrangement (APL) of Gems, Jewelry, Mineral Crafts, and

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Tourism of Cristalina, Goiás. This initiative represented an opportunity for the Ministry of Science, Technology, and Innovation (MCTI) to promote the consolidation of the APL based on mineral resources.

In 2018, a survey carried out with the APL of Gems, Jewelry, Mineral Crafts, and Tourism of Cristalina led to the interest of government agencies and sector entities in planning to strengthen the APL. Thus, the idea arose of developing a project to create effective and coherent intelligence for public action in the municipality.

The Territorial Prospective (aka, *La Prospective*) process was chosen to support long-term planning aimed at the sustainable development of the APL of Gems, Jewelry, Mineral Crafts and Tourism in Cristalina. The practice of this prospective process allows for long-term planning and the formulation of strategies to face changes in the context of the APL, as well as the adaptation in the face of possible adversities or opportunities that arise in the territory. The process allows for anticipating and guiding actions to face challenges and take advantage of opportunities over time.

This study describes the application of the Territorial Prospective process in the APL of Gems, Jewelry, Mineral Crafts and Tourism of Cristalina and includes the main results of its application in the APL until 2024.

Socioeconomic Indicators of Cristalina

The economy of the municipality of Cristalina was initially based on the exploitation of crystals, which were exported for a long time to several European countries and even used in jewelry for the European nobility. The arrival of rural producers from the south of the country in the 1970s changed the economic situation of the municipality. In addition to the exploration of crystals, the cultivation of different crops was added, thanks to the mild temperatures and the quality of the soil.

Cristalina benefits from more than 240 springs and rivers that allow farmers to irrigate the cultivation of different products. This ensures a uniform and constant distribution of water, which allows this activity to be carried out even in periods of drought. Table 1 presents geographic and economic data for Cristalina and its neighbors, considering that territorial planning must take into account the surrounding region where the APL is located.

The selected data are based on the resident population on August 1, 2022, according to the 2022 Census (IBGE 2022). It can be observed that the Municipal Human Development Index - Education component (IDHM-E) of Cristalina is one of the lowest when compared to neighboring municipalities. It is also noticeable that the GINI index of Cristalina (0.573) presents values close to those of neighboring municipalities and reveals a relative concentration of income. Although with a relatively high GDP per capita (~USD 10,181.25) (considering the Brazilian standard), the high concentration of income in the municipality can result in social imbalances typical of this scenario (Barros et al. 2000, Adorno 2002), creating an environment conducive to socioeconomic exclusion and urban violence, not only in the municipality of Cristalina, but also in neighboring cities.

Table 1. Indicators of the Municipalities of Cristalina and Surrounding Areas

	Cities						
	DF ^(a)	Paracatu	Unai	Cidade Ocidental	Luziânia	Cristalina	Cabeceira Grande
Population 2022	2,817,068	94,017	86,619	91,767	208,725	62,249	6,627
Territorial area (km ² , 2022)	5,760.78	8,231.03	8,445.43	389.98	3,962.11	6,153.92	1,033.06
Demog. Dens^(b) (hab/km ² , 2022)	489.01	11.42	10.26	235.31	52.68	10.12	6.41
GDP per capita R\$ - 2020	87,016	59,239	39,132	11,808	22,550	55,561	55,628
HDI Aveg^(c) 2010	0.824	0.744	0.736	0.717	0.701	0.699	0.648
HDI-Income 2010	0.863	0.704	0.723	0.706	0.689	0.716	0.638
HDI-Education 2010	0.742	0.685	0.651	0.641	0.602	0.587	0.542
HDI-Longevity 2010	0.873	0.854	0.847	0.814	0.831	0.814	0.788
GINI^(d) 2010	0.637	0.5151	0.5347	0.5247	0.5128	0.5753	0.4826
ODS 2023	57.52	54.88	54.35	50.48	46.67	45.61	48.17

Data of Population, HDI Ave, HDI-I, HDI-E, HDI-L, GINI are published by IBGE. ODS Index is published by IDSC BR (2023).

(a) DF: Federal District. Includes the cities: Ceilândia, Samambaia, Brasília, Taguatinga, Planaltina, Recanto das Emas, Águas Claras, Gama, Guará, Santa Maria

(b) Demog. dens - Demographic density

(c) HDI Aveg- Human Development Index Average.

(d) GINI Inequality index.

Methodology and Literature Review of the Territorial Prospective Process

According to Berger (1958), the practice of the prospective process allows us to see far, with breadth, depth, boldness and to take risks while respecting the centrality of the human being. Godet (2001b, p. 330) adds: "to see together and in a different way, to hunt for ideas, with appropriation, and to use rigorous and participatory techniques and methods."

The notion of toolbox, proposed by Godet et al. (1999), is a combination of scenario-oriented techniques (Arcade et al. 1999) that support the application of the method, without necessarily linking the process to a specific set of tools. The prospective process comprises three main stages: building the base through participatory workshops; identifying the main issues at stake by understanding the influence of all actors; and building scenarios (Arcade et al. 1999).

Appropriation is a central concept for Territorial Prospective related to the feeling of belonging, of owning the results, and the internalization of the knowledge developed by stakeholders during the process. Appropriation leads to a collaborative dynamic and to the integration of knowledge in the visions, decisions, and actions of stakeholders. To promote appropriation, it is essential to involve civil society (Aulicino 2008). The more diverse and inclusive the participants are, the more

comprehensive and enriching the interactions will be, favoring the formation of a solid governance. It is proposed to create a governance with different social agents responsible for developing the diagnosis of the Local Productive Arrangement. The creation of a governance is considered an initial and crucial step to coordinate, lead and conduct actions in a consensual manner with all participants.

To address and operationalize the resolution of challenges, determining a temporal horizon is essential and should not significantly exceed the expected period of existence for the problem being addressed (Godet and Durance 2010; Aulicino and Fischmann 2020). During a prospective study, a symmetrical time retrospective is adopted as a rule, meaning that when planning a temporal horizon of n years ahead, an analysis of the behavior of variables in the past n years is conducted. The past and present are related to explain the present based on the past to provoke conscious changes grounded in facts. Seminars are organized with the aim of hunting for ideas, identifying changes and disruptions, brakes and inertia, constructing competency trees of the present, past, and future, as well as analyzing actors with strategies and projects that will strongly interfere with the themes and objectives (Aulicino 2006).

