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Artisanal mining and the use of plant diversity

La Minería Artesanal y el uso de la diversidad vegetal

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ABSTRACT

This essay presents the variety of vegetation which is utilized in traditional mining activities in the municipalities of Cértegui (Subdistricts of: Cértegui cabecera, La Toma y Recta Larga) and the Panamerican Union (Subdistricts of Animas, Agua Clara and Quiadó). The data is a product of an ethnographic investigation which selected 57 active traditional miners of the local population in the project's area of influence to demonstrate a sample of the "Application of techniques and practices for cleaner production in gold and platinum mining in the department of Chocó". These miners aided in recognizing, collecting, photographing, and identifying 78 species of vegetation used in activities associated with traditional mining such as: separation of metals (separating gold from jagua, settling the greasy gold and blackening the troughs), creating traditional tools (troughs, sifters, mining tools to store save and weigh gold) to work in different types of traditional mining ('guaches' or pits, mazamorreo or barequeo (gold-panning), hoyadero (underground mining), zambullidero (underwater mining), canalon (sluice box), agua corrida (streaming water), cuelgas (channels) and arrimadero), and confirming the affectivity by performing demonstrations of the separation of gold from jagua with mucilaginous strata of vegetation. Examples of this vegetation include: snakewood (*Cecropia peltata*), rhombus-leaved sida (*Sida rhombifolia*), Common Broom (*Pavonia fruticosa*), Shoeblackplant *(Hibiscus rosa-sinensis*), Balsa tree (*Ochroma pyramidale*) and Guácimo (*Apeiba tibourbou*).

Key words:
Mining tools
Types of mining
Species of vegetation
Chocó
Colombia

RESUMEN

Se presenta el inventario de las especies vegetales utilizadas en las actividades de la minería artesanal en los municipios de Cértegui (Cértegui cabecera, La Toma y Recta Larga) y Unión Panamericana (Ánimas, Agua Clara y Quiadó), los datos fueron producto de una investigación etnográfica en la cual se seleccionaron 57 mineros artesanales activos como muestra poblacional de los sitios beneficiarios del proyecto "Aplicación de técnicas y prácticas de producción más limpia en la minería auro-platinífera del departamento del Chocó" quienes permitieron reconocer, colectar, fotografiar e identificar 78 especies vegetales utilizadas en las actividades de minería artesanal como son: separación de metales (separar oro de jagua, asentar el oro grasoso y negrear las bateas), elaboración de herramientas artesanales (bateas, cachos, cabos de herramientas, para guardar y pesar oro), elaboración de equipos artesanales (matracas, malacates y elevadores) y para la elaborar los tipos de minería artesanal (guaches o socavón, mazamorreo, barequeo, hoyadero, zambuyidero, canalón, agua corrida, cuelgas, arrimadero) y comprobar su efectividad con la realización de cinco ensayos de separación de oro de la jagua con estratos mucilaginosos de especies vegetales como: Guarumo o Yarumo(*Cecropia peltata*), Escobababosa (*Sida rhombifolia*), Escoba negra (*Pavonia fruticosa*), Resucito *(Hibiscus rosa-sinensis*), Balso (*Ochroma pyramidale*) and Guácimo (*Apeiba tibourbou*).

Palabras claves:
Utensilios mineros
Tipos de minería
Especies vegetales
Chocó
Colombia

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The Spanish conquistadors occupied the territory which is currently Colombia and they stripped the indigenous people of their gold at the beginning of the XVI century. When this period ended, many of them went to rivers and ravines which the natives had shown them to sift through the sand to obtain precious metals from their natural sources. This is how mining was born in our country (Poveda, 2002). Mining in Colombia has been a common activity since the colonial period despite not having been an economic leader or representative of the country until the beginning of this century in which a global boom in the demand for minerals and an increase in the price has awakened the interest of foreign investors and the central government (Ronderos, 2011).

The rivers in Colombia, which are born from three mountain ranges, were loaded with gold and silver in grains dispersed through the river sands in the deep silt (Poveda, 2002). The "trough" or "cuna" was sufficient for the Spaniard or Mestizo with enough physical fortitude, ambition, and tenacity to dedicate years to this work and eventually become rich (Poveda, 2002). During more than three centuries, neogranadine mining worked in this simple and primitive manner. When the indigenous people workforce had been exhausted due to mortality (Poveda, 2002) and their resistance to forced labor which they always opposed, the Spaniards saw the necessity to import slave labor for mining activities (West, 2000). Spain authorized the bringing of black Africans to Cartagena, where they were sold to their new masters who brought them to their respective mining regions where they were required: Antioquia, Chocó, Alto Cauca, and the Valley of Patia. During the first years of the XX century, precious metals continued to be the only products of national mining (Poveda, 2002).

