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Sustainability of Informal Artisanal Mining in the Peruvian Andean Region

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Abstract: The purpose of this article is to reflect on the sustainability of informal artisanal mining in the Peruvian Andean area until the year 2022. The research is basic and non-experimental in design and ex post facto in scope. The sample consisted of crime prevention statistics on socio-environmental conflict from guardianship institutions and a television program on mining. Our research procedure focused on gathering secondary information for a documentary review analysis based on past proven and disseminated facts. Informal artisanal mining is strengthened in the Peruvian Andean area due to the following influencing factors: support represented as the social license granted by communal assemblies; the flexibility of governmental management in relaxing compliance related to formalization and preventive laws regarding environmental protection; the resistance to formalization and the 50% increase in socio-environmental conflict; and the 25% increase in production costs related agricultural activities, which promotes the displacement towards mining activities. The environmental sustainability consequences are as follows: limited reconversion of agricultural land-use change in one-third of the communal territories at the headwaters of the basin, which generates the displacement of environmentally friendly economic activity, and a parallel positive action is the impossibility of modification or intervention affecting water surfaces and wetlands due to communal agreements that mining companies must respect during operation.

Keywords: conflict costs; land degradation; laws; social license

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1. Introduction

We begin this article by examining the effects of mining extraction, the favorable policies that allow its production, and the recognition of mining's contribution to the Peruvian GDP and analyze and understand the degrees of conflict.

In Latin American countries, there has been an increase in the level of environmental deterioration in the Andean zone, generated by the expansion of the extractive mining industry, which has led to socio-environmental conflicts; according to [1] the number of environmental conflicts reported, the mining industry has been based on productive specialization for more than 25 years in the primary sector and has remained due to neo-extractivism and structural changes in economies, which has triggered a considerable

number of environmental conflicts, which predominate and are associated with mining activity in 37% of all cases of environmental conflict, with Peru representing 63% of the total, whose main mining product corresponds to the following metallic minerals: gold at 20.7%, copper at 8.0%, and silver at 5.2%.

The representativeness of mineral resources is demonstrated by the authors of [2] whose data estimate silver, copper, zinc, and tin reserves in Latin American soil amounting to 25%, 11%, 15%, and 11%, respectively, of the global total, with main export destinations Asia, North America, and Europe accounting for 32%, 28%, and 13% of total exports.

Foreign direct investment reached 23% of Latin American GDP two decades ago; however, mining exploitation since has consolidated a problem that remains to this day—one that is difficult to solve and has environmental impacts. We refer to the illegal mining that, in Peru, reached 28% of the gross added value of the mining sector in mined gold [2]. During this period, another problem related artisanal mining began. In the case of gold, from 2011 to 2016, 22 million people were estimated to have participated in mining activities despite the serious effects on health due to the use of mercury. There is no further information on the mining extraction of copper and iron resources.

The studies of [3] state that neoliberal extractivism in Colombia and Peru was strengthened from the 1990s onwards and the management of mining resources was based on a model that favors the accumulation of private and foreign wealth, strengthened by modifications and updates to the tax system together with scheduled intervention activities to suppress social mobilization; thus, between 1995 to 2011, the Peruvian mining sector consolidated an economic growth of the Peruvian GDP of 3.5%, while the mining sector grew by 7.2%. In 2013, the sector contributed 9.4% to the Peruvian GDP and, in the first decade of the 21st century, 55% of foreign exchange came from the mining sector, supported by the policies of the governments of Toledo (2001–2006), García (2006–2011), and Humala (2011–2016).

For this reason, governments in power and those at the ministerial level encouraged foreign direct investment in mining to strengthen conditions for medium- and large-scale mining [4]. However, this generated considerable environmental impacts along with acts of human rights violations, the consequences of which were acts of social violence; as an example, one can consider the murders of representatives of environmental unions and others, driving weak governance among various actors, whose jurisdictions and regulations were heterogeneous.

We continue to develop regarding the causes and effects of decisions of the peasant organizations represented by associations of artisanal miners, the policy decisions made by the Peruvian government in favor of this mining modality, and the problems of environmental deterioration.

Areas of the Peruvian Andean zone, especially central and southern areas, contain mining deposits whose exploitation periods exceed 30 effective years. Furthermore, each site contains a variety of mineral concentrations. The contributions of [5] indicate that mining activities currently in operation are concentrated in the regions of Tacna (Figure 1), Puno (Figure 2), Cusco (Figure 3) and Arequipa (Figure 4); this is because the age of exploration attracted expansion into immature areas and strong exploration in the case of Apurimac (Figure 5) and Moquegua (Figure 6). Likewise, the relationship between mining activities and the development of socio-environmental conflicts is latent due to pollution and the evacuation of solid and liquid waste [5]. Research data show that, by 2015, regions with extended periods of exploitation received funding ranging from PEN 10 million exploration) to PEN 500 million.

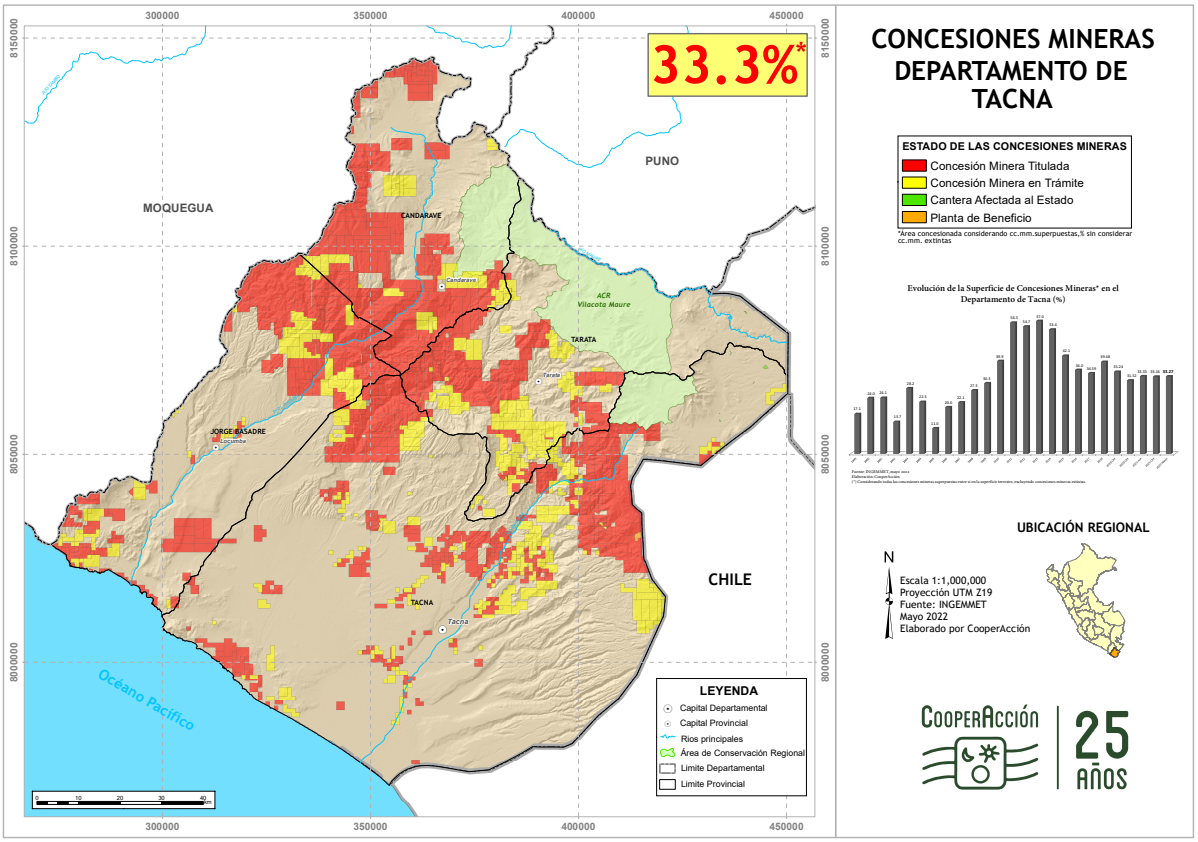

Figure 1. Mining concessions map in Tacna region [6].