Territorial prospective workshops are conducted through an action-learning process, which provides participants with the essential conditions to trigger prospective reflection. In addition to acquiring new knowledge, the group can play the role of researcher, problematizing and raising hypotheses for problem-solving. Participants become familiar with the method and tools of the prospective process to identify and prioritize the main challenges of the future, in favor of the development of people, places and products (Aulicino and Fischmann 2020).

There are six stages to develop the prospective process based on Berger (1958), Giget (1989), Godet (2001a & 2001b), De Jouvenel (2010), Durance et al. (2008), and Aulicino and Fischmann (2020): situational analysis, structural analysis, competency trees, morphological analysis, scenario building, and creation of actions with evaluation of the prospective process through results and impacts.

The application of the prospective process allows proactive and preactive anticipation to clarify the action taken now, considering possible and desirable futures. Anticipation cannot be transformed into action without appropriation by the actors involved (Godet et al. 2008), as this ensures coherence between current actions and desired changes. In this sense, it is observed that two symmetrical errors must be avoided: the first consists of thinking from the top down, with experts under the action of leaders, forgetting about the appropriation of knowledge; the second consists of distancing experts and theoretical analyses to give voice to ordinary citizens and favor current consensus.

Courageous decisions to face future challenges are rarely consensual. Since foresight must be participatory, the strategy it inspires is aimed at representatives, leaders or managers who have been designated or elected. It is up to them to demonstrate the will and courage to avoid the trap of participatory demagogy (Godet et al. 2008). In this sense, governance, agreed upon in a coexistence agreement (Aulicino and Fischmann 2020) and applied in each workshop, plays a fundamental role.

Applying the Prospective Process in the Mineral-based Local Productive Arrangement (APL) of Cristalina

This section describes the steps taken to implement the prospective process in the territory within the Cristalina 2040 project.

Situational Analysis

This step involved a set of workshops with the purpose of understanding the present time, considering the past and visualizing possible future changes and disruptions. The workshops were conducted in small groups (six to twelve members) with the participation of representatives of social agents, who experienced activities aimed at raising awareness and understanding of the local reality. Subsequently, based on the collected information, the main key variables of the Productive Arrangement of Gems, Jewelry, and Mineral Crafts were identified. From these discussions, the importance of developing local tourism emerged, expanding the project's scope to include *tourism*.

The initial workshops were: (i) ideas hunting; (ii) changes and disruptions; (iii) brakes and inertias; (iv) competency trees of past, present, and future; and (v) the actors' game. During the workshops, it was sought to emphasize democratic, participatory, cooperative processes and the sharing of ideas, in favor of identifying and defining key variables and scenarios. The following principles were respected: (i) freedom of expression, providing all participants with time for reflection and the collection of ideas in writing; (ii) treating the participants' production through the proposition of ideas treated using resources and techniques such as classification, prioritization etc.; and (iii) simplicity in execution with a method that is easily appropriable, with the expectation that, in the end, the group will reach levels of understanding about the problems to be solved (Aulicino and Fischmann 2020).

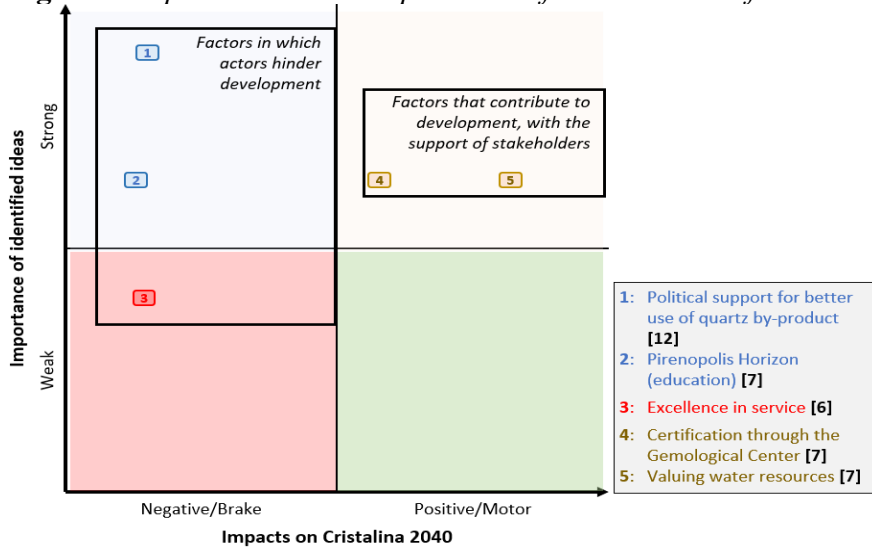
The workshops are detailed below.

Workshop: Idea Hunting

The result of this workshop is represented in Figure 1, which indicates the degree of importance of the prioritized idea by plotting the top five most voted ideas. If positive, it represents motricity; if negative, it indicates a brake.

Figure 1 allows for the identification of the collected ideas, defining their degree of importance and their impacts, such as brakes or motors (or drivers). The group formulated concise statements to express the main ideas, identifying, still in the initial phase, the theme in which the set of ideas consolidates, namely: (i) social mobilization and dialogue with the political class; (ii) planning of education and qualification actions in a broad sense; (iii) creation of the Gemological Center; (iv) environmental education; and (v) qualification actions for customer service.

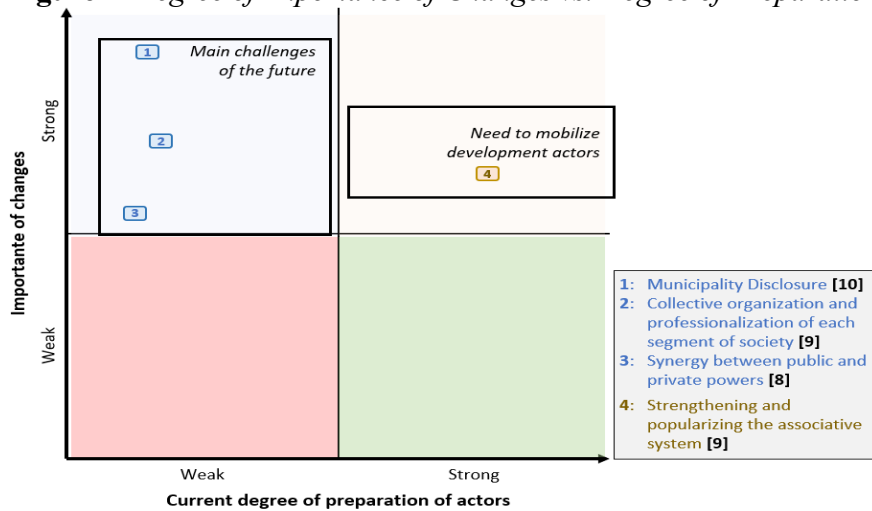
Figure 1. Importance versus Impact Plan of the Main Identified Ideas