The Colombian Pacific region had historically been practicing a traditional mining activity which is called "barqueo". For this activity, large machines were not used. On the contrary, human labor was used to extract minerals in a traditional way, obviously in small quantities (González, 2013). This is the type of mining which was performed by Afro-Colombian commoners (Vergara, 2007). Under the vision imposed by the members of the network for responsible mining (RESPOMIN) and the Alliance for Responsible Mining (ARM), Traditional Small Scale Mining (MAPE) was conceived as: A formalized activity which was organized, profitable, used efficient technologies and was socially and environmentally responsible. It has increasingly developed as a framework for governance, legality, participation and respect for diversity, and has increased its contribution to countries by generating dignified employment, local development, fight against poverty and social peace. It is stimulated by an increasing demand for sustainable minerals and jewelry for consumers (RESPOMIN, 2007).

At the Cocoana region, the exploitation of gold has been seen as an activity with an ancestral character, however, the indiscriminate practice has become a strategy of territorial colonization which deteriorates the environment and causes high levels of poverty and social inequality (Álvarez, 2013).

Mining since the XVI century has maintained the traditional systems of production which dominated the slavery period. About 30 municipalities are entirely dedicated to gold and platinum material extraction. This highlights that traditional mining has historically been sustained in environmentally friendly practices, which perhaps are done with traditional tools which support their own traditional technologies or ethno-technologies which move small volumes of golden nuggets; the environmental impact of which is not wide-spread, significant, or difficult to assimilate with natural processes (Ayala, 2011).

Just as mining has persisted as an economic activity, the forms of organization for this type of activity have also persisted. Understanding this organization is important to understanding the community organization which has surged as a social and political resistance toward the State (Vergara, 2007).

The thousands of informal miners who seek to exploit the gold in the rivers are contaminating the water with heavy metals like mercury and cyanide. Furthermore, amalgams which form with these metals are burned to extract the gold, and the air is also poisoned (Ronderos, 2011). Treating this problem created the project "*Application of techniques and practices of cleaner production and mining of gold and platinum materials in the department of Chocó*" with the purpose of bringing about sustainable production practices to benefit processes related to gold and platinum materials

in the municipalities of Certegui and the Panamerican Union of the department of Chocó. One of its objectives is to implement a process of technological innovation to eliminate the use of mercury and backhoes in small or medium scale mining, and conserve the tradition of using substances of native plants in the excavation of minerals to eliminate the use of mercury.

In the Tumbes-Chocó-Magdalena biodiversity hotspot, between 7000 and 8000 species of vegetation exist, and in the department of Chocó, 3,866 species have been registered (Forero and Gentry, 1989). Many of these have multiple uses for medicine, food, religious magic and traditional crafts according to the register which says that 160 species are used for traditional purposes (Garcia and Restrepo, 1997) which are used by miners. A mucilage substance can also be extracted which ancestrally has most often been used in the process of separating gold from jagua.

This project indirectly benefits the 19,059 inhabitants of the municipalities of Certegui and the Panamerican Union in the department of Chocó and directly benefits the 320 people who work in ten mining entables in this municipality according to a study which has "the design and implementation of the technological process which benefits the development of medium or small scale mining without the use of mercury" as its' second phase.

The lack of knowledge about the experience of afro communities in relation to the use of vegetation species in mining provokes the following questions: What species of vegetation are used in mining in the municipalities of Certegui and the Panamerican Union? Which parts of the vegetation species are employed for the separation of gold and jagua?

To collect this information, the following techniques were applied: polls, interviews, participant observation, classes and documented analysis through strategies like visiting work zones, conversations and consulting bibliographies by which the inventory of vegetation species was obtained and currently recognized by the miners in the area of the study and who are employed in the extraction of gold. Demonstrations in the field and the laboratory of the separation of gold and jaguar using these species were also performed.