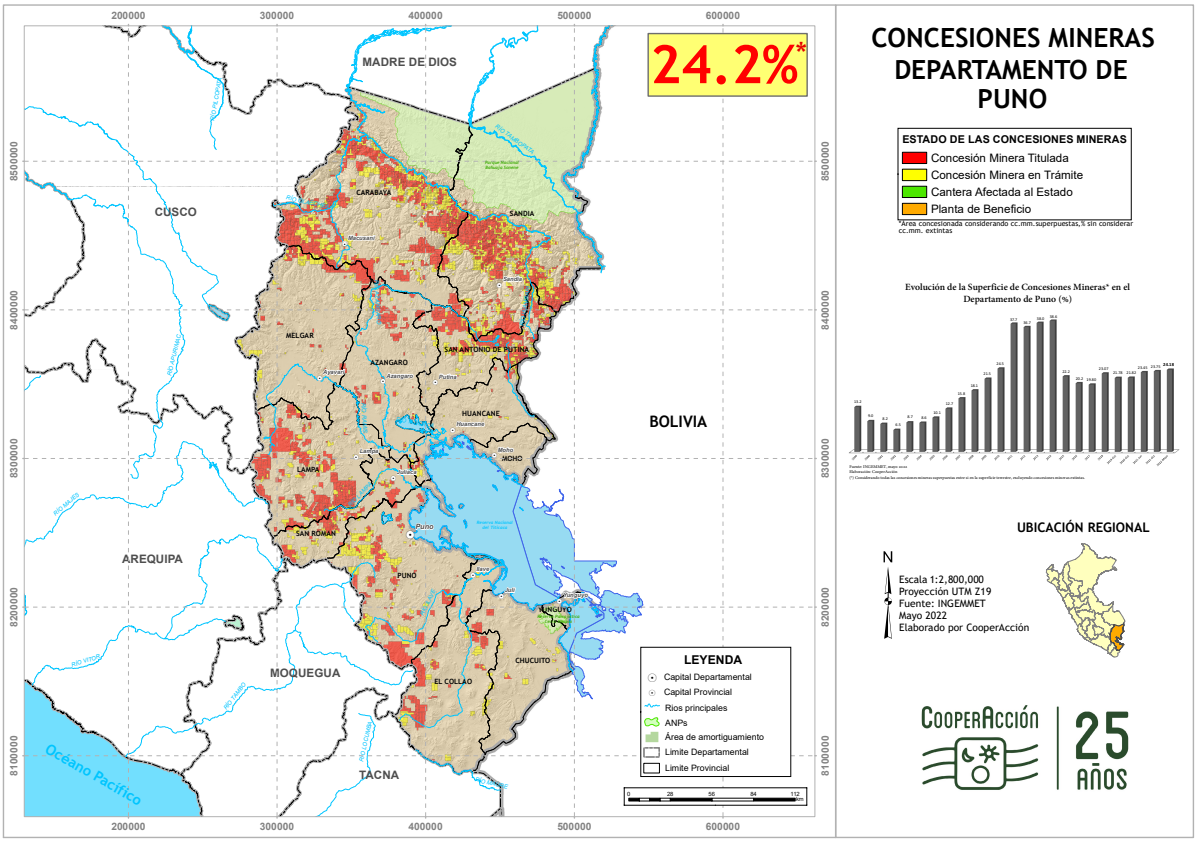

Figure 2. Mining concessions map in Puno region [6].

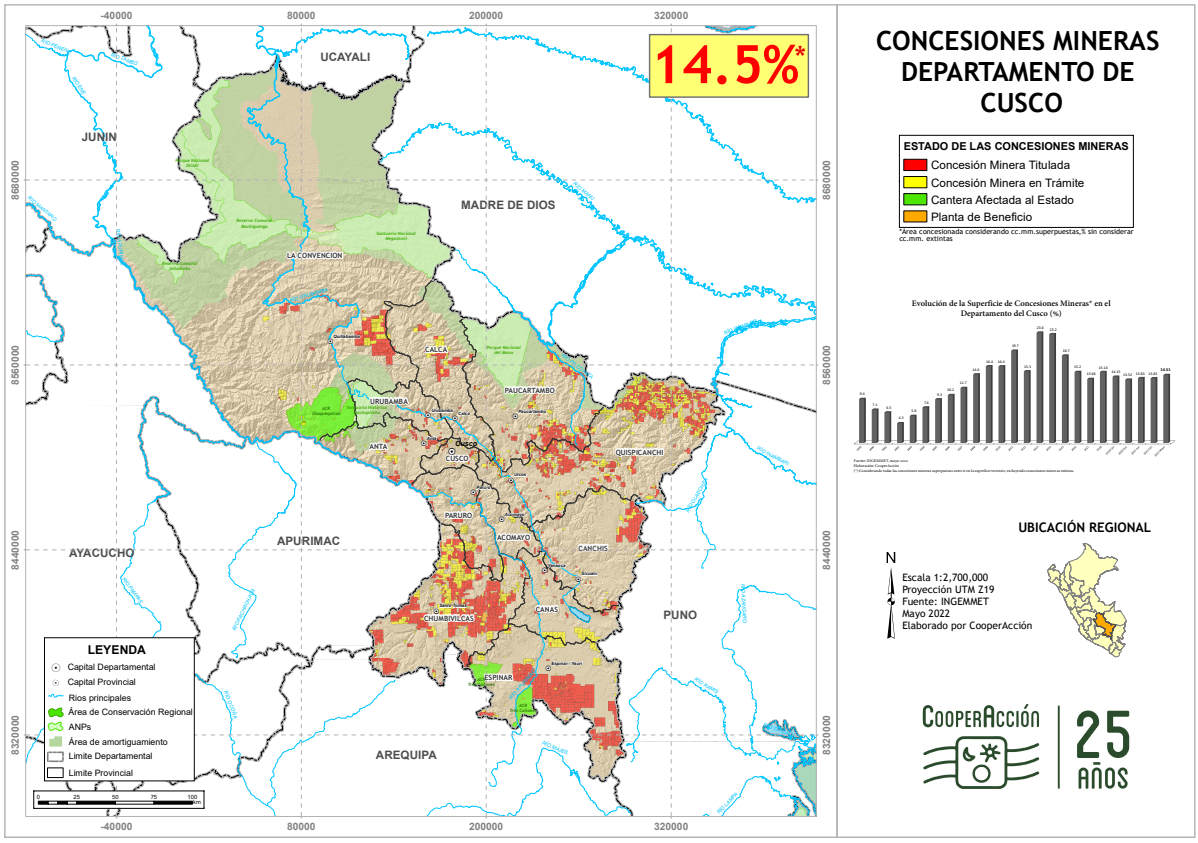

Figure 3. Mining concessions map in Cusco region [6].