Workshop: Changes and Disruptions

The aim of this workshop was to identify anticipated, desired, or feared changes – whether regulatory, economic, social, cultural, technological, environmental, demographic, political, or otherwise, and whether external or internal – that could impact the development of Cristalina by 2040, considering how its environment might evolve in the future. This workshop facilitates the uncovering of implicit beliefs that often shape attitudes and strategies, thereby influencing the actions of participants. Figure 2 illustrates both the actors’ level of readiness and the importance of the prioritized idea. A positive outcome indicates motricity, while a negative outcome suggests a brake.

Figure 2. Degree of Importance of Changes vs. Degree of Preparation of Actors



Based on the actors’ readiness level and in the importance of the prioritized ideas, the participants decided by four critical changes: (i) development of a marketing

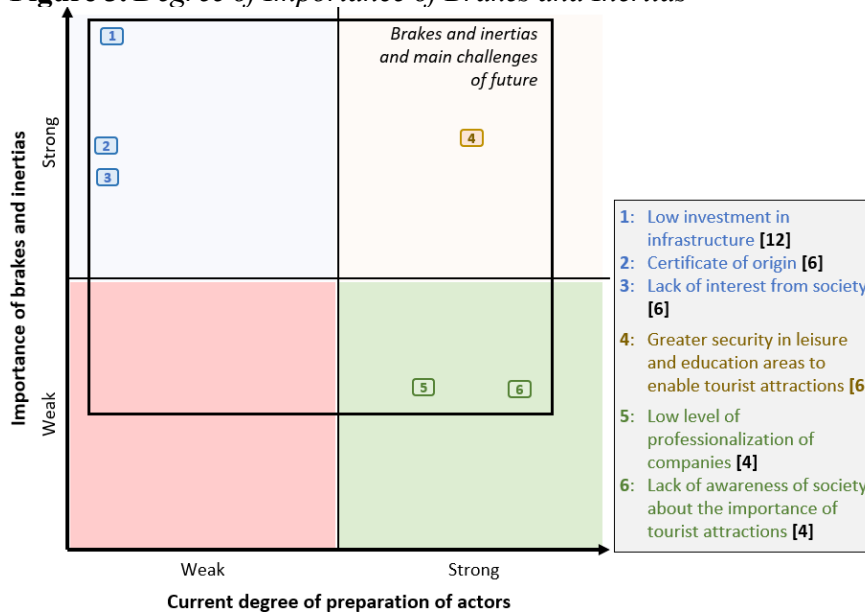
plan to promote the municipality; (ii) mapping of collective organizations; (iii) fostering and encouraging the advantages of acting collectively; and (iv) creation of a strategic plan between public and private powers.

Workshop: Brakes and Inertias

This workshop focused on identifying obstacles and inertia that could impede or delay the development of Cristalina 2040, considering both its current and future environments. Like the previous workshop, it facilitates the revelation of implicit beliefs that may affect stakeholders' actions. Figure 3 illustrates the significance of these obstacles and inertia in relation to the stakeholders' preparedness for the Cristalina 2040 Project, indicating whether their impact is strong or weak.

The strategies proposed to address the identified obstacles and inertias included: (i) developing an action plan by the Municipal Government; (ii) negotiating budget amendments with legislators; (iii) undertaking economic and financial planning; (iv) coordinating the budget across federal, state, and municipal levels; (v) ensuring compliance with environmental regulations and laws; and (vi) launching campaigns by public officials to engage the community and offer professional training.

Figure 3. *Degree of Importance of Brakes and Inertias*



Workshop: Competency Trees of Past, Present, and Future

The objective was to develop a tree representing the past and present dynamics of Cristalina's development up to 2040, identifying competencies such as knowledge, skills, and attitudes, while considering environmental changes. Initially, the trees representing the past and present were constructed, and then the strengths and weaknesses of the present tree were analyzed in relation to the past, as detailed in Table 2.

Table 2. Factors of the Competency Trees of the Past and Present, Strengths and Weaknesses

	Competency trees		Present in relation to the past	
	Past	Present	Strengths	Weaknesses
Branches	<ul style="list-style-type: none"> • Information search • Quality of craftsmanship • Crystal extraction • Market conquest – international – “embassies” • Informal trade of mineral (crystal) • Increase in per capita income 	<ul style="list-style-type: none"> • Technological advance • Online sales • Financial empowerment • Improving productive process • Involving the community in decisions that affect the municipality. • Legality of mineral extraction • Largest deposit in Latin America • Disclosure of the municipality's public policies 	<ul style="list-style-type: none"> • Financial training • Mapping and detailed scaling of the deposit • Technological advancement in improving the quality of the gem (colored stones) 	<ul style="list-style-type: none"> • Online sales • Non-participative community
Trunk	<ul style="list-style-type: none"> • Teamwork • Pursuit of quality craftsmanship • Division of manual labor among family members • Informality • Contingents of artisans in the mineral product • Poorly finished products • Identify products and services that promote economic development • Lack of accessibility 	<ul style="list-style-type: none"> • Increase in foreign exchange (fairs, exhibitions, ...) • Gemstone certification • Professional training • Mineral product offering • Accessibility to the job market • Land use planning • Reduced contingent of artisans • Community participation in compliance with the Master Plan guidelines 	<ul style="list-style-type: none"> • Professional qualification of the craftsman • Increase in foreign exchange (fairs, exhibitions, ...) 	<ul style="list-style-type: none"> • Informality • Reduced number of artisans • Adhere to the guidelines of the Master Plan
Roots	<ul style="list-style-type: none"> • Lack of time to dedicate to studies • Difficulty in accessing finances • Child labor • Lack of information • “Cultural and behavioral” misinformation • Artisanal manual labor • Environmental degradation due to the exploitation of natural resources 	<ul style="list-style-type: none"> • Rescue of local culture (seeking) • Lack of participatory governance • Access to information • Search for sustainability with natural resources • Review of legislation regarding social, economic and cultural development • Access to financial resources • Rescue of the commercial development of the mineral factor • Lack of interest in studies • Inadequate disclosure 	<ul style="list-style-type: none"> • Pursuit of Sustainability • Greater access to financial resources • Revival of local culture 	<ul style="list-style-type: none"> • Lack of information on potential • Environmental degradation

Next, the future tree was constructed, and opportunities and threats were identified in relation to the present tree (Table 3).