MATERIALS AND METHODS

The study was oriented around the Descriptive Method combined with Qualitative Ethnography and Participatory Focus. The first because it is directed at describing the concrete conjunction of identified phenomena, each of which will be analyzed at the moment determined by itself to specify its characteristics (ICFES,1995). The second is about discovering the origin, the reason for the existence of a social fact, or the process of finding the interpretations and relationships. It is not a rigid design, nor does it delineate the steps inflexibly; it is above all adaptable to cultures, situations and contexts, aids the investigator because it is an instrument which may constantly be in revision and is permanently being reconstructed (Watson (1998). This methodology has its' own specific quality. It manifests as much in the data identified with "words" as much as in the treatment characterized by the use of different mathematical and numerical strategies and in the procedures to assure the validity and confidence of the obtained results (Hubert and Marcelo, 1990 cited by Lorenzo, 2011).

From the vision of the participatory method, the enforced regulations on the channels, mechanisms and levels of participation from the citizens and the community were taken into account: Congress of Colombia, Political Constitution, del 4 de julio de 199, Art. 79. Congreso de Colombia. Ley 136 del 2 de junio de 1994, Cap. VIII, Art. 141. Congreso de Colombia Ley 134 del 31 de mayo de 1994, Arts. 98 y 100. Congreso de Colombia, LEY 99 del 22 de diciembre de 1993, Art. 74.

Description of the study area

This project was executed in the municipalities of Certegui and the Panamerican Union, in the department of Chocó Colombia (Figure 1).

Population and Sample

The population is represented by 320 miners of the municipalities of Certegui and the Panamerican Union. To select our sample, the Simple Random Sample method was used because when everything of which the universe is composed is known; everything has an equal chance of being selected for the sample. It was chosen because it is considered to be very practical when the population is not very large and is located in a small area (Instituto Colombiano para el Fomento de la Educación