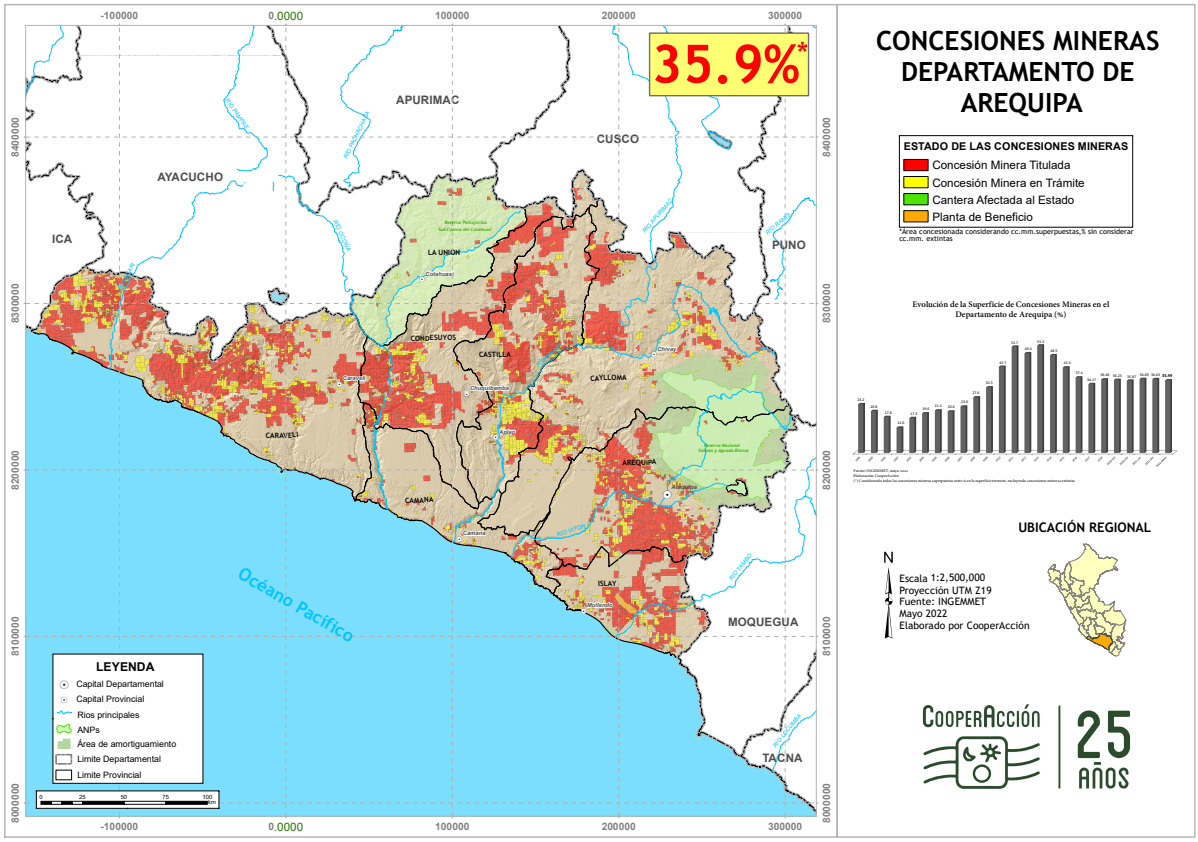

Figure 4. Mining concessions map in Arequipa region [6].

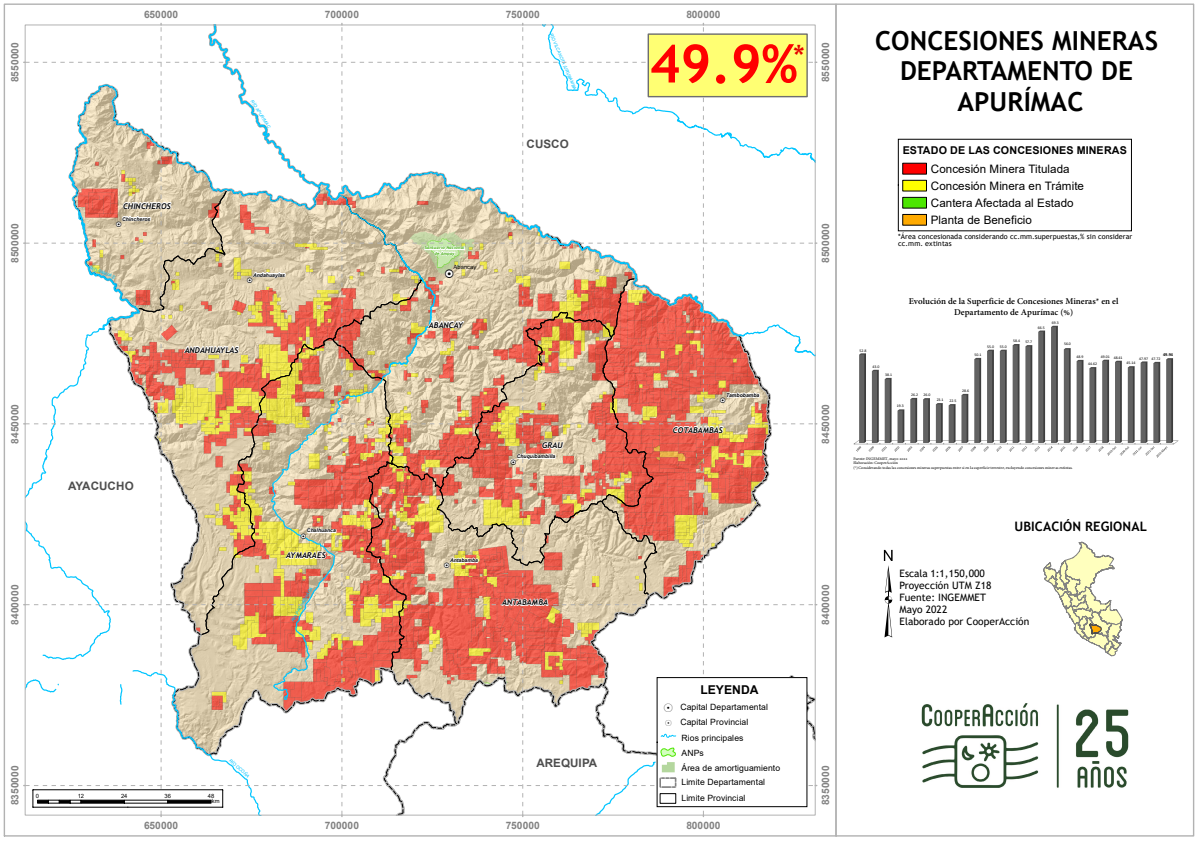

Figure 5. Mining concessions map in Apurimac region [6].