Table 3. *Factors of the Competency Tree of the Present and Future*

	Competency trees		Future in relation to the present	
	Present	Future	Strengths	Weaknesses
Branches	<ul style="list-style-type: none"> • Technological advance • Online sales • Financial empowerment • Improving productive process • Involving the community in decisions that affect the municipality • Legality of mineral extraction • Largest deposit in latin america • Disclosure of the municipality's public policies 	<ul style="list-style-type: none"> • Society involved in appropriation in the mineral tourism sector • Consolidation of the APL Cristalina 2040 • Creation of the Gemological Center • Certified gems 	<ul style="list-style-type: none"> • Being a great exporter of Crystals 	
Trunk	<ul style="list-style-type: none"> • Increase in foreign exchange (fairs, exhibitions, ...) • Gemstone certification • Professional training • Mineral product offering • Accessibility to the job market • Land use planning • Reduced contingent of artisans • Community participation in compliance with the Master Plan guidelines 	<ul style="list-style-type: none"> • Consolidated ecological mineral tourism • Strengthening partnerships and joining new partners • Environmental preservation policy to prevent mineral exploration • Implementing guidelines for tourism and mining in the Master Plan 		<ul style="list-style-type: none"> • Lack of financial resources and Investments • Failure to carry out detailed geological mapping • Difficulty in formulating public policies
Roots	<ul style="list-style-type: none"> • Rescue of local culture (seeking) • Lack of participatory governance • Access to information • Search for sustainability with natural resources • Review of legislation regarding social, economic and cultural development • Access to financial resources • Rescue of the commercial development of the mineral factor • Lack of interest in studies • Inadequate disclosure 	<ul style="list-style-type: none"> • Local culture rescued • Tourism strengthened • Basic and technological education strengthened • Continuing education in tourism and mining 	<ul style="list-style-type: none"> • Largest deposit in Latin America 	

Throughout the prospective process, following the creation of the scenarios, the competency trees were revisited. By evaluating the selected scenarios – both desirable and achievable – as well as the ones deemed undesirable and to be mitigated, opportunities and threats were analyzed. This analysis focused on identifying the competencies essential for advancing the Cristalina 2040 Project.

Table 4. Key Variables

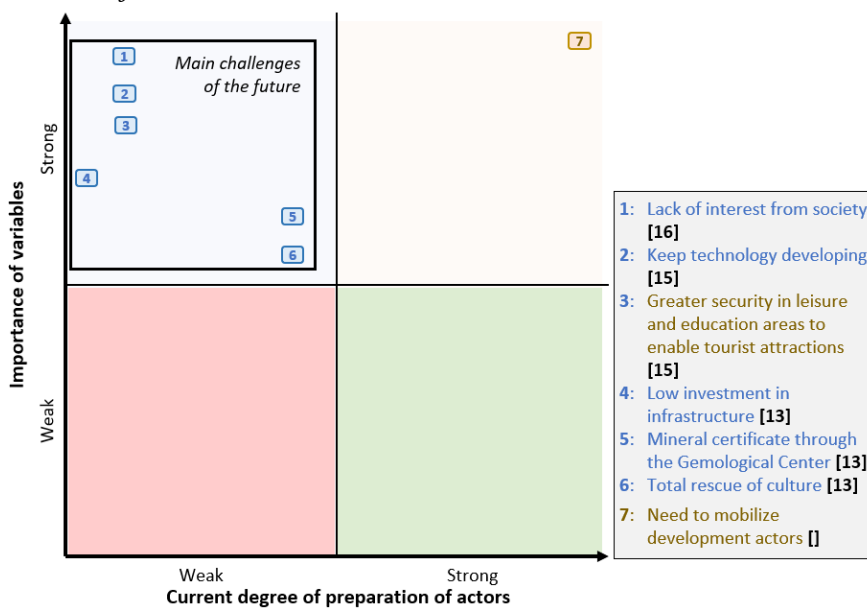
Order	Variable	Hierarchy
1 st	Lack of interest from society	16
2 nd	Keep technology developing	15
3 rd	Greater security in leisure and education areas to enable tourist attractions	15
4 th	Low investment in infrastructure	15
5 th	Total rescue of culture	13
6 th	Mineral certificate through the Gemological Center	13

Workshop: Actors’ Game

The workshop aimed to identify key variables, highlighting the most important ones for the development of Cristalina 2040, in addition to identifying the stakeholders involved in the situations at stake. A mapping of social agents and stakeholders was conducted, identifying 26 variables. A ranking criterion was applied with the following scoring scale: 1 (weak or limited impact), 2 (noticeable impact), 3 (strong impact), or 4 (critical impact). It was decided to use the top three key variables. With a tied score, the total number of selected variables increased to six, as shown in Table 4.

Figure 4 shows the degree of importance of the variables, whether strong or weak, and the degree of stakeholders’ readiness in relation to the Cristalina 2040 Project.

Figure 4. Current Degree of Stakeholders’ Readiness in Relation to the Cristalina 2040 Project



In this workshop, stakeholders involved in the situations at stake were identified based on the critical variables, considering the project's objectives and timeline, as well as its current and future environment. Table 5 presents the variables, and the stakeholders involved. Next, the participants described the mission and strategic objectives of each stakeholder.

Table 5. Key Variables and Main Stakeholders

Critical Variables	Stakeholders
1 st Societal Disinterest	1. Mineral technology Center (CETEM)
2 nd Maintaining Technological Development	2. Public Prosecutor's Office
3 rd Improved Security in Leisure Areas and Solutions for Tourist Site Preservation	3. Municipal Guard
4 th Mineral Certification through the Gemological Center	4. Mining Superintendency
5 th Low Investment in Infrastructure	5. GrenGold
6 th Complete Cultural Revival	6. Educational and Research Institutions
	7. Society
	8. AAC
	9. Secretariat of Education, Culture, and Leisure
	10. COMTUR
	11. Fire Department
	12. Secretariat of Planning, Management, and Infrastructure
	13. ACAIC
	14. Municipal Security Council
	15. Secretariat of Health

It is worth noting that each workshop contributed to the understanding of the situational analysis, with prioritized variables being extracted to form the basis for formulating the project's actions.