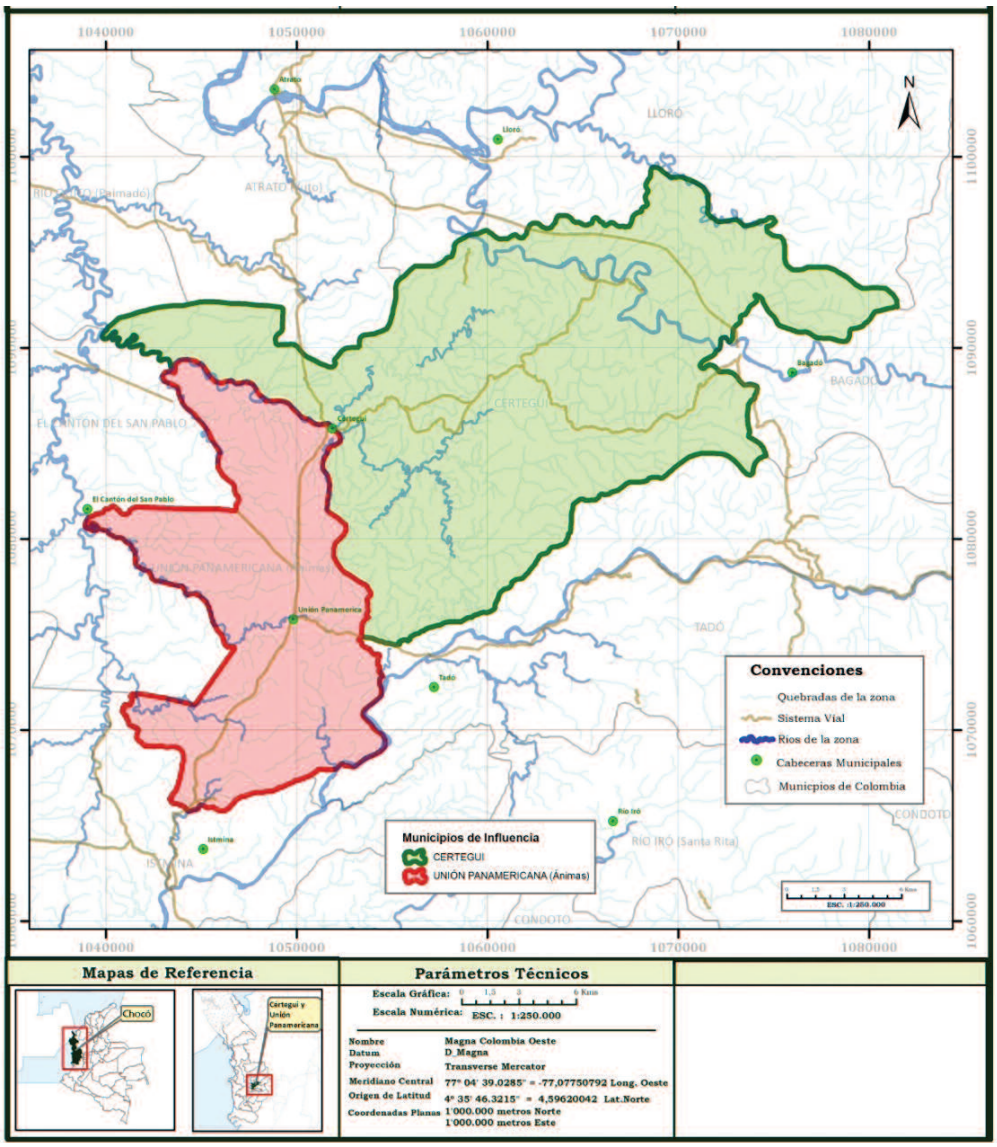

Figure 1. Municipalities of Certegui and the Panamerican Union. Source. Agreement 020 24/12/ 2013 CODECHOCO - UTCH

Superior - ICFES, 1995). The result was that 57 people participated in different identification activities of different vegetation species, information collection, participatory classes and information validation activities.

Strategy for information collection

It begins with the plan for information, applying tactics to awaken the sensibility of the mining community around the project, generating confidence, visiting the study zone, social events and conciliation dialogues. The purpose is to motivate active, experienced miners to make decisions which will promote their free and spontaneous connection to the investigative process.

The primary information was the principal source for summarizing the rest of the information by applying specialized techniques to bring together the information in a qualitative form such as: The Direct Structured Observation, the Structured Ethnographic Interview, the Interview and classes, using index cards with experiential ethnographic questions, observation guides, and instruments which were composed of open and closed questions with the function of numerical weight.

Collection and recognition of vegetation species
With the participating research groups, made up of the mining stakeholders who were part of the population sample, the selected sites were chosen in each municipality. The following sites were chosen: The municipality of Certegui, the municipal head, the township of Toma and the jurisdictional division Recta Larga; In the Pan-American Union, the village of Animas, the village of Quiado and the village of Agua Clara. The vegetation species used to separate the gold from the jagua were collected at these sites. Studies performed in the field were an important means of increasing the number of plant species under study. Binnacles, field journals, cameras and video recorders were used to take morphological data for later identification.

Classes and miner interviews in the selected zones
In the classes for collecting information, groups were formed which created a list of vegetation species used to separate gold from jagua easily, to settle the greasy gold or to ferry as it is known ancestrally, and to blacken the troughs which allows the gold to be seen, especially when it is quite small or minute, individual interviews with some miners were performed which strengthened the lists and the knowledge of the mining extraction in the areas.

Species identification
For comparison with the experiments of the herbarium "CHOCO", from the Technological University of Chocó, which includes websites, databases, scientific collections online, from the database which was constructed with specify, dictionary common names of Colombian plants, from tropical plant guides, neotropical herbarium, and specialized literature were used to identify species with the most specific taxon possible (Missouri Botanical Garden; The Plant List; The Field Museum; Instituto de Ciencias Naturales (ICN) - Universidad Nacional de Colombia).

Experimental field tests: verification of the selected species in each case
With the support and knowledge of the natives, people with greater knowledge and mining tradition, who reported the use of plant species in the separation of gold and jagua and settling gold, gave demonstrations with the species, showing the effectiveness of these for the specific purpose of separating gold and jagua. It consisted of demonstrative practices of separation by rotating the material in the trough, removing the stones until only gold combined with jagua remained and then they continued to rotate as they applied more water and the mucilaginous substance extracted from the vegetation, leaving only gold in the trough. Finally, 5 species with the most tradition were selected and the demonstrations were carried out, with the volume and quantity of material maintained constant to demonstrate the effectiveness of the method.

RESULTS AND DISCUSSION

In the framework of the ethnographic project, six information gathering workshops and 57 interviews with miners of the municipalities of Certegui and the Panamerican Union were carried out, which allowed the registration of 199 samples of individual vegetation samples employed in mining activities, which were distributed into 78 species ; equivalent to 0.97% of the biogeographic species of Chocó, 2.0% of those in the department of Chocó and 48.7% of the artisanally used plants in Chocó, which are classified in 39 botanical families. The most represented families are Malvaceae with 10 species, followed by Fabaceae and Rubiaceae with five each and Melastomataceae, Lauraceae and Annonaceae with 4 species each respectively (Table 1). It is important to emphasize that the higher representation of the Malvaceae and Annonaceae families is due to the fact that all their species have mucilage directly in their structures which were ancestrally used for the separation of gold from jagua. New products were found as a result of the research process because no existing documentation was found with information on the plant species used in traditional mining.