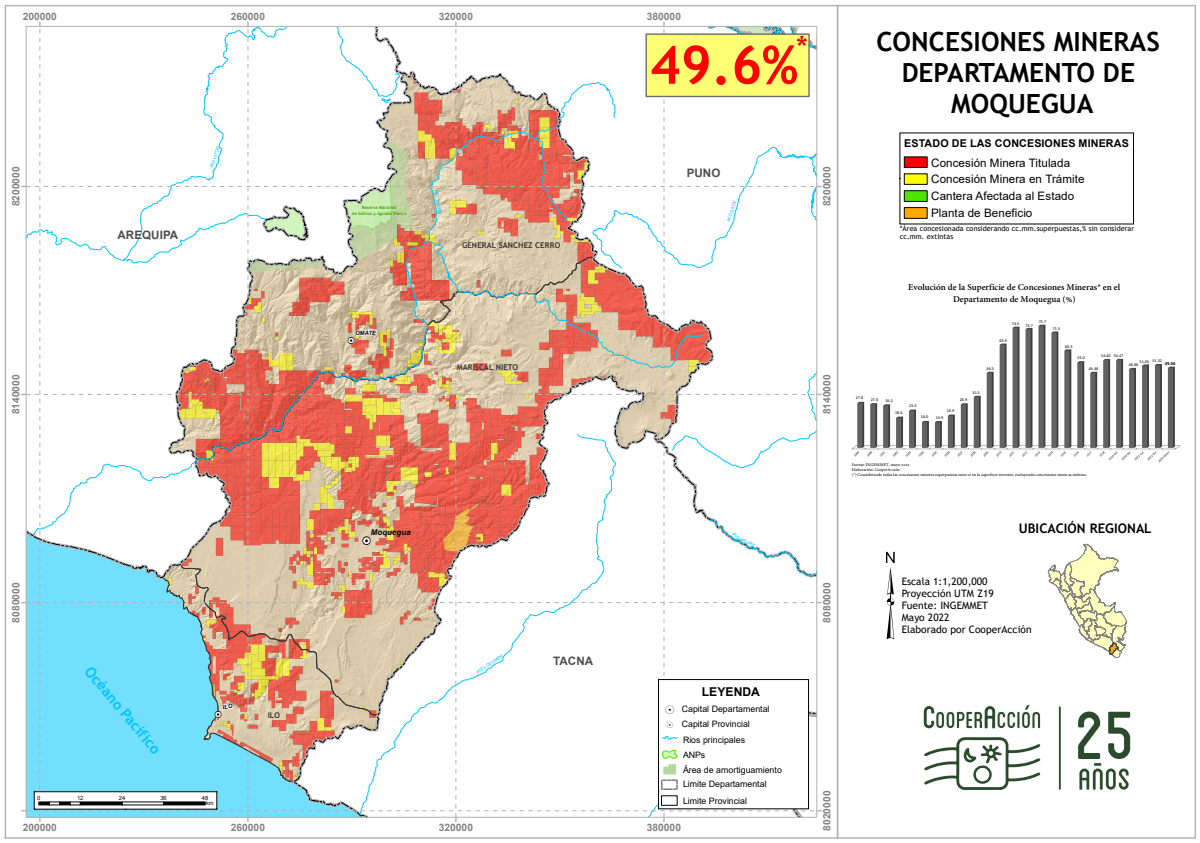

Figure 6. Mining concessions map in Moquegua region [6].

Informal artisanal mining operations in the Andean zone are characterized by work that directly exploits mining resources. They are generally community members, organized in an association identifying as artisanal extractors or marketers of metallic minerals, namely gold, copper, and iron (located and registered in mining complaints). When starting and operating within artisanal mining activities, it is with the primary objective of satisfying basic needs, seeking an improvement in family income in the medium term and obtaining tangible defense assets against any external or internal situation that may harm household economies. Artisanal mining operations are commonly identified by the use of manual methods and basic (adapted) equipment, predominantly unskilled labor sourced from local community members and caverns and closed pits as forms of extraction. Likewise, in a few cases, artisanal mining organizations acquire mining rights to obtain an income derived from the celebration of different mining contracts and, on the other hand, although unacceptable, this allows the exploitation of abandoned or unclosed mines for subsistence or by invasion in the case of concession from a third party; this is apparent in the Andean mining sector known as filonian mining.

The conflicts generated by mining exploitation, according to [7], were in response to the high rates of environmental deterioration between 2010 and 2019 and subsequently trended downward. Thus, the highest rate of social conflicts was 5.01 per 100,000 inhabitants, which fell to 3.93, the rate remaining latent due to the COVID-19 pandemic. In 2018, the three regions with the highest contributions of the mining sector to the regional GDP were Apurimac (Figure 5), Cusco (Figure 3), and Ancash (Figure 7). Likewise, the highest rates of conflicts were concentrated in the central and southern regions of Peru, namely the regions Moquegua (Figure 6), Apurimac (Figure 5), Cusco (Figure 3), Ancash (Figure 7), and Ayacucho (Figure 8).