Structural Analysis

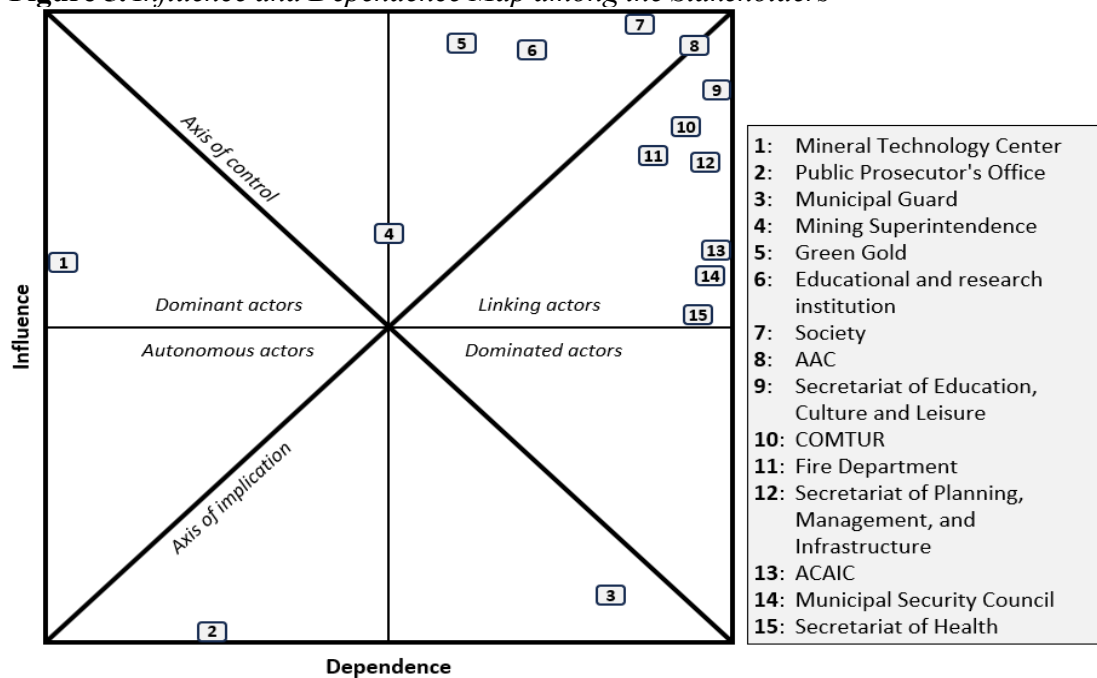
The stakeholders identified in the Actors' Game workshop were placed in a dual-entry matrix to analyze their mutual influences using the MACTOR¹ software from LIPSOR/CNAM, as follows:

- For each pair of stakeholders, a value is assigned corresponding to the influence of one over the other, generating the Direct Influence Matrix (DIM).
- Two indicators are calculated from the DIM: (i) the degree of direct influence of each stakeholder (I_i , by the sum of the rows) and (ii) the degree of direct dependence of each stakeholder (D_i , by the sum of the columns).
- The Indirect Influence Matrix (IIM): determines the second-order indirect influences among stakeholders, providing a more comprehensive view of competitiveness dynamics. For example, one stakeholder can reduce the number of choices of another by influencing them through an intermediary stakeholder.

The map (Figure 5) is a graphical representation of the stakeholders' positions regarding their mutual influences and dependencies. It contains information about the stakeholders, the meaning of each quadrant, and the axes of control and implication. On the Implication Axis, a stakeholder that is neither influential nor dependent is considered out of the game. Conversely, if a stakeholder is both highly influential and dependent, they belong to the network of influence due to having means of action. The Control Axis distinguishes between dominant and dominated stakeholders.

¹<http://en.laprosperspective.fr/methods-of-prospective/downloading-the-applications/download/YR EUj6TAZ56msz0v0VS7/johan.veltmeyer@bigpond.com/47-mactor.html>

Figure 5. Influence and Dependence Map among the Stakeholders



Considering the Control Axis, the dominant stakeholders are the Mining Superintendence and the Mineral Technology Center. In relation to the Implication Axis, the influential and dependent stakeholders are Society, Educational and Research Institutions, Secretariat of Education, Culture, and Leisure, GreenGold, Secretariat of Planning - Infrastructure, Fire Department, COMTUR, AAC, ACAIC, Municipal Security Council, and Health Secretariat.

From the workshops, 27 key variables were specified, elaborated, and presented by their authors in three seminars. These variables guided the definition of actions that enabled the development of the Cristalina 2040 foresight process across cultural, economic, legal, political, social, sustainability, and technological dimensions.

The seminar involved 106 participants and aimed to promote the integration of economic activities, sustainable territorial development, and the strengthening of the APL. The presentation of variables corresponding to the region's development factors was conducted to raise awareness among organized civil society and public authorities so that they could work together to achieve the project's objectives. In addition to raising awareness, the seminar aimed to motivate their participation in the Action Plan development phase in the following months.

Morphological Analysis

The 27 variables were classified in four themes: (i) Economy, Politics and infrastructure, (ii) Governance and Management, (iii) Education, Technology, Innovation and Sustainable development, (iv) Synergy and Collective Strengthening. The process advanced to constructing partial and global scenarios. Informative data were analyzed, defined, and resolved according to each participant's choices.

Participants submitted spreadsheets indicating values of 0 (no influence), 1 (low

influence), 2 (medium influence), or 3 (high influence) for each variable. During the workshop, scoring ties were settled through simple voting, leading to the creation of the final matrix (Table 6).