The mining community reports that the vegetation species Cedro Macho (*Tapirira guianensis*) is the most used in the traditional mining troughs. It is a tool which was ancestrally used in barequeo mining.

As a result of the bibliographic review, workshops, surveys and informal talks, four artisanal mining methods are recognized as areas of ethnographic study in which vegetation species are used for accomplishing work or labor, among which we have seen: Separation of the metal (gold), use of artisanal tools, use of artisanal equipment and construction of systems or types of exploitation in traditional mining.

Table 1. Best represented families

Families	No. species	Families	No. Species
Malvaceae	10	Convolvulaceae	1
Fabaceae	5	Euphorbiaceae	1
Rubiaceae	5	Musaceae	1
Lauraceae	4	Caryocariaceae	1
Annonaceae	4	Burseraceae	1
Melastomataceae	4	Lecythidaceae	1
Meliaceae	3	Myrtaceae	1
Apocynaceae	3	Chrysobalanaceae	1
Poaceae	2	Commelinaceae	1
Urticaceae	2	Acantaceae	1
Vochysiaceae	2	Bignoniaceae	1
Olecaceae	2	Ochnaceae	1
Sapotaceae	2	Simaroubaceae	1
Moraceae	2	Gesneriaceae	1
Araceae	2	Elaeocarpaceae	1
Myristicaceae	2	Cyatheaceae	1
Arecaceae	2	Clusiaceae	1
Anacardiaceae	1	Asteraceae	1
Humiriaceae	1	Cucurbitaceae	1
Nictaginaceae	1		

Of the 78 species used in artisanal mining in the areas studied, 48.7% are used in the direct separation of gold from mining lands, 43.5% in the development of manual tools used by traditional miners to facilitate the selection of soil from which the gold is extracted, 21.7% in the production of artisanal equipment and 29.4% in the production of different tools used in traditional mining or in ancestral forms of extracting gold from mining lands (Table 2).

In ancestral mining, the mining communities in Certegui and the Panamerican Union used vegetation species largely in three activities:

Separation of gold from jagua. The process uses the maceration of the vegetation species to generate an emulsion with the obtained mucilage, and proceeds to separate the elements by means of the system of rotation and manual separation in the trough, adding water and the gelatinous emulsion with a consistency which is a product of the experienced miners.

Settling of greasy gold. To settle the greasy gold, or ferry, use the mucilage with a different viscosity, add some to create a muddy solution.

Blacken the troughs. To blacken the troughs, other plant species are used which macerate over it until obtaining the desired effect, which is completed by placing them in the sun. The purpose of blackening is to generate greater visual contrast with the small particles of gold as they are separating. In these processes, 38 plant species were used. The jagua gold separation process was the one with the highest requirement of plant species, with 71.0% being used for this purpose, followed by blackening troughs with 28.94% and settling greasy gold with 10.52%; this input was also new for Chocó because only the work of ASOCASAN (2010)

Table 2. Number of species by artisanal activity.

Activity	No. species	%*
Separation of gold	38	48.7
Development of artisanal tools	34	43.5
Development of artisanal equipment	17	21.7
Different types of traditional mining	23	29.4

* The results are above 100% because some species are used in various different activities.

reports that "we use natural components to cut gold (in the process of separation of gold from the jagua), for which balsa (*Ochroma pyramidale*) A forest species that is neither polluting nor toxic to aquatic life is used (Fermín, 2016)[1].

The species best represented by frequency of community use and registered as being in use by the six communities are: rhombus-leaved sida *(Sida rhombifolia)*, common broom *(Pavonia fruticosa)*, snakewood *(Cecropia peltata)* and blackberry *(Clidemia catroughellata)*. These were used ancestrally in mining to separate gold from jagua which they extracted from the ground and accumulated during the course of the day. The part of the vegetation most used for the separation of gold and jagua are the leaves, corresponding to 23 species followed by the sap with 10 as shown in Table 3. It is important to note that the miners state that "any plant that produces slime (mucilage) can be used in the separation of gold from jagua. You only need to have the experience to take it at the right point" (degree of optimum viscosity).