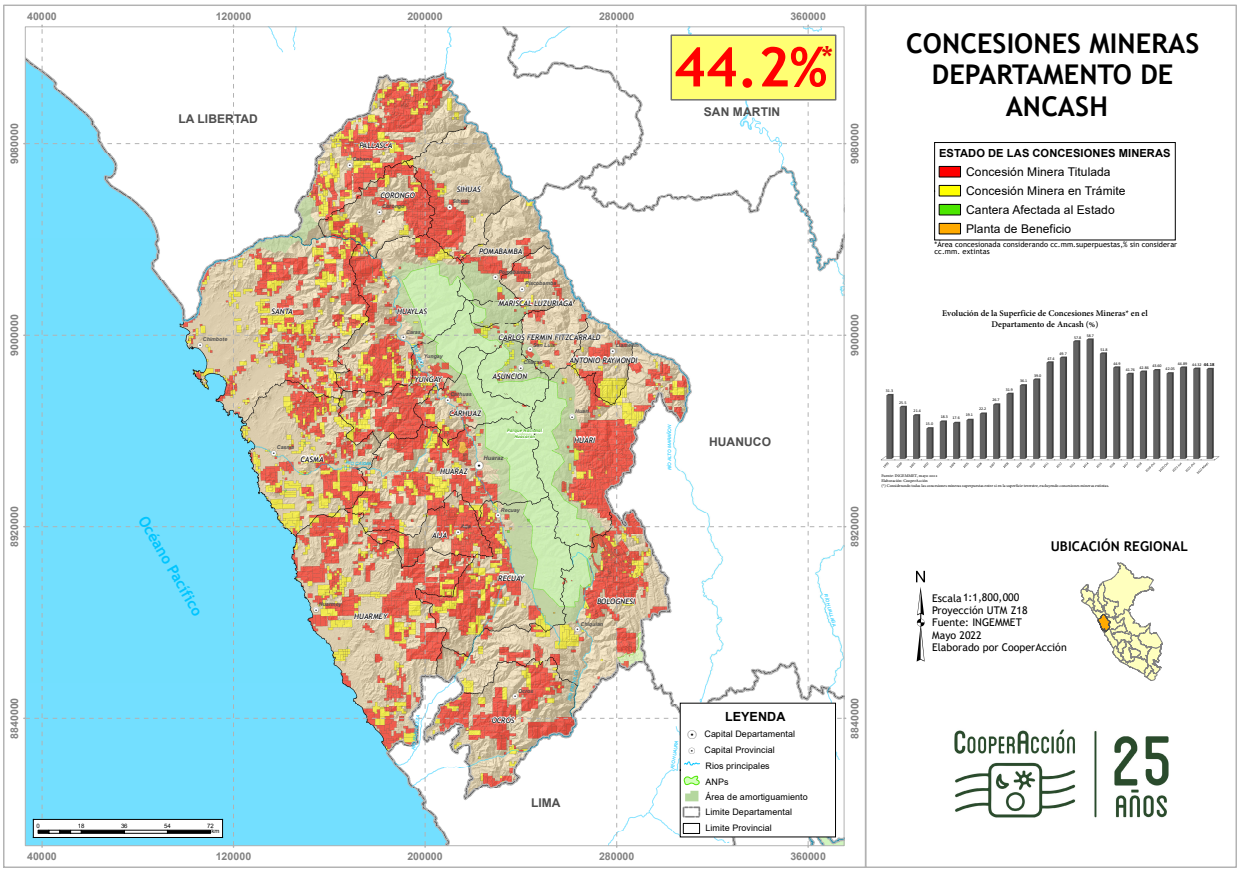

Figure 7. Mining concessions map in Ancash region [6].

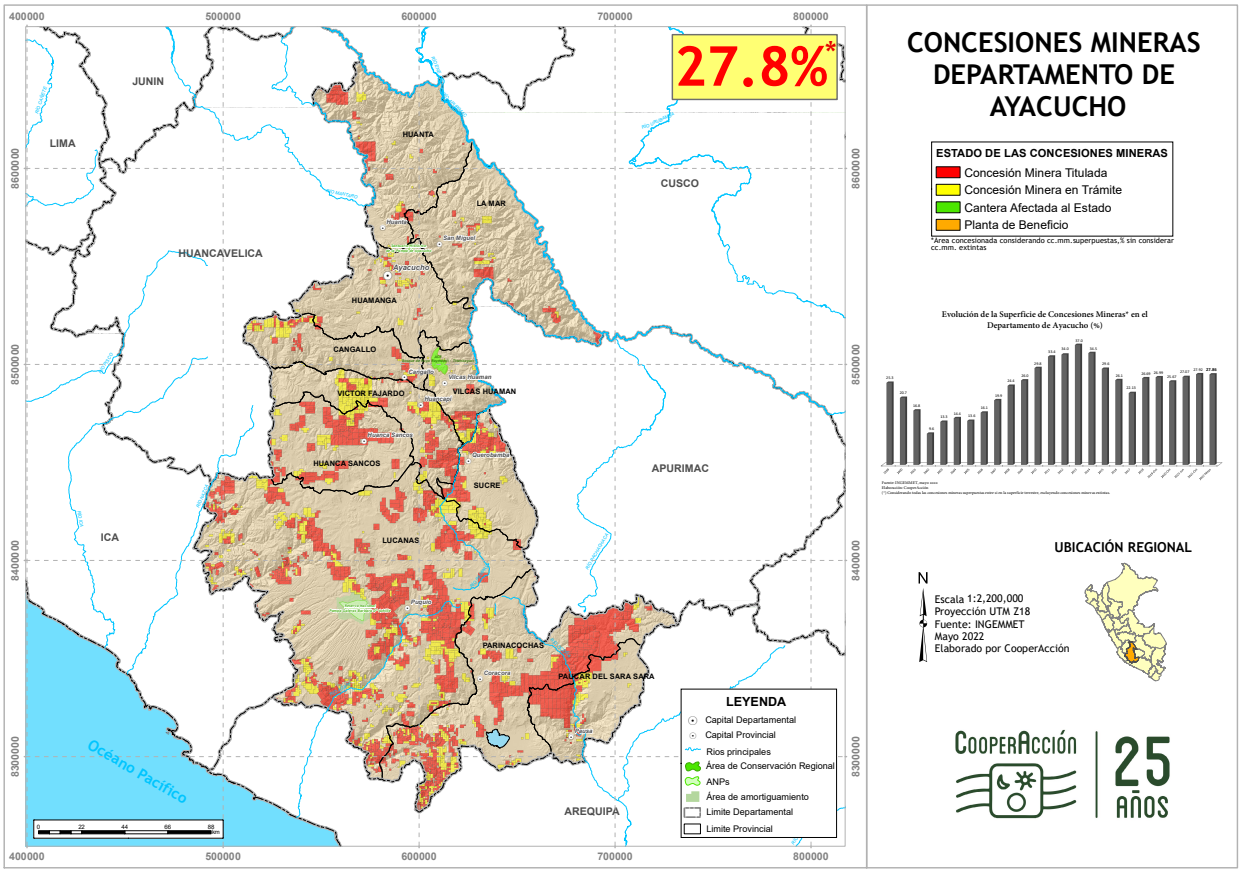

Figure 8. Mining concessions map in Ayacucho region [6].

From both international and national perspectives, current research related to mining is available and there is a sufficient amount of scientific evidence on the deterioration and environmental impact generated by mining production, especially in regard to those with informal, illegal, and even formal organizational systems, adding to socio-environmental conflicts. However, there is not enough information about why and under what conditions informal artisanal mining is sustained.

Informal artisanal mining is justified because, despite the environmental deterioration it causes in addition to processes not supervised by quality, it provides economic safety in the labor remuneration it provides. These conditions allow informal artisanal mining to exist and be sustainable in the Peruvian Andean zone; it is a phenomenon linked to social and cultural domains, with parallel economic intervention being added to government protection policy given the conflict in the country. The reason why we delimit only the Andean zone is because of the presence of direct foreign and domestic investments. Foreign investment is formal in its implementation, enforcing requirements, standards, indicators, and controls; domestic investment is implemented in two ways, formal and informal, and enforces only limited compliance with requirements.

In the Peruvian Andean zone, there is tangible evidence, sourced from the ombudsman's office and other institutions, indicating the presence and advancement of associations of informal artisanal miners, who operate under various conditions. Supervision of these organizations cannot solve problems related to physical sanitation, whose growth is complemented by a force of social protection. The environmental deterioration is tangible, but it is difficult to find a solution. The general research question of this article as follows: Why is informal artisanal mining sustainable in the Peruvian Andean zone? The dimensions determined to be the causes allowing the continued operation of informal artisanal mining were (a) the social license issued by the peasant community, (b) the state of the filters and directives that allowed the formalization of artisanal mining, (c) the role

of socio-environmental conflicts, and (d) losses of income in the agricultural sector. The general objective that guided our research was a reflection on the sustainability of informal artisanal mining in the Peruvian Andean area in 2022.

The innovation of this research work lies in the fact that the conclusions drawn allow one to understand why informal artisanal mining activities continue to strengthen, which, when acting within the political and regulatory framework, result in barriers to formalization in such a way that new programs and standards should be reformulated to allow, in an effective and efficient manner, improvements not only in the conditions of artisanal exploitation but also in the adoption of formality.

2. Methodology

Existing research is basic and non-experimental in design and ex post facto in scope [8]. Based on the documentary review method and concurrent triangulation design, we compared qualitative and quantitative data. The sample was made up of crime prevention reports related to socio-environmental conflicts sourced from the national prosecutor's office and the ombudsman's office, a television program on mining, and reports on interviews with informal artisanal miners.