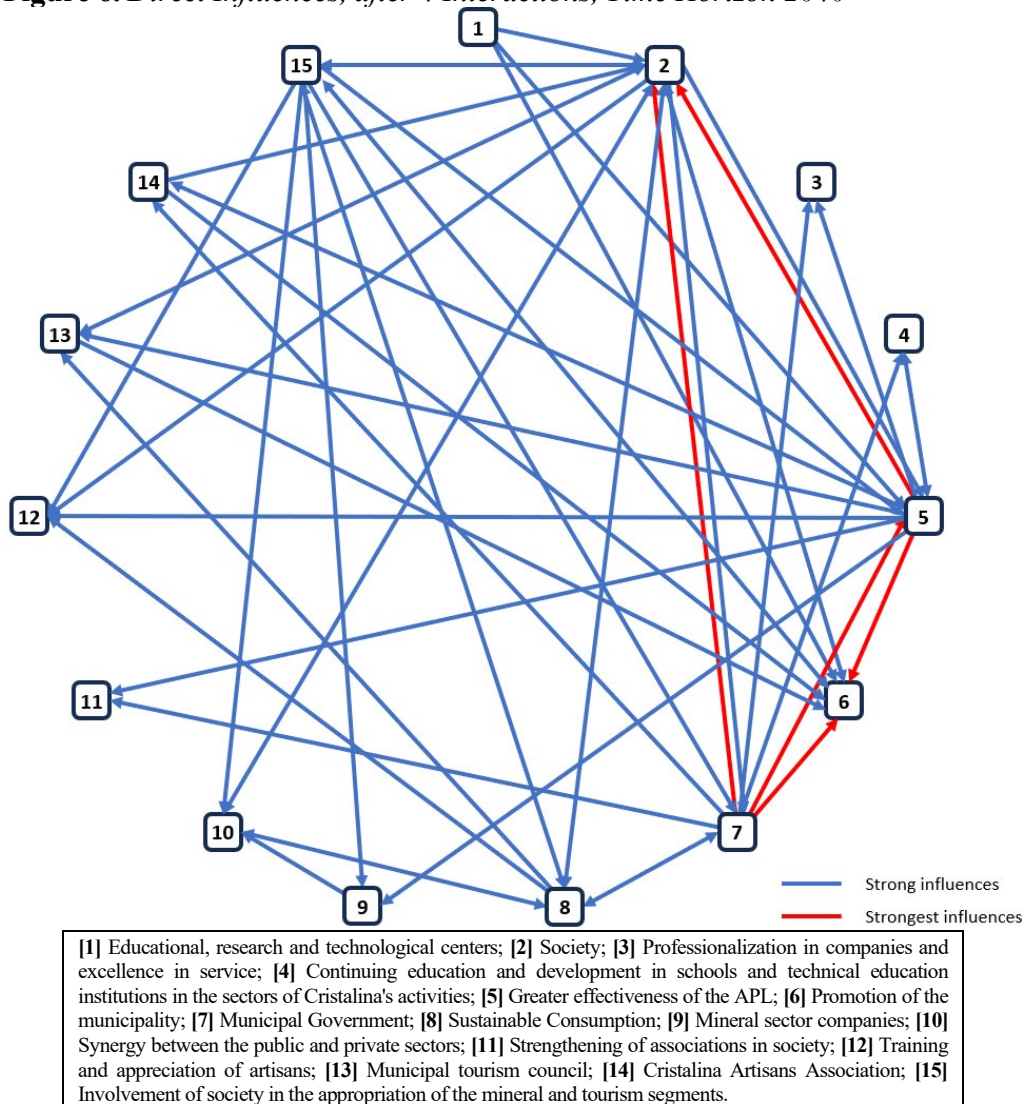
Table 6. Consolidated Matrix, with Entries selected by each Participant and voted on by Majority Criteria for Options 0, 1, 2, or 3

	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7
1	0	2	3	3	2	3	2	2	2	3	2	3	3	3	3	3	3	3	2	3	3	3	3	3	0	3	3
2	1	0	3	2	3	2	1	2	3	3	1	1	1	3	3	3	0	3	2	2	3	1	3	1	1	0	1
3	1	3	0	3	3	1	3	3	3	3	3	3	3	3	3	1	3	3	2	3	3	3	2	2	0	3	
4	3	2	3	0	3	2	3	2	1	1	3	1	1	1	1	3	1	3	3	2	3	2	1	3	0	1	3
5	3	3	3	3	0	3	3	2	1	2	2	1	2	2	2	2	1	2	3	2	3	1	2	1	2	1	3
6	3	1	2	3	3	0	1	3	1	3	1	3	3	3	2	3	3	2	3	2	2	1	3	3	1	1	0
7	2	1	3	3	2	1	0	2	1	1	1	0	0	1	2	2	2	3	3	2	3	2	1	2	3	1	1
8	2	2	2	3	2	3	3	0	3	3	2	2	2	2	3	3	3	3	3	2	3	3	2	3	2	2	3
9	2	3	1	2	1	2	2	3	0	3	3	1	0	3	3	3	2	3	2	2	2	3	3	1	1	1	2
10	3	3	3	2	2	1	2	2	3	0	3	2	2	3	2	3	3	3	3	3	2	2	2	1	1	1	3
11	1	1	3	2	2	1	2	3	2	3	0	2	2	3	2	3	3	2	1	3	3	3	3	3	0	0	3
12	2	0	2	0	1	3	0	1	2	1	0	0	3	3	3	3	1	0	1	2	1	1	3	3	0	0	0
13	3	0	3	0	1	3	1	1	0	1	2	3	0	3	2	3	1	2	2	2	1	1	3	3	1	0	1
14	3	3	2	2	1	3	0	1	3	3	3	3	3	0	3	3	1	2	2	2	3	1	3	2	0	0	0
15	3	3	3	2	2	3	3	3	3	3	3	3	3	3	0	3	1	3	3	2	3	2	3	3	2	0	0
16	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	0	3	3	3	2	3	3	3	3	2	1	1
17	3	1	3	2	1	3	3	3	2	3	3	3	3	3	2	3	0	2	3	3	1	1	1	3	0	0	3
18	3	3	3	3	3	1	3	3	3	3	2	1	1	3	3	3	2	0	3	2	3	3	3	1	3	3	3
19	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	2	3	3	0	2	3	3	2	3	3	3
20	2	3	3	1	2	3	1	2	3	3	3	3	3	3	2	3	3	3	2	0	2	2	2	2	1	1	3
21	3	3	3	3	2	1	3	3	2	1	3	3	3	3	3	3	1	3	3	1	0	2	3	2	3	0	2
22	3	2	3	1	2	2	1	3	3	2	3	1	1	1	3	3	2	3	2	1	3	0	2	3	1	0	1
23	3	3	3	1	2	3	3	3	3	2	3	3	3	3	3	3	2	3	2	1	3	3	0	3	1	0	1
24	3	1	3	2	0	3	2	3	3	1	2	3	3	3	3	3	3	3	2	3	1	3	3	0	1	0	1
25	1	1	1	1	1	0	3	2	1	0	1	0	0	0	1	1	0	3	3	0	3	1	1	1	0	3	2
26	1	0	0	1	1	1	3	2	1	1	1	0	0	0	1	0	3	3	1	1	1	0	1	1	0	1	0
27	3	1	3	3	3	1	0	3	2	2	2	0	0	1	1	2	3	3	3	2	1	3	1	0	1	1	0