Table 4 shows the number of plant species used for the production of handcrafted tools, as well as those reported for correction (troughs, tool handles for hoes, shovels, pick axes and machetes, among others. The tool handle is one of the more species registered tools, especially in the correction of Quiadó.

According to Escalante (1971), Córdoba and Rovira (sf), Álvarez (2013), Ayala and García (2011), there are approximately 18 artisanal tools used by the Chocó miners (mud, pick axes, leather, troughs, hoes, spouts, shovels, hoes, machos, wedges, axes, wagons, poles, jagueros, machetes, wooden supports, picks and hollows). Some of these form the so-called tool handles. Our ethnographic work registers five types of tools being tool handles which reports the most species used for this purpose with 28 plant species, followed by troughs with 14 as shown in Table 4. This is why this documentation which reports 34 vegetation species used in the production of artisanal tools is novel.

Table 4 presents the number of vegetation species used by participating communities in these types of traditional mining. The exploitation of the system of Guaches accounts for the largest number of used species as can be observed on the Table 5.

Field trials with the twenty-seven plant species used in the area of study to separate the gold from the jagua with the use of mucilaginous substances demonstrated the effectiveness of this practice which makes it possible to corroborate that this ancestral practice is necessary. It should remain active in miners from generation to generation and thus prevent the use of mercury in this traditional practice.

Table 6 shows the demonstrated exercises with the mining groups while using the most useful and recognized species in the study area. For the practice, a sample weight and constant water volume were defined with the purpose of knowing in the first instance the effectiveness of the vegetation species in this process, thus it was found that the process is more efficient with balsa (*Ochroma pyramidale*) which used only 20 mL of the substance in less than two minutes, followed by common broom (*Pavonia fruticosa*) with 25 mL of the substance.

[1] Artisanal mining. Personal communication. October, 2016.

Table 3. Vegetation species used in the separation of gold by different communities

No	Common Local Name	Scientific Name	Family	Use			Part Used				Location					
											Cértegui			Pan-American Union		
				OJ	N	G	H	T	R	S	C	T	RL	A	AG	Q
1	Baba zaíno	*Cochliostema odoratissimum*	Commelinaceae	X			X					X				
2	Babosa	*Aphelandra* sp	Acanthaceae	X			X				X		X		X	
3	Balso	*Ochroma pyramidale*	Malvaceae	X			X			X			X	X	X	x
4	Batata	*Ipomoea batatas*	Convolvulaceae	X			X							X		
5	Caidita	*Ocotea oblonga*	Lauraceae	X			X	X				X	X			
6	Carbonero	*Licania macrophylla*	Chrysobalanaceae		X		X					X	X			
7	Cargadero trougha	*Annona cargadero*	Annonaceae	X			X			X			X	X		X
8	Cascajero	*Palicourea sp*	Rubiaceae		X		X				X		X			
9	Chocolate	*Theobroma cacao*	Malvaceae	X			X			X				X	X	
10	Chuscal	*Andropogum bicornis*	Poaceae			X	X				X			X		
11	Coronillo	*Bellucia glossularoides*	Melastomataceae		X	X	X				X	X	X		X	X
12	Cuadrado	*Musa balbisiana*	Musaceae		X		X									X
13	Escoba babosa	*Sida rhombifolia*	Verbenaceae	X			X				X	X	X	X	X	X
14	Escoba negra	*Pavonia fruticosa*	Verbenaceae	X			X				X	X	X	X	X	X
15	Guácimo blanco	*Apeiba membranácea*	Tiliaceae	X			X	X		X	X	X	X		X	
16	Guácimo colorado	*Luehea seemnnii*	Tiliaceae	X			X	X		X		X	X	X	X	X
17	Guarumo	*Cecropia peltata*	Urticaceae	X			X				X	X	X	X	X	X
18	Guayacán negro	*Minquartia guianensis*	Olacaceae		x											X
19	Hierba mora	*Clidemia catroughellata*	Melastomataceae	X	X	X	X				X	X	X	X	X	X
20	Jaboncillo	*Isertia alba*	Rubiaceae	X	X								X		X	X
21	Jagua macho	*Genipa* sp	Rubicaeae		X		X									X
22	Malangá	*Xanthosoma sagitifolium*	Araceae	X			X									X
23	Malva	*Malachra alceifolia*	Malvaceae	X			X				X	X	X		X	X
24	Moro grande	*Miconia reducens*	Melastomataceae		X		X				X		X			
25	Palma Zancona	*Socratea exorrhiza*	Arecaceae	X			X		X	X		X	X			
26	Palo perico	*Simarouba amara*	Simaroubaceae		X		X					X	X		X	
27	Pavonal	*Andropogum sp*	Poaceae			X	X							X		
28	Pavonilla	*Glossoloma panamense*	Gesneriaceae		X		X				X					
29	Pos	*Spathiphyllum sp*	Araceae	X			X				X		X			
30	Potranca	*Senna occidentalis*	Fabaceae	X			X						X			
31	Quitasol	*Mauritella pacifica*	Arecaceae	X					X		X		X			
32	Resucito	*Hibiscus* sp	Malvaceae	X			X									X
33	Tasi	*Cyathea sp*	Cyatheaceae	X				X		X	X	X	X		X	
34	Vaina	*Quararibea sp*	Malvaceae	X			X			X	X		X			
35	Virgusa	*Cecropia virgusa*	Urticaceae	x												X
36	Yerba dulce	*Borreria sp*	Rubiaceae	X			X							X		
37	Yogo	*Bidens* sp	Asteraceae	X			X									X
38	Zapallito	*Cucurbita sp*	Cucurbitaceae	X			X			X			X			