Our research procedure focused on collecting secondary information for a documentary review analysis based on proven, disseminated facts and on crime prevention and/or the judicial process. Interviews were conducted with communal authorities and active mining members where there was a presence of artisanal mining. There was little collaboration from various authorities and former community members linked to informal artisanal mining activity; hermeticism is predominant. The context of informality in which artisanal miners operate means that their activities are not widely publicized; many are in danger and face insecurity due to pressure from larger groups operating in the same field (Figure 9). They are generally a closed family group, which prevents them from continuing to delve deeper into other aspects.

Figure 9. Artisanal mining socavón [9].

3. Results

Documentary Review

The results and discussion in this section are supported by facts and statistics, located in the Peruvian literature, whose contents support the scope of our general objective.

The effect of mining activity is notable as indicated by increases in exports, the generation of foreign currency, and strength in the balance of payments [10]. As a consequence, the impact at the microeconomic level is poorly determined, presenting weaknesses in the generation of direct and indirect employment and potentially generating negative externalities if environmental monitoring plans are not followed. Regarding systematization, the real direct economic contribution of mining is known. The data on the social contributions

of mining are ephemeral due to a lack of data and semi-consistent instruments because it is understood that, in the social sphere, the contribution of indirect investments from mining in areas of influence allows the calming of extreme demands. It is noted that mining operations are still carried out in territories with historical environmental and social liabilities, but considerable progress is being made in the provision of public services.

Environmental impacts proven to date, for example, in the Inambari basin, can be summarized as three predominant factors. According to [11], we have: (a) physical: in very high magnitudes, this factor comprises soil loss, alteration of the water table, and air quality and, in high magnitudes, alteration of water courses, accelerated water erosion, surface soil movement, water turbidity, tailings, sediments, and mercury contamination; (b) biological: in high magnitudes, this factor comprises the movement of vegetation cover and wildlife, impacts on tree species, and the alteration of ecosystems; and (c) socio-economic: in very high magnitudes, this factor comprises conflicts over land use and, in high magnitudes, sources of economic income, impacts on public and occupational health, prostitution, crime, and migration and immigration.

The gold extraction methods that cause the highest impact are strake, dredge, and shute processes; those of medium magnitude are: drag, caranchera, chupadera and Gringo's raft processes. All of them contribute to deforestation, earth movement, gravel accumulation, water pollution due to suspended material, clogging of river beds, and hydrocarbon pollution [11]. In 2017, 32,000 hectares of forest land were converted to mining, deforestation due to mining reaches a projection of 19,000 hectares and 17,000 hectares due to agriculture you have.

When we speak of issues related to informal artisanal mining, we primarily refer to its expansion and the contribution of its income to the economy in an irregular manner due to the formalization requirement, restricting the development of this economic activity and generating health problems resulting from risky work [12]. It is onerous for artisanal mining to become formalized under the protection of Legislative Decree 1040-2008; this rule defines artisanal mining as that which is performed with non-technological means, without explosives, and within a small and determined area. In addition, it is regulated by Law 27651, the law of formalization and promotion of small mining.

Likewise, under the indicated standard, informal mining is defined as that which the state identifies as a valid business and intends to formalize, is favorable regarding its development, is characterized by use of equipment or machinery that does not correspond to or is used for mining activity, does not meet the requirements of administrative regulations, or exploits areas where mining is prohibited [12]. In the year 2000, in the area of Huaypetue, Madre de Dios, a record of 9500 families dedicated to artisanal mining were identified, operating in adverse conditions poor in occupational safety and health and exposed to mercury contamination.

In several regions and communal territories in the northern zone of Peru, specifically in the district of Huamachuco, farmers involved in artisanal mining have incomplete knowledge about the formalization process but are linked to this activity by the excitement of the benefits it brings when extracting and directly trading gold [13]. Of additional note is the aversion to taking greater risks with respect to adding administrative workloads and other major commitments; the growth of mining activity is par excellence linked to the family group by kinship or consanguinity.

On the other hand, informal mining activities, for example, those in Cerro El Toro, involve violation of the soil, and the resultant recycled material waste is spread throughout free areas close to the resulting sinkholes, whose chemical substances destroy surrounding ecosystems [13]. Common roads and motor trails are deteriorated, potentially causing accidents. Potential bottlenecks to continuing and complying with procedures are environmental impact studies or environmental management instruments.

According to a study carried out by a competing institution [14] in the district of Santa Rosa de Quives, province of Canta, Lima region, Yangas locality, the population dedicated to artisanal mining was approximately 2000 inhabitants, the mineralized area was a gold vein with high values located in normal faults. In Quives, there were 63 titled mining rights, 25 mining rights in progress and, on that date, there were 200 artisanal mining operations. Artisanal miners were organized in associations. However, formalization management was at an embryonic level.

According to [14], artisanal mining associations are members of the National Federation of Artisanal Miners (FENAMARPE). Methods comprising exploration and exploitation are aimed at detecting outcropping deposits and continuing with horizontal or vertical underground work to a maximum depth of 80 mL, following the mineralized structure. They only characterize the geometry for veins of reduced thickness and high grade. However, the lack of resources and little technical knowledge affect operations, following the mineralized body with basic tools and intense labor.

According to [15], from the middle of the last decade of the 20th century until the beginning of the first decade of the 21st century, artisanal and small-scale mining activities were a means of subsistence and an opportunity for growth for its operators, in addition to closing the social inclusion gap and the fight against poverty. However, the demand for international gold and the pressure on international prices (troy ounce) transformed the market in favor of gold traders and collectors, and many mining operations became illegal on account of exploiting on a larger scale, often with minimal conditions and extreme risks, becoming a problem for the administration of the state and the well-being of society.

In [15], illegal mining is characterized by the exploitation of gold or other minerals in places prohibited by the state such as national parks, national reserve areas, historical monuments, protected natural areas, areas of national interest for isolated populations, etc. In the year 2019, taking the Piura region as an example, 823 informal artisanal miners were in the process of formalization subject to Legislative Decree 1336-2017, protected by the law of delegation of Powers No. 30506. The process of formalization by informal artisanal miners was subsequently resisted; the only measure that was implemented was the extension of expiration terms of all processes since the promulgation of the original law, Law No. 27651-2002.

In [16], it is indicated that the process of formalizing small-scale mining and artisanal mining activities is a means of confronting and stopping the strong advance of illegal mining, because illegal mining does not concern itself with the health and safety of mining workers and deteriorates and, in many cases, destroys the ecosystem. It violates the security and conservation of cultural heritage, evades taxes, and does not register commercial operations in some cases, constituting an unsustainable practice. Among the problems faced by small-scale mining operations, as a result of an internal study, we find the following: financing = 19%, safety = 12%, environment = 13%, technical assistance = 11%, training = 8%, health = 6%.

Ref. [16] differentiates forms of exploitation, indicating that artisanal mining focuses on exploiting abandoned or unclosed mines for subsistence, known as vein mining in Andean and coastal areas. In the jungle, it is characterized by the mechanization of operations through the use of dredges, known as alluvial mining. Mining exploitation in the Andean zone is characterized by miners working directly in the exploitation and benefiting by satisfying their basic needs, using manual methods and basic equipment, and acquiring mining rights to obtain an income derived from the celebration of different mining contracts, an unacceptable practice.