[1] Sustainable Consumption; [2] Full rescue of culture; [3] Promotion of the municipality; [4] Rural urban tourism infrastructure; [5] Municipal policy for the tourism segment; [6] Public policy on mineral exploration and use of byproducts; [7] Safety in leisure and tourism areas; [8] Synergy between the public and private sectors; [9] Strengthening of associations in society; [10] Continuing education and development in schools and technical education institutions in the sectors of Cristalina's activities; [11] Professionalization in companies and excellence in service; [12] Mineral certification by the Gemological Center; [13] Certificate of origin; [14] Training and appreciation of artisans; [15] Involvement of society in the appropriation of the mineral and tourism segments; [16] Greater effectiveness of the APL; [17] Continuous development of technology; [18] Society; [19] Municipality of Cristalina; [20] Educational, research and technological centers; [21] Municipal tourism council; [22] Cristalina agro-industrial commercial association; [23] Cristalina Artisans Association; [24] Mineral sector companies; [25] Community security, social defense council; [26] Public prosecutor's office; [27] Agribusiness.

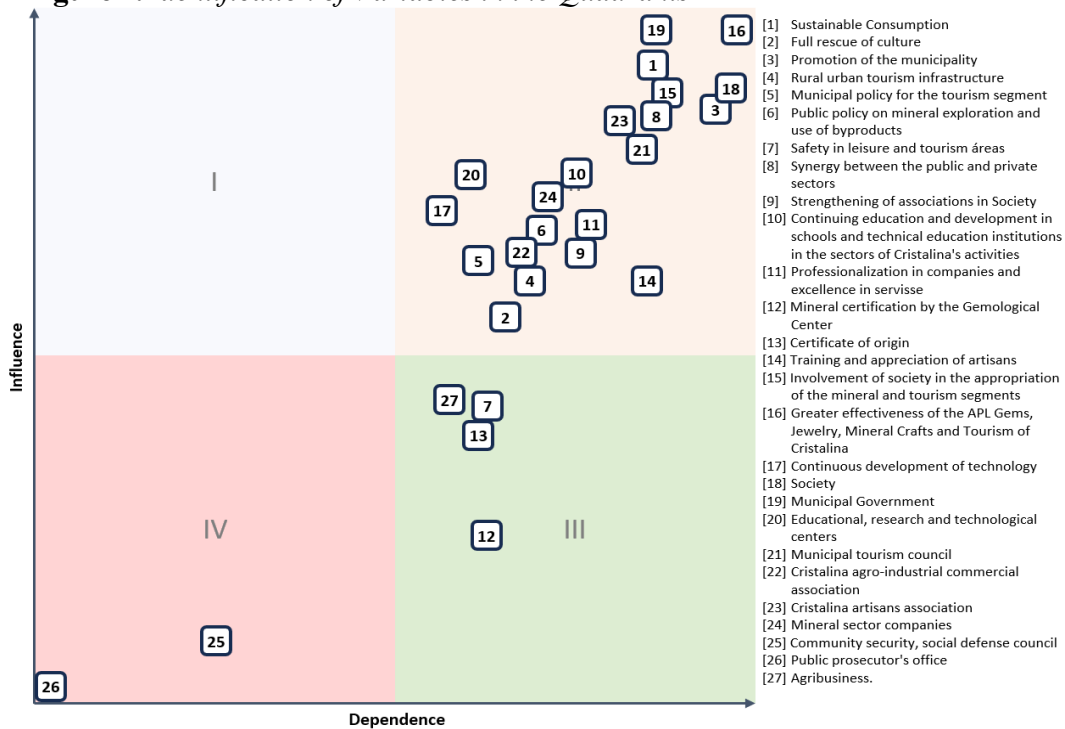
Based on this matrix, the direct influence diagram was obtained (Figure 6) as well as the direct influence/dependence map (Figure 7).

Figure 6. Direct Influences, after 4 Interactions, Time Horizon 2040



It is evident that the most significant influences are among the variables Society, Local Productive Arrangement (APL), Sustainable Consumption, and the Municipal Government. These variables are not only the most influential and dependent but are also highly interconnected, as shown in Figure 6.

The quadrants in Figure 7 represent the following variables distribution: **(I)** Input (or explanatory): have a priority character in the construction of scenarios and explain the evolution of the system, both as a driver and as a brake; **(II)** Linking: mediate the influences of driving factors on outcomes and are inherently unstable; **(III)** Excluded (or autonomous): these should not be prioritized as they lack synergistic effects; and **(IV)** Outcome: which are indirectly influenced.

Figure 7. Identification of Variables in the Quadrants

The driving variables with the greatest influence are in the upper quadrants, and those with the greatest dependence are in the right quadrants (Godet 2001a). Table 7 presents the variables ordered by driving power.

The 27 variables were categorized according to their driving force². Of these, 21 were utilized in the development of both partial and global scenarios, based on hypotheses selected by the participants. A series of actions, spanning the designated time horizon, were associated with these variables and their corresponding themes (Table 8).

²Calculated by the MICMAC app from CNAM (Arcade et al. 1999).