OJ = Separation of gold and jagua, N = Blackening troughs, G = Eliminating grease in the gold.
Part of the vegetation. H = Leaf, T = Stem, R = Root, S = Sap.
Location of the Information: C = Cértegui, T = La Toma, A = Ánimas, AG = Aguaclara, RL= Recta Larga, Q= Quiadó.

Table 4. Vegetation species used to create tools by community.

Artisanal Tools	Total of species	Species by community					
		Certegui	La Toma	Recta Larga	Animas	Agua clara	Quiado
Troughs	14	10	5	5	1	11	10
Cachos	13	11	6	5	1	9	11
Tool Handles	28	13	7	7	3	14	20
Storing gold (Totumo)	1	1	1	1	1	1	1
Weighing gold (balances)	2	1	1	2	2	1	2

Table 5. Vegetation species used in the practices of traditional mining for the purpose of correction.

Types of traditional mining	Total of species	Species by correction					
		Certegui	La Toma	Recta Larga	Animas	Agua clara	Quiadó
Mazamorreo	3	3	2	2	1	2	2
Holladero	17	14	7	10	1	6	11
Guache o Socavón	23	20	13	10	1	9	16
Zambullidero	1	0	0	0	1	1	1

Table 6. Volume of the substance and amount of time required to separate gold from jagua.

Species	Sample weight (oz.)	Volume of water (mL)	Volume of vegetation substance used in separation (mL)	Time used (min)
Hibiscus rosa-sinensis	4	300	40	5
Sida rhombifolia	4	300	40	4.35
Pavonia fruticosa	4	300	40	1.18
Ochroma pyramidale	4	300	40	1.45
Cecropia peltata	4	300	40	5.28
Apeiba tibourbou	4	300	40	2.35

The process of separating the jagua from the gold requires the following steps: first the vessel is filled with the gold and platinum material. Second it is washed by rotation with water to classify the coarse material until obtaining the fine material conformed of jagua and gold to initiate the application of the mucilaginous substance, the data is presented in the previous table.

CONCLUSIONS

In traditional mining practices in the municipalities of the Panamerican Union and Certegui in the department of Chocó, Colombia, 78 vegetation species are being used for the extraction of gold in all mining activities.

It is relevant that mining communities take advantage of plant species for two important mining activities: the separation of gold from the jagua and the development of their artisanal tools.

According to the tests and the information collected, there are 27 vegetation species which serve to separate gold from jagua, leaving it totally clean and does not require

to be amalgamated when at least 27 vegetation species are used for this purpose, replacing the use of mercury.

The mining community reports that the plant species Cedro Macho (*Tapirira guianensis*) is the most used in the production of artisanal troughs, a tool used ancestrally in barequeo mining.

The plant species Hibiscus rosa-sinensis, *Hibiscus rosa-sinensis, Sida rhombifolia, Pavonia fruticosa, Ochroma pyramidale, Cecropia peltata* and *Apeiba tibourbou* are the most used in the separation of gold and jagua.

Therefore, this work is novel, since the tests were carried out with the active participation of the community where the experience originated, who confirm the effectiveness of the separation and generate questions for the continuity of this investigative exercise.

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