As described in [17], informal illegal mining is harmful to human health, especially to those who are in direct contact, does not contribute to sustaining an adequate infrastructure for health through taxes, and does not apply optimal extraction technologies. In the lowland jungle, illegal mining operations generate deforestation and forest degradation, illegal logging for commercial use, the expansion of land for agricultural use, and other

illicit activities such as drug trafficking and human trafficking. In addition, minimal intervention is enforced by the state to comply with regulations.

In [18], it is estimated that one million families in 2022 were directly or indirectly linked to artisanal mining activities, being an instrument in the fight against poverty, because those involved seek to escape poverty by improving their family income. Given its importance, social justification, and production deemed valuable in international markets, this activity is carried out in precarious conditions in terms of social, health, labor, and the environment, presents restrictions to developing value and sustains a formal value chain, barriers to ownership, limitations to the use of surface area, knowledge deficit, and aversion to formality. All of these problems have been happening for more than twenty years.

In Ref. [18], it is shown that government management systems and competing institutions are only dedicated to extending the validity of formalization, whose rules—Supreme Decree No. 013-2011-EM and mining formalization processes represented by Legislative Decrees No. 1105 and No. 1293 in years 2012 and 2017—stopped the formalization process by extending and extending deadlines; therefore, we observe low environmental performance, low working conditions, and low competitiveness because there is no national policy that effectively addresses the unsustainability of artisanal mining activities.

According to [19], the Peruvian state has attempted to establish mechanisms through regulations affecting mining activities related to exploration and exploitation in artisanal mining, with respect to its own or third-party concessions, for mining requests in progress or extinguished concessions. Legislative Decree No. 1105-2014 represented a setback in the fight against illegal mining, because illegal miners were given the opportunity to join the formalization process, ensuring the continuity of illegal activities. As a result, an estimated 75,000 people were involved in mining activities and only 300 people were registered. This was a chaotic result because less than 5% of participants were registered in direct contrast to the plans of 2014 administration of former president Humala. The deadline was merely extended and the RUC was deemed the only requirement.

According to [20], as of July 2022, there were 208 registered social conflicts, namely 152 active conflicts and 56 latent conflicts, with 274 collective protest actions. The territorial distribution was 18 in Cusco and 17 Apurimac. Socio-environmental conflicts were numerous, accounting for 63.0% of total conflicts and have been maintained since April 2007; conflicts directly linked to mining accounted for 66.4%.

According to [21], the last known conflict was located at Las Bambas mining company, Apurimac region, with mine-access roads being blocked for more than 50 days; the conflict is now moving towards dialogue. It is not the only one: there are 183 social conflicts that presently threaten Peru, of which 73 are related to miners. Of them, 59 are active and the rest are latent. The consequences are extreme, for example, the case of Cajamarca with Conga. Today, we understand that poverty affects 41.9% of inhabitants of the area of influence and nearby districts.

According to [22], the Peruvian government closed 2022 with social and political crises and a habit of social conflict. Cusco was the region with the greatest number of conflicts in the mining sector, maintaining 12 unresolved disputes, whose demands are limited to non-compliance with agreements and delays in executing agreements between mining companies and communities. This problem dates back 18 years; despite progress, there is no complete model being implemented to reduce social conflict.

According to [22], key points of the confrontations are the demand for greater economic compensation for land and the use of easements by mining companies. Although the mining sector contributes to the productivity and competitiveness of the sector and direct and indirect employment, poverty and health indicators in the local population remain low. Social conflicts are exacerbated by a lack of political impetus, that is, a failure of governments taking responsibility for ensuring that agreements are fulfilled, are included in operational plans, and have a budget and deadlines for compliance within the function of each ministry.

According to [23], the Peruvian mining sector accumulated losses of USD 760 million in 2022, centered on and caused by multiple social conflicts, whose gross added value of the mining sector went from a potential growth of 2.9% for the year 2021 to a drop of 0.3% in 2022. Peru closed with a production of 2.2 million MT of copper, 3.3 million ounces of gold, and 1.2 MT of zinc in 2022. By 2023, copper drops of over 250 thousand MT are expected. The copper mining sector, despite the fall, maintains a positive outlook for 2023. Gold and zinc production for 2023 will fall to 3.2 million ounces and 1.1 million MT. Mining investment will contract by 21% by 2023, a figure that is close to USD 4 billion. The investment portfolio for 2023 amounts to USD 547 million, which includes 47 projects, of which 11 have operations restricted due to social conflict.

4. Interview and Discussion

Informal artisanal mining is strengthened in the Peruvian Andean zone due to the following influencing factors:

4.1. The Social License and Agreements by Communal Assembly

Peasant communal territories occupy between 75% to 85% of the entire Peruvian Andean zone. Properties are communal, the form of organization is community, and final decisions are determined by assemblies after presentation of an agenda From the evidence analyzed, we can conclude that peasant communal organizations exist in territories with mineral deposits with the potential for exploration and exploitation. Negotiations begin under the current legal framework for small-scale mining, artisanal mining, the law of peasant communities, and the communal statute; the process allowing for initial sustainability, is summarized as follows:

(a) A general meeting is called and the decision to approve the social license and use of easement for the beginning of exploration and exploitation of the mining deposit is taken as an agenda with a technical report on the quality and quantity of metal contained in the mining concession, issued by the Ministry of Energy and Mines, adding to the verification of the ownership and validity of the mining complaint;
(b) The approval of the community assembly continues from the beginning of formalization of an association of local mining extractors and marketers of the peasant community;
(c) The process continues with the approval of delivery of a share of profits to the owner of the mining claim who holds the property title and taking him as an eventual community member;
(d) The approval and agreement of the directors of the miners' association with the community members continue, which stipulates that unskilled labor for the exploitation of the mine must be assigned preferably to community members or qualified assets of the community, whose order of participation is according to mining requirements;
(e) The process is closed with the approval of the demarcation that includes the mining area, the buffer zone, and the waste collector area to be subsequently treated;
(f) An environmental surveillance committee is formed whose function is to supervise the treatment process and dumping of mining waste.

Therefore, the sustainability of informal artisanal mining is based on respecting the agreements made by community assemblies. It is important that the directors of artisanal miner associations maintain their activities, respecting the commitment assumed, in order to guarantee the continuity of mining extraction operations. On the other hand, the number of environmental conflicts reported is based on more than 25 years of productive primary sector specialization, the impulse of neo-extractivism, and structural changes of the economy, which allow non-compliance with commitments, The number of environmental conflicts predominate and are associated with mining activities in Peru, representing 63% of total conflicts, because the economic interests of investors and extractive mining companies take precedence and the demands of the population are left in the background.

4.2. The Flexibility of Formalization and Preventive and Environmental Protection Law Compliance

From 2008 onwards, legal regulations regarding the flexibility of the formalization registry triggered a considerable number of associations of illegal miners to move to artisanal associations, giving more time for the regularization of formality. Law 27651 is the original law that regulates the formalization and promotion of small-scale mining, which was modified with Legislative Decree 1040-2008, which changes the concept, specifying that artisanal mining is that which is conducted with non-technological means, without explosives, and within a small and determined area. In addition, informal mining was defined for the first time as that which the state identifies as a valid business and is intended to be formalized to promote its development, characterized by use of equipment or machinery that does not correspond to or is not useful for mining activity, does not meet the requirements of administrative regulations, or exploits in areas where mining is prohibited.