Table 7. Variables ordered by Driving Force

#	Variable	Influence ×10 ⁻⁶	Dependence ×10 ⁻⁶
<i>Quadrant II</i>			
19	Municipal Government	740	660
16	Greater effectiveness of the APL	739	730
1	Sustainable Consumption	702	658
18	Society	688	704
15	Involvement of society in the appropriation of the mineral and tourism segments	684	653
3	Promotion of the municipality	684	703
8	Synergy between the public and private sectors	681	653
23	Cristalina Artisans Association (AAC)	665	633
21	Municipal tourism council	653	651
20	Educational, research and technological centers	635	537
10	Continuing education and development in schools and technical education institutions in the sectors of Cristalina's activities	632	609
24	Mineral sector companies	618	590
17	Continuous development of technology	606	517
11	Professionalization in companies and excellence in service	599	615
6	Public policy on mineral exploration and use of byproducts	595	579
22	Cristalina agro-industrial commercial association	588	578
9	Strengthening of associations in society	778	608
5	Municipal policy for the tourism segment	575	541
14	Training and appreciation of artisans	562	656
4	Rural urban tourism infrastructure	559	576
2	Full rescue of culture	535	557
<i>Quadrant III</i>			
27	Agribusiness	494	523
7	Safety in leisure and tourism areas	483	546
13	Certificate of origin	467	543
12	Mineral certification by the Gemological Center	397	544
<i>Quadrant IV</i>			
25	Community security, social defense council	323	364
26	Public prosecutor's office	281	241

Table 8. Number of Actions, by Theme and by Year of Start

Themes	Total Actions	Start Year						
		2020	2021	2022	2023	2024	2025	2026
Economy, politics and infrastructure	17	2	5	6	1	1	2	
Governance and management	21	5	6	7	1	1	1	
Education, technology, innovation and sustainable development	13		3	3	4		2	1
Synergy and collective strengthening	26		10	12	3	1		
TOTAL	77	7	24	28	9	3	5	1

This resulted in a total of 77 actions. Due to their continuous development and maintenance, these actions are designed to incorporate innovations, transforming them into truly dynamic projects.

Competency Trees

The competency trees developed in the situational step are now revisited to define actions related to the competencies needed for the project's future. The prospective process considers that the future is uncertain, open to possible scenarios,

and requires new competencies over the timeline. Revisiting the competency trees of the past and present becomes important in the step of constructing actions to achieve the desired scenarios.

Presentation of the Prospective Process Results

At this step, it was assessed whether there were results and whether they contributed to improving the prospective process and achieving the objectives set for the Cristalina 2040 project. This assessment took place throughout the prospective process and after its completion, as recommended by Aulicino (2006).

A hybrid event was held for the launch and presentation of the Cristalina 2040 project in August 2021, at the City Council of Cristalina. Additionally, ongoing actions were detailed, along with the results obtained and the respective percentages achieved in each thematic area up to that point.

Results of the Application of the Prospective Process

A commitment letter was signed by pre-candidates for mayor and city council members of Cristalina in November 2020, seeking to contribute more effectively to ensure that the actions planned throughout the project's time horizon would, in fact, be implemented.

To build desirable, possible and achievable scenarios, two agreed actions stood out: (i) the development of public policies that facilitate the integration of gems, jewelry, mineral crafts and tourism activities; and (ii) environmental conservation with the establishment of parameters to characterize a geographic area recognized for its unique and significant characteristics.

Additionally, the commitments of the legislative and executive branches from 2021 to 2024 include: (i) adoption of participatory municipal administration models; (ii) strengthening of organized civil society; (iii) institutionalization of the APL governance as a Permanent Governance Committee; (iv) expansion of policies with a long-term perspective; (v) increasing people's engagement and raising awareness among new generations; (vi) permanent information channel with society's support for effective appropriation; and (vii) attracting new investments and expanding mining, handicrafts, tourism, and agriculture in Cristalina's economy.

During the project implementation, the following actions were defined and materialized, with the participation of civil society, in projects included in Cristalina's development plans, in accordance with the commitment made by the public authorities:

- Specific actions were reviewed with a long-term perspective, changing the scope and responsibilities over a 20-year horizon.
- The City Council carried out a participatory review of the Multi-Year Plan (PPA) projects and included the 2022 actions in the Budget Guidelines Law (LDO).
- A post Covid-19 program was created to develop actions to promote employment and income.

- Parliamentary amendments were coordinated with state and federal deputies to include Cristalina 2040 actions for the short, medium, and long term. Additional budgetary funds amounting to R\$ 1,250,000.00 were released, impacting projects such as the Casa da Cultura and infrastructure for the Cristal Market.
- A hybrid seminar was held at the City Council with the Executive and Legislative branches, Tourism Secretariat, state and federal deputies, organized civil society, technical and specialized educational entities, entrepreneurs, artisans, citizens of Cristalina, and neighboring cities, including virtual participation from Ministry of Regional Development (MDR), MCTI, IBICT, Mineral Technology Center (CETEM), Prospective Institute (Inspro), and citizens of Cristalina.

Key results include: *(i)* Organization of an APL database; *(ii)* Transformation of the practice of using the prospective method into shared knowledge in the context of the mineral-based APL, facilitated by action-training interventions; *(iii)* Workshops for sharing ideas, envisioning future scenarios, and creating actionable plans; *(iv)* Active involvement of civil society towards the desired future scenario; *(v)* Engagement and support from public authorities; *(vi)* Thorough documentation and reporting of each stage; *(vii)* Publication of an e-book on the Cristalina 2040 Prospective Process; *(viii)* Implementation of 19.5% of the actions (15 out of 77) by August 2023; and *(ix)* Annual evaluation and monitoring of economic, social, and environmental impacts. These results express progress and commitment to achieving the project's long-term goals.

Conclusions

The Cristalina 2040 Project, initiated in February 2019 proposed strategic actions that are generating significant transformations for local stakeholders. Under the coordination of the Permanent Governance Committee, which includes representatives from MCTI, IBICT, and Inspro, cycles of annual and five-year follow-ups and scheduled reviews were implemented. These cycles involve professionals and entities from other regions, in addition to local operational management. Simultaneously, a project was developed for assuring funding aimed at stimulating the local innovation ecosystem and promoting strategic actions for mineral tourism and the enhancement of the production chain. As an additional benefit, this project developed a replicable methodological framework for other Mineral-Based Local Productive Arrangements.

The active participation of organized civil society was crucial in addressing challenges, especially during the pandemic, which necessitated a transition to the digital environment. The alignment of strategic actions with the Sustainable Development Goals (SDGs), particularly SDG 12 - Responsible Consumption and Production, strengthens the role of the Cristalina community in meeting the UN's 2030 Agenda targets. Additionally, the project contributes to achieving SDG 11 - Sustainable Cities and Communities, and Strategic Objective 5 of the Brazilian

Charter for Smart Cities, within the economic dimension context of APL.

Finally, it is important to emphasize that achieving the desired future depends on the appropriation of the knowledge involved in the prospective process by the Cristalina society. This empowerment can transform and make the goals established during the project's development phase attainable.

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