Likewise, illegal mining preys on the environment; it is here that many illegal miners were favored because, after this norm, Legislative Decrees 1105-2012 and 1293-2017 were approved. This meant another setback in the fight against informality in the mining sector by illegal and informal miners, subject to the security of the continuity of their activities. By this date, an estimated 75,000 people were involved in mining activities and only 300 people were formalized. it was a chaotic result. Exploration mining activities, exploitation, and benefits from artisanal mining in own or third-party concessions were allowed for mining requests in process and extinct concessions.

4.3. The 50% Growth in Socio-Environmental Conflicts over Mining Activities

The increase in the number of socio-environmental conflicts is due to the fact that one million families in 2022 were directly or indirectly linked to artisanal mining activity and depended on this economic activity, being an instrument in the fight against poverty, because the families of community members seek to minimize and progressively exit poverty through improving their families' income. Given its importance, artisanal mining is justified by social reasons, in addition to the fact that its production is valued in the international market, despite the fact that this activity is carried out in conditions of precariousness in terms of health, labor, and the environment, which strengthens the restrictions to developing value and maintaining a formal value chain, whose origin are represented by barriers to ownership, limitations to the use of surface, knowledge deficits, and the aversion to formality. All of these problems have been happening for more than twenty years and government management systems and competing institutions are only dedicated to extending the validity of formalization.

According to [24], one of the main factors that involves the sustainability of informal artisanal mining in the Peruvian Andean area comprise social conflicts that grow in number due to the lack of understanding between the parties involved (company–community) in addition to the ways in which they prefer to exploit. In the case of land use in protected natural areas, protected reserves, and other cases, which are supported and even, in some cases, hidden by relevant populations due to treatment and associated advantages, they intend to proceed with illegal or informal mining activities. Likewise, in these enclaves, other illicit activities are carried out whose position violates the rights of residents and visitors. Therefore, the environmental impacts generated by informal artisanal mining activities, not controlled due to the lack of interest of leaders in conserving the ecosystem in which they operate, do not allow the generation of shared value or a better or greater distribution of benefits that mining activities would receive if their operation were certified.

4.4. A 25% Progressive Growth in the Production Costs of Agricultural and Livestock Activities

According to [25], from 2011 onwards, in various areas of the regions of Madre de Dios, Ayacucho, Puno, and Cusco, among others, prior interventions by anti-drug personnel identified the violation of Andean and jungle territory. Informal artisanal mining, settled

on Andean soil, operates in different conditions than those located on jungle soil; the type of mechanization differs depending on the investment made. However, the effects are the same for both compromised ecosystems, where the most affected resources in jungle areas are the water, soil, and forests, while in the Andean soil, they are the water and soil.

According to [25], for both cases, the problems are demonstrated in the literature; for the jungle, it is terrifying due to the devastation caused by the operation of unauthorized mining dredges. Studies also reveal that this activity is expanding and strengthening because, compared to agricultural and livestock activities, it is less risky and the return on investment is greater; this ensures the displacement of agricultural labor in areas leaning towards mining activity.

In the case of the Andean zone, the production of various agricultural crops is characterized by land whose degree of inclination ranges between 18° degrees to 35°, with abrupt changes in slope that affect the yield per unit of surface area. In light of poor cultivation (in this case, 1/4 hectares), extended smallholdings (strengthened in the progressive distribution and division of plots whose initial area ranges between 1/2 hectares and 1/4 hectares), the preference for gravity irrigation techniques that impoverish the soil due to the washing of considerable amounts of biological nutrients, agronomic management against pests that is heterogeneous (not uniform due to the diversity of crops in the agricultural sector), and the high wage cost, equal to that of a civil construction worker, agriculture is deemed unfeasible in the study area. The yield per common surface area, which is 1/4 ha, is low, and the investment and costs exceed the income obtained per agricultural campaign; the common commercial measure in the Andean zone is the arroba (representing 11 Kgs). For more than 6 years there has been a progressive fall in the final prices of agricultural products, which is exacerbated by the increase in the costs of agricultural inputs from February 2021 to date. The average increase in production costs over the last six years is close to 25%.

The direct consequences on environmental sustainability are as follows:

4.5. Limited Reconversion of Agricultural Land-Use Change in One-Third of the Communal Territories in Headwaters

A considerable number of communal territories have a cadastral registry, a legal organization. However, in many of them, it does not exist. In the altitudinal zone of Puna, economic and ecological demarcations are carried out by the community to approve access to permits and social licenses; this process is what allows the dry agricultural land to be modified, up to a maximum land area permitted by the communal assembly. Generally, the maximum area of total demarcation in a basin head does not exceed one-third and this demarcated area should not be close to an area where water resources flow. The distribution of the space of internal and external mining veins is appropriate for the specific functions of mining exploitation.

4.6. Displacement of 20% of Eco-Friendly Economic Activity in Waterheads

Regarding ecological economic demarcation, the permission and social licenses of peasant communities in favor mining exploitation, in any case, are modified and the conversion of agricultural land to mining land is developed. Due to mining exploitation, the agricultural activity of basin heads is affected by 40%; from that area, a minimum of 20% is displaced by the unfriendly economic activity that is uncontrolled mining.

4.7. The Inability to Modify or Take Action on Freshwater Surfaces, Groundwater, and Wetlands Due to Communal Agreements

Social conflicts affect the sustainability of informal artisanal mining in the Peruvian Andean zone; they were established mainly due to environmental deterioration as a result of the alteration of natural structures. However, it should be noted that it is very important to contribute to the sustainability and harmony in mining activities in Peruvian Andean areas, complying with the provisions of communal assemblies for the granting of social licenses and their approval. Geographical and ecological delimitations with mining activities must

not cross established borders or boundaries, even less so if unauthorized water resources are used for exploitation. This results in annulling the agreement and the expulsion of the mining company.

5. Conclusions

We can conclude that, in the Peruvian Andean zone, the sustainability of informal artisanal mining has been positioned by the economic interests of investors and mining companies that encourage exploitation, demanding social licenses, obtained after consultation with local communities.

Failure to fulfil the agreements made by mining companies leads to social conflicts that impact poverty, opportunities, the quality of life of community members and, furthermore, operational stoppages of mining companies, resulting in a loss of favorable market prices due to stagnation in production logistics. The Peruvian state, through the ministry of energy and mines, lacks solvency from human resources to physical means, so they execute rules and laws that require the formalization of informal artisanal mining activities in the Peruvian Andean area where the largest number of mining deposits are concentrated.

Mining companies and the communities surrounding areas of mining exploitation tend to have the same goal of reaching a democratic consensus that results in social license, the use of easements, the direct and indirect participation of the community in mining activities, the mitigation of environmental impacts, and the distribution of profits or gains generated by mining activities based on the commitments made by mining companies.

The lack of opportunities for the growth and development of the population, in addition to their traditional production activities forced by their needs strengthen informal artisanal mining activities, limited to the expectation of being part of taking advantage of the high international price of metals during periods of demand. However, it should be noted that exploitation without taking into account technology, personal safety, or environmental deterioration and contamination has widespread consequences.

The sustainability of informal artisanal mining in the Peruvian Andean zone is limited to strengthening the capacities of communities and miners, respect for agreements for the harmonious coexistence between all organized actors, and the fulfillment of mutual commitments, as well as reducing the environmental deterioration that brings about negative consequences and does not contribute to human development; instead, we promote improving the economic income and quality of life for families.